AT THE ORIGINS OF THE BUILT ENVIRONMENT IN THE HORN OF AFRICA

THE CASE STUDY OF ADULIS ERITREA

Edited by

S. Massa • N. Cattaneo • S. Bortolotto • A. Zerai • T. Medin

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Editors

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The Case Study of Adulis

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1. Il Corno d'Africa

*Stampato nel rispetto dell'ambiente su carta proveniente
da zone a deforestazione controllata.*

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Institutional Forewords

State of Eritrea
H.E. Commissioner Zemede Tekle
Commission of Culture and Sports of the State of Eritrea

I am indeed privileged to shed some remarks in reference to the current volume *At the Origins of the Built Environment in the Horn of Africa: the Case Study of Adulis, Eritrea*. The archaeological site of Adulis has featured in the historiography of the Horn for more than a hundred and fifty years. Moreover, the significance of the archaeological site of Adulis in terms of national, regional and global connotations has been elaborated numerous times by the variety of research ventures undertaken in the course of centuries. In this respect, the archaeological site of Adulis holds a central place in fostering national identity and collective memories of Eritreans in as much as instilling the notion of a melting pot of ancient civilizations in the Horn and beyond the Red Sea littoral. Despite the equation of the site with the historically attested role in the interregional trade involving the Red Sea, Mediterranean and Indian Ocean, several questions related to its chronology and topography have remained virtually unexplored using systematic approaches until recently.

Cognizant of the immense importance of the site, the Eritrean government has over the last decades of independence actively supported research projects that aim to incorporate multi-disciplinary and interdisciplinary approaches sufficient to tackle several research questions involving the archaeological site of Adulis. The joint Eritrean-Italian project, which began in 2011, reflects the firm support of the Eritrean government to valorise the archaeological site through active research and conservation approaches.

Subsequent to fifteen years of extensive endeavours, the current volume is a presentation of different research themes that shed light into different environmental and cultural aspects central to the emergence, and rise of Adulis. Of particular mention is the multi-disciplinary nature of the engagements, which I believe has tackled several chronological and topological questions while equally unlocking a multitude of questions that will be addressed within the framework of the project in the future. Furthermore, the contour of the chapters in the volume gives an impression that the contributions from Eritrean and Italian researchers echo the unswerving conviction of the Eritrean government that projects of such magnitude should aspire to address local capacity-building and exchange of state-of-the art approaches between Eritrean and Italian archaeologists. On this occasion, I would like to remind that bridging gaps in terms of the transfer of skills and developing the needed interface between local and Italian colleagues to broaden the comprehension of the site in its entirety should remain the core of the joint Eritrean and Italian venture at Adulis. The integration of ethnographic accounts and site management issues in the volume is also equally significant to explore ways of harmonising community and professional approaches to the protection and valorisation of the site locally, nationally and internationally.

While commending the current volume and the contributions from the respective authors, I would also like to emphasize that the production and dissemination of research results from the archaeological ventures in Adulis should not be limited to this very first volume. Considering the thematic outline of issues that feature in this volume, it is my strong belief that several monographs of this nature will also be coming out in the future as the knowledge from the archaeological research in Adulis solidifies in the course of time.

Finally, I take the opportunity to emphasize the importance of Adulis and reiterate the commitment of the Eritrean government to actively develop research endeavours, protection and valorisation mechanisms for the site. I would like to congratulate the editors of this volume and the respective authors for their remarkable contribution.

State of Eritrea
H. E. Ambassador Pietros Fessahazion
Embassy of the State of Eritrea to the Republic of Italy

As Ambassador of the State of Eritrea to the Republic of Italy, it gives me a great pleasure and I indeed feel honoured to introduce to the reading public the present publication, *At the origins of the built environment in the Horn of Africa. The case of Adulis, Eritrea*.

This publication is authored by Serena Massa of the Università Cattolica di Milano, Nelly Cattaneo of the Politecnico di Milano, Susanna Bortolotto of the Politecnico di Milano, Abraham Zerai, of the Eritrean Commission of Culture and Sports, Tsegai Medin, of the Eritrean Commission of Culture and Sports, to whom goes our appreciation and heartfelt gratitude not only for their commendable scientific work to deepen and divulge knowledge on the once thriving city of Adulis, but also for their constant work in consolidating a fruitful and friendly cooperation between Eritrea and Italy.

It was thirteen years ago, in November 2011, when the late Castiglioni twin brothers met President Isaias Afwerki to illustrate and eventually discuss their proposal regarding the possibility of starting archaeological excavations where Adulis is located, fifty kilometers south of Massawa in the Zula Bay. Since then, thanks to the hard work of dedicated women and men who followed in the footsteps of the two brothers, the excavations already carried out could unearth important archaeological remains, as the early AD basilicas, the buildings and the beautiful artifacts illustrated here.

As it is known, the ancient port-city of Adulis is mentioned in the *Periplus Maris Erythraei*, dating back to almost two millennia. By virtue of its geographical position in the middle of the western Red Sea coastline of present-day Eritrea, Adulis was bound to become one of the primary crossroads connecting the Mediterranean Sea to Africa, the Middle East and Asia and, through the Indian Ocean, to India and the Far East. It is a widely known fact that it was an important port through which much trade in precious metals, ivory, spices, frankincense and myrrh, exotic animals, animal skins and shells, other valued commodities, as well as slaves with Pharaohs' Egypt, the Greek and Roman empires took place.

But in this volume the role of Adulis is expanded and deepened not only as a commercial hub, but as an early centre of development of the urban civilisation of the Horn of Africa, older than Aksum by several centuries.

Located in the Red Sea coast, the territories that make up today's Eritrea are lands of ancient civilization. Present day Eritrea is placed at a crossroads of the north-south and east-west global connections. Its geographical location has exposed it to a millennia-long connections with other civilizations, societies and cultures in its history. The result of these connections is clearly manifested today in widespread archaeological remains of its inland and maritime civilization. In today's Eritrea, there are some magnificent preaksumite archaeological sites such as Qohayto, Methera, Keskese and other places scattered all over its territory.

In the course of its history, Adulis had extensive trade connections especially with the Pharaohs' Egypt and it has certainly been a vital link to the outside world. This nodality is highlighted in the volume with an interdisciplinary approach, which considers the different aspects, environmental and cultural, which have determined the origin and development of the ancient splendid town.

In spite of its historical importance as a major maritime commercial emporium and urban centre of its time, however, not much was known so far about its sudden waning, as we do not have, as for instance in the case of Pompei in October 79 AD, information on when precisely it disappeared, all of a sudden, under layers of clay and sand drift. Some important clues are gradually emerging from the excavations and surface surveys, illustrated here, which open the vision of a longer duration of the settlement than previously known.

Time will tell because much work remains to be done and much has still to be learnt about Adulis.

Therefore, I strongly believe that this volume represents a precious point of reference for the ongoing studies and research, contributing to building up a more broad and complete picture of the "Pompei of Africa" as well as Eritrea's early history.

Italian Republic
H. E. Ambassador Alfonso Di Riso
Embassy of the Italian Republic in Eritrea

It is a great pleasure and honour for me to be among those who are introducing this publication, the result of a successful archaeological project focused on the site of Adulis in Eritrea. This volume represents a milestone in a multidisciplinary endeavour that annually brings together numerous experts from diverse professional backgrounds, both Italian and Eritrean.

The sponsorship of archaeological missions abroad has long been a cornerstone of Italian public and cultural diplomacy. These missions not only promote Italian scientific excellence but also support the preservation and valorization of heritage sites in partner countries, fostering intercultural scientific dialogue. Since the late 19th century, Italian archaeologists have been active in over sixty countries, illuminating our shared ancient past, sharing expertise, and building an increasingly interconnected network of international specialists.

The Horn of Africa is a region rich in human history, with Eritrea playing an important role in tracing the origins of humanity and its built environment. A landmark discovery is the fossilized skull known as *Signora Buya* (also called "Madam Buya" or Hawa), unearthed in 1995 by a University of Florence team led by Prof. Lorenzo Rook in collaboration with the Archaeological Heritage Branch, Commission of Culture and Sports. Dating back approximately one million years and now housed at the National Museum of Eritrea in Asmara, this find highlights the region's significance in understanding early human ancestors.

With its long-standing and fruitful collaboration between Italy and Eritrea, the Adulis project stands as a prime example of successful scientific and cultural diplomacy, particularly in archaeological research. The ancient port city of Adulis is a key case study of early urban development in the Horn of Africa. As a thriving hub of trade and cultural exchange linking Africa, the Arabian Peninsula, and the Mediterranean, Adulis offers invaluable insights into early construction techniques, urban planning, and intercultural interactions. The architectural remains - fortifications, religious structures, and dwellings - reflect the dynamic history and diverse influences that shaped Eritrea's built environment. Over the years, new findings have expanded our understanding of Adulis's historical importance, revealing the city was far larger than previously estimated. Thus, the ancient port of Adulis holds not only Eritrea's history but also the legacy of all civilizations that once traded there, leaving behind invaluable traces.

If the archaeological site of Adulis is the tree rooted in peaceful cultural cooperation, this publication is its fruit, sharing discoveries widely and enriching not only Italian and Eritrean communities but humanity at large.

I hope this volume inspires further research and a deeper appreciation for Eritrea's rich cultural legacy and its vital role in the history of human civilization and architectural development in the Horn of Africa.

Italian institutions such as the "*Politecnico di Milano"* or the "*Istituto per lo Studio del Medio e Estremo Oriente"* (ISMEO) apply a modern, interdisciplinary approach to archaeology. Utilizing soil and water analysis, territorial surveys, Geographic Information Systems (GIS) mapping, and digital documentation, their work ensures these sites' value extends beyond history and culture, providing critical data for territorial development.

The Adulis excavation project exemplifies mutually beneficial cooperation between Italian and Eritrean scientific institutions and local communities. It enables Italian researchers to fulfil their scientific mission while allowing Eritrean partners to acquire expertise in archaeology and cultural heritage preservation. The knowledge gained here is globally significant, enriching our collective understanding of history while being closely tied to Eritrea's ancient past.

The site of Adulis symbolizes the special bond underpinning Italian-Eritrean relations, especially in scientific, cultural, archaeological, and anthropological fields. The project's success owes much to the many Italian institutions that embraced Eritrea's readiness to cooperate.

It is essential therefore to honour the memory of Angelo and Alfredo Castiglioni, whose vision and dedication were instrumental in the project's development. Eritrea's sustained interest - both institutional and popular - has also been a vital factor in the project's ongoing success. Since its inception in 2011, the Eritrean government has provided continuous support, and local communities have increasingly engaged, with new apprentice archaeologists joining annually.

This shared commitment exemplifies the extraordinary potential of scientific and cultural cooperation to unite peoples in pursuit of a noble goal rooted in peace. The authors of this volume, many involved since the project's inception, can attest to this better than anyone.

I am confident that Adulis will continue to yield important discoveries as the project advances. As Ambassador of Italy to Eritrea, I have the privilege of witnessing firsthand the positive outcomes generated by this collaboration.

Finally, I am delighted to take this opportunity to extend my warmest congratulations to Ambassador Zemede Tekle, Commissioner of Culture and Sports of the State of Eritrea; Professors Susanna Bortolotto and Nelly Cattaneo of Politecnico di Milano; Professor Serena Massa of Università Cattolica di Milano; Dr. Tsegai Medin; Dr. Abraham Zerai from the Archaeological Heritage Research Branch; and to all the researchers and professionals who have contributed to this exemplary project and publication, whose dedication has significantly strengthened the cultural partnership between Italy and Eritrea.

Italian Agency for Development Cooperation - AICS
Dr. Michele Morana
Head of the Italian Agency for Development Cooperation - AICS Addis Ababa Office

Italy has consistently supported the conservation, study, and enhancement of historical and archaeological assets in the Horn of Africa, drawing upon its longstanding tradition of cultural diplomacy. This commitment has been realized through the integration of advanced technical expertise, multidisciplinary academic research, and meaningful community engagement. By fostering inclusive heritage management and promoting local ownership, Italy's approach has not only preserved invaluable sites and artifacts, but also contributed to social cohesion, identity-building, and the transmission of knowledge across generations. Cultural heritage, in this context, is not seen solely as a legacy of the past but as a driver of sustainable development, peacebuilding, and dialogue among civilizations.

The Italian Cooperation, in particular, has always placed cultural heritage and scientific research at the heart of its action, promoting projects that combine the best of the Italian system: universities, research institutions, and know-how in the field of restoration and heritage management.

When one reaches Adulis - some fifty kilometers from Massawa and a three-hour drive from the capital Asmara, in a vast geographic area marked by an extremely hot and arid climate - there is a striking sense of arriving at the edge of the world. Yet, as you descend into the excavation areas, what unfolds is a place of wonder. Far from being a barren expanse of sand and stone, Adulis reveals itself as a rich archive of information: a historical and archaeological treasure trove. Long before becoming part of the Kingdom of Aksum, Adulis was already a prominent Red Sea port anchoring vital trade routes between the Mediterranean, the Arabian Peninsula and India. It served as a key center for the exchange of exotic goods and raw materials such as ivory and obsidian, underscoring its central role in ancient global networks of commerce and culture.

The Adulis Archaeological Project stands as a symbol of continuity and excellence, embodying Italy's enduring commitment to cultural heritage and its ability to foster long-term, high-level partnerships grounded in scientific rigor, mutual respect, and shared historical responsibility. Through the systematic exploration and valorization of the ancient port city of Adulis, the project not only revives a vital chapter of Red Sea history, but also serves as a living example of how cultural cooperation can promote dialogue, education, and sustainable development.

This volume stands as testimony to the extraordinary scientific and institutional collaboration that has made possible the rediscovery and valorization of Adulis. It is with pride and gratitude that we continue to support this journey, convinced that investing in culture means investing in the future.

Politecnico di Milano
Prof. Emanuela Colombo
Rector's Delegate for Science Diplomacy,
Full Professor - Department of Energy - Politecnico di Milano

This book is part of the story of the VITAE Project - *Sustainable Valorization of the Eritrean Heritage Adulis Archaeological Site Project* - a story that is not only about archaeology or development cooperation, but about what it means for a university to act as an institutional player in international dialogue through knowledge.

VITAE was developed within the framework of Politecnico di Milano's commitment to scientific cooperation, with the support of the Italian Agency for Development Cooperation (AICS) and the Ministry of Foreign Affairs and International Cooperation (MAECI) and in collaboration with the Commission of Culture and Sports of Eritrea. Yet beyond the formal structure, it represents something deeper: the capacity of academic institutions to boost connections between different geographies, to bridge knowledge systems, and to place people and communities at the centre of innovation processes.

In this sense, the project is not just a technical intervention - it is part of a diplomatic exchange rooted in knowledge. Working with Eritrean partners on the Adulis archaeological site has enabled an approach based on mutual learning, co-design, and long-term relationship building. These elements are not accessories to the scientific work; they are integral to it.

The book reflects on three key dimensions that define this experience:

- Time and trust: VITAE was intentionally designed beyond the short-term logic of many development projects, being the result of an Eritrean-Italian scientific partnership started in 2011 with the Adulis Project, and allowing space for a deeper investment in relationships, ownership, and shared responsibility.
- Interdisciplinarity and institutional learning: The project started from a strong disciplinary base but was enriched through the contribution of diverse fields - from engineering to digital technologies to heritage studies - creating new forms of collaboration and institutional learning.
- Research as a lever for local agency: At its core, the project sees research as a process that strengthens local capacities and institutions. It is through this approach that cooperation becomes sustainable - not because it lasts longer, but because it grows within the territory itself.

This is the meaning of *Science Diplomacy* as we understand it: not an abstract concept, but a concrete practice where science becomes a space for dialogue, and the university becomes a trusted actor in global partnerships. This book offers not only a record of what Adulis has achieved, but also a reflection on how academic institutions can contribute to global challenges by generating shared knowledge and supporting innovation that is both inclusive and locally rooted.

Politecnico di Milano
Prof. Marco Bocciolone
Rector's Delegate for Technology Transfer,
President of PoliHub, the Innovation Park & Startup Accelerator,
'VITAE' Project Manager,
Full Professor, former Head of the Department of Mechanical Engineering – Politecnico di Milano

I am delighted to accept the invitation to write the introduction for the publication containing the scientific articles developed as part of the "Adulis Project" and thanks to VITAE: "Sustainable enhancement of Eritrean heritage - Adulis archaeological site project".

During my years as director of the Department of Mechanical Engineering of Politecnico di Milano, we have interpreted the third university mission and public engagement by promoting, stimulating, and encouraging projects and research focused on cooperation and social responsibility.

These projects play a central role in line with the mission of training future responsible engineers, architects, heritage managers and designers. The Politecnico di Milano firmly believes that the university is not limited to transmitting technical and scientific knowledge but pursues the ultimate goal of supporting both our students and younger colleagues in their growth as human beings, social beings, and ethical individuals. Therefore, not only studying at university help to acquire new skills, but also to grow into a more mature person.

For these reasons, I supported since the very beginning the VITAE project promoted and funded by the Italian Agency for Development Cooperation (AICS) and the Ministry of Foreign Affairs and International Cooperation (MAECI) with the collaboration and support by the Eritrean Authorities.

I also shared the great enthusiasm shown by Susanna Bortolotto of the Department of Architecture and Urban Studies, along with her colleagues Serena Massa and Nelly Cattaneo, who have been involved for years in various research programs on Eritrea's cultural heritage in close collaboration with the Eritrean authorities and other Italian universities.

The multidisciplinary project - combining history, archaeology, preservation and knowledge - relies on the *corpus* of knowledge and the scientific rigour typical of a Politecnico Institution, where architecture and engineering can combine their goals defining new concrete growth opportunities in Eritrea, in terms of higher education, learning, science technology and innovation.

In this case the main objective is to enhance the impact of long-term archaeological research and link it to the promotion of sustainable development at the local level, focusing on the archaeological site of Adulis in Eritrea as a case study, safeguarding, preserving, and enhancing its cultural and landscape heritage.

The research activities were based on two pillars:

- from an archaeological perspective: an interdisciplinary model with the prevalent use of remote sensing and non-invasive techniques, such as geomatics, geophysics, and surface surveying;
- from a social and environmental impact perspective: the design and realization of a sustainable archaeological park, in which the conservation of cultural heritage is linked to environmental protection through renewable energy and the sustainable management of water resources, along with the understanding provided by local communities.

By achieving its specific objective, the action will contribute to the project's overall aim to design new strategies for heritage sustainable development. The action will lead to the enhancement of socio-economic and cultural value. This pattern will come from understanding the potential of past civilization to support problem solving for the present society and suggest viable alternatives for territorial planning, creating better living conditions for local communities, while preserving the planet and its resources.

Introduction

This volume provides a summary of the work carried out since 2011 and still ongoing at the archaeological site of Adulis, located on the south-western coast of the Red Sea, in present-day Eritrea.

The title chosen aims to highlight the role of Adulis, usually considered due to its function as an emporium and commercial port, in the context of a topic of great importance in the history of the Horn of Africa and more generally of the African continent, namely the origins of the system of territorial organisation characterised by the emergence of towns.

In the area under study, currently divided between Eritrea and Ethiopia but known in ancient times as *Aithiopia*, meaning 'the land of men with burnt faces', which included the vast territories south of Egypt and sometimes the Indian continent itself, the birth of urban centres is attributed to the rise of Aksumite power, with the development of the metropolis of Aksum and the urban centres gravitating in the political orbit of the kingdom.

The multidisciplinary research presented here allows one to understand the various environmental and cultural aspects that determined the early urban function of Adulis, in an era that predates by several centuries the oldest evidence of permanent occupation in the area around Aksum. These are the whole of the natural factors, such as the availability of both long-distance land and sea routes and raw materials and resources for agriculture and livestock farming, as well as the cultural and social aspects that led, precisely in this location, to the origin and development of the splendid town made of stone known in historical times as Adulis.

In the narratives proposed, the protagonists are material sources and production cycles, rather than the search for 'models'. In the field of knowledge, archaeology redeems architecture from its excessive dependence on Art History and the 'typological' History of Architecture; their importance remains intact, but it should not be forgotten that the aesthetic and typological aspects in architecture have always coexisted with the functional and durability-in-use aspects.

Knowledge of the materials and techniques and the constant use of archaeometric investigations have been particularly valuable aids to the project for the conservation, maintenance, protection and enhancement of the unique architectural artefacts of Adulis, which were in a state of ruin.

The research raises perhaps more questions than it answers: as always, a stratigraphic excavation must proceed from the most recent to the oldest layer, and in the case of Adulis, the vastness of the site – over forty hectares – together with the priority of preserving the architecture as it is gradually uncovered, has required caution and a lengthy process over the course of these thirteen years. This has also entailed a focus on the most recent levels, corresponding to the most critical phases in the history of the ancient town, namely those relating to its destruction towards the end of the seventh century AD following one or more natural disasters, which caused extensive and impressive layers of rubble of the collapsed masonry buildings.

The complex removal of the rubble required considerable effort and time, with the possibility of bringing to light mainly evidence of life in the town during the historical period.

However, some clues about the previous phases are provided by the mobile finds discovered in the foundation levels of the buildings, which await further stratigraphic investigations for a more comprehensive contextualisation.

The abundant finds, mainly ceramics, discovered both during the excavations and the surface surveys, will be the subject of a specific volume. They are mentioned here only as diagnostic elements for the chronology of the contexts presented.

We believe it is worth highlighting the approach adopted in the excavation and research work carried out *in situ*, which consisted firstly in the exchange of knowledge between the members of the Italian and the Eritrean teams, pursued continuously as regards both the scientific and the operational aspects, from excavation to treatment of the finds, to conservation and restoration.

The very nature of the site, immersed in a natural and scenic setting of great appeal, which is simultaneously a source of economic activities for the surrounding communities, has led to the utilisation of multidisciplinary skills. In addition to those normally used in archaeology, such as geophysics, bioarchaeology and archaeometry, the project involved the collaboration of architects and engineers (hydraulic, energy, mechanical structural engineers) as well as agronomists. This was done with the aim of protecting both the archaeological site and the surrounding area from major environmental threats, thereby contributing to the quality of life of the surrounding communities.

In keeping with the approach outlined above, we felt it appropriate to begin this volume with the voices of the communities of Zula and Afta, who live near the archaeological site and frequent it for various reasons and are its first heirs and custodians.

The *first chapter*, therefore, collects the testimonies of the elders of the two villages, with the aims of understanding the relationship of the current communities with the ancient site, their perception of the archaeological remains and their tradition in relation to its history, of which the village of Zula in particular can be considered part, due to the use of some areas of Adulis for funerary purposes; and also of learning about and evaluating the memory of climate changes and traditional practices for using and managing resources.

The *second chapter* contextualises the archaeological site within the historical and current landscape on a local, regional and broader scale, in relation to the environmental and geomorphological characteristics and the natural land and sea transport routes, which are closely interdependent factors. An analysis of the role of the Red Sea as a long-distance linking axis, throughout the various geopolitical events of its history, is essential for understanding not only the origins and fortune of Adulis, but its decline as well.

The *third chapter* presents the results of the archaeobotanical analyses carried out on the plant remains found during the excavations, which for the first time provide insight into the diet and agricultural practices, consisting mainly of the cultivation of barley and spelt, of the inhabitants of Adulis in ancient times.

The *fourth chapter* introduces a summary of the archaeological knowledge relating to the Gulf of Zula in order to contextualise the origins of human settlement in the area of Adulis, highlighting the importance of this stretch of coastline from the Middle Stone Age onwards as a probable route followed by human migration out of Africa, as well as an ideal habitat due to its wealth of marine food resources favourable to occupation by human groups.

The *fifth chapter* uses geological and geophysical surveys to address one of the most important issues concerning the town of Adulis, namely the location of its port, which, as we know from literary sources, was about three miles from the town centre. A possible location for the landing place is proposed at the eastern edge of the ridge of the rocky outcrop on which Adulis stands, parallel to the sea.

The *sixth chapter*, focusing on hydrology, completes the geomorphological and environmental framework with an in-depth analysis of what is perhaps the most vital factor for the origin and development of Adulis in ancient times and for the life of today's communities in the area, considering its potential elements and risk factors. Simulations are proposed to implement the traditional irrigation techniques and reduce the threat of catastrophic events caused by flooding events from the Haddas and the other torrential watercourses affecting the area.

The *seventh chapter* introduces the archaeological research in Adulis, with an overview of the history of studies in the region of the northern Horn of Africa, useful for focusing on the main issues, many of which are still open, concerning the origin of the permanent settlements and the urban civilisation in the area. Literary, epigraphic and archaeological sources, as well as a methodological review of the very concept of town and its archaeological recognisability compared to other settlement forms, provide the framework for understanding the early urban character of Adulis from the time of its first settlement, dating back to the second millennium BC, and serve as a prelude to the next chapter.

The *eight chapter*, after a review of the literary and archaeological sources available on the site of Adulis, presents the results of the excavations and research conducted between 2011 and 2024. The descriptions of nineteenth-century visitors make it possible to identify persistent features, such as the cemeteries in the village of Zula, still located in the central-southern sector of the site, and to gain an impression of the landscape during the two centuries before our intervention. The reports of the excavations, the first of which were carried out in 1868, followed by a few but important interventions in the following century, are analysed in detail as a prerequisite for choosing the current excavation areas and focusing on the main historical questions to be answered. Stratigraphic readings, surveys, diagnostic finds and absolute dating are the documents underlying the proposed reconstruction. The most significant new aspects concern the duration of the city, well beyond the sixth century AD, which until now had generally been considered the end of Adulis' function as an emporium and international port; the chronology of the three early Christian basilicas that have been unearthed; a new discovery in the field of urban planning in contemporary towns in the region is the presence of fortification structures.

The *ninth chapter* explains the specific aspects and difficulties of excavating the site from a methodological and technical point of view, with detailed information on the stratigraphy of excavation sector no. 6, corresponding to the British excavations of 1868 and the area where the largest monument unearthed so far in Adulis, the cathedral, is located. The underground chambers of the cathedral are a fully new discovery as regards the churches of Adulis.

The *tenth chapter* summarises the results of the archaeometric investigations conducted on the most representative classes of artefacts found at the site, namely locally produced pottery and amphorae. The ambiguity surrounding the definition of Ayla/Aksum amphora is resolved, ruling out any local production. Moreover, imports of torpedo jars and glazed pottery from the Persian Gulf are identified with certainty for the first time.

The *eleventh chapter* deals with the issue of the necropolises, complementary to the city of the living but not yet studied by research. We analysed the few burials found in the excavations carried out both during the last century and the present day: some infants entombed in amphorae and burials of adults within the city, dating back to the third-sixth centuries AD. A new discovery is represented by the Muslim burials that reused the interior spaces of the cathedral from the fifteenth to the eighteenth centuries, helping to bridge the chronological gap between the abandonment of the ancient town and the establishment of the Islamic clans in Zula, with the use of the archaeological area as a burial ground. The accurate reconstruction of the taphonomic processes, the characterisation of the osteological material, the use of absolute dating and ethnographic research provide documentation of primary interest not only at a local level.

The *twelfth chapter* analyses the material sources that enable the definition of the construction techniques used in the architecture of ancient Adulis. Building material sources, quarry locations, characterisation through archaeometric analysis of the stone and binders, stratigraphic readings and accurate surveys make it possible not only to reconstruct the operational chain in the most comprehensive way available in the literature to date, but also to understand the choices made by the ancient architects and craftsmen in response to environmental problems and in ensuring the structural solidity of the buildings. The analysis of the masonry techniques and architectural elements, closely correlated with the excavation data, allows us to recognise an evolution of the techniques over time and differences that correspond to the different functions of the buildings. The *corpus* of knowledge also constitutes the scientific basis for the methodology applied to the restoration of the architecture gradually brought to light by the excavations, in accordance with the historical and material truth of the monument. In fact, the restoration project is focused on conservation work that is as non-invasive as possible (minimal intervention) and fully reversible, capable of slowing down material deterioration and structural instability.

The *thirteenth chapter*, which complements the previous one, presents in detail the methodology and techniques used in the diagnostic analyses carried out on numerous samples of natural and artificial stone material selected during the excavations, with various aims: to determine the nature and source of the original materials and the ancient construction techniques, and to define the most suitable materials to ensure compatibility, reversibility and durability for the maintenance and restoration activities.

The *fourteenth chapter* explores in detail the issue of the various types of architecture of Adulis from the perspective of the geometry of the buildings in order to define modules and proportional relationships between the various construction elements, in both plan and elevation, and identify the use of one or more units of measurement. The construction process of the northern urban church and the cathedral is reconstructed using *ad quadratum* modules, determined starting from the apse portion and the centrality of the altar. In contrast, in the case of the eastern church, the central generation point does not seem to coincide with the position of the altar, but with the centre of the hall delimited by the dome supported by eight columns. As regards the unit of measurement, the anthropometric reference is identified as the local cubit.

The *fifteenth chapter* presents the methodology and technique used for terrestrial and aerial surveying, at different scales, of the entire site, monuments, individual architectural elements and artefacts, useful for positioning, photogrammetry and three-dimensional surveying.

The *sixteenth chapter* examines the issue of protecting and enhancing the site through strategic actions in the management plan for the future archaeological and nature park. These actions must ensure that synergy is generated between the various stakeholders to ensure that the archaeological remains are protected, the environment is kept safe, and the local communities stay socially and economically viable now and in the future, concurrently raising awareness and visibility locally, nationally, and internationally.

THE COMMUNITIES OF THE WESTERN BAY OF ZULA: MEMORIES OF THE PAST. PERMANENCE, DISCONTINUITY AND OBLIVION

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Throughout the years a series of archaeological research has identified several sites alongside the Gulf of Zula. The archaeological evidence of the Gulf of Zula ranges from traces of Middle Stone Age human adaptation at the site of Abdur to early and middle Holocene human occupations in the sites of Asfet, Gelalo NW and Misse East[1] and the ancient port town of Adulis, with chronology spanning from second millennium BC to early eighth century AD.[2] At present there are around ten villages along the western side of this gulf. In the area of the western Bay of Zula, following the rise and demise of Adulis, perhaps the next permanent settlement to emerge was the village of Zula, whose toponym, as we will see, might have some relation with Adulis.

As part of the 2024 Adulis field campaign, an ethnographic study was carried out in the communities of Zula and Afta. The study aimed at observing these two communities to assess the continuity of their cultural practices, their relationship with the surrounding environment and subsequently understand their oral tradition in relation to the archaeological site of Adulis. This is crucial to have a comparative outlook of the ancient ways of utilizing and manipulating the environment and to extrapolate their affinity and relationship with the archaeological site of Adulis, if any.

Interviews were conducted with 35 elders from the villages of Zula and Afta, who were selected by the local administrations based on their understanding of the area and their permanence in the Zula Plain. This was paramount also for understanding the patterns in climate change, river action, settlement and socio-economic mutations throughout the history of these two communities. Some recent aspects of the history of the inhabitants of the Zula Plain were reported by Commissioner Teobaldo Folchi, appointed in 1898 by the Italian Colonial administration to survey cultural and economic aspects of the Region of Massawa[3] and in other colonial reports, and have been recently illustrated by the historian Jonathan Miran.[4] Some contents in the Italian colonial reports and what had been illustrated by the elders might differ in a few details; however, the objective of this contribution is not to ascertain historical issues, but to provide comprehensive insights on the past and the current cultural system and landscape of this part of the Bay of Zula, based on the local oral traditions.

The Environment

The villages of Zula and Afta are located in the wider coastal environs of the ancient port town of Adulis. The wider coastal environment generally incorporates the western plain of the Gulf of Zula, which extends from the Ghedem Massif to the north, to the Komayle watercourse to the south and from the coast to the foothills of the eastern escarpments on the western edge. This vast environment is constituted by an alluvial plain and is the drainage surface for many streams and torrents that originate from the Eritrean Highlands, including large watercourses like the Haddas and the Alighede[5] (fig. 1, Map 1). Hydraulic agents such as torrential floods and sedimentation cycles shape

[1] Zerai, Medin in this volume.
[2] Manzo 2010; Massa, Cattaneo 2022.
[3] Zaccaria 2007.
[4] Miran 2009.
[5] Baioni, Porta, Guadagnini, in this volume.

Fig. 1 - Aerial photo of the fluvial plain of western Zula Bay.

much of the surrounding landscape and its wider ecosystem. Hence, the topography of this environment changes almost annually, for instance, high levels of sedimentation and soil deposition have caused the rapid progradation of the coastal line (occurring in short timespans easily noticeable within a person's lifetime), changes in the structure of the landscape[6] and sedimentation of mineral-enriched soil for the agricultural fields. Torrential floods led to an accelerated course deflection and divergence of the rivers and also prompted change in the vegetation, which subsequently altered the wildlife, the pastoral way of life and the broader socio-economic activity of these communities.

Large trees such as those locally named *ghaba* [*Ziziphus spina-Christi*]*, kenteb* [*Acacia laeta* (A. Trentiniani)], *tsihdi* [*Juniperus procera*]*, weiba* [*Terminalia brownii*]*, hanse* [*Anogeissus leiocarpus (A. Schimperi)*]*, awhi* [*Cordia Africana*]*, leshem* [*Celtis africana*]*, tserob* [*Combertum molle*]*, gafal* [*Commiphora Africana*]*, kermed* [*Boscia angustifolia]*, *chea* [*Acacia abyssinica subsp. Abyssinica*],[7] etc., are prevalent in the Ghedem Massif. However, the coastal plain has very few species of small shrubby trees such as *htum* [*Suaeda monoica*], *chea* [*Acacia abyssinica subsp. Abyssinica*], and also a few species of grass. The locals say that the stripping and consequent decline of these large trees is due not only to excessive human usage and exploitation, but also to changes in climate. The transportation of new floral specimens by the annual torrential floods brought about a gradual decrease in the indigenous grass species, creating an environment dominated by plants mostly used for camel fodder. Due to their dominance over local species, some allochthonous plants are considered also by experts as biohazards, as it is the case of *Prosopis juliflora*, also known as 'Mesquite tree' or 'Temr-Musa', a plant from the Americas introduced to mitigate desertification.[8]

According to these communities, this environment is home to several and diverse species of wildlife such as hyenas, foxes, leopards, gazelles, monkeys, warthogs, rabbits, ostriches, hedgehogs, guinea fowl and the like. The local oral history suggests that it was also home to lions, elephants,

[6] CENSINI, in this volume.
[7] BEIN *ET AL*. 1996.
[8] OGBAZGHI 2018, p. 106.

rhinos, and an animal resembling a bear that is presumed to be extinct and is locally known as *Uf.* Even though elephants are not common in the area anymore, a number of villages and places in the Bay of Zula such as Irafayle (deriving according to a folk etymology from the Arabic *ara fila* "I see an elephant")[9] and Dähono (past local name for H'rgigo, from the Saho *dakano* meaning 'elephant'[10]) are named after this large animal. As highlighted above, according to the interviewees, it is predominantly the environmental changes in general and the degradation of the vegetation in particular that provoked the extinction of these animals. In general, it is well known that human intervention, at least as of the late nineteenth century, both in terms of deforestation and of limiting the presence of such voracious herbivore competitors for pastures, contributed much to their disappearance from the region.

The People of Zula and Afta

The ancient port town of Adulis is located between the two villages of Zula and Afta on the western side of the Bay of Zula. The people of these villages practice the Islamic religion, and their livelihood is based on agro pastoralism. They belong predominantly to the Tigre ethno-linguistic group, while few families, which arrived in the more recent times, belong to the Afar. Yet, many people in the villages are multilingual who can also speak Arabic, Saho, Afar and Tigrinya.

The informants from these villages agree that the territory was a grazing land for the Asaorta Saho pastoralists prior to the arrival of their ancestors. Early mention of the Asaorta in literature dates back to the fifteenth century[11] and as regards the seasonal migration, the British anthropologist Nadel states that *"during the coastal rains, from November to April, the Asaorta live in the plain west of the Bay of Zula while moving to the foot hills and western edge of the plateau from May to July during which the area is rich in vegetation. The tribe, moreover, moves up to the plateau during the rainy seasons in the highlands in the remaining months of the year. Afterward, during the inland rainy season, the tribe moves up to the plateau itself"*.[12]

According to the local oral tradition, the toponym *Zula* is believed to have originated from Adulis which is located only 2 km north of the village. The area is known in the local Tigre language as *Azuli*. Local oral history also refers to a sunken city and hence '*Zalet'* an Arabic word denoting 'to subside' or 'to sink' that perhaps owes to the abundance of archaeological remains in the area where Adulis/Azuli is located. The name Zula, therefore, derived from the fusion of these two names. The historian Jonathan Miran[13] on the other hand, reports that the Saho called the area *ado lay*, meaning 'clear water', as a name related to Adulis; the same name for the area is still in use in the region of Àdi Qheyh'. *Adulay* was also the name of an ancient ruling family in Massawa, and, as reported by Teobaldo Folchi in 1898,[14] *Adulà* was the name of an Asaorta clan that had settled on Desie Island for the preceding five generations. The ancient etymology is probably an ethnonym, meaning 'place of the Ule or Uli'.[15]

The local population claims that the first tribes to establish the village of Zula are the Bet (i.e. 'home' in the sense of 'family') Khalifa, Bet Tawkal and Bet Šek Mahmud, which were later followed by Bet Qadi, Ad Jembogo and the most recent arrival of some families belonging to the Afar. However, the first two tribes to settle in the Zula Plain, namely the Bet Khalifa and Bet Tawkal, have different versions in their oral history as regards their arrival and the genealogy of their ancestors.

The Bet Khalifa and Bet Tawkal trace their arrival to the Zula Plain with the coming of Omar Assawur, who originated from Mecca and made his way through the Dankalia region, where the association of the word *Assawur* (literally translated as 'red stud') to his first name was given by the Afar. According to these clans, the name Asaorta is also believed to have derived from his name.

One version of the oral history narrated in the area ascribes that *"Omar Assawur who assimilated to the Saho ethno-linguistic group, had married*

[9] A. Saleh Mohammad, *Irãfálo*, in *EAe*, vol. 2, *ad vocem*.
[10] R. Pankhurst, *Ḥərgigo,* in *EAe*, vol. 3, *ad vocem*.
[11] Trimingham 1952 p. 177.
[12] Nadel 1944, p. 61.
[13] Miran 2009, p. 124.
[14] Zaccaria 2007.
[15] Bowersock 2013, p. 8; Massa, in this volume, Chapter 7.

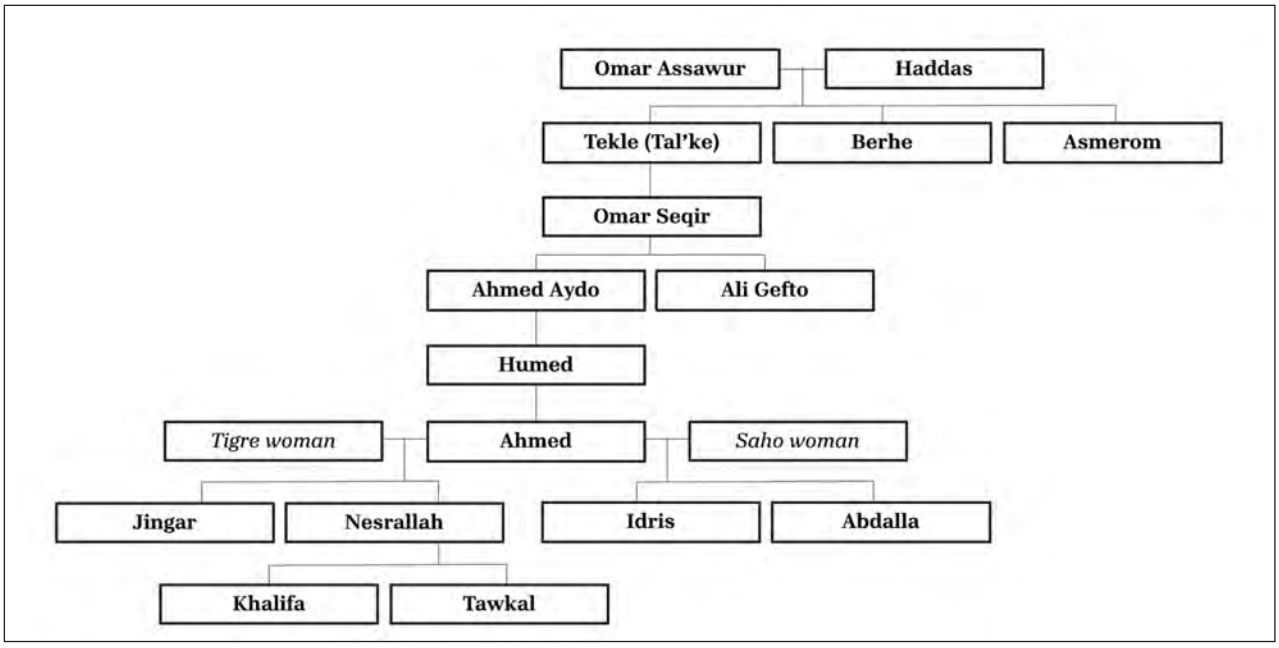

Fig. 2a - Genealogical diagram of one of the versions of ancestral claim of Bet Khalifa and Bet Tawkal.

Amhara, a daughter of the Habab (Tigre) chief of Degdegi". The informants identify Degdegi with Desset, a place with exceptional funerary stone monuments located about fifteen km north-west of Massawa. Desset means 'island', owing to the water courses surrounding the area during the rainy season. According to ethnographic accounts collected in Afabet and Zula, the area was home to a Tigre clan called Degdegi, and thus adding a double meaning for the toponym Degdegi. This version of the oral history postulates that *"Omar had two sons, namely Ali and Ahmed. The former remained Saho while Ahmed was assimilated to the Tigre. Nesrallah, who is one of the four sons of Omar Derir, seven generation descendant of Ahmed, begot two sons, Tawkal and Khalifa, and thus the bet Khalifa (in Zula) and bet Tawkal (of Zula and Afta)"*. Some informants however claim that *"Nesrallah and his three brothers are the sons of Omar Assawur"*. In Folchi's report the genealogic scheme indicates that Omar Assawur had two sons, Ahmed and Ali, and the latter was the father of Nesrallah, who bore Humed, the father of Ahmed (Bet Tawkal) and Khalifa (Bet Khalifa).[16]

Another version of the oral history of the area asserts that (fig. 2a) *"Omar Assawur, eventually continued his journey from Dankalia to the plateau and married a woman named Haddas, and had three sons, namely Asmerom, Berhe and Tekle. Tekle and his mother moved down the escarpments following the route of the Haddas river. The name of the river itself is derived from Haddas who died during the journey. Tekle was assimilated to the Saho and converted to Islam, changing his name to Tal'ke. Tal'ke gave birth to Omar Seqir, who in turn fathered Ahmed Aydo and Ali Gefto. Ahmed Aydo on the other hand bore Humed, the father of Ahmed. Ahmed gave birth to four sons, from his two wives. The mother of Abdalla and Idris belonged to the Tora tribe of the Saho while Jingar and Nesrallah were born to another wife from the Degdegi belonging to the Tigre. Nesrallah eventually gave birth to Tawkal and Khalifa, thus the Bet Khalifa in Zula and the Bet Tawkal of Zula and Afta. Disagreements and conflicts led to the Bet Tawkal leaving Zula and as a result the village of Afta was established"*. Oral tradition in the area attests that *"the shum [leader] of Bet Tawkal, Humed swore never to live in Zula with his kin Bet Khalifa, so took his clan men and moved to the south. The new environment was not hospitable to the people and animals, so elders and Šeks begged*

[16] ZACCARIA 2007, p. 291; MARTINI 1913, p. 35.

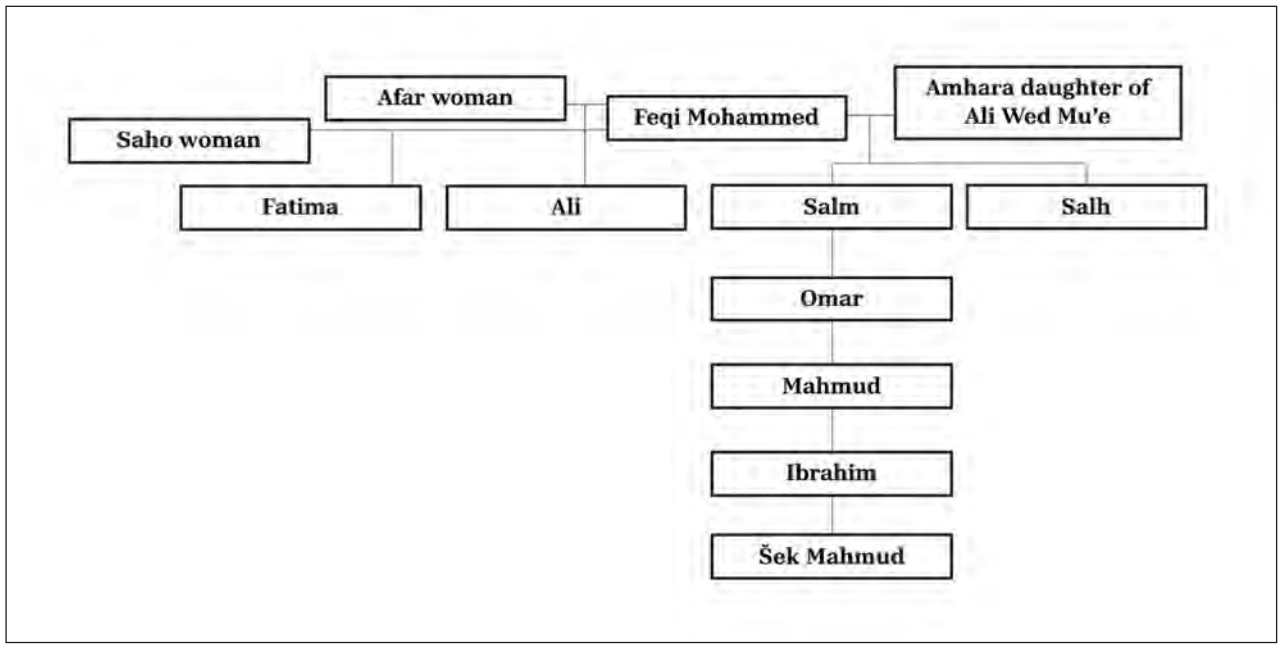

Fig. 2b - Ancestral tree of Bet Šek Mahmud.

him to return. The Šek, furthermore, made a fetwa *and relieved Humed from his original oath, who eventually agreed to settle across the river [Haddas]".* Thus, the toponym of Afta is believed to have derived from the word *fetwa* [consultation]. The Bet Tawkal were consequently followed by Ad Nayb, Ad shHmo, Ad Jembogo and Ad Šek Adem who moved and settled in the area across the years.

In a similar vein, the documentation of the oral history of the area through interviewing resourceful elders postulated the genealogy of the Bet Šek Mahmud of Zula (fig. 2b), who trace ancestry to Salm, one of the sons of Feqi Mohammed. Feqi Mohammed, according to the informants is believed to have come with other holy men (known as *sebuie*, to literally mean seven) from Arabia through Aussa to Senafe and eventually to the Zula plain. He is believed to have reached the Eritrean coast by the 11th century. Ahmed (who fathered Abdella, Idris, Nesrelah and Jingar and earlier settler of the plain) asked Feqi to provide the teachings of the Quran, enabling the latter to settle in Zula. The latter eventually married a woman from Degdegi with blessings from Ahmed and fathered Salm and Salh. Another version stipulates that Feqi Mohammed settled in Degdegi and married Amhara, the daughter of the chief of Degdegi Ali Wed Mu'e. This version holds that Feqi Mohammed moved to Zula when Salm was born and when Amhara was pregnant with Salh. The Bet Šek Mahmud of Zula believe to have descended from Salm.

The oral history also attests that other holy men from Arabia have established the Bet Qadi and Ad Jembogo, whose descendants moved and settled in the area through intermarriage. The most recent arrivals are the Afar families from the Buri Peninsula, who according to the informants also intermarried with the communities in the area. The different versions of the oral traditions attest to a common apical ancestor and yet ancestry becomes vague and inconsistent in as much as the sharing of individual names.

In 1832, the German explorer Rüppel mentioned the presence of about a hundred huts in Afta and a comparatively better water in Zula than in Afta.[17] A well estimated to be 500 years old and presumably built during the Ottoman colonial period (1557-1865) is found in the village of Zula. Nevertheless, the British Army that settled in the Zula Plain around 1867 did not record the presence of wells, describing other techniques for col-

[17] Massa, Cattaneo 2022.

Fig. 3 - Traditional *mae'deni*, also known as *arisc*, its roof and façade covered with tall grass known as *gelil*; (photo from Cipriani 1940, p. 208).

Fig. 4 - *Mae'deni* is still preferred today because it allows natural ventilation, which is important during the hot season.

lecting water and noting a specific spot near the ruins of Adulis where freshwater run not deep under the soil surface.[18] A well built in the 1940s is also found in the village of Afta. The elderly recount stories of how people in the past used to get water from the *Gofer*, near the Komayle watercourse, 12 km south-west of Zula. Even though Zula is established in the alluvial plains of major watercourses that drain to the Red Sea, the rivers are only seasonal and dry during most of the year. Thus, they had to resort to the Komayle as a water resource, since year-long streams flow in its vicinity. At the same time, a well in Wi'a [Ua-à], a place located 21 km north-west of Zula and known as *Fatma Are*, was also used for fresh water.

There is no tradition of stone buildings in the villages of Zula and Afta. The houses known as *mae'deni*, are made of sticks, tows and shrubs, similar to the *arisc* described in literature from the Italian colonial period (figg. 3-4).[19] Given the hot climate of the area, this form of construction is still favoured to allow ventilation. There are two types of *mae'deni*, the traditional and the *hanfex*, a mixture of old and new materials such as corrugated iron for roofing and concrete pillars for support. In the past when the area was rich in herbaceous plants, they used *gelil*, a tall grass, for the roofing of the *mae'deni.*

Gefho (fig. 5), a big water container that keeps water at optimum temperature, *tandoor* (fig. 6), used as a baking oven (the Indian name *tandoor* is commonly used in Eastern Africa), *Kel'e,* used for preparing porridge, are some of the ceramic objects in use around this area. In addition, some of the many crafts that have been handed down from generation to generation include palm-tree leaf-based *tofiet* and wooden bowl *tisho*. The drum is the main musical instrument, and a specific drum known as *kebero mewlud* is still used in celebrations to perform the *Jebajib* – a spiritual dance. *Ali gurgur*, *Berj, Zfan, Mrgdi* are some of the unique folk dances in the Zula Plain.

Fig. 5 - *Gefho,* traditional water container pot handed down from generation to generation in Zula.

Socioeconomic activity

The first settlers who made their way to the plain were initially pastoralists who later combined agriculture with their subsistence. The evolution to agriculture seems to have taken a long time due to environmental changes. At the beginning, they used to farm small plots with *sluka* during the rainy season of the coast. *Sluka*, a traditional farming technique in which a stick is employed to pierce the ground using the feet for pressure, was widely practiced. It is believed that large scale cultivation was mainly introduced during the Italian colonial period (1890-1941). The Italian colonial government and companies such as 'Batran' (most likely Ernesto Beltramo, an Italian entrepreneur active in cotton farming, who settled in Eritrea in 1895),[20] attempted to irrigate sugar cane,

[18] Holland, Hozier 1870, p. 287.
[19] Cipriani 1940, p. 208.
[20] Puglisi 1952, p. 41, Beltramo Ernesto, *ad vocem*.

Fig. 6 - *Tandoor*, used for baking bread and roasting fish.

tobacco and cotton crops with the construction of a dam. Similar observations were also made by Nadel who stated in the 1940s that *"about 10-15 years ago small groups of Asaorta started cultivating on the banks of Haddas river, which was irrigated using channels and primitive sluices in the agricultural colonies, which sprang up over a period that spanned for 25 years the trend from nomadic herds men to sedentary cultivators"*.[21] The trend according to Nadel highlighted a shift from nomadic herding to sedentary cultivation. Later in the fifties and sixties, Salih Kekya is believed to have expanded agriculture in the area.

Rain-fed and spate irrigation using diversion canals from the Haddas-Komayle are often combined to take advantage of the rainy seasons of both the highlands and the lowlands. Nowadays, the communities irrigate the flood plains based on channels, taking advantage of the fertile mineral-enriched soil that flows with the torrents down from the highlands and of the rainy season of the coastal area during the months of November - February. They harvest fast-growing crops such as sorghum, millet, maize and all sorts of vegetables like okra, pumpkin, green pepper, tomatoes and watermelon. Oil seeds like sesame and peanut also used to be harvested in the past.

Earlier, when pastoralism was the main source of sustenance, every family had large herds. The people migrated constantly and, accordingly, they had customs and traditions strictly related to pastoralism, which were eventually abandoned with the advent of agriculture. An example thereof is the making of large round troughs with clay called *samun*. Today, in addition to agriculture, pastoralists keep goats, cattle and camel as livestock, however they do not move around like typical nomadic people did with all their family and property in search of grazing land. Instead, the main part of the family remains in their home, i.e. in Zula or Afta, while part of it, mainly the young men, move around with the herd up to the highland plateau during the dry season. Also, pastoralists from the plateau come down to graze their animals in the coastal Zula Plain during the rainy season in the lowlands.

The seasonal migrations and small-scale trade still use the old caravan routes of the Haddas and the Komayle watercourses to reach the highlands. As one of the abundant resources of this area, specifically from the Buri Peninsula, salt was traded in ancient times as far as the markets of Hazemo and further into Intcho (Ethiopia). As previous ethnographic studies in 2011 by the National Museum of Eritrea indicates that "*took local products such as salt were traded to the highland region towns of Àdi Qheyh', Kuaàtit, Segeneyti, Àla, Deqemh'are, Mai Âdaga, Mai Àyni, Tsorona, Addigrat, Geresernai, Beleza, Àdi Helebo, Intcho, Tenben, Âdaga H'amus, Adwa, Aksum, Mäqälä, Shire, and Welqayt where there were big markets to acquire goods such as linen, cereals, chickpea, horse bean, sesame, linseed, and oil-seed and that were brought to the plains"*.[22]

THE CASE OF ADULIS

The communities in the Zula Plain see Adulis as the ruins of an ancient trading city set in the midst of their lands. For them it was a town that once existed and was punished by God to suffer desolation long before the arrival of their ancestors. Though some claim *Azuli* is the name of the man who came from Egypt and founded the town of Adulis, the majority say that the origin of the toponym *Azuli/Azooli* is not known, except that it was handed down from generation to generation. As already mentioned, the term *ado lay* in the Saho language, which means "clear water", is also

[21] NADEL 1944, p. 63.

[22] DAWIT 2011, p. 46.

believed to be used to refer to *Adulis/Azuli* in a parallel context. Further research is necessary in order to confirm the statement, as many centuries separate the ancient name from the meaning attributed to it by the Saho.

There are hardly any myths and legends associated with this ancient port; the few stories the locals recount about this place tells a legend that the people of Adulis were known to have immense strength. One narration associated with it is the following: *"one day a man was on a trail to trade his goods in the highland, but the donkey got tired thus he carried the donkey with the goods and went on"*. By the same token the destruction of Adulis is attributed to a myth which is told as follows, *"the people of Azuli were dancing drinking and playing drums for days, so God punished them by sinking the city with an earthquake",* which is a variation on the story locally narrated and reported by the British man Henry Salt from his travel in 1809-1810: *"Shum Hummar […] told me, 'that great remains of an old own could still be traced near Zula, which had been called 'Azoole;' that the houses appeared to have been larger and more numerous than those at Massawa; immense masses of square stones, four or five feet in breadth, lying heaped confusedly together in the bed of a 'gorf' or 'torrent;' by the sudden overflowing of which, it was traditionally reported, the town had been destroyed"*.[23] In the very accurate guide published by Touring Club Italiano in 1929, the disappearance of Adulis is referred as the consequence of a probable flood due to the emptying of a lake upstream, caused by an earthquake; according to the legend, the rumble of the event was heard even in Aksum.[24]

Though the mythical elements are prominent in the story, the community is very much aware of the environment and state of earthquakes in the plain; furthermore, since the area is considered an "axial volcanic range zone",[25] there seems to be a strong correlation between the frequently occurring earthquakes in this area and the myth. Therefore, the oral tradition may confirm the hypothesis that an earthquake was a primary cause for the destruction of Adulis.

From the preliminary observation carried out, the gullies created by the torrents and their consequent topographic changes have become one of the main threats for the settlement pattern in Zula Plain. For instance, the construction of the Foro Dam concluded in 1960 has caused the deflection of the Haddas watercourse from its former bed around the ruins of Adulis to the south of Zula (figg. 7-8). Throughout these years, the riverbanks have been constantly encroaching by around 5 m annually, threatening the very existence of the villages. Thus, with such a magnitude, prior to its deflection the Haddas must have had a great impact in the destruction of Adulis, which today is evidently visible by the erosion of the southern section of the ancient town.

The interviewees further stress that ruins are not just limited to *Azuli*; traces of structures and settlements are still buried in the plain stretching from the feet of Mount Ghedem to Zula and further to the Komayle. This includes the area north-east of Adulis, presumably Samidi, which the locals refer to as *Adwam* ('elevated area'), and the Galala Hills (fig. 9) on the south-east of Adulis believed to be the Gabaza harbour.[26]

Until very recently, the Zula community used to bury their dead in Adulis. They probably preferred Adulis because it is at a higher elevation than the rest of the plain, and, due to the alluvial process, the difference was even more relevant in the past centuries. A higher elevation would ensure that the corpses would not be washed away by floods. Moreover, the ruins at Adulis provided the necessary gravestones at hand. Since some of the notable Šeiks of Zula, such as Šek Mahmud Ibrahim and Šek Mahmud Zebibi, are buried there, village elders and other Šeiks also used to be buried next to the notables at their request. The tombs of the Šeiks are distinguishable from the others and can be easily identified, either because they are characterized by lime mortar or because they have long schist slabs erected on them. A fence is also used to separate the cemetery ground for Sheiks and common villagers. In another perspective, some also believe it is the notion that 'the deceased belong with the deceased' that drew the early communities to bury there.

[23] Salt 1814, pp. 451-453.
[24] Bertarelli 1929, p. 684.
[25] Beyin 2011.
[26] Peacock, Blue 2007, pp. 34; 65.

Fig. 7 - Aerial photo of the Haddas-Komayle watercourse cutting through Zula Plain and expanding its banks every year threatening Zula.

Fig. 8 - Aerial photo of the silt carried by the torrents claiming territory from the sea, Malkato, Zula.

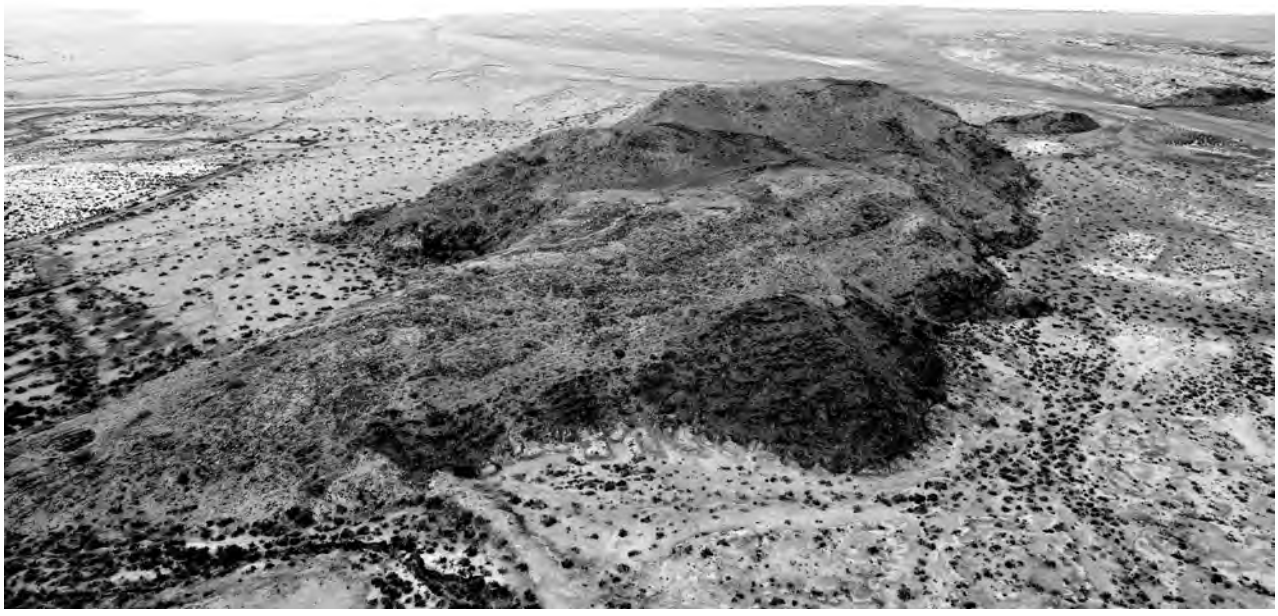

Fig. 9 - Aerial photo of the Galala Hills.

The current relationship of the community with the ruins of Adulis can be best understood by observing the tombs partially covering its upper layers. The grave digging techniques can be classified into two types: *Lhat*, roughly translated as 'his home', and *Aqliyet*, meaning 'patience'. All graves in Adulis are of the *Lhat* type. Basically, a burial trench is 1.5 - 2 m long, 2.5 m deep and 1.5 m wide. Then, after the trench is dug, with the characteristics listed above, in east-west orientation, a lateral chamber is carved out on the northern side of the trench floor. This chamber is called *Lhat*. After carving out the *Lhat*, the deceased is positioned in the *Lhat* on their side, the head facing north towards Mecca with the body oriented east to west. Then the *Lhat* is closed with flat schist stones and plastered with mud before the trench is refilled. On the top, gravestones are piled up to form either a rectangular or an oval shape. No headstone is placed on the tomb, but rather two stones at its extremities to signify that the deceased was male and three stones, two at the extremities and one in the middle, to signify that the deceased was female. The presence of quartz stones on the tombs in Adulis is associated with a past tradition that is no longer practiced today. There used to be a yearly pilgrimage or *Zyara* to the notable Šeiks in October, celebrated with a religious feast (*sedeka*) and *jebajib*. White flags known as *birak* were placed on the tombs by women seeking a blessing. They would also bring shells from the sea and used to leave a *mesbhat* (an object with the same function as the Christian rosary*)* and an incense burner on the grounds after the pilgrimage. Nowadays, these pilgrimages are no longer practiced or very rarely to fulfil a pledge or *Neder.*

In 1950s, the community moved their burial grounds to the current location near the village. This was done because the Haddas started washing away the burials on the southern edges of Adulis. In the current cemetery, they abandoned the *Lhat* type because it required a lot of stones to cover the side chamber. In Adulis, stone was readily available from the ruins, but in the new cemetery, to minimize the effort and reduce the need for stones that are far away, people needed to come up with a technique that required patience to carry out, hence *Aqliyet.*

Conclusions

Eventually, the constantly moulding fluvial environment has forced the community to alter its

way of life. The reduction in woods and grasses has been affecting not only the construction of their dwellings and their livelihood, but their burial techniques as well. Development has introduced new services and tools. Thus, permanency in this area would mean adapting to and managing the constantly changing environment of the plain due to the ever-changing environs, influenced by the torrents and climate.

The communities of Zula and Afta have no attachment with the history and glorious past of the ancient port town of Adulis, thus no recall of any form of continuity, to the extent that they have only limited myths and legends to tell. The oral tradition on their genealogical history regarding the arrival of their ancestors and the establishment of settlement lacks consistency and is often ambiguous. In the case of the Bet Khalifa and the Bet Tawkal, in particular, the line between Omar Assawur[27] and Nesrallah is confusing and subject to variations, making it hard to draw a conclusion concerning the history of occupation of this area based on a generational count. For example, based on the different versions of oral tradition, the arrival of the early settlers varies between the eleventh century (the arrival of Feqi Mohammed claimed by his current descendants of Bet Šek Mahmud) and the sixteenth century (based on the generation count of the Bet Khalifa that extends from 14 to 21, hence fourteenth to sixteenth centuries), using the age of 35 as a conventional benchmark for genealogical calculation, in accordance with the works on genealogy by Eritreans researchers Selemun Isak, Zemhret Yohanes and Bereket Amare.[28]

Thus, it seems that the area may not have been permanently settled for some centuries, creating a historical or cultural gap between the fall of Adulis and the current occupants of the western Zula Plain. One cannot disregard, however, the fact that these peoples have unconsciously become a part of Adulis history, adding a layer to the broader chronology, and have thus embedded themselves, their ancestors, their history and their burial traditions into the upper layers of this ancient port town. Indeed, the recent owners of Zula Plain have created their own stratigraphic layer in Adulis.

References

*This insight was possible thanks to the support and participation of informants.

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From Afta: Mohammed Humed Jaber; Mohammed Ali Jaber Mohammed; Omar Alamin Hamed; Ahmed Yasin Osman; Salih Fager Yasin; Osman Omar Salih; Salih Humed Salih; Nafie Ali Humed; Abedla Mohammed Jabera; Salieh Ahmed Abedela; Ali Ahmed Salieh; Osman Mohammed Osman; Jaber Jaber; Ahmed Nur Hasen Mohammed; Osman Hamed Ahmed Nur; Ali Mohammed Idris; Hassen Ahmed Salieh; Salieh Hamed Ahmednur; Fatna Salieh Ahmed; Amna Mohamednur Ahmed.

*A special thanks to Dr Soliana Mebrahtom for her devoted editing.

[27] A. SALEH MOHAMMAD, *Asaorta*, in *EAe*, vol. 1, *ad vocem*.

[28] Personal communication.

ADULIS AND THE ZULA PLAIN: AN OVERVIEW OF A STRATEGIC AND VULNERABLE AREA

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The current route to arrive to Adulis from Massawa goes along a 50-km paved road that crosses the Samhar, that is the Red Sea coastal area extending from the Labqa River to the north of Zula. The road skirts H'rgigo Bay, slips between Mount Ghedem and the escarpment of the plateau to enter a region which was called 'lower Asaorta',[1] and finally arrives at Foro, in the plain where the villages of Zula and Afta stand (Map 1).

The entire route crosses a semi-arid landscape in which only thorny acacias and bushes offer grazing and some shelter from the sun during the dry summer season (fig. 1). In winter, immediately after the so-called 'little rains', the same places are quickly covered with grasses and flowers. Some of the buildings of the sparse villages visible from the road are made of masonry or stone, but more often than not they are built in the traditional way with plant material in the form of *mae'deni*, technically similar to the *arisc,* a type of dwelling particularly suited to the torrid climate[2] documented in the early 1900).

Arriving eventually at Adulis and seeing the archaeological remains of its monumental architecture usually arouses great amazement. The whole landscape around the Zula Plain seems very distant today from its ancient monumentality, as it is the outcome of different strategies of environmental adaptation and livelihood, concurring with its present marginal position with respect to the city and port of Massawa, one of the main nodes of the country. In addition to the remains of the ancient buildings, the finds collected in Adulis and displayed at the National Museum of Asmara and the Northern Red Sea Regional Museum of Massawa, coming from the Far East, the Mediterranean and the hinterland of the northern Horn, invite visitors to imagine ancient times in which the vast semi-arid territory today overlooking the Bay of Zula was not at all a peripheral area, but a cosmopolitan place set in a likely different natural environment and rich in both precious assets and cultures, interacting with a vast area.

According to the definitions codified in the growing Cultural Landscape disciplinary *corpus*, the archaeological site of Adulis can be defined as a 'relict' or 'fossil' landscape, that is *"one in which an evolutionary process came to an end at some time in the past, either abruptly or over a period"*.[3] In the case of Adulis, as we will see, research is still underway to clarify the precise dynamics of its abandonment, due to a combination of factors, including a natural disaster. What can however be noted, taking up the definition of 'fossil' landscape, is that the surroundings apparently do not show, in the material culture they display, any signs of continuity that link contemporaneity to this ancient anthropized landscape: currently, the physical connections with the past only rely on the reuse of built materials and on the attendance of burial places, mainly dating from the past two centuries,[4] on the site. What seems

[1] A. Saleh Mohammad, *Asaorta*, in *EAe*, vol. 1, *ad vocem;* Gezae, Negassi, in this volume.

[2] Cipriani 1940, p. 151; Gezae, Negassi, in this volume.

[3] UNESCO WHC 2023, art. 39 "*Operational Guidelines for the Implementation of the World Heritage Convention of 1972"* art. 39 (ii) online resource: https://whc.unesco.org/en/guidelines/ [accessed on 15/09/2023].

[4] Larentis, in this volume.

Fig. 1 - Photo of the current landscape in the surroundings of Adulis.

macroscopically evident from this first glance is that with the end of the transcontinental emporium-city of Adulis and the multifaceted conditions that had guaranteed its prosperity until the sixth - seventh centuries, the Zula Plain could maintain a role of a certain importance only at the local and supra-local scales, and that a renewed interest in its strategic position resumed in only in the nineteenth and twentieth centuries.

The objective of this contribution is to identify some of those historic junctures when, over the centuries following the splendour of Adulis, these places began to again have, or were perceived as having, a new centrality, even if at a scale not comparable to the intercontinental one. The aim is to investigate those characteristics that made the Bay of Zula alternately central and peripheral, in particular as they emerge from the primary and secondary European written sources available, which are mainly contemporary (nineteenth-twentieth centuries), to enable a better understanding of its current landscape.

The purpose is to highlight the double nature of the area of Zula, a sort of contradictory manifestation of its *genius loci*. While the combination of its peculiarities, i.e., its conformation and position, its local resources and the natural land and sea-routes, was a factor of prosperity over the centuries, at other times it was an underutilized asset or even a vulnerability, depending on the economic and geopolitical dynamics occurring in a much broader territorial framework. Analysing these characteristics could provide us with some further keys to understand the archaeological landscape in a broader palimpsest that reaches the present day.

The discontinuity of historical sources available from the ancient and late antique periods to the nineteenth century, makes it unadvisable at this time to attempt to reconstruct the palimpsest of the cultural landscape along a chronological progression, whereas it is possible to focus on some specific timeframes.

As already extensively investigated, Adulis is known through Greek, Roman and Chinese and later through Arabic sources; it is important to remark that it is merely symbolically present in the historical cartography inherited from Ptolemy's "*Geographia*" at least until the sixteenth century, when the knowledge of the Portuguese navigators of the African coasts, who published new portolan maps on empirical bases, did not report the existence of Adulis. In the seventeenth and eighteenth centuries, Adulis was mapped again in European cartography, but more on philological bases than due to direct knowledge of the site, which was un-

explored. This is clearly visible, for example, in the well-known and often misinterpreted "*Golfe Arabique ou Mer Rouge*" map edited by the French geographer Jean-Baptiste Bourguignon d'Anville in 1765. Afterwards, numerous European explorers and Christian missionaries reported in general terms on this region of the Horn of Africa, including accounts rich in more or less imaginative descriptions. In the 1810 report[5] by the British governmental official, Egyptologist and traveller Henry Salt, there is an attempt to identify the ruins of Adulis on a map, but the correct positioning of the archaeological area and a description of its ruins must be ascribed to the D'Abbadie brothers and to Theophile Lefebvre's expedition, respectively. Previous and contemporary cartographic sources in Arabic, not covered in this article, may be the subject of future study.

Several reports provided some specific details on the Bay of Zula and delivered some precious oral sources, although with the limits that cultural biases and linguistic differences posed at that time, and that were posed also later, when numerous British military (1865-68) and Italian colonial (1885-1941) published and unpublished writings were circulated. The copious documents present in Eritrean and Italian archives and the detailed reports published by European soldiers, missionaries and explorers, provide a vast amount of information, with the major limitation of focusing on a limited timeframe, as well as of reporting largely instrumental (i.e. collected around analyses with specific objectives) and certainly culturally biased information, therefore blind to part of the local complexity.

Despite all their limitations, it is important to bring to attention the contemporary documents, usually neglected, since, as we will see, they give the area of Zula a role that is anything but marginal, even if in some cases its new centrality remained only at project stage.

To overcome the problem posed by the discontinuity of sources, an approach based on a systemic reading of the historic landscape[6] is proposed, which enables us to focus on specific issues and to address the relationships between the components of the whole system bypassing chronological constraints.

It goes without saying that the first component that will be considered is the Red Sea at multiple levels, trying to focus on the Bay of Zula following a general view of the whole body of water as a corridor between the East and the Mediterranean, Arabia and Africa, and after the peculiarities of its southern segment. Geomorphological characteristics are another paramount component, as they contribute to understanding the natural land routes and general assets of the territory. The networks of relationships might be relevant at local, regional, supra-regional scale. This approach is consistent with the idea that the extension of the area of interest at the centre of which we place the Zula Plain cannot have a permanently drawn precise boundary, as it changes over time along with the relationships investigated.

Given the enormous topic and the vast bibliography, any ambition for a general synthesis must obviously be set aside. We refer instead to works of researchers who expended remarkable efforts to combine manifold primary and secondary sources and archaeological outcomes in order to provide exhaustive historical frameworks of the Red Sea, and to the Red Sea Project Conferences that gather many contributors on different issues;[7] we also refer to important studies on the Aksumite civilization[8] and works of researchers who focused with thorough analysis on the area of Adulis.[9] The historical complexity of the wider region where Adulis is, is also evidenced by the names by which it has been called over the centuries, names that have overlapped and changed meaning several times in the past, leading even to the creation of an ancient-sounding neologism like *Orbis Aethiopicus*[10] to bypass the different connotations that *Ethiopia*, *Aithiopìa*, *Abyssinia*, *Ḥabašat* had, and which are, by themselves, a research topic.

The following outlines, although jeopardized both geographically and chronologically, aim at understanding, away from any deterministic approach, some specific patterns occurring in the area of the Red Sea, where commercial net-

[5] Salt 1814.

[6] Chavarria, Reynolds 2015, Brogiolo 2012.

[7] De Romanis 2006, Nappo 2018, Power 2012, Margariti 2008, Couto 2022, Miran 2009.

[8] Phillipson 2012, Munro-Hay 1991.

[9] Peacock, Blue 2007, Zazzaro 2013.

[10] S. Uhlig, *Orbis Aethiopicus*, in *EAe*, vol 4, *ad vocem.*

works and power hegemonies at local, regional and supra-regional scale define infrastructures capable of integrating a complex and multifaceted space.

The Red Sea as a corridor connecting regions in search of commercial contacts

The spatial configuration of the Red Sea is very peculiar: according to the Portuguese sailors from the seventeenth century it had the shape of an enormous lizard, with its neck at the Strait of Bab al-Mandab.[11] Due to its longitudinal development, it could be considered a *corridor*, i.e. a communication axis running mainly along one dimension characterized by obligatory passages, in this case chiefly the Strait of Bab al-Mandab to the south and Egypt, the 'key to the Mediterranean', to the north. The concept of *corridor* does not imply that the Red Sea was only a sea to pass through *"on the way to somewhere else"* as the historian Will Facey wrote.[12] It is instead a useful approach to consider it as whole, and to evaluate the routes across it as part of communication and transport infrastructures,[13] which needed several components and conditions to be efficient and more profitable than land routes.

Considering the maritime route itself, the Red Sea was an important junction between regions at different latitudes, and therefore largely complementary in terms of goods to trade. In fact, also the well-known fleet of Queen Hatshepsut that reached the Land of Punt around 1470 BC had mainly trade purposes,[14] renewing *via* a maritime route a commercial relationship that had started centuries earlier during the Middle Kingdom, thus testifying to the search for connections to lands with different and peculiar natural resources.

It is clear that across the centuries, in certain historical moments, this diversity of natural resources and manufactured goods was a trigger for enhancing trade exchanges, in others the different geopolitical ambitions turned the Red Sea into a field of conflicts and tensions. Since ancient times, the alternating periods of flourishing commercial networks and decline in trade, the reconfiguration of routes reflecting the decadence or affirmation of new hegemonies and cultural and religious instances, have altered the geographic and economic order of the Red Sea, but the flow of people and goods has rarely ceased: comparisons of material found in excavations of port cities testify to shifts in polarity rather than to episodes of break down in sea trade, even in periods of crisis such as the third century AD.[15] Thriving port cities such as Myos Hormos, Leuke Kome and Adulis itself disappeared - notoriously never for a single cause -, and new centres sprang up in nodes that were more functional to the new general patterns (see Ayla and Clysma, Aydhab, Sawakin, Badi, Jedda, etc.). The parameters to describe these patterns and their change are many and variable, precisely because of the vastness of the sphere, defined as 'global' by several historians, in which the Red Sea trade has gravitated since antiquity (fig. 2).

Even if it cannot be assumed as a sufficient condition, a fairly obvious constant seems to be that the periods from antiquity to the modern age that saw hegemonies over large portions of the sea, also experienced intensity and richness of trade: not so much due to security issues, but mainly thanks to a valuable integration of sea and land, and to the political and economic possibility of establishing infrastructures, a term by which a wide range of facilities, policies and structures is meant, such as well-equipped ports on protected sea routes, safe land routes, regular customs systems, agreements and stable conditions that allowed the circulation of reliable information useful to merchants and travellers.

Infrastructures for navigation: mooring spots and ports

The need for infrastructural facilities was primarily due to the fact that despite its layout as an internal body of water, the Red Sea was not easy to navigate. Certainly, the discovery of the monsoons, dating back to the second century BC according to historians,[16] together with the naval improvements

[11] Couto 2022, par. 34.
[12] Power 2012, p. 24.
[13] *Ib,.* p. 17.
[14] Haarmann 2020, p. 125.
[15] Nappo 2018, p. 171.
[16] Power 2012, p. 17.

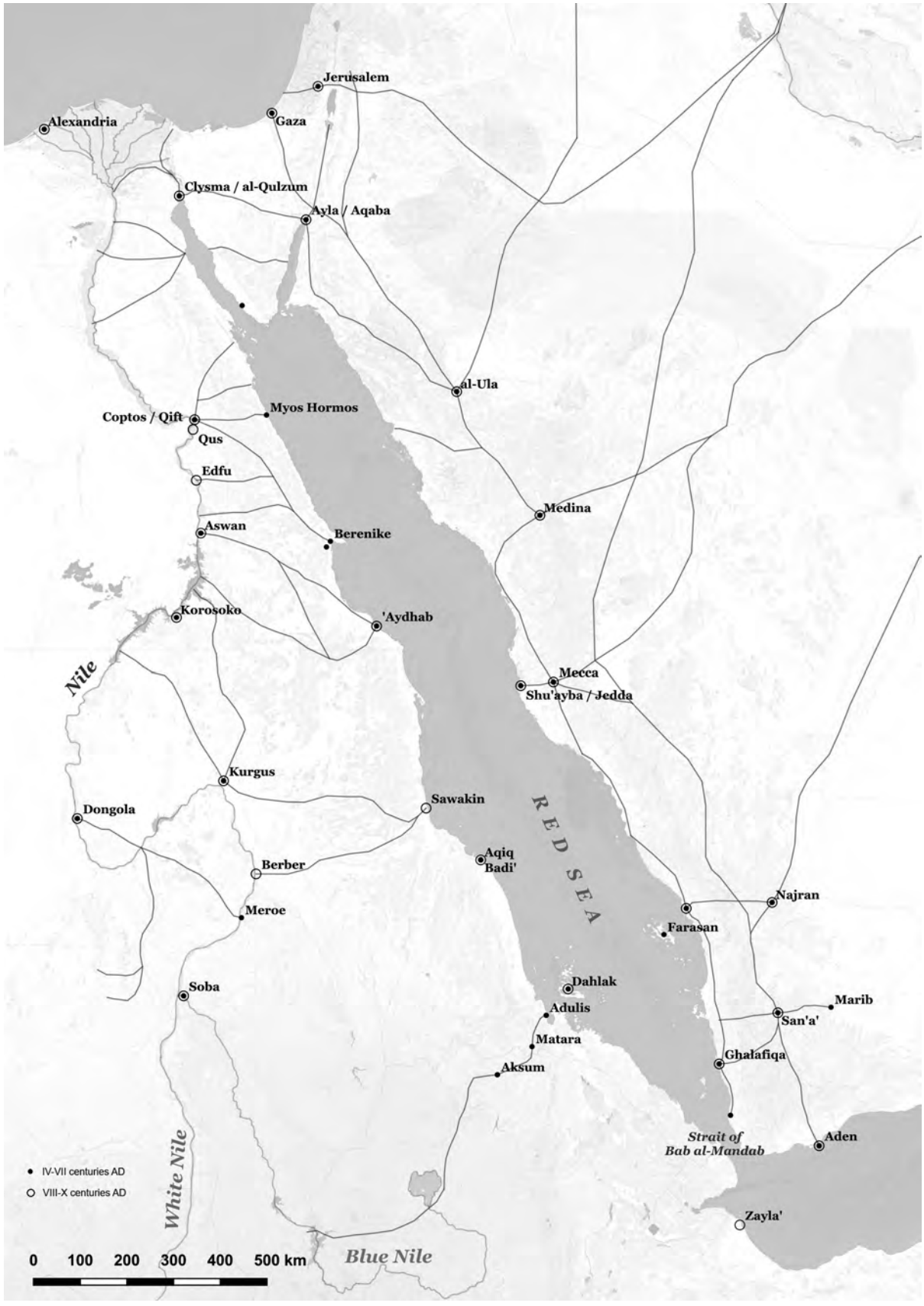

Fig. 2 - Map showing the main ports and trade towns in the area of influence of the Red Sea, active between the IV to VII century AD (black points) and between the VIII and the X century (black circles) (Power 2012).

made by the Romans in the first centuries AD,[17] enhanced the importance of this sea and the interest in improving its infrastructures. However, the Red Sea was known as difficult to navigate: paragraph 20 of the renowned "*Periplus maris erythraei",* a collection of useful information for merchants dated to the first century AD, reports that *"navigation is dangerous along this whole coast of Arabia, which is without harbours, with bad anchorages, foul, inaccessible because of breakers and rocks, and terrible in every way"*. Centuries later, medieval European and Arab travellers were still dismayed by navigation in the Red Sea, named by the Turks the 'Coral Sea' because of the dangerous and extensive coral reefs which made also cabotage difficult,[18] as well as because of the exposed and dangerous seabed and erratic currents, which in some cases forced sailors to anchor at night and navigate only during the day, and necessitated the presence on board of navigators experienced in the area.

A requirement for navigation was the availability of well distributed spots for safe mooring and the supply of fresh water and food. Accessing the coast safely was so paramount that it could strongly affect the pattern of sea-routes.

When speaking of ports and not simple moorings, it is necessary to remark that they "*are dependent on their hinterland to varying degrees so that it becomes necessary to define where the coast ends and the hinterland begins and how much of the hinterland is relevant to an understanding of the coast"*.[19] In fact, the most important ports from antiquity to the present are also points of interchange connected by major land-routes to the assets of the internal regions. In the case of the Red Sea region, these assets are particularly important because "*the vast majority of the Red Sea hinterland on both shores is comprised of the Arabian-Nubian Shield (ANS), an exposed section of the mineral-rich continental crust. The gold of the pharaohs came from this geological formation*".[20]

No need to explain that the long-lasting flourishing of a port, i.e. an articulated territorial system, depended on a complex balance of several factors, including the presence of well-equipped land routes. This is the case in antiquity, for example, of the caravan route linking Adulis, Aksum and Lake Tana to the Blue Nile, of the caravan route from the ports of Berenike and Myos Hormos to Coptos, and of the *Nova via Traiana* that boosted the development of Ayla. Centuries later, the Portuguese strategy for controlling the trade from India seemed to be sea-oriented, focusing mainly on well-positioned ports to be conquered from the Mamelukes and the Ottomans with demonstrations of naval military supremacy. For this and many other reasons, the durable outcomes of the Portuguese presence in the Red Sea are quite rare. During the European Imperialism of the nineteenth century, triggered along the African Red Sea coast by the opening of the Suez Canal in 1869, the connection of the ports with the inland became a central infrastructural issue, leading to the construction of new ports, railways and roads[21] to maximise the exploitation of resources.

Ensuring safe navigation through praesidia and diplomatic networks

To ensure the safety of merchants at sea, the concept of infrastructure includes garrisons and strongholds, and even official fleets for security, such as the Roman fleet that had been stationed as far as the Farasan Islands in the second century AD.[22] In fact, beside natural hazards, a body of water with obligatory passages like the Red Sea could be particularly unsafe due to piracy - 'a *longue-durée* phenomenon'[23] indeed - a problem quite systematically mentioned in ancient and late antique sources that became quite unsustainable in the seventh century.[24] On several occasions the ships were raided also by former fleets of the local powers to discourage trade competitors and to gain extra revenues:

"Ancient Greek authors, including Diodorus Siculus and the geographer Strabo, record that Nabataeans frequently raided Ptolemaic ships on the Red Sea, but the Periplus of the Erythraean Sea notes that the west coast of Arabia remained a hotbed of piracy in the first century CE. The Periplus also notes that an anchorage near Adulis, the entrepôt on the Eritrean coast with links to

[17] Whitewright 2007.
[18] Power 2012, p. 24.
[19] *Ib.,* p. 25.
[20] *Ib.,* p. 26.
[21] Headrick 1984.
[22] Nappo 2018, p. 78.
[23] Simmons 2022, par. 13.
[24] Conti Rossini 1928, p. 211.

Aksum in the Ethiopian highlands, was susceptible to raids by unspecified barbarians".[25]

Control over the seas and over the land had to be coordinated and complementary; ensuring security was a strategy for steering the preferred routes of the goods. In fact, for a ruling power a port was a source of wealth and therefore it made sense to invest in its security and in the security of its sea-routes, as well as of the caravan roads that allowed goods to circulate from and to the port.[26]

Alongside military garrisons, the Red Sea infrastructure could also include diplomatic networks, with representations that, together with the diasporic trader communities, also ensured the coordination of the links to informers. These networks add an important layer to the complexity of the history of the Red Sea. For instance, in the tenth and eleventh centuries, in order to exploit Egypt's role as a commercial pivot for luxury goods whose demand was growing in Europe, the Fatimids shifted their interests southwards, not so much through conquests, but by developing a system of supplies and financing to support their commercial fleets. They also set up, with agreements and dynamics that have yet to be fully elucidated by historians, a sort of management of the ports of the Beja territories (Sawakin and Badi) involved in trade with India and of the port of Aydhab, main destination of the North African pilgrims to Mecca. The caravans and caravan routes across the desert were under the direct management and control of the Beja people.

It is interesting to point out that the Fatimid presence along the coastline in Yemen was favoured from 1030 onwards by the emergence of a pro-Fatimid Ismaelien power.[27] In the light of the Islamisation process that affected the Red Sea following the Arab hegemony of the seventh century,[28] it would be important to draw up specific considerations on the role of the Islamic religion as either a support or limitation to the establishment of political and commercial ties and alliances: the formation of internal currents acknowledged specific supra-local religious authorities and refused others, defining overlapping political issues that had both religious-ideological matrices and economic-commercial outcomes.

The spatial configuration of the Red Sea with an entrance through the forced gate of Bab al-Mandab that could be easily controlled was another vulnerable aspect and highlights the importance of constant negotiations between the local powers. This became particularly evident during the sixteenth century. The Portuguese expansion along the African coasts following the new routes opened in 1487 and consolidated up to the Indies in 1497-98, led Portugal to engage in commercial interference activities to reduce the commercial role of the Mamluk sultanate in Egypt, very close to being a monopoly towards the seas of East Africa and the Indian Ocean.[29] This was the side effect, or the real aim, of a geopolitical strategy in which the Portuguese supported Christian *Aithiopìa* in its defence against the Mamluk and the Ottomans,[30] changing supremacies in the control of the sea trade routes to India. The Italian merchants who still depended on the routes along the Red Sea and the Nile up to Alexandria for transporting goods from the Indies, reported the impossibility of obtaining supplies at the beginning of the 1500s.[31] From sources dating back to the end of the 1500s, it appears that the Portuguese fleets still monitored the Strait of Bab al-Mandab blocking access to competitors in order to encourage the new routes around Africa under their control.[32]

Portuguese written sources of this time, in particular 'pilot books' and portolan maps, are very important: Albuquerque's exploration of the Red Sea around 1513 *"may be considered as the first early modern western attempt to measure and rationally order the spatiality of the Red Sea by recording sea depths and coastal geological morphologies, distances between cities, hamlets and the roads that connected them"*.[33] And these documents reveal the relevant role of Massawa and Dahlak, with no reference to the Bay of Zula.

Adulis and Aksum in the Red Sea

As mentioned above, in Antiquity and Late Antiquity a caravan route led south from Adulis to the capital of the Kingdom at Aksum, from where further routes tapped into the territories between the

[25] Simmons 2022, par. 5.
[26] *Ib.,* par. 7.
[27] Bramoulle 2022, par. 1.
[28] Power 2012, p. 67.
[29] Couto 2022, par. 4.
[30] *Ib.*, par. 2.
[31] Main 1899, p. 58.
[32] *Ib.*
[33] Couto 2022, par. 17.

Tegeze and Blue Nile that supplied the ivory, gold and slave trade. The early rise of Aksum was also founded on the control of the supply lines bringing such commodities down to the coast, and their export from Adulis attracted considerable attention in the Greco-Roman sources. By Late Antiquity, the importance of these traditional exports was eclipsed by the paramount 'India trade' now routed through the port of Adulis.[34] Around the third to fourth centuries, when the expansion of the Kingdom of Aksum was at its peak and the southern part of the Red Sea could be considered an internal sea, merchants of this part of the Horn were the intermediaries of Byzantine trade for the route to India.

The decline of Aksum started in the first half of the sixth century.[35] For Conti Rossini Islam,[36] whose conquest of the eastern coast of Africa coincides chronologically with the decline of Aksum, did not lead to the end of the kingdom in a direct way due to reasons of exclusivity and religious separatism, but it was a contributing cause of the end of its hegemonic role in trade and seems to be associated with the abandonment of Adulis and the rise of other ports like Badi and Jedda. *"The Muslim conflict with [Ai]thiopia and conquest of Egypt therefore provided the basis for a new maritime communications infrastructure spanning the Red Sea"*.[37]

The following synthesis provided by Power outlines a set of the multiple factors affecting the end of the hegemony of Aksum: "*numerous other causes have been put forward for the decline and fall of Aksumite civilization, including the Justinianic plague, environmental degradation of the Yeha plateau, Beja and Agaw nomadic aggression, declining volume of the 'India trade,' and the rise of Islam. Civilizational collapse results when long-term contributing factors reach a 'tipping point,' achieved by some perhaps arbitrary event, yet can only gain a critical mass if sociopolitical formations possess an inherent structural weakness*".[38]

The invasions by the Beja peoples from the north probably contributed to the decline of the Aksumite Kingdom in conjunction with the Arab conquest of the coastlines. As already mentioned, the Beja started managing the trade along the caravan routes from the sea to the Nile.[39] Yet the tenth century Arab author Mas'udi describes the rise of *Aithiopìa*, with territories that extended to the sea, where Arab families paid tribute to the local *Aithiopian* leaders. The area of influence of this power outside its landlocked borders seems to have moved south according to several Arab authors from the tenth to the twelfth centuries, like the geographer Abu el-Kasim, describing a kingdom with maritime cities that supplied themselves with trade to Yemen. Zeyla stood out among these cities: located three days sailing from Yemen, it was very populated thanks to the fact that the ships importing goods into *Aithiopìa* landed here and took on board slaves, gold and silver. It is important to note that Zeyla is located at the bottom of the Gulf of Aden, before the entrance to the Red Sea marked by the Strait of Bab al-Mandab. This choice is consistent with the idea of a kingdom searching for sea routes with safer navigation, and which probably was no longer interested in trade with the Mediterranean.

There is currently a gap in the data about the Bay of Zula in this period that has emerged from the archaeological excavations going from the end of Adulis, which occurred in the sixth-seventh centuries, to the sixteenth century, date of some burials in discontinuity with Adulitan occupation.[40] The conformation of the Bay of Zula, as better described below, makes it favourable only if the entire territory is under control, otherwise it risks being a trap. The only assumption that can be proposed is that the trading activities moved to safer ports further north on the Beja caravan trails or further south where the sea routes were more strategic for merchants from the highlands; in between, the Dahlak islands were an important point of refuge or exchange.

From this macroscopic perspective it is clear that the role of Adulis in antiquity, strategic and flourishing when on an important sea route linked to a significant land route within the same sphere of power, could not remain stable as the multifaceted boundary conditions changed.

[34] POWER 2012, p. 54.
[35] MASSA, in this volume, Chapter 7.
[36] CONTI ROSSINI 1928, p. 211.
[37] POWER 2012, p. 67.
[38] *Ib.,* p. 79.
[39] CONTI ROSSINI 1928, p. 273.
[40] LARENTIS, in this volume.

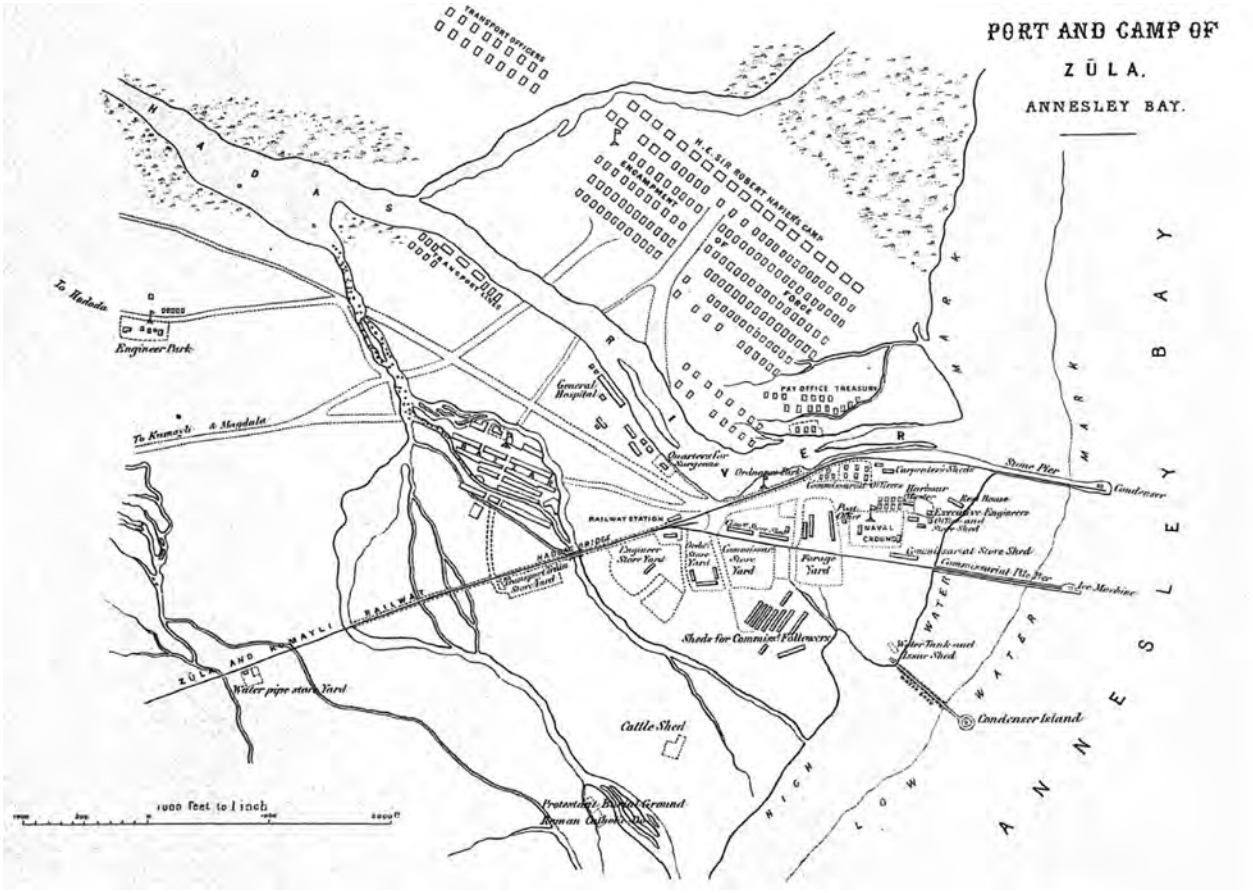

Fig. 3 - Map of the military camp set up near Zula by the British Army in 1868 (Holland, Hozier 1870 p. 337).

The characteristics of the Plain and the Bay of Zula, however, must be read on multiple levels, so that some of the characteristics that made Adulis so important at the beginning of the first millennium AD can be fully appreciated.

The position of the Bay of Zula in the Red Sea

The Bay of Zula lies in a particular position in relation to the north-south development of the Red Sea: it is located in the southernmost third of this maritime corridor. The well-known studies reported by Julian Whitewright[41] in his investigation on the relationship between environmental conditions and naval technology in ancient times, focus on the limits of navigation in the Red Sea due to the general prevalence of southwards winds. Wind conditions were balanced in both directions only in the southernmost third, enabling ships to sail almost equally both north and south, combining with the sea-routes from India that could take advantage of the monsoon winds. The months from October to December were the most favourable for sailing up the Red Sea towards the ports connected with the Nile valley and therefore with the Mediterranean. The Gulf of Aden follows the same seasonal wind pattern: from the Indian Ocean in winter and towards the Indian Ocean in summer, to which summer currents coming out of the Red Sea, linked to its seasonal salinity difference, must be added.

Adulis was in a very favourable position: it benefited from the most reliable seasonal winds, and it was on the African coast, greener and with more accessible moorings than the Arab coast. Moreover, it was on the obligatory route to the northernmost ports of Berenike and Myos Hormos, and later even further north, to Ayla and Clysma, con-

[41] Whitewright 2007.

necting to the Mediterranean (fig. 2). Archaeological evidence and written sources thoroughly examined by Timothy Power[42] remark that from the fourth to the early sixth centuries, the navigation from and to India in the Red Sea increased on new trade patterns and was strategically divided in two parts, the southern and the northern, with Adulis serving as a paramount point of exchange.

Adulitan and Aksumite merchants played such a primary role in this intense phase of commerce with India, that they, as well as the South Arabians, were referred to as 'Indians' in the Byzantine sources. *"Both [Aksumite] and Yemeni merchants were active in the maritime trade with Egypt and Palestine* [the keys to the Mediterranean], *though the general impression is of [Aksumite] prominence. It is notable, for instance, that such travellers to India as Scholastcus of Thebes (fl. 355-60), Palladius (wr. 420), and Cosmas Indicopleustes (fl.525-50) must first journey to the […] port of Adulis in order to find a ship bound for India proper"*.[43] Different ships made for different sailing conditions, those from the open Indian Ocean and those to the upwind area of Clysma and Ayla in the very north of the Red Sea, met in Adulis.

When we then consider the characteristics of the Bay of Zula itself, the advantages of Adulis - even just as a stopping point in case of need - must have been as numerous in ancient times as they are today. The bay is in fact protected by the Dahlak Archipelago which break the waves coming from the north. The Island of Desie, acknowledged as the ancient *Oreinè*, is set in a lookout position at the entrance to the bay; freshwater sources which currently coincide with the Komayle and the Wi'a springs are half a day walk from Adulis, and seasonal watercourses can support all kinds of farming. As already remarked, Adulis was also the terminus of the caravan road to Aksum and the Blue Nile.

The seabed near the coastline is shallow and since it is an alluvial plain, it might have been similar also in ancient times, when the coastline was not yet so far into the bay. Nevertheless, geophysical investigation[44] confirms the presence of a bedrock that in ancient times could have outlined a different kind of shore and deeper waters.

In any case, as extensively argued by Peacock and Blue,[45] to think of ancient Adulis as an *emporium* town distant 20 *stadia* (equivalent to about 3.15 km) from the port means to examine the entire bay as a port system (Map 4): the most suitable mooring spots were in *Oreinè* and in *Gabaza*, i.e. the Galala Hills currently surrounded by land. In both places traces of buildings and ceramic sherds testify the importance of their role in antiquity.

It is noteworthy that at the end of 1867, when the British army placed its military base near Zula to wage war against Emperor Tewodros, they had to build a pier from Ras Malkato that jutted out over 250 m into the sea (fig. 3) to allow their big vessels to unload, stressing how shallow the waters were in that part of the bay. Nevertheless the British praised its advantages: "*Annesley bay is formed by nature to be a first-rate harbour*",[46] but they also pointed out the critical issues linked to the vulnerability of such a closed bay: "*the position of a fleet in a deep bay extending for some miles inland, and with no exit but to the north, might be one of extreme risk*",[47] which, as for the Red Sea, required control on a supra-local scale for its defence.

Including a wider territory in the picture, it is important to remark that other mooring points and ports played significant roles in different historical times in the same area.

The Dahlak Islands (Ptolemy's *Elaía* islands and Pliny the Elder's *Aliaeu*)[48] in antiquity were suppliers of tortoise shells for the Adulis *emporium* and were in relation with Aksum between the fourth and seventh centuries. Due to their strategic position and labyrinth-like coastlines, they played different roles within the powers of the Red Sea and in the trade to India, with a dominance during the eleventh and twelfth centuries[49] when Dahlak Kebir *"served as an important stepping stone between Aden and the Red Sea entrepots of Aydhab and Sawakin"* testified by findings and remains, especially tombstones.[50]

[42] POWER 2012, pp. 59, 78.
[43] *Ib.*
[44] CENSINI in this volume.
[45] PEACOCK, BLUE 2007.
[46] HOZIER 1869, p. 80.
[47] *Ib.,* p. 281.
[48] E. VAN DONZEL, R. KON, *Dahlak islands*, in *EAe,* vol. 2, *ad vocem*.
[49] MARGARITI 2008.
[50] E. VAN DONZEL, R. KON, *Dahlak islands*, in *EAe,* vol. 2, pp. 64-69, *ad vocem*.

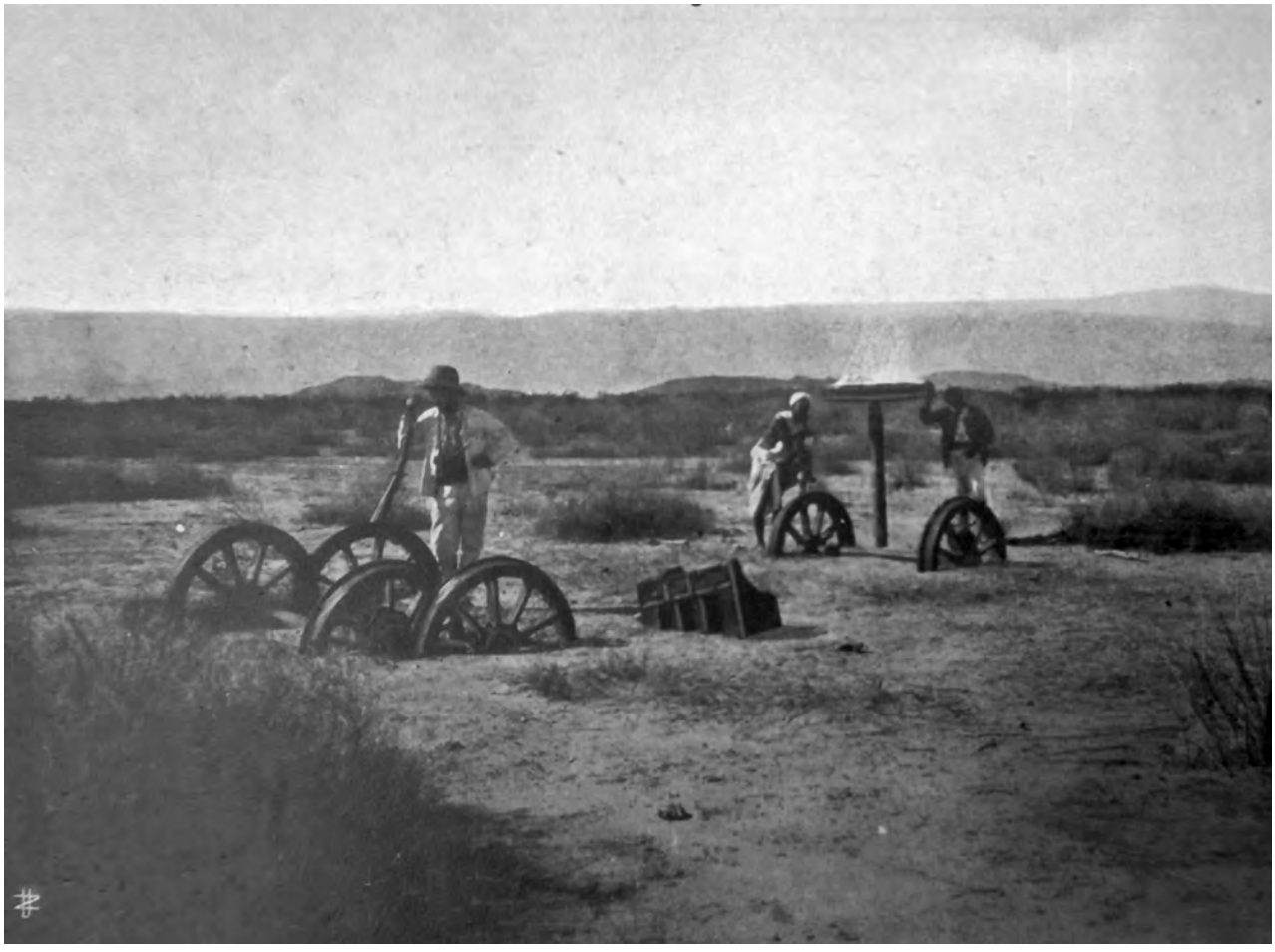

Fig. 4 - Railway rolling stock abandoned by the British Army in the Zula Plain, in an Italian picture of the early 1900s (Checchi 1913, p. 118).

Along the coast to the north is H'rgigo, facing the homonymous bay. Rich in fresh water and an ancient elephant hunting spot, this village was reported as particularly flourishing by the Portuguese in the sixteenth century. The shallow water of the bay did not allow for mooring big vessels, which anchored instead at Garar or at Massawa, with which H'rgigo established an enduring *"symbiotic trade link"*[51] made of small local crafts carrying water and fresh vegetables directed to the port-island.

Local assets and resources: water

Another category of factors that has certainly influenced settlement strategies from ancient to contemporary times, is the presence of freshwater. This is not just the water from the wells of Wi'a and Komayle already mentioned, nor the hot springs located in Asfet and at the feet of the Galala Hills, but above all the water brought seasonally by torrential flows. The alluvial plain itself, in the centre of which Zula, Afta and the remains of Adulis are located, is in fact the clear sign of waters so abundant and impetuous as to transport enormous quantities of stones and soil eroded along their course. The steep escarpment of the plateau begins immediately behind the coastline. Three torrential watercourses converge upstream from Adulis, which carry the summer rainwater falling on the plateau towards the sea: the Alighede, the Haddas, the Komayle and their minor tributaries affect a catchment area of over 2,000 km^2 and

[51] R. Pankhurst, *Ḥərgigo*, in *EAe,* vol. 3, *ad vocem*.

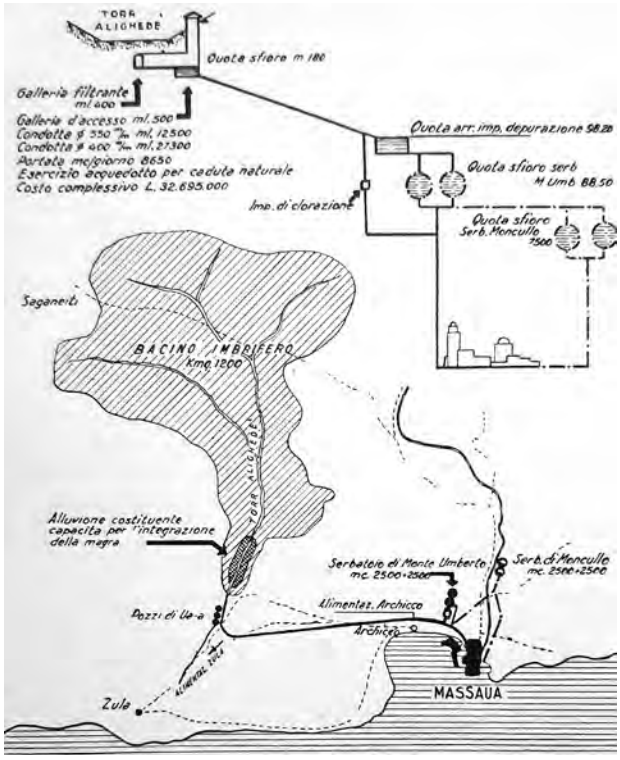

Fig. 5 - Project for a water caption at Ua-à [Wi'a] to provide freshwater to Massawa from Alighede watercourse (AA.VV. 1939, p. 496).

have an annual flow of around 100 million m^3.[52] Such an abundance of water is concentrated over the summer months and flows rapidly, sometimes disastrously, into the sea. This peculiarity in the 1920s and later in the 1950s, suggested the construction of a dam to create a reservoir. The conformation of the Foro Narrows,[53] with their basalt walls acting as a support and limit to the barrier, were perfectly suited to this purpose.

Although there is no certainty today, it cannot be ruled out that a barrier had been built in ancient times: the main port activity was probably concentrated in the winter months, when, considering a regime similar to the current one, only small rains fell along the coast that could green the land, but were not sufficient either for agriculture or for the daily uses of a town and a port. Oral sources reported by nineteenth century travellers mention the end of Adulis as a consequence of the sudden collapse of a dam.[54] The Foro Narrows, once different from what can be seen today, were surely a more than suitable place, and the technology for constructing a similar work was certainly governed locally in antiquity, as witnessed by the dams of Safira at Qohayto and of Mai Shum at Aksum. It should not be surprising that of the three dams, the one at Adulis was the only to be destroyed, since the occasional violence of the floods of the Haddas is unfortunately known. The flood problem in the Adulis area had also been raised by the Italian colonial administrators in the summer of 1907,[55] when the excessive flow of water was reported as a risk for the archaeological remains of Adulis just excavated by Roberto Paribeni.

In the historical series of destructive floods witnessed by the Zula Plain, two have been recorded in the near past.

In 1924, the force of the water was so strong that it destroyed the dam built four years earlier by Ernesto Beltramo[56] to farm cotton in the valley plain. It was a barrier made of dry stone resting on a slightly sandy bottom, perhaps not so different from what might have been constructed in antiquity.

The current dam, built in the late 1950s for irrigation purposes, is partly made of reinforced concrete and is equipped with large spillways. This structure has significantly changed the landscape: beside the fact that Foro started being a significant village after its construction, the agricultural project downstream, involving the cultivation of 7,000 hectares of cotton and *dura*,[57] consists of diversion canals and high embankments enclosing each field, as foreseen by the spate irrigation technique.[58] The landscape upstream of the dam has also changed significantly: without sediment retention systems, a good part of the 23 million m^3 of the reservoir capacity were filled with soil and deposits within the first fifteen years and the basin is now a vast terrace of alluvial deposits. The dam no longer functions as a water barrier, which today constitutes a risk factor, as occurred with the 2015-

[52] Reviglio 1954.

[53] Baioni, Porta, Guadagnini, in this volume.

[54] Salt 1814, p. 452; Bertarelli 1929, p. 684.

[55] Archivio Storico Diplomatico del Ministero degli Affari Esteri - Archivio Eritrea, envelope 500.

[56] Puglisi 1951, *Beltramo Ernesto*, p. 41, *ad vocem*; Reviglio 1954; Finlinson *et Al*. 1961.

[57] Finlinson *et Al*. 1961, p. 61.

[58] Mehari, Ghebru 2005.

16 flood, for the villages and crops of the plain, as well as for its important heritage.[59]

But above all, the deposits transported by the Haddas, with the smaller contribution of the strong occasional *kamsin* wind, have created a thick layer over the centuries that has covered many traces, not only ancient ones but also contemporary ones such as the British railroad[60] and causeway that connected the Malkato landing place to the wells of Komayle on the way to the plateau, both still well visible in the early 1900s[61] (fig. 4). In 2004-5, Peacock and Blue could only see a few minimal traces of these artefacts, which shows that layers and remains in this area are rapidly covered even without any anthropic intervention.[62]

Furthermore, we do not know whether the current dam has modified the sub-watercourses, characteristic of the streams of the Eritrean Coast, and an important drinking water supply system in the plain. In the report of the soldiers of the 1868 British Expedition,[63] who paid particular attention to the availability of freshwater, reference is made to the absence of wells in Zula and Afta, and to the presence of holes dug to fill, according to the author, with rainwater for animals. At 3.5 km from Zula, the sub-surface waters were more superficial, and the inhabitants went there to stock up on water. The interesting note[64] by the British is that the place where the inhabitants dug to find water was on the bank of the Haddas watercourse, immediately opposite the ruins of Adulis. Similar information had also been provided by Dr Beke who was in Zula Bay[65] in 1866.

The phenomenon of sub-watercourses was certainly significant in a large portion of the valley, so that around the 1930s the Italian government, in its search for a range of solutions for the water supply of Massawa (fig. 5), evaluated the hypothesis of creating a filter tunnel in the bed of the Alighede where the Wi'a wells are located, estimating a minimum flow rate of 100 l per second of freshwater even in dry periods.[66] The wells in the centres of Zula and Afta, which are from the late 1800s and 1900s, provide slightly brackish water. Indeed, we do not know whether the dam, especially with its current configuration in which the basin is filled with approximately 13 m of sediment, caused the alteration of these waters; however, it seems clear that before its construction, freshwater was a resource available in the close and medium range. And it certainly must not have been so scarce if the plain is described in early 1900s as very rich in herds:[67] although the herds were subject to summer migrations towards the plateau, they nevertheless required relatively abundant water and pastures.

Going back to antiquity and considering the water supply for boats, we just report what was hypothesized by Peacock and Blue, who, during their survey, identified the well for this service on Desie Island.[68] Still in late 1800s, Desie was reported to have two *mersa* (i.e. mooring spots) used by dhow boats solely to stock up on freshwater.[69]

Looking beyond the Zula Plain, there are other resources that are extremely important because of their commercial value: first of all the natural salt pan of Barduli, in the centre of the Buri Peninsula, which had certainly been exploited as a source of wealth for centuries. Between the end of the nineteenth and the early twentieth centuries, before the large artificial salt pans of Massawa were opened, 50 tons a day were extracted under the almost exclusive management of the Zula population and the Minifires and Ancala peoples, and then transported by dhow or camels.[70] Volcanic activity had also made the Buri Peninsula rich in obsidian, whose importance in ancient times is well known. To the north of Zula Bay, Mount Ghedem is relatively rich in limestone and iron: it is not currently known whether these resources were also quarried in ancient times.

[59] Ogubazghi, Tsighe 2018.

[60] Street, Ghebreselassie 2009, pp. 21-34, Holland, Hozier 1870.

[61] Checchi 1913, p. 118.

[62] Peacock, Blue 2007, pp. 14-15.

[63] Holland, Hozier 1870.

[64] *Ib.,* p. 287.

[65] Massa, Cattaneo 2022, pp. 61-62.

[66] AAVV 1939, pp. 496-497.

[67] Martini 1913, vol. II, p. 995: the herds, limited to the ones registered in 1895, amounted in the lower Assaorta to over 3,500 cattle and 6,000 sheep and goats, as well as 900 camels (declared) and around 200 mules and donkeys.

[68] Peacock, Blue 2007, pp. 57-58.

[69] Folchi 1898, p. 374.

[70] Martini 1900, p. 212.

Fig. 6 - Photo taken by the Royal Engineers of the British Army in 1868 of the Surù Narrows, a six-hour walk upstream the Komayle watercourse from the British camp at the Komayle wells (image available at https://collections.vam.ac.uk/item/O142530/abyssinia-expedition-1868-9-photograph-royal-engineers/). The human figure, visible at the bottom-centre of the photo, can hardly be detected due to the difference in size.

It is known from extensive literature on this subject that the resources of wild fauna were exploited. In particular tortoises, whose carapaces were traded in ancient times, and which, together with pearls, could be found in the Dahlak Islands. Furthermore, the abundance of elephants, which even in the last century were considered a main contributory cause of the deforestation process in Eritrea, guaranteed a meaningful supply of ivory.

A harbour as a territorial system

As previously highlighted, a port can be all the more significant the better it is connected to a hin-

terland with resources relevant for medium and long-distance trade. Since antiquity, maritime and land routes can be fully defined as communication infrastructures. They are not to be intended only as impressive works like the canal connecting the Nile and the Red Sea restored by Traianus between the first and second centuries, or the caravan road between Myos Hormos and Coptos equipped during the Ptolemaic Kingdom with wells, cisterns, strongholds and observation towers,[71] but also as an integrated communication network made of safe natural routes.

In the case of Adulis, the connections relying on the two valleys of Haddas and Komayle are paramount. They start not far from the semi-arid coastland and lead to the plateau of southern Eritrea known in the past as Akkale Guzay, renowned for the richness of its crops and its healthy climate. According to certain sources, some of the inhabitants of Adulis even used to leave the city in the summer to move to Qohayto, identified - yet not unanimously - by historians with ancient *Coloë*, an important centre for the ivory trade in the highlands.[72] The two valleys in question are very incised, and sometimes cross very narrow, dangerous and overshadowed passes, like the frequently mentioned 'Devil's Staircase' (fig. 6). Being seasonal waterways that swell especially with the summer rains on the plateau, they are not passable all year round; however, winter coincides with the months with the best wind conditions, that is when it is possible to navigate the Red Sea from Bab al-Mandab northwards with the winds in favour.

The two Haddas and Komayle routes certainly constituted in ancient times the main access to the plateau and to the important caravan roads in the direction of Aksum, the Tana Lake and from there to the Blue Nile. It must be investigated whether the connection between Adulis and Aratu, a settlement from the Aksumite period a few kilometres north of Keren on the way to the White Nile, was *via* Qohayto or by the northern seacoast and then along the Labqa watercourse.

About the Haddas and Komayle routes, not much is known of their frequentation and use after the abandonment of Adulis, and an archaeological investigation is strongly hoped for. Nevertheless, these connections seem to have been frequented assiduously for several reasons at least in the past centuries until recently. The colonial reports of late 1800s point out that the summer transhumance of Zula's herds led to the pastures of Àdi Qheyh' along the Komayle and Haddas routes. The course of the Alighede was also followed to reach Aidereso and the lush Ala Plain.[73] It is evident that the land routes along such incised valleys, forced by the orography through obligatory passages and overshadowed points, posed risks for travellers. Shortly after the mid-nineteenth century, French testimonies speak of groups of bandits ("les farouches Chohos") settled in caves dug into the walls of the mountains, who lived by thieving, robbing and extorting caravans,[74] and we can easily suppose that similar conditions were quite frequent across the centuries unless a strong territorial control system was put in place to ensure the safety of traders.

Beside security issues, the relatively easy access to the plateau, taking only three days from the Bay of Zula, meant that in 1866 the Egyptians in the service of the Ottoman Empire considered it strategic to occupy the area and guard its landing place, in order to prevent Ethiopia from being supplied with weapons.[75]

The rapid sea-plateau connection provided by the Komayle Valley was truly strategic. An exhaustive analysis in this sense was reported during the 1865 British military preparations, which led to the defeat of Emperor Tewodros at Magdala in 1868. The arrival of a massive number of Indian and British soldiers, and of pack animals like horses, donkeys, elephants and camels for transporting the equipment, required a logistical organization that could not ignore some fundamental natural factors including convenient natural land routes to access the plateau.

After several attempts,[76] of the two valleys the British chose the Komayle Valley, because it proved to be less difficult and ten miles shorter.[77] This route is a three-four day walk from Zula to the plateau. If protected resting places with availability of water,[78] pasture and firewood were sufficient for caravans,

[71] Nappo 2018, pp. 57; 75.
[72] Bertarelli 1929, p. 661.
[73] Folchi 1898.
[74] Simon 1885, p. 240.
[75] A. Saleh Mohammad, *Zula*, in *EAe,* vol. 5, *ad vocem*.
[76] Hozier, Holland 1870, p. xviii.
[77] Hozier 1869, pp. 74-75, 82
[78] Osio 1869, p. 14.

Fig. 7 - Aerial photo of the jetty at Zula for the exclusive use of the Italian Military Air Force in 1936 (Lioy 1965, p. 24-25).

the English army of 1868 needed a basic carriageway suitable for carts transporting heavy weapons and therefore made some changes in some parts of the valley. The following describes some works accomplished by the British in three months: "*the road that leads to Komelu [Komayle] is entirely traced by two parallel rows of stones; comfortable and wide on the plain, it becomes irregular as it progresses into the hills: the main difficulties, however, are overcome and the whole road is passable for carts. […] The road is entirely traced in the bed of the stream; the valley, always narrow, sometimes narrows to the point of leaving no more than 5 or 6 meters between the two walls which rise steeply; […] passages had to be opened using mines, some streams had to be channeled, earth and stone mounds had to be made*".[79] This carriageway was not meant to last longer than one season, and in a short time no remains were visible except for the irreversible enlargement of some passages.

A few years later, when the European nations had already largely begun the so called 'Scramble for Africa', made unilaterally official by the Berlin Congress in 1884, the French started consolidating their presence along the coasts of the Horn of Africa. The Red Sea had become highly strategic through the opening of the Suez Canal in 1869, and the French recognized the Bay of Zula as a location of great interest. Occupying this part of the coast was the way to maintain a French influence in the region, since unlike Obock, too far from the routes that lead to the Abyssinian riches, Zula was a few days walk from the Akkale Guzay region and could be "*the most favourable port to implement further trade relations, especially since this part of the Abyssinian plateau [was] the first to be able to be exploited from an agricultural point of view, the only territory that [could] be exploited both for its fertility and for the healthiness of its air. The French agent to the king of Ethiopia therefore [had] the aim of obtaining that the caravans headed towards the Red Sea abandon the routes to Massawa and Zeyla to head towards Obock and Zula*".[80]

[79] *Ib.*, pp. 10, 12.

[80] SIMON 1885, p. 240.

Fig. 8 - Traces of the Italian Military Air Force landing place, still visible from satellite imagery of 2024 (©GoogleMap, Airbus/CNES, position 15°15’11.5”N 39°42’28.4”E).

Fig. 9 - The pier still visible in 2025, with traces of the iron railroad sleepers.

However, in 1887, this was contested militarily by the Italians,[81] who had occupied Massawa in 1885 replacing the Egyptian army ruling for the Ottoman Empire, and in 1890 established the Eritrean Colony. During the Italian colonial period (1890-1941), Eritrea underwent a series of transformations, functional to the various projects for turning the colony into a source of profit. This process gave rise in a few decades to a territorial structure based on new networks and new centralities. In this new layout, the Bay of Zula and its assets were often the object of interest and on several occasions even of detailed projects.

The itinerary map issued by the *Istituto Geografico Militare Italiano* in 1923[82] shows the travel times of the rolling roads created by the Colonial Government for its own needs, as well as of the previous tracks and paths, an essential network to be known in order to control the territory. The sea-plateau connection had always been strategic and so it was for the Italians as well: after taking possession of Massawa and occupying Asmera and Keren in 1889, they continued to strengthen the ascent route along Saati, Gindaâ and Nefasit up to Asmera, which was in a central position towards the borders with Sudan and Ethiopia.

However, this single infrastructural axis connecting the coast to the plateau made the supply and trade system extremely vulnerable and penalized the development of the potentially very rich Akkale Guzay. In 1916, the Massawa - Wi'a - Senàfe carriageway through the Komayle Valley had been explicitly requested by the traders of Senàfe who offered to contribute to the construction costs,[83] but the initiative ended with no result.

After the First World War, when numerous cableway systems were built and used along the Italian Alps, the colonial government hypothesized the construction of a ropeline called the 'Gulf of Zula-Àdi Qheyh' Aerial Way'. From a general report on the Eritrean Colony dated 1918: "*the construction of the cableway 'Ad Caiè* [Àdi Qheyh']-*Golfo of Zula' always presents itself as a problem of appropriate implementation in the first 'post-war' period. The lower end would lead to a pier in the inlet to the west of Irafayle, from where the transport of goods to and from Massawa would be ensured with a local navigation service*".[84] This would have allowed the export of Akkale Guzay products and the exploitation of its timberland. The cableway would have reached the plateau at 2,500 m on a horizontal distance of 34 km.

To complete the transport system, the project of an economic railway (narrow gauge or even, perhaps, *Decauville* type, i.e. a preassembled railway)[85] was under study. The railway was intended to run along the coast, linking the Labqa Valley, Êmkulu, Zula and Irafayle towards Cabuia, in order to support agricultural development, possible thanks to seasonal watercourses in Weqhiro-Êmberemi and Zula, and to exploit the wood and coal resources of Mount Ghedem.[86] This coastal line and the cableway would have intersected in the Gulf of Zula and would have provided a competing and subsidiary line to the Massawa-Nefasit railway for the connection with the Akkale Guzay. A light rail line was actually in use from Massawa to H'rgigo to connect the latter port to the Campo di Marte (Massawa) logistics base in the 1930s.

Much of the Italian colonial infrastructure was built or upgraded during the preparation of the Ethiopian Campaign (1934-36). The vulnerability of a coast-plateau transport system based on the Massawa-Asmera axis alone was particularly evident in the military studies that preceded the planning of the 1935 attack on Ethiopia, the success of which was based on the uninterrupted flow of supplies and vehicles.[87] It was therefore essential to find alternative routes south of Massawa, i.e. closer to the border with Ethiopia. To relieve the port of Massawa from aeronautical material, a pier was restored in Zula and an airfield was built (fig. 7), of which some traces are still visible (figg. 8-9), and which is still remembered by local inhabitants as *Abiasione*, i.e. 'Aviazione'. The plain was in fact easily arranged and the base was directly accessible from the sea and usable in every season.

[81] DEL BOCA 1976, p. 302.

[82] IGMI, *Carta Itineraria della Colonia Eritrea-Asmara*, 1923 online source: https://www.igmi.org/it/carte-antiche/digitale_300_dpi/carta-1658483754.2 [accessed on 06/03/2025].

[83] *"Ricognizione dell'organizzazione militare Eritrea, Aprile Maggio 1934"* p. 10, ACS (Rome, Italia), Fondo Badoglio, envelope 4, file 6, 1-4.

[84] MINISTERO DELLE COLONIE 1918, p. 63.

[85] *Ib.*, p. 136.

[86] MARTINI 1913, p. 1829.

[87] DALL'ORA 1937.

This aviation centre was not among the permanent bases, which included Asmera, H'thmlo, Àseb and Gura; nevertheless, Zula was extremely strategic in terms of logistics compared to Gura. The hypothesis of stationing aviation centres along the coast saw Zula within a sequence that started from H'thmlo and arrived at Mersa Fatma, Eid, Àseb, all reachable from each other with half an hour flight.[88]

Furthermore, the need for a second artery alternative to Massawa-Asmara promoted the design of a possible new route that would connect Massawa - Wi'a - Àdi Qheyh' for a total of 133 km. This so-called 'Haddas Road' was not located along the valley bottom but along the ridge between this valley and the Komayle Valley. Avoiding the bottom of the valley was necessary to make it an all-season road and to reduce maintenance costs: the layout was identified during a reconnaissance survey along a ridge between the Haddas and Komayle Valleys, which presented favourable conditions for the construction of a road for vehicles. Given the high construction costs, the works should have started to make the road accessible only for foot troops and pack animals, but from archival documents in March 1935 not even this basic road had been built yet. The sources found do not make it possible to say whether the current 105-km dirt road, which from Wi'a to Àdi Qheyh' follows the ridge of the mountains between the Komayle and Haddas Valleys (Map 1), is the outcome, improved over time, of the route for foot troops and pack animals constructed in the 1930s, or whether it was built later, and whether the project route was resumed in some way. However, it is the evidence of the need for a direct connection between two systems that are also two cultural landscapes and two different climatic and natural environments, complementary today as they were in ancient times.

The coastal road that joins Massawa to Foro in the Zula Plain and continues to Assab is strategic as well: in the 1920s it was a dirt truck road up to Mersa Fatma, a mooring spot linked to the important Dallol potash mines by a *decauville* railway. The road after Foro was very difficult and more like a caravan road. The wadis reaching the sea from the highlands in the summertime made the maintenance of this basic road challenging. The Massawa-Àseb track has undergone constant improvement since Eritrean independence in 1991 to turn it into an all-season road; for travellers coming from Massawa, Foro is the last resting point - a green and lively village, provided with freshwater - before approaching the harsh and barren landscape of the Buri Peninsula and the Danakil coast.

Conclusions

Across the millennia until today, the Zula Plain has played different roles: an advantageous settlement area due to the presence of water, an intercontinental emporium, grazing land for semi-nomadic peoples, a strategic military spot, an extensive farming area, a logistic pivot in a colonial economic exploitation regional project, and so forth. The variety of these roles provide some hints on the *genius loci* of the Zula Plain, which has been alternatively central and peripheric, as it is the result of a strong interconnection and overlap of different factors, just to mention the most relevant categories: a very strategic position on a continental and regional scale; a peculiar geomorphology combining the resources of different environments (sea, escarpments, alluvial plain) and connecting through natural routes to complementary resources (e.g. the highlands and the inland in general, other coastal regions) or to other countries. Connections and intertwining in a multifaceted and multiscale system changing over time according to multiple factors, seem to be the keywords to interpret the *genius loci* of the Zula Plain.

[88] ACS, Fondo Badoglio, envelope 3, f. 5, 107-126.

PRELIMINARY ARCHAEOBOTANICAL EVIDENCE FROM ADULIS: THE ROLE OF EMMER AND BARLEY

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Emmer and barley were undoubtedly important in the diet and agriculture practised in the region of the current Ethiopia and Eritrea in the first millennia BC and AD.[1] There is ample evidence of emmer and barley, considered among the most significant of the Near Eastern founder crop package,[2] in the Ethiopian-Eritrean archaeobotanical record of this period, based on archaeobotanical investigations conducted at some of the sites examined in recent decades in the Northern Horn of Africa.[3] The importance of emmer cultivation in the modern epoch is attested by Vavilov,[4] who relates that this cereal was grown in the early twentieth century by dwellers near the Maze River and by the Amhara, an ethnic group from central Ethiopia.

Further evidence relating to cereal exploitation in the Aksumite period comes from preliminary archaeobotanical research carried out as part of the *Adulis Project*. The coastal town of Adulis was very important due to its geographical position between the Red Sea and the Indian Ocean, shedding light on the long-term history of contacts in this area from prehistory to the Classical period. It was the main trading port in the Northern Horn of Africa during antiquity.[5]

During the archaeological exploration conducted at the site in 2017 and 2018, a first archaeobotanical investigation was launched aimed at reconstructing the diet, agricultural techniques and exploitation of the surrounding environment by the town's ancient inhabitants.

The investigation employed two approaches including the archaeobotanical analysis of plant remains and the identification of plant impressions on brick fragments found at the site.

Due to the absence of a protocol for processing the collected soil samples for archaeobotanical study in this area, a dual processing system was planned that consisted of both dry sieving and water flotation to determine which technique was better suited to this environment that could favour the preservation of desiccated organic material. Sustained exposure to water, in fact, often may play a large role in the destruction of large, desiccated plant remains during the flotation process. After measuring them, each sample was divided into two parts: the first half of each sample was dry sieved through a sieve column with mesh sizes of 0.8, 0.4 and 0.2 mm and the resulting size fractions were sorted under low magnification (8-35x). Only charred plant remains and wood charcoal fragments were sorted as no desiccated remains were found, so it was possible to use water to collect plant remains from the other halves of the samples. A simple wash-over method of bucket flotation was used, and the floating organic materials was collected using a 0.2 mm sieve.

The second approach consisted of detecting and identifying plant imprints on brick fragments found at the site. The study of this evidence provided an initial impression of the relationship that existed between humans and their environment in this area of the Eritrean lowlands.

The preliminary results point to the cultivation of barley, *Hordeum vulgare* L., and emmer, *Triticum turgidum* L. subsp. *dicoccum* (Schrank) Thell.

[1] D'Andrea, Haile 2002; D'Andrea *et Al.* 1999; D'Andrea *et Al.* 2011, p. 369.

[2] Zohary *et Al.* 2012, pp. 20-22.

[3] Delle Donne 2021; Ruiz-Giralt, Beldados 2024.

[4] Vavilov 1926, pp. 33-36.

[5] Zazzaro 2013; Zazzaro *et Al.* 2014; Zazzaro, Cocca, Manzo 2014.

Fig. 1 - Sector 5, Room 3, Tannur 3. Position where a charred barley grain fragment was found during the 2014 fieldwork.

A charred barley grain fragment was found in a sample taken from the content of a *tannur* located in the living area of a building situated in a craft and residential district (Sector 5, Room 3, Tannur 3, fig. 1) at the southern edge of the town along the Haddas.[6] Radiocarbon determination of the charcoal fragments found at the bottom of this oven dated these remains to the second half of the fifth - late sixth century AD.[7] Further evidence of the presence of barley was the impression of a grain in a brick fragment collected from a feature investigated in Sector 2 (SU 2127), where the Northern Urban Church is located (fig. 2). Another grain of barley, along with two glume bases and a rachis segment of emmer (fig. 3) were found in the fill of a cut in the same area (Sector 2, SU 2514). Associated potsherds date these features to the fifth-sixth century AD, which includes what are known as the Middle Aksumite and Late Aksumite periods.[8]

Barley is a cereal of low cytogenetic and taxonomic complexity, comprising only diploid species, with two sets of seven chromosomes in each cell nucleus (2n=14) and with a generally constant ear structure featuring three spikelets, not always all fertile, per internode of the rachis.[9] Emmer, *Triticum turgidum* L. subsp. *dicoccum* (Schrank) Thell., is tetraploid wheat, a hulled wheat in which the grains are firmly enclosed within the spikelets. It has twice as many chromosomes (2n=28) as barley.[10] The rich plant biodiversity of the Eritrean-Ethiopian Highlands led Vavilov to include this area among what he called the primary centres of origin of tetraploid grains. According to Vavilov, the primary centres of origin are those regions of the world in which certain plant species display a high degree of polymorphism, i.e. the coexistence of numerous varieties, a variability much greater than that present in other areas. This

[6] Zazzaro *et Al.* 2014; Ead. 2019.
[7] Zazzaro, Cocca, Manzo 2014.
[8] AAVV 2017, p. 53; AAVV 2018, p. 51.
[9] Zohary *et Al.* 2012, p. 52.
[10] Zohary *et Al.* 2012, pp. 23-33.

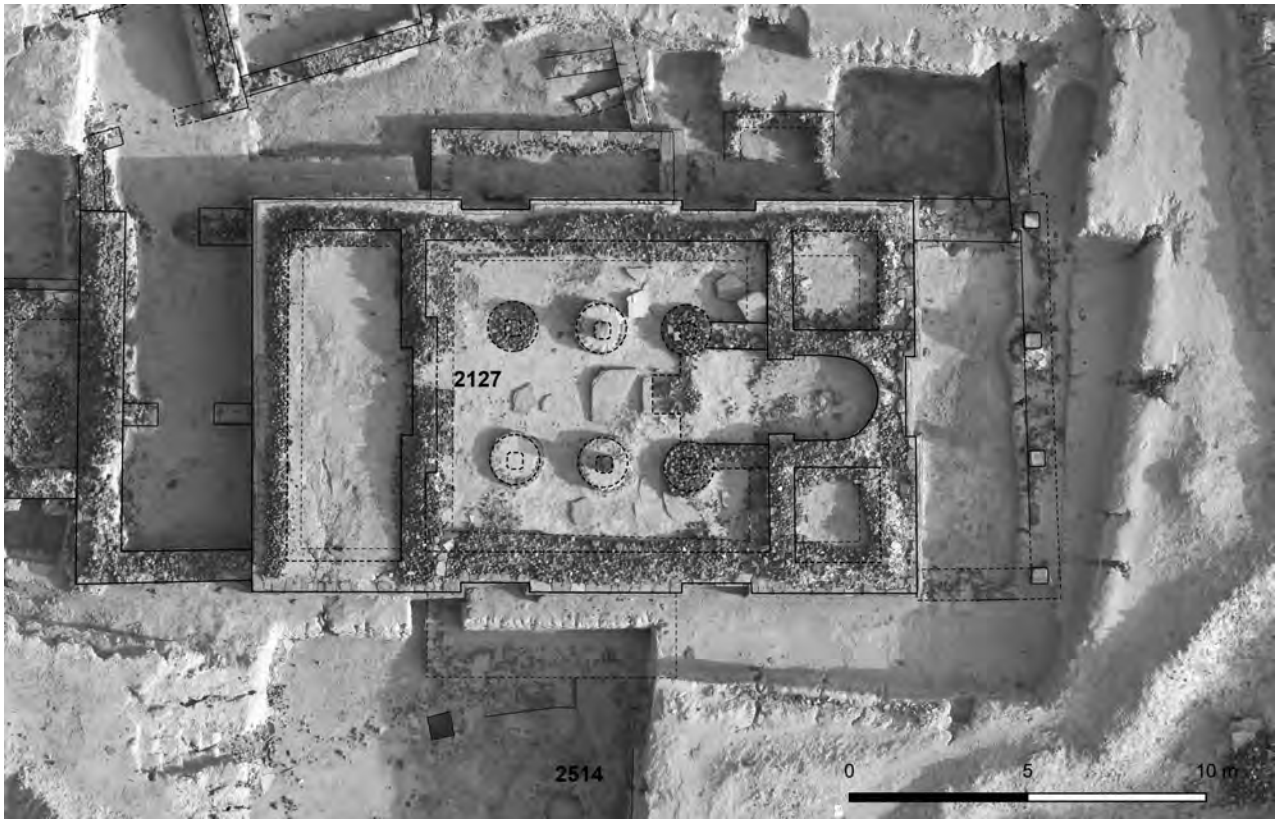

Fig. 2 - Map of Sector 2 with position of SU 2127 and SU 2514, where grains of barley were found.

situation is due to an elevated level of dominant characters. Secondary centres of origin, on the other hand, are areas into which certain plant species have spread, undergoing new selection processes dictated by environmental conditions that are different from those of the primary centres. This led to the formation of new cultivated varieties that manifest recessive characters in these areas that are not displayed in the primary areas of origin.[11] Although Vavilov's initial theory has been widely reconsidered and revised in recent decades - including (among other changes) the reclassification of Ethiopia among zones that Vavilov considered secondary areas of origin of tetraploid grains[12] - the fact remains that the Eritrean-Ethiopian Highlands are a privileged observatory for studying the historical development of these cereals. An additional observation is that over the centuries the farmers of the region, intentionally or otherwise, have cultivated different cereal varieties in order to diversify their diet and, at the same time, to reduce the risk of financial loss in case of pest attack or adverse weather conditions.[13] At times these diverse varieties were grown simultaneously on the same terrain, in accordance with the *hanfetse* practice, which in recent times involves the contemporary cultivation of barley and free-threshing wheat - or, more traditionally, emmer and barley. The same term was used to refer to the simultaneous cultivation of other crops, such as teff with linseed or barley, sorghum with finger millet, and many other combinations, including certain legumes.[14]

The study of the plant remains found in archaeological deposits at Aksum's ancient port of Adulis has yielded an - albeit preliminary - understanding of the practices of the Adulis civilization regarding the exploitation of cereal resources, mainly barley and emmer, in this coastal sector of the Eritrean lowland during the Aksumite period.

[11] Forni 1969 and references therein.
[12] D'Andrea, Haile 2002 and references therein.
[13] Ethica *et al.* 2006; Bekele 1984.
[14] D'Andrea *et al.* 1999, pp. 111-112.

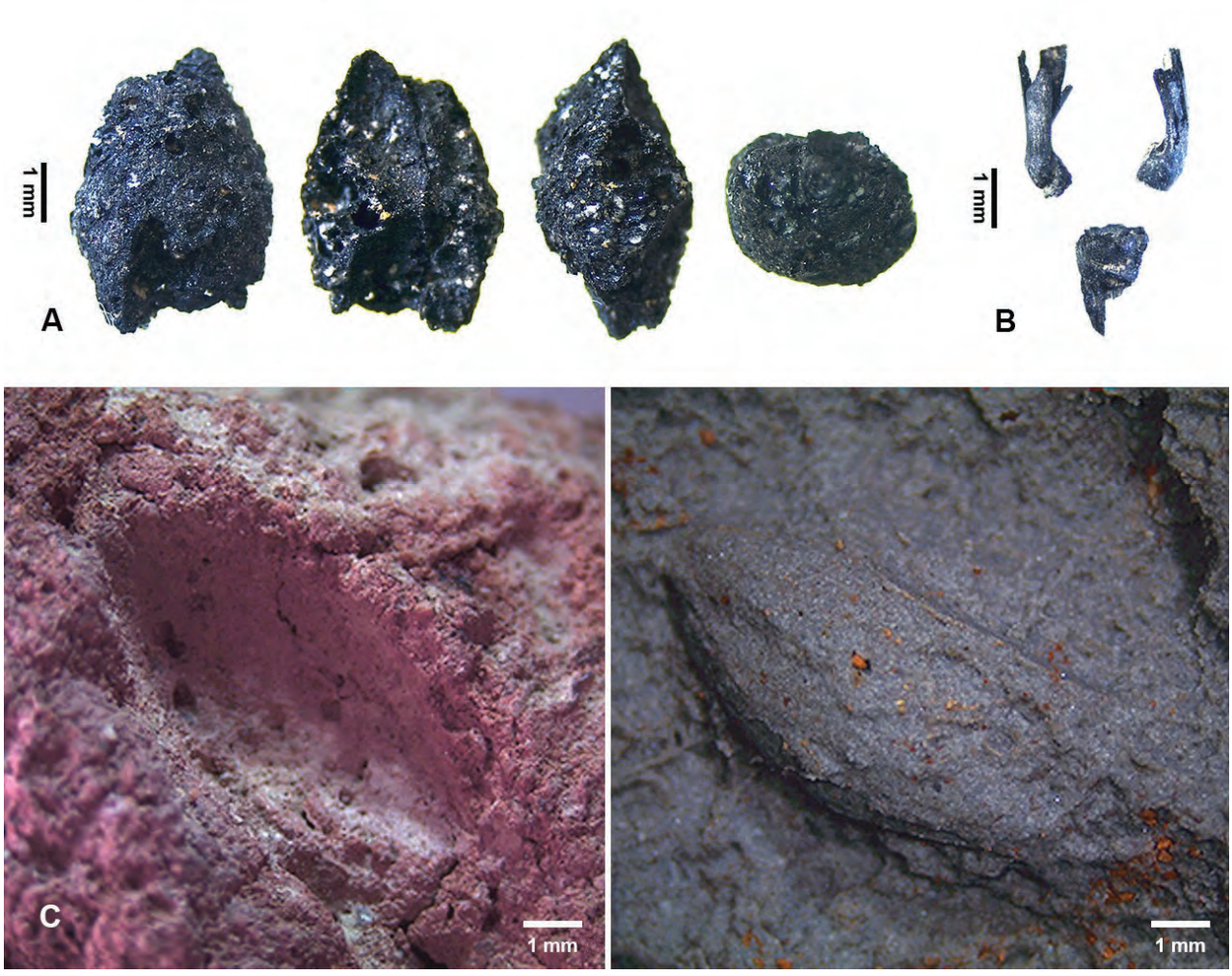

Fig. 3 - Preliminary archaeobotanical evidence from Adulis. A. Charred grain of barley, Hordeum vulgare L., in dorsal, ventral, lateral view, and transverse section. B. Glume bases and rachis segment of emmer, Triticum turgidum L. subsp. dicoccum (Schrank) Thell. C. Impression of barley grain, Hordeum vulgare L., in brick fragment (left) and cast (right).

BRIEF PREHISTORIC EVIDENCE FROM THE GULF OF ZULA

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The paper examines a review of prehistoric studies conducted in the area of Adulis to give a glimpse of major archaeological finds in the Gulf of Zula and the Buri Peninsula corresponding to the Middle Stone and Late Stone Ages.[1] The Red Sea coast of Africa, in particular the Gulf of Zula, where Adulis is situated, is the centre of the major tectonic setup of East Africa as well as an ancient human settlement area. Geographically, the Gulf of Zula lies North of the Afar Triple Junction where the Red Sea Rift meets the Aden Ridge and the East African Rift centered in the Danakil Depression.

Adulis lies north-northwest of the Danakil Depression, a continental rift which radiates north-northwest from a plate-tectonic triple junction within complexly rifted and faulted basaltic lowland, called the Afar triangle, which is characterized by active crustal spreading centre and volcanism associated with basaltic centres of silicic volcanism.[2] The volcanic terrain extending from Irafayle to Alid, for instance, is a favourable host of obsidian outcrops due to the predominance of pyroclastic deposits and lava flows. Obsidian is found in many localities of Ghelti and Wanghebo as well as abundantly in the area of Kusrale, a place between Irafayle and Abdur situated along the coastline (fig. 1). The exploitation of obsidian raw materials in different epochs of human settlements along marine and terrestrial environments (including Adulis) in the Gulf of Zula and the Buri Peninsula is of relevance to the discussion set out in this paper. Having highlighted the geological context relevant to this review, the authors now provide a synthesis of coastal and terrestrial adaptation in the Gulf of Zula and the Buri Peninsula as well as of the archaeological finds related to the Middle and Late Stone Ages.

Synopsis of Archaeological Finds

Africa´s position as the origin of modern humanity is widely accepted, with fossil and archaeological finds from different parts of the continent demonstrating such events. The Middle Stone Age holds a special place in the study of human evolution because it was during this cultural phase that the first anatomically modern humans are believed to have emerged in Sub-Saharan Africa between 200,000 and 150,000 years ago. Their subsequent dispersal to other parts of the world is also believed to have occurred during the Middle Stone Age and is thus partly understood in light of technological and cultural traits of this phase discovered in the African and Eurasian landmasses.

Similarly, the origins and dispersals of early modern humans within and outside Africa were shaped by changes in global climate that oscillated in terms of repeated glacial and interglacial events that featured during the Late Pleistocene (200,000-10,000 years ago). These climatic fluctuations, as will be clarified here, were significant for the evolution of the biological and behavioural traits of the human lineage. Apparently, the pat-

[1] The Middle Stone Age is currently dated about 300.000-30.000 BP: Will, Scerri 2024, with previous literature; the end of the Late Stone Age and the beginning of the following period, which in European and Asian prehistory is called Neolithic, regarding the African continent is a matter of debate both from a chronological and a terminological point of view: Sadr 2019.

[2] Clynne *et al*. 2005.

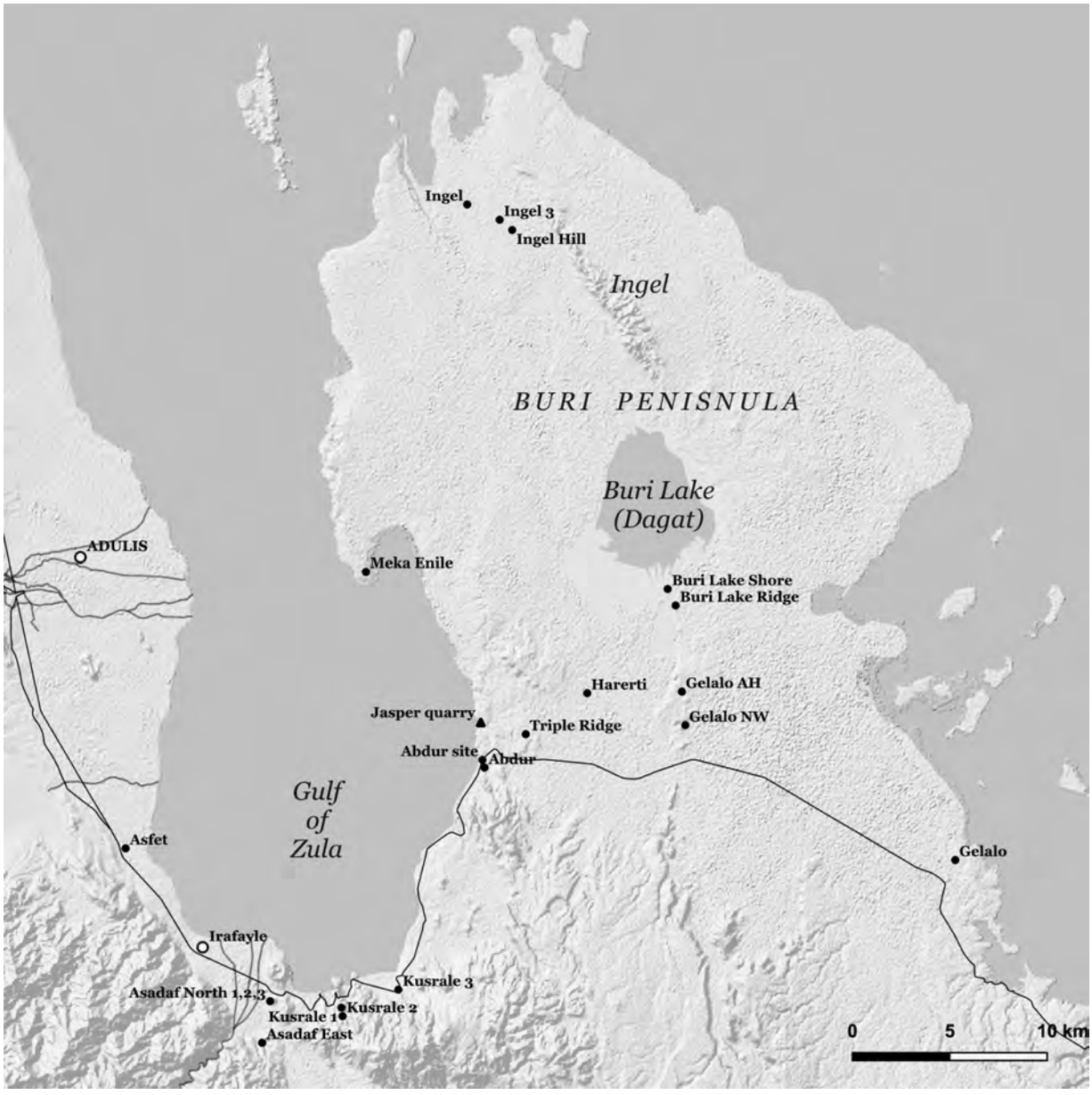

Fig. 1 - Elaboration of the map showing the distribution of the Prehistoric Sites on the Buri Peninsula, as documented by Amanuel Beyin and John J. Shea in May 2005 (Beyin, Shea 2007 p.2).

terns of human ancestry, as understood from genetics, are at present producing models of human migration that need to be tested with independent lines of fossil and artefact evidence. In this respect, it becomes important to frame the presumed dispersals of early modern humans within two major events that occurred between 130,000-100,000 and 80,000-60,000 years ago, respectively. As regards the dispersals, two routes have been considered, namely the Northern Route, (which included the Nile-Sinai pathway) and the Southern Route (which involved the Southern Red Sea).

The geographic position of the Red Sea makes it an important place in the context of the current debate on human origins and dispersal hypotheses. The Bab al-Mandab Strait at the southern end of the Red Sea has been proposed as a credible gate through which prehistoric maritime connections were possible between Africa and the Arabian Peninsula. As has been postulated recently, the coastal margins of both the African and Arabian sides of the Red Sea coasts must have been inhabited by early humans who used the Bab al-Mandab to enter the Arabian Peninsu-

la.[3] Thans to its strategic geographic position along the African side of the Red Sea, Eritrea represents a model to search for Stone Age Sites associated with Late Pleistocene human dispersals out of Africa.

The Red Sea basin is emerging as an important region for testing current hypotheses concerning early human dispersal routes out of Africa.[4] Yet, the African coastal basin saw little research related to the Palaeolithic where assessment of the temporal-cultural framework for human adaptation becomes crucial. In this respect, the Gulf of Zula, which occupies a vital position at the nexus of three broad ecological zones (the highland escarpments to the west, the Danakil depression to the south and the coastal plains adjoining the shorelines), makes it a plausible destination for hunter-gatherers dispersing from the interior landscapes. There are various incentives for hunter-gatherers to disperse to the Buri-Zula plains. The low flood plains at the southern periphery of the Gulf and the flat terrains of the Peninsula are home to a number of grazers, such as Soemmerring's and Dorcas gazelles (*Nanger soemmerringii, Gazella dorcas* respectively), dik-dik (*Madoqua sp*) and one of the last free-ranging populations of African wild donkey (*Equus africanus*). On the other hand, dependence on aquatic resources and shellfish would have been a logical subsistence choice amid the uncertainties regarding terrestrial game. As attested by the discovery of several Holocene shell midden sites from inland and near coastal landscapes,[5] diverse shellfish species can be harvested from the shorelines of the gulf. Beyin has noted that the past climate might not have been milder owing to an interglacial phenomenon of the present times.[6] An arid environment and a concomitant prehistoric human adaptation can thus be surmised along the Buri-Zula coastal plains. Recent archaeological investigations at Abdur and Asfet localities on the Red Sea coast of Eritrea have provided cultural and ecological contexts for these Middle and Late Stone Age human adaptations along the Eritrean coast. Drawing on evidence from the Eritrean Red Sea coast, a summarized account is provided here by pinpointing the importance of these sites to understand the dispersal of early modern humans from Africa to the Arabian Peninsula and eventually to other parts of Eurasia.

Stone tools within the emerged reef terraces on the western shoreline of the Buri Peninsula, were discovered in late 1990s and dated to 125,000 years ago.[7] These artifacts are the earliest well-dated evidence for human occupation of coastal marine environments. The Massawa Archaeological site is located approximately 60 km southeast of the port town of Massawa, along the eastern peripheries of the Gulf of Zula. The Abdur finds comprised two settlement scenarios represented by bifacials (handaxes) belonging to the Achuelian tradition (therefore from the lower Palaeolithic) on the one hand, and Middle Stone Age obsidian stone tools on the other.[8] Large land mammals and marine invertebrates were also found in close association with these artefacts. The marine terrace belongs to Pleistocene events and stone tools were found embedded within the reef limestone, further implying that early modern humans had adapted to the Eritrean Red Sea coast by exploiting marine food resources. This trend signifies behavioural changes in resource exploitation and feeding habits of early modern humans, who needed to respond to climatic stresses of the respective interglacial period. Early humans who were forced to move from terrestrial habitats (around lakes and rivers) during this time should have settled along the coast in response to diminishing water resources further inland in the Danakil Depression and the Eastern escarpments.[9] These early human adaptation strategies induced by climatic fluctuations must have, in turn, enabled early modern humans to use the shores as routes for their dispersal out of Africa and migration along the shorelines of Arabia into Southwest Asia during the lowering of the sea level. The evidence from Abdur in Eritrea, together with the proof of coastal occupations at the mouth of the Klasies River in South Africa (dated to 116,000 years ago), indicates that early humans

[3] Beyin 2006, Beyin 2015.
[4] Bailey 2009.
[5] Bar-Yosef, Beyin 2009.
[6] Beyin 2011.
[7] Bruggemann *et Al*. 2004.
[8] *Ib*.
[9] *Ib*.

were well adapted to exploit marine foods by the last interglacial period evinced during the Late Pleistocene (200,000-10,000 years ago). Accordingly, uplifted marine terraces, like those around Abdur, along the Eritrean coast could be important geological contexts for the study of human evolution and behaviour.

Furthermore, archaeological investigation at Asfet, along the southern edge of the Gulf of Zula, has recorded a surface Middle Stone Age (MSA) assemblage.[10] The pioneer survey was further extended to Gelalo Northwest and Misse East, where shell middens dating to the mid-Holocene and reflecting the exploitation of different coastal environments, have been revealed. Misse East and Gelalo Northwest were both dated to the eighth millennium BP.[11] Asfet, dated to the sixth millennium BP, together with the aforementioned sites, reflects a coastal settlement that resulted due to adverse climatic conditions that prevailed in the hinterland during that period. Change in the regime of monsoons in the Sahara and Northeast Africa may have caused human populations to settle in better-watered areas, the Red Sea coast among them, and to adapt to the new conditions by exploiting the marine environment.[12]

The nature of MSA hominin adaptation is manifested from the Asfet surface assemblage that constitutes point production, prepared core and blade technologies fashioned from local sources. The plausibility of the region as a potential refugium and exit path for hominin dispersals towards the Levant and Arabia is further reinforced from the finds.[13] The MSA holds a special place in the study of human evolution because it was during this cultural phase that the first anatomically modern humans are believed to have emerged in sub-Saharan Africa, later dispersing to the rest of the world. Because typical MSA artefacts (i.e. points and prepared core products) are often regarded as characteristic behavioural innovations of *Homo sapiens* in Africa, the makers of the Asfet assemblage must belong to the *Homo sapiens* fossil hominins recovered from MSA contexts in northeastern Africa.[14]

Recent archaeological investigations in southern and eastern Arabia have reported lithic entities that resemble northeastern African and Nile Valley MSA complexes. Such similarities have suggested to researchers a major phase of human expansion into Arabia during Marine Isotope Stage 5 (MIS 5),[15] therefore between 130,000 and 80,000 years BP. The archaeological entities from both regions show affinity with the Asfet assemblage.[16]

Conclusions

The sites of Asfet and Abdur attest to a wider adaptation along the coast by African hominins on the African margins of the Red Sea before their later dispersal to neighbouring Eurasian landmasses. Considering the plausible dispersal routes, the hominins who adapted to the Buri-Zula corridor might have continued to settle southwards along the Southern Red Sea coast and further to the Arabian Peninsula via the Bab al-Mandab Strait or conversely to disperse northward up to the Levant along the Sudanese Egyptian Red Sea littorals. The discovery of the Asfet and Abdur sites from the Gulf of Zula suggests, therefore, that numerous sites may yet be discovered along the African side of the Red Sea basin by future systematic research.[17]

Future research remains to broaden the *nexus* of spatial and chronological questions to adaptive variability by integrating further surveys and excavations in coastal margins in as much as enlarging the evidence from elsewhere in the Red Sea basin.

[10] Beyin 2013.
[11] *Ib*.
[12] *Ib*.
[13] *Ib*.
[14] Leakey 1969; White *et Al.* 2003.
[15] Parker 2009.
[16] Beyin 2013.
[17] Beyin 2011.

THE INFLUENCE OF THE GEOMORPHOLOGICAL EVOLUTION ON THE PORT OF ADULIS

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This contribution presents an evolutionary hypothesis regarding the geomorphological and environmental dynamics surrounding the archaeological site of Adulis, on the Gulf of Zula, Eritrea. By examining the natural and anthropogenic factors influencing the region, this study aims to provide a plausible concurrent cause for the decline of Adulis, a city of utmost importance in ancient times.

Adulis, historically recognized as a paramount maritime port, owed its prominence to its strategic location along the Gulf of Zula. This coastal region, situated near the southern end of the Red Sea and relatively sheltered from the monsoons originating from the southeast, provided a secure anchorage for ancient vessels navigating the trade networks that connected major civilizations of the ancient world. The site's position in a calm stretch of sea contributed significantly to its development as a port and facilitated the exchange of goods and cultural interactions across the Indian Ocean and the Middle Eastern worlds.

The geological and hydrological characteristics of the western side of the Gulf of Zula provide further context for understanding the town's evolution. The region is dominated by the extensive alluvial fan (delta) formed by the Haddas-Alighede and Komayle watercourses, which transport vast quantities of sediment from the mountainous terrain of the highland escarpments. Spanning over 20 km along the coastline and extending more than 4 km into the sea, this delta has markedly altered the coastal topography. The rapid accumulation of sediment is evidenced by modern observations, such as the filling in of the Foro Dam, which was rendered non-functional within a few years after its completion in 1960 due to sediment deposition.

From the period when Adulis thrived as a key port of the international network of trade in antiquity to the present, the delta appears to have advanced significantly into the sea. Historical cartographic analyses support this hypothesis: comparisons between contemporary shorelines and maps from the Italian colonial era, specifically the Zula Sheet of the Italian Military Geographical Institute based on 1889 surveys, reveal that the coastline near the Galala Hills has shifted seaward by approximately 700 m in just over a century. This data underscores the dynamic nature of coastal change in the region.

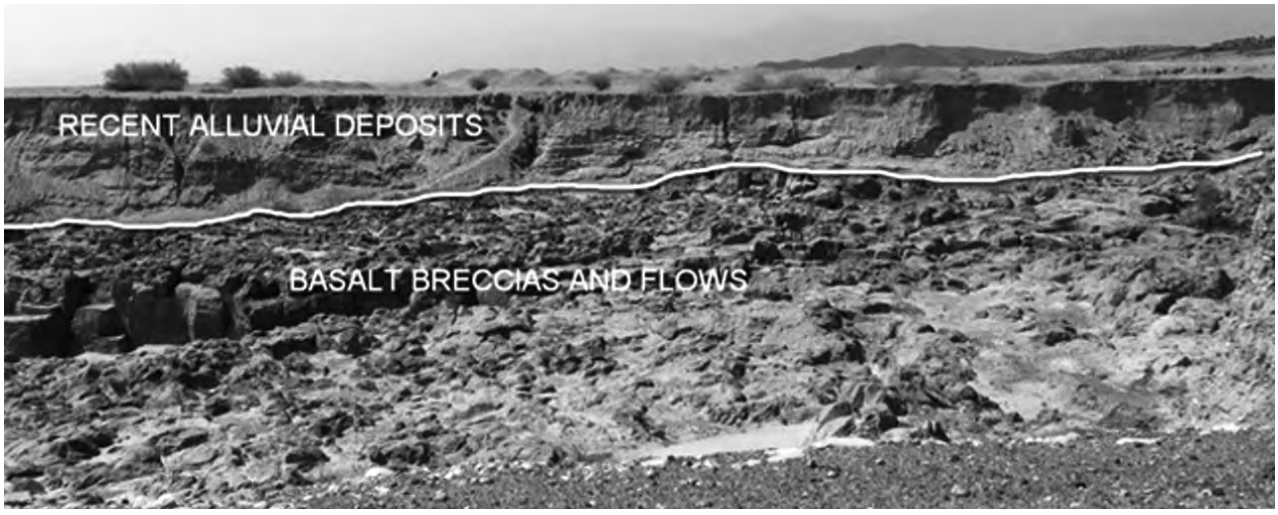
However, the mere progression of the coastline does not fully account for the impossibility of using the site as a harbour. The cumulative effects of coastal accretion, coupled with changes in seabed morphology and shoreline characteristics, likely had a more profound impact. These alterations would have affected the site's utility as a deep-water port, compromising its ability to accommodate maritime activity.

To investigate these hypotheses, this study employs a range of methodologies to examine the region's coastal evolution. Particular attention has been paid to identifying features that would have facilitated the functionality of a port, such as rocky shorelines with steep underwater slopes located near to the ancient settlement.

By integrating archaeological, historical, and environmental data, this research contributes to highlight the interplay between natural processes and human activity in shaping the course of ancient coastal settlements.

Location of the site of Adulis

The archaeological site of Adulis is situated on the western shore of the Gulf of Zula, approxi-



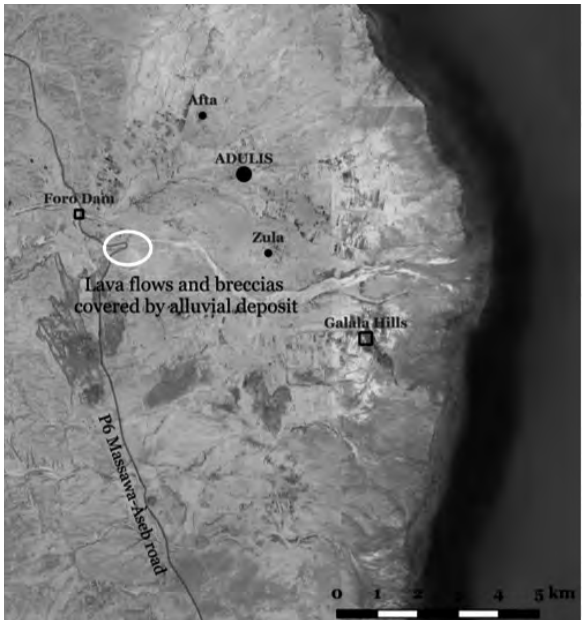


Fig. 1 - Volcanic rocks covered by few meters of alluvial deposits near Foro.

mately 50 km south of Massawa (Map 1). Today, the site is located approximately 5 km inland from the modern coastline, at altitudes ranging from 15 to 25 metres above sea level (according to the Elevation Model in use by GoogleEarth). This inland position reflects significant geomorphological changes since antiquity, likely driven by sediment deposition and coastal evolution.

The presence of an ancient port near Adulis[1] is strongly supported by the region's favourable geomorphological conditions. Unlike much of the Red Sea coastline, the Gulf of Zula features a broad, open inlet to the north, offering a natural harbour with reduced exposure to the winds and currents that typically originate from the south and southeast. Such conditions would have been highly advantageous for the anchorage and operation of ancient maritime vessels, which relied on sheltered harbours for safe landing and trading activities. The strategic placement of Adulis within this relatively protected maritime environment underscores its significance as a key port in antiquity.[2]

A comparable geomorphological setting can be observed in the region of Àseb, which features a similar, albeit less pronounced, inlet. Notably, Àseb remains one of Eritrea's most important

[1] MASSA, CATTANEO 2022; PEACOCK, BLUE 2007.

[2] CATTANEO in this volume, Chapter 2, fig. 2.

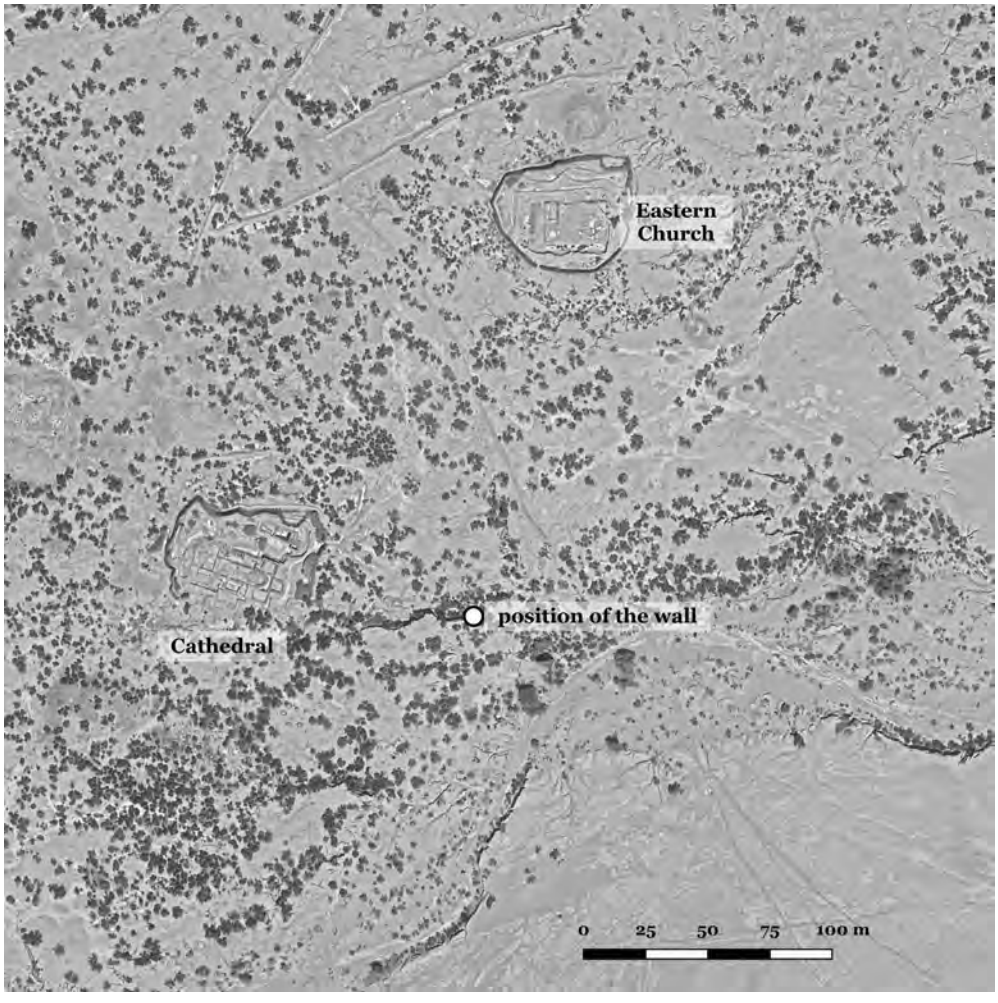


Fig. 2 - Probable part of the eastern wall of Adulis, filled by basalt breccias and covered by alluvial deposits.

modern ports, highlighting the enduring value of such geographic features for maritime activities across different historical periods.

As illustrated in fig.1, the coastline near the archaeological site of Adulis is significantly shaped by the extensive alluvial fan (delta) formed by sediment deposition from the Haddas-Alighede and Komayle seasonal watercourses. This hydrographic system,[3] originating in the mountainous terrain of the highland escarpment, transports substantial amounts of sedimentary material due to the pronounced erosion occurring in the region. The absence of vegetation cover in these mountainous areas exacerbates soil erosion and contributes to the river's high sediment load.

The geomorphological impact of this process is considerable, as the massive transport of solid material by the watercourses has led to the formation of a delta that extends far into the Gulf of Zula. This dynamic sediment deposition process has transformed the local coastline over the centuries, pushing the shoreline seaward and altering the maritime environment. These changes have likely influenced both the accessibility and the functionality of the ancient port of Adulis, providing key insights into the interplay between environmental factors and human settlement patterns in the region.

Geological conditions of the area

The basin of the Haddas-Alighede and Komayle watercourses exhibits a diverse geological composition, encompassing metamorphic, sedimentary, and volcanic formations. Within the vicinity of the archaeological site of Adulis and its immediate surroundings, however, geology is limited primarily to recent sedimentary deposits and volcanic formations of relatively recent origin.

East of the Massawa-Àseb Road (P6), the geological landscape beginning near the village of Foro can be broadly characterized as comprising recent alluvial sediments interlayered with equally recent lava flows. In several areas, these lava flows 'crop out' through the alluvial cover, particularly in regions such as the Galala Hills. Additionally, the lava flows emerge prominently along the main erosion channels of the alluvial sediments. This phenomenon is shown in fig. 1.

The interplay between recent sedimentary and volcanic activity has significant implications for understanding the geomorphological evolution of the area and its impact on the archaeological landscape of Adulis. These geological features not only shape the physical environment but also offer critical insights into the natural processes that have influenced human settlement and activity in the region.

The geological conditions described for the broader area of the Haddas-Alighede and Komayle basin can also be reasonably extended to the immediate surroundings of the archaeological site of Adulis. Although no direct evidence of volcanic rock outcrops has been identified within the site itself, their presence is suggested by the substantial quantities of volcanic materials found within the remnants of ancient structures and the excavation debris from past archaeological campaigns. It is plausible that building materials for major constructions, such as basalt blocks or metamorphic stones used in architectural elements like columns, steps, and thresholds, were sourced from quarries outside the immediate vicinity of Adulis. However, the extensive use of basalt breccias and slag as wall-fill material, including in walls of significant thickness, strongly suggests a local origin. This hypothesis is further supported by the proximity of volcanic outcrops observed in the region, such as those identified approximately 3 km west of Adulis, as shown in the map in fig. 1.

The probable structure of the town walls, visible along one of the more deeply incised gullies, provides additional evidence (fig. 2). The presence of such volcanic materials within the walls raises the possibility that interlayered volcanic rocks exist within the alluvial sedimentary series of the Adulis area, similar to the geological configurations identified in nearby regions. Future geological and archaeological investigations in the immediate vicinity of the site may help to confirm the presence of these volcanic layers and their role in local construction practices.

If the geological configuration near the archaeological site of Adulis is confirmed to include interlayered volcanic rocks within alluvial deposits,

[3] BAIONI, PORTA, GUADAGNINI, in this volume.

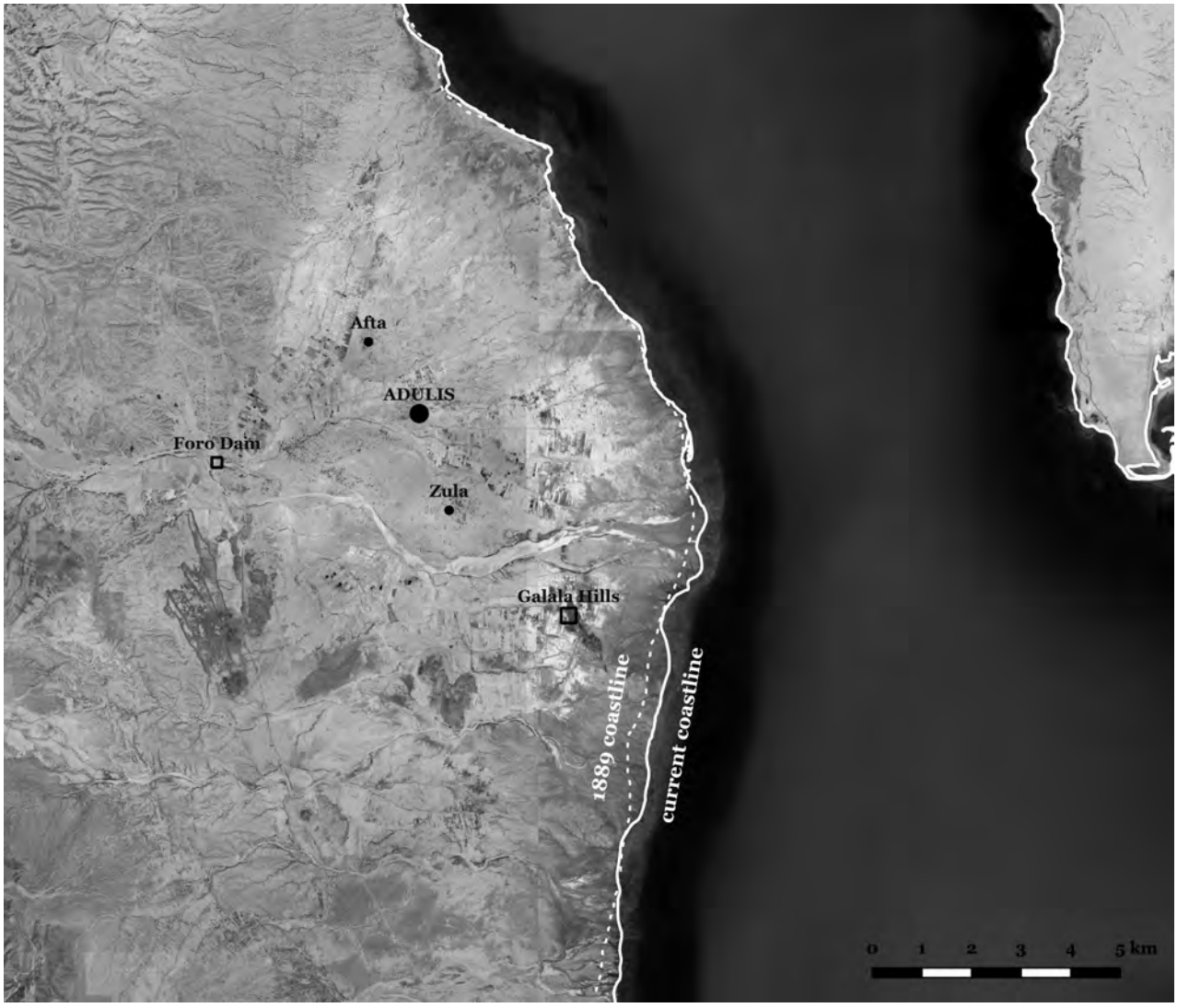


Fig. 3 - Shore line in 1889 (IGMI "Zula" map) and in 2024 (Google Earth satellite imagery).

this would have significant implications for reconstructing the ancient coastal environment during the town's period of prominence. Such a configuration suggests that the coastline in antiquity was not solely composed of river delta deposits, which typically feature shallow seabeds suitable only for small boats. Instead, it likely included sections of rocky coastline with localized coves and deeper waters, providing safe mooring for larger ships. These conditions would have been essential for supporting the role of Adulis as a major maritime hub.

However, the substantial sedimentary input from watercourses draining the interior mountains - much like the processes observed today - may have gradually transformed this favourable coastal landscape. Over time, these alluvial deposits likely buried the rocky coastal features and filled in the coves, reducing the seabed depth and rendering the area unsuitable for large vessels. This geomorphological shift would have severely affected the functionality of the port.

The evidence for the recent expansion of the alluvial fan can be assessed by comparing the current shoreline with that shown on a map produced by the Italian Geographic Military Institute (IGMI) during the colonial period (surveyed in 1889) for the "Zula" sheet at a 1:50,000 scale. This comparison is presented in fig. 3, and demonstrates that the shoreline within the coastal zone near the Galala Hills has migrated seaward by approximately 700 m over the past century.

In the previous discussion, it is also important to consider the impact of the construction of the

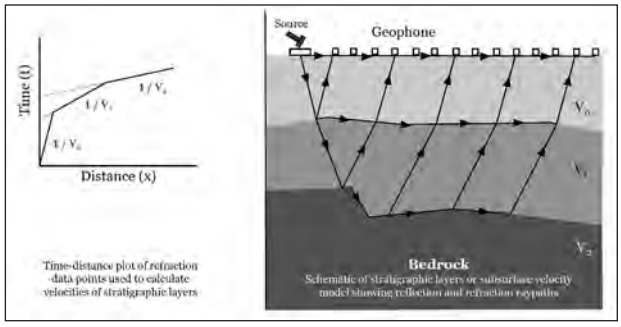


Fig. 4 - General schema for the investigation by means of the Seismic Refraction Survey.

Foro Dam, completed in 1960, which altered the course of the Haddas and Alighede. This alteration provides a plausible explanation for the limited progression, or even regression, of the shoreline in the northern part of the alluvial fan, while accounting for the significant seaward advance observed in the southern part.

This hypothesis underscores the critical role of environmental and geological processes in shaping the history of Adulis. Further interdisciplinary studies, including sedimentological studies, like those already conducted,[4] geomorphological and archaeological investigations, are needed to confirm the presence of these interlayered volcanic rocks and to provide a more comprehensive understanding of how natural forces influenced the port's decline.

Scope of work and survey program for geophysical investigations

The confirmation of the geological scenario described above could provide critical support for the hypothesis explaining the decline of Adulis. Specifically, it suggests that the progressive infilling of rocky coastal areas by alluvial sediments may have rendered the port non-viable during a key historical period. This hypothesis, however, requires corroboration through further evidence. Such evidence could be obtained through targeted excavations or drilling to collect soil and rock samples, enabling a chronological analysis of the sediment layers. This would help in determining whether the burial of compact rocky substrates by alluvial sediments occurred during a timeframe consistent with the historical prominence of Adulis as the principal port of the Gulf of Zula.

The primary objective of the proposed geophysical survey is to identify, using non-invasive tech-

Fig. 5 - Eritrean Laboratory Network's Team using the DAQ LINK III Seismograph.

[4] Peacock, Blue 2007, Chapter V.

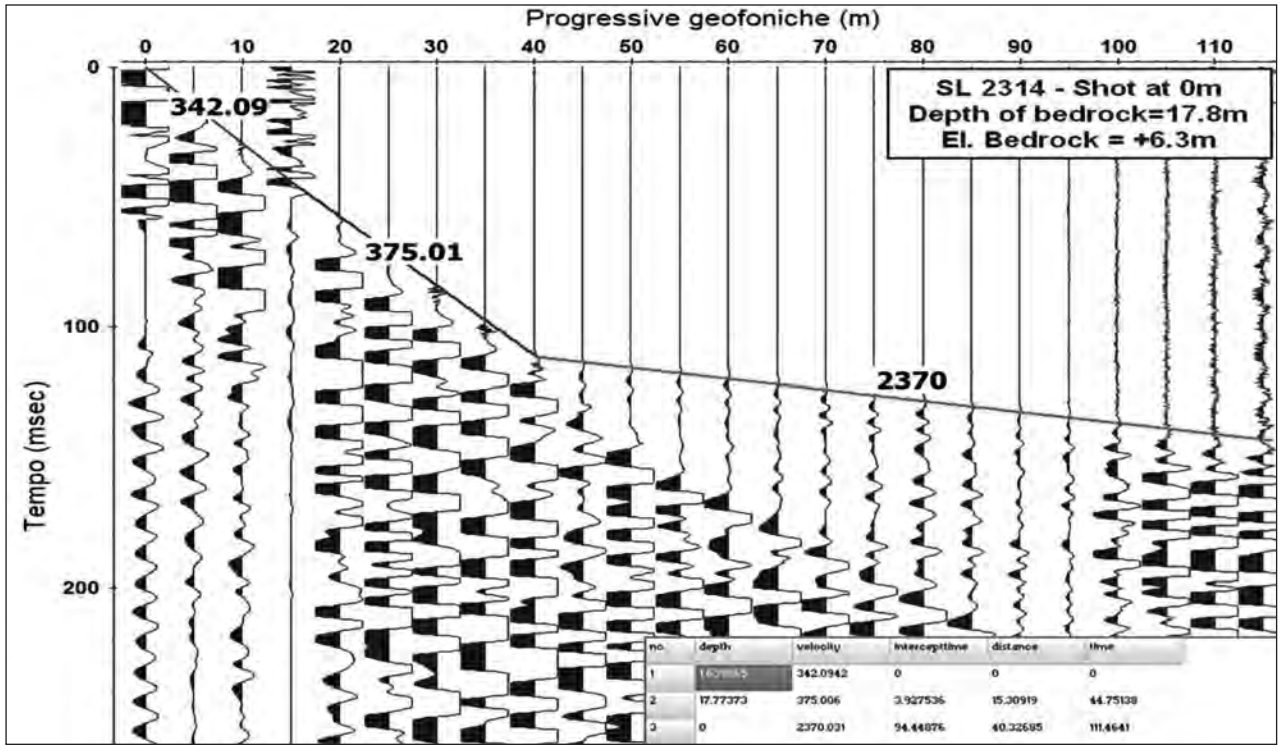


Fig. 6 - Example of data processing with the "intercept time" method to calculate the depth of a layer with velocity higher than the upper layers.

niques, the presence of compact rock formations - such as basaltic flows, breccias, or cemented volcanic slags - beneath the current surface and at elevations above sea level. These formations, if located, could substantiate the hypothesis by indicating areas that were once favourable for docking but are now buried under alluvial deposits.

Among the various geophysical methods available through the operational structure of the Eritrean Laboratory Network, seismic refraction has been selected as the most efficient approach for this purpose. This method, also defined in the ASTM Standards[5] is particularly well-suited for detecting the presence of compact rock layers beneath loose sediments. By analysing the seismic wave refraction data, this technique can accurately delineate the depth and extent of buried rock strata beneath the surface. The results will provide valuable insights into the subsurface geological conditions and their role in the historical course of Adulis.

This non-invasive methodology offers a promising avenue for reconstructing the ancient geomorphological environment of Adulis and testing the hypothesis that environmental changes, particularly the sedimentation-driven burial of the docking areas, contributed to the city's decline.

Short description of the methodology applied

The fundamental principle of seismic refraction surveys lies in analysing the propagation velocity of compression waves (P-waves), which are generated at the surface and travel through the subsurface layers. These seismic waves are produced by the impact of a sledgehammer striking a metal plate positioned at various points along a designated survey line. The waves propagate through the subsurface materials and are detected by an array of geophones strategically placed along the same line (fig. 4).

The geophones record the arrival times of the seismic waves, which vary depending on the density and elasticity of the subsurface materials. Compact and dense layers like basalt or cemented volcanic slag exhibit higher seismic wave velocities,

[5] ASTM D5777-00.

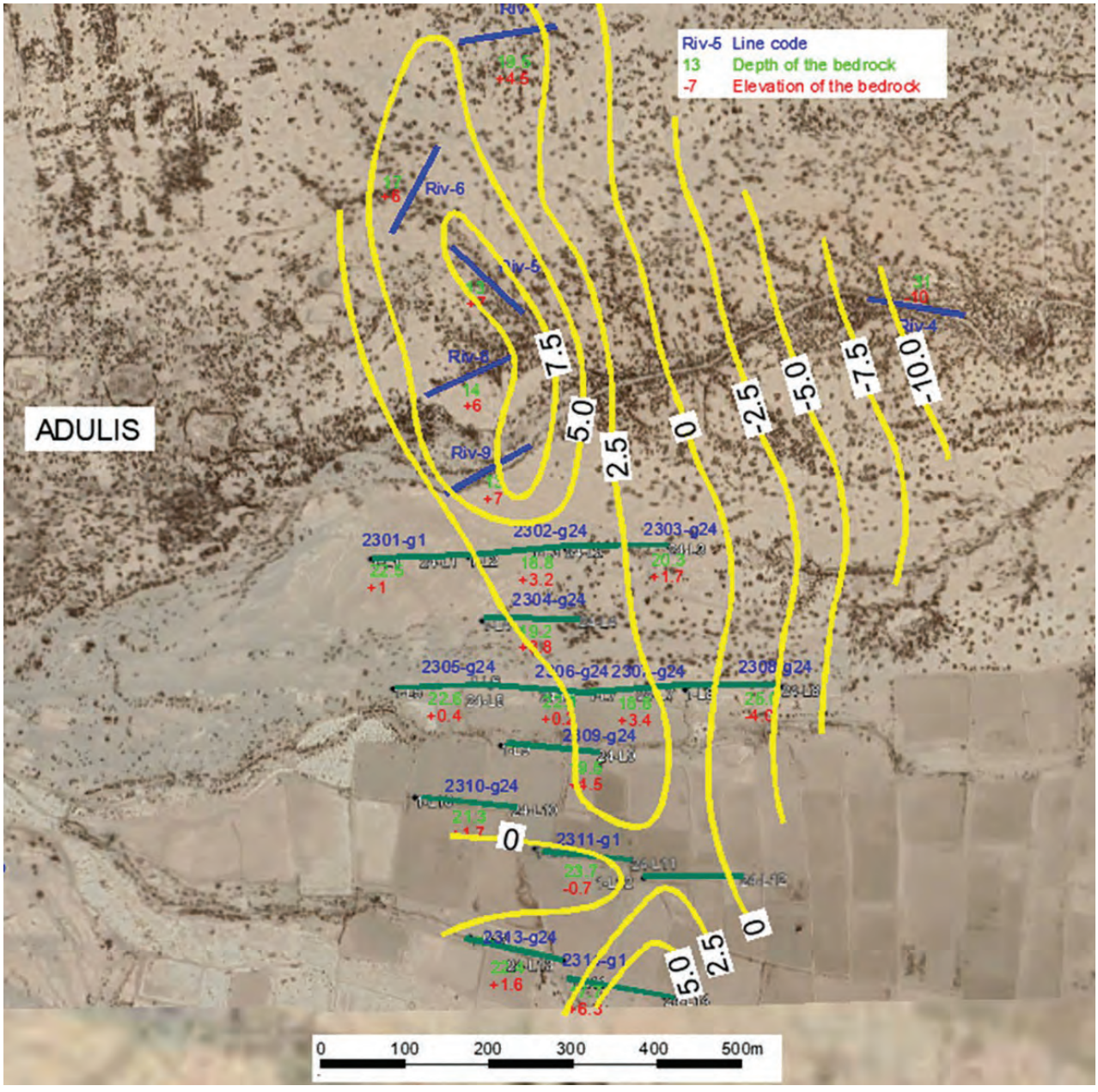


Fig. 7 - Elevations map of the rocky layer covered by the alluvial deposits.

whereas loose unconsolidated layers like alluvial sediments demonstrate lower velocities. By interpreting the recorded travel times, it is possible to model the subsurface structure, identify the depth and extent of compact rock layers, and distinguish them from overlying unconsolidated materials.

This technique is particularly effective for detecting buried compact rock formations and assessing their relationship to the overlying sedimentary layers, providing critical data for reconstructing the geomorphological history of the site.

In stratified subsurface conditions, the presence of dense, compact rocks underlying softer materials is effectively detected through seismic refraction techniques. The refraction phenomenon occurs as seismic waves, propagating through the underground layers, are bent (refracted) at the interface between materials of contrasting densities and elasticity. These refracted waves often return to the surface earlier than the direct waves, enabling identification of the subsurface layering.

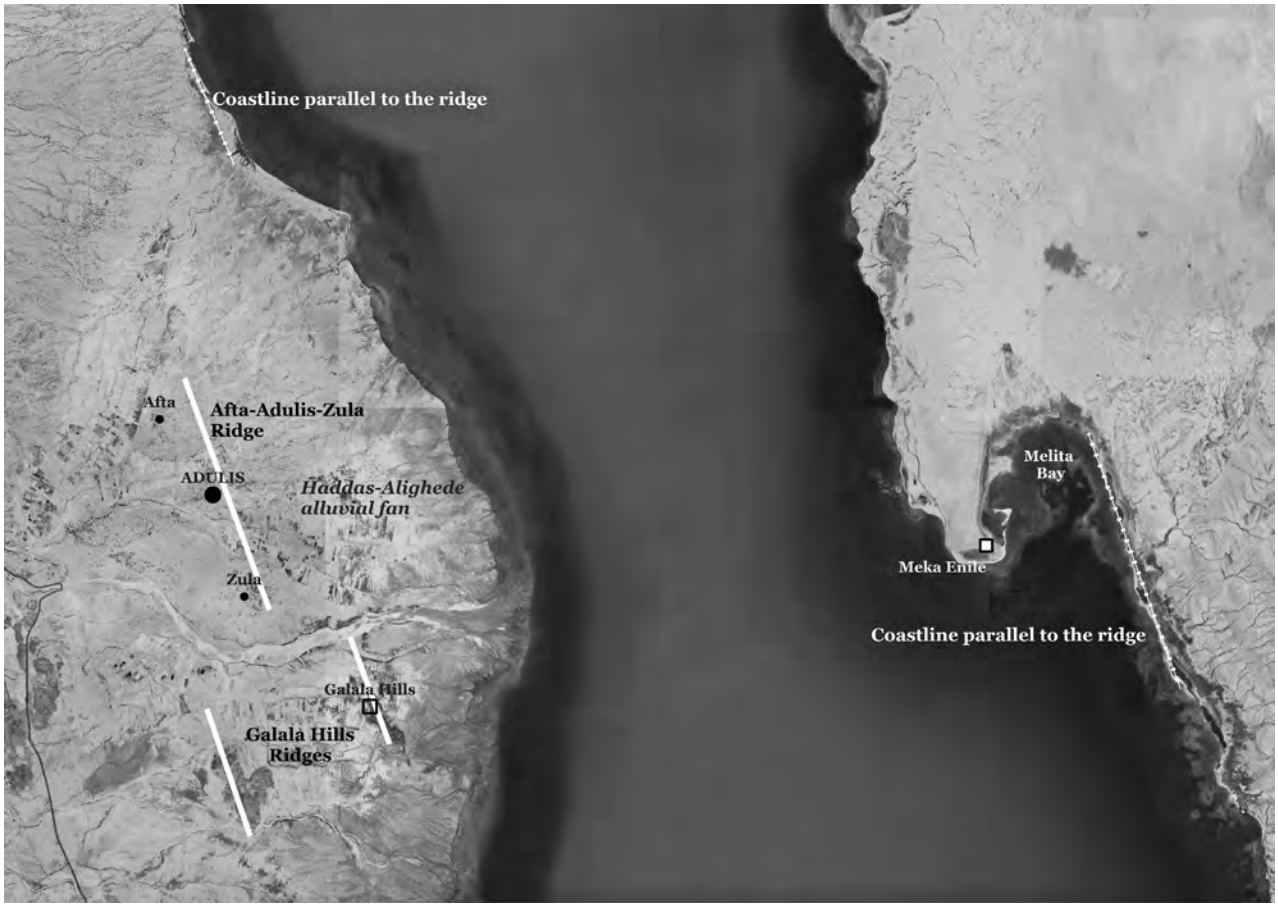


Fig. 8 - Synthesis of the results.

Advanced software applications are employed to analyse the wave paths and construct mathematical models of the subsurface. These models use the measured propagation velocities of seismic waves to infer lithological characteristics of the materials. Higher velocities typically correspond to dense, compact rock layers, whereas lower velocities are indicative of softer, unconsolidated sediments.

Seismic refraction surveys in the Adulis area have revealed a progressive increase in wave velocity with depth, reaching values exceeding 2,000-2,500 m/s at depths ranging from 18 to 40 m below the ground surface. These velocity ranges are consistent with rocky materials such as basalt, volcanic breccias, or cemented sedimentary rocks, supporting the hypothesis of compact rocky substrates beneath the alluvial cover. These data provide critical geological insights, enhancing our understanding of the subsurface conditions and their implications for the historical coastal environment of Adulis.

Data Processing

For this survey, we employed the standard 'intercept time' methodology to evaluate the depth of the high-velocity layer, rather than utilizing the more recent 'tomographic modelling' approach. This decision was based on the specific geological conditions at the site of Adulis and the comparative advantages of each method. The intercept time approach is well-established for producing detailed depth estimates of bedrock layers, especially in scenarios where there is a clear velocity contrast between the overlying soft materials and the underlying compact rock.

In contrast, the tomographic modelling method tends to generate smoothed results with a progressive increase in velocity, making it better suited for geological conditions where weathered rock layers of variable thickness are present and sharp velocity contrasts are absent. However, at the site of Adulis, where compact rocky layers

are expected beneath the soft alluvial deposits (either dry or wet), the "intercept time" method provides greater precision in determining the depth of the bedrock.

Data processing for this survey was conducted using the specialized software ReflexW, which is widely acknowledged for its accuracy in seismic refraction analysis. Several examples of the processed results are included herein to illustrate the effectiveness of this approach in delineating the subsurface structure.

GEOPHYSICAL SURVEY

The seismic refraction survey was conducted over multiple field missions, beginning in 2020 and continuing through 2022 and 2023. A total of 25 seismic lines, each 120-m long, were explored, and the collected data were processed using the methodology and software described above.

Data collection was carried out by a multidisciplinary team comprising young engineers and geologists from the Eritrean Laboratory Network, who were trained by the author of this study in operating the digital seismograph DAQ LINK III, manufactured by Seismic Source (USA). We thank herein each one of them without exception, because their activities have been carried out with strong interest and appreciable capabilities. Fig. 5 shows the team conducting a survey near the base camp, illustrating the cooperative and hands-on approach employed during the fieldworks.

This equipment, which is part of the resources available at the aforementioned Laboratory, includes all necessary cables, sensors, and accompanying software to ensure high-quality data acquisition.

This initiative not only generated valuable geological data, but also contributed to capacity building within the local scientific community, fostering technical expertise in geophysical methods.

RESULTS

The processed seismic data enabled the identification of the rocky bedrock, its depth below the ground surface (b.g.s.), and its elevation above sea level (a.s.l.). It is important to notice that the coordinates in this paper are always indicated with the metric values for the System UTM WGS84 zone 37. The elevations are defined with the Geodetic information of the EPGS 32637 system and indicated in metre above the sea level (a.s.l.) in accordance with the elevation model used by GoogleEarth; the elevations in the IGMI maps indicated for the area of Adulis were different, higher than those resulting from the modern GPS survey, and referred to the hydrographic 'zero' calculated at Massawa.

As an example for the results obtained, fig. 6 illustrates the interpretation for one seismic line (with the standard methodology indicated by ASTN D577-00), where the bedrock was identified at a depth of 17.8 m b.g.s., corresponding to an elevation of +6.3 m a.s.l.

A synthetic map of the primary results is presented in fig. 7, overlaid on a Google Earth aerial image. This map includes the positions of 20 of the 25 surveyed seismic lines, along with the interpreted bedrock depth and elevation above sea level for each line. The analysis reveals several key trends:

1) in many areas, the bedrock is observed at elevations above sea level and at depths less than 15 m b.g.s.;
2) however, a few hundred metres east of this zone, the bedrock descends significantly, reaching depths of at least 10 m below sea level.

The zone where the bedrock exhibits the highest elevation is further delineated with contour lines at 2.5-m intervals. These contours suggest the presence of a subsurface ridge aligned in a direction similar to that of the Galala Hills. This alignment indicates potential geological continuity and highlights the importance of this feature in the broader geomorphological and archaeological context of the area.

These findings contribute to understanding the geological structure near Adulis, offering valuable insights into the subsurface conditions and their potential influence on the history of the town.

CONCLUSIONS

Fig. 8 provides a comprehensive synthesis of the results within a broader geographical view encompassing the entire Haddas-Alighede and Komayle alluvial fan, the Gulf of Zula, and extending to the eastern coastline. The Adulis Ridge, as inferred from the seismic data, is shown extending northward toward the village of Afta

and southward to the village of Zula. This ridge aligns closely with the direction of the Galala Hills, as well as with a secondary ridge located approximately three kilometres west of the primary structure.

The alignment of the Adulis Ridge exhibits a striking parallelism to several prominent regional features. North of the alluvial fan boundary, the ridge runs parallel to the coastline in that zone. Similarly, along the eastern border of the Gulf of Zula, south of the small Melita Bay, the ridge maintains a parallel orientation to the coastline. This consistent alignment highlights the structural coherence of the region, suggesting that the orientation of the ridge is influenced by the same tectonic or geomorphological processes that have shaped the coastal and inland topography.

This regional synthesis reinforces the hypothesis that the Adulis Ridge represents a significant geological feature, with implications for both the geomorphological evolution of the Gulf of Zula and the historical development of the Adulis area as a port and settlement.

The Adulis Ridge and the Galala Hills Ridge appear to be interrupted and laterally displaced by the terminal section of the current Haddas-Alighede wadi bed. Interestingly, the wadi itself exhibits a "disturbed" flow direction influenced by the Adulis Ridge. This interaction between the ridge and the wadi bed provides further evidence of the geological prominence of the ridge and its potential role in shaping the historical landscape.

These findings support the hypothesis that the rocky Adulis Ridge, when the Haddas-Alighede alluvial fan was confined to the area west of the ridge, provided the stable coastal conditions that enabled the establishment of Adulis as a significant port. However, as alluvial sediments progressively encroached upon the Adulis port area, its functionality may have diminished.

An alternative port location, possibly situated on the eastern side of the Galala Hills Ridge, may have temporarily served the town.[6] However, this secondary position likely faced a similar fate, as it too became buried under accumulating alluvial deposits. This sequential infilling of potential docking sites likely culminated in the eventual decline of the port of Adulis, underscoring the critical impact of geomorphological processes on the historical course of the city.

[6] Peacock, Blue 2007.

HYDROLOGY: WATER AS AN ASSET AND A THREAT

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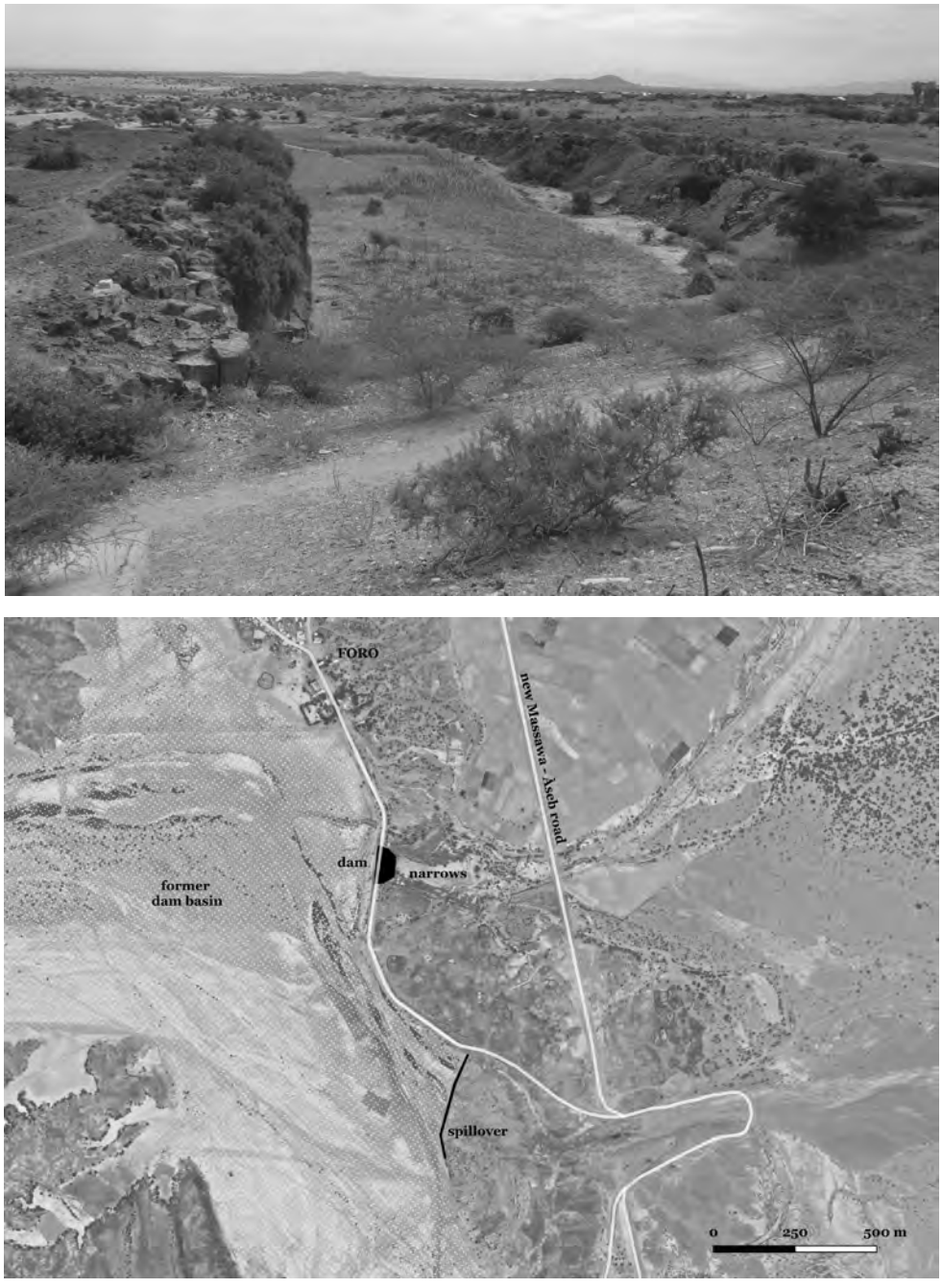

Fig. 1 - Map Study area: satellite view of the dam at Foro and the natural rift. Photo of the Foro narrows from the dam.

Water management in Sub-Saharan Africa is a critical issue due to the combined effects of the climate dynamics and the expected significant population growth.[1] The high temperatures recorded in recent years amplify the effects of water evaporation and population increase,[2] increasing water demand. From a water management perspective, the Adulis archaeological site is located close to the Foro Dam, which was formerly used for agricultural water supply, a service currently hampered due to excessive solid material deposition. This work focused on investigating the key surface processes that take place upstream of the Foro Dam and the sustainability of restoring the dam as an agricultural water deposit. Water management has been recognized as a priority for safeguarding the archaeological site of Adulis and for securing a viable water supply for agriculture and domestic uses in the surrounding villages, alternately threatened by flooding and drought. An estimation of the water fluxes is essential to identify the best intervention strategy.

The study is conducted in the catchment area that includes the Foro Dam (fig. 1), which is located 3.5 km upstream of the Adulis archaeological site. The area lies within a delta fan bounded by the isolated mountain of Ghedem to the northwest, the eastern central highland slopes to the west, and the Red Sea to the east at 7 km from the coast (Map 1).

The reference area is characterized by a marked alluvial activity and a semiarid climate. The hot season goes from June to September with a temperature ranging between 40-50°C. The rainy season typically comprises the months from December to February (T = 20-35°C), with mild rains generally seen in October and November. The average annual temperature is about 30°C with an overall annual precipitation of about 200 mm.

The site is drained by the Haddas and Alighede watercourses and numerous tributaries. They run along steep valleys that are typically narrow and winding. The Haddas collects water from the Komayle and Alighede watercourses and is at the same time both a resource and a vulnerability factor for the Zula, Afta, and Foro areas. These are subject to seasonal flooding, as evidenced by fluvial depositional layers observed during direct inspections along the western bank of the Haddas.[3] Floods in the seventh and eighth centuries AD likely caused the destruction of Adulis. In 1924, the floods of the Haddas broke the soil and stone barrier erected a few years earlier, leading to severe damage to downstream plantations, while in the winter of 2015 they damaged the village of Foro, resulting in a reduction in agricultural and farming activities in the region.[4] Sudden and violent floods pose a serious risk for the preservation of the archaeological site.

The upstream land around the areas of Foro and the Ghedem Mountain comprises conglomerates, vesicular basalt, and pyroclastic rocks, gneisses, and mica schist with mafic dykes.[5] As shown in figure 1, there is a natural rift where the Foro Dam was built, which was suitable to be converted into a reservoir to supply agricultural water and to contain floods. Built in the late 1950s, the dam served as a water source for the spate irrigation system along the coast. Since early 2000, it has been completely silted up due to sediment depositions caused by channel erosion and the lack of silt traps (check-dams).[6] Agriculture at the site relies on the spate irrigation system consisting of a reservoir and a series of diversions dug into the ground and connecting the reservoir to the fields. As a result of the current inefficiency of the dam, the amount of water available for agriculture has decreased significantly leading to a reduction in the cultivated area from 10,000 to 1,000 ha.[7] Restoration of the dam would enhance the ability to irrigate crops; however, flooding and sediment transport require careful consideration of appropriate management strategies.

To deal with the hydrological features of the study area, a model was built that is structured across four conventional steps: (i) data collection, (ii) data pre-processing, (iii) simulation, and (iv) calibration and validation of the results.[8] Data collection considers (a) the precipitation information, (b) the area's topography, (c) the land use, and (d) the soil type (fig. 2).

[1] Mutunga *et al*. 2012, Zeraebruk *et al.* 2017, p. 45.

[2] Tewolde; Cabral 2011.

[3] Carannante *et al*. 2015, Bortolotto, Cattaneo, Massa 2021.

[4] Bortolotto, Cattaneo, Massa 2021.

[5] Carannante *et al*. 2015.

[6] Ogbazghi 2018.

[7] Bortolotto, Cattaneo, Massa 2021.

[8] Baioni *et al*. 2022.

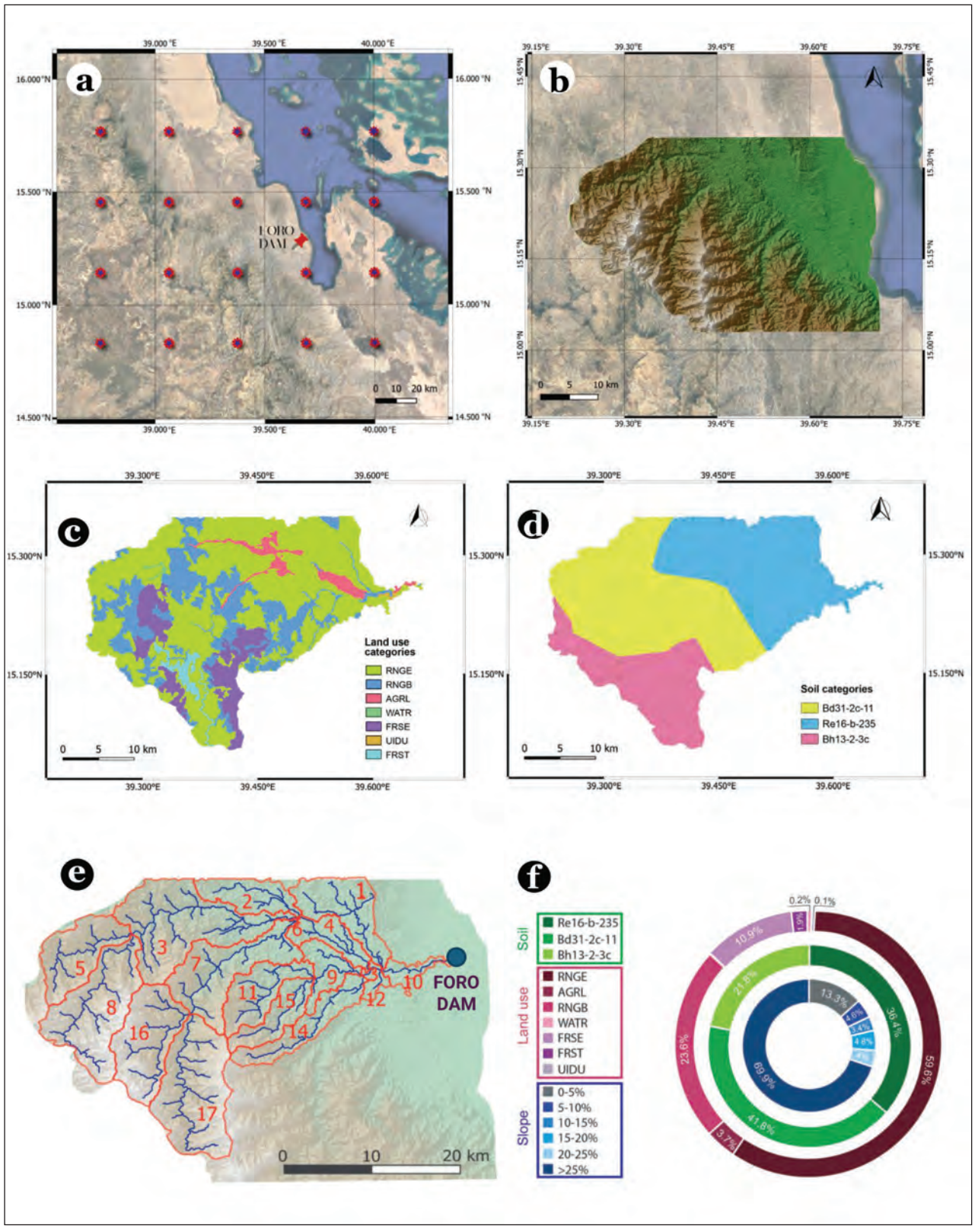

Fig. 2 - Input data: (a) Locations associated with climate data provided by NCEP (Saha *et al.* 2014) within the area of interest, (b) Topography of the area (DEM); (c) Land cover map: RNGE (range grasses), RNGB (range brush), AGRL (agriculture land-generic), WATR (water), FRSE (forest evergreen), UIDU (rock sand), FRST (forest-mixed) provided by FAO; (d) Soil map provided by FAO; (e) delineation of the watershed and the river network (f) and percentage of the land use, soil, and slope categories across the basin.

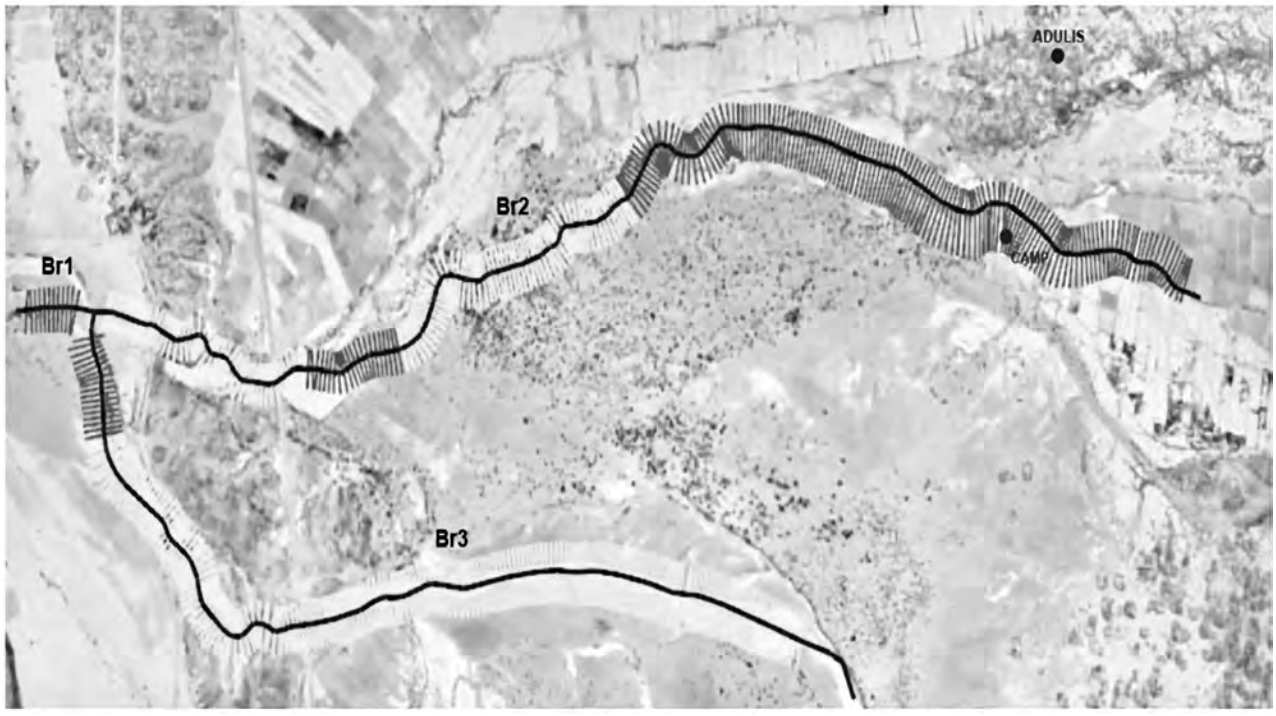

Fig. 3 - Scheme of the hydrologic-hydraulic logical system: upstream branch (Br1) at the dam site and two downstream branches (Br2 and Br3). Location of the critical (dark lines) and non-critical (light lines) river sections for scenarios simulating extreme hydraulic events associated with a low probability.

A Digital Elevation Model (DEM) with a resolution of 30 m x 30 m - see fig. 2 (b) - provided by the NASA Shuttle Radar Topography Mission Global is used here to obtain topographic information, including local elevation and slope, of the study area. The land use map shown in fig. 2 (c) is derived from the land cover map of Eritrea provided by the United Nations' Food and Agriculture Organization (FAO). The Land Cover Classification System (LCCS) is employed, distinguishing eight main categories. The soil type - see fig. 2 (d) - was obtained from an FAO database and successfully integrated with observations gathered from the Soil Grids project.[9] Each soil type is identified by a code indicating the percentage of the dominant soil type, the grain dimension, and the slope. In detail, Bd31-2c-11 comprises 90% of BD (29.8-32.7% sand, 30.3-37.6% silt, 32.3-37.1% clay), Re16-b-235 70% of RE (68.3-71.6% sand, 15.2% silt, 13.2-16.6% clay), and Bh13-2-2c: 70% of BH (55.2-60.4% sand, 16.5-21% silt, 23.2-13.8% clay). The percentage of clay, sand and silt affects the hydrological properties of the soil. Climatic data are retrieved from the Climate Forecast System Reanalysis (CFSR) dataset, provided by the National Centres for Environmental Prediction (NCEP)[10] and available for 20 locations close to the target area, as shown in fig. 2 (a).

Here we focus on data pre-processing to better understand the hydrological features of the area under assessment. The pre-processing is performed in the Geographic Information System (GIS) environment, relying on the QGIS platform.[11] The Terrain Analysis Using Digital Elevation Models (TauDEM) tool[12] is applied to the DEM in fig. 2 (b) to delineate the watershed and the river network - see fig. 2 (e). The basin is characterized by an extent of 83,075.94 ha and comprises 17 subbasins. As shown in fig. 2 (f), the majority of the area features slopes exceeding 25%, located primarily in upland areas, and low sparse shrubs with herbaceous vegetation.

Our simulations considered three scenarios where the transition from grass to brush cover pro-

[9] Tarboton.
[10] Saha *et al*. 2014.
[11] Dyle Yiun *et al*. 2021.
[12] TauDEM.

gressively extends across the watershed in order to assess the influence of surface coverage variation on sediment transport at the Foro Dam. The results indicate that the greatest reduction (~19%) in the average sediment load transported to the dam can be achieved by increasing surface coverage in seven upland subbasins within the watershed. To achieve a more practical and cost-effective approach, surface cover changes could be targeted strategically in areas with steeper terrain, thereby minimizing the intervention area and associated costs while still effectively reducing sediment transport.

As part of the evaluation of the risks and the mitigation of Haddas flood impacts close to the archaeological site and the related infrastructure, the hydraulic system of the area comprising the Foro Dam and Adulis is analysed to identify hydraulic hazards. Satellite images with a resolution of 10 m x 10 m are employed to determine the flow path and surface width of watercourses. As shown in fig. 3, the hydrological system comprises three branches: the inlet at Foro Dam (Br1) that is diverted to the Haddas (Br2), which drains into Adulis, and the Alighede (Br3), which flows towards Zula.

An elevation point cloud extracted from Google Earth is processed in QGIS to determine the terrain elevation of the study area. Without detailed information, it is assumed that the watercourse cross sections are 1.5 m deep everywhere except for the final portion of Br2, where a depth of 1 m is considered to simulate the spate irrigation canals supplying the agricultural fields. The flood hazard zones are identified by simulating seven flow rate scenarios, with different occurrence probabilities, under steady flow conditions. Please note that steady state simulations provide an over-estimation of the water depth if compared with unsteady simulations where the river discharge varies over time.

When the water level obtained from the numerical simulation exceeds the maximum stream cross section height, the latter is considered critical. The most critical zones in terms of water level are shown in fig. 3. According to our results the surface water level exceeds the watercourse cross section height close to the camp and the archaeological site only for flow rate values at the inlet of the Haddas exceeding 36 m^3/s. The aforementioned analysis offers the basis for planning strategic interventions to minimize the disruptive effects of flooding in the Adulis area. The results depend on the input hypotheses regarding the cross-section dimensions and flow rate values assumed to address the lack of on-site measurements. A possible strategy consists in realizing a reservoir at the Foro Dam before the Br2-Br3 junction. A reservoir connected to the Br1 river branch by a lateral structure contributes to reducing the flow rate and water level at both the Br2 and Br3 river branches. Our simulations suggest that the reservoir presence may lead to a reduction in the surface water level of about 20 cm. The simulations also indicate that a combination of further actions may be necessary to reduce water depth in the Br2 river branch to decrease the risk associated with floods in the archaeological areas. Various options may be considered in a new release of the developed model also considering the input from local authorities and the development of the archaeological park.

PREMISES FOR THE RISE OF URBANISATION
THE ORIGINS OF URBAN CIVILIZATION IN THE NORTHERN HORN. A CENTURIES-OLD TRADITION OF STUDIES

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Before entering into the heart of this chapter, dedicated to exploring the premises following which the first urban centres arose in the northern Horn of Africa as well as the key archaeologically recognisable elements that allow us to distinguish a city from other forms of inhabiting the territory, it seems useful to begin here with an examination of the state of knowledge in this region of sub-Saharan Africa before the new research season in Adulis that started in 2011.

This analysis of the literature, which does not claim to be exhaustive, but aims to retrace the main interpretations of the phenomenon of the birth of urban civilization, in addition to contextualizing more adequately the geography and chronology in the area under study, will also enable a better evaluation of the contribution of the stratigraphic excavations of Adulis.

It will also be a useful methodological premise for explaining the scientific and operational approach adopted since 2011 and compare it with the results of other research projects, more or less recent, active in the region.

It is important to remember that the Northern Horn, currently divided between Ethiopia, Eritrea, Somalia and Djibouti, in ancient times was designated with the name *Aithiopia*, "the land of men with burnt faces",[1] that is, a vast area that from the southern borders of Egypt extended as far as India.[2]

Review of previous studies: colonists or indigenous people?

In the area of interest, a centuries-old tradition of studies identifies the birth of the city with the appearance of masonry architecture on the Plateau, predominantly of an elitist character and a religious and/or political nature, not of indigenous origin but imported from South Arabian peoples, in particular from the Kingdom of Saba (present-day Yemen).

Following these external impulses, the development of urban civilization in the northern Horn of Africa would have coincided with the expansion of the Aksumite Kingdom, the largest political entity in the region at the beginning of the first millennium AD.[3]

Progenitor of this school of thought is the monumental work of the Deutsche Aksum Expedition, directed by the orientalist Enno Littmann in 1906.[4] The expedition operated on the plateau of the Aksumite capital and at other sites that are now part of Eritrea and the results, published in Berlin in 1913 in four volumes, undoubtedly still represent an essential reference work. Equally fundamental, on the Italian side, is the work of Carlo Conti Rossini, written a few years later.

For both authors, the archaeological, linguistic and ethnographic evidence then available led to the conclusion that an urban civilization, the only one to be considered a true civilization at their time, did not originally exist in the Horn of Africa. Along with architecture, the organized management of agricultural and hydraulic resources, as well as writing, it had to be traced back to the more advanced - and therefore considered "superior" - knowledge of peoples who came from the opposite shore of the Red Sea, from the South Arabian Peninsula, in very ancient times, perhaps as early as the second millennium BC.[5]

[1] Hom. *Il*., I, 423; XXIII, 206 (*Homer. The Iliad with an English Translation* by A.T. Murray, Ph.D. in two volumes. Cambridge, MA., Harvard University Press; London, William Heinemann, Ltd.1924).

[2] Bernand 2000, pp. 5-11.

[3] Anfray 1974; Munro-Hay 1991; Phillipson 1998, Id. 2000.

[4] *DAE* 1913.

[5] Littmann 1913, p. 41; Conti Rossini 1928, pp. 101-106.

It is easy to frame this vision in the cultural and political climate of the time, which interpreted the discoveries of archaeology in the light of Western European culture and its glorious roots in ancient classicism, a deliverer of civilization in respect of "primitive" societies.[6] In particular, the Italian Colonial Government of Eritrea (1890-1941) could boast, with the excavations of Adulis, of having returned the current inhabitants of the desolate Plain of Zula to the high level of ancient civilization: *"L'averli restituiti a quel grado sia presto nuova gloria della gran madre Italia"*.[7]

From a methodological point of view, no categories of analysis were taken into consideration other than those used for the cities of the Eurasian continent, using schemes that have long been misleading for a proper framing of the urban phenomenon in the African context:

"*What, however, has been missing in theoretical debates and empirical engagement with pre-colonial African urbanism is the promotion of definitions and criteria for distinguishing archaeological cities set on indigenous or native philosophical pivots*".[8]

There remained, as the authors themselves acknowledged, large areas of ambiguity regarding the relationship between the South Arabian colonization and the origin of the subsequent Kingdom of Aksum, the reality of the population before and after the period of the reign, with many uncertainties regarding the chronological sequence of the two cultural phases, as Ugo Monneret de Villard highlighted in 1937, well ahead of the scientific approach of the time.

The eminent engineer and archaeologist, following the fieldwork carried out in the Aksumite capital, highlighted two major gaps in the archaeological knowledge of the northern Horn of Africa:[9] the first relating to the prehistory of the region of Aksum, in which, according to indigenous traditions, there must have been a metropolis older than the Aksumite city; the second relating to the history of the events that occurred between the decline and the abandonment of the ancient city of Aksum, in the seventh century AD, and its reappearance in the description of Francisco Alvarez in the sixteenth century, shortly before the last devastating Muslim invasion.

Ugo Monneret therefore believed, despite the great scientific value of the work of the Deutsche Aksum Expedition, that it was now necessary to proceed with another method, *"... Quindi i sondaggi devono lasciare il posto allo scavo stratigrafico il più completo e metodico, l'indagine parziale che vuol tutto al più localizzare qualche monumento d'eccezionale importanza deve essere sostituita dalla sistematica esplorazione di tutta la città*", and that to understand the origin of the Aksumite civilization it was impossible to ignore the need to broaden the field of investigation to the populations that occupied the Ethiopian Plateau in prehistoric times, to better evaluate the South Arabian contribution and the reciprocal influences.[10]

Thus, a fundamental theme was brought into focus early on, one that is still the subject of debate among scholars, namely the origin of the Kingdom of Aksum and its relationship with a pre-existing indigenous reality; the limit of generalized historical reconstructions based on limited evidence of a monumental nature was also highlighted, a "trace" that will be repeatedly followed later by other scholars in the area.[11]

It is worth highlighting the archaeological excavation method of the Italian school of the early twentieth century, which, as we will see in depth with regard to Adulis, already proposed not only a stratigraphic reading of the site under investigation, but also an understanding of the broader territorial and cultural context in which it was inserted. The illustrious archaeologist Roberto Paribeni, to whom we owe the most complete archaeological research of the last century in Adulis, was on site in 1906.

Before starting the excavations, Paribeni carried out a complete surface survey of the archaeological remains: *"...per trarre il maggior numero possibile*

[6] For a synthesis about the meaning of colonialism and decolonization, a very broad theme particularly in relation to Africa, see lastly CATTANEO 2024; JUMA 2004; on the Horn of Africa: MONROE 2013.

[7] PARIBENI 1907, p. 572: "May having restored them to that rank soon be new glory of great mother Italy."

[8] CHIRIKURE 2020, p. 51.

[9] MONNERET DE VILLARD 1938

[10] ID., *Ib*, pp. VIII-IX: "Therefore the soundings must give way to the most complete and methodical stratigraphic excavation, the partial investigation that aims at most to locate some monument of exceptional importance must be replaced by the systematic exploration of the entire city".

[11] MUNRO HAY 1991.

di dati sulla topografia generale della antica Adulis, sulla ricchezza e conservazione sua, e quindi sulle speranze che ragionevolmente potrebbero fondarsi nello scavo completo della città.

Prima di ogni altra questione si imponeva quella della ricerca della cinta di mura. Il ritrovarla ci avrebbe dato subito la posizione delle porte e delle strade, forse ci avrebbe anche guidato a rintracciare le tombe. Inoltre volevamo studiare le relazioni della città col mare, vedere con qualche saggio stratigrafico profondo, quante sovrapposizioni di civiltà avevano lasciato la loro traccia in quel luogo, ricercare le necropoli, e finalmente non trascurare tentativi di rintracciare le famose iscrizioni copiate da Cosma Indicopleuste".[12]

Ethio-Sabaean/Pre-Aksumite/ D'MT ? Problems of terminology

The term "Ethiopo-Sabéenne" or "Sudarabisante" was coined in the 1960 to define the cultural *facies* originating from the encounter between the colonizers and the local people, intending to underline with this double denomination phenomena of "interaction, differentiation and assimilation".[13] This definition, included in a generic Pre-Aksumite period, of which it would constitute the oldest phase, during the fifth-fourth centuries BC,[14] has been criticized by the Italian school and other scholars because of the schematic nature, simplification and generalization of cultural and chronological aspects derived from testimonies investigated in a restricted area, mainly constituted by the monumental remains of Yeha and Aksum;[15] on the contrary, the German school still considers it valid.[16]

Certainly, models and techniques borrowed from South Arabian architecture have long been recognized in the Great Temple of Yeha as well as in the Safira Dam on the Qohayto Plateau.[17] Moreover, recent investigations in the oldest building of the Grat Be'al Gebri in Yeha, dated to 800 BC, also demonstrate the direct participation of South Arabian workers in the planning and construction of the monument, which, in addition to a cultic, is believed to have had an administrative function as well. In the Great Temple of Yeha, dated about one hundred and fifty years after the Grat Be'al Gebri, materials imported from the Marib region are also used.[18]

However, there are still diverging opinions regarding the ways in which architectural models and other technologies, as well as writing and religious and symbolic elements, were adopted from South Arabia to the opposite side of the Red Sea.

A first hypothesis traces its origin to the direct transfer of colonists. The initially small groups, established on the coast to exploit the resources and control the traffic in the Red Sea perhaps as early as the second millennium BC – and the Bay of Zula, the Peninsula of Buri and the Bay of Irafayle must have been the first places favourable for landing and settlement – were followed by larger groups that then settled permanently also on the plateau. These South Arabian peoples are credited with introducing not only masonry architecture, but the most advanced agricultural and livestock farming techniques, metallurgy and writing as well.[19]

This model of direct colonization has been questioned, posing the hypothesis that the South Arabian influence was mediated by the presence of a small number of immigrants, specialists in

[12] Paribeni 1907, p. 444: "…to obtain as much data as possible on the general topography of ancient Adulis, on its wealth and conservation, and therefore the reasonable hope for the complete excavation of the city. Before any other question, the search for the town walls was a priority. Finding them would immediately give us the position of the gates and streets, perhaps it would also guide us to find the tombs. Furthermore, we wanted to study the city's relations with the sea, see with some deep stratigraphic soundings, how many superimpositions of civilizations had left their trace in that place, search for the necropolises, and finally not neglect attempts to find the famous inscriptions copied by Cosmas Indicopleustes". Cosmas Indicopleustes, a Christian merchant, visited Adulis at the beginning of the sixth century AD. In in his work *Topographia Christiana* he gives us very valuable information on the topography of Adulis and on the presence of a monument placed at the western entrance of the town, a basalt stela and e marble throne, with the inscriptions mentioned by Paribeni.

[13] Anfray 1964, 1967.

[14] Anfray 1967, p. 49.

[15] Fattovich 1990; Phillipson 2012, pp. 19-20; D'Andrea *et al.* 2023 with extensive bibliographical review.

[16] For example Wolf, Nowotnick 2011; Gerlach 2013, 2017.

[17] Manzo 1995, with previous references.

[18] The dating, in addition to the stylistic features, is based on the 14C analyses of the wooden beams of the gate pillars: Gerlach 2013, 2017.

[19] Conti Rossini 1928, pp. 99-106; Ullendorff 1960; Anfray 1967; Gerlach 2017.

different technologies or traders, not by the transfer of entire family nuclei.[20]

The protagonists would instead be the indigenous élites, who would have appropriated the exogenous models in order to use them as symbols of power to legitimize their role in the broader network of contacts of the southern Red Sea. This would occur within a broader series of environmental phenomena and indigenous cultural processes that, during the first millennium BC, culminated in the development of complex societies in different areas of the northern Horn of Africa,[21] participants in a broad circuit of exchanges and interactions that originated in a much more ancient era, starting from a phase from the seventh to the fourth millennia BC, during which the search for and commerce of raw materials, in particular obsidian, was at the origin of the movements between Africa, Arabia and the Nile Valley.

In the following millennia, third and second millennia BC, Egyptian commercial expansion in the Red Sea and the circuit of trade between Africa and southern Arabia intensified, while pastoral communities, with similar cultural traits in the manifestations of rock art, occupied the Horn of Africa and Arabia. In particular, evidence provided by ceramics in an area that includes eastern Sudan, the Horn of Africa and Yemen, indicates more intense contacts between the mid-third and mid-second millennia BC. Around 1500 BC, an Afro-Arab cultural complex distinguished by the characteristics of the Tihama culture would have originated, similarly documented by ceramics.

Adulis would be part of this "Tihama Cultural Complex", based on the similarities identified between the ceramics found at the deepest levels reached in trench number 1 of the Paribeni excavations,[22] at level II at Mätära[23] and the ceramics found at sites in the Tihama region of Yemen.[24]

These similarities, which according to researchers operating in the South Arabian region are not convincing,[25] are nevertheless also supported by the findings of Mersa Wadi Gawasis, the Egyptian port from which the pharaonic expeditions departed towards Punt, most likely directed towards the southern Red Sea landing place that, in historical times, would be known by the name of Adulis.[26]

In addition to archaeological evidence, linguistic traces have long been highlighted in archaic Greek that preserve the memory of Egypt's ancient commercial contacts with Punt, the African region to the south of Egypt overlooking the Red Sea, from which the aromatic resins, ivory, wood and exotic animals sought after by the Pharaohs came.[27]

Similarities with the ceramics of the Tihama culture are also proposed for some types found on the Asmera Plateau, within the "Ona Culture", whose first classification is due to Italian research.[28]

The improvement of surface archaeology and stratigraphic excavation techniques starting from the last twenty years of the last century, together with the increasing use of archaeometric analyses, have however led to the exclusion of the presence of artefacts of South Arabian origin in the Ona culture, which therefore cannot be included in the "Ethio-Sabaean" cultural complex.[29]

It is also affirmed that this cultural facies of the Eritrean Plateau is more ancient than the monumental centres of Tigray like Yeha, and the hypothesis is advanced that the stable settlements of the Ancient Ona agro-pastoral communities, where the existence of stone architecture is documented in the eight / seventh centuries BC, are at the origin of the development of urbanism at the beginning of the first millennium BC, a phenomenon that would have spread southwards from here, to Mätära and Keskese, towards the middle of the first millennium BC.[30]

[20] Fattovich 1977, 2009, 2012.

[21] Curtis 2008.

[22] Paribeni 1907, pp. 446-451.

[23] However, level II of Mätära is dated later, approximately between the tenth and the seventh centuries BC.: Anfray 2012a, p. 45.

[24] Fattovich 1977; Manzo 2009; Boivin, Bench, Fuller 2010.

[25] Buffa 2002, 2004

[26] Bard, Fattovich, Manzo 2021, pp. 241, 590.

[27] De Romanis 1996.

[28] Tringali 1965, 1981.

[29] Curtis 2008.

[30] Schmidt, Curtis 2001 ; Schmidt *et Al*. 2008, pp. 118-119. The complex picture reconstructed there regarding the existence of villages, cities, ceremonial and production centres is certainly the result of considerable work, which however requires methodological refinement and critical reflection on the survey methodology and the statistical procedures for the subsequent data processing, as brought into focus since the 1980s (Francovich, Patterson, Barker 2000; Terrenato 2004; Massa 2016; Allen 2022).

In parallel, during the same period, the encounter between the local population and South Arabian immigrants in Tigray culminated in the "kingdom" of D'MT (*Daamat/Di'amat*), characterized not only by several South Arabian cultural elements, but also by indigenous traits both in the material culture and in the ritual, social and symbolic sphere.[31]

As demonstrated by recent research in the eastern Tigray region, the impact of South Arabian colonization did not have the same intensity here as in central and western Tigray, as already seen in relation to the Ancient Ona culture of Eritrea. The South Arabian ruling elites or sovereigns attested by the inscriptions, therefore, do not appear to have dominated large regions of the Eritrean-Ethiopian Plateau either politically or culturally. For this reason, it is considered more appropriate to define this phase with the term pre-Aksumite rather than "D'MT" and "Ethio-Sabaean".[32]

In fact, there does not seem to exist a hierarchically recognisable entity either in the density of distribution or in the size of the settlements in areas less close to the centres of Yeha and Aksum to justify a unifying power in the period preceding the Aksumite domination,[33] which would seem to have been further fragmented into various local chiefdoms also on the basis of epigraphic evidence.[34]

Conversely, in the area of the Aksumite capital, a growth of sites in a few square kilometres is registered already in the pre-Aksumite era, characterized by a different hierarchical/functional rank and distribution density in the central area and in the rural periphery.[35]

In conclusion, the processes that led to the development of the first urban centres in the northern Horn of Africa, as we know them in historical times thanks to the testimonies of sources and archaeology, did not follow a schematic and generalizable course for the entire territory under examination. The differences found in the field of material culture are the reflection of a complexity in the construction of which the interaction between human systems and natural systems was a determining factor, that is, a social expression in constant construction and evolution.

Comments on words: Village/Town/City/Urban…? Theories and archaeology

In the second half of the first century AD, more or less contemporaneously, the maritime guide for merchants *Periplus Maris Erythraei* and Pliny the Elder, two authoritative sources, describe the settlement of Adulis in apparently very different terms.

The author of the Periplus, who certainly passed through Adulis while carrying on his commercial activities and who we can therefore consider a first-hand source, defines the settlement "*kome sýmmetros"*, "a fair sized village", that is, a village of appropriate size.[36] He also specifies that the inhabited place was located about three miles away from the sea, from the landing places of Didoros and Oreiné, and was subject to customs laws.[37]

Pliny, who is equally to be considered a reliable source,[38] uses instead the term *oppidum*, which in Latin distinguishes the urban character of a settlement, differentiating it from other forms such as a village or a military fortress.[39]

Which of the two authors should we give more credit to in trying to understand the reality of Adulis in the first century AD? As we shall see from the following considerations, the two terms may have been not so different from each other.

[31] Manzo 2009; Fattovich 2012, who proposes to replace the definition "pre-Aksumite" with "period of "D'MT", to indicate the phase preceding the establishment of the Kingdom of Aksum.

[32] D'andrea *et Al*. 2023, p. 381.

[33] Harrower, D'Andrea 2014.

[34] Phillipson 2012, pp. 38-39.

[35] Sernicola, Sulas 2012.

[36] My translation from the Greek, which I find preferable to "modest in size", as commonly understood.

[37] Casson 1989, p. 8.

[38] Pliny is known for his precision in reporting his sources, in this case Juba II of Mauretania, whose interests in the exploration of Africa and the Red Sea are the basis of a deep geographical knowledge of those places, reported in his work *Lybika*, written in the last twenty years of the first century BC. This knowledge could also be first-hand, as well as based on older Ptolemaic sources (Roller 2003, in particular pp. 191-192). The interests of the Ptolemies in Adulis are testified by the well-known inscription of the *Monumentum Adulitanum*, the one on the stela, dated to the third century BC, which records the conquests of Ptolemy III in Asia. A few centuries later, Adulis was defined *polis* by Cosmas Indicopleustes, *Topographia Cristiana* II, 54 (Wolska-Conus 1968, p. 364) and by Procopius of Caesarea, *History of the Wars*, I, 19, 22 (Loeb Classical Library, 48, pp. 182-183).

[39] Tarpin 2000.

It is necessary at this point to clarify what we mean by the term "city", and how, on an archaeological level, it is possible to distinguish it from other settlement types, in that geographical area and at that time.

The theme of the origins of the city has fascinated historians, anthropologists, sociologists, philologists and archaeologists starting from the fundamental work of Fustel de Coulange.[40] The French historian identified in the cultural aspects, in particular in the cult of the sacred hearth, the founding nucleus of the family and therefore of the institutions not only of the Greek and Roman, but also of the Eastern cities. He recognized in fact the remote antiquity and importance of this cult in the common Indo-European origins, as demonstrated by its presence also in the Brahmanic religion.[41]

Subsequently, the main categories in which the "urban" character of a settlement has been schematized, in an attempt to find factors generally applicable to the phenomenon of urbanization that occurred at different times in different geographical areas of the world, have been more closely linked to dimensional and functional[42] rather than to cultural aspects.[43]

In synthesis, the city could be identified as a site with a high density of permanent and heterogeneous population, extended in size, organised according to regular planimetric schemes and endowed with public monumental architecture, of a religious and/or political nature, or as a centre whose specialised functions served a larger territory.[44]

As has long been highlighted,[45] such categories in the ancient world are not applicable in many cases to the centres that the sources indicate with the name of city.

In the 1950s, the contribution of archaeology substantially implemented the theoretical reflection on the concept of city and urbanization, starting from the famous article by Gordon Childe *The Urban Revolution*, in which ten formal criteria characterizing urban civilization were indicated: the city, a constituent element of civilization, is characterized by larger settlements, population density, composition and function of the urban population, it is no longer governed by kinship relations but by residence; natural resources, thanks to technological capabilities, allow the accumulation of food surplus and wealth; the society is differentiated and specialized in various productive activities; the symbolic values of wealth are expressed by monumental public buildings; writing and administrative tools are used, and artistic expression and long-distance trade are carried out.[46]

Although surpassed by the progress of archaeological research methodology and the growth of knowledge, Childe's model, the subject of countless comments and debates, is still relevant for understanding the origins of the ancient city and distinguishing it, on an archaeological level, from the village.[47] This is true not only at a physical level, but also in the aspects of social organization that can be inferred from the material data.[48]

Recent works resume the criteria indicated by Childe, systematizing and expanding them into a series of "archaeological attributes" useful for distinguishing different types of cities, recognizing however that these are not rigidly applicable parameters, and that there is no single definition or a single best approach for analysing ancient cities and urban societies.[49] As already expressed by Childe: *"No specific elements of town planning for example can be proved characteristic of all such cities"*.[50]

Further reflections have refined the analytical tools to evaluate the different outcomes, from an economic and demographic point of view, of the compact city model, traditionally coinciding with the very idea of the city, compared to settlement forms with a lower density but equally 'urban', leading to a critical reconsideration of the equation of the term city with the greater density of material remains.[51]

[40] Fustel de Coulanges 1864.

[41] Id., *Ib*. pp. 26-27.

[42] Smith 2017 with previous references.

[43] Some considerations of Nas 2011 on the contemporary city can be useful to not neglect some aspects in general, also valid with regard to the ancient city.

[44] The criterion of social density and heterogeneity was proposed starting from Wirth 1938; Sjoberg 1964; Trigger 1972; for a recent synthesis of the vast literature Zuiderhoek 2016, particularly pp. 1-16.

[45] Weber 1950.

[46] Childe 1950.

[47] Smith 2009, who traces the success of Childe's article, noting the validity of the criteria, adopted by subsequent studies not only in the archaeological field. Only the existence of a sophisticated artistic style would not be relevant.

[48] Feinman 2018.

[49] Smith 2017.

[50] Childe 1950, p. 16.

[51] Fletcher 2019.

Furthermore, the actual possibility of arriving at realistic calculations on the population density of ancient cities is notoriously a matter of debate.[52]

Likewise reductive appears the distinction elaborated between modern cities, which would be characterized above all by their economic functions, while urban centres in antiquity would have had an essentially political function.[53]

As Max Weber pointed out, the existence of a regular market for exchanges which meets local needs, and is concurrently the place to which merchants from other centres flock, is one of the essential characteristics of the city: in the first century we know from the *Periplus* that Adulis offered goods for local consumption and luxuries that were the object of long-distance exchanges, and Roman coins circulated for the needs of foreign merchants residing in the town.

These exchanges were regulated by specific customs laws, which evidently presuppose the existence of administrative and protective powers, including military powers, exercised by an authority. We know from the testimony of the *Monumentum Adulitanum*, located in a position visible to all who entered the town from the western gate, that vast military actions were undertaken in the third century AD to protect the trade route that, passing through the Red Sea, reached Egypt.[54]

These are therefore all characteristics that can properly define the reality of Adulis as reconstructed on the basis of the sources: a centre controlled by an aristocratic power, which prospers due to the income derived from trade of regional and international importance, a "city of transit trade", which exports products both with and without storage on site. A legally established emporium, where foreign currency circulates and there is a customs house.

Another element considered fundamental by Weber to denote a settlement as 'urban' is the character of a fortress, which did not necessarily imply the existence of surrounding walls, but certainly of a garrison. Now the apparent absence of walls to delimit the settlements is known in the archaeological literature of the Horn of Africa and in general of the African continent, which would imply, according to the common opinion, a non-urban connotation as in the case of Aksum.[55]

However, the first walls of Adulis could also have been fences made of perishable material, as is known in other cases on the African continent, with a variety of types.[56] An initial delimitation made of wood or shrubs could have been followed, in historical times, by a protection consisting of a line that was not continuous but alternated with towers and fortified segments, suggested by the evidence provided by some wall sections currently recognized on the surface, as we will see in the next chapter.

If we consider that Adulis is defined as a "legally constituted emporium" by the author of the Periplus, that Cosmas' testimony reports that judicial activities were carried out in front of the throne, together with the probable defensive function of some wall structures identified right on the western edge of the site, where the throne stood at the time of Cosmas, at the point where the route that connected Adulis with the plateau reached the town, we find other fundamental elements, of an institutional nature, which enhance the image of the town of Adulis between the first and the sixth centuries AD.

As for the most ancient settlement, a comparison with Syria and Phoenicia can probably be a useful suggestion, since the first cities there were commercial centres, both maritime and caravan, ruled by a despotic government: in the Land of Punt, based on the reliefs of the temple of Hatshepsut, in the second millennium BC there were lineages of chiefs, as demonstrated by the scene of the couple receiving the officials of the Pharaoh.

Criticisms to Weber, as Ian Morris notes, have been raised by historians and philologists, in search of more refined analytical tools, but even in the case of Adulis, as already noted for ancient Greece, Weberian

[52] Morris 2006

[53] Trigger 1972; Smith 2017.

[54] With the definition *Monumentum Adulitanum* (Allacci 1631) are indicated two Greek inscriptions, one on a stela, dated to the third century BC, and a second one on a throne, dated to the third century AD. It is known to us only thanks to the copy transcribed, about eight centuries later, by the Christian merchant Cosmas Indicopleustes. Cosmas was in Adulis in 518 or 523 AD together with his fellow traveller Means, therefore his description of the places and artefacts is to be considered of primary importance, as it is a first-hand account (Wolska-Conus 1968, p. 16; G. Fiaccadori, *Monumentum Adulitanum*, in *EAe*, vol. 3, *ad vocem*; Bernand 1991, p. 27, dates the visit of Cosmas to Adulis to the end of the sixth century).

[55] Phillipson 2000.

[56] Connah 2000.

categories are crucial for explaining how economic relations made the emergence of cities possible.[57]

Another consideration must be made regarding the relationship between city, urbanism and state, which are certainly connected realities, but should not be considered according to a consequential scheme, as already highlighted with numerous examples taken from both the Mediterranean world and elsewhere at a global level.[58]

Another component that can be generalised for the ancient city is the necessary presence, in addition to the market, of an agricultural production and water management/distribution, to guarantee the supply of basic everyday necessities for the local population, even if this reality was perhaps less decisive for the mercantile centres, which could count on imported foodstuffs in addition to local resources.[59]

African city

The subject of the origins of urbanism on the African continent is perhaps one of those that has been most affected by the colonialist prejudice that considered the city a settlement model imported by foreign peoples, and non-existent at an indigenous level, as we have already seen above with regard to the northern Horn of Africa.

In the post-colonial era, the reaction to this paradigm has generated antithetical positions, while maintaining the parameter of ethnic identity, this time indigenous, to explain the appearance of social complexity. But not yet of the city, which to be defined as such had to be characterized by stone architecture: consequently, the phases preceding the appearance of buildings in durable materials, have long been ignored. The presence of stone architecture has long conditioned the archaeological recognition of cities in Africa, with the simplistic equation between stone buildings and urban reality, while structures in perishable material were considered representative of villages.

Later, this scheme was superseded by the theory whereby the birth of the city would have developed, through an organic process, due to the natural growth of the villages where agriculture and iron working were practiced.

Further progress in the studies has been made by recognizing the presence of a market as the main mechanism for explaining the origin of the first urban centres in East Africa between 500 and 1000 AD, as well as the diffusion of stone building technology, knowledge mediated by the activity of the Red Sea merchants.[60]

The emphasis then shifts to functional aspects rather than to the characteristics of a durable architecture and a regular organization of spaces, arriving at the recognition that: *"Africa's towns took many different spatial forms; some were highly visible with clearly demarcated boundaries, such as the walled cities of the Sahelian West Africa or the stockaded villages found in parts of East Africa, whilst others amounted to little more than 'a heap of huts' - clusters of scattered settlements interspersed with tract of cultivation and pasture, seeming to lack order or formality to the visitor's unfamiliar eye. The vastness of Africa and its cultural pluralism defies a typology of urban settlements"*.[61]

The validity of the terms "urban" and "city", traditionally attributed to compact *nuclei* delimited by walls or in some other way, is called into question by the archaeological evidence of forms of extensive and low-density urbanism, just as the correlation between settlement size and population density, which until the 1980s was evaluated with a ratio of one hundred people per hectare, can be considered misleading: *"...At lower densities the areal extent of settlements can be vastly larger than the equivalent for the largest dense settlements of the same kind of socio-economic system… The maximum settlement size ranges for compact settlements which have prevailed over several millennia, are about 0.7–1.0 ha for mobile communities, then about 70–100 ha for agrarian settlements and then 70–100 sq km for the great compact agrarian imperial capitals…It is therefore not tenable to argue that all settlements will have a simple spatial dichotomy between occupation area and crop resource hinterland, with the latter delimiting the extent of the former"*.[62]

[57] Morris 2006, p. 32.
[58] Smith 2020, Id. 2023.
[59] Juma 2004, p. 39.
[60] Juma 2004, pp. 31-39
[61] Anderson, Rathbone 2000, p. 1-2.
[62] Fletcher 2019, pp. 16; 18.

From theory to the field: the Adulis approach

The theoretical considerations seen so far summarise some of the main issues and questions we ask ourselves in order to try to understand the reality of ancient Adulis.

In particular, our methodological approach refers to what has been observed for the birth of the city in the protohistoric context.: "*Il concetto di città varia a seconda dei punti di vista e degli aspetti che si prendono in considerazione (geografico, architettonico, economico, sociale e politico). In età protostorica, esso non fa riferimento tanto all'aspetto fisico dei centri abitati che si esprime in un'architettura duratura e monumentale e in un preciso tessuto urbanistico. Si deve tenere presente piuttosto la definizione weberiana di un centro in cui la maggior parte delle persone non sono impegnate nelle attività economiche della produzione primaria. Si tratta di insediamenti proto-urbani che svolgono funzioni di centro di riferimento per il territorio circostante, indipendentemente dal ritrovare o meno tipologie edilizie monumentali e durature o tecniche edilizie progredite. Sul piano archeologico, l'emergere della città si può cogliere spostando l'attenzione dai caratteri fisici, ed in particolare dalla morfologia dell'abitato, alla distribuzione geografica e ai modelli di insediamento*".[63]

From a procedural as well as theoretical point of view, it is therefore appropriate to keep in mind the context, that is, the historical landscape of which the settlement is one of the components, within a system of relations of which it certainly constitutes a central element, alongside infrastructures, productive resources, administrative and social organization, symbolic and immaterial aspects. Infrastructures, both terrestrial and riverine, determine the connectivity of a territory, according to a hierarchy that can vary from the local to the regional or broader level, characterizing its nodality or marginality.[64]

Without a doubt, the subjects of nodality and the market are central for understanding the early origins of the settlement of Adulis, and as we have already seen, the testimony of the sources enables us to perceive their importance already in the second millennium BC.

An inter-regional hydrographic and terrestrial network, protected maritime landings, marine resources are the generating elements from which to start to build the stratigraphic sequence of the site and its relationship with the surrounding landscape. This horizontal stratigraphic reading will then be connected with the vertical stratigraphy of the excavations, to arrive at the definition of a historical sequence.[65]

At the current state of research, the earliest archaeological evidence available in the area of the Bay of Zula dates back to the Middle Stone Age, starting from about 125,000 years ago. These pieces of evidence, consisting of lithic industry and food remains, demonstrate the occupation of Bay of Zula and the Buri Peninsula by groups of *Homo sapiens* capable of exploiting the marine resources of the coastal environment.[66]

The main routes followed by these first human groups, coming from the interior of East Africa, were the fluvial axes of the Ethiopian Rift and the Danakil Depression. The coastal plain that extends West of Zula Bay, crossed by seasonal watercourses; the hills, protected inlets and beaches that surround the Buri Peninsula, certainly represented a favourable habitat for the possibility of exploiting water and food resources.

Particularly important are the results of some excavation surveys conducted at the sites of Asfet and Gelalo, dated between 5475-5672 and 7000-8500 BP, respectively, which in addition to a lithic industry have yielded abundant remains of different types of shells. In addition to being exploited as a precious food resource, capable of providing highly nutritional proteins and minerals, in some

[63] De Marinis 1984, p. 22: *"The concept of city varies according to the points of view and aspects taken into consideration (geographical, architectural, economic, social and political). In the protohistoric age, it does not refer so much to the physical aspect of inhabited centres that is expressed in a lasting and monumental architecture and in a precise urban fabric. Rather, we must keep in mind the Weberian definition of a centre in which the majority of people are not engaged in the economic activities of primary production. These are proto-urban settlements that perform the function of a reference centre for the surrounding territory, regardless of whether or not monumental and lasting building typologies or advanced building techniques are found. On an archaeological level, the emergence of the city can be understood by shifting attention from the physical characteristics, and in particular from the morphology of the inhabited area to the geographical distribution and settlement models".*

[64] Brogiolo 2015, p. 360.

[65] *Id*., *ibid*., p. 374.

[66] Medin, Zerai in this volume.

cases the shells had also been worked to obtain ornamental objects, probable indicators of social or cultural identity (gender, status or ethnicity).[67]

Possible remains of a lithic industry, of unspecified chronology, seem to have been found in the Bay of Zula in the locality of Malkato, where the remains of the dock built by the English in 1868 are still visible today, and there are numerous reports of archaeological remains indicated in the descriptions of those who visited the coast between Massawa and the Strait of Bāb al-Mandab in the nineteenth and twentieth centuries,[68] unfortunately rarely attributable with precision to a specific chronological phase.

Although requiring further investigation, with both surface and underwater archaeological research, the distribution and continuity over time of a stable occupation in the territory of the Bay of Zula, on the nearby islands and on the Buri Peninsula, weather conditions not unlike those of today[69] allow us to imagine that new systematic research could fill the gap in time currently existing between the evidence from the sites of Asfet and Gelalo and the most ancient settlement of Adulis.

This, in the second millennium BC, as emerges from the review of the concept of city discussed above, already possesses some "urban" characteristics that, at present, represent the oldest evidence of the origins of urbanism in the Horn of Africa.

Adulis and Aksum

According to common opinion, Adulis reached its peak when it became the port of Aksum, during the zenith of the capital of the Kingdom of Aksum, mainly between the third and seventh centuries AD.[70]

As already mentioned above, archaeological evidence indicates that the coastal settlement predates the chronological sequence available to date for Aksum by many centuries,[71] with elements that denote its 'urban' function at a very early stage, the main one being its role as a trading centre at the heart of a network of local and interregional connections.

The etymology of the place name Adulis, as reported in Greek and Roman sources, probably has much older African origins: it has been linked to *wdltt* (=Adulis), a name found in Pharaonic texts in the list of places included in the district of Punt prior to the fifteenth century BC.[72] The continued use of the place name could be further validated by the name *wzl* (Uzal), a descendant cited in the genealogy of Shem in the biblical Table of Nations, and plausibly located in 'erythraea' southern area. The similarity between Uzal and *Azuli*, the name repeatedly used by the indigenous people in the nineteenth century to refer to the site of the ancient ruins in Zula Bay, is evident.[73]

In the second-first millennium BC Adulis was not only already part of the long-distance trade network that involved both shores of the Red Sea, but also a centre with monumental spaces that hint to a complex social organisation, as documented by an alabaster throne, dated about the mid first millennium BC,[74] and by the famous Greek inscription of the third century BC, seen and copied about eight centuries later by Cosmas Indicopleustes. This inscription, engraved on a basalt stela, was located behind a second monument, a marble throne, also inscribed with a Greek text, celebrating the wartime conquests of an Aksumite king in vast regions of Aithiopia and Arabia, dated to the third century AD.[75] The stela and the throne, since the seven-

[67] Beyn, Bar-Yosef Mayer 2018.

[68] Zazzaro 2013, pp. 16-24.

[69] Beyn, Bar-Yosef Mayer 2018.

[70] R. Fattovich, S. Munro-Hay, *Adulis*, in *EAE*, vol. 1, *ad vocem*; S. Munro-Hay, *Aksum*, in *EAe*, vol. 1, *ad vocem*; among others: Peacock, Blue 2007; Phillipson 2012; Power 2012; Harrower, D'Andrea 2014; Harrower *et al*. 2020.

[71] The first evidence of permanent occupation in the area around Aksum appears at the beginning of the first millennium BC, Sernicola 2017.

[72] About the Land of Punt see *supra* and note 27.

[73] De Romanis 1996, pp. 147-156; about the name Azuli in 19th and 20th centuries see the following chapter.

[74] Manzo 2010, pp. 34-36; Massa, Cattaneo 2022, pp. 6-7.

[75] Although the interpretation of some place names in the long list of conquests proclaimed by the anonymous king is controversial, in other cases the names of places and peoples also known from other sources enable us to understand the extent and purpose of the military operations that marked the rise of Aksumite power: not only to secure the kingdom's borders in the geographically adjacent regions, but also to guarantee, with overseas expeditions to southern Arabia and by securing the route connecting Aksum to Egypt, control over any trading conducted through the ports of the Red Sea and the caravan routes connected to it. Some South Arabian inscriptions confirm the presence of Aksumite forces in the region, referring to them by the Sabaean name for Aithiopians, namely 'habashat'. The events described in the Adulis inscription mark the beginning of an Aithiopian occupation of the Arabian Peninsula in the third cen-

teenth century, are known as *Monumentum Adulitanum* thanks to the copy made in the 6th century AD by the Christian merchant Cosmas, together with his fellow traveller Menas.[76] They made the copy of the inscriptions at the request of Asbâs, the governor of Adulis, and by order of Ella Asbeha, the king of Aksum, who was about to wage war against the kingdom of Himyar, on the opposite shores of the Red Sea. The order made by the Aksumite King to the governor of Adulis to procure him the copy, as well as the reference to protective actions undertaken to guard the aromatics trade route, making the road from his kingdom to the borders of Egypt and the ports accessible, contained in the second inscriptions, has led to the hypothesis of a hegemony of the Aksumite kingdom on the Eritrean and Arabian coasts in the third century AD.[77]

As well known, the transcription made by Cosmas and inserted in his book *Topographia Christiana*, is accompanied by the famous drawing showing a map with the location of Adulis between Samidi and Gabaza.

The position of Adulis is slightly set back from the coast, near a place named Gabaza, indicated as a customs point, placed exactly on the coast.

The link between the Gabaza customs seen by Cosmas at the beginning of the sixth century, the actual Galala Hills near Adulis and the location of the ancient port of Adulis, already advanced in 1907 by Richard Sundström,[78] has been definitely demonstrated by the research conducted in 2004-2005 by the Eritro-British survey project.[79]

The meaning of the name Gabaza seems to be connected to the Geez term *gabaz*, 'riverbank', and means 'guard, keeper, protector', also in reference to religious contexts.[80]

A king of Gabaza is recorded in an inscription attributed to the Aksumite King *Ousanas* (approx. 325-345 AD), possibly indicating the territory of an autonomous kingdom identifiable with the area of the Adulites,[81] as suggested also by earlier sources: in the first century AD, we know the name of Zoskales, who ruled over the vast coastal region of the Red Sea between Ptolemais Theron in the north and the Strait of Bāb al-Mandab in the south, which also included Adulis, possibly the most important centre.[82] However, according to some, Zoskales was the first Aksumite King, or rather a local governor of the coastal territory, subject to the King of Aksum.[83]

Also in the first century AD, Pliny the Elder described the place as the 'town of the Adulites' and the main emporium for the Troglodytes and the Aithiopians, thus distinguishing its identity from that of the other inhabitants of the coast and the nearby plateau.[84] Ptolemy's subsequent indication of a territory pertaining to the Adulites, placing Adulis in the Adulitic Bay and mentioning separately Adulites and Aksumites;[85] the distinction reported by Epiphanius between Aksumites and Adulites,[86] and the recurrence of the term Adulites later in Nonnosus and Procopius,[87] could lead to the identification of the territory of an Adulite kingdom autonomous and distinct, or to the maintenance of the ethnic name.[88]

It appears no coincidence that the port of Adulis is also referred to in the *Periplus* as a 'legally regulated emporium', in Greek *empórion nómimon*, an attribute that is only assigned to two other ports: Muza (in present-day Yemen) and Apologos (in the Persian Gulf), perhaps sharing similar characteristics in terms of the extent of the routes and

tury AD, which lasted for about 70 years: Arabic inscriptions from around 270 report that power had been restored to the local Arab tribes. It was precisely at this time that the use of Aksumite coinage began, followed in the fourth century by the numerous inscriptions of King Ousanas containing claims to rights over the previously occupied Arab territories (Bowersock 2013, pp. 44-62).

[76] See *supra*, notes 12 and 54, and Massa, Cattaneo 2022, pp. 7-11, for further description and references about the *Monumentum Adulitanum*.

[77] Munro Hay 1991.

[78] Sundström 1907.

[79] Peacock, Blue 2007. For the analysis of the issue relating to the port of Adulis Massa, Cattaneo 2022, pp. 15-20; Censini in this volume.

[80] S. Munro Hay, *Gäbäz*, in *EAe*, vol. 2, *ad vocem*.

[81] *Ib*.

[82] *Periplus Maris Erythraei* 5: 2.19-20 (Casson 1989, p. 45).

[83] *Ib*., p. 109.

[84] PLIN., *Nat. Hist*. VI, 34 (PLINY. *Natural History*, Volume II: Books 3-7. Translated by H. Rackham, *Loeb Classical Library 352*. Cambridge, MA: Harvard University Press, 1942).

[85] PTOL., *Geog*. 4.7.8; 4.7.27 (E.L. Stevenson (ed., tr.), New York 1932, https://topostext.org/work/209).

[86] EPIPH., *De Gemmis* (R.P. Blake, H. De Vis (ed., tr.), *The Old Georgian Version and the Fragments of the Armenian Version. The Coptic-Sahidic Fragments*, London, Christophers, 1934, p. 243).

[87] PHOT., *Bibl*., I, III (J. H. Freese, The Library of Photius, London 1920, p. 19); PROCOP., *History of the Wars*, I, 19, 22 (Loeb Classical Library, 48, pp. 182-183).

[88] Munro Hay 1991, p. 37.

territories controlled, of which they constituted obligatory and therefore strategic passages also from a political point of view: «an *emporion nomimon* was a 'legally limited' port, i.e., one whose ruler insisted that all trade pass through his hands or those of his agents, where there was no free bazaar but only an authorized office of trade".[89]

Certainly, relations with Aksum, which had become the main centre of the powerful kingdom of the same name, ranked third among the four largest kingdoms in the world by the prophet Mani in the third century AD,[90] were close due to commercial and economic reasons, given the strategic location of Adulis both as terminus of the caravan routes connecting the Plateau and, concurrently, as access point to the trans-marine trade routes, a crossroads for the transit of luxury goods from which great wealth flowed to the Aksumite metropolis and its main trading partners, the Roman Empire first and the Byzantine Empire later.

On a political level, however, it is not possible to say with certainty whether this was a relationship of direct dependence or patronage, or an alliance, as the situation in previous centuries would seem to indicate.

The Periplus describes the variety and abundance of goods that could be found in the emporium of Adulis: ivory, tortoiseshell and rhinoceros horn for export; products from the Italic peninsula, the eastern Mediterranean, Egypt and the Indian Ocean such as wine, oil, fabrics and clothing, metal for everyday objects and precious metals, glass and Roman coins.[91] Alongside these, archaeology increasingly documents the circulation of amphorae and fine tableware from the eastern Mediterranean, Tunisia, Egypt, the Indian Ocean and the Persian Gulf.[92]

Architectural artefacts and styles characterise the spread of a culture that is typical of the major centres of the Aksumite era located along the route that leads from the sea to the capital Aksum,[93] climbing along the Haddas and Komayle valleys to reach the plateau at Koloe/Qohayto, the most important ivory market, which can be reached in three days from Adulis and another five days from the capital.[94]

A significant element for understanding the international relevance of Aksum is the introduction of its own coinage, minted by the kingdom between the third and seventh centuries AD. This was a unique case in Africa at the time outside Roman rule.[95]

In the third century, Aksum extended its influence into southern Arabia as well, as evidenced by some inscriptions reporting an Aksumite military presence in the context of shifting alliances with the main political entities in the region (Saba, Himyar Hadramawt and Qataban), with a clear interest in strengthening control over trade in the Red Sea.[96] "*At least from the time of Ezana in the fourth century, the Aksumite king adopted the title of 'king of Saba and Himyar', asserting a suzerainty probably difficult to enforce in practice. It is very likely that there was continuous contact during the fifth and early sixth centuries between the two sides of the Red Sea*".[97]

The ties between Aksum and Byzantium grew stronger between the fourth and sixth centuries, at the height of tensions that had long been moved, with alternating phases, by the main powers aiming at direct control of trade between the Mediterranean and the Far East: Byzantium and Persia.

The Red Sea and the Arabian Peninsula represented strategic territories in the connections between the Mediterranean and the Indian Ocean, but they were difficult to control directly along the entire route. Hence the need, by the main consumer, the Byzantine Empire, and the main producer, the Persian Empire, to establish rela-

[89] CASSON 1989, pp. 49-51.

[90] C. SCHMIDT 1940, *Kephalaia*, cap. LXXVII, p. 189, *Manichäische Handschriften Dr Staatlichen Museen Berlin*, Preussische Akadiemie der Wissenschafte, Stuttgart 1940 https://archive.org/details/kephalaia0000mani/page/n1/mode/2up?q=axumiten

[91] *Periplus Maris Erythraei* 4-6 (CASSON 1989, pp. 51-55).

[92] MASSA, GORLA in press.

[93] Also, at Aratu, in direction of Barka River.

[94] *Periplus Maris Erythraei* 4-6 (CASSON 1989, p. 53); according to Nonnosus, the distance between Adulis and Aksum takes fifteen days; twelve days according to Procopius (note 17).

[95] MUNRO HAY 1991; The number of Aksumite coins found in excavation contexts outside the territories controlled by the kingdom is increasing, calling into question the interpretation of Aksumite coinage as a function of prestige and representation rather than economic circulation, GIROLA 2006, p. 481.

[96] MUNRO HAY 1991, pp. 71-75; according to others, there is no certainty about the political involvement of the Kingdom of Aksum (PHILLIPSON 2012, p. 203).

[97] MUNRO HAY 1991, p. 55.

tions, or rather alliances, with intermediary states both by land and by sea: Yemen and Aksum respectively. Traffic between Aithiopia and Egypt by land was difficult due to the invasions of the *Nobadai* and the *Blemmyes*. The chronographer Johannes Malala (second half of the 6th century) accurately describes the situation: "*Roman merchants arrived in Aksum and the innermost empires of India through the territory of the Homerites"*.[98] As a result, the importance of the incense route and Yemen for Byzantium grew in the sixth century, as evidenced in the two wars between Abyssinia[99] and Himyar (in present-day Saudi Arabia, near the border with Yemen), which were aimed at defeating the Himyarite king, a Persian ally. Najran was one of the most important stations on the incense route, from which its most important trade routes branched, one to Syria, the other to Iraq and Persia. Politically, Najran supported Byzantium, and his conversion to Christianity was proof of this. Many sources speak of Najran's wealth as one of the most important centres of Yemenite trade.[100]

The *Martyrdom of Areta,* or *History of the Martyrs of Năgrān*[101], contains the hagiographic narration of the massacre that took place in 523 by the Jewish king of Himyar, Jusuf, who perpetrated the extermination of St. Areta and the Christian community living there.

Following this event, the Emperor of Byzantium, Justin, requested an alliance with the King of Aksum, Ella Asbeha (or Kaleb, his corresponding biblical name), to send an army and punish the crime committed by the Homerite king. The fleet was assembled by Ella Asbeha *"in the port called Gabaza, which is within the boundaries of the town of Adulis*".[102]

It is during this period that the archaeological documentation reveals the maximum splendour of the town of Adulis, represented above all by its basilicas, but also by the wealth of some private houses, which testify to the strategic leading role played by the port town in the international political events mentioned above, and probably also to direct links with the Byzantine capital.[103]

The Aksumite conquest of South Arabia was short-lived: internal struggles within the Ethiopian forces that remained in Himyarite territory after King Kaleb withdrew from the political scene facilitated the Persian conquest of Yemen in 570, which profoundly altered the political and economic balance between the great late-antique empires vying for control of the trade routes between the East and the Mediterranean, creating a vacuum between the Arabian Peninsula and the coasts of East Africa. The most serious consequences hit the Kingdom of Aksum, which became marginalised, no longer capable of maintaining a strong Christian presence in Himyar to counter Persia.

The decline of Aksum probably started at the end of the sixth century, attributed to various causes of environmental and demographic crisis,[104] besides the political and economic crises already mentioned, to which must be added the conquest of Nubia by the Blemmy (543), who ensured Aksum's communications with Egypt; the Persian conquest of Palestine in 614; Muhammad's advance towards Syria and Palestine.

Probably among the main causes of the demographic crisis is the epidemic plague that spread during the reign of Justinian (527-565), which according to some contemporary authors would have disseminated from the territories of the Aksumite kingdom.[105]

[98] MALALA, Chron. 18, 15 (ed Thurn, p.362 IOANNIS MALALAE *Chronographia*, recensuit I. Thurn, Berolini-Novi Eboraci 2000 (Corpus Fontium Historiae Byzantinae, 35).

[99] The use of the name Abyssinia as a synonym for Ethiopia is attested in South Arabian inscriptions in Ge'ez, and refers to the ancient region within the borders of the kingdom, while for Greek and Latin authors the term Ethiopia included the vast area that from the southern borders of Egypt extended as far as India; Arab authors distinguish Abyssinia from Nubia and India. (Munro Hay 1997, pp. 11-14; Bernand 2000, pp. 5-11).

[100] Simon 1989, p. 48, note 213.

[101] The importance of these events is testified by the multiplicity of traditions that have passed on their narration: Byzantine, Arabic, Syriac and Ethiopian sources, and the vast literature that has addressed them. In addition to the literary sources, the testimonies contained in South Arabic and Ethiopic inscriptions are extremely important: Bausi, Gori 2006.

[102] *Martyrium Sancti Arethae* (*Acta Sanctorum*, *Octobris*, vol. 10, 747).

[103] As is evident from the rich liturgical furnishings, some of which were probably donated by Byzantium, Massa 2017.

[104] Sernicola 2017, p. 99.

[105] Contemporary authors record the appearance of the epidemic in the Egyptian port of Pelusium in 541, from where it spread the following year to Constantinople through Alexandria, Palestine and Syria. The accounts of the sources, among which the main one is Procopius of Caesarea, according to some scholars would be disproportionate to the real impact of the conta-

Shortly after the Persian conquest of Jerusalem (614), some of Muhammad's followers decided to emigrate to the other side of the Red Sea, to Aksum. It is not known whether this was at the invitation of the Aksumite king himself.

In 622, Muhammad decided to emigrate from Mecca to Yathrib, which from then on became known as Medina, 'the city'. This was the Hegira, the date from which the Islamic era is calculated.[106]

The Republic of Mecca has control over much of the trade between Yemen, Abyssinia and Syria, as well as over part of the Indian trade, culminating in Aden, where it stops to avoid confronting the pirates of the Red Sea. According to tradition, at the end of the sixth or beginning of the seventh century, one of the Coreisciti of Mecca, Amr (or Haschim) ben Abd Abud Manàf, was the first to organise two large regular annual expeditions, one in summer to Syria, reaching as far as Gaza, the very ancient destination of the South Arabian caravans, and the other in winter to Yemen and Abyssinia. His sons concluded important trade agreements with the countries with which Mecca had the closest commercial relations: Abyssinia, Christian governors of the Byzantine frontier, the Sassanids and the Himyarites.

In 702, Abyssinian pirates surprised Jedda, the port of Mecca, prompting the Islamic authorities to occupy positions on the erythraean coast to dominate the pirates' refuges and their main sea routes, settling permanently on the Dahlak Islands, which also became a place of exile.[107]

With the Muslim settlement of the Dahlak Islands, piracy was eradicated and with it the possibility of Aksumite expansion beyond the borders of Africa. All ancient outlets were closed, and Aksum was forced to withdraw in itself.[108]

The impact that this situation must have had on the port and emporium of Adulis is evident: the archaeological levels relating to the final stages of the city document the destruction and abandonment of buildings, a destruction that seems to be mainly attributable to a natural disaster rather than to acts of war.

However, it is not possible to date the abandonment of the city to the sixth century,[109] as evidenced by the findings of the last century and the new excavations, which unequivocally indicate a continuity in the arrival of imported goods at least until the following century, as will be seen in detail in the next chapter.

gion, but recent scientific and archaeological discoveries seem to confirm the vastness of the epidemic (Sarris 2022). No direct evidence of the propagation of the epidemic in the area of Aksum is archaeologically recognisable (Sernicola 2017, p. 102).

[106] Bowersock 2013; Power 2012.
[107] Tedeschi 1969.
[108] Conti Rossini 1928, pp. 200-214.
[109] Power 2012, p. 93.

ARCHAEOLOGICAL AND HISTORICAL CONTEXT: NEW PERSPECTIVES ADULIS 2011-2021

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Fig. 1 - Adulis 2011, Remains of collapsed buildings in the foreground, in the background spoil heaps from the twentieth century excavations.

Return to Adulis

At the beginning of the new research season, inaugurated by the Adulis Project with the first excavation campaign in 2011, the area where the ancient town stood was an expanse of sand dotted with a few *htum* bushes and even rarer acacia trees (fig.1). Against the background of this natural landscape, mounds of squared stones or sand mixed with fragments of pottery and stones jutted out. In some cases, one could recognize the remains of collapsed ancient walls, in others, the accumulations of debris from previous excavations.[1]

[1] Castiglioni, Castiglioni 2011.

Fig. 2 - Adulis at the beginning of the twentieth century, Paribeni 1907, Table II, 2.

A panorama that is not very different from what is reported in the descriptions of those who visited Adulis for various reasons between the nineteenth and twentieth centuries, as can be seen from the photo taken over a hundred years ago shown in fig. 2, and that is interesting to read anew in view of the current situation of the site. This, firstly, to assess the rapid change in the landscape over the two hundred years that have passed between the rediscovery of Adulis in modern times and the beginning of our research, and thus to complete the picture that has emerged in this regard from the geomorphological investigations.[2]

THE ADULIS LANDSCAPE IN THE NINETEENTH CENTURY

The first attempt - of which we have published evidence - at a survey of the site was made in 1810 by the expedition of Henry Salt, who had arrived in Massawa for commercial and geographical purposes, but who was also an Egyptologist with an interest in archaeology.[3] Based on information provided by the inhabitants of Zula, as he was unable to personally visit the site, Salt wrote: *"that great remains of an old town could still be traced near Zulla, which had been called "Azoole"; that the houses appeared to have been larger and more numerous than those at Massowa; immense masses of square stones, four or five feet in breadth, lying heaped confusedly together in the bed of a "gorf" or "torrent"; by the sudden overflowing of which, it was traditionally reported, the town had been destroyed"*.

Although Salt himself was unable to carry out the survey, based on the descriptions narrated to him, the site of the ruins of Adulis is shown - albe-

[2] CENSINI, in this volume.

[3] SALT 1814.

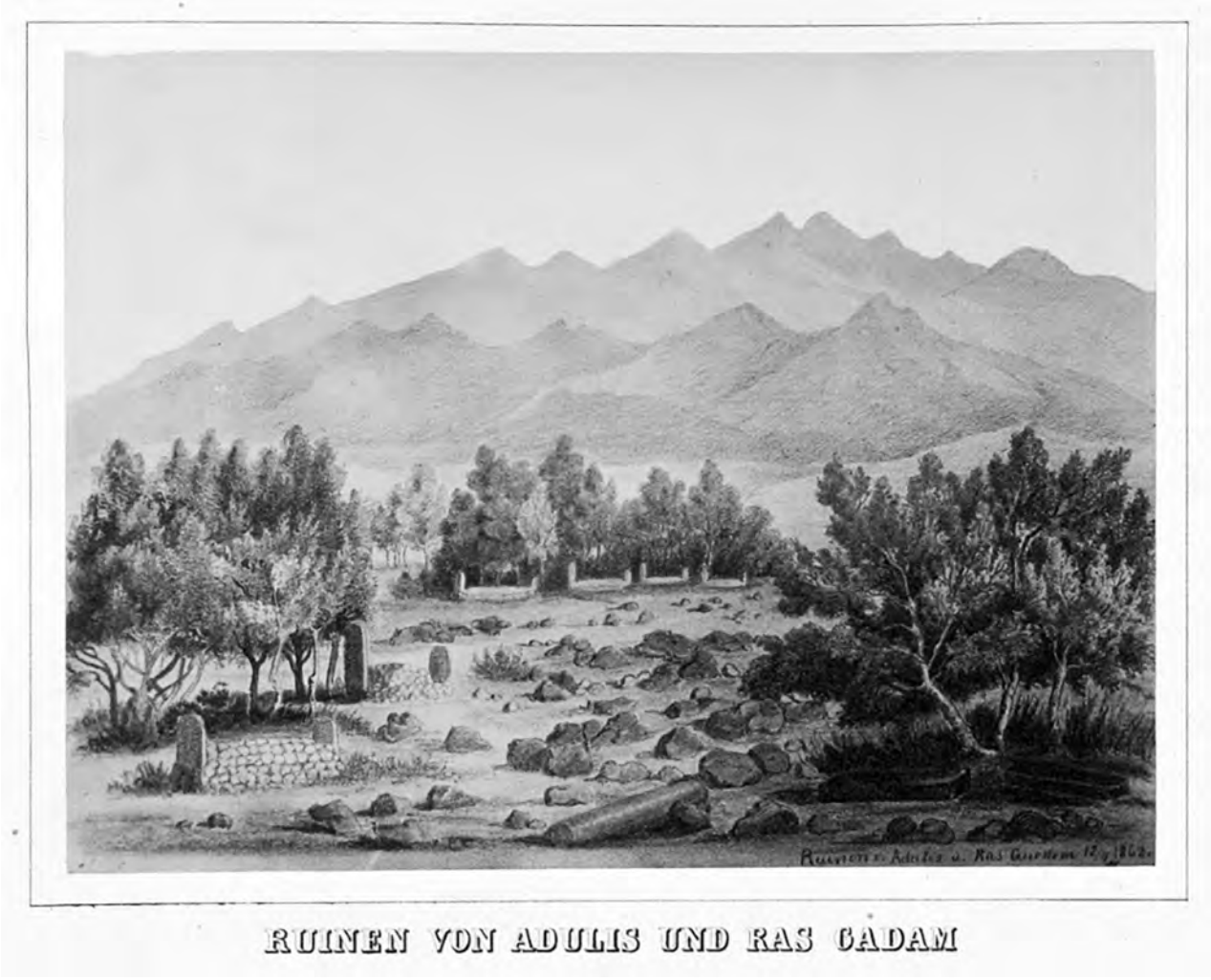

Fig. 3 - Adulis, April 1862. Sketch made by the Duchess Alexandrine of Saxe-Coburg and Gotha, in the foreground a column, and the ruins of the main Islamic cemetery within the archaeological area. Coburg-Gotha 1864, Table 20.

it imprecisely - for the first time in European cartography, positioning it near the village of Zula, erroneously indicated at the bottom of Annesley Bay.[4] For the first time, an archaeological find from Adulis is also published.[5]

About twenty years later, on 30 January 1832, the German naturalist and explorer Eduard Simon Rüppell visited the place, describing many piles of rubble along the northern side of a wide dry stream. He interpreted these piles as belonging to houses "*all built with small rough lava stones"*. These ruins occupied a flat area of about 500 paces in an east-west direction. About halfway through the piles of ruins he observed the remains of a large building, most probably a Christian church. Here, in a sixty-foot square space, were numerous quadrangular column drums and five capitals. A large cemetery lay to the southwest of the ruins.[6]

It is possible that the remains of the construction seen by Rüppell correspond to the building located in the central-eastern sector of the site, which some thirty years later was to be excavated by the British military expedition led by Sir Robert Napier, which we will discuss later, and to the southwest of which lies in fact the largest late Is-

[4] As Zula Bay was called after Lord Annesley's expedition in 1805, which also included Henry Salt; Salt 1814, pp. 451-453; Cattaneo 2022, fig. 29.

[5] Salt 1814, Plate 31.

[6] Rüppel 1838, pp. 258-268

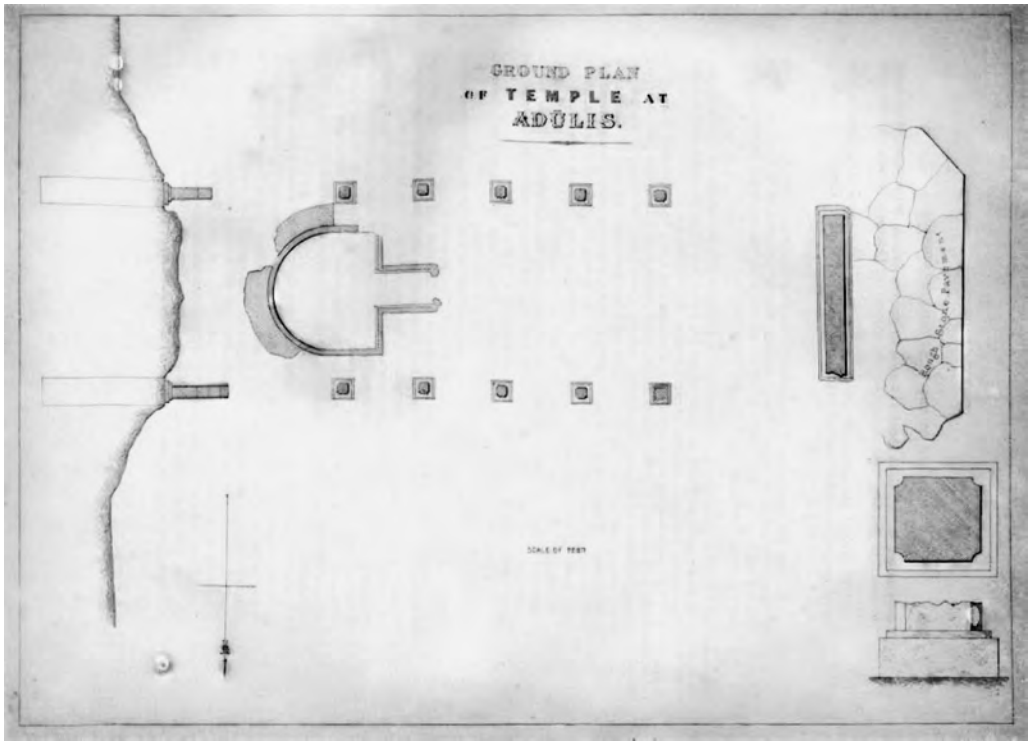

Fig. 4 - Plan and elevation of the church, and drawings of the finds entered in the British Museum from Captain Goodfellow's report (Holland, Hozier 1870).

lamic cemetery of the village of Zula, still used today.[7]

A few years after Rüppell's visit, in 1839, the doctor and zoologist Antoine Petit, accompanied by the geologist and draughtsman M. Vignaud, both members of the geographical expedition to Abyssinia led by the officer Téophile Lefebvre, carried out an exploration and topographical surveys of the site. They too describe the Islamic cemetery already recognised by Rüppel, the tombs of which are said to be built with fragments of the ancient town, and the basalt stones scattered on the ground. They also identified the remains of three 'temples', located on three hills arranged in a triangle, not far from each other.[8] It is possible that the first, which is located on a hill overlooking the main cemetery, corresponds to the church that was to be excavated about thirty years later by the British Museum. The second temple, identified 200 m to the west of the first, could correspond to the 'Altar of the Sun', while the third, and largest, could be the 'palace' that the Swedish missionary Sundström would excavate about fifty years later.

In 1860, Captain Stanislas Russel, while on a mission aimed at a project for French intervention in Abyssinia, assigned to him by Napoleon III, arrived in Adulis and carried out some excavations as well: *"...The so-called ruins of Adulis. In fact, numerous remains of cut stone, marble and pottery attest to the location of a town over a vast area from east to west, approximately one and a half miles by half a mile from north to south. The square columns with bevelled sides, their bases and their capitals with rectangular steps are arranged in a certain order. We believe we can trace a parallelogram structure among these ruins. I have dug in various places without success; not an inscription, not a medal"*.[9]

Brief news was reported in 1864 by the expedition of Duke Ernest II of Saxe-Coburg and Go-

[7] LARENTIS, in this volume.

[8] LEFEBVRE 1845, pp. 437-439; Plate XI, figg 1-3.

[9] RUSSEL 1860, p. 35: *" ...les ruines dites d'Adulis. En effet de nombreux débris de pierres taillées de marbres de poteries attestent l'emplacement d'une ville sur une grande étendue de l'est à l'ouest, environ un mille et demi sur un demi-mille du nord au sud. Des colonnes carrées à pans coupés avec leurs soubassements et leurs chapiteaux à feuillures rectangulaires gisent dans un certain*

tha,[10] accompanied by the Duchess, to whom we owe the usual description of the ruins of Adulis, and the drawing shown in fig. 3.

In 1868, De Rivoire wrote a very concise description, in which, as usual, he noted the piles of black stones and a few 'scattered column shafts, arranged clearly to trace the perimeter of a temple'.[11]

The first excavations published: 1868

The first excavations at Adulis were carried out in 1868, as is well known, by the British military expedition led by Sir Robert Napier against Emperor Theodore II of Abyssinia.[12] On their return from the victorious battle against the fortress of Magdala, the military expedition, accompanied by R. R. Holmes, the British Museum envoy, stopped at Adulis. Captain William West Goodfellow decided to deepen a dig after having probed the mounds of rubble with trenches that had revealed the walls and foundations of ancient buildings. The most promising mound seemed to be the one containing some columns among the rubble, and in fact it turned out to be a basilica-shaped construction, which was dug down to a depth of thirteen feet (about 4 metres): "*in which the bases of the cut stone columns were found in true position"*.[13]

Fragments of marble and alabaster architectural decoration as well as numerous artefacts were also found during the excavation, some of which are illustrated together with the plan of the building (fig. 4).[14] The topographical location of the operations was not reported, but thanks to Paribeni's survey some thirty years later we can place the building, now known as the 'church of the British Museum' or 'British Church', in the central eastern sector of the town. As we shall see later, our excavations have brought the building to light and identified its function as the town cathedral.

The year after the English excavations, on 24 December 1869, the explorer and orientalist Giuseppe Sapeto arrived in Adulis by sea, having departed from Massawa.

Sapeto gives an interesting report about the landing on the Island of Desie, in the southern part, where, at a very short distance from the shore, the mooring was 20 m deep: on 16 December the steamboat Yemen, on board which he was travelling: *"ran aground at the south of the island, which overlooks the Bay of Aduli, called Gubb-Dakno and Gubbat-el-Koffar, i.e. the Gulf of the Infidels, by the natives; from the town, I believe, of Aduli, now completely in ruins, which was a trading post for the Egyptians and later for Christian Abyssinia: and which I had indicated to the French minister as favourable for a naval and commercial station"*.[15] Moving towards the north of the island, Sapeto reports having counted *"11 wells or pools of bitter-tasting water; near them there were a few small houses with stone slab walls, one on top of the other without cement"*. Two miles further north of the village there is, instead, good quality fresh water. After taking measurements of the seabed around the island and in the gulf, he travelled to Adulis, which he describes as follows. Also stating that they had carried out excavation work: *"Having drunk our coffee, we went with hoes and pickaxes to the ruins, spread over an area of a thousand paces from east to west, and 700 from north to south. The ground is all strewn with pitted black stones, six to eight inches across, mixed with fragments of ancient pottery and 5 cm thick remains of bricks: of such fine and hard earth, that modern technique could not produce anything better. The field is also completely overrun with the low walls and rubble of the main buildings, and choked by various species of euphorbia, mimosa, cissus, aloe, panicum turgidum, milkweed and by soda.*

While the commander set the men to work digging a mound of wreckage, I studied the topography of the town. I walked around it, noting the major buildings, picturing the squares, the caravanserais and the markets.

Its main gate faced east: towards which there are mountains of broken columns with Egyptian-style pedestals and capitals. The columns are

ordre. Nous croyons pouvoir retracer un édifice en parallélogramme dans ces débris. J'en fais fouiller diverses parties sans succès; pas une inscription pas une médaille".

[10] Coburg-Gotha 1864, pp. 63-65.

[11] De Rivoire 1868, same description repeated in De Rivoire 1880.

[12] Holland, Hozier 1870; Munro-Hay 1989b.

[13] Munro-Hay 1989b, p. 47.

[14] *Ibid*.; Holland, Hozier 1870, pp. 398-399, with a list of the artefacts sent to the British Museum, where they are still kept.

[15] Sapeto 1871, pp. 29-31.

made of two or three pieces, the square ones with hollowed edges have a 47 cm diameter: the capitals and pedestals have a 65 cm diameter. The most notable ruin is in the middle and opposite Orina: it measures 22 paces from east to west and 16 from the opposite sides; and it appears to have been a temple. Two other smaller buildings of a similar shape were at the two ends of the straight line, with the door set in its centre. The warehouses and markets were in the north-west part. The town was surrounded by a wall, which was still visible in many places: it was located on a peninsula formed by two streams that flowed into the sea, and in rainy weather filled the cisterns with water. Today, digging in the riverbed of the Habascit, one finds good water in abundance. The streams have flown over many buildings, covered other ruins with silt, and devastated many more recent Muslim graves.

Making an archaeological judgement of those ancient works would have required large-scale excavations, which were impossible for us due to lack of time... We were content with a probe; and having made a general drawing of the works, my companions returned to the tents. I continued searching among the tombs for a long time, looking for an inscription that the camel drivers from Massawa had assured me existed on the slab of an Islamic tomb. I combed through the entire, extensive necropolis: its tombs serve as dens for hyenas and jackals, but I was unable to find any inscription. Instead, I saw various small columns and white marble gravestones at the head of some of the tombs".[16]

Note the reference to the town walls, which only Sapeto seems to have seen and whom we do not know whether we should believe, given that no one before or after him mentions them, in particular Paribeni, who searched for them systematically.[17]

In 1885, the Bulletin of the Italian Geographical Society published Luisa Reinisch's description of Adulis:[18] *"Near a wide riverbed lie the lonely, abandoned ruins of an ancient and glorious town, in the middle of which is a Muslim cemetery, surrounded by cypress trees and decorated with all the possible remains of a bygone world. Large, half-ruined fluted vases, mighty slabs of marble, and all kinds of carved stones serve as tomb decorations... near the cemetery, shaded by some trees, are the remains of an ancient temple, a rectangular quadrilateral with eight octagonal columns on each side. The portico is still standing, and the sanctuary can still be recognised on the opposite side. Hefty quadrangular boulders form the foundations.*

The entire town was built with lava stones, which suffered almost no damage from the bad weather... Not a single house is still standing; rounded piles of rough-hewn stones and pottery sherds mark their location. The bricks of the houses are like ours; 16 cm long, 9 cm wide and 5 cm thick. The same remains of houses can be seen on small hills for several kilometres towards the mountain...".[19] It is conceivable that Luisa Reinisch's description refers to the church excavated not many years earlier by the British military expedition.

Theodore Bent paid a very brief visit in 1893, where apart from a few columns from the British excavation of 1868, he considered there was nothing else to see,[20] followed in 1895 by Max Schoeller[21] and in 1900 by Conti Rossini, who reported concisely: *"I examined the few ruins that are now uncovered - the remains of a temple, a few capitals, some fragments of a column, broken obelisks - and I hope to be able to make them better known than my predecessors"*.[22]

The twentieth century excavations

1906, Richard Sundström

The Swedish missionary and physician Richard Sundström travelled to Eritrea in 1898 follow-

[16] Id., *Ib*.

[17] Sapeto's indications are rightly considered to be 'not very precise and partly fantastic' by Dainelli, Marinelli 1912, p. 521.

[18] Wife of the better-known orientalist Leo Reinisch, who carried out linguistic research in Eritrea in 1877-78.

[19] Reinisch 1885, pp. 584-587.

[20] Bent 1896, pp. 228-230. The expedition only stayed at the site for one night, recognising some columns excavated by the British expedition of 1868 among the piles of ruins. Bent, an archaeologist, rightly thought that it was pointless to dig in a hasty manner (p. 230): *"But the ruins cover a vast area, and consist of a conglomeration of mounds, each of which represents an important building overgrown with a low scrub. So that the work to accomplish anything would have to be systematic and presenting labour not much less than that of unearthing Pompeii itself. For the history of Africa in remote ages this work would be of exceptional interest and value, but the excessive heat and unhealthiness of the climate would also be a further bar to the accomplishment of this end"*.

[21] Schoeller 1895, pp. 193-194.

[22] Conti Rossini 1900, p. 106.

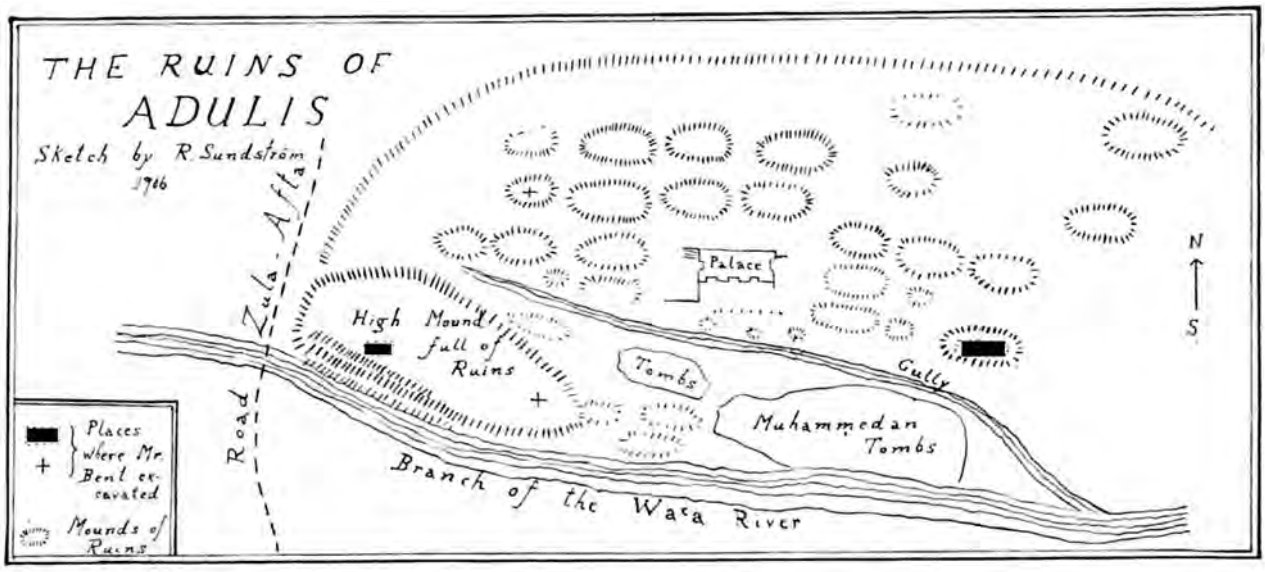

Fig. 5 - Sketch of the ruins of Adulis in 1906, by Richard Sundström. The position of the previous excavation attributed to the British expedition, that Sundström recognised as coinciding with the indication also by Bent 1896, as reported in the legend, is in the black rectangle (1868: Sundström 1907, fig. 1).

ing the Swedish Evangelical Mission. His cultural and scientific interests - particularly in the oral historiographical traditions of the Tigrean ethnic groups - led him to visit the ruins of Adulis, where he was able to travel having obtained permission from the Italian colonial authorities.[23]

The account of his research, translated into English by Enno Littmann,[24] preserves important information on the landscape and the state of preservation of the site at the beginning of the last century, accompanied by the first topographical sketch of the town (fig. 5).

The landscape of Adulis on Tuesday, 16 January 1906 is described as follows:

"all was now quiet and dead. Hatüm [Suaeda monoica] *bushes were thriving exuberantly, and the grass around and betwixt them was high and abundant. But where were the ruins? I was very much astonished when my companion pointed at a few low piles of small black porous stones saying that those were the ruins. Wandering about I found in fact at several places parts of columns which were said to have been excavated by an Englishman In one of these places a large hole had been dug into the ground, and parts of beautiful columns and large slabs of stone had been unearthed. The natives have decorated the tombs of their ancestors with parts of columns and with larger or smaller pieces of surprisingly beautiful and almost transparent marble plates, which they found on the hills. Upon careful examination lines of walls may be recognized here and there; whether they are walls of houses or courtyards remains to be determined. In a few places the mounds are about two meters higher than the level of the surrounding plain. At various spots the ground is covered with sherds of different kinds of earthenware, snails, shells and corals. Furthermore there were a few beads, red, blue, green or white. Also some pieces of metal, viz. iron, copper and a brass-like alloy, were found. My attention was drawn especially to the fact that in certain places the small pieces of copper which I saw were melted and had the form of lead that had been melted and poured out and then had cooled off. It seems, therefore, that the ancient town was destroyed by a fire which melted the copper*".[25]

The observations made by Sundström during his inspection are very interesting, as they confirm that the British intervention was not only limited to the

[23] B. Lindhal, *Sundström Gustaf Richard*, in *EAe*, vol. 4, *ad vocem*.
[24] Littmann 1907.
[25] Sundström 1907, p. 174.

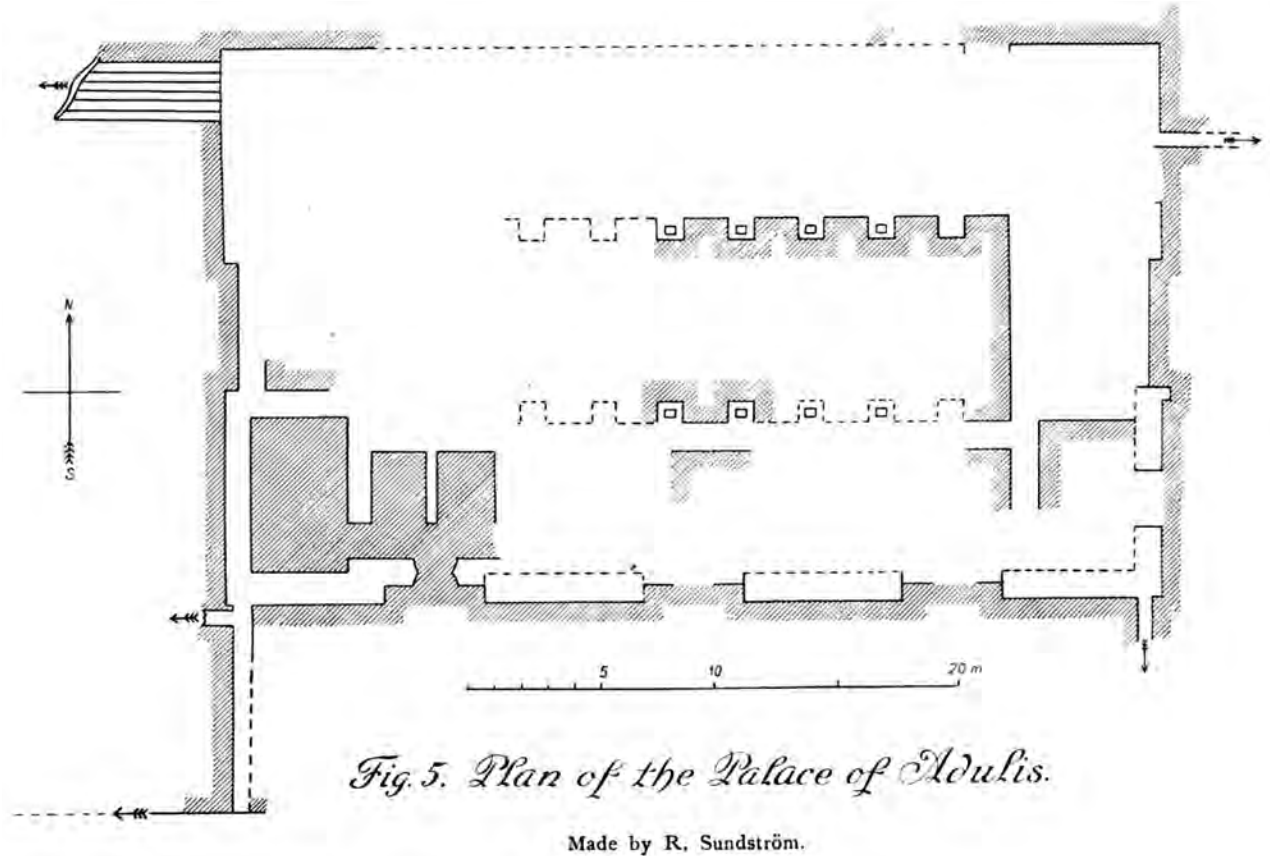

Fig. 6 - Sketch of the so called 'Palace', Sundström 1907, p. 177.

excavation of the so-called 'British Museum' church, but also involved the south-western sector of the site, as Paribeni will note shortly afterwards,[26] in correspondence with the hatched area in Sundström's plan and the probe marked with no. 8 in Checchi's survey al later shown in fig. 7.

Other significant notes are those relating to the reuse of architectural materials by the locals, the emergence of sections of walls and the abundance of movable artefacts on the surface: a situation quite similar to today's, which makes us realise that apart from the stripping of elements to be reused for funerary or other purposes by neighbouring villages, there was no reoccupation of the ancient settlement in the period following its destruction, but only sporadic habitation or partial reuse of spaces, with a different function than the original one.[27] Among them, the melted metal fragments observed in some of the points lead the Swede to speculate that the town had been destroyed by fire.

He continues the reconnaissance moving from SW to NE, giving the following indication:

"*As you go from south - west in the direction of north-east, the ruins take up a space about 800 meters long; but the width of this space is rather narrow. The above-mentioned river branch seems to have changed its bed, in the course of time, further towards the north and to have undermined, disintegrated, and washed away the ruins on that side. This agrees with what the natives told me, viz., that after a heavy flood it happened that rusty swords and other iron objects were found. On account of their superstition, however, they had not dared to touch them, but had let the flood bury what it had thrown out on a former occasion*".[28]

This description of the site does not differ from what can be seen today, more than a hundred years

[26] PARIBENI 1907, c. 440 and note 1.

[27] This is the case, for example, with the Islamic burials in the cathedral (LARENTIS 2021); or the hearth traces observed by Paribeni in the apse of the northern church.

[28] SUNDSTRÖM 1907, p. 175.

later. The changes in the riverbed, with the widening of the bed towards the north, can still be observed in the section of the riverbank, where segments of walls and floors are preserved, and it was documented by our excavations in 2014, with the discovery of production structures that are now submerged.[29]

Based on what he observed on the surface, the Swede chose the most promising spot to investigate by excavation, convinced that he would find an important monument. And so it was, since the building he unearthed (fig. 6) is the largest among those excavated to date:

"*Now I concluded that this mound, although not quite so high as the others near by, ought to contain a structure of unusual importance, and therefore, I chose it for my excavations. Soon after we had begun to dig, we met with a very well preserved wall of black porous stone, furthermore we found pieces of marble plates and of glass jars. We then excavated on the east side of the hill, a place which the natives had been using for burning tar. Here we began to dig a slanting trench into the hill, breaking away stone after stone with the hoe. The following day we found a wall here also. We continued to dig the trench deeper and longer, always keeping to the side of the same wall. We worked through the masses of stones to a depth of 4 meters, and there we found the foot of the wall. The form of this wall was unusual. It rises in steps, comparable to a staircase, each step being about half a meter high, and not quite a hand's breadth deep. The length of this wall seemed to be without end. Here on the west-side we unexpectedly came across a piece of a marble column hewn in screw form. This must have been of unusual beauty, when it was standing in its whole length. I was now once more confirmed in my opinion that we were here on the place of a large and important house or a palace. I shall now give the results of my excavations without describing the progress of the work in detail. A sketch of 'the Palace of Adulis' may serve as an illustration* [fig. 6]. *In this sketch the slanting lines indicate excavated portions, the dotted lines presumable course of the walls.*

The house in its present state represents only the lower story: the upper story has probably been destroyed, and its stones and mortar lie round about in heaps of debris. The walls are built in the above named 'graduated style', except in the recesses for the doors in the southwall, where the walls are straight: they consist on the outside of large ashlar blocks, some of which measure up to 2'/2 meters in length, on the inside of smaller blocks. The whole length of the house measures in the ground floor from E. to W. 38 m; the width from N. to S. 22.50 m. The southside is doubtless the front, and it seems to have had an enclosure in front of it, as is indicated by the adjoining walls in the east and the west corners. It is divided into four parts by the recesses made for the doors: in every one of these parts, which are each 6.50 m long, two openings are found of the following form, T; these windows are 1.05 m found of the following form, T; these windows are 1,05 m high (perpendicularly) and wide (vertically), the opening itself having a width of 0,35 m. On this side even the stucco is very well preserved. About the form of the northside I cannot make any definite statement, since I had no opportunity of excavating there, except near the corners. It seems to me, however, that the north-wall was somewhat different from the south-wall. On the other hand, the east and the west sides are of the same style, i.e. in the centre they both have a recess 5.10 m long, dividing either wall into two sections each 8,70 m long. But there is a conspicuous difference with regard to doors: the east side has two portals, the west side none. Moreover, there is a splendid flight of stairs on the west side.

We could not excavate more than 7 very well preserved steps, and even these only for a space 6 m long. But these steps are certainly longer and more numerous. Did they lead up to the second story? After we had, in this way, gone around the edifice in order to determine the outlines, as far as possible under the circumstances, we went back to the south side and set in at the first recess from the west. This one, as well as the other two, is 4 m wide. During our excavations in these recesses, we found among the debris of the destroyed upper story a large amount of ashes and charcoal and half burnt trunks of cypress-trees. In the door-opening, which measures 1.60 m, we discovered even the charred door-posts, undoubtedly also of cypress wood. It looks as if at the time

[29] Zazzaro *et Al*. 2014, p. 510.

when the town was looted and destroyed, all the combustible material at hand had been piled up in front of the doors leading into the lower story. We now enter the room which has been excavated first. The floor is here made of pounded clay. In the centre of the room there is a foundation wall 0.40 m wide, dividing it into two parts, each of a width of 2.30 m. This wall is quite well preserved except in its front part. At the right and the left, doors were found leading into the inner rooms. Curiously enough the opening at the left was walled up. In this first room we found pieces of glass and a gold coin on the floor among the ashes and the charcoal. In order to enter the room to the left more easily I had the walled-up door opened. This room is quite large, measuring 4 m x 6.15 m; and it is 3.50 m high up to the groove in the wall where the ceiling (or roof) adjoined. The floor was covered with two layers of well preserved tiles: the lower layer consisted of square tiles measuring 0.26 X 0.26 m, the upper of rectangular ones measuring 0.26 X 0.12 m. The stucco of the walls has now entirely disappeared. Excavating on this spot, we found some silver coins, a few of which are well preserved, especially those which we found lying in a roll. Near this, we found piles of bones, the greater part of which were decayed. The form of one of them, a thighbone, indicated that it was part of a human skeleton; and the same is true of a heavy collar-bone which was also found there… Beside these things we found here only a few pieces of glass and of metal… fragments of marble slabs with reliefs of vines and grapes, some other marble ornaments, parts of a thin copper chain, nails and spikes of copper and pieces of painted glass".[30]

Thanks to the description:

▪ we know the dimensions of the building, 22.50 x 38 m, with the considerable thickness (4 m) of the collapse of the walls;

▪ we can recognise the existence of at least three chronological phases: the first, linked to the layout of the building, with a high-level function, which cannot be identified with certainty as a Christian basilica, as believed instead in the wake of a misunderstanding initiated by Krenker.[31] Lacking comprehensive excavation data, it is difficult to tend to one rather than to the other of the two interpretations; however, the plan published by those who excavated the building, even if only partially, seems more reliable; a second phase, signalled by the closing of the door of the SW 'room'; the third phase, from the reuse of certain spaces of the building with a funerary function;

▪ we cannot say whether the silver coins found next to the skeletal remains should be interpreted as grave goods, together with the glass and metal fragments, or whether they are a small treasure trove, which would indicate a further phase of precipitous abandonment, to be considered prior to the burials.

▪ some details: the probable existence of a *portico* along the south side; of a staircase on the west side; of *stucco* cladding and marble and alabaster architectural decoration.

The listed finds include also gold coins, one with the name of Gersem (late sixth to early seventh centuries), one probably attributable to Hethasas, the last of the series, dated to 620. In particular, the gold coin found in the layer of ashes and charcoal of the 'room' in the SW corner could indicate the date of the fire, therefore to be placed as *terminus post quem* after the early seventh century or after 620 (Sundström does not specify which of the two gold coins was found there). It certainly must have been a destructive fire as, in addition to ashes and charcoal, parts of half burnt trunks, identified by the Swede as cypresses, and the charred posts of the jambs in the doorway opening on the south side were also found. The discovery of skeleton parts and human bones could confirm the same phenomenon documented in the excavation of the cathedral, i.e. a use of certain spaces, after the destruction or abandonment of the town, as burial grounds. In the case of the burials found in the area of the main church, their Islamic character can be recognised based on the orientation of the bodies and the burial ritual;[32] whereas, as regards Sundström's findings, the absence of any description makes it impossible to attribute the

[30] SUNDSTRÖM 1907, pp. 176-180.

[31] KRENKER 1913, p. 165, considers Sundström's drawing to be unclear and incorrect and therefore proposes a different development of the interior space, based not on a first-hand verification but on an alleged similarity between this building and the church excavated by the British Museum. It is thus that from this moment onwards, the inner walls become rows of free-standing pillars, suggesting a basilica plan. ANFRAY 1990, p. 126, reproposes Krenker's drawing and attributes it to Paribeni; HELDMAN 1994, pp. 239; 245.

[32] LARENTIS 2021.

burials to a specific religious belief: they could be either a surviving group of the inhabitants or the new conquerors, or even a later occupation.

One of the silver coins, bearing on the reverse side the golden cross surmounted by the arch symbolising the Holy Sepulchre in Jerusalem, with the legend '(the king) whom the Saviour exalts' could refer to Ella Gabaz or Israel, both of whom can be placed in the second half of the sixth century.[33]

The coinage of Israel is exceptionally represented at Adulis by the 33 gold coins found at the west wall of room S, which was to the east of the northern church portico.[34] According to Hahn, this is not a small treasure trove, as it consists exclusively of coins from the same period, but rather a merchant's deposit, concealed at a time when the Sasanian expansion into Yemen began to disrupt the Red Sea trade.[35]

As Paribeni comments: "*the improvised expedient used by Dr Sundström of depositing all the excavated soil on the edge of his trenches*"[36] has rendered unrecognisable the wall sections, the staircase and the columns excavated by the Swede, together with the deposits and vegetation that have covered the area over the period of more than a hundred years that had elapsed until the cleaning intervention carried out during the 2022 mission.

But perhaps of greater interest than the excavation is the surface survey carried out by Sundström in the search for the port of Adulis and his identification of Gabaza, mentioned by Cosmas, with the present-day hills of Galala:

"The natives themselves, especially the Danakil, carry on traffic along the sea-shore, and as a harbour or anchoring place they use Malcatto, situated due east of Adulis. Here the English had their harbour at the time of their Abyssinian war in 1868, and from here they built their railroad to the Comaile valley, traces of which are still to be seen. One is led to believe, therefore, that this was possibly the place of the ancient harbour. There are, however, several reasons for assuming that ancient Gabaza was situated to the south-east of Adulis, and to the south of Malcatto. Here, about twelve minutes from the present seashore, there is a chain of small hills, the northernmost of which has a height of 61 m above the sea-level, while the rest slope down gradually until the last one rises very little above the ground. This chain is called by the natives Gamēz, a name which recalls the form Gabaz. Not only does the similarity of the names advocate the identification of this place with the seaport of ancient Adulis, but several other circumstances make it almost certain. Between the northernmost hill and the others runs a gully of fresh water. When I visited the place, situated 1 1/2 hours from Adulis, I found near the water pits dug by the natives in order to water their cattle, large heaps of potsherds of different kinds like those found at Adulis, pieces of glass, broken tiles, beads, ashes and charcoal. The natives told me that they found such objects in the earth every year. This indicates that a town was situated here. On account of the name and of the fact that fresh water and ancient fragments are to be found here, I presume that Gabaza, the harbour of Adulis, was situated on this spot. But it lies a short distance away from the shore. Was it then fit for a harbour? There is, of course, a considerable difference between the conditions of nowadays and those of 1500 to 2000 years ago, especially on a shore as low as this one consisting only of sand: furthermore, the rivers of the highlands have carried with them, in the course of centuries, much sand and gravel, and thus they can and must have changed the whole shore a great deal. For this reason, it is impossible to tell whether the former conformation of the shore made the place fit for a harbour or not".[37]

As we shall see later, more recent research seems to confirm Sundström's hypothesis.[38]

1906, Roberto Paribeni

Roberto Paribeni, an illustrious archaeologist and a historian of antiquity, director of archaeological excavations in Italy, Montenegro, Greece, Libya, Egypt, Asia Minor, Palestine and Eritrea, and author of numerous books on Greek and Roman history and archaeology,[39] in 1906-1907 was

[33] Hahn 2015, p. 67: 1. Armeh Ella Amidas, 2 Wazen Ella Gabaz, 3. Israel succeeded each other between approx. 540 and 580.

[34] Paribeni 1907, c. 501

[35] Hanh 2015, p. 62 and note 134.

[36] Paribeni 1907, c. 443.

[37] Sundström 1907, pp. 181-182.

[38] Censini, in this volume.

[39] (1876-1956), Director of the Roman National Museum in 1919, Superintendent of Antiquities in Rome and Latium and then Director General of Antiquities and Fine Arts (1928-1933),

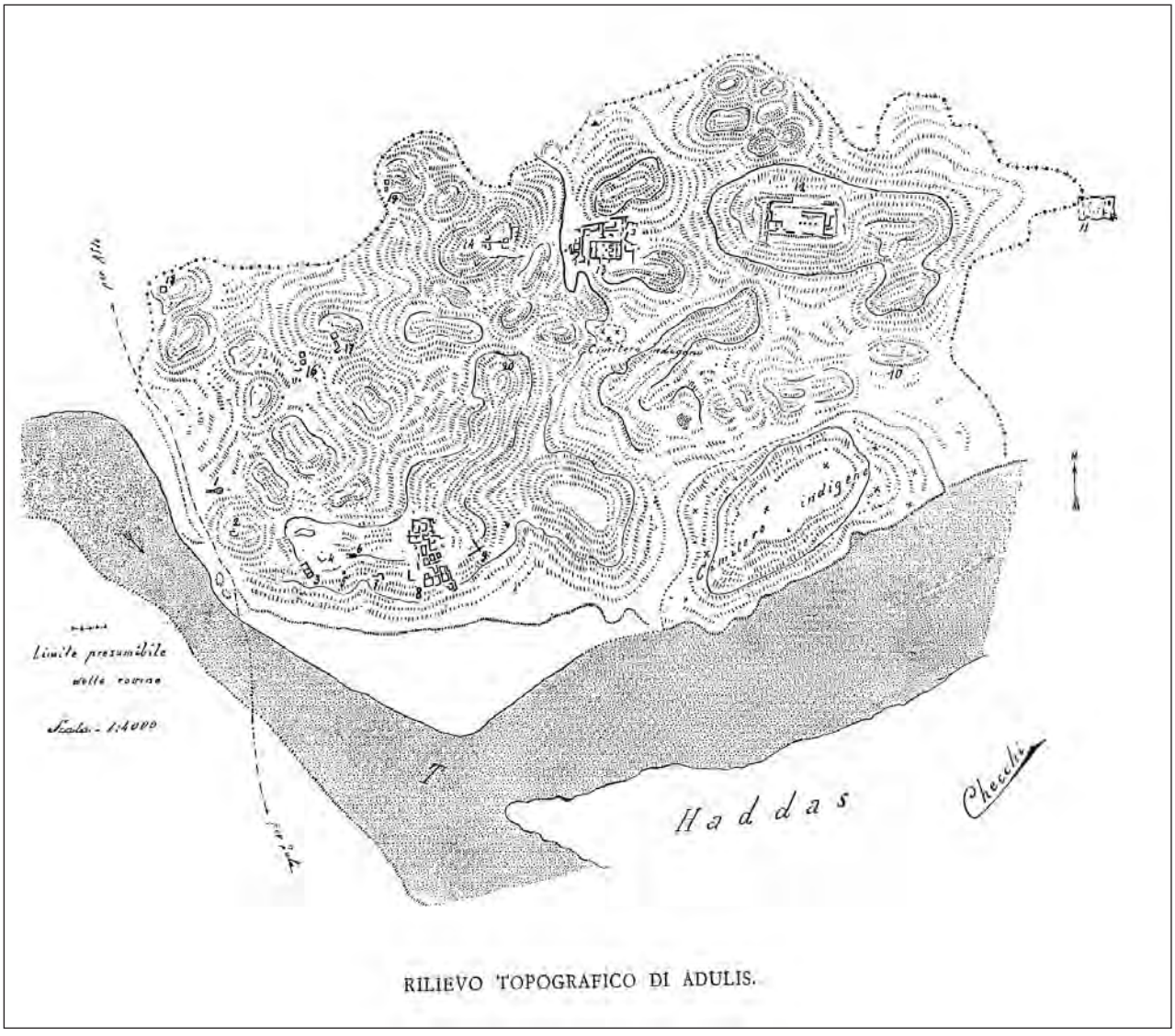

Fig. 7 - Map drawn by Captain Michele Checchi, Paribeni 1907, Table I.

commissioned by the Italian Government, together with Francesco Gallina, with the archaeological mission to Adulis. The works of Paribeni and Gallina, published very shortly after the conclusion of the excavations,[40] represents the most extensive series of excavation probes carried out at Adulis to date. This is due to Paribeni's clear objectives for obtaining knowledge of an ancient town, and in particular a port town: to verify its extent, its relationship with the territory and the sea, the location of the necropolises, and the existence of a town wall. Based on the indications of ancient authors and visitors who had described the site before him, Paribeni also hoped to find the

professor of archaeology and history at Università Cattolica di Milano (1934-1948), Academician of Italy (1929), National Member of the Lincean Academy, Corresponding Member of the Royal Academy of Naples and Turin, Corresponding Member of the Institute of France, Ordinary Member of the Pontifical Academy of Archaeology, Ordinary Member of the Royal Roman Society of Homeland History, Ordinary Member of the Germanic Archaeological Institute, Ordinary Member of the Austrian Archaeological Institute, Ordinary Member of the Archeolojiki Eterìa of Greece. Information taken from the professor's file kept at the Education Archive of the Università Cattolica of Milan, position no. 2107. I would like to thank Dr. Mario Gatti, Director of the Università Cattolica, for making this documentation known to me.

[40] PARIBENI 1907; ANZANI 1926.

famous throne and the stele with the inscriptions copied by Cosmas.[41]

He therefore began with an extensive site survey to assess the most promising areas to be excavated, in order to understand the extent of the remains visible on the surface, recognise the possible existence of a boundary wall enclosing them, the presence of necropolises, the relationship of the town with the land routes and the sea. Paribeni's approach should be emphasised, as it appears to be pioneering in the archaeology of the time, anticipating methods that would only be systematised much later by landscape archaeology and stratigraphic excavation. Also noteworthy is the objective that the archaeologist set himself: *"...however, we did not seek the easy triumph of immediately excavating the most beautiful, the richest, the most central of the buildings of Adulis; the work can be done later, should the scholars deem it appropriate..."*.[42]

It is interesting to retrace the steps of his surface reconnaissance, carried out in 1906 (fig. 7):

"*The town is on a flat and sandy site, to the S and W it is surrounded by the bed of the Haddàs River, at the bottom of which it rises by just a few metres. Scattered with shrubs almost as tall as a man (hetum in tigrè = Suaeda monoeca Fk.), there are piles of stones of a porous and very weathered lava material, which has not, however, flowed down, so that it cannot be thought of as deposits left by the floods of the Haddàs (see Table II). Those piles are instead produced by the decay of the upper parts of the buildings, and they conceal what still stands of them.*

Not infrequently, in fact, when the surface stones have been removed, one sees the edge of a wall emerging. It is presumable, therefore, that there must be buried buildings as far as the piles of stones can be seen, and indeed the first probes carried out mainly to the N of the town, beyond these piles, revealed nothing but the remains of huts or rubble dumps, or virgin layers. Having verified the probable assumption that buildings were to be found only under the piles of stones, we asked the Colonial Government to grant us the services of a surveyor for a few days to mark the presumed limits of the town... What is enclosed within the dotted line marks the foreseeable boundaries of the settlement, boundaries that we must indeed consider smaller rather than larger. In fact, as we will note below [c. 529], the probes that brought to light the major Christian church were carried out to the east beyond the limits of the piles of stones, where the presence of pure sand would have led us to believe that the settlement ended".[43]

The description of the surface reconnaissance carried out by Paribeni before starting the excavation probes is extremely important, because it allows us to:

- ascertain the state of preservation of the site and landscape since the first surveys in the nineteenth century;
- verify that, as Sundström has already noted, the British intervention in 1868 was not only limited to the excavation of the church;
- identify the excavated areas in order to make appropriate choices for future stratigraphic investigations;
- identify the dumping areas of the excavated soil, which Paribeni often indicates.

Paribeni's reconnaissance started at the western end of the site, at the point indicated with number 1 on the map and then continued eastwards.

Paribeni's probe 1 documents the oldest settlement levels in Adulis, since the excavation, which went down to a depth of 11 m below ground level, revealed the remains of huts that, thanks to the associated pottery, can be dated to the second and first millennia BC.[44]

It is also worth noting that that area must have been marked by buildings without stone walls even in later times, since subsequent levels of huts were recognised down to a depth of -1 m, above which there was a pit burial with a stone enclosure, considered Islamic at the time.[45]

In the section between the points marked with no. 1 and no. 8, Paribeni describes numerous small rounded mounds, which he considered similar to the present-day Muslim tombs *"but the modern inhabitants of Zula and Afta do not remember them as tombs of their people or their fellow believers; on the contrary, our workers and the heads of the*

[41] Paribeni 1907, c. 444.
[42] Paribeni 1907, c. 446.
[43] Paribeni 1907, c. 439.
[44] Manzo 2010.
[45] Paribeni 1907, cc. 446-451.

town, questioned by us, doubted that they were Muslim tombs".[46]

He was thus able to open two of them, and verify that they contained skeletons laid on their backs without any grave goods, with their heads pointing eastwards: these details lead us to think that they might be Christian burials, but it is impossible to specify whether they were laid at the same time as the existence of the Christianised town, i.e. between the end of the fourth and seventh centuries, or later, the result of sporadic habitation.

Continuing further eastwards, Paribeni notices, at the highest point of the embankment, a long and shallow recently opened trench (45 m long by about 1 m deep), which locals attribute to the British army that excavated the church located in the south-eastern sector of the town in 1868. The location matches that shown on Sundström's map.

Continuing in the same direction there is a kind of plateau, where the remains of the buildings appear more abundant and more agglomerated; "*the terrain then gently slopes down to a level stretch along the river seemingly clear of ruins, after which begins a vast Muslim cemetery known, from its most revered tomb, as the cemetery of Sheikh Mahmud, where those of his descent, i.e. a good third of the inhabitants of Zula, are still buried*".[47] This is followed by a description of the tombs, typically Muslim, among which he recognises the reuse of marble and alabaster stripped from the ancient buildings for burials of greater importance.

To the north of the Šek Mahmud cemetery, the piles of stones, signs of old buildings begin again; one of them, in the immediate vicinity, was damaged by the British: the trench they opened, wide but shallow, splits the building lengthwise.

This is the British excavation of 1868, of which Paribeni, some thirty years later, can still see the remains of the west part of the church, but the apse, which he would certainly have recognised and described, must have already been buried again.

"From this building, marked with no. 10 on the plan, proceeding towards the N and NW, one encounters a dense settlement, the main and highest nucleus of which is in the immediate vicinity of that excavation. Also conspicuous for the height and thickness of the material is the large mound that was attacked by Dr Sundström (plan Table I, no. 12). Towards the W, this entire group descends almost into a small valley to the S-SE of the building we excavated (plan no. 13), a small valley that lies between the large nucleus of the buildings 10-12 and the other on the banks of the Haddàs. We observe no noticeable elevations of mounds in this section.

To the south of excavation no. 10 and to the S-E of no. 13 there are two small shallow trenches, also attributed by the natives to the 1868 excavations.

To the SW of our excavation is a small cemetery of the descendants of Bet K[h]alifa ... Beyond that cemetery, we re-join the large elevated plateau full of ruins of the group on the bank of the Haddàs.

To the north and NW of our excavation no. 13, the mounds of ruins soon cease. To the W, there are small, inconspicuous and rather sparse mounds. A more important group, perhaps consisting of several houses, is the one that appears to be arranged in the shape of an amphitheatre (plan no. 20), but even there the ruins do not reach great heights. Returning to our starting point from this group there are again more low mounds, and some of those older Muslim tombs forgotten by the current inhabitants. This is the general appearance of the place, as also shown in our photographs".[48]

At the end of the site inspection, Paribeni concludes that he found no trace, on the surface, of sufficiently continuous alignments to suggest the existence of the town wall. That is why he decided to open soundings at the 'suburbs' of the town, i.e. just up against the last piles of stones. Probes were opened in the northern, southern and western area, that were not considered sufficiently interesting to be marked in the plan, but Paribeni's observations are worth bearing in mind:

"*The last stone-built buildings were followed by wooden huts or, more likely, completely destroyed straw huts, recognisable only by the remains of hearths and dunghills; beyond those, moving even further away from the town centre, the archaeological layers seem to cease*".[49]

Paribeni's description gives us a glimpse of the suburbs of the town or a neighbourhood of com-

[46] *Ib*., cc. 439-441.
[47] *Ib*., c. 440.
[48] PARIBENI 1907, cc. 438-443,
[49] *Ib*., c. 445.

mon dwellings, distinct from the monumental centre where the civil and religious powers resided. Huts from the late ancient period, judging by the materials found in them, were sometimes also inside the nucleus of masonry houses or in their vicinity, as for example in pits 1, 5 and 9.[50]

Another important notation regarding the northern sector of the town is that of the deposit, in that space devoid of masonry, of the material resulting from the excavation of the buildings marked on the plan with no. 13.

In addition to 'pit' 1, interesting results were offered by probe no. 14, in the northern part of the town, "*which was given little depth but a great deal of extension on the surface*" (fig. 7). Walls belonging to two rooms were documented that rested on an older wall, built in off-sets, which was followed up to a depth of 2.80 m (it must therefore have been in an excellent state of preservation). The rooms overlooked a rectangular courtyard, outside which, along the southern wall, were burials of infants in *amphorae*.[51] The type of these *amphorae* enable us to place the burials between the fourth and seventh century AD.

Along the Haddas, probe no. 9 also returned a sequence of superimposed walls. Of particular note is the wall with a north-south and east-west direction with recesses, followed for a length of 10 m and a depth of 1.20 m from ground level, resting on a substructure of large stones and earth.

Pit no. 7 also presented traces of a complex of several buildings, while no buildings were brought to light in pits 5 and 6. Pit 5, with the remains of a hearth, was interpreted as a circular hut, of which part of the enclosure in river rocks that described an arc of a circle could be observed from the upstream side; based on the findings described by Paribeni, the hut is from the late ancient period, evidence that confirms that buildings made of perishable materials existed alongside those built of stone.

Pits 3 and 4 presented quadrangular rooms with poorly constructed walls, preserved only for a very small height, with no apparent traces of opening. The room of pit 4 cut another probably older one, the western side of which is set above a third wall made of large stones, running in a N-S direction at a depth of about 2.00 m; at the N-W corner is a small masonry podium measuring 0.80 x 0, 44 m at a depth of 0.90 m... pit 2 revealed at a shallow depth a few stones of a low wall going in an E-W direction, and lower down, at about 1 m, the remains of scattered hearths, rounded and smoothed stones perhaps for grinding... other hearths were at 2 m and 2.70 m ... pit 17 revealed a room and several walls of a private house... pit 18 revealed a rather irregular quadrangular room (the four sides measure 5.20 x 4.23 x 5.00 x 4.26 m) with fairly well-preserved walls; since it had only a beaten earth floor, it was excavated until the foot of the wall was uncovered at one point, i.e. down to 2.00 m below ground level. There were no traces of doors or windows, quite a singular fact that was repeated in other cases... pit 19 revealed two quadrangular chambers with good masonry, also without any traces of doors or windows, and with a floor of simple beaten earth. In the middle of each of them, two cylinders made of rough masonry were found, 0.66 m in diameter, 0.85 m and 0.81 m apart, respectively, ending at the top with two discs of the usual basalt. Similar cylinders were also found in other chambers.[52]

Continuing the exploration of the northern sector of the site, Paribeni identifies the remains that would lead to his most in-depth excavation: this is the probe with number 13 on his map, which will be described later, the so-called 'Altar of the Sun', corresponding to Sector 2 of the new excavations.

The search operations now moved south again, to the banks of the Haddas (fig. 8 a-b), where an attempt was made to *"extend one of the many probes that had been opened there. The place was chosen, where the pile of stones rises most conspicuously and most densely on the riverbed. The English had already opened a long trench in 1868 on the highest part of the mound, uncovering a section of wall and cutting, without realising it, two others. Our excavation uncovered walls and rooms of private houses belonging to different ages. On the plan, we have marked the various buildings in full black or with different hatches ... the section of the primitive wall is the one that*

[50] *Ib*., cc. 457-458.
[51] *Ib*., c. 452.
[52] *Ib*., cc. 458-460.

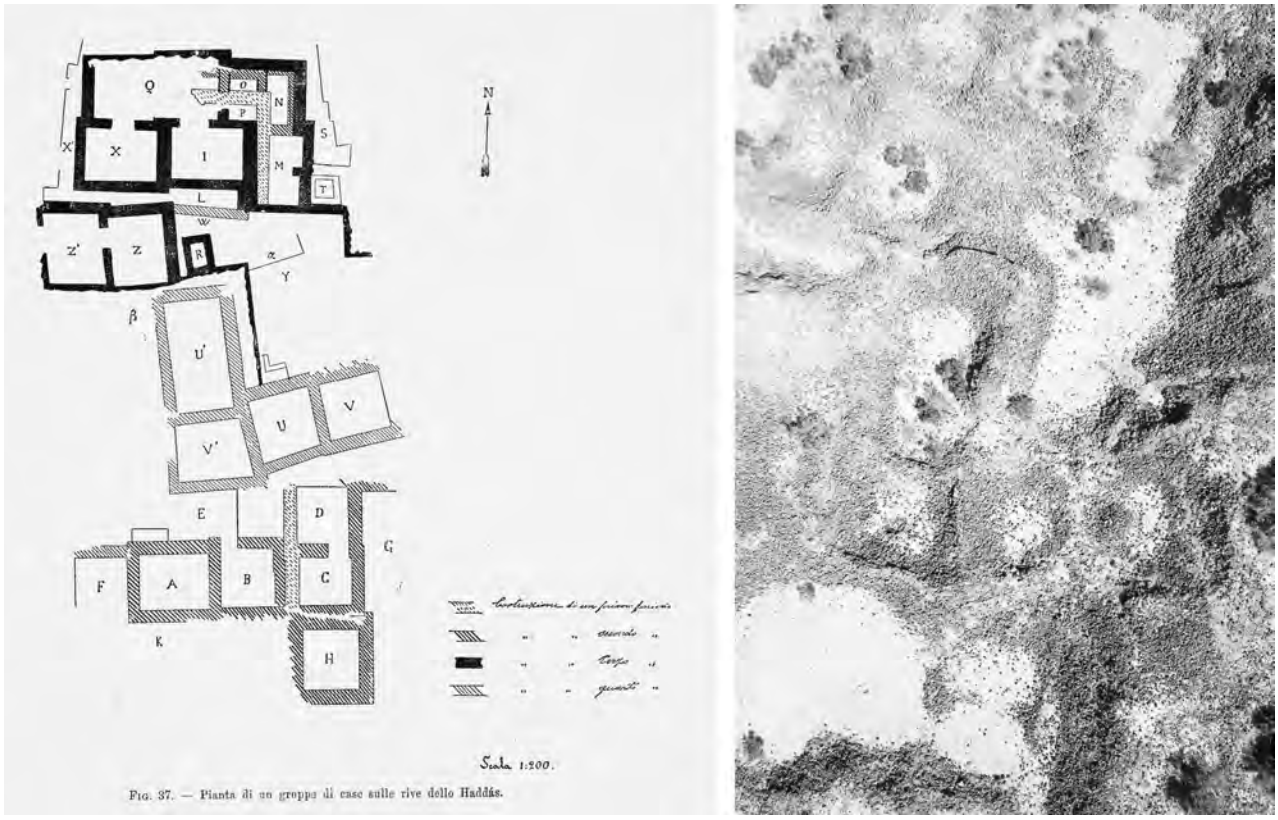

Fig. 8 a-b - Plan of the group of buildings along the Haddas River (Paribeni 1907, fig. 37), and aerial photo of the actual remains of the buildings.

runs in a S-N direction attaching itself to the N-E corner of B, a wide and well-constructed wall with off-sets on both sides. The 'AB' building had been backed against it already in ancient times and before others. It consists of two chambers with very robust and beautifully constructed walls with 0.47 m high off-sets and 0.05 m protrusions. The stones used here are larger than any of the buildings we excavated, and also appear to be made of a more compact and less porous basalt than usual. The largest of the polygonal boulders used measures 0.65 m in length by 0.38 m in width. Sandstone slabs are used as usual for the off-sets. The two chambers do not appear to have had an internal communication, and instead had two doors towards the N, one of which (room B) is well preserved. The wall of the building to the S immediately after the S-W corner is ruined and it was not followed. The older S-N raised wall then served to enclose as its western side two rectangular rooms C and D, the other three walls of which show a more neglected construction. Only the outer east side of these chambers shows the off-sets structure like the oldest south-north wall. The two chambers were connected by a door facing north, and both had in the middle those peculiar masonry cylinders surmounted by two basalt disks, which we already saw in the other chambers. In these, the lava disc is slightly higher than the door threshold, and the cylindrical sub-foundations sink even lower than the perimeter walls. Chamber C was possibly connected with chamber B; however, this could not be ascertained with certainty because the wall was poorly preserved.

The south-eastern corner and the south side of E are covered by a second section of masonry leaning against the first, which encloses room H to the east, explored only in the interior; this room also had the two basalt discs, but they had no masonry construction but simple beaten earth. The excavation was not continued to the south of this room. Attached to the northwest corner of A is a much more recent wall, the lowest stones of which are approximately 0.70 m above the corresponding ones of the walls of A. It was only followed for a short distance. Near the same corner

Fig. 9 - The excavation area of the 'Eastern Church', eastern limit of the archaeological remains at the beginning of the last century (Paribeni 1907, Table II no. 1).

is a small masonry podium contemporary with the primitive room A.

To the north of this group are poorly preserved remnants of various walls, which could not be fully explored because the later rooms U, U', V, V' are superimposed thereon.

The other, more northerly group also results from an intersection at various heights and in various directions of walls of different ages and different constructions.

The oldest remnant consists of a large wall with off-sets, one section of which runs northsouth along rooms M, N, another turns east-west passing between rooms O and P and ends in Q. Two walls were already attached to it in ancient times; one of which an east-west section was discovered between M and N, another that closes the O room to the east, and then continues, forming the northern side of O and Q.

The two walls do not look to be much later than the primitive one, because they sink almost to the same foundation level.

These remains of older buildings all disappeared under a large house that covered the place they occupied, and extended beyond that, with rooms Q, X, I, T... on the wide vestibule Q, in the middle of which we found another small section of very old wall, two doors open into the spacious chambers I and X. The eastern wall of I is for a small part set on the very ancient south-north wall".[53]

Paribeni extends his research eastwards, to investigate whether the town was closer to the seashore in an era prior to what is reported by sources starting from the first century AD.[54] He therefore thought it would be promising to investigate the area at the eastern end of the space marked by the piles of ruins, where a flat expanse contained a few stones and blocks of basalt col-

[53] Paribeni 1907, cc. 511-529.

[54] In the first century AD the author of the *Periplus* specifies that the town of Adulis does not coincide with its port, but lies at a distance of twenty stadia (corresponding to over 3 km) from

umns (fig. 9): *"At a very shallow depth (about 50 cm below ground level) we immediately found the slabs of a floor. The entire pile of ruins of the large-sized building has disappeared, taken away by men who needed stones or, more probably, by the floods of the Haddas, which, while it had not been able to show all its force in the centre of the town, where the buildings and the ruins jumbled together, shoring each other up, had resisted the impact of the current, here in front of the expanse of sand it was able to freely drag away everything it encountered"*.[55]

This building (no. 11 on the Paribeni map, fig. 7 above), corresponding to our excavation Sector 4, is also described in the section on the new excavations. However, it is worth emphasising some of the elements indicated by Paribeni: the floor was at a height varying between -0.50 and -0.90 m; access to the church was through three doors, the thresholds of which were formed by a large beam with its ends embedded at the base of the side walls. The building had suffered a serious fire, and the charred beams were still in place. Paribeni left them *in situ*, taking also care not to clean the doorposts.

The doors were preceded by a paved area. Three other doors from the narthex led into a large space which, according to Paribeni, corresponded to the atrium of the church. These doors were not aligned with the first ones, and their threshold was also made of a large, charred beam; we found traces of the central door, burnt and fallen inwards, and the bronze door knockers in the shape of two beautiful lion protomes, one of which had a large bell in its mouth. In the atrium there were seven basalt columns of the usual shape, arranged around the perimeter; "*there were undoubtedly eight of them, but the eighth is missing. The trunks do not have bases, and they are not even all the same... so they come from earlier buildings. They do not have solid underpinnings, in fact one of them is simply planted on the floor slabs themselves. They certainly had to support something, but due to their small size and the lack of a sturdy foundation, it cannot be believed that they supported a brick structure. And in truth, just a few centimetres of earth rose above them and there was no trace of the pile of ruins that the fall of a masonry dome would have produced. A wooden pavilion with an octagonal shape supported by columns therefore occupied the centre of the vast atrium*".[56] Paribeni wonders what could have been monumentalised under the pavilion, but finds no trace on the floor, which is smooth and intact, deducing that any possible object kept under the pavilion was also made of a removable material.

He then describes the traces of the presbyterial enclosure and a shallow apse, to the right of which is a circular pool with steps for descent and ascent, immediately recognisable as a basin for baptism by immersion. The bottom of the basin was made of a mixture of earth and stones covered with *opus signinum*, dug by 'later treasure hunters'; the remains of the upper walls are plastered and painted red.

This church is also built on a podium, which, while similar in its structure of protrusions and recesses to the so-called 'Altar of the Sun', differs however in the use of basalt stones "*cut not in polygons but often in an almost parallelepiped shape, interrupted as usual by sandstone slabs that mark the recesses at equal intervals of 0.50-0.55 m"*.[57]

Paribeni observes here as well that 'the most miserable little constructions' are attached to the wall of the building 'in various directions'. He also reports that due to lack of time and means, the excavation was not carried out in depth, except in the south-west corner, where we reached 2.08 m below ground level, noting that the wall continued. He also identifies interventions attributable to a subsequent reworking, represented by the closing of the central external door, and by the construction of a wall that divides the narthex into two rooms, of which the western one probably remained accessible only from the atrium.

Nothing remains of the rich decoration of this church, but Paribeni found alabaster slabs, alabaster and marble cornices as well as a fragment of marble slab that must have belonged to the pres-

the coast (*Periplus Maris Erythraei* 4:4:6, CASSON 1989, p. 53). This exact distance was later confirmed by Cosmas Indicopleustes (*Topographia Christiana* II, 54, WOLSKA-CONUS 1968, p. 364) and Procopius of Cesarea in his *History of the Wars*, I, 19 (Dewing 1914, LCL 48, pp. 182-183).

[55] PARIBENI 1907, c. 530.

[56] PARIBENI 1907, cc. 530-531.

[57] BORTOLOTTO, in this volume, for the analysis of the construction technique and structural considerations.

byterial enclosure, with a carved crown similar to the fragment reproduced in his fig. 36.[58]

1961-62, Francis Anfray

Francis Anfray headed the French archaeological mission at the Institute of Ethiopian Archaeology in Addis-Abeba for a long time and conducted field research in Yeha, Dongour and Mätära. In 1961-62, in conjunction with a Ministry of Agriculture project in the Zula Plain that would also affect the archaeological site area, Anfray conducted two excavation campaigns at Adulis.[59]

The first took place between 31 March and 22 April 1961, the second between 8 February and 8 March 1962. The site chosen for the excavations was near the Islamic cemetery of Bet Khalifa, in the central western sector of the ancient town, which had been used since at least the seventeenth century as the burial place of the clan of the same name, residing in the village of Zula. An area of 350 sqm was excavated in which stretches of stone constructions, interpreted as the remains of dwellings and storerooms, were brought to light from a depth of 0.30 m below the ground level. Twenty-two rooms were recognised, which in some cases (numbers 7, 11, 12, 16 and 17) overlapped with structures belonging to an earlier phase, perhaps a quadrangular building (?), with masonry showing recesses and protrusions (fig. 10).

The stratigraphic relationships between the walls drawn in the plan are unclear, but a continuous wall line can be seen, characterised by recesses and protrusions, as is also evident from the published photo.[60]

The wall technique of the second phase recognised by Anfray consisted of irregular stones bound by earth. In room no. 1, a floor of schist slabs was unearthed at a depth of 1.45 m. In particular, the south wall appears to be interrupted by two openings communicating (?) with room no. 2; the threshold of the west opening was made of rectangular fired bricks (22 x 12 x 8 cm). As Anfray notes, the use of bricks in Adulis is quite rare.

Room no. 3, based on the plan, seems to precede the first two, as the walls of rooms 1 and 2

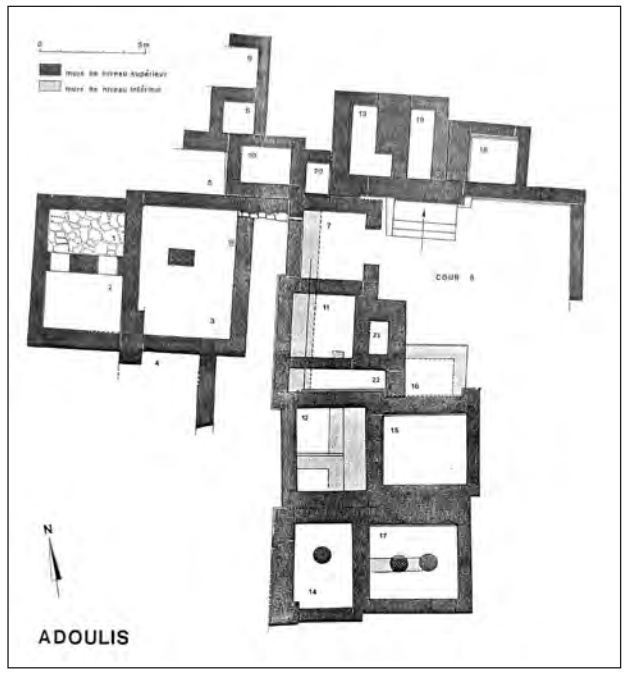

Fig. 10 - Map of the 1961-62 excavations (Anfray 2016, p. 30).

lean against the west wall of room 3. A special feature reported by Anfray is the presence, almost in the middle of room 3, of a rectangular masonry platform, interpreted as a support for a column.

In addition to the remains of buildings, the Anfray excavations yielded numerous movable artefacts, including 143 Aksumite coins, as well as amphorae and fine tableware imported from the Mediterranean. Of particular importance is the discovery of an elephant tusk, material evidence of Adulis' role in the trade of this luxury good, repeatedly mentioned in the sources, and possibly even artisanally produced on site.

The excavation season in Adulis of the last century ended with the Institut Éthiopien's intervention.

In 2004-2005, an Eritro-British mission did not carry out any excavations, focusing on surface research instead, with important results: the validation of the identification of Desie Island with Oreinè of the *Periplus*,[61] already put forward in 1810 by Henry Salt,[62] thanks to the discovery of traces of buildings and ceramic materials datable from the first century AD onwards, and the possible identifi-

[58] Paribeni 1907, fig. 36.
[59] Anfray 2016, pp. 26-77.
[60] *Ib.*, fig. 2.13.
[61] Peacock, Blue 2007.
[62] Salt 1814, p. 451.

Fig. 11 - The area of the Anfray excavations in 2017.

cation of submerged linear structures, which could reveal the existence of ancient docks.[63]

As for the absence of an island in the southernmost part of the bay in present times, the results of geophysical surveys have shown the remarkable progradation of the coastline in relation to the ancient shoreline, identifying the island of Didoros in the heights of the Galala Hills, the only high ground that now rises in the Zula Plain nearest to the coastline.[64]

In particular, structures interpreted as foundations for watch/defence towers have been identified on the highest hill. To the east of this hill is an isolated elevation with ceramic materials dating from the first century BC onwards.

The results of the samples taken through core drilling support the hypothesis that in ancient times the elevation was surrounded by the sea, hence an island, corresponding to the island of Didoros mentioned by the *Periplus*.[65]

Furthermore, masonry sections have been recognised in the area between the isolated elevation and the main elevation of the Galala Hills, which could belong to buildings or to the road that connected the island of Didoros to the mainland, as the *Periplus* says.

Analysing these data in the light of Cosma Indicopleuste's testimony and Richard Sundström's observations,[66] the British researchers confirmed the identification of the port of Adulis near the elevations of the Galala Hills, the current name of which reflects the ancient placename Gabaza known to us from Cosma Indicopleuste's map. In fact, Cosma's drawing shows the position of Gabaza, which is

[63] Peacock, Blue 2007, pp. 57-64.
[64] *Ib*., pp. 33-56.
[65] Peacock, Blue 2007, p. 37; 47.
[66] *Supra*, pp. 102-103

significantly indicated as a 'customs point', exactly on the coast, while Adulis appears slightly set back.

The survey of the 2004-2005 expedition was also able to map an area of about forty hectares of the archaeological remains of Adulis, recognising the trench and spoil heaps from the British excavations of 1868; the trench from the Sundström excavation (1906); probe no. 8 of Paribeni (1906); Anfray excavations (1961-62). Evidently, nothing of the so-called 'Altar of the Sun' was recognisable because it was not located on their map.[67]

Adulis, January 2011

Upon arrival in Adulis, at the beginning of the new excavation and research season, none of the buildings unearthed at the beginning of the last century and described so far were visible anymore: neither those excavated by the Italian mission led by Roberto Paribeni, nor the only one excavated by the Swedish missionary Richard Sundström, who had improvised the investigation of the so-called 'palace' in the same year 1906; not even any element of the church excavated by the British in 1868 could be seen on the surface.

Only the areas excavated in 1961-62 by the mission of the Institut Éthiopien d'Archéologie directed by Francis Anfray were still visible, covered by vegetation and unfortunately in a very poor state of conservation (fig. 11).

The new investigations had the following main objectives: firstly, to bring to light the monuments excavated in the last century, so as to make tangible for the communities of the nearby villages the extent of the archaeological and cultural heritage of which they were the direct heirs and custodians, but which they only knew through the oral legend narrated on ancient *Azuli* and on the ruins not far from the village of Zula, whose name they knew derived from that of the more ancient site, an antiquity that however did not date back any further than the Islamic era.[68]

It is possible instead, as Paribeni had already hypothesised, that the place name could have been in use as early as the pre-Ptolemaic era[69] and indeed at the time of the Egyptian expeditions to the Land of Punt, in reference to which several geographical names, including Adulis, were indicated in the 'Lists of Foreign Peoples'.[70]

In addition to bringing the main monuments to light, a further objective was to open new stratigraphic surveys to document the origins and evolution of the settlement throughout its history, in relation to the landscape, the environment and the daily life of its inhabitants.

Of course, we still asked ourselves the questions that Roberto Paribeni, a century earlier, had been unable to answer: the possible extension of the settlement beyond the limits identified in 1906; the presence of town walls or fortifications to defend it; the location of the necropolises; the sequence of the different cultural phases indicated by the overlapping of the buildings and by the material culture; the connection of the town to the sea; the causes that led to its ruin and abandonment, and any possible reuse in a subsequent period.

Some answers, new questions

The surface surveys[71] and aerial reconnaissance[72] have confirmed that the extension of the remains emerging on the surface covers an area of at least forty hectares (Map of Adulis Arcaheological Site), an area that must be considered 'too small' based on the discovery of archaeological remains in the current bed of the Haddas Stream, at the southern and western border of the site;[73] other findings indicate a probable extension beyond the eastern limit represented so far by the 'Eastern church'.[74]

Furthermore, new evidence of stone constructions not known from previous research has been recognised and mapped, exposed by erosion that, in the hundred or so years since Paribeni's survey, must have removed substantial surface layers.[75]

In particular, a more ancient stretch of the current camel route has been recognised. This route currently starts from the village of Zula, skirts Adulis to the west, continues towards Afta and then branches off in a northerly direction along the coast, while another stretch joins the Haddas and

[67] Peacock, Blue 2007, p. 20, figg. 3.2, 3.5, 3.6.

[68] Gezae, Negassi, in this volume.

[69] Paribeni 1907, c. 566, nota 1.

[70] See the previous chapter for the analysis of the etymology of the name Adulis.

[71] 2017; 2022; 2023.

[72] Made with a drone, available only from 2022.

[73] Zazzaro, Manzo 2012; Zazzaro *et al.* 2014.

[74] Zazzaro *et al.* 2014; Larentis, in this volume.

[75] Censini, in this volume.

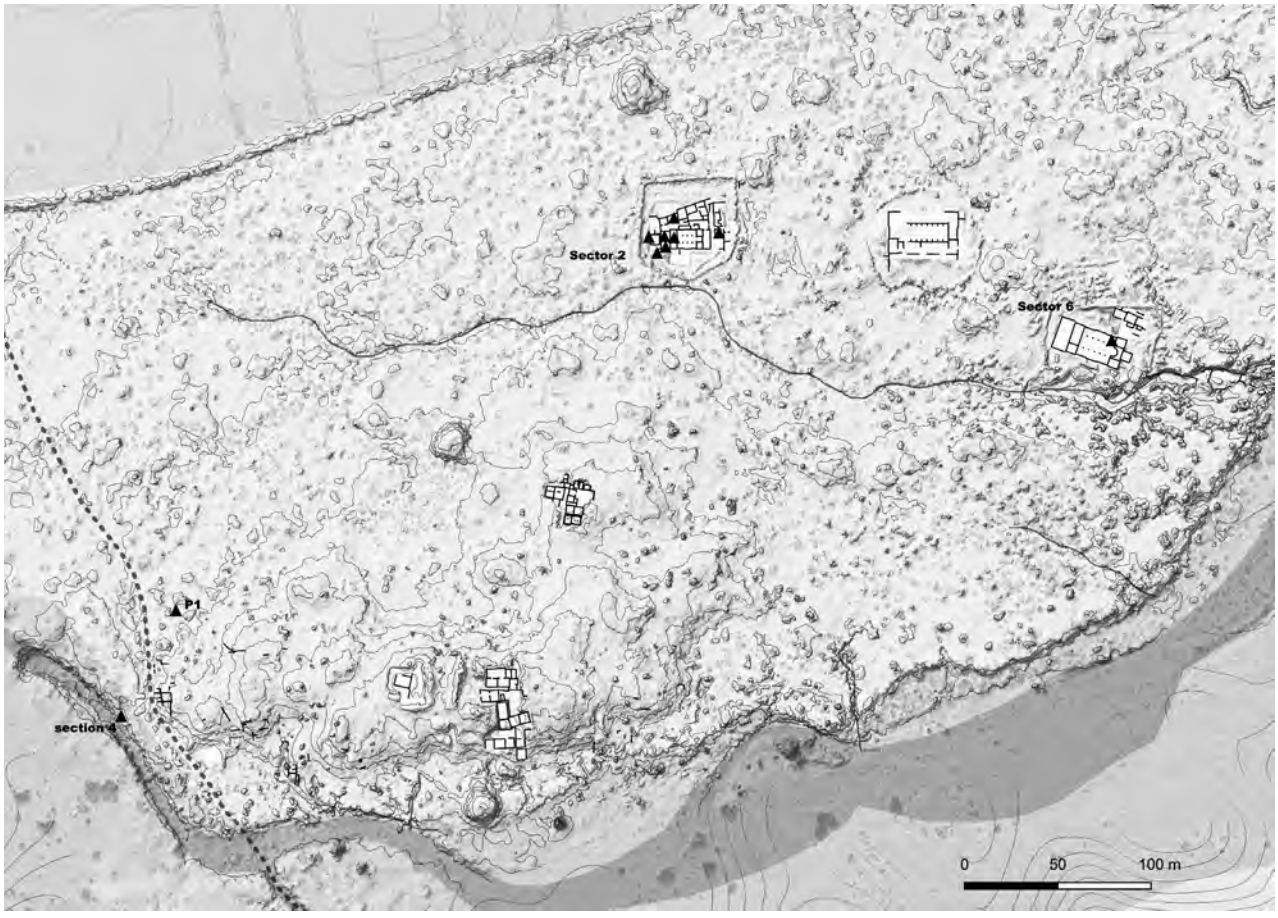

Fig. 12 - The black triangles mark the position of the pieces of evidence from the prehistoric period.

the route towards the plateau that leads to Mätära (Maps 3 and 4).[76] The segment made of basalt stones might follow an older natural trail, connected to opportunities for resourcing, first and foremost the availability of water.

The prehistoric settlement

It is no coincidence that the oldest evidence of the Adulitan settlement is found at the edge of the land route and the course of the Haddas Stream, which we can therefore hypothesise constitute its main original points of reference. These, together with the proximity of maritime landings, have also characterised the place since then as a hub for connections that exceed the range of just local connections.

In addition to the huts excavated by Paribeni in his probe 1, already mentioned above, new evidence referring to the second-first millennia BC – and perhaps even further back in time – has been discovered in an exposed section of the bed of the Haddas, not far from the Paribeni probe 1, adding further evidence of Adulis' early contacts with Egypt, Sudan and southern Arabia.[77]

Such evidence could help to fill the time gap between the settlement of the site of Asfet, in the same Bay of Zula,[78] which can be traced back to the sixth millennium BC, and the occupation of the area of Adulis.

Other testimonies attributable to prehistoric times are represented by artefacts found by Paribeni in the area surrounding the Northern Urban Church, in particular two female statuettes with steatopygian features. Although precise strati-

[76] Cattaneo, in this volume.
[77] Zazzaro, Manzo 2012.
[78] Zerai, Medin, in this volume.

Fig. 13 - Excavation Sector 1.

graphic references are not available, we know that the first statuette was found in room 'H', north of the northern church; the second in room 'S', east of the same church. There is also an indication for the latter that it was found below the stone floor, in the lower layers.[79]

Similarly, the remains of hearths found by Paribeni at a depth of -4.30 m, reached after emptying the filling of the narthex of the Northern Church, can be traced back to a settlement phase characterised by huts;[80] in addition, at a depth of about 4 m, reached by deepening the excavation under the foundations of the western side and the south-eastern corner of the podium on which the church stands, further evidence - perhaps attributable to the same phase - is represented by rectangular *ustrina*, filled only with 'purest ashes' and oriented differently than the church.[81] As Paribeni had already observed, these could be elements related to arrangements of a ritual nature, just like the female figurines. In fig. 12 the approximate positioning of the prehistoric evidence.

The town in historical times
South-western district

Based on the topographical information provided by the map of Paribeni's excavations, the most promising point for investigating the oldest phases of the site was the area close to probe number 1 in 1906. For this reason, the new Sector 1 was opened between 2011 and 2015. The excavation revealed the part of a structure used as a residential building[82]. The levels of use of the dwelling, consisting of beaten earth floors with hearths, have yielded a conspicuous series of containers, many in locally produced and

[79] Paribeni 1907, c. 486; 497-499.
[80] Paribeni 1907, c. 469.
[81] *Ib*., c. 470.
[82] Zazzaro, Manzo 2012; Zazzaro, Cocca, Manzo 2014.

Fig. 14 - The Northern Urban Church, from left: northern, eastern, southern and western elevation.

common ceramics, alongside imports that document a continuous sequence of use of the quarters between the second/third and the seventh centuries AD, when the collapse that marked its abandonment occurred.

The oldest phase is characterised by walls of which we know only the foundations made of large boulders and postholes, which probably supported the ceiling made of perishable material. The level of use associated with this phase has yielded an abundant series of finds, particularly ceramics, some of which are intact or can be completely reconstructed. In particular, among the imported artefacts, it is worth noting the presence of an *opus doliare* mortar of Italic production, with a rectangular cartouche stamp bearing the name *Faustina,*[83] probably to be identified with the empress consort of Marcus Aurelius, datable to the mid-second century AD.[84]

The walls of this first period then served as support for a subsequent construction phase of rough basalt courses alternating with schist slabs, attributable to a period between the fourth and fifth centuries. It is the most widespread technique in late antique Adulitan architecture, both in the public and the private sphere.[85]

A third construction phase, later and probably attributable to the sixth-seventh centuries, is distinguished by the use of irregular basalt ashlars of different sizes, apparently without alternating courses of schist slabs (fig. 13).

Therefore, Sector 1 contains a chronological reference for a construction phase of the town characterised by the use of large uncut stones and probably partly wooden supports, just as the roofs must have been made of perishable material. This building technique, reported in several places by Paribeni's excavations under walls made of basalt

[83] Nardi 2014.
[84] Massa, Gorla, in press.
[85] Bortolotto, in this volume.

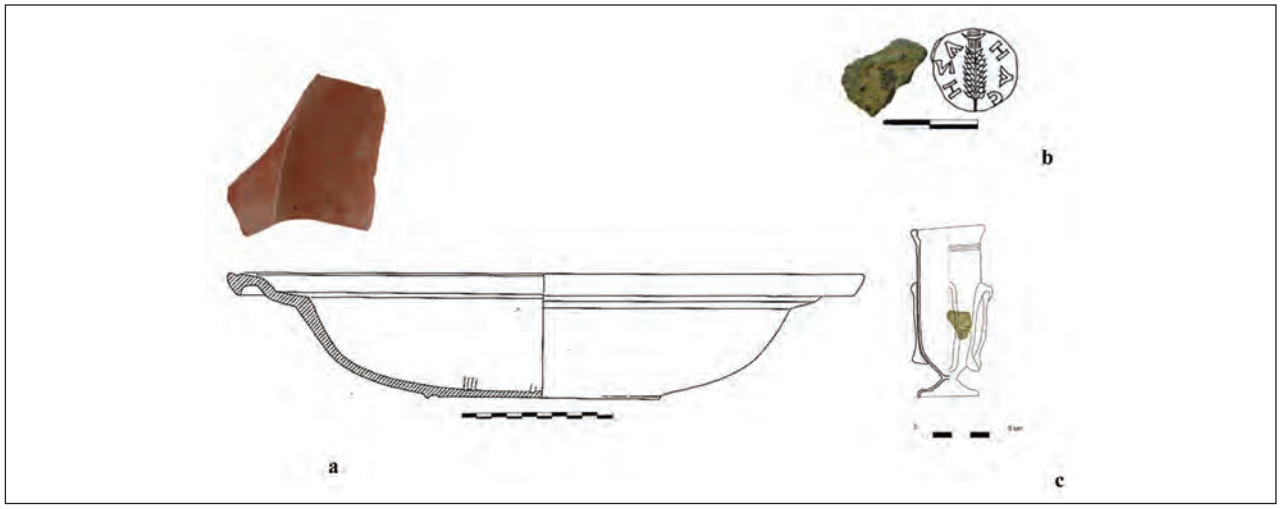

Fig. 15 - Diagnostic artefacts found in the foundation levels of the Northern Urban Church: a) fragment of African sigillata, form Hayes 67, D1-production; b) coin of Ezana attributable to a type minted before the conversion; c) fragment of a glass chalice.

ashlars alternating with schist, with a different orientation compared to the buildings of the overlying levels, testifies to an earlier building phase of the town which, as regards Sector 1, can be traced back to the first-second centuries AD.

The town in historical times
Central-northern district

A monument already excavated in 1906 (excavation Sector 2) has been unearthed in the central-northern sector of the settlement.[86] This was the most exhaustive probe carried out at Adulis by Paribeni, where the archaeologist brought to light an imposing monument in the shape of a truncated pyramid with steps, on top of which were the remains of a Christian church and around which there were numerous other rooms made of masonry.

The archaeologist, noting the difference between the building on the top and the base, hypothesised that they were two distinct constructions, the oldest of which was the pyramid-shaped structure, which he interpreted as a temple dedicated to the worship of the sun, calling it the '*ara solis adulitana*'.[87]

Reported in the 1907 map with the number 13 (above, fig. 7), it corresponds to Sector 2 of the new excavations (fig. 14, Plan of Sector 2).

The first question we asked ourselves when we unearthed this monument was to verify whether we really faced a pagan temple dedicated to the Sun, on which a Christian church had been built later, and of course to document its chronology.

This was done by means of stratigraphic surveys inside and outside the church, reaching the foundation levels of the base and the elevated part of the basilica and verifying its identical composition of earth mixed with bone, shell, coal and ceramic fragments.[88] The presence of chronologically homogeneous finds has allowed us to date the construction of the single building structure,[89] base and church, to the second half of the fourth century, to be understood as a *terminus post quem*.

Of particular significance are a coin from Ezana (333/345-375 AD) belonging to the series minted before the conversion, found in the foundation of the western perimeter wall of the church,[90] a fragment of African sigillata, form Hayes 67, D1-production, excavated in the foundation of the base (fig. 15a), and two coins unearthed in the foundation of the central column of the southern nave. The first is attributable to Endubis or Aphilas, therefore

[86] Excavations in this area were conducted between 2011 and 2019.

[87] Paribeni 1907, cc. 463-511.

[88] SU 2148 base foundation; US 2056 foundation of the central column of the south nave; 2013 west perimeter wall of the basilica, Massa 2017.

[89] As Krenker 1913, p. 166 had already clearly expressed, while Anfray 2016, p. 59, maintains the difference between the base and the church.

[90] SU 2013.

to a period between the end of the third and the beginning of the fourth centuries.[91] On the second, one can read the wheat spike in the field and the letter alpha of (HZ)A (NAC), also attributable to a type minted before the conversion[92] (fig. 15b).

The foundation level of the central column of the southern nave also revealed a fragment of a glass chalice belonging to a type commonly found in the Aksumite area in the third century AD[93] (fig. 15c).

There are also fragments of locally produced, common pottery and transport containers, classes that have wider dating ranges.[94]

Based on the evidence provided by the diagnostic materials anchored to sure stratigraphic references, it is therefore possible to propose the mid-fourth century as the *terminus post quem* for the construction of the church. The presence of the Endubis gold coin found by Paribeni under the laying surface of the south perimeter wall,[95] datable between 295 and 310, should also not be overlooked.[96]

It is therefore a single complex consisting of a building with a three-nave basilica plan,[97] oriented east-west, placed on a high base. The hall is preceded by a narthex and ends, to the east, with an apse inscribed in the square perimeter wall, flanked by two rooms. A connection between the northern room and the nave, indicated by Paribeni's survey, is no longer visible at present. It is conceivable that a similar connection with the nave also existed in the southern room.[98]

In the absence of specific arrangements, it is not possible to specify the function that the two side rooms of the church of Adulis could have had among the numerous attested variables; however, both the funerary and baptismal functions can be excluded, therefore suggesting that they were used as service areas for the performance of religious celebrations.[99]

In any case, based on observations made regarding the evolution of the Eucharistic ritual, in particular concerning the moment of preparation of the offerings for the liturgy, which takes place directly on the altar from the sixth century onwards, some scholars affirm an early dating for the churches of Aithiopia with side rooms flanking the apse, no longer present after the sixth century:[100] this constitutes a further element for dating the church, which is added to what has already been provided by the evidence of the stratigraphic excavation.

The presbyterial area is raised two steps and separated from the hall by an enclosure, of which the foundations of the northern and southern walls and fragmentary remains of the furnishings remain. Traces of the base of an altar can be seen at the 'span' of the apse.

The interior of the hall, paved with large schist slabs, some of which are still *in situ*, is divided by three columns on each side, made of quadrangular basalt drums with concave bevelled edges.[101]

The monumental base on which the church stands is also built with carefully hewn basalt blocks, alternating with courses of schist slabs, bound with clay (fig. 14). The perimeter is characterised by projections and recesses and a sloping elevation with niches at regular intervals, typical of the monumental architecture of this area and of the Aksumite kingdom.[102] In addition to the imposing staircase set in front of the church façade, access was also possible by climbing the stairs leaning against the northern and southern perimeter

[91] Manzo 2014, pp. 552-553.

[92] Coin minted according to Hahn 2015 between 345 and 360 AD. I would like to thank Dr Giuseppe Girola of the Italian Numismatic Society for reading the coin. Unfortunately, he passed away in 2024, before he was able to publish his work on the entire *corpus* of Aksumite numismatic finds at Adulis, in particular with the complete catalogue of coins found in the 2011-2023 excavations. The manuscript will be published in the next volume, dedicated to the movable artefacts.

[93] Morrison 1989, figg. 14.2-6.

[94] Massa 2017, fig. 5.

[95] Paribeni 1907, c. 468.

[96] Hahn 2015.

[97] Its size is 19 m x 11.30 m.

[98] One type of the different possible connection methods between side rooms and presbytery in the Christian architecture of Ethiopia is illustrated in Fritsch, Gervers 2007.

[99] Paribeni had already carried out an in-depth probe of the two rooms, excluding the presence of furnishings, relics or burials (Paribeni 1907, c. 468-470). The interpretation of the function for which the side rooms were intended is debated; according to some it can be explained by structural reasons, but more convincingly by liturgical requirements., Michel 2001, p. 29 ss.; Weber 2010.

[100] Fritsch, Gervers 2007, in particular pp. 9-10.

[101] Some slabs of the original floor of the central nave, adjacent to the steps leading to the presbytery, and some of the northern nave remain *in situ*; a collapsed column was found *in situ* outside the west side (Paribeni 1907, fig. 12); for the type of columns Krenker 1913, fig. 218 b; Bortolotto, in this volume.

[102] For details on materials and techniques Bortolotto, in this volume.

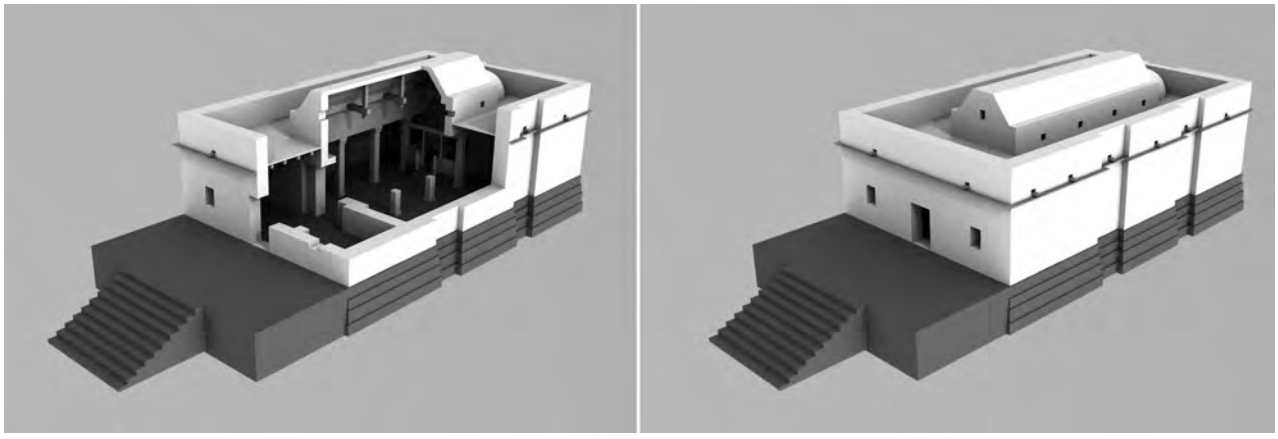

Fig. 16 - 3D model of the northern urban church, 3D processing by A. Mazzieri, G. Sottocornola, A. Todeschini (Politecnico di Milano).

walls, probably in order to provide separate spaces for men and women.[103]

Remains of plaster on the external surface of the base were noted in the old excavations[104] and slender slivers still survive today, serving perhaps not only to decorate but also to protect the walls.

The current state of conservation does not provide any direct evidence about the roofing system, nor for the lighting of the interior spaces, however the total absence of tiles already noted by Paribeni, not only in the excavation of this building but more generally in the rest of the town,[105] together with structural considerations,[106] has suggested the hypothesis presented in the reconstruction model, developed before the excavations revealed the northern and southern access staircases (fig. 16).

The presence of windows is instead suggested by the fragments of alabaster and glass plates found in the excavations, which together with the lamps and candelabra must have created a very evocative quality of light.

Regarding the reference models for the planimetry of the church, the layout of the spaces and above all the 'horseshoe' apse inside the square-shaped perimeter wall, as well as the presence of the side rooms, limit the area of comparison to regions where this architectural solution appears widespread, with greater frequency in Palestine and northern Syria, as well as in Cyrenaica and northern Africa.[107]

As for northern Syria, buildings with a moderately developed longitudinal layout, sanctuaries with a tripartite interior and a rectilinear exterior, and a hall divided into three naves by closely spaced columns represent the most widespread type from the second half of the fourth century AD onwards.

These are buildings dating from the second half to the end of the fourth century, which often have two entrances on the southern side.[108]

In Ethiopia, basilica-type churches with a semicircular apse flanked by two rooms and inscribed in the masonry are known, in addition to Adulis, in Mätära, Arbaetu Ensesa and Bet Gyorgis. The basilica of Matara has been dated to the sixth century based on the Byzantine-style finds,[109] but this dating is disputed.[110] The church of Arbaetu Ensesa, located at the foot of the hill of Mai Qoho, along the road that led from Aksum to Adua, dates back to the second half of the sixth/seventh centuries,[111] while the church located on the hill of Bet Gyorgis, also

[103] It is likely that the right nave was reserved for men, the left one for women.: Brandt 2018, p. 29.

[104] Paribeni 1907, c. 464.

[105] Paribeni 1907, cc. 504-505.

[106] Bortolotto, in this volume.

[107] Michel 2001, p. 3. Close original ties with Syria are generally recognised with regard to the Christian architecture of ancient Ethiopia.: Monneret De villard 1937, pp. 330-331; Doresse 1956, p. 223; Marrassini 1990, pp. 35-46; Weber 2010.

[108] Butler 1969, pp. 25-37, figg. 21, 23, 26, 27, 32, 36; Farioli Campanati 2008, pp. 19-20; Castellana, Fernandez 2013, pp. 122, 144, 151, 167, 236, 247.

[109] Anfray, Annequin 1965, p. 70.

[110] Phillipson 2009, p. 46.

[111] Tekle 2011, pp. 91-92.

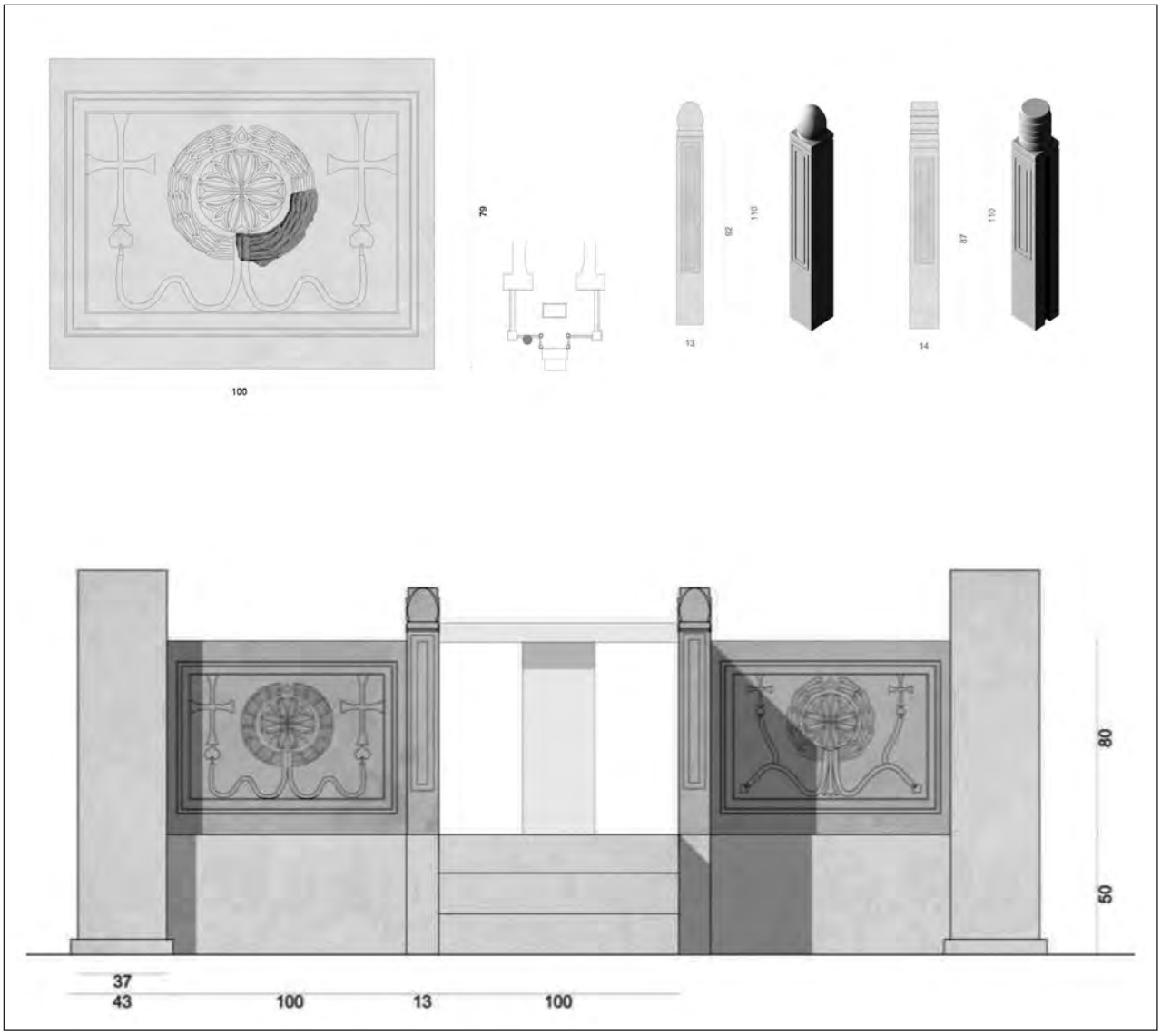

Fig. 17 - Reconstruction of the presbyteral gate based on fragments conserved at the National Museum of Asmara, graphic processing by A. Mazzieri, G. Sottocornola, A. Todeschini (Politecnico di Milano).

near Aksum, dates back to the fourth-fifth/seventh-eight centuries.[112] Recently, the excavation at Beta Samati has brought to light a basilica that, together with the northern urban church of Adulis, documents the early construction of Christian places of worship in the Northern Horn.[113]

Turning to the liturgical furnishings of the northern urban church of Adulis, their renewal or enrichment can be traced to a period after the construction of the building, as documented by the furnishings and decorative motifs typical of the sixth century Byzantine repertoire (figg. 17-19), which Paribeni did not find *in situ*, but outside the church, in ruins.[114] As we have already analysed in detail, the decorative motifs, made of imported materials such as Proconnesian marble and perhaps alabaster,[115] but also of local stone, highlight the issue of the identity of the workers employed at the construction site of the Adulis church, which in turn is closely connected with the level of the

[112] RICCI, FATTOVICH 1987, p. 181.

[113] HARROWER *ET AL*. 2019.

[114] We would like to thank the National Museum of Asmara for the photographic shootings and laser surveys (the author is Engineer Andrea Gregorini, Politecnico di Milano). For a detailed description and related comparisons MASSA 2017.

[115] For which a provenance from areas close to Adulis cannot be excluded, BORTOLOTTO, SOROLDONI in this volume.

patrons. Whether they were local workers or workers who arrived together with the imported furnishings,[116] it is certainly worth emphasising that, in the first case, they were familiar with the latest artistic trends in the Byzantine capital, which was open to Sasanian-inspired influences.

The decoration (fig. 19), hewn out with holes for inserting encrustations made of metal or stones or marble of different colours, consists of a stylised plant motif of symmetrically juxtaposed and repeated leaves, in the shape of 'open pincers' or a half-palmette, a motif very common in Sasanian stucco decoration. It is present in some marble panels of the internal lining of the apse of Saint Polyeuctus in Byzantium, and can also be found on the consular diptychs of Flavius Areobindus from 506, conserved in the Louvre, and on a consular diptych conserved in the church of Saint Gaudenzio in Novara; it also frequently appears in sixth-century sculpture and also in the silver furnishings.[117] Part of the liturgical furnishings were also marble basins, among which one preserves the Greek inscription: 'God the Saviour' (fig. 20), oil lamps and precious candelabra.[118]

As regards the function of this church, currently the third known Christian place of worship in Adulis, the presence of tombs around it suggests it was intended as a burial ground, most probably from the very beginning, given that the construction of the staircase along the northern perimeter wall obliterated tombs from an earlier period, which were however reduced with compassionate care and not simply destroyed.[119] In particular, there are an adult and a

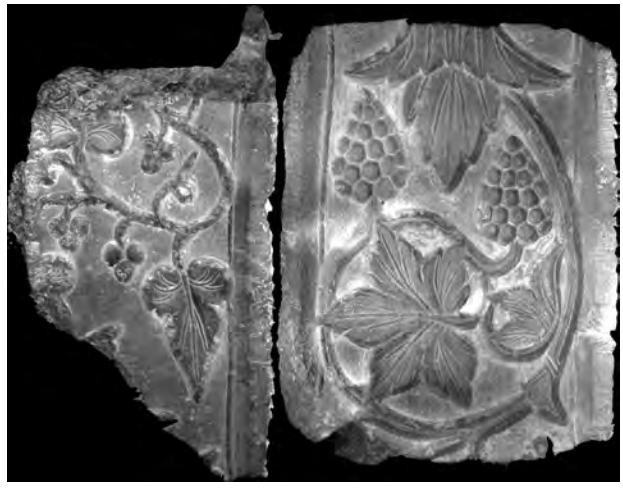

Fig. 18 - Fragment of architectural decoration made of sculpted marble with a spiral of a rising vine from an acanthus leaf and ivy shoots, conserved at the Museum of Asmara. 3D survey by Andrea Gregorini, Politecnico di Milano.

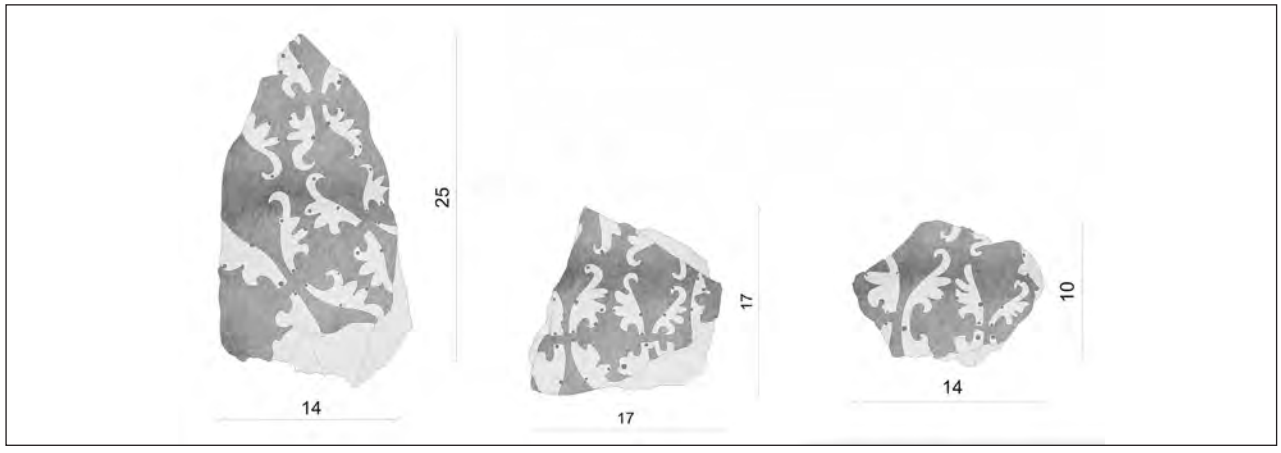

Fig. 19 - Fragments of architectural decoration made of schist kept at the National Museum of Asmara. (Graphic processing by A. Mazzieri, A. Todeschini, G. Sottocornola, Politecnico di Milano).

[116] The issue of the work phases is complex, many hypotheses are possible besides the import of the finished piece, which could have been made entirely in the workshops at the quarries, or on the construction site where it was intended for installation, Sodini 1989, p. 164.

[117] Massa 2017, pp. 433-435.

[118] Inscription reading by Carlo Maria Mazzucchi, Full Professor of Byzantine Philology at Università Cattolica di Milano.

[119] Lampugnani in this volume; Larentis, in this volume.

Fig. 20 - Liturgical furnishings from the Northern Urban Church, fragment of a marble basin with the Greek inscription 'God the Saviour'.

Fig. 21 - The privileged interment burial, excavated near the northern perimeter of the church in 2015. Above the stone coffin, containing the skeleton of an adult male, there are the remains of the masonry enclosure with a niche on the eastern side.

non-adult individual (fig. 21), for which radiometric dating indicates a period between the end of the second century and the first twenty years of the fourth century AD.[120] These timelines indicate that the date of death of the individuals predates the construction of the church, the foundations of which yielded materials that can be dated to the second half of the fourth century AD.

In addition to the privileged burial of an adult at the northern perimeter, excavated in 2015,[121] monumentalised by an overlying structure that is unfortunately poorly preserved,[122] other amphora tombs containing the remains of children had been excavated by Paribeni around the western perimeter of the church,[123] perhaps a space reserved for this age group.

The new investigations have also clarified the function of some spaces around the church, recognising the overlapping of several presumably residential locales, and the reuse of some of them for burials, already desecrated in ancient times, to be investigated with the continuation of the excavations.

The 'Eastern Church'

The large church excavated in 1906 at the eastern edge of the town was unearthed between 2014 and 2018.[124]

Nothing of this building was visible on the surface anymore, but based on Paribeni's topographical indications it was possible to trace its position and bring the 'eastern church' back into view. Paribeni called it thus because it was identified and excavated at the eastern limit of the site, in an area where the archaeological traces apparently ended.[125]

We are yet unable to say with certainty whether the building is actually outside or inside the walls, as the stretch of the walls identified in the 2022 campaign to the east of Sector 6 has not been excavated, and it is necessary to expose a larger portion to verify its continuation.[126]

The floor made of large schist slabs (fig. 22), already described at the beginning of the last century, was still preserved about a hundred years later, unfortunately in extremely fragile condition. Only two of the eight columns arranged in a circle in the centre of the hall, one of which was already missing in 1907, remained *in situ* in 2014. As already hypothesised by Paribeni, from a structural point of view the columns, resting on the floor, could not support a masonry dome, as has recently been argued,[127] but much more likely a wooden pavilion.[128]

[120] Larentis, in this volume.
[121] Massa 2017, pp. 438-442.
[122] Lampugnani, in this volume.
[123] Paribeni 1907, c. 480.
[124] Giostra 2016; Castiglia 2019.
[125] Paribeni 1907, cc. 529-540.
[126] *Infra*.
[127] Giostra 2016, who in fig. 14 proposes a reconstruction with a tall domed masonry window; Castiglia 2022, p. 169, believes it is a 'massive dome'.
[128] Paribeni 1907, cc. 530-532; Bortolotto, in this volume.

Fig. 22 - The Eastern Church seen from the south-west at the end of 2018 excavation.

This large basilica also rests on a base with steps and recesses,[129] in a general layout like that already described for the northern church, but with considerable differences in the masonry technique, which sees the predominant use of basalt worked in the shape of small parallelepipeds and not of polygonal interlocking ashlars.[130] This difference, as we will see also with regard to the 'British Church', is most probably due to an evolution of techniques over time, or to different workers.

The first hypothesis is supported by stratigraphic data and radiometric analyses, which place the construction of the eastern church at a later time, about a century after the Northern Urban Church: a coin of Armeh found in the preparatory layer of the threshold of the central portal, in all likelihood intentionally placed there for inaugural purposes,[131] establishes a time range between 540 and 580 as *terminus post quem* for the threshold.[132] Samples taken from the threshold (fig. 23), charred because of a fire, have returned 2-sigma-calibrated radiometric dating at 425-650/435-635 AD.[133] Furthermore, a lamp, found in the preparatory layer of the schist floor of the church porch, provides further evidence for a dating to the sixth-seventh centuries.[134]

A staircase, of which today only the preparatory ballast remains (fig. 24), gave access to the church porch which, through three portals, led into the narthex, from which, through another three doors - not perfectly in line with the first three - one entered the large rectangular hall, ending to the east with a semicircular apse inscribed in the rectilinear perimeter wall. The apse was flanked

[129] About 25.50 x 16.30 m.

[130] Bortolotto in this volume, for details of the construction techniques used for the various buildings.

[131] Liverani 2023.

[132] I would like to thank Dr. Giuseppe Girola, of the Italian Numismatic Society, for reading the coin.

[133] Maspero 2017.

[134] Massa, Gorla, in press.

Fig. 23 - The charred remains of the wooden beam of the entrance threshold to the Eastern Church.

Fig. 24 - In the foreground remains of the preparatory ballast for the steps leading to the porch of the Eastern Church.

Fig. 25 - Baptisimal font of the Eastern Church.

by two small rooms, the southern one of which contained a circular basin for baptism by immersion, with two steps for descent and two for ascent. The bottom of the basin was made of a mixture of earth and stones covered with *opus signinum*, as Paribeni noted a century earlier; the remains of the upper walls are plastered and painted red[135] (fig. 25).

Of the presbyterial enclosure, only traces remain of the bases for inserting the columns, while nothing remains of the marble panels of the gate, of which Paribeni describes a fragment with a crown, like that found in the northern church,[136] and other fragments with marble and alabaster frames. Among the artefacts excavated in 1906, in addition to the fragments of marble and alabaster mentioned above, noteworthy are the bronze door knockers of the central entrance portal to the hall,[137] the ampulla of Saint Menas found in the hall, together with bronze elements belonging to small wooden boxes.[138]

Comparisons with central plan buildings reported for the Eastern Church of Adulis have led to the hypothesis that its function was to memorialise a martyrdom or serve as a sanctuary connected to a possible monastery, or that it was a building serving a community of a different faith[139]. However, with regard to the latter hypothesis, it is more likely that the basilicas of Adulis answered to different needs of the community's spiritual life rather than to different and heretical forms of worship.[140]

The building underwent some alterations at a later stage, represented by the closing of the central external door and the construction of a wall that divided the narthex into two rooms. The discovery of a lamp dating from between the late Byzantine period and the early Islamic period in the northern room provides a useful chronological reference for situating such a reuse.[141]

The 'Church of the British Museum'

Starting in 2018, the so-called 'Church of the British Museum',[142] was brought to light, and the investigations concerning it are still ongoing (fig. 26).[143]

This is the largest religious building found so far in Adulis Plan of Sector 3 and 6):[144] a longitudinal basilica divided into three naves, bordered by two rows of five columns each. The grand building was accessed via a monumental staircase (fig. 27) that led up to the churchyard, probably crowned by a portico with columns, through which one entered the narthex.[145]

The massive granite threshold of the large portal leading into the hall was repositioned *in situ.*[146] Passing through it and proceeding along the central nave, there was the space reserved for the clergy and the apse, at the centre of which stood the altar. The apse was flanked by *pastophoria*, the southern one of which probably served as a baptistery, as suggested by the floor level with hydraulic mortar and *cocciopesto.*[147]

Like the Northern and Eastern churches, this basilica also stood on a stepped podium, with a profile characterised by recesses and protrusions. In two segments, however, the recess was interrupted by an opening, most likely closed by a monumental portal, through which one could access the underground areas.[148]

Another difference compared to the Northern and Eastern churches is the masonry technique: small basalt blocks of almost uniform size arranged in regular rows separated by schist slabs, rather than polygonal or parallelepiped blocks.

Based on comparisons of floor plans and decorations, the building has been dated to the 'full sixth century AD'.[149] The construction of the presbytery enclosure and its rich marble decoration was attributed to a later phase following the construction of the church.[150] However, the continua-

[135] Paribeni 1907, c. 534.

[136] Paribeni 1907, fig. 36.

[137] Kept at the Museo delle Civiltà in Rome, Inv. N. 5131.

[138] Paribeni 1907, fig. 54. Another fragment reproducing the iconography of San Menas comes from room I of the Paribeni probe no. 8. (Id., fig. 41).

[139] Giostra 2016.

[140] It is recognised by many scholars that it is impossible to distinguish the monuments of dissident groups from those of the orthodox groups, which could possibly be identified by the presence of several contemporaneous buildings with the same function. (Chavarria Arnau 2009, p. 142; Grossmann 2002, p. 6; Ward Perkins, Goodchild 2002, p. 16).

[141] Massa, Gorla, in press.

[142] Castiglia *et al.* 2021.

[143] Lampugnani, in this volume.

[144] 30 metres long and 20 metres wide.

[145] Lampugnani, in this volume.

[146] See following chapter, fig. 11.

[147] Bortolotto, Soroldoni, in this volume.

[148] Lampugnani, in this volume. The continuation of the excavations will enable us to understand the function of the underground chambers.

[149] Castiglia *et al.* 2021, p. 57.

Fig. 26 - The 'Church of the British Museum', cathedral of Adulis (Sector 6 of the new excavations); Sector 3 lies to the north of the church, residential building aligned with the basilica.

tion of the stratigraphic investigations has shown that the foundations of the presbytery are contemporary with the construction of the naves.[151]

The presbyterial enclosure is bordered by a chancel with posts (fig 28c) and panels made of different types of white marble in addition to Proconnesian marble, decorated with the motif of the blossom cross inside a laurel wreath with *lemnisci*. One fragment found in the last campaigns pertains to the same panels of which the first fragment was recovered in the 1868 excavations and brought to the British Museum.[152] The Cross is located in the centre of the slab, framed by a crown composed of three rows of leaves (fig. 28 b).

The detail of the bifurcation of the *lemnisci*, as well as the laurel wreath, seems to be a motif particularly common in Palestine, while elsewhere the *clipeus* motif prevails, one of the best known and most widespread in early Christian and Byzantine sculpture,[153] also depicted in the cathedral of Adulis.[154]

Other fragments belong to a slab that features a cross motif within a double moulding frame (fig. 28 a).

The richness of the building's decoration is also evidenced by elements made of polychrome marble, such as the fragments of antique black and white marble, presumably belonging to the altar, and of serpentine marble (fig. 29 a-d), which broaden the already known repertoire.[155]

In addition to marble, numerous fragments of alabaster with engraved linear decoration or more elaborate plant motifs (fig. 29 e), which once again refer to motifs that were widespread in classical and oriental artistic culture, reworked in a new way in the Sasanian decorative repertoire, as already seen in the decorative elements made of marble, local stone and alabaster in the Northern Church,[156] complete the picture of the precious

[150] Id., p. 54.

[151] Lampugnani, in this volume, fig. 12.

[152] https://www.britishmuseum.org/collection/object/H_1868-1005-15.

[153] The same motif decorates the gates of the presbytery of the northern church (above, fig. 20); for extensive comparisons, please see Massa 2017, pp. 427-429.

[154] Castiglia *et al.* 2021 fig. 23 A.

[155] *Ib*., p. 47.

[156] Above, p. 115.

Fig. 27 - The monumental staircase with ruined columns of the portico, the threshold in the background.

decoration of this building, which, together with its size and the presence of the baptistery, indicate its function as town cathedral.[157]

The construction – or rather the delimitation – of the southern portion of the narthex is attributed to this phase as well. Within it, at the centre of a schist slab floor, there is a quadrangular structure interpreted as the probable base for an altar inside a chapel, or pertaining to a stairwell, thus hypothesising the existence of a women's gallery on the upper floor.[158] Comparisons with contemporary churches in the same cultural and geographical area suggest that it was more probably a tower.[159]

The resumption of excavations in 2023 brought new and unexpected evidence:[160] in addition to the monumental entrance staircase already mentioned (fig. 27), the latest excavation campaign revealed the existence of an underground chamber inside the southern side of the base, completely obliterated by the collapse of the upper walls of the church. Removing the rubble, an entirely preserved column was discovered, with traces of red painted decoration in bands (fig. 30). It has also been understood that a presumed modification phase of the side naves actually represents the *cavaedium* of the supporting walls connected to the chain wall of the central nave.[161]

Along the northern perimeter wall, at a depth of 3.50 m, the base construction level was reached, which, in addition to ceramics dating back to between the fourth and sixth centuries AD, yielded a fragment of a statuette with steatopygic features, a remnant of older layers damaged by the excavation for the foundations.[162]

A much later reuse of some spaces in the cathedral is documented by Islamic burials dating from the fifteenth to the eighteenth centuries.[163]

Building north of the cathedral

A building located a short distance from the northern side of the cathedral, which we began to excavate in 2011,[164] has provided very interesting data on the

[157] Castiglia 2021.
[158] Castiglia *et al*. 2021.
[159] Littmann, Krenker, Von Lupke 1913.
[160] Lampugnani, in this volume.
[161] Id., *ib*.
[162] LRA3, Aswan Ware, Massa, Gorla, in print.
[163] Larentis 2021; Id., in this volume.
[164] Excavation sector 3, Zazzaro, Cocca, Manzo 2014. The excavation was halted for safety reasons in 2015 and resumed in 2020.

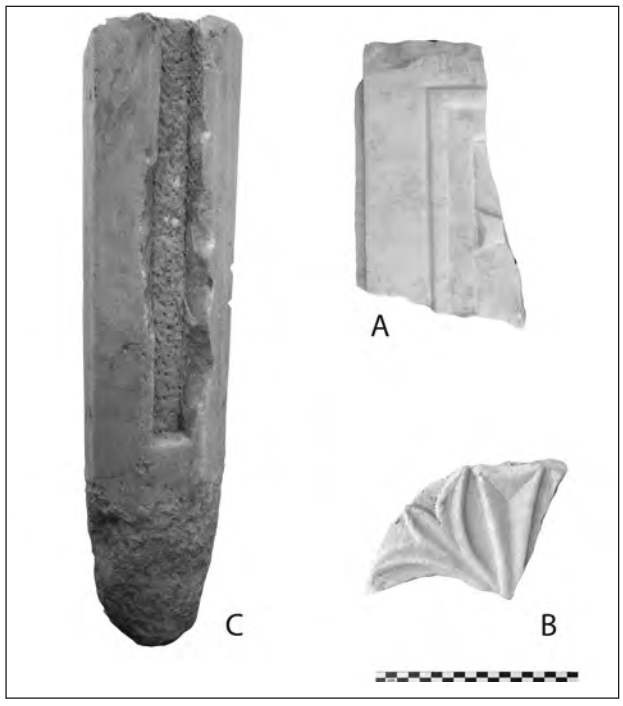

Fig. 28 - A) fragment with cross within double moulded frame; B) fragment of marble decorated with the blossom cross; C) marble post with groove for the insertion of the panels.

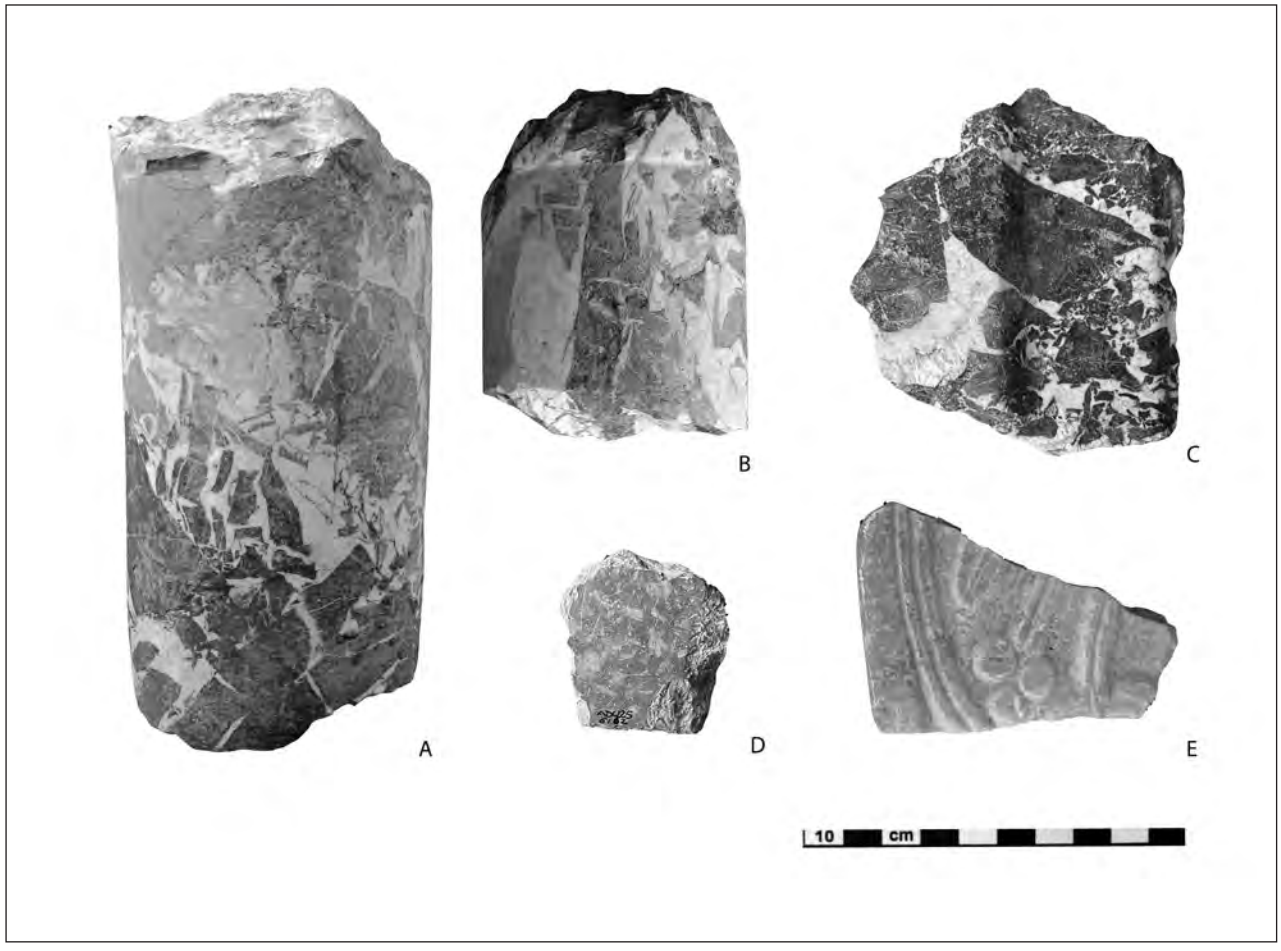

Fig. 29 - A-C) Black and white marble; D) serpentine; E) alabaster.

Fig. 30 - The collapsed column in the underground chamber beneath the south nave to the southwest.

Fig. 31 - Building in Sector 3 (left), aligned with the northern wall of the Cathedral.

phase of destruction of the town, documented by an impressive layer of rubble 1.50 m thick (fig. 31).

The collapse, consisting of stone material, constituted the ruin of the walls of three rooms arranged in a NW-SE orientation, almost in line with the cathedral, which stood a few metres away to the south.

The upper levels of the collapse[165] contained a Wazena coin, dating from between 540 and 580 AD,[166] and a fragment of an African terra sigillata bowl of Hayes form 104C, dating from between the second half of the sixth century and the first quarter of the seventh century.[167] These artefacts establish a firm *terminus post quem* for the catastrophic event.

Numerous other ceramic artefacts for everyday use, such as amphorae, kitchenware and fine tableware, dating mainly from the fifth to the seventh centuries, indicate that the rooms were used as dwellings.

During the 2024 campaign, the foundation level of the perimeter walls of the building was reached, for which the associated materials indicate a *terminus post quem* of the fifth to the sixth centuries AD.[168]

The topographical and chronological proximity of these rooms to the cathedral could suggest that they had a prestigious function, such as the residence of a religious, military or civil authority figure.

We know from sources that Adulis was a bishopric at least since the fifth century.

Palladius,[169] in his work 'On the People of India and the Brahmins' recounts his journey to India in the company of 'the blessed Moses, bishop of Adulis'. A philological analysis of the text rules out any date later than the fifth century, a time which corresponds with the mention of an Egyptian bishop named Moses in a letter by Saint Jerome dated 404, whose see, although unknown, could be a graphic alteration of the name Adulis.[170]

From the outset, Adulis belonged ecclesiastically to an Egyptian province, most likely the southernmost province of Thebaid II, which also included Coptos, the terminus of the caravan route connecting the Nile Valley to the Red Sea. A certain Sabinos, bishop of Coptos and Adulis, was present at the Council of Chalcedon.

Monneret de Villard's subtle reflections on the motivations, more political than religious, that may have led Bishop Moses to undertake the long journey to India fit perfectly into the geopolitical context of the late antique Red Sea, in which the Aksumite Kingdom and the port of Adulis, allies of Byzantium against Persia, played a leading role.

The lower level of the collapsed building of Sector 3, which was previously misinterpreted as the floor used for the central room,[171] yielded an Indian terracotta statuette from the Gupta period, dated between the fourth and sixth centuries AD.[172]

This is certainly an intriguing clue confirming, in a timeframe that also includes Bishop Moses' journey, the relationship between Adulis and India and perhaps even the permanent presence of Indian merchants in Adulis, as would also seem to be suggested by the ring gem with an inscription in Brahmi script found in the Paribeni excavations.[173]

During the 2024 campaign, the foundation level of the perimeter walls of the building was reached,[174] for which the associated materials indicate a dating *post quem* of the fifth century AD.[175]

The end of the emporium and the international port

The chronological indicators for dating the beginning of the decline of Adulis' role as a central hub in the long-distance trade network between the East, Africa and the Mediterranean are currently based on the imported goods and the later coins found in some excavation contexts of the last century as well as in current ones.

In particular, these are: two gold coins found in the layer of ashes in the 'Palace', which place the *terminus post quem* of the catastrophic event after the beginning of the seventh century AD (*post* 620);[176] the cache of 33 coins of Israel, found at the west wall of room S, to the east of

[165] SU 3037, 3042.

[166] Hahn 2015.

[167] Massa 2014.

[168] SU 3117.

[169] Not to be confused with the bishop of Helenopolis of the same name.

[170] Monneret de Villard 1947.

[171] SU 3057, this interpretation was disproved by subsequent excavations, given the discovery of contemporary materials in all the multiple layers into which the collapse had been divided, as well as in the layers excavated below 3057.

[172] Filigenzi 2014.

[173] Ead, *ib*.

[174] SU 3117.

[175] Massa, Gorla, in print.

[176] Above, p. 102.

Fig. 32 - Pole holes in the open area between the cathedral (the northern perimeter wall of the basilica is on the right of the image) and Sector 3.

the northern portico of the Northern Urban Church,[177] a merchant's deposit, concealed at a time when the Sasanian expansion into Yemen began to disrupt the Red Sea trade,[178] dated to the second half of the sixth century AD; a coin of Armeh found in the preparatory layer of the threshold of the central portal of the Oriental Church, in all likelihood intentionally placed there for inaugural purposes, which establishes a time range between 540 and 580 as *terminus post quem* for the threshold,[179] delimiting the range provided by radiometric dating,[180] further specified by the imitation African lamp found under the floor of the atrium of the Oriental Church, dating back to the end of the Byzantine and the early Islamic era;[181] the collapse levels of the building north of the cathedral, containing a Wazena coin dated between 540-580 AD,[182] and a fragment of an African terra sigillata bowl of Hayes 104C shape, dating from the second half of the sixth to the first quarter of the seventh century,[183] which establish an important *post quem* date for the catastrophic event.[184]

In addition to this, imports of fine tableware, lamps and amphorae from Egypt, the eastern Mediterranean and the Persian Gulf found in the collapse and abandonment layers of the Northern Church and the Cathedral, offer further evidence to date this phase of crisis of the town at a time no earlier than the 7th century.[185]

The collapses could be attributed to one or more seismic events,[186] while the traces of fire do not appear to be so extensive in the town as to imply systematic organised warfare. Rather, they could be the outcome of the period of instability that followed the Kingdom of Aksum's loss of the

[177] Above, p. 102.

[178] HAHN 2015, p. 62 and note 134.

[179] Reading by courtesy of Dr Giuseppe Girola, Italian Numismatic Society.

[180] Charred samples of threshold returned 2sigma calibrated radiometric dating at 425-650/435-635 AD (MASPERO 2017), that has to take in account the *terminus post quem* of the coin, so the interval is 540/580-635/650 AD.

[181] MASSA, GORLA in press.

[182] HAHN 2015.

[183] MASSA 2014.

[184] Above.

[185] MASSA, GORLA, in print.

[186] Numerous earthquakes have been registered in the Red Sea region in the last 1400 years, ZUHAIR HASAN EL-ISA 2015.

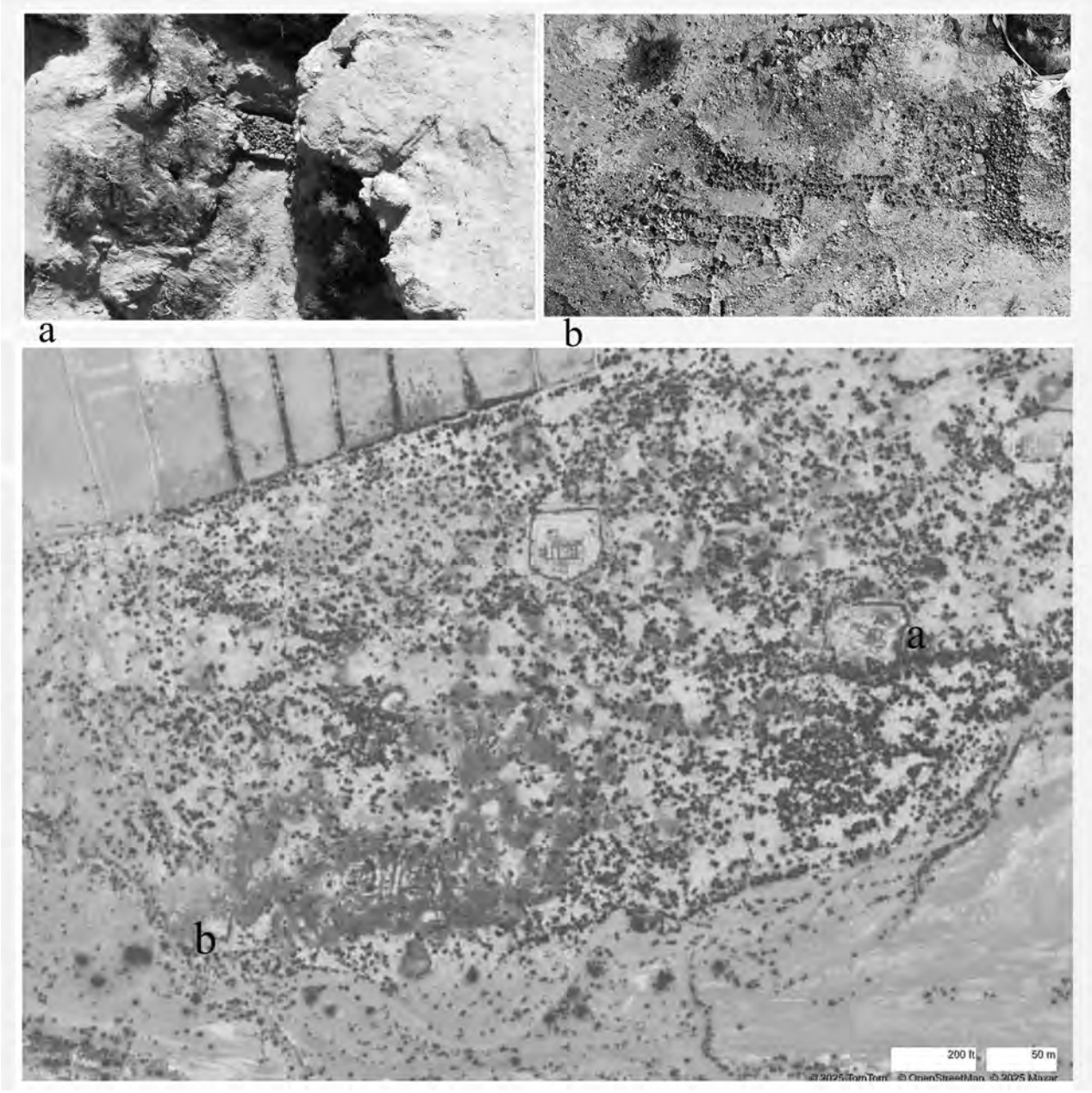

Fig. 33 - a): impressive section of wall at the eastern boundary of the town; b): structures most likely referring to towers, south-western boundary of the town.

South Arabian territories, which were conquered by Persia around 575. The Persian conquest of Yemen, in fact, not only marked the end of Ethiopian rule in Arabia, but also the insecurity of the Eritrean coast, which was subject to Persian raids, with the consequent loss of control over the transmarine routes that had contributed to the fortune of Adulis and the Aksumite Empire for centuries.[187] There are various reports in both Byzantine and Arab sources about the piracy that plagued the Red Sea in the seventh century. These pirates were not only Persian but also Abyssinian, and their raids reached their peak in 702 with the attack on Jeddah, the port of Mecca. Following this episode,

[187] Conti Rossini 1928, pp. 199-201.

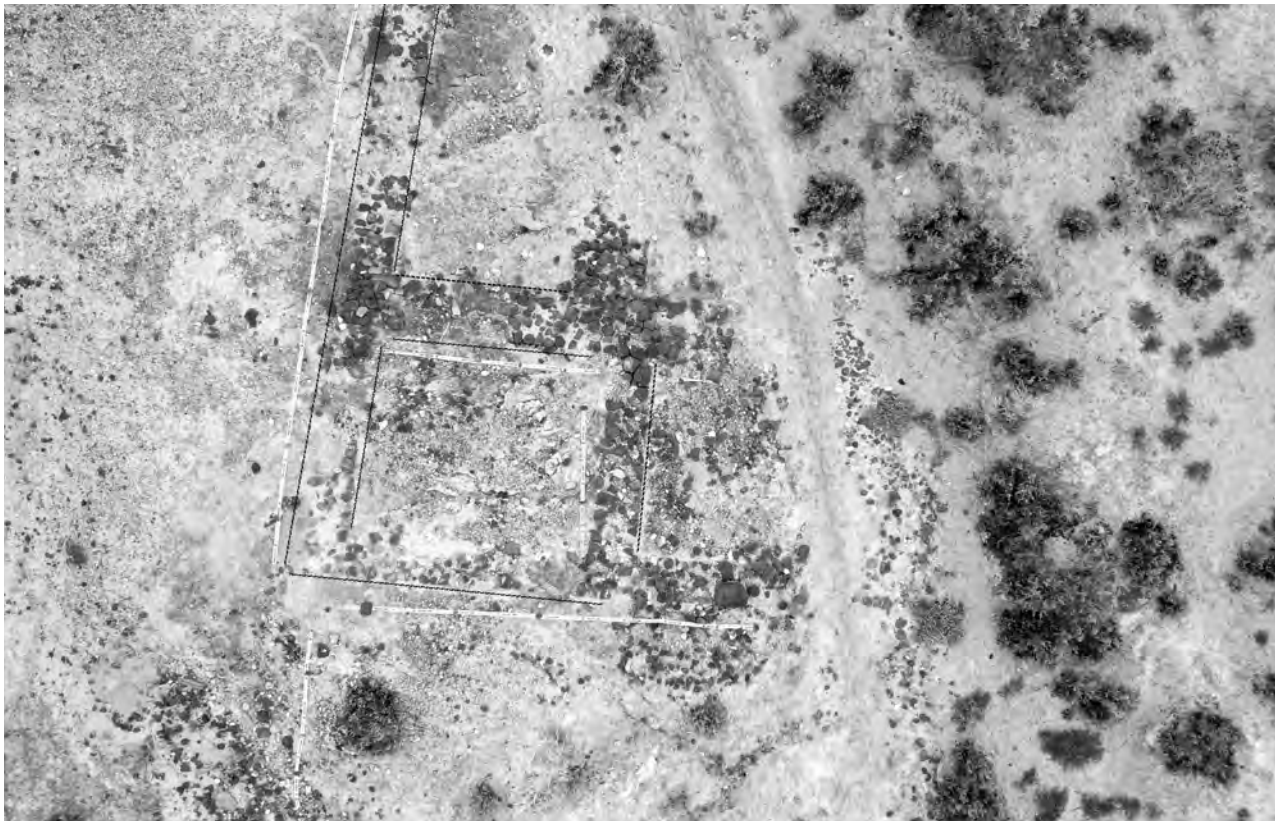

Fig. 34 - New rooms brought to light in the western sector, drone image.

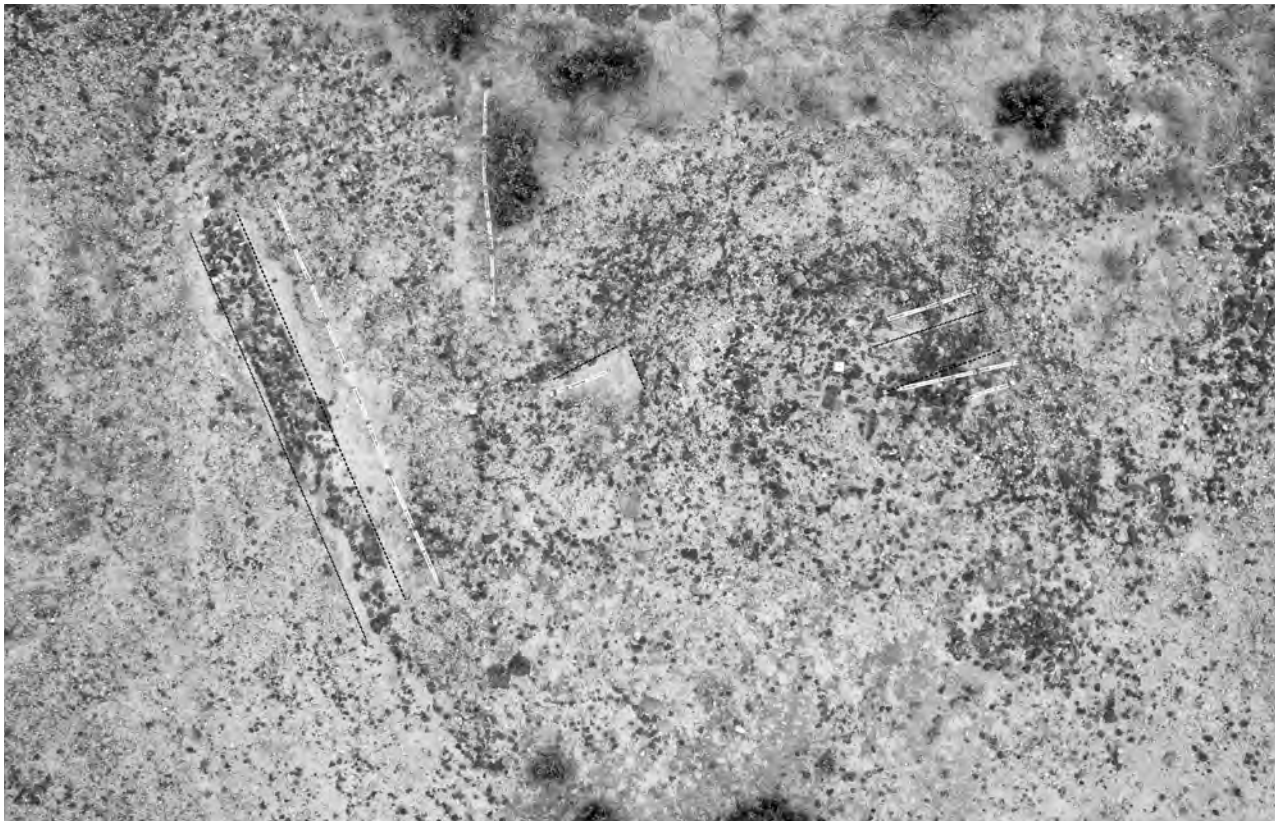

Fig. 35 - Walls to the east of the previous ones, drone image.

Fig. 36 - Walls to the north-west of the rooms in fig. 38, drone image.

the Islamic occupation of the Dahlak Islands by the governors of Medina became permanent.[188]

It is therefore highly probable that Adulis was also affected by these events, which, together with the destruction of the buildings caused by natural disasters, led to the end of its economic and commercial role, but presumably not to its sudden and total abandonment. In fact, traces of use of certain areas are indicated by the remains of hearths in the apse of the northern urban church;[189] the readaptation of the atrium of the Eastern Church; the use for burials in the 'palace'; the alteration of spaces in the cathedral; the post holes in the open area separating the cathedral from Sector 3 (fig. 32). The alterations are characterised by a construction technique that uses small, unhewn stone elements arranged in a somewhat irregular manner.

Other buildings characterised by the same technique, currently identified only on the surface in various areas of the town, may also refer to this phase.

However, although the initial moment of this period can be given a reference dating *post quem* of the end of the seventh century AD, it is not currently possible to establish the duration of this phase of reuse of the site. In fact, archaeological documentation reveals a gap of several centuries before evidence that could be dated with certainty became available again, in the form of Islamic burials in the nave of the cathedral, dating back to the seventeenth-eighteenth centuries.[190]

Conclusions

The methodological considerations expressed in the previous chapter, together with the documentation provided by written sources and archaeological evidence, have highlighted some key elements for understanding the early urban character of the town that, in historical times, we know as Adulis.

The characterisation of the site as a place of long-distance trade exchanges in the second millennium BC, at the time of the Pharaonic expeditions to the Land of Punt, is one of the main premises behind the development of a settlement with urban functions.

[188] Please see the previous chapter.
[189] Paribeni 1907, c. 504.
[190] Larentis, in this volume.

Several clues relating to ritual and/or religious practices, such as the *ustrina* beneath the foundations of the Northern Urban Church and the female figurines with steatopygic features found nearby, shed light on the social complexity of the oldest settlement.

This is significant not only for understanding the evolution of Adulis, but relevant also for the entire region of the Northern Horn of Africa, where, according to common opinion, there were no true towns in ancient times, as the main archaeological complexes with monumental architecture, i.e. the Aksumite centres, apparently had no walls or other fortification systems, or any formal organisation of spaces and functions.[191]

The new investigations initiated in 2011 have brought to light some sections of masonry walls that can be attributed to structures serving to delimit and/or defend Adulis (fig. 33), currently dated to the late ancient phase of the town, pending excavations that will better define its time of foundation. This evidence is currently a new element in the state of the art on contemporary urban centres in the region and constitutes a further distinctive feature of the urban functions of the site, alongside the existence of a market regulated by customs laws.

The presence of a dense urban fabric covering an area much larger than that which could be identified by research in the last century (figg. 34-36) is a further novelty, currently documented only by surface research and aerial filming. These are buildings characterised by walls made of alternating layers of polygonal or parallelepiped basalt stones and schist, or in other cases by a less regular technique using only unworked basalt stones. The chronology of these buildings identified on the surface currently has as its *terminus ante quem* the destruction and loss of function of the emporium town, which, as we have seen, took place no earlier than the end of the seventh century AD.

The continuation of the excavations may expand the clues currently available regarding the continuous use of the site in subsequent centuries.

Lastly, the question regarding the 'city of the dead', that is, the burial place or places that necessarily had to serve the 'city of the living', is still unanswered. At the moment, the few, unique tombs that have come to light in Adulis can be referred to the cultural and chronological horizons of Christianity or Islam, with no evidence of the more ancient era.

According to Agatharchides, Diodorus and Strabo, the funerary ritual of the people living along the Red Sea coast was to lay out the dead along the shoreline at ebb tide, so that the corpses were carried out to sea with the rising tide, or buried in the sand along the beach.

This could perhaps be an explanation for the lack of funerary evidence prior to the introduction of the Christian burial ritual, but obviously it cannot be ruled out that the investigations carried out so far have not intercepted one or more areas possibly located outside the known limits of the town.

[191] Phillipson 2012, p. 119.

EXCAVATING ADULIS: STRATIGRAPHY AND METHODOLOGICAL APPROACH

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Introduction

The archaeological research underway since 2011 on the site of Adulis has posed a series of methodological issues with regard to both the excavation and the conservation of the remains brought to light, issues that have suggested new intervention strategies that have been refined over the years.

In attempting to summarise the data resulting from the stratigraphic survey, it is necessary to keep in mind some peculiar factors that have strongly influenced field research, starting from the very nature of the site. The town of Adulis stands today in a semi-desert area pedologically characterised by silty-sandy deposits, which are easily subject to deep erosion following the infrequent seasonal rains.[1] The area is also bordered to the south by the course of the Haddas, a torrential watercourse that alternates between dry periods and rapid and violent floods. Soil erosion leads on the one hand to the accidental and poorly controllable exposure of the archaeological deposits, and on the other to their consequent and fairly rapid deterioration.

During the winter months, roughly from mid-November to mid-March, the territory enjoys a climate characterized by the so-called small rains, pleasant and occasionally refreshed by the sea breeze, with temperatures that, however, tend to rise rapidly with the arrival of spring, making the excavation site no longer practicable. The average duration of the excavation campaigns cannot therefore exceed 60-70 working days per year. A truly short time considering that the possible extension of the archaeological site is around 40 hectares, of which less than one tenth has been investigated to date.

Lastly, the need to bring to light remains that can be easily understood by non-specialist users, with the aim, strongly desired by the Eritrean authorities, to create an archaeological park has led to the preference, with the exception of small samples, for monumental buildings already investigated in the twentieth (Sectors 2 and 4) if not indeed in the nineteenth century (Sector 6).

In these sectors, the natural stratigraphic sedimentation has often been disrupted by the addition of excavated material that is relocated *in situ* or in the immediate vicinity; in other cases, the mostly natural re-burial of the structures has caused a greater workload in terms of removal in order to reach the still unexplored levels.

The difficulty and complexity of the research are well understood from the foregoing indications.

Below we will analyse specific situations that have characterised the individual sectors with particular attention to the latest excavation campaigns.

Sector 2

Sector 2 corresponds to the area characterized by the presence of the so-called "Altar of the Sun" investigated by Paribeni in the early 1900s. After the closure of the excavations - it should be noted that Paribeni himself warned of the need to maintain the site - the entire investigated area was progressively covered by sand, due either to a natural

[1] Baioni *et al.*, in this volume; Censini, in this volume.

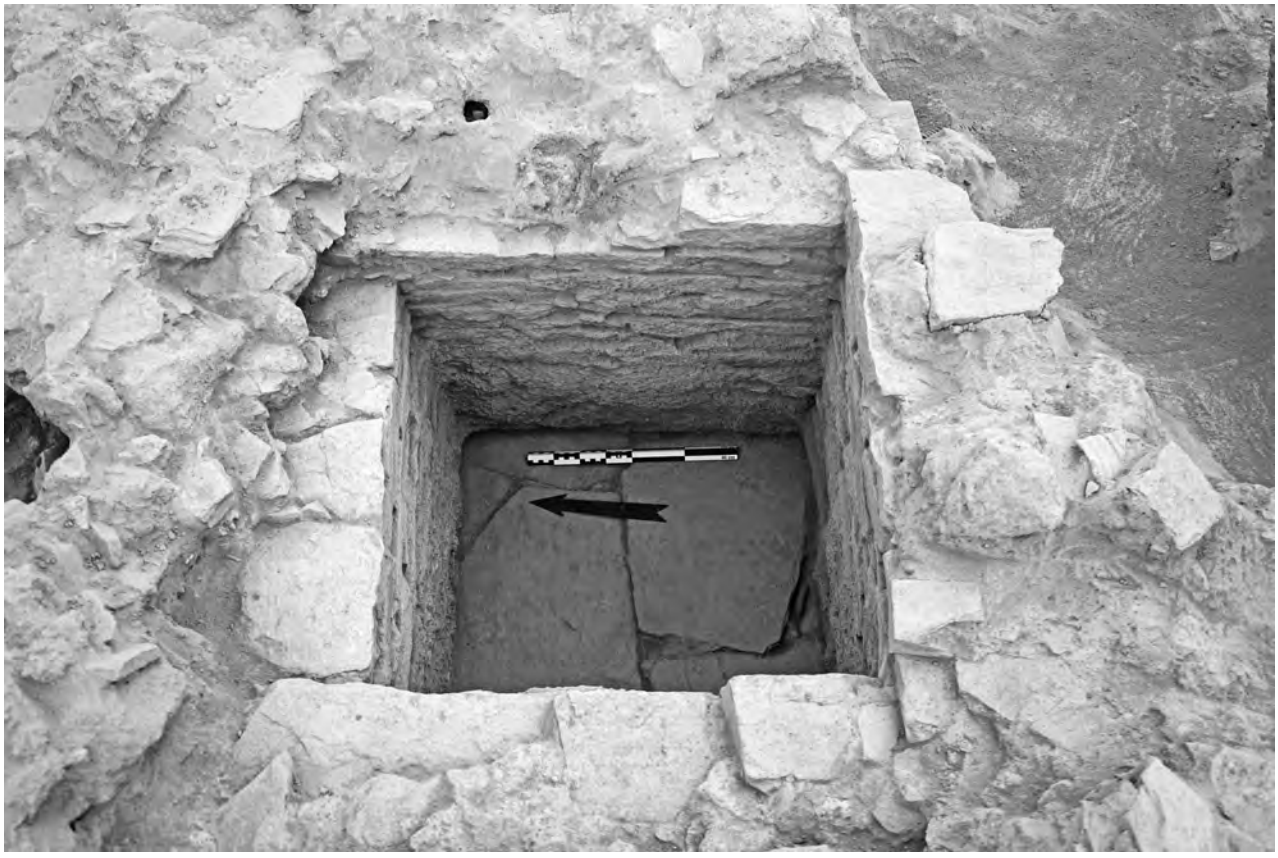

Fig. 1 - Sector 2, near the southern staircase of the church: ritual well (?).

accumulation phenomenon or to alluvial events, which in stratigraphic terms means, depending on the depth reached by the excavation, the removal of one to three metres of archaeologically sterile sand (i.e. without any artefacts or levels of interest) in order to bring the structures already explored to light. Consequently, after having identified the exact position of the main building, the presumed "Altar of the Sun", the first years of fieldwork were spent removing these sand accumulations. Compared to the situation documented by Paribeni, the operation highlighted, despite the generally good level of conservation of the remains, the disappearance or deterioration of some walls following collapse or localized lesions.

The investigation led to a partial rectification of Paribeni's interpretation of the complex.

The stratigraphic reading of the monument associated with the advancement of comparative studies has enabled first of all a review of the intended use of the powerful base identified as an "altar", therefore attributed to a pre-Christian cult, on which only later a church was erected according to the usual practices of exauguration and reconsecration in a Christian sense of pre-existing places of worship. The basement and the church in reality belong to a single building according to a model known in Middle Eastern and in particular the Aksumite contexts.

Reaching the foundation level of the base then allowed the recovery of coins and ceramic fragments useful for estimating the dating of the building to around the fifth century AD.[2]

A small walled space located on the north side of the base, already investigated by Paribeni, was revealed upon closer analysis as a sort of funerary aedicule placed above a still sealed tomb, the first of this type to be found in Adulis. The burial can be identified as Christian both because of the lack of grave goods and of its privileged position; fur-

[2] Massa, in this volume, Chapter 8.

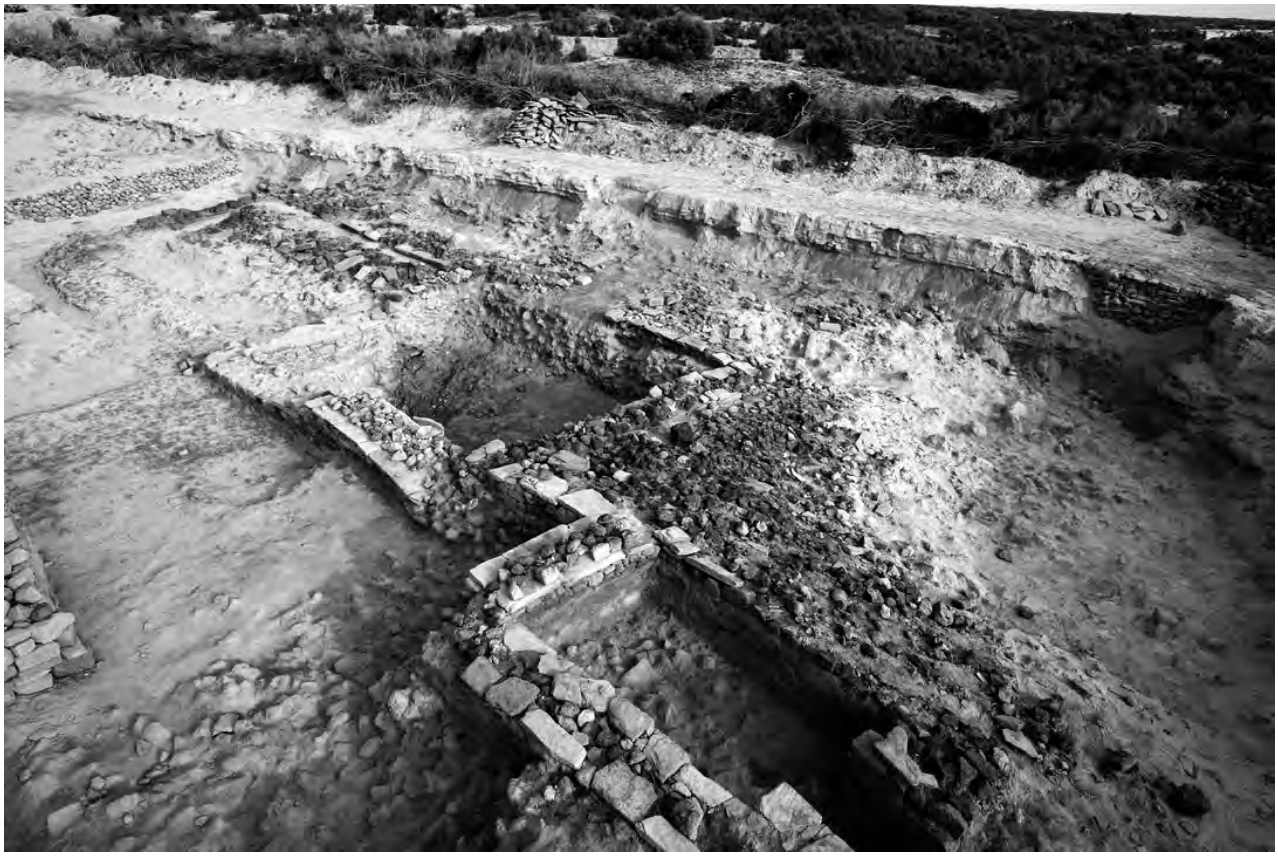

Fig. 2 - Overview of Sector 3 excavation.

Fig. 3 - Sector 3: door between rooms C and B.

thermore, a small opening on the east side of the masonry of the upper structure must have allowed the introduction of votive objects, suggesting the particular attention that must have been shown to the deceased.

Remains of a second burial, inserted between pre-existing walls, perhaps already in disuse, confirm the funerary use of the space immediately around the church; near the north lateral staircase leading to the church, there is a small reduction funerary box with the bone remains of several individuals. Stratigraphic evidence seems to indicate the pre-existence of the burial, disturbed by the construction of the stair.

At the same time as the buildings on the north and east sides of the church were brought to light, a trench was opened along the south side of the base in order to investigate with a stratigraphic excavation an area not affected by previous research work so as to obtain terms of comparison with what Paribeni had deduced. After having emptied the trench that Paribeni had created to allow a complete path around the base, the collapse levels of the church itself were collected here, exposing the base of the lateral access staircase to the church, a staircase that corresponds to the identical structure on the north side. A small quadrangular well with a slab bottom was also identified, the use of which remains to be deciphered (fig. 1). The two structures are inserted in a level characterized by superficial dispersion of ceramics and holes of uncertain use. Since the elevation of this possible level of use is decidedly higher than that of the foundation of the base, we can hypothesize that the area was frequented at a time well after the construction of the church, when part of its base was already buried and the access staircase perhaps demolished to reuse the material.

The research work was accompanied by careful restoration and consolidation of the structures that emerged. Where it was not possible to proceed in this direction, a buffer zone of unexcavated deposit was maintained close to the structures.

In the case of the basement, after having experimented with various restoration techniques which proved to be poorly suited either to the nature of the monument or to the characteristics of the site, we opted for a reconstruction that reused traditional building materials (schist slabs and basalt blocks) and simply introducing ceramic or brick fragments to mark the beginning and the end.[3]

Sector 3

Sector 3 is located immediately north of the building known as the British Church. The research, which began in the 2013 campaign, brought to light, under a relatively modest layer of earth, a group of rooms (called A, B, C, D) probably belonging to the same building, whose orientation differs slightly from that of the church (fig. 2).

In 2014, a test in room C allowed the recovery of a small earthenware statuette of Indian origin, precious evidence of the town's trade with the East. From a stratigraphic point of view, the sequence divided into several units recorded during the essay proved to be redundant at the time of the complete excavation (2022-2023) of the entire room. A single large rubble layer, originating from the collapse of the perimeter walls inwards occupies, in fact, two thirds of the deposit, evidence confirmed by the substantial uniformity of the ceramic materials found during the excavation, attributable to the sixth-seventh centuries AD. The rubble layer lies on a level that can be interpreted as the construction plan of the building, without any traces of depositional layers of frequentation, at least no well-definable ones.

The discovery of an opening that connected rooms B and C through the western perimeter raises the question of the actual usage level of the rooms (fig. 3). The level of the threshold is in fact at least 50 cm higher than the construction level of the walls; it is therefore necessary to assume that the floor of the room, supported by a system of wooden beams or *suspensurae*, was equipped with a sort of underlying shaft. Assuming this hypothesis to be correct, the internal level of the building would be higher than the construction level of the church base, thus suggesting that the building is posterior to the church, with which it would have aligned respecting its orientation.

Adjacent to room D, which has not been investigated yet, there is a small rectangular room of uncertain function (room A); it has an opening to-

[3] Bortolotto in this volume.

Fig. 4 - Sector 6: overview of the excavation of the so-called “British Church”, the Cathedral of Adulis.

Fig. 5 - Sector 6: chamber at the northern perimeter of the podium, opening in the wall for the insertion of jambs.

wards the east, also in this case placed at a definitely higher elevation than that hypothesized as external. Although a collapse layer with a thickness greater than one metre was removed from the room, it was not possible to identify a use level, not even in correspondence with the hypothesized threshold.

SECTOR 6

Adulis Cathedral: A New Reading of the architecture in the light of stratigraphic evidence

The continuation of the investigation started in 2018[4] on the place of the Cathedral of Adulis[5] has led in the last two campaigns (2024 and 2025) to the planimetric and architectural definition of the church as well as to the specification of some construction phases (fig 4).

The building, of imposing dimensions (30 x 18 m), constructed on a high podium in the usual forms of Christian Basilica architecture in this region of the Horn of Africa, has a layout rotated approximately 20° clockwise with respect to the canonical east-west orientation.

The walls of the building, made of basalt, schist and a little mortar, have a constant width of 120 cm which narrows to 100 cm at the point of separation between the podium and the elevation of the church.

The podium and the chambers

Made with a profile of protruding segments, the podium has an internal structure consisting of two powerful central chains designed to support the overlying pillars, linked to the perimeter by 6 crosspieces (3 per side), effectively creating a substructure of cells measuring approximately 5 by 4 meters each, entirely filled with backfill; the exceptions are the four cells located at the ends (east and west) of the side naves. For two of them (southern nave to the west and northern nave to the east), the excavation has documented that they were real rooms with direct access from the outside.

The external facing of the masonry presents, in the protruding segments only, the usual alternation of different lithic materials - basalts alternating with schists for the levelling courses - even if not regular in the relationships between the two components, as it is instead clearly evident in the church in sector 2.[6] The masonry is normally set back 5 cm every 50 cm of elevation for a total of 7 steps and an elevation of approximately 3.50 m.

Instead, the walls corresponding to the four chambers at the eastern and western ends (see ground plan) do not have steps and the sequence of schist and basalt bands is not always aligned with that of the stepped protruding segments. The explanation for the perfect planarity of the wall lies in the need to have a continuous thread to facilitate the insertion of the jambs, whether wooden or stone, for the monumental doors that closed the access to the chambers in the elevation of the podium (fig. 5).

What remains of the external wall of the chambers, with an opening for the access in the centre, consists of two portions of masonry, only partially connected to the remaining facing of the podium at the joining point with the corner of the projecting segment. After the removal or collapse of the jambs and the architrave of the portal, these two portions of masonry were particularly fragile and therefore subject to partial or total collapse.

The masonry texture of the internal facing of the four rooms, well-prepared but not as regular as the external one, presents in the four corners overlapping pairs of grooves 120 cm long and 15 cm high, possible locations of wooden elements joined in a triangle by a crosspiece and placed to reinforce the points of greatest structural stress. The presence along the walls of fragments of white plaster allows us to hypothesize that the facing was plastered as was the external one (fig. 6).

The investigation inside chamber 1 (southern nave to the west) started in 2024, was suspended following the discovery of a pillar, made up of several drums, ruined inside it (fig. 7).

The removal of the filling layer of the space, consisting mostly of schist and basalt slabs, both

[4] From 2018 to 2020 co-directed by G. Castiglia (Pontificio Istituto di Archeologia Cristiana) and Tekleweni Negassie (Commission of Culture and Sports); since 2022 the direction is by the writer, in collaboration with Tekleweni Negassie.

[5] Sector 6 of Adulis excavations. The building is known as the "British church" due to the first excavations conducted by the English at the end of the 19th century, MASSA, Chapter 8 in this volume for the details.

[6] For the different mason techniques BORTOLOTTO, in this volume.

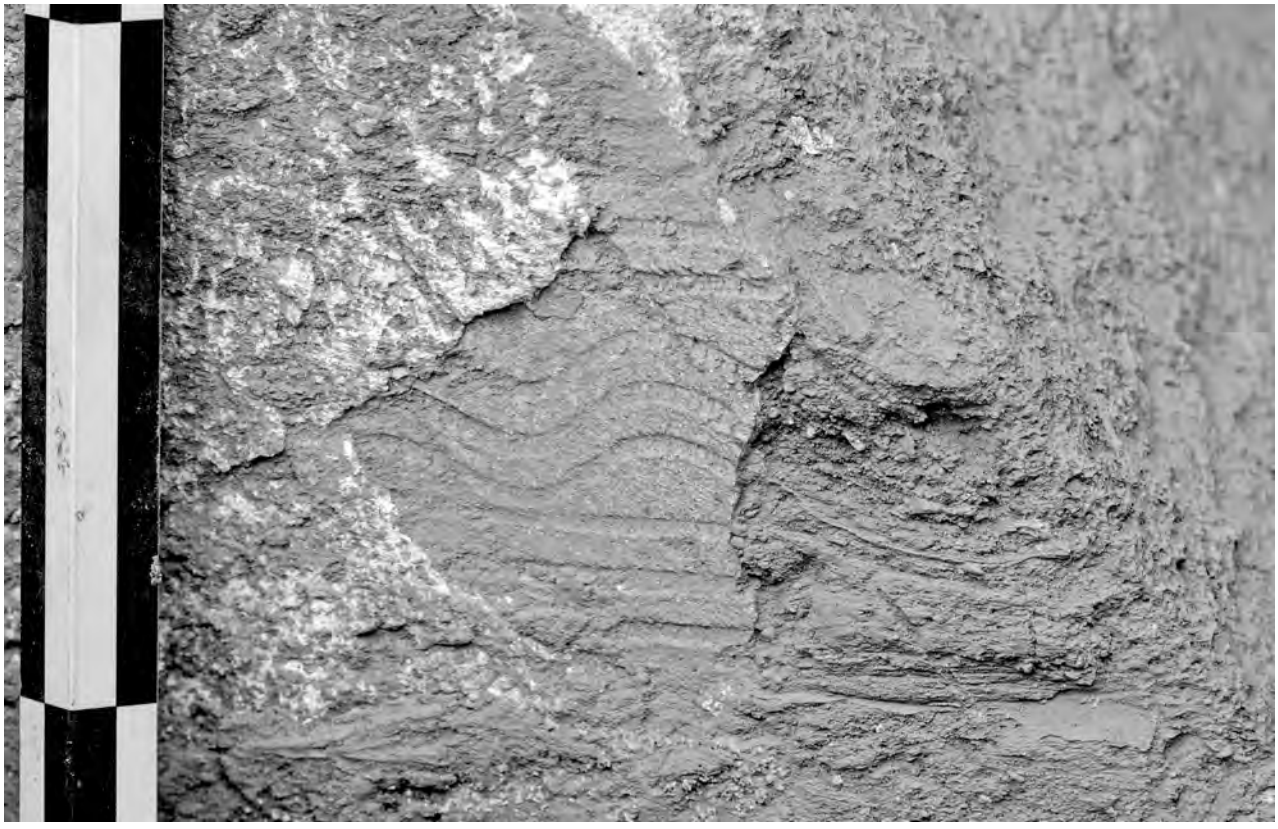

Fig. 6 - Sector 6: detail of the plastering of the external northern wall of the podium.

Fig. 7 - Sector 6: the pillar ruined inside chamber 1.

Fig. 8 - Post of the chancel separating the presbyterium from the nave.

Fig. 9 - Sector 6: the monumental staircase giving access to the cathedral façade.

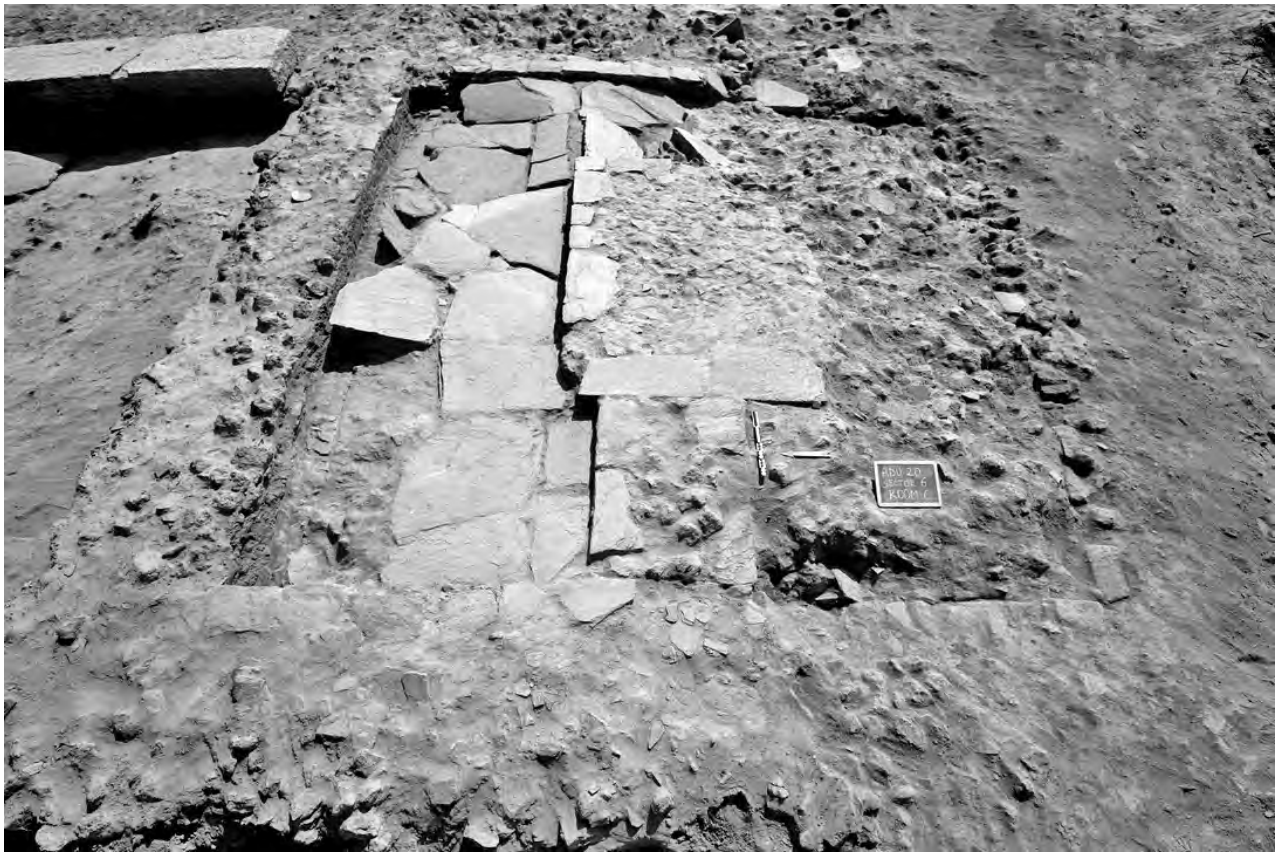

Fig. 10 - Sector 6: room south to the narthex, with probable stairwell.

squared and not squared, constituent elements of the walls, allowed the progressive recovery of part of the perimeter of the room, even if partially collapsed. During the excavation of the filling, an entire ruined pillar was brought to light inside the room when at least half of it had already been invaded by rubble. The discovery is of great importance because until now, despite the presence of numerous elements belonging to the pillars that divided the central nave from the lateral ones, their real height was unknown, as it was not possible to verify the correctness of the anastylosis carried out by the English expedition. The individual elements constituting the shaft (11 plus capital and base), whose height decreases vertically in order to facilitate their positioning, were covered with a double layer of plaster: the lower, coarser layer has strigilations designed to improve the grip of the upper layer, which in some cases retains traces of red colour. Considering that a red colouring of the entire pillar is unlikely, a decoration with white and red bands can perhaps be imagined.

Finally, it is interesting to note how a horizontal groove along the internal facing of the perimeter walls of the room marks the narrowing of the wall thickness in probable correspondence with the plan for building the walls of the church itself. The groove could also be a support point for the supporting beams of the floor slab.

The excavation of chamber 3 (northern nave to the east), conducted in the 2025 campaign, has removed the accumulation of collapsed material, but did not reach the floor level, stopping on a powerful anthropized silty layer whose genesis, at the current state of the excavation, can be attributed to a reuse of the room or to an alluvial accumulation of material.

It is worth noting, in the collapse layer, which clutters more than 4/5 of the filling of the chamber itself, the presence of large, well-finished schist slabs that were certainly part of the nave flooring, as evidenced by the two in pseudo-primary position present on the surface of the layer itself along the western part of the chamber and left in situ to improve the readability of the struc-

Fig. 11 - Sector 6: the monumental granite threshold at the entrance of the cathedral's interior.

ture. Also of great interest are the numerous fragments of the decorative apparatus of the church, among which two sculpted columns stand out, one belonging to the presbytery enclosure and the other more likely supporting some other liturgical furnishings (fig. 8).

Due to a lack of evidence, the primary use of the four rooms is still difficult to interpret.

The narthex and the naves

The access to the church to the west is guaranteed by an imposing staircase that extends along the three sides of the churchyard with steps in regular schist slabs 40 cm deep and raised about 20 cm.

The staircase was probably crowned by a *portico* with columns, whose drums were found collapsed along the main front of the staircase itself. Remarkable is the particularly important size of the blocks constituting the columns with regard to the height of the individual elements, over one metre and fifty centimetres. The width is however slightly minus than the usual module of 47-49 cm per side (fig. 9).[7]

The staircase surrounds a small courtyard, paved with partially preserved schist slabs, which precedes the narthex. The narthex is partially occupied by a room to the south[8] which can perhaps be interpreted, on the basis of comparisons, as a stairwell.[9] The room has a schist slab floor surrounding a rectangular masonry base which possible function could have been to support a wooden staircase (fig. 10).

[7] BORTOLOTTO, in this volume.

[8] The northern perimeter of the room sets onto the corner of the salient of the façade, suggesting if not a later phase of the construction yard at least a non-synchronous moment of construction, otherwise it would be a rethinking in the implementation phase with respect to the project.

[9] Narthex of the church-mausoleum of Kaleb at Aksum, in the space on the right there is a tower-stairwell; in that of the church-mausoleum of Gabra Masqal (next to the south of the first), in the space on the left there is another tower-stairwell perhaps for access to an upper floor (?), KRENKER 1913. Similarly, in the Debre Damo Church (9th-10th century), in the narthex on the left we have the staircase leading to the upper floor.

Fig. 12 - Sector 6: the altar's foundations.

From the narthex a monumental granite threshold, provided with recesses for the insertion of the portal hinges, marks the access to the central nave of the church (fig. 11).

Each of the two side naves, separated by a double row of five pillars approximately 4 metres high, ends to the east with a pseudo-quadrangular room which flanks the presbytery (the *pastophoria* of the Byzantine tradition). The one on the right in particular should be identified as a baptistery due to the presence of a *cocciopesto* floor,[10] the one on the left is assumed to have served as a sacristy. The entrance to the two rooms was probably directly from the naves, while it is not known, given the state of conservation only at the foundation level of the walls, as well as due to the disturbances caused by the British excavations, whether there was a direct connection with the apse area.

The apse, preceded by a presbyterial enclosure of which the foundation masonry with a double square shape is preserved, is not directly inscribed in the rectilinear perimeter masonry of the base, but is separated from it by a modest corridor perhaps used as a connection between the *pastophoria*.

Similarly, it is not known to what extent the apse wall, whose foundation is similar in construction characteristics and dimensions to the rest of the building, was solid or also had a semi-circle of pillars that continued the colonnade of the nave.

The presence of numerous bricks found among the rubble filling of a hole, likely attributable to English excavation activities, located in the centre of the apse area, could indicate the presence of a triumphal arch decorated with alternating motifs of white stone (marble) and bricks.[11]

The red pigments of the finishing plaster preserved in some blocks of the pillar found in room 1 could also suggest a similar colour scheme for the structural elements of the church.

The 2025 campaign also allowed the correct positioning of the altar in the presbytery, the foun-

[10] Castiglia *et al*. 2021, pp. 31-32, for details.

[11] Although it cannot be ruled out that this is material from the elevation of the altar.

dation of which was found in a more advanced position towards the nave than that hypothesized in the previous investigation (fig. 12).[12]

Unfortunately, the detected stratigraphy does not provide conclusive data on the ways and historical moment of abandonment, since the total stripping of the floor slabs was followed in more recent times by the Muslim occupation for cemetery purposes as witnessed by several burials,[13] as well as from various break-ins once again attributable to the British or to a later moment of exposure (?) after the abandonment of the building.

Side notes: the end of the town

At the end of the seventh century AD, Adulis seems to have ceased to exist, at least as regards that which had characterized it as one of the main emporia on the coasts of the Red Sea.

The hypothesis that a powerful flood had decreed its end, as initially advanced, does not seem entirely convincing at the current state of the investigations.

The stratigraphic sequence observable in the section along the northern perimeter of the Cathedral clearly shows the collapse dynamics of the upper masonry of the church in two phases. The first moment, characterized by the presence of fragments of white plaster certainly coming from the covering of the masonry of the base and from isolated ashlars and slabs, is followed by a decisive collapse of the masonry that overturns in a S-N direction and extends along the base itself. There is no layer of sandy-silty matrix between the two moments that can be interpreted as an alluvial deposit.

Some observations on the state of the walls seem to suggest the possibility that a strong seismic event contributed to the town's decay. In some cases, notably the western perimeter of the church in Sector 2 as well as the southern perimeter of room C in Sector 3, the structure presents longitudinal twists that are difficult to interpret if we exclude them as effects of an earthquake. Similarly, some phenomena such as the expulsion of some ashlars from the wall facing or the twisting of the south-west corner of room A, again in Sector 3, could be attributed to such effects.

After all, we are in the middle of a territory of volcanic nature, marked by important and frequent seismic events: the city of Massawa, located only 40 km from Adulis, was repeatedly damaged by earthquakes during its existence.

Research has only reached ancient levels of frequentation in some points, and no evidence has been found yet attributable to a sudden catastrophic event such as a level with household furnishings ruined *in situ* or bone remains of individuals overwhelmed by the alluvial mass or deceased during the earthquake.

While not excluding this scenario, we could imagine that one or both natural events occurred at a time when the town was already in severe decline if not completely abandoned; this hypothesis could be supported by the deposit of valuable materials, pillar elements and worked slabs found by Paribeni near the so-called 'Altar of the Sun', in reality the Northern Urban Church, possible evidence of systematic despoliation activities that were abruptly interrupted.[14]

[12] CASTIGLIA *ET AL.* 2021, p. 29.

[13] LARENTIS, in this volume.

[14] Although with a different origin, we recall the similar deposits found in Pompeii intended for the reconstruction of buildings after the earthquake of 62 AD, which preceded the great eruption of the volcano in 79 AD.

UNDERSTANDING ANCIENT CULTURAL NETWORK THROUGH CUTTING-EDGE POTTERY ANALYSIS

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The site of Adulis, on the Eritrean coast, was investigated in many episodes beginning from the end of nineteenth century and in the early twentieth century as well as in recent times[1] and new investigations have been undertaken at the site in the past fifteen years.[2] The recovery in Adulis of many pottery assemblages representing different classes of imported and locally produced pottery corroborates the role of the archaeological site in the past in connecting the hinterland to the coast and beyond to the wider Red Sea, Eastern Mediterranean and Indian Ocean littoral.

Much of the discussion on imported versus local pottery generally dwelled on macroscopic typological classification. The development of a complete ceramic sequence for the archaeological site remains a major task that needs to be coupled with archaeometric studies. These studies have been virtually non-existent until recently when a comprehensive archaeometric approach integrating mineralogical and geo-chemical studies was carried out.[3]

The role of physical sciences in answering a multitude of questions related to the provenance, production technology and function of ceramic objects has been growing over the years where contributions from microscopy, geo-chemistry and spectroscopy for ceramic studies have proved to be crucial. The rationale for carrying out archaeometric work on pottery recovered from excavations from Adulis was driven by the need to discriminate mineralogical and chemical signatures for different classes of imported and local production.

Recent archaeometric work carried out on pottery materials from Adulis allowed the identification of fabrics related to several classes of imported and local pottery. The work involved chemical and mineralogical characterization using microscopic and spectroscopic techniques and/or tools. The identification of fabrics from petrographic observations and chemical studies made it possible to link fabrics and chemical signatures to raw material sources and/or production centres, further corroborating the macroscopic typological classification outlined by archaeologists working in Adulis previously. The archaeometric study also indicated that the fabrics identified for the local production can be used as parallels for studying regional forms to further discern the interconnections of Adulis to sites in the hinterland on the highlands of Eritrea and as far as Aksum in present-day Ethiopia.

Another important feature where archaeometric studies of pottery from Adulis yielded significant results deals with understanding the production technology from morphological and micro-structural observations using Scanning Electron Microscopy (SEM) as well as through phase and/or mineralogical identification involving X-ray Diffraction.

Moreover, one of the highlights of the comprehensive archaeometric study of pottery classes recovered from excavations at Adulis pertained to the identification of organic residues found on vessels termed as 'Torpedo *jars*', which were properly identified by coupling macroscopic typological classification and archaeometric studies. The iden-

[1] Zazzaro, Manzo 2012; Zazzaro *et al*. 2014.
[2] Peacock, Blue 2007; Zazzaro, Manzo 2012; Castiglioni *et al*. 2013; Massa, Giostra 2019.
[3] Zerai 2022.

tification of organic residues through proper extraction methods and later studies using Fourier Transform Infrared Spectroscopy (FT-IR) and Gas Chromatography Mass Spectrometry (GC-MS) resulted in the ascription of the fragments to *Torpedo jars*.[4] This work made it possible to identify the organic residues firmly as bitumen, a substance used as a sealing liner for the internal surfaces of the vessels. The identification of bitumen has become the discriminating element for recognizing *Torpedo jars* and their discovery in Adulis made it possible to situate Adulis in the ever-growing map of the study of the vessels, further confirming the inclusion of the port city of Adulis in the Indian Ocean trade in Late Antiquity.[5]

In general, the construction of the ceramic sequence is in its early stage when the application of archaeometric studies remains crucial. The range of pottery classes recovered from excavations at Adulis is growing, where macroscopic typological classification is not sufficient to identify their provenance firmly. A particular case deals with classes of imported common wares and several *amphora* variants that were never studied from an archaeometric point of view. Gaps also exist in terms of databases, where parallels with samples from elsewhere remain a challenging task. In this respect, archaeometric studies are needed with proper sampling to bridge these gaps.

Future approaches should emphasize the archaeometric study of the evolution of raw material variability in local pottery production in Adulis taking into account the different settlement phases in the site. The study of *Torpedo jars* involving a larger sample size and samples from other sites can be addressed. Likewise, archaeometric works need to be broadened for North African *amphora* types and Levantine forms such as *Gaza amphorae* where existing gaps need to be filled. Another aspect that remains to be explored fully also deals with thermoluminescence dating of ceramics recovered from the Adulis archaeological site. A good selection of samples from *in situ* contexts in excavations can be important for this purpose to draw a firm chronological sequence.

In conclusion, it can be said that the use of cutting-edge technologies in ceramic studies can significantly contribute not only to identify the provenance, production technology and use related to the wide range of pottery classes, but also to explore many paths related to interregional trade and exchanges involving regional scales.

[4] Zerai *et al* 2022.

[5] *Ib*.

FUNERARY EVIDENCE FROM ADULIS: TWO CENTURIES OF RESEARCH

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Introduction

The area where the ancient city of Adulis once stood was likely inhabited from at least the second millennium BC continuously until around the early seventh century AD. This interpretation is supported by a gold coin probably attributable to Hethasas and dated to 620 AD found in the so-called 'palace', a monumental building excavated in 1906 by the Swedish missionary Richard Sundström, suggesting that the duration of the settlement could extend significantly beyond this period.[1] The currently available information about the urban context and inhabitants of the city derives from materials uncovered during numerous excavation campaigns conducted from the second half of the nineteenth century to the present. The excavations, conducted by different archaeologists in distinct periods and sectors, featured heterogeneous methods, objectives, and interpretive processes. This diversity has hindered the development of a unified and coherent interpretation of the archaeological evidence. A preliminary step towards addressing this issue emerged in the work of Serena Massa, with the results of such work evident in this volume.[2] The excavations in the nineteenth and twentieth centuries were primarily aimed at understanding the topography by investigating and documenting the main civil and religious buildings and situating the role of Adulis within ancient cartography.[3] These excavations, combined with a survey of the territory carried out in the second quarter of the nineteenth century,[4] remain our primary source of knowledge regarding the city's funerary evidence, thanks to the discovery, description, excavation, and interpretation of more or less elaborate tombs. This evidence has provided archaeological data and allowed hypotheses regarding the funerary rites and ritual practices adopted in the city during the first half of the first millennium AD and subsequent periods.

These aspects have been studied more in-depth, including from a biological perspective, over the past decade, especially during the most recent excavations led by Massa. However, despite some discoveries, the currently available information remains insufficient for an exhaustive analysis of the funerary sphere of Adulis, and the location of its ancient necropolises has yet to be determined.

This work gathers, for the first time, all the available archaeological, anthropological, and osteological data to outline the funerary landscape of the city and its surroundings. The data obtained from various studies are presented in chronological and spatial order. Funerary remains from the first half of the first millennium AD, which represent the peak of the urban development of Adulis, are analysed, as are those from the subsequent decline and eventual abandonment. Additionally, the work examines the remains associated with a more recent use of the area transformed into a large necropolis serving nearby settlements. For each period considered, the remains are classified based on the current knowledge of the city's topography, distinguishing be-

[1] Massa, Cattaneo 2022, pp. 3, 35.
[2] Massa, Cattaneo 2022.
[3] Paribeni 1907; Anfray 1974.
[4] Rüppel 1838.

tween *intra moenia* burials and those in the suburban area. In this contribution, the term '*intra moenia'* highlights the central area of the city, given the absence of a continuous city wall.[5]

Methods

The research employed various methodological approaches, each focusing on specific aspects. To achieve a holistic interpretation, it was necessary to draw upon historical, anthropological-physical, ethnological, and ethnographic sources as data collected through spatial surveys of the area. A description of the methodology adopted in each field of inquiry is given below.

Historical Sources

The analysis of written sources proved fundamental in expanding our understanding of the funerary evidence of Adulis, making it possible to reconstruct significant cultural aspects and the spatial and chronological distribution of burials discovered since the nineteenth century. A wide range of literature was examined to this end, including historical documents from antiquity, administrative records from the colonial period, and published and unpublished excavation reports. These sources enabled the integration of information obtained from archaeological campaigns with textual data, thus contributing to a more complete and nuanced understanding of funerary practices and their evolution over time. The interpretation of documentary data with archaeological findings provided essential insights into the social and cultural dynamics that characterized the population of Adulis across different historical periods.

Biological sources and taphonomic considerations

The methodology applied to the osteological remains uncovered during excavation campaigns after 2019 followed a homogenous protocol, while the relevant scientific publications, when available, were referenced for earlier remains.

Due to the compactness of the soil, which adhered to the skeletal remains, the burials discovered after 2019 were subjected to *in situ* micro-excavation. This approach enabled the acquisition of all relevant information required to reconstruct the taphonomic processes, essential for understanding the deposition and preservation conditions of the remains. Anatomical portions of particular interest or requiring more careful conservation were removed *en bloc* and subsequently micro-excavated at the Massawa Museum, ensuring greater precision in the study and documentation phases.

The preservation of the bones, generally compromised by taphonomy and diagenesis, limited the application of some traditional techniques in the anthropological analysis. Metric parameters were used for sex determination when possible.[6] Age-at-death for adults was estimated by analysing the wear stage of the fourth rib,[7] the degree of degeneration of the auricular surface,[8] and the pubic symphysis, techniques widely accepted in osteoarchaeology thanks to their reliability in providing accurate estimates.[9] For non-adults, age was estimated both by assessing the eruption and development of teeth[10] and by measuring the long bones.[11] Paleopathological analysis provided information on quality of life, habits, and health status by comparing the findings with available clinical and paleopathological literature.

Given the aim of this contribution, which offers a broad interpretation of the funerary evidence, we reserve a more detailed examination of this aspect for a future study. To estimate the time of death and address specific research questions, radiocarbon dating was performed on human and non-human calcined bone and charcoal. The ratio of ^{12}C to ^{14}C in graphite was converted into a radiocarbon age (expressed in BP years) after correction for isotopic fractionation. The radiocarbon age was calibrated to calendar years using OxCal 4.4 software[12] and the IntCal20 atmospheric calibration curve.[13]

Ethnographic and Ethnological Sources

The Adulis context stands out due to its unique nature, as a significant portion of the funerary evi-

[5] Massa, in this volume Chapter 8.
[6] Bružek *et al*. 2017.
[7] Işcan, Loth 1986a, b.
[8] Reimer *et al.*1985.
[9] Brooks, Suchey 1990.
[10] Ubelaker 1999.
[11] Maresh 1970.
[12] Bronk Ramsey 2009.
[13] Reimer *et al.* 2020.

Fig. 1 - a) In one of the surveys, a village chief demonstrates to our research group the construction techniques used for Muslim tombs, both currently and historically by their predecessors. He provided guidance by drawing construction schemes in the sand. b) Together with the village chief, we initiated the reconnaissance and cataloguing of the tombs; his presence proved crucial for verifying the size of the pits and the actual dimensions of the burial structures. c) The tomb of Bet Khalifa (15°15.77′N, 39°39.63′E) highlights the use of worked schist slabs (arrow) and the presence of offerings, reminding us that the veneration of these eminent individuals remains alive in the villages (circle). d) The tombs often overlap, or their boundaries have become less distinct over the centuries. The presence of village chiefs during the surveys was essential for organizing these chaotic situations.

dence identified in the archaeological area belongs to the most recent phase of site usage, extending up to the contemporary period. These burials belong to the inhabitants of the nearby villages of Afta and Zula, whose village elders preserve, through oral tradition, valuable fragments of historical and anthropological knowledge.[14] These oral testimonies have enriched the information on local funerary practices, providing crucial details about the burial methods characteristic of these peoples and the funerary topography

[14] Gezae, Negassi, in this volume.

of the archaeological site. This information was collected through formal meetings with the village chiefs conducted in the field with the support of Dr Yotam Gezae, who acted both as linguistic mediator and cultural interpreter. These meetings, which took place in the villages and the archaeological area, were organized to facilitate direct dialogue with local authorities, making it possible to acquire valuable oral information that cannot be obtained through material or written sources alone. Furthermore, ethnographic field surveys were conducted, during which the village chiefs guided the research team through the archaeological area, indicating sites of funerary or historical significance and providing details about their cultural importance (fig. 1a).

The data collected through these interactions were systematically transcribed and catalogued, then compared with material evidence uncovered during the archaeological excavations and with historical information already available (fig. 1b-d).

Survey

The survey work, conducted in collaboration with Dr. Nelly Cattaneo, collected ethnographic information, enabling a deeper understanding of the funerary areas. Several zones characterized by a high concentration of burials with extremely diverse construction solutions visible on the current ground surface were identified (figg. 2a-f, 3a-c).

Through detailed surface investigation, we mapped each burial in the archaeological area, carefully documenting their dimensions, the construction techniques and materials used, and their state of preservation. This approach enabled us to create a comprehensive and systematic database, essential for the accurate documentation of these funerary remains. The database collects all technical and metric information about the burials and serves as a tool for comparison with other archaeological sites or future discoveries. Each burial was also georeferenced using GNSS coordinates, enabling the creation of a detailed map of the spatial distribution of the graves within the site. This revealed specific burial aggregation areas, subsequently interpreted considering the cultural, social, and structural variables of the communities that inhabited Adulis and its surroundings.

Results and discussion

The funerary findings discovered during all surveys and excavations conducted in Adulis and its surrounding areas from the nineteenth century to the present are set out below. The description of the findings is preceded by Table 1 and each discovery area is highlighted in a distribution map (fig. 4).

Table 1 - Tombs discovered in and near the city of Adulis. The findings are listed chronologically, with the chronology expressed by century for burials subjected to radiocarbon analysis, detailed in Table 2 below. Where possible, the number of individuals uncovered is reported or estimated, while the term 'cemeteries' indicates large areas containing numerous tombs for which no accurate estimation of quantity is available.

	Location	**Chronology**	**No. of Individuals**	**Bibliography**
1	Paribeni SW Haddas Riverbank	Pre-abandonment	1	Paribeni 1907, p. 524; table I, 8; fig. 37.
2-3	N and S Church Sector 2	III-VII BC	4-7	Paribeni 1907, pp. 480, 488; table I, 13; table VII.
4	N Church Sector 2	II-IV AD	2	Unpublished.
5	N Church Sector 2	V-VI AD	1	Giostra & Massa 2016, p. 89; Giostra 2017, p. 270.
6	Anthropomorphic Tomb Sector 2	Pre-abandonment	Empty	Unpublished.
7	Paribeni's Trench 14	Post-abandonment	1	Paribeni 1907, p 452; table I, 14.

8	Palace of Adulis	Pre-abandonment	1	Sundström 1907, p. 179; Massa. Cattaneo 2022, p. 36.
9	Paribeni's Trench 14	III-VII BC	Several Burials	Paribeni 1907, p. 452; table I.
10	Paribeni's Survey N of 20	Post-abandonment	Cemetery	Paribeni 1907, p 443; table I, at W of 20.
11	Bet Halīfa Cemetery	Post XVII AD	Cemetery	Paribeni 1907, p 442; in the middle of table I; Littmann & Sundström 1907, p. 173, fig. 1.
12	Šek Mahmūd Cemetery	Post XVII AD	Cemetery	Rüppel 1838, pp. 258-268; Paribeni 1907, p 441; table I at southeast; Littmann, Sundström 1907, p. 173, fig. 1.
13	Paribeni's Trench 1	Post-abandonment	1	Paribeni 1907, p. 446; table I, 1.
14	Paribeni's Trench 8	Post-abandonment	2	Paribeni 1907, p. 439-440; table I, 8.
15	N Wall of Nave Sector 6	XVII-XVIII AD	1	Larentis 2021b.
16	Nave Sector 6	XV-XVII AD	1	Larentis 2020, 2021a.
17	Area C	IV-VII AD	1	Carannante *et Al.* 2015, p. 282.
?	Šek Ismael Cemetery	Post XVII AD	Cemetery	Lefebvre 1845, table XI, fig. 1-3.

Discoveries from the Third to the Seventh Centuries AD.

The urban context

Paribeni identified several burials within the urban context of Adulis dating to the period between the early third and seventh centuries AD. Some of these burials were uncovered during the excavation of a large trench in the northern part of the archaeological area, which revealed a series of rooms likely intended for residential use and an external courtyard. This courtyard yielded several amphorae, placed horizontally against a perimeter wall, containing the remains of non-adult individuals buried according to *enchytrismòs*, dated to the third-seventh centuries AD based on the ceramic typology. Paribeni does not specify the exact number of individuals found.[15] Other likely contemporaneous burials were identified in the residential area surrounding the building Paribeni referred to as the 'Ara del Sole' (current Northern Urban Church - Sector 2). Specifically, four amphorae were found to the southwest of Room N, one of which contained the remains of a non-adult individual. Additionally, three amphorae leaning against the southern wall outside Room H contained the bones of infants. In this case, although the number of amphorae is recorded, Paribeni makes only brief observations about the remains and does not indicate whether each amphora contained osteological remains.[16]

Another discovery by Paribeni came from excavating a residential complex in the southwest, along the banks of the Haddas River, where the skeleton of a non-adult individual was found in the corridor between Room T and Space S, buried in a simple pit dug into the ground. The absence of dating elements for the individual found between Room T and Space S prevents a secure chronological framework.[17] The poor preservation of the remains, combined with the rudimentary state of anthropological analysis at the time, did not allow for in-depth hypotheses regarding taphonomic and osteobiographical aspects of these burials. The same applies to the anthropomorphic tomb built with squared stone blocks recently found in Sector 2, which was discovered empty.

[15] Paribeni 1907, c. 452; table I, 14.
[16] Paribeni 1907, cc. 480-488; table VII.
[17] Paribeni 1907, c. 524; table I, 8, fig. 37, c. 514.

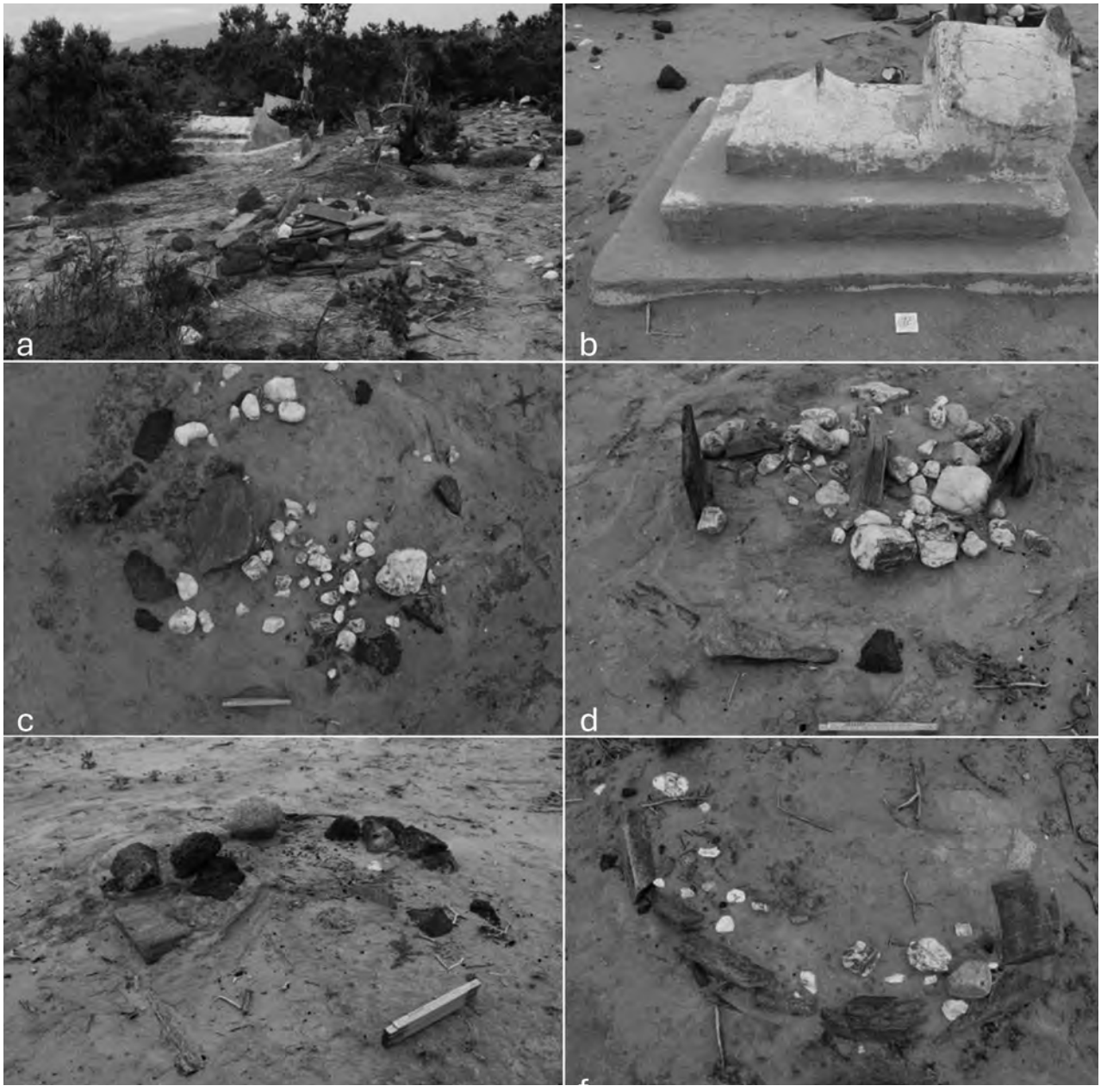

Fig. 2 - a) The southeastern portion of the burial area developed around the monumental tomb of Šek Mahmud (15°15.75′N, 39°39.75′E), whose lime-washed tomb is visible in the background. b) The tomb of Bet Khalifa, around which a second cluster of Islamic burials develops. c) An Islamic burial constructed with white quartz pebbles, schist slabs, and squared basalt blocks. The pebbles represent gifts from the living to the deceased during funerals and commemorations, while the other materials likely derive from dismantling surrounding ruins. The shape is sub-circular but may result from the migration of stone elements near the main rectangular structure. d) A sub-rectangular Islamic burial features three schist slabs set perpendicularly into the ground to mark the extremes and centre of the burial. e) A sub-circular Islamic burial preserves only a portion of its perimeter. f) A sub-circular Islamic burial delineated by schist slabs embedded in the ground.

Two additional burials were uncovered near the church in Sector 2 during recent excavations. The first was discovered during the 2015 excavation campaign, north of the cult building, and consists of a single inhumation in a stone-built rectangular tomb (fig. 5).[18] The tomb is a wide stone cist

[18] Massa 2017, pp. 437-439.

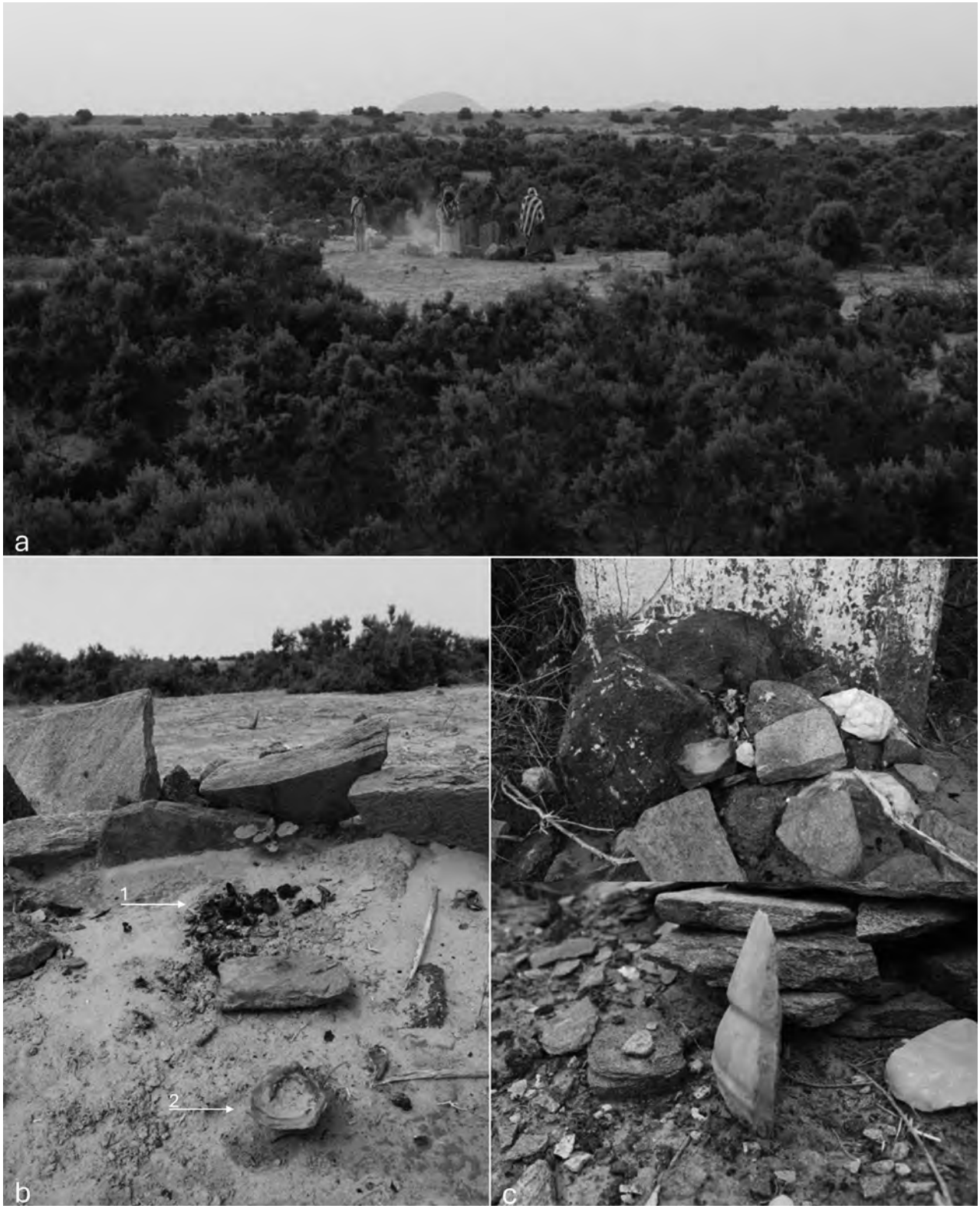

Fig. 3 - a) The Islamic tombs belong to areas still venerated by nearby villages. In this case, women celebrate a ritual on a cult platform close to Šek Mahmud's cemetery. The photograph was taken from the nave of the church in sector 6 (Cathedral). b) At the end of the ceremony, charcoal and fragments of local pottery, sometimes used as offering containers and other times as incense burners, remain on the cult platform. c) A construction feature characterizing many burials, particularly those closer to Šek Mahmud and Bet Khalifa, involves the reuse of decorative elements that adorned the monuments of the city of Adulis.

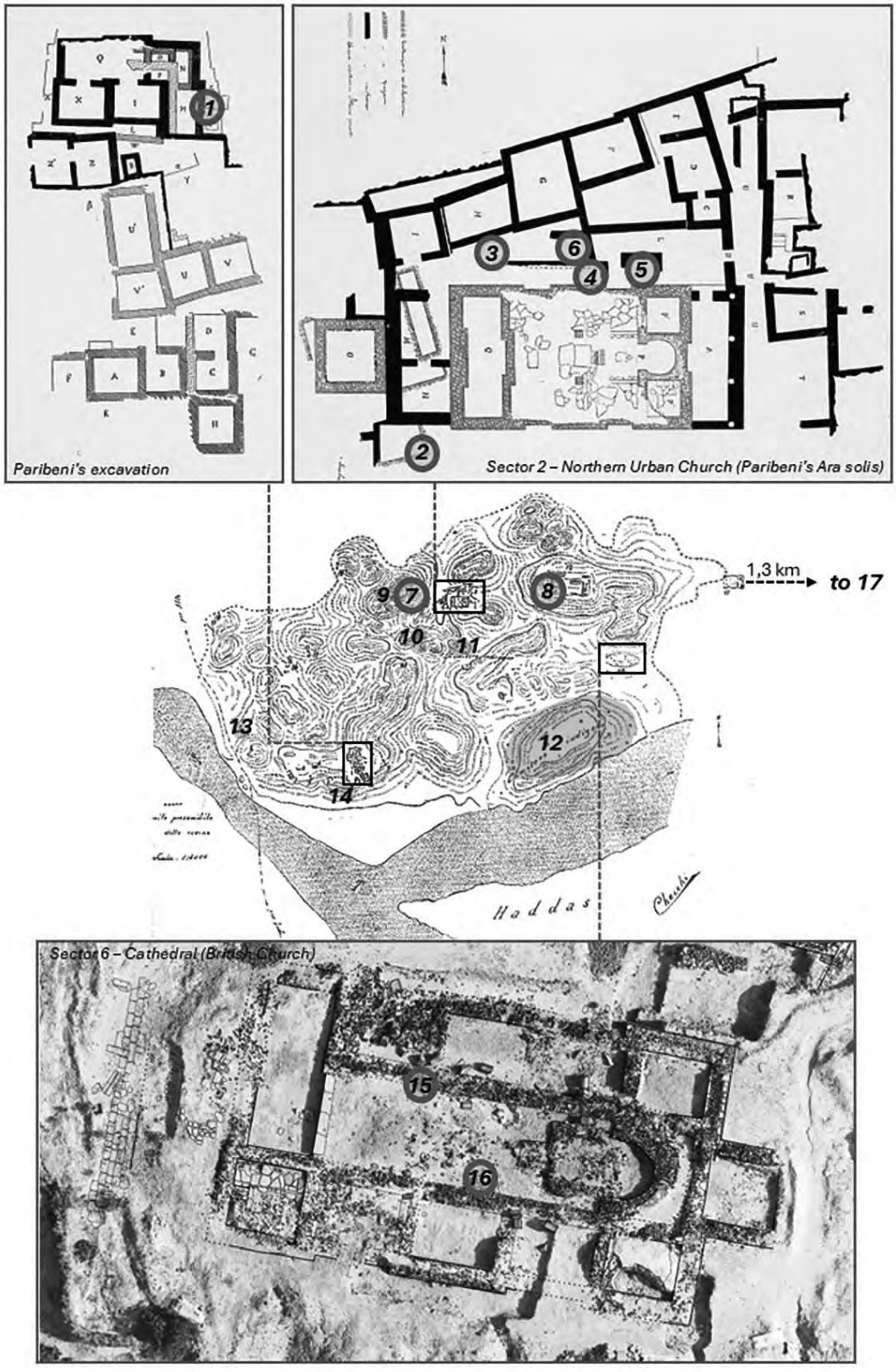

Fig. 4 - Distribution maps of tombs and burial groupings discovered or described during the Adulis surveys and excavations.

made of large, squared blocks with a stone slab floor. There is no information regarding the cover of the burial chamber, which was found beneath rooms already known to Paribeni, who had not excavated below the masonry structures surrounding the burial space. These structures likely included a window in the east wall. The tomb contained a skeleton embedded within a homogeneous silty-sandy matrix that had seeped into the chamber over time. Decomposition occurred in a void space, with clear evidence suggesting the use of a shroud. The individual was found in complete anatomical connection, a condition maintained by the silty-sandy sediment infiltrating the chamber. The subject, placed in a supine position in primary deposition within the burial, was recovered *en bloc*, limiting the preliminary assessment of the skeleton, which was then stored at the Massawa Museum. The micro-excavation was carried out in 2019 at the museum, making a detailed macroscopic anthropological analysis possible. The skeleton belongs to an adult male in his 40s to 50s. Morphologically, the skull presents features cautiously attributed to a Caucasoid form. The analysis did not identify any pathologies, though the poor preservation of the cortical bone tissue may have limited the findings.

The second burial was discovered in 2018, just a few metres west of the one found three years earlier (fig. 6a-d). The grave was excavated in situ in 2019, enabling the preliminary anthropological analyses conducted in greater detail at the Northern Red Sea Regional Museum in Massawa (fig. 6a-b). This tomb, like others, is quadrangular, with walls formed by roughly cut blocks and a compacted earth floor (fig. 6b). The west wall of the tomb, marking the narrower side, is an adjoining wall built with squared blocks, serving as part of the foundation for the northern access staircase of the church. Both the covering and the western section of the tomb are missing. The fill is homogeneous, consisting of loamy soil mixed with small pebbles and gravel, which rarely exceed 2 cm in diameter, with numerous charcoal fragments that are densest in the southwestern corner of the chamber (fig. 6d).

The lower portion of an adult skeleton is in anatomical connection, as are parts of the forearms and hands (fig. 6b, c). Both femurs and humeri exhibit post-mortem fractures close to the foundation blocks (fig. 6b). Skull fragments, vertebrae, ribs, scapula, and the distal portion of the humerus were found in the southwestern corner, concentrated within a small, dedicated area. In the southeastern section of the chamber, the lower limbs of a non-adult individual and part of the adult's pelvis were uncovered (fig. 6c). Several of these bones show varying degrees of burning, including the right mandible, the right scapula and clavicle, and parts of the proximal third of the right humeral shaft. Numerous small charcoal fragments appear throughout the fill (fig. 6d).

Fig. 5 - Tomb discovered north of the church in Sector 2. The tomb is a large, deep stone-block structure that contained a single male individual. The body was laid in a supine position and oriented west to east.

This evidence indicates a primary deposition of an adult in the lateral left decubitus position, with the upper portion of the skeleton later disturbed during the construction of the foundation for the north staircase entrance to the church. The upper portion was then recovered, reduced and partially burned, and redeposited in the southwest corner of the chamber. The long bones, likely selected, belong to a second, non-adult individual. Specifically, the remains in-

Fig. 6 - a) The burial was discovered in 2018 in Sector 2 before excavation and anthropological recovery. The bones were covered by a layer of aluminium foil and a layer of sterile soil. b) After cleaning the surface, the subject showed a left femur transected transversely at mid-diaphysis by the foundation wall of the northern staircase of the church (1). The best-preserved portion includes the lower limbs of an adult in anatomical connection (2). c) The pubic symphyses of both pelvises (1) appear eroded but in anatomical connection, located in the southeast corner of the structure, along with several long bones of the lower appendicular skeleton of a non-adult individual (2). d) Numerous large charcoal fragments were found within the burial fill.

clude an adult female approximately in her 40s and a non-adult around four years old. Alongside the human remains, numerous non-human bones, some calcined, were found and morphologically identified as belonging to an adult specimen of *Capra sp.*

The extra-urban context

Surveys conducted in the area surrounding what would have been the city centre revealed evidence in 2014 likely connected to extra-urban life. Among these, a non-adult burial in an amphora was discovered in Area C, located south of the site along the erosion front of the Haddas watercourse, showing signs of damage from water erosion by 2015. This prompted the team to recover the tomb *en bloc* and conduct a preliminary study of the remains that same year.[19] Preserved within the fluvial sediments of the Haddas basin, the *enchytrismòs* burial could not be examined due to the lack of vertical excavation, leaving the pit cut and base level of this simple pit burial.

Archaeologists recovered the individual in a supine position within the amphora, maintaining primary placement, and transported the remains *en bloc* to the Massawa Museum, where an initial skeletal assessment was conducted.[20] In 2019, a thorough cleaning and paleopathological analysis of the bones was completed. The individual has the hands crossed over the chest, though fluvial erosion had caused the loss of some skeletal elements. The remains belong to a non-adult of approximately 9±3 months and undetermined sex, showing dense, diffuse porosity on elements such as the cranium, temporomandibular joint, basilar part, dorsal portion of the scapula, and ventral portion of the ilium. These features can cautiously be linked to a form of micronutrient deficiency disease, likely related to vitamin C deficiency; however, the absence of advanced radiological analysis for more precise differential diagnosis precludes greater certainty.

Post-abandonment findings

The urban context

The first information of a tomb in this area is provided by Eduard Rüppell in 1838, recounting his 1832 journey to Adulis. Arriving among the city ruins, he reported a large building, likely a Christian Basilica due to numerous column elements, with a burial site nearby, to the southeast, which contained the remains of a famous Mohammedan saint.[21]

A few years later, during his Eritrean journey between 1839 and 1843, Théophile Lefebvre noted the inhabitants of Zula and their cemetery with significant marble decorations from ancient Adulis. Lefebvre's report provides clues for identifying the

[19] Carannante *et Al.* 2015.

[20] Carannante *et Al.* 2015, p. 282.

[21] Rüppel 1838, pp. 258-268.

tomb of Šek Ismael, an eminent figure from village of Zula, upon whose tomb was placed a fragment of white marble bearing a laurel wreath. Near his tomb but within the same burial nucleus, other funerary structures were adorned with emblematic elements, such as a 1.50 m high pillar with a 15 cm diameter and fragments of marble slabs.[22]

Richard Sundström provided similar information in 1906 during his excavation campaign, describing how locals had decorated the tombs of their ancestors with pillar and marble slab fragments from nearby hills. He also mentioned discovering at least one human skeleton inside a room in the 'Palace of Adulis', buried after the area's abandonment but with an uncertain chronological framework.[23]

In his 1906 archaeological campaign, Roberto Paribeni described circular tombs approximately half a metre high in the southwestern part of the city, near the Haddas riverbank.[24] Excavating two of these structures, whose association with local ancestors was not remembered by locals, allowed the identification of two adult skeletons. Although in bioarchaeological terms these did not reveal ritual characteristics that could define their mortuary practices, a cautious exclusion of Muslim customs was possible, as we did not observe the canonical position curled on one side with the head towards Mecca.[25] Paribeni also visited the Zula cemetery near the tomb of Šek Mahmud, featuring prestigious materials from ancient city structures.[26] Specifically, the tomb of Šek Mahmud was adorned with a large basalt slab, while a nearby tomb bore a rudimentary monolithic basalt column. Paribeni does not mention the two prominent alabaster slabs currently standing over the tomb, suggesting they may be later additions. The tombs within this burial ground fall into at least two groups: one group within an enclosure that marks the area of the Šek's tomb and an outer group. The outer group also includes occasional high-quality materials from Adulis structures, among which, as Paribeni lists, a column drum, two crafted capitals, and two square-section pillar drums. Slightly to the southwest of the Bet Khalifa burial ground,[27] Paribeni identified additional burial structures unknown to the local inhabitants.[28] During his excavation, Paribeni conducted several stratigraphic test pits; among them, test pit number 1, located at the westernmost portion of the site near the Haddas, revealed an adult Muslim burial without grave goods, except for a shell, whose significance as a funerary gesture Paribeni could not determine.[29] In a broader excavation area in the northern sector of the site,[30] the Italian archaeologist uncovered an

Fig. 7 - a) The burial was discovered in 2018 in Sector 6 (Cathedral) before excavation and anthropological recovery. The bones were covered by aluminium foil and a sterile soil layer. b) Following cleaning, the position of several anatomical regions became identifiable, allowing recognition of a subject lying in a left lateral decubitus position. c) Bone remains of the subject during in situ micro-excavation. Detail of the skull and upper thoracic area.

[22] Lefebvre 1845, table. XI, fig. 1-3.
[23] Sundström 1907, p. 174.
[24] Paribeni 1907, cc. 339-340, table. I, 8.
[25] *Ib*., cc. 440-441.
[26] *Ib*., table I, "Indigenous cemetery" southeast.
[27] *Ib*., c. 442, table I, "Indigenous cemetery" in the middle.
[28] *Ib*., c. 443, table I, at W of 20.
[29] *Ib*., c. 446, table I, 1.
[30] *Ib*., c. 452, table I, 14.

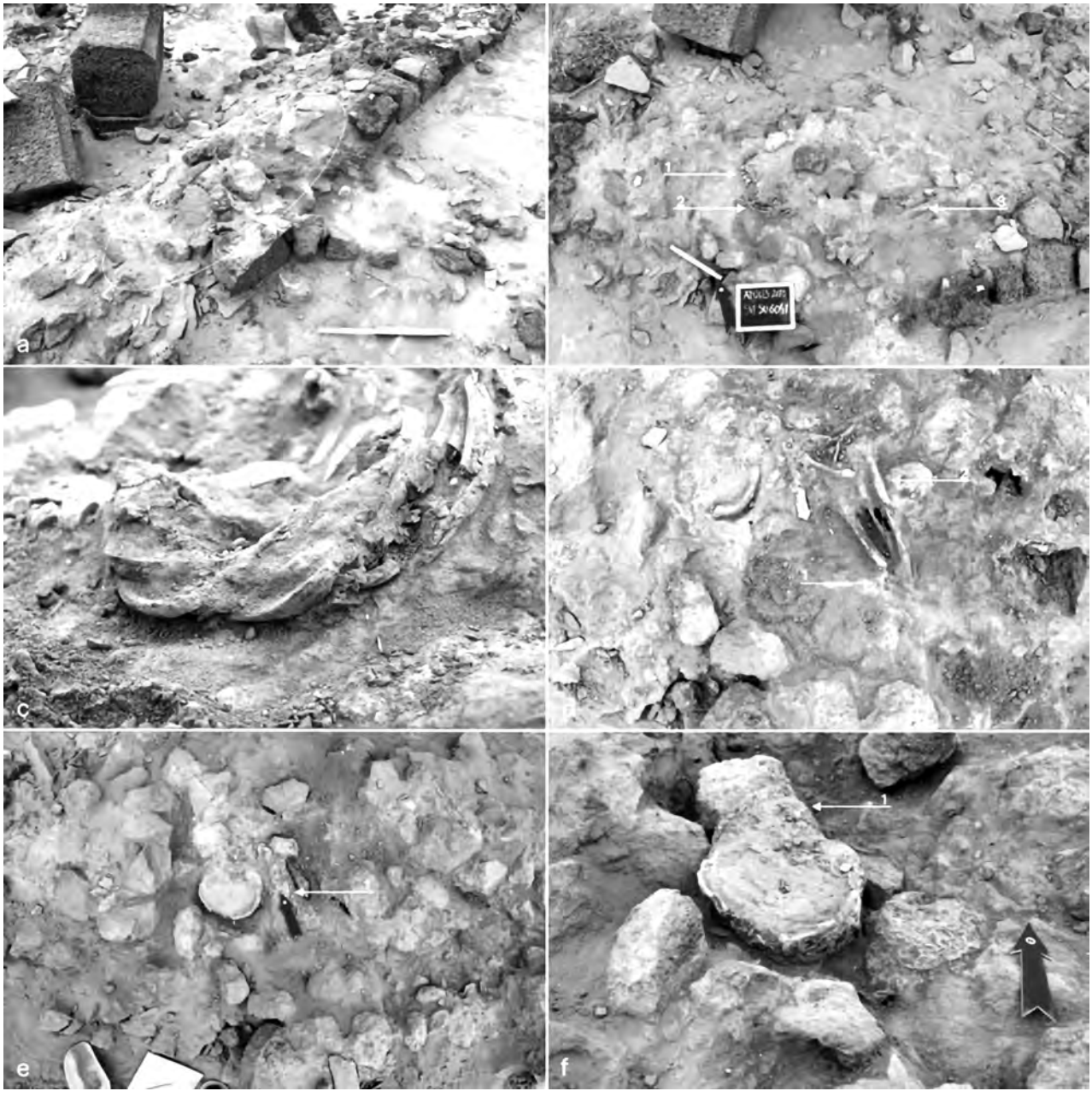

Fig. 8 - a) The burial was discovered in 2020 in Sector 6 (Cathedral) before excavation and anthropological recovery. The perimeter, carved into the northern stylobate of the church, is outlined by a continuous white ellipse, while a dashed white ellipse marks a stone perimeter perpendicular to the primary structure, whose interpretation remains uncertain. b) The initial excavation phases revealed the upper thoracic spine (1), the right ribs (2), and the right femur of the subject, positioned in left lateral decubitus. c) The collapsed right ribs within the empty thoracic cavity. d) The humerus (1), radius, and ulna (2) allow reconstruction of the upper appendicular position. e) Bone preservation is poor, and the bone matrix appears friable and fragmented (1). f) Excavation of the skull revealed the splanchnocranium region (1). The face is oriented northward, with the head held in position by an orderly circle of stones.

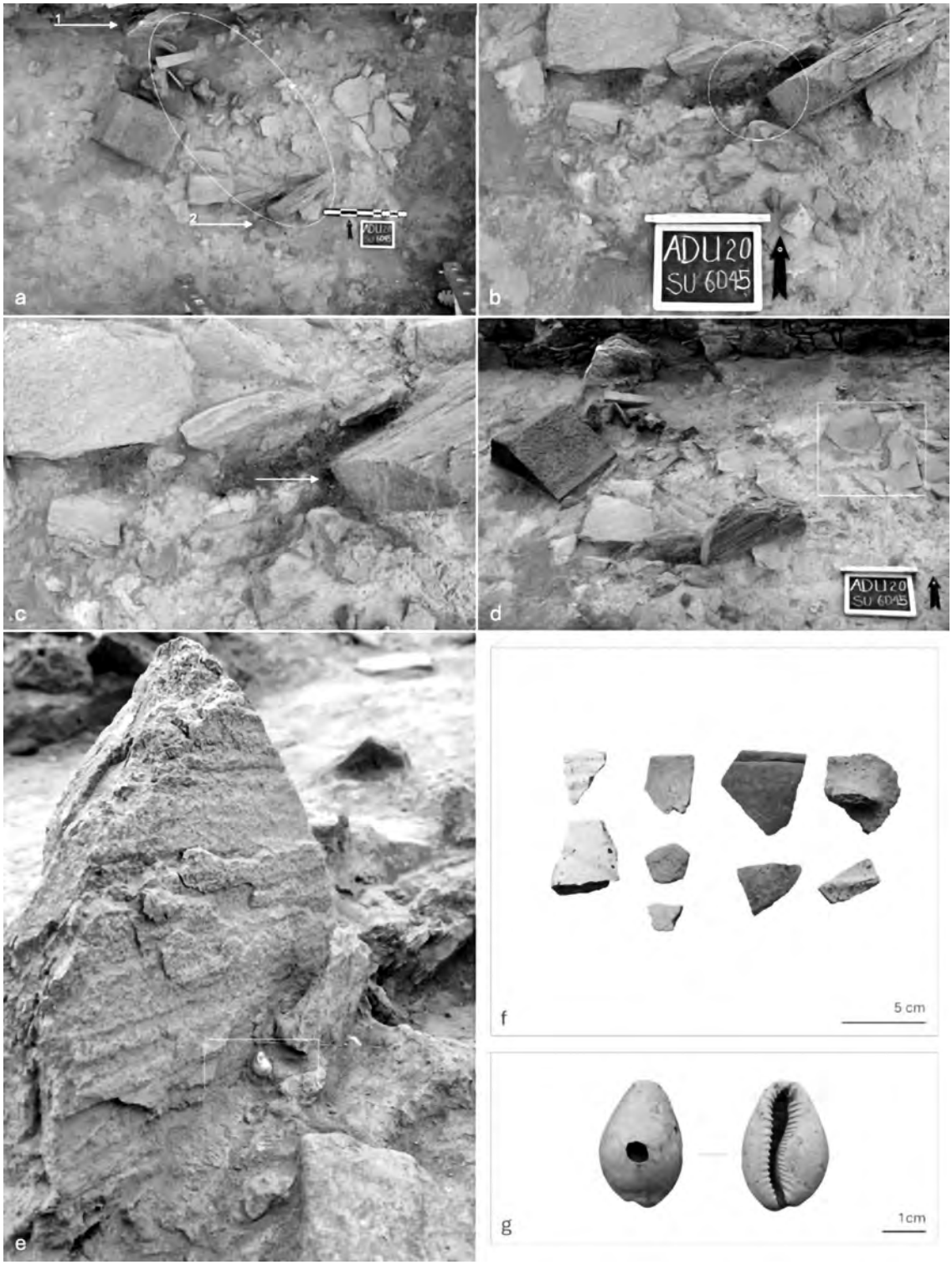

Fig. 9 - a) The burial was discovered in 2021 in Sector 6 (Cathedral) before excavation. The structure, carved into the church nave, is marked by a continuous white ellipse. The schist marking the tomb is indicated by white arrows, with the northern marker indicated by arrow 1 and the southern marker by arrow 2. b) A thick carbon layer was visible at the base of the southern schist (white circle). c) The white arrow marks the point from which the charcoal sample for radiometric 14C dating was taken. d) Several schist slabs positioned horizontally to the east of the pit formed a flat surface, from which numerous fragments of local pottery were recovered, shown in table f. e) A perforated cowry shell, shown in figure g, was found in front of the schist slab.

adult skeleton in the upper strata, which he interpreted as the result of an accidental death rather than a formal burial.

During the 2018 excavation season, an inhumation burial was discovered in the central-southern part of the church nave in Sector 6 (Cathedral) (fig. 7a-c). The remains were micro-excavated on-site during the 2019 campaign (fig. 7a-b).[31] The tomb structure consists of a pit dug directly into the soil with an earthen floor, over which two stone slabs were positioned: one beneath the neck and the other near the right forearm of the deceased. There are no preserved elements suggesting a possible covering. There are no boundary stones in the northeastern part of the structure, while several large stones appear to have been arranged in a loosely regular pattern to demarcate the grave in the northwest and southwest parts. At least two shale slabs bordered the pit along the southeastern side, positioned behind the subject's shoulders. A large stone served as a headrest in the southeastern corner. The pit filling consisted of a clayey-sandy sediment with frequent, randomly distributed centimetre-sized lithic inclusions, fragments, and shards, including some marble. Decomposition occurred in loco, resulting in secondary voids, indicated by the displacement of some bones. While most bones remained in anatomical connection, there were exceptions, such as the atlas, which had shifted beneath the chin, and the left ribs (IX, X, XI, and XII), which had rotated slightly toward the pelvis. A fine, stratified silt-sand fill was found inside the thoracic cavity and neurocranium, likely resulting from natural sedimentation and distinct from the material in the surrounding pit. The skull, left arm, left ribs, and left hemipelvis had been partially removed by a later cut that intercepted the upper part of the burial. The remains belong to a skeletal female individual, aged between her fourth and fifth decades. Cranial morphology indicates typical Negroid characteristics, with an elongated form along the sagittal plane and jaw protrusion, known as prognathism. Additionally, the orbits are distinctly rectangular and widely spaced, with a notably broad nasal bridge above a relatively large nasal aperture. Finally, the teeth are large, with substantial spacing between them.

During the 2020 excavation campaign, burial site US 6043 was identified, located within the northern stylobate of the central nave in the Cathedral (Sector 6) (fig. 8a–f).[32] The skeletal remains underwent microscale excavation in situ, where preliminary anthropological analyses were performed. Significant skeletal parts, such as the skull and spine, were further excavated at the Northern Red Sea Regional Museum in Massawa. The tomb structure is an ellipsoidal pit measuring approximately 1.57 × 0.63 m, slightly wider on the western side where the upper portion of the skeleton lies (fig. 8a). It is bordered by roughly hewn basalt and schist stones, ranging in diameter from 10 to 20 cm. The southern part of the structure overlaps the area likely occupied by square blocks that had fallen from the northern stylobate of the church, possibly removed during the pit construction (fig. 8b).

A section of the nave wall remains visible in the southeastern part of the tomb, identifiable by its squared dressing, well-defined corners, and a size noticeably larger than the stones used to border the grave. Seven stones were arranged radially around the individual's skull. No data is available regarding any possible markers above the tomb. The pit fill comprises stones like those used to border the tomb, arranged chaotically and tightly interlocked with the bones, frequently damaged by the stones themselves (fig. 8b-e). A sandy-clay loam with ochre-burnt earth tones fills the spaces between the stones. This matrix also includes numerous randomly oriented elements, mostly gravel with sharp edges and some marble fragments.

Decomposition likely occurred in a filled space, as most bones retain anatomical connection (fig. 8c-d). However, the mid-spine is distinctly divided between the ninth and tenth thoracic vertebrae. The two spinal sections are separated horizontally by approximately 8 cm and vertically by around 15 cm. This displacement, however, did not disrupt anatomical continuity, with the bones maintaining an orderly arrangement on different planes. The only non-anatomically connected bone is the ninth thoracic vertebra, which rotated 90° to the left in relation to the spine's axis. The right section of the neurocranium and splanchocranium is missing, likely due to natural erosion or human intervention.

[31] Larentis 2020, 2021a.

[32] Larentis 2020, 2021a.

The bone tissue is deteriorated and friable, probably due to bone substance loss from diagenesis (fig. 8e). This is likely attributed to the depositional environment, which, when present, had a thin cover layer and was exposed to factors like high temperatures, significant seasonal and daily thermal variations, and abundant rainfall during certain periods of the year. Some bones, particularly those in the knee joint and right hand, show considerable damage, possibly from partial exposure along the natural erosion face on the northern side of the burial. A cavity beneath the individual may reflect a preserved primary void. Determining the formation of secondary voids is not possible, as events likely altered the original burial arrangement, preventing this assessment.

The remains belong to an individual with skeletal morphology typical of the sub-Saharan area, male, in his 40s, positioned facing Mecca, in accordance with Islamic practices (fig. 8f).

The grave structure's boundaries are marked by two shale slabs embedded in the ground (figg. 2d, 3a, 9a). A thick carbon layer (fig. 9b) was found at the foot of the southern stele, from which a charcoal sample was taken for radiocarbon dating (fig. 9c). A platform made of thin, horizontally placed shale slabs was discovered near the grave, which stratigraphic analysis indicates was contemporaneous with the grave's construction (fig. 9d). A cowry shell with a central perforation, likely an offering to the deceased, was recovered from the carbon layer (fig. 9e, Plate g). Local pottery fragments were also found among the shale slabs in the rectangular platform adjacent to the grave (fig. 9d, Plate f). These elements support interpreting this structure as an Islamic tomb.

The individual was not recovered, as the pit floor has not yet been reached during excavation. A series of radiocarbon datings was performed on the available skeletal remains, supplementing archaeological data and contributing to a chronological framework of the site based on burial evidence (Table 2).[33] This clarified that the remains, dating from the late fifteenth century to the late eighteenth century, represent a subsequent reuse of the site by Muslim communities, occurring many centuries after the building had ceased functioning as a Christian church.

In the 2021 excavation, another grave was uncovered within the nave of the Cathedral (fig. 9a-e). The tomb's boundaries are marked by two slate slabs embedded in the ground, indicating the pit's limits (figg. 2d; 3a; 9a). A thick carbon-rich layer (fig. 9b) was found at the base of the southern stele, from which a charcoal sample was extracted for radiocarbon dating, the results of which are still pending (fig. 9c). A platform of thin, horizontally positioned slate was discovered near the burial structure. In stratigraphic terms, this platform aligns with the tomb's construction (fig. 9d). A perforated cowry shell, possibly an offering for the deceased, was found at the centre of this carbon layer (fig. 9, e, Plate g). Additionally, local pottery shards were located among the slate slabs in the rectangular platform near the grave (fig. 9, d, Plate f), suggesting a likely Islamic burial. The bottom of the pit has not yet been reached in the excavation, so the human remains are still uncovered. These dates were obtained from buried human bone, calcined non-human bone, and charcoal. Given the significance of the tomb discovered in 2020 in Sector 2 for the site's interpretation, multiple radiocarbon dates were conducted on various materials.

Table 2 - Available radiocarbon dating of remains unearthed at Adulis. Findings are organized by area, discovery year, calendar year intervals with 95.4% confidence (two sigma).

Sector	Year Excavated	Individual #	US	Material	Date	Calibrated AD Years	Sample Name
Survey	2015	1	Area C	Buried human bone	1505,12	550-600	ADU_ANPH_2015
II	2020	1	2194a	Buried human bone	1820,40	124-338	ADU_II_2020_1H
II	2020	2	2194b	Buried human bone	1804,14	215-321	ADU_II_2020_2H
II	2020	-	2172	Non-human calcined bone	1818,17	175-322	ADU_II_2020_1NH
II	2020	-	2172	Charcoal	1780,8	240-326	ADU_II_2020_1Ch
II	2015	-	?	Buried human bone	1548,32	431-591	ADU_II_2015_1H
VI	2019	1	6039	Buried human bone	278,41	1480-1799	ADU_VI_2019_1H
VI	2019	-	6040	Buried non-human bone	282,11	1526-1655	ADU_VI_2019_1NH
VI	2020	1	6041	Buried bone	245,14	1641-1795	ADU_VI_2020_1H

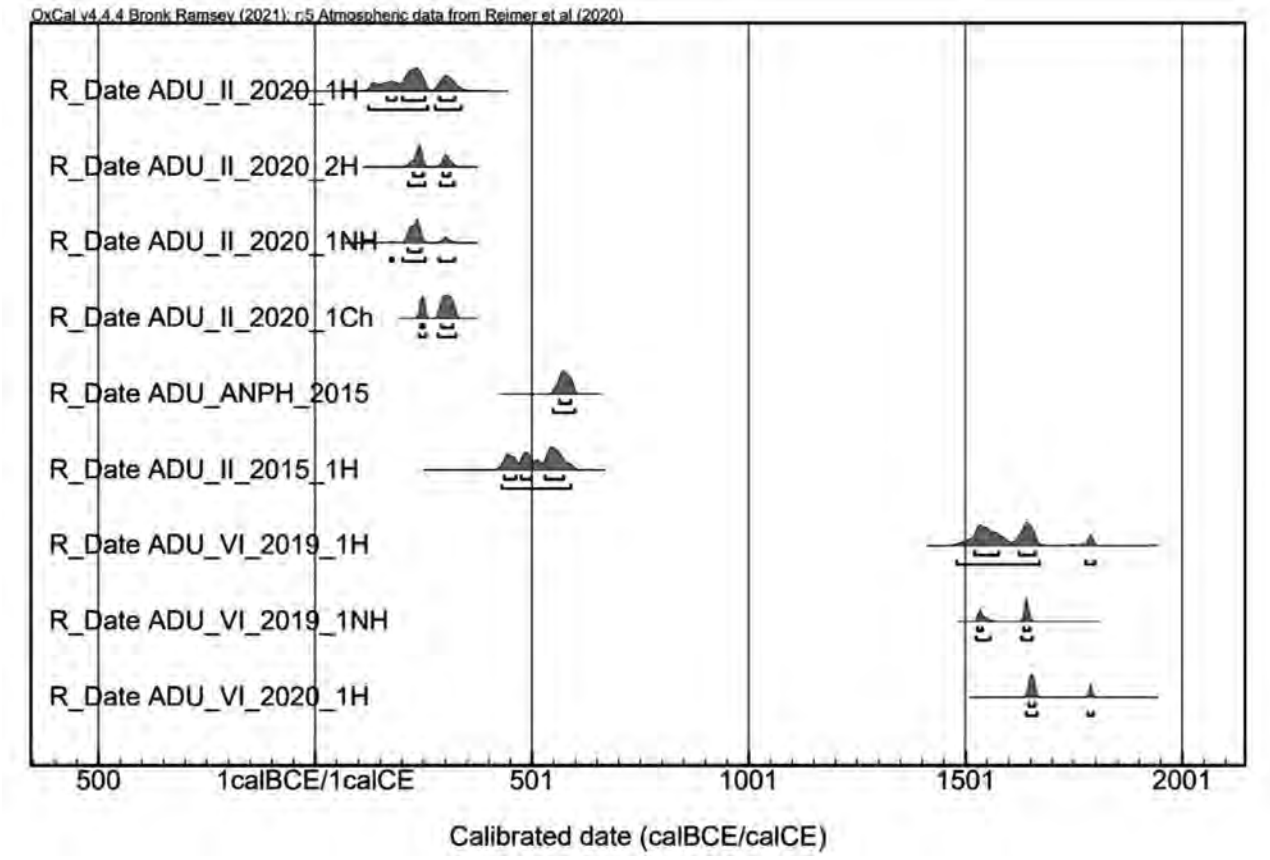

Fig. 10 - Box plot representing all radiocarbon dates associated with tombs or osteological material from Adulis. Date ranges are shown with bars indicating one- and two-sigma confidence intervals.

Radiocarbon dates with two-sigma confidence levels (95.4% of probability) have been integrated into a single plot to visualize chronological distribution in context (fig. 10).

Reflections on the Use and Development of the Burial Space at Adulis

The only information on the funerary use of Adulis within the city boundaries to date has come from Paribeni, who based his analysis on the stylistic dating of amphorae used in *enchytrismòs* burials found in the current Sector 2 and in the 1906 Trench 14. His findings indicate that it was customary to conduct burials either within the city limits or near its residential areas. Additionally, Paribeni often notes that the skeletal remains recovered from these amphorae belonged to non-adults, suggesting a common Mediterranean practice of urban burials for infants.

However, the main challenge to Paribeni's findings lies in the extensive chronological span of the amphorae in which these bodies were interred. Spanning five centuries, this timeframe is too broad to pinpoint a specific period in the city's history, especially one marked by significant changes and transformations - from the early centuries AD to its decline and abandonment. The bones recovered from the amphorae could have provided crucial information for a more precise contextualization of this funerary practice. Unfortunately, these remains are no longer available, as they were either lost or not preserved even in Paribeni's time, thus precluding radiocarbon dating.

A more precise indication, however, comes from the discovery of the infant burial in Area C described above. This burial, within an amphora typologically dated between the fourth and seventh centuries, was radiocarbon dated to between 550 and 600 AD. Although it is not possible to confirm with certainty that Paribeni's findings are contemporary with this burial, nor that Area C served as a formal cemetery rather than a peripheral zone containing a single burial structure, we

can hypothesize that the practice of amphora burials was indeed in use by the sixth century. Paribeni also documented findings of infants buried near buildings southwest of the Haddas watercourse in pits dug directly into the ground, but these discoveries do not add significantly to the general understanding of funerary practices at Adulis.

Of particular interest is the double burial found in Sector 2, see above, partially cut through by the construction of the northern access staircase to the church. The tomb preserves the lower portion of an anatomically connected adult female, alongside the partial remains of a child, approximately four years old, and non-human remains (identified as *Capra sp.*). Both human and non-human bones display traces of exposure to fire, further evidenced by small charcoal fragments found within the tomb fill. Interpreting this context is complex, and no definitive conclusion has been reached. One possibility is that the human remains represent two separate burials disrupted by the construction of the northern staircase; in this scenario, the child's remains may have been moved to the adult's tomb, which was partially spared from the construction activity. Alternatively, this could be an actual double burial that has been disturbed in its lower section.

The burnt non-human bones may suggest a ritual offering, perhaps performed in response to a perceived disturbance to the tombs during the staircase construction, viewed as a violation of the peace of the dead. In this case, the offering might be interpreted as a gesture of appeasement, meant to soothe the deceased's spirit. Supporting this theory is the evidence of burning on the woman's bones, which aligns with the likely area where the ritual involving the non-human bones took place.

Regardless of these ritual aspects, the tomb is significant for dating purposes. The human remains in the burial date between the first/second and fourth centuries AD; the animal bones range from the second to the fourth centuries AD; and the charcoal fragments have been dated from the third to the fourth centuries AD. Thus, this context does not extend beyond the fourth century and predates the construction of the northern staircase, which postdates the podium of the church in stratigraphic terms. It is likely that the tomb belongs to an earlier phase, with its location possibly no longer visible on the surface, or that the staircase construction may have caused its partial removal. Notably, the tomb was oriented east-west, parallel to and near the podium.

Additionally, the position of the adult, laid on the right side in a slightly crouched position, is uncommon in Christian burials. This raises the question of whether the tomb in Sector II might belong to a pre-Christian burial phase, and whether the podium's respect for its position could suggest the presence of a pre-existing symbolic or cultic site, which may have fostered the development of a burial area nearby. However, this interpretation remains speculative and will require further extensive excavations in the area for confirmation.

To better contextualize this burial, we should compare the available data with findings from the Kingdom of Aksum, dating between the second and seventh centuries AD, and key cities like Yeha, Mätära, and Qohayto. Notable discoveries at Aksum include the "Tomb of the False Door," the "Tomb of the Brick Arches," and the "Mausoleum", which reflect the architectural achievements of the Aksumite Empire at its height between the second and fourth centuries AD. However, these monumental contexts do not provide an adequate comparison to the Adulis burial.[34] Even the stone platform tombs, stelae, pit graves, shaft graves, and staircase tombs at Aksum - often marked by their monumentality - find no comparable examples in the Adulis area.[35]

At Yeha, the funerary evidence dates to the first millennium BC, consisting mainly of rock-cut tombs, such as those at Daro Mikael. These tombs, positioned at a distance from the religious sites, consist of vertical shafts leading to multiple lateral funerary chambers, likely intended for collective family burials, often accompanied by a wealth of grave goods. Although these findings are primarily from the first millennium BC, this burial method appears to have persisted largely unchanged until the sixth century AD, when the temple was consecrated as a Christian church.[36]

Matara also provides relevant data, with ten tombs discovered in the latter half of the twentieth

[33] Larentis 2021b.
[34] Larentis 2020, 2021a, 2021b.
[35] Munro-Hay 1989a; Phillipson, Phillips 1998.
[36] Fattovich *et Al.* 2000; Phillipson 2012, pp. 139-157.

century.[37] These tombs share similarities with those at Yeha, reaching depths of 2 to 4.5 m and occasionally sealed with stone slabs. However, unlike Yeha's designs, which incorporate two or three lateral chambers, the tombs at Matara contain only one side chamber.[38]

Direct comparison between the burial in Sector 2 and the tombs in the Aksumite area does not yield sufficient evidence to define the cultural or religious identity of the individuals buried here. However, given that Adulis was a port city likely inhabited and frequented by groups from diverse origins, it is possible that cultural and ritual influences also came from other regions, such as the nearby Arabian Peninsula. The Arabian Peninsula and coast likely played a critical role in the historical development of Adulis' surrounding region, as Folchi notes in "The Foundation of Zula" (see below), as well as in the *Periplus of the Erythraean Sea*. In this regard, the archaeological site of Daba al Bayah, excavated in Oman in 2012, provides an interesting parallel. This site includes a complex of large collective tombs, where the deceased were often accompanied by grave goods. The evidence dates from the Iron Age II (1100-600 BC) to the Late Pre-Islamic Period (250 BC-400 AD),[39] with burials frequently featuring overlapping bodies. Some specific features at Daba al Bayah, such as burials with the deceased positioned on their right side, the practice of selecting and reducing bones, and the common presence of goat bone offerings within tombs, offer intriguing points of comparison.[40] However, this comparison remains speculative, as recent systematic excavations in the Arabian Peninsula have only just begun to provide data, and Adulis lacks a sufficiently large sample of burials to support reliable statistical comparisons.

The other burial in Sector 2, a privileged tomb located near a place of worship, offers information on a later phase, dating to the fifth-sixth centuries.[41] During this period, alongside *enchytrismòs* burials in urban and suburban areas, it was likely customary to bury prominent individuals near what were possibly the primary spiritual centres of the city. In this case, numerous indicators suggest a canonical Christian burial: the single interment, the use of a shroud, the tomb's proximity to the church, its orientation, and the deceased's position, supine with arms extended along the sides. These elements support the hypothesis that this tomb belongs to a burial phase closely associated with the spread of Christianity in Adulis.

Early explorers of Adulis observed that the area, marked by ancient ruins, had been transformed in a later period - likely after the first millennium CE - into an extensive necropolis. The relatively recent tombs stood out because the burial level aligned with the surface, while the older archaeological evidence lay several metres below. This hypothesis was further supported by the builders' use of fine materials taken from the monuments of Adulis, often repurposing the ancient ruins. Additionally, local memory preserved the knowledge that these clustered tombs belonged to the ancestors of the surrounding community.

The first records of this cemetery come from Rüppel, who, in the early nineteenth century, mentioned a burial ground associated with Šek Mahmud. His observation was later echoed nearly a century later by Sundström and Paribeni, who described a large cemetery built around the tomb of an important figure from nearby villages. Other similar sites within the archaeological area are noted in historical accounts, such as Bet Khalifa, mentioned by Paribeni as another clan leader's burial place. Lefebvre, in 1845, solely mentions a cemetery linked to Šek Ismael, painting a picture of Adulis as a region scattered with cemetery clusters linked to prominent Islamic nearby village leaders.

While nineteenth and early twentieth century explorers and archaeologists provided only limited descriptions, Teobaldo Folchi adds valuable information in his notes on the Massawa Commissionerate, although he was not an expert in these areas. Folchi recounts the history of the village of Zula and the clans that led it, highlighting three main tribes: Bet Qadi, Bet Khalifa, and Bet Šek Mohammed.[42] According to Folchi, the Bet Qadi claim Arab origins, although he suggests they may come from the Ambra Debra mountains. The Bet

[37] Phillipson 2009.
[38] Anfray 1967.
[39] Anfray 2012b.
[40] Harrower *et al.* 2019.
[41] Genchi *et al.* 2022.
[42] Harrower *et al.* 2019.

Šek Mohammed trace their ancestry to seven priests from Mecca who settled in Aussa (modern-day Djibouti, formerly the Afar Sultanate). One of these priests is said to have founded the tribe in Zula, whose members were deeply respected across a broad region, including among the Habab, Mensa, and Bogos.[43] Notably, the Bet Šek Mohammed enjoyed significant esteem due to their role as 'holy men' and thus were exempt from Italian taxation.[44] Folchi's account also describes how this group lived largely as pastoralists, following seasonal livestock migrations, and how they elected their tribal leaders independently during Egyptian rule (1865–1885).[45] His documentation provides insights into the social, economic, and political dynamics of Eritrea at the time, inadvertently preserving key information for understanding the funerary practices of Adulis.

A local legend holds that the people of Zula trace the origin of their village back to a descendant of one of the seven priests from Mecca, a spiritual connection that has long defined the Bet Šek Mohammed clan, who selected Adulis as their burial site. The tomb of Šek Mahmud, the clan's most prominent village leader, lies within the city's ruins. The tomb, constructed from large alabaster slabs from Adulis, is surrounded by an extensive cemetery within a quadrangular area, with graves of less closely related families positioned beyond this space. In this light, the toponym *Adulis* takes on a deep symbolic meaning for the inhabitants of Zula, connecting them to a sacred lineage embedded in the ancient city's fabric.

A similar pattern seems to apply to the Bet Khalifa cemetery, though more evidence is needed to determine if there was a dedicated burial area for the Bet Qadi clan or if Šek Ismael, mentioned by Lefebvre, could be linked to this group. Paribeni provides a potential lead, identifying another cluster of graves southwest of Sector 2.[46]

Recent systematic excavations have addressed these burial sites, an integral part of Eritrea's archaeological and historical heritage, which continue to be revered by the descendants of the Zula clans. Dialogue with the local communities and clan leaders, guardians of the site's historical memory, has been essential in this process. For these custodians, the site embodies not just historical data but mainly a profound spiritual connection to their land, heritage, and ancestors. Numerous meetings have fostered this exchange, making it possible to verify and expand the available knowledge about the history of these cemeteries.

During these discussions, surveys were conducted across the area, where local village chiefs joined in examining each tomb. Together, they discussed construction techniques, material differences, tomb dimensions, spatial arrangements, and complexities. This collaborative approach highlighted the importance of respecting and preserving these spaces, steering away from intrusive excavation. Consequently, a comprehensive survey was completed, mapping each tomb with GNSS data. This resulted in the creation of the first map documenting all tombs and marking protected zones to prevent future digs.

This triangulation of ethnographic sources, archaeological data, and historical documents has provided a richer understanding of the funerary practices and their evolution over time. Supplementing oral history with archaeological evidence has offered new interpretative insights, not only revealing the site's recent occupation phases but also uncovering the cultural and symbolic ties between the present-day communities and the Adulis site.

Since 2018, excavations in the Cathedral (Sector 6) have uncovered a series of tomb structures within and near the nave. Anthropological, taphonomic, and stratigraphic analyses quickly suggested a possible Islamic cultural association for these tombs. This hypothesis was supported by the discovery of local objects interpreted as votive offerings, such as perforated shells, animal bones, and lenses of charcoal around the vertical markers typical of Muslim graves. Archaeological data have also provided a temporal boundary, indicating that these burials predate the British excavation of 1868. Radiocarbon dating confirmed this timeline, placing the graves between the late fifteenth and late eighteenth centuries. This timeline is significant because the tomb of Sheikh Mahmood dates to the mid-nineteenth century,[47] and the indigenous cemetery that grew around his monumental

[43] Folchi 1898, p. 87.
[44] *Ib*., p. 218
[45] *Ib*., p. 124.
[46] *Ib*., attachment n. 39.
[47] Paribeni 1907, cc. 438-443.

tomb developed afterwards. The findings within the church reveal an earlier Islamic presence than the one associated with the clan leader, showing that Adulis already held symbolic importance for local Islamic groups in earlier periods.

Conclusions

In summary, these recent discoveries have expanded our knowledge of the funerary practices of Adulis,[48] offering new hypotheses about the city's ritual and burial significance. However, the scarcity of ancient remains and the limited number of identified burials indicate that we are only beginning to understand the funerary landscape of Adulis. A critical question remains unanswered: where are the city's primary necropolises located: within or near the urban centre? The latest findings suggest evidence of burial practices predating the Christianization of Adulis, raising new questions about the identities, origins, and connections of the people buried in the area, which could relate to worship sites of different natures than the known churches.

[48] Puglisi 1952, p. 189, Mahmud Maasini, *ad vocem*.

[49] Harrower *et al.* 2019, p. 1537.

Building Techniques and Architectural Skills in Ancient Adulis

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Introduction

In antiquity Adulis was a rich town, a trading centre with a port on the Red Sea extending to the inland protected area of the Gulf of Zula. The settlement, whose stone buildings remain, was an important commercial hub between the East and the West. The site is currently located about 5 km from the coast, at 33 m above sea level according to the 1889 topographic surveys by the Italian Military Geographic Institute (IGMI),[1] on a sort of protected 'river island' raised with respect to the alluvial plain bathed by three rivers: the Haddas, the Alighede, and the Komayle.[2]

Although still awaiting confirmation by archaeological evidence, the documented ancient technologies for water management in the hydro and geomorphological context of the area suggest that there was a dam upstream, which was likely built and anchored between the sides of a rocky basalt bank 2 km from Adulis, where also the modern Foro dam is located. The dam could regulate the seasonal waterflow descending from the upland via the three aforementioned torrential watercourses; an artificial basin could ensure valuable water resources throughout the year for both agricultural and everyday domestic uses.

The dam probably represented a strong point in the urban development of Adulis, as were other dams in antiquity, like Mahrib in Yemen, Mai Shum at Aksum and Safira at Qohayto on the Ethiopian and Eritrean plateaus. At the same time, it represented also a critical point for Adulis, as acknowledged by oral sources, collected by the first European travellers in nineteenth century and still awaiting full archaeological confirmation, recounting that the fate of Adulis and the fact that it was covered by sand and silt was due to an earthquake that destroyed the barrier, consequently causing a ruinous flood.[3]

More recently, in 2015, floods seriously damaged villages close to the dam. Today, control of the modern civil construction built in the 1950s in the village of Foro is a priority not only for the prosperity and safety of the valley communities of Afta and Zula, and for water regulation and proper irrigation of farmed fields, but also for the conservation of the future archaeological and natural park of Adulis.

From a methodological point of view, territorial understanding is important not only for understanding the reasons for the location of a settlement, its survival over time, its abandonment and the various later phases of reuse, but also - and this is the case with the site of Adulis - for defining its archaeological risk, i.e. the hazardous and vulnerable conditions related to the overall cultural heritage in its context. In fact, the risk in archaeological areas may be defined as the result of relationships between hazard and vulnerability, i.e. the product of extrinsic environmental stresses due to the context in which the buildings are located, and intrinsic stresses related to its material/technological components. This is why the cognitive investigation ranges from the territorial scale to the understanding of the critical aspects of the various excavation sectors and the decay/instability of the archaeological ruins.

[1] *Carta dei possedimenti italiani in Africa*, 1:50.000 Sheet C4, Zula in 1890.

[2] Baioni, Porta, Guadagnini in this volume.

[3] Bertarelli 1929, p. 684; Salt 1814, p. 452.

Since 2012, the Politecnico di Milano, in agreement with the *Centro di Ricerca sul Deserto Orientale* (Ce.R.D.O. - Research Centre on the Eastern Desert) - under the coordination of the Eritrean Commission of Culture and Sports - initiated several activities such as contextualizing Adulis in the regional area; conducting surveys of the architectural and archaeological artifacts; studying decay and instability; conducting diagnostic analysis; framing the scheduled conservation/maintenance work; outlining protection measures; designing enhancement activities; and carrying out *in situ* training with restoration school-yards.

Actions in the field saw an immediate cooperation between archaeologists and architects - in relation with other important disciplinary sectors - to understand the site, the chronologies from subsoil to elevations, the functional uses of the architectural constructions, the materials and the construction techniques.

One particular aspect during the excavation campaigns concerned the interaction when planning the archaeologists' activities related to surveying and reading the stratigraphy and the architects' activities related to understanding the building methods (building archaeometry) and securing the areas and buildings in a state of ruin.

The fitting combination between these two disciplines and their players, thanks to continuous dialogue, as called for already in the Athens Charter of 1931, led to the definition of excavation areas and restorations as acts of understanding and conservation, leading up to the narratives of the future park.

Stratigraphic research in the archaeological palimpsests and investigations on the construction materials and technological features of the architectural structures in Adulis enabled greater understanding of the chronology of the evolutionary and transformational phases of the ancient city up to today, reconstructing a long-lasting history.

In the field of conservation, the stratigraphic method helped to validate the material data and contributed to the acceptance of an architecture in the form of a palimpsest, in full respect of the stratified material culture that has reached us, providing an analytical view of the actual state of the surviving architecture.

Understanding materials and techniques provided information on their state of conservation and the causes of decay and instability. Assessments of the conservation state of the buildings, the speed at which some decay/instability develops over time, and the potential risk that certain degenerative forms may represent in the future led to safety, restoration, and enhancement operations. These related to the areas of the excavation sectors as well as to the architectural buildings, including planned maintenance procedures that necessarily also consider conservation measures of the larger territorial context.

Methodological premises on Conservation

Over the course of the history of ideas concerning worksites on architectural heritage, the term 'Restoration' has become loaded with meanings that are often different and sometimes contradictory. A unifying factor can nevertheless be seen, namely a shared idea of restoration as a particular type of project/intervention on a pre-existing *status* that holds value as historical evidence (a monument, document) of a bygone era.

One of the concepts of the contemporary culture of restoration is based on the principle that it is not the image of a building that is being restored, but rather its material, because restoration primarily conserves the authenticity of the work.[4] The task of restoration is not to return to an impossible past, as Viollet-le-Duc would assert, through a stylistic restoration redesigning a potential unitary and complete state: *"restaurare un edificio non è conservarlo, ripararlo o rifarlo, ma significa riportare il monumento ad una condizione primigenia che può anche non essere mai esistita"*.[5] Rather, it means allowing the building or artifact to be transmitted into the future, guaranteeing respect and care for the material or document instead of losing its identity or falsifying it irreversibly. In this sense and in the modern language of restoration, we speak of 'Conservation'. This means intervening to ensure that the artifact entrusted to

[4] Brandi 1977.

[5] Viollet-Le-Duc 1984, p. 247: *"restoring a building does not mean conserving it, repairing it, or redoing it, but rather bringing it into a primigenial condition that may never have existed"*.

us remains available for the future, for us and for the generations to come, removing or slowing the causes of decay that endanger it and enabling its enjoyment and use. This important affirmation has been achieved over the course of about 150 years of history of restoration consisting of condemnations and lectures from the great masters of civil thought, including Victor Hugo, John Ruskin, William Morris, Camillo Boito, Alois Riegl, Georg Dehio and others: history as common heritage, cultural reference, and undeniable ethics.

In addition to 'care', worksite operations are followed by the theoretical precepts already stated by Camillo Boito in 1893: *"bisogna che i compimenti, se sono indispensabili, e le aggiunte, se non si possono scansare, mostrino, non di essere opere antiche, ma essere opere di oggi […]* [completando] *le opere in materiali o con metodi diversi",*[6] pursuing the practices of minimal intervention and conservation/maintenance.

Therefore, proper interventions to preserve architectural constructions cannot transcend an initial cognitive act carried out through historical research[7] and the study of direct sources, 'the writing made of stones',[8] i.e. the information contained in the masonry itself. Together with rigorous independent documentary research and accurate surveys, the analysis of material or direct sources contributes to laying a new cognitive path aimed at understanding the building's 'text' through the set of historical/construction concepts. Such analyses lead to the identification of chronologies relating to the built parts, recording the technical knowledge and the use and processing of the materials.

As a 'text', a building thus becomes the source of practice in analysis/interpretation.

In addition to providing metrical knowledge, surveys enable us to fully realize the actual state of the building, by means of its geometrical, physical, material, and pathological features and its actual static, performance, morphology, and distribution capacities.[9]

The data processed in plans, elevations, sections, 3D views and suitable mappings provide bases and thematic maps that are fundamental for laying out the conservation project. In addition to autoptic readings based on visual evidence and instrumental analyses then rendered in drawings, we also rely on *in situ* and lab-based diagnostic analyses. The case study in Adulis required - as often happens in practice - the performance of specific diagnostic analysis in the lab. This allowed us to understand the historical mortars and their supports in order to formulate and use compatible new mortars with elevated durability, employed with the utmost attention to the historical and material authenticity of the monument.

This historical analysis led us knowledgeably to an appropriate conservation project, which in the case of Adulis involved both reinforcement and maintenance operations on the existing material *facies* and its layers. This was also thanks to the preparation of a programmed maintenance project for both the building and the surrounding area.

These are the theoretical and methodological assumptions underlying the project for the conservation, maintenance, protection, and enhancement of the architectural structures present in a state of ruin in the archaeological area of Adulis. The restoration project is aimed at conservation, with interventions that are the least invasive as possible (minimal intervention) and with the utmost reversibility, capable of slowing material degradation and structural instability.

Finally, while respecting the value of use, future interventions for the usability of the site (providing shelter and new accessibility, defining visitor itineraries, services, etc.) should be expressed in modern-day language - the language of twenty-first century people and architects - as a quality addition to the design so as to produce authentic added cultural value.

Adulis: the Context and the Communities

The archaeological restoration worksite of Adulis - following the aforementioned principles - served as an opportunity to deepen the research on issues related to conservation in archaeological

[6] Boito 1893, pp. 14, 17. *"the completions, if they are indispensable, and the additions, if they cannot be avoided, need to show they are not ancient works, but works of today […]* [completing] *the works in different materials or ways".*

[7] Massa, in this volume, Chapter 8.

[8] *Carta del Restauro* 1883.

[9] Dezzi Bardeschi 2004, p. X: *"*[thus] *introjecting careful preliminary diagnosis in the respect and care of the construction".*

sites, also in relation with the communities. From this point of view, the site constitutes an interesting 'laboratory-in-the-making' for multiple reasons. Among these, Adulis involves multiple aspects:

- stone architecture of great interest - the site holds specimens of internationally recognized importance - in a vast area of about 40 hectares, most of which has still to be uncovered from thick layers of alluvial deposits;
- ongoing activities for the future realization of an archaeological and natural park, an example that can be replicated in relation to the adopted training methods (on desk and on field) in research, conservation, safeguard of archaeological sites and cultural landscape in the Horn of Africa; based on a holistic approach as a key element for sustainability;
- settlements near the archaeological area of resident communities in traditional villages (Afta and Zula);[10] supporting their livelihood is important to avoid depopulation, for example by providing opportunities/suitable measures, and improving accessibility to services with renewed connections;
- developing this place as a territorial centre in transition towards equitable and sustainable prosperity from the environmental and cultural points of view, integrating local knowledge with international experience in agriculture/breeding and agroforestry in semi-arid contexts;
- identifying a suitable master plan that clearly defines the limits of the park, the permitted anthropic expansion, the borders of the farmed fields and pasture areas; the occasional presence of nomadic Rašāyida[11] communities, one of the nine ethnic groups of Eritrea, is also considered, and in this sense it will be useful to design proper and compatible transit corridors specifically for caravans with livestock;
- developing experimental guidelines for a preservation/maintenance programme to contrast the effects of persisting extreme environmental conditions and hazardous events in the area (rising temperatures, flowing water and gullies; strong gusts of *khamsin* winds; infesting vegetation), occurring with increasing intensity occasionally and/or cyclically and putting pressure on both the excavated areas and the structures over time; these best practices could be replicated in other similar contexts;
- particularities of the cultural/rural landscape and the panoramic natural/environmental landscape, with the possibility of seeing views of the upland and sea from the site, as well as glimpses of local micro and macrofauna (birds, hyenas, ostriches, hares, etc.);
- opportunity to use operations in the field (reconnaissance, survey, excavation, conservation, etc.) as good practices for the lifelong learning of a new generation of public workers and researchers in Eritrea, and of collaborators in the local communities, who will guarantee not only the management of the process in the long term, but the protection and enhancement of the site as well;
- supporting economic development without threatening the cultural and natural heritage, which also forms part of the traditional knowledge of resource management;
- and finally, the expertise and support of authorities, Eritrean colleagues, and local operators.

Materia Signata

The documents brought to our attention - generally in the form of 'things' and 'objects' - consist of *artefacts* (products of human work) and *ecofacts* (the result of the human-nature relationship). Marc Bloch states, *"knowledge of all human events of the past has as its first characteristic that of being knowledge acquired through traces"*[12]: material traces of human existence, material evidence with civil value.[13]

Paraphrasing Braudel, contemporary historiography focuses on the 'material civilization', repetitive gestures, silent and almost forgotten stories of people, long-term conditions, whose weight

[10] POLLERA 1935, p. 262.

[11] W.C.YOUNG, *Rašāyida*, in *EAe,* vol. 4, *ad vocem*; POLLERA 1935, p. 214.

[12] BLOCH 1969, p. 63.

[13] 'Franceschini' Commission [Francesco Franceschini, Member of Italian Parliament and Politician] *Commissione di indagine per la tutela e la valorizzazione delle cose di interesse storico, archeologico, artistico e del paesaggio*, was instituted in 1964 and ended in 1967.

was immense and whose noise was barely perceptible.[14] This is why we need to 'listen' to the *materia signata* as a vehicle for understanding *"how human beings have developed their conduct, communicated, and built knowledge"*.[15]

With this line of reasoning, understanding the 'material nature' of the site in question starts from investigations in the field, with later confirmation through laboratory analysis, in continuous, necessary interaction with the ancient landscape.

At Adulis, the stones - schist and basalt - represent a predominant part of the natural construction materials that have reached our time.

Mineralogical/petrological analysis on thin cross-sections using polarized light microscopy helped to identify the type of stone and its possible origin. For the schist, the petrological definition is *biotite gneiss* (metamorphic). The one generically called 'basalt' actually consists of two types of stone: *ignimbrite* (an effusive magmatic rock with a high silica content) and *alkali basalt* (effusive magmatic rock); the latter has a vesicular structure. The original geological formations are the following: for biotite gneiss, Precambrian high-grade metamorphic rock; for ignimbrite, probable Miocene-Pleistocene volcanic rock; and for alkaline basalt, probable Pleistocene lava flows.[16]

Studies of the 'stone cycle' - from the quarries to the finished object - raised questions regarding the choices and operations of professional know-how in antiquity. This know-how begins with the choice of the raw material in the reference context, continues with the methods and tools used to quarry and work it, and ends with the construction of the buildings using specific techniques. Other materials, not just stone, contribute to the construction of masonry in Adulis, including soil, used in various ways, mortar, and wood.

From what can be seen today, stone constituted the basis for religious, residential, and production buildings (workshops).

In this area, there is an enormous difference between construction in antiquity and today. In fact, today's remains of cities of stone are flanked by the simplicity of the villages of Afta and Zula, which mainly consist of huts, called *arisc*.[17] These have a rectangular floor plan and were built with a simple structure made of wooden beams and a roof and walls made of bush cladding, which were treated with *cicca*, a traditional organic mortar used to waterproof the outer walls of the huts, consisting of clay, animal hair and manure.

The sources of stone supplies were probably quarries located in the surroundings of the place where they were used. These were likely open-pit quarries capable of supplying ashlar, quarried with the 'detach, collect, and build' procedure. The natural stratification of the schist (fig. 1) made its quarrying process possible along the sides of Mount Ghedem about 10 kilometres north of Adulis (Map 1), while the cracks in the basalt rock formed by the rapid surface cooling of the lava ejected during eruptions enabled the extraction of ashlars along the pebbly riverbeds of the Haddas and Komayle watercourses (about 5 km upstream of Adulis). Upon breaking, the rock formed both angular blocks ideal for dovetailing techniques, and square blocks with horizontal and/or vertical surfaces useful for 'bricklaying' techniques (fig. 2).

The methods for transporting these ashlar stones, and especially the larger ones (i.e. slabs of schist for the floors, blocks for preparing the base, basalt drums for columns and capitals) are still not entirely clear. Given the significant amount of construction material needed to build the entire city, theories on the transport of these nearby materials (not the special pieces arriving from other places in modern-day Eritrea, like the approximately 5-m-long granite threshold in the Cathedral, or from Anatolia and the Mediterranean, like the prized stones used for interior coverings) have had to consider both the reliability of locally available materials and short hauls that were 'easy' to implement from the logistical point of view. To transport the construction materials, the hypothesis of using animals, even elephants, cannot be excluded, with the possible use of rolled trolleys, simple sledges, or rafts when it was possible to follow the course of the Haddas. Toponyms reflecting the strong presence of elephants in the area, although not as ancient as Adulis, include Irafayle (deriving, according to folk etymology, from the Arabic *ara fila* "I see an elephant"[18]) and H'rgigo (originally named Dähono from the Saho language word *Da-*

[14] Braudel 1967.

[15] Jervis 1999, p. 14.

[16] Map issued by Consiglio Nazionale delle Ricerche: "Carta geologica dell'Etiopia e della Somalia 1:2,000,000", Firenze 1973.

[17] Cipriani 1940, pp. 150-152; Gezae, Negassi, in this volume.

[18] A. Saleh Mohammad, *Iɣāfálo*, in *EAe*, vol. 3, *ad vocem*.

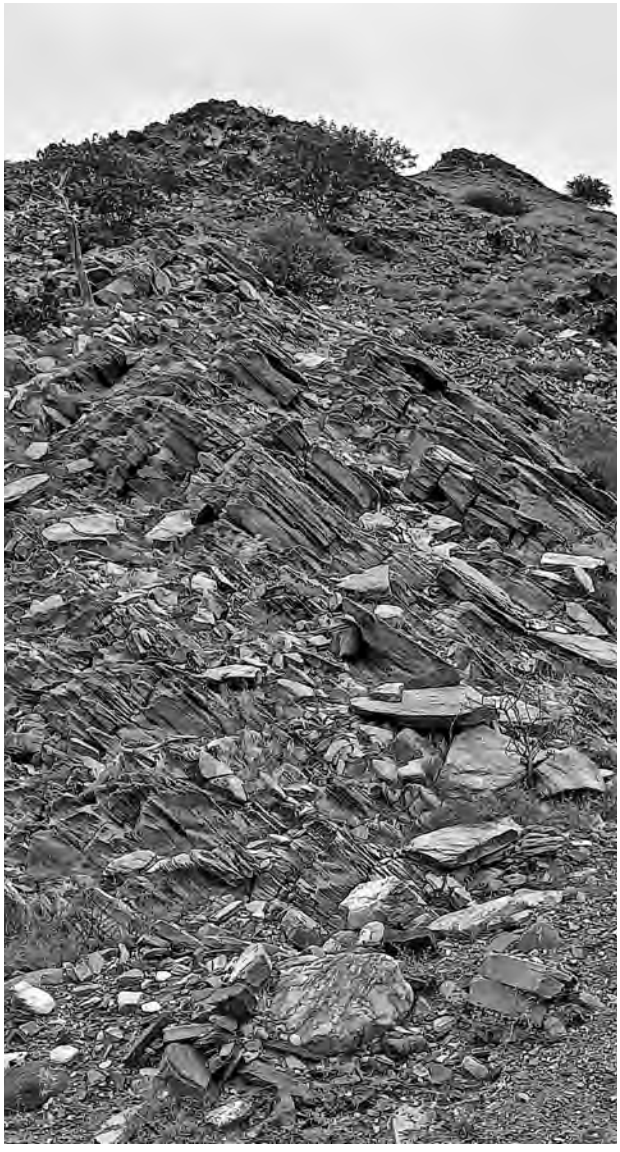

Fig. 1 - Schist quarry, Ghedem Mount, near the entry pass from the north towards Foro along the road to Àseb.

kano, meaning "elephant"[19]). The description of the Buri Peninsula states that the area "*was an elephant-hunting ground for the port of Adulis"*,[20] and moreover the oldest inscription of the *Monumentum Adulitanum*, dated to the third century BC, explicitly refers to elephant hunting.

The premises underlying the construction at Adulis would therefore be the affordability of materials near the site, short-distance transport between the quarries and the worksites, assembly of the individual elements partly roughed out by local workers, a presumably significant workforce, and even trade by sea for the arrival of other prized materials.

As regards the clay, the presence of banks of this material has been noted in the flood plain or edges of the riverbeds, where sand of various grain sizes is also available.

The difficulty in recognizing ancient clay beds - used not only for building, but also for ceramic production - is partly due to the fact that such intensive activities were carried out over a long time and the size of the sites was very probably reduced, with traces that can hardly be detected now.

Asregards the wood, historically the territory - undoubtedly less arid - presumably included an area along the coast and on the highland well connected with caravan routes, where it was possible to procure wood for both construction and shipbuilding. European travel reports from the nineteenth and early twentieth century describe more or less dense forests, mainly of juniper trees, which in Bent's memoires surrounded the ruins of Qohayto,[21] while Paribeni refers to bushes of *Suaeda monoica* (locally named *htum*) in the area of Adulis, in the coastal lowlands.[22] However, procurement and transportability issues were not insignificant.

There are few remains of wood on site. Radiocarbon dating of the only consistent combustion residue of a probable threshold (a large charred beam found during the archaeological excavation of the Eastern Church), performed by Milano-Bicocca University in 2017, showed a chronological range between 530 and 635 AD. Paribeni, in his description of how the Eastern Church could have been originally, writes *"le soglie delle porte erano formate da un grosso trave le cui estremità sono incastrate alla base dei muri laterali. Avendo l'edificio subito un grande incendio, le travi carbonizzate erano al loro posto e si è procurato di lasciarvele, rinunciando anche a ripulire bene gli stipiti"*.[23]

It is possible that not only wood, but also manure, straw, dry branches and the like were used

[19] R. PANKHURST, Ḥərgigo, in *EAe*, vol. 3, *ad vocem*.

[20] A. SALEH MOHAMMAD, *Buri Peninsula*, in *EAe*, vol. 1, *ad vocem*.

[21] BENT 1896, p. 220.

[22] PARIBENI 1907, c. 238.

[23] PARIBENI 1907, c. 530 "*the door thresholds were made of a large beam, the ends of which are embedded in the base of the side walls. As the building suffered a major fire, the charred*

Fig. 2 - Basalt quarries along the Komayle River.

Fig. 3 - Circular foundations for column and/or pillar bases in the central nave of the Northern Urban Church.

Fig. 4 - Northern urban Church: Construction Techniques.

in the construction process as fuel to produce bricks, tiles, and lime. In this respect, no brick-production sites or lime kilns are found at Adulis today.

However, bricks have been recovered sporadically. A certain number of bricks, which are now being dated using thermoluminescence, were found in the apse area of the Cathedral.

As Munro-Hay states, the presence of fired bricks brings to mind the preparation of brick 'horseshoe' arches found at Aksum.[24] It could be that bricks were used for certain parts of the construction, such as the realization of a probable arch in the apse of the cathedral, both due to their 'light weight' compared to stone, and for better management of the geometric shape.

With no identification yet at Adulis of lime production sites, but only 'usage sites' (i.e. buildings where the presence of lime-based mortar has been proven by diagnostic laboratory analysis),[25] the field of observation is, unfortunately, limited to analysing lime as a 'product' present in mortar fragments from the external plasterwork and in the interior finishes of buildings at Adulis. The latter are evident on pillars and columns, as well as in the ruins of materials fallen in several rooms. These traces are also very useful for establishing the scope of use.

Little is known about the means of ancient lime production in this particular area. The raw material for lime production is a calcareous rock. To determine the origin of the materials for essential lime

beams were in their place and we made sure to leave them there, not even cleaning the door jambs properly".

[24] Munro-Hay 1989c, pp. 157-161; Phillipson, 1997, pp. 187-189.

[25] Analysis by DIARTLAB at Luigi Soroldoni & C. S.A.S.; Soroldoni, in this volume.

Fig. 5 - Cathedral: Construction Techniques.

production, a comparison was first made of the geolithological properties of the place.[26] In this case, suitable characteristics for lime production are found in pebbles from the Haddas watercourse, in some still unverified sites to the west of Mount Ghedem, and in the compact banks of the coral reef in the Dahlak Archipelago and in Buri peninsula, just on the opposite shore of the Gulf of Zula. This last resource is certainly the best due to the mineralogical/petrological properties of the calcium carbonate. The use of basic kilns such as pit or earth ovens can be hypothesized, considering, as Mannoni and Giannichedda state, that lime production is often held to be one of the simplest fired arts and the least demanding with respect to the plant structure.[27] Quicklime was produced and then slacked with water.

Finally, continuing with the stones, the presence of numerous alabaster fragments is of great interest: hypotheses supported by mineralogical analysis may suggest that the origins of this crystalline calcareous concretion could come from the Arabian Peninsula (Yemen, in particular), but also from nearby areas. The different work on the two sides of some slab fragments recovered at the site attest to varied uses. Slabs with two 'smooth' sides (often also decorated with low relief) were used for window panels. Slabs with one smooth side and one unfinished side (suitably prepared to be grasped easily) were used as valuable wall cladding. The cladding and decorative friezes could also be made using polychrome marble, even Proconnesian marble, red porphyry, green and black porphyry, serpentinite, or, as in the case of particular finds in the Northern Urban Church, slabs of schist with *"carved leaves"* for *"metal incrustations*".[28]

Marble from the quarries on Marmara Island in the Sea of Marmara also arrived to Adulis. The arrival of material from these quarries, dating to the second - sixth centuries, was supported by the significant construction of Christian churches (in-

[26] Censini, in this volume.
[27] Mannoni, Giannichedda 1996, p. 313.
[28] Paribeni 1907, c. 506.

Fig. 6 - Eastern Church: Construction Techniques.

cluding the cathedral). The presence of Proconnesian marble and even semi-finished products for construction, derived from economic and political relationships that Adulis entertained with production centres in the Marmara, Aegean, and Eastern Mediterranean Seas has also been noted.

Architecture: Construction Techniques

At the current state of research, we do not have a complete understanding of the preparation layer for the foundations of buildings raised in Adulis. The surveys show the presence of layers of beaten earth mixed with small stones, shells, and bones. These levels are in direct contact with the ground. They were therefore mainly created to level out irregularities of the terrain and to compact it before constructing the buildings.

As regards the subgrades of the Northern Urban Church, Paribeni writes: "*come parte sotterranea dell'edificio resta un muro verticale senza ulteriori riseghe, alto poco più di m. 0.50, un fondamento, come si vede, piuttosto esiguo"*.[29]

For prestigious buildings, the risk of landslides, slippage, and cave-ins was compensated by podium bases with steps and recesses, and by their anchorage to the foundation. Situated within the perimeter of the podium base, the latter constitute a sort of 'case structure' containing fill material, thus constituting an effective plateau useful for preventing the base from cave-ins and for distributing the superstructure load uniformly over the ground. The same technique was used in the towns on the highlands, as evidenced by the surveys of buildings in Aksum, Tekhondaâ and Qohayto made in 1906 by the Deutsche Aksum Expedition (*DAE*).

[29] Paribeni 1907, c. 465. *"as the underground part of the building, there remains a vertical wall without any further recesses, slightly higher than 0.50 m, a rather scarce foundation, as can be seen".*

Fig. 7 - Northern Urban Church: general view from south-east of the podium with recesses.

In residential and production buildings, the foundation walls are not different than the walls above ground; they are mainly rubble masonry walls. The larger ashlar blocks are placed at the base on the external side of the masonry section; the solidity of the stonework depends on the thickness, corner reinforcement, and joints of the upper walls. When these conditions are lacking, the rubble masonry walls have little structural resistance.

There are also circular foundations for the columns and pillars, both for religious (see the central nave of the Northern Urban Church, fig. 3) and residential buildings. An example of the latter are the rooms excavated in 1961-1962 by Francis Anfray from the Institut Éthiopien d'Archéologie.[30] Examples of refined buildings at Aksum include cylindrical foundations like these in the *Ta'akha Maryam* palace, which was documented by the *DAE* in 1906.

In neither case are these circular foundations anchored to the perimeter stonework; rather, they are used to manage point-like loads, such as columns and pillars made of basalt or probably wood.

When describing residential buildings, Paribeni calls them "*sottofondazioni cilindriche*", i.e. "cylindrical subfoundations", because they also sink lower than the perimeter walls.[31] The top is described as made of a basalt disc for better distribution of point-like loads of trunks of palm or other trees that supported the roof platform.[32]

One of the objectives of this contribution is to describe the stonework of the buildings in Adulis, by referring to direct observation of materials, construction techniques, and, where possible, the evolution of the type as 'indicators' in a chronological perspective. Other possible variables are the specific technical choices in relation to particular parts of the building.

[30] Anfray 1974, pp. 745–765; Massa, in this volume, Chapter 8.

[31] Paribeni 1907, c. 512.

[32] *Ib.,* c. 545.

Fig. 8 - Northern Urban Church: angle brackets, masonry devices enabling strong junction of the perimetral walls (northeastern corner of the podium).

In the prestigious buildings, it seems clear how the need to construct complex monuments with significant heights - also ensuring a higher quality standard than for common buildings - must have required notable organization at the worksite. An attempt to list the specializations would include - beside the director of the works - miners, quarrymen, and labourers; cutters for large stones; workers specialized in working smaller stones; stonecutters and masons; brick makers; lime producers; mortar workers; carpenters; woodworkers; blacksmiths; plasterers; and decorative and finishing workers, probably also coming from other regions.

Thanks to the stonework in the buildings at Adulis known today, we can confirm and list several construction techniques.

Wall masonry techniques

At Adulis, the *podium base* is present in prestigious buildings, where there are also fragments of a lime topcoat. Richard Sundström, a Swedish missionary who excavated the so-called 'Palace' at Adulis in 1906, calls the podium construction technique 'graduated masonry'.[33]

This is a stepped base, but only towards the exterior side: the single steps are about 50 cm high and recede by about 5 cm between each step. The podium wall has a rubble-filled section. The inner side does not have steps and is vertical; in contact with the fill material of the foundations, it is made of roughed basalt and some schist, sometimes acting as bond stones (*diatona*) occupying the entire wall thickness.

Building techniques for the large steps can vary, while maintaining both the overall shape of the structure and its static function.[34]

In the Northern Urban Church, the steps of the podium show a technique consisting, like in the other cases, of basalt and schist, bound using a small amount of mud mortar and clay. From bottom up, the structure of each individual step involves first two schist courses with slabs placed horizontally, then two basalt courses wedged together and bound with a bit or mortar, and lastly another schist layer.

The peculiarity is that the first basalt course consists of slightly roughed blocks with the flat part in contact with the underlying schist and the wedged part directed upwards. The second course is made of the same but smaller blocks, and the wedges point downward instead with the flat facies directed upwards in contact with the last schist row. Therefore, the two basalt rows of each step are interlocked. Following this in the elevation, the step ends with the last schist row, which is useful for aligning and levelling the basalt by virtue of preparing the next narrowed step (fig. 4).

In the Cathedral, the steps of the base are made of the same materials (basalt, schist, and mortar),

[33] Paribeni 1907, c. 464.

[34] *DAE*, Band II, p. 99, fig. 215.

but with a different technique. In fact, while the Northern Urban Church shows a surface in which the stonecutter's primary work is to rough out the basalt ashlar and then dovetail the stones, in this case the stonemason shapes the basalt stones in parallelepiped shapes (squared blocks). These are laid in rows and suitably 'staggered' (when done properly) at half the length of the underlying block. Therefore, the horizontal preparation of the basalt blocks refers to a surface like one made by a 'mason'. Like the Northern Urban Church, there are two schist rows at the foot of the step and one at the top; their purpose, here as well, is to rectify and level, as is done with the basalt (fig. 5).

In the Eastern Church, Sector 4, the base is designed with the same rhythm - two schist rows at the base of the step and one at the top - while there are three/four courses of small and medium-sized basalt, both polygonal and more often parallelepiped shaped.

This is Parabeni's description of the base of the Eastern Church: *"Il muro è costruito con molta regolarità a massi di basalto poroso, tagliati non a poligoni, ma spesso a forma quasi parallelepipeda, interrotti al solito da lastre di arenaria [scisto] che segnano a intervalli uguali di m.0,50-0,55 le riseghe. Ciascuna di queste rientra sulla più bassa di cinque o sei centimetri precisamente come nell'altro edificio* [i.e. Chiesa urbana settentrionale]*"* (fig. 6).[35]

The structures of the *podium* have such characteristic shapes that they make these 'original' buildings in the Horn of Africa distinguishable. In addition to the stepped *podium*, the peculiarity can also be seen in the 'recesses', indentations of about 25 cm, which fully become an important element of the formal lexicon, strongly denoting the architectural layout of the external elevations, not only of the *podium* itself, but of the stonework of the walls above it as well. The recesses are present in prestigious buildings, but also in the wall surfaces of common structures (fig. 7).

As an explanation of these particular structural connections, we could refer to how local workers understood that the *podium*, as a base with the function of supporting a building above, must also support the horizontal forces transmitted by the foundation fill.

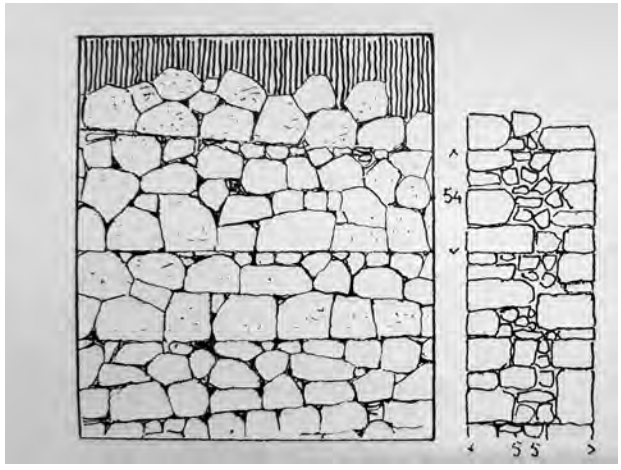

Fig. 9 - Graphic description of the construction technique for the upper walls, the so-called 'simple band' stonework or 'listed' structure, of a building in Qohayto in which the aforementioned bands are approximately 54 cm, while the thickness of the wall is 55 cm (*DAE* Band II, p.96, fig. 210).

If we read these recesses today, they may be interpreted as features with a dual purpose. In fact, the construction concept involves both a good response of the 'recesses' in the *podium* as a structural solution of the perimeter containment walls to support the pressure of the inner fill, and a positive response to the seismic risk, to the particular nature of the ground, and to the peculiar elevation placement. Over time in fact, *podia* with recesses have shown greater endurance and adequacy with respect to seismic, geotechnical, and other vulnerabilities, which are all intertwined at Adulis. A recent study by the Department of Earth Sciences of the Eritrea Institute of Technology indicates a band of elevated hazard on the plate boundaries and around Massawa, the Gulf of Zula and Bada.[36]

What do these recesses consist of, exactly? These peculiar structural elements - in cases where the walls of the recess are joined together - reinforce the external elevation of the podium thanks to the multiplication of the corner stones, which have the purpose of guaranteeing the solidity between the walls of the room and ensuring good overall performance of the wall box.[37]

[35] Paribeni 1907, c. 534. "*The wall is built very regularly of porous basalt blocks, not cut as polygons, but often with a near parallelepiped shape, usually interrupted by sandstone [schist] slabs that mark the recesses at intervals of 0.50–0.55 m. Each of these is set back on the lowest by 5 or 6 cm exactly as in the other building* [i.e. the Northern Urban Church]".

[36] Goitom *et al*. 2018, p. 691.

[37] Cattaneo, in this volume.

Fig. 10 - Graphic description of the construction techniques for the upper walls, the so-called 'monkey head' structure (*DAE* Band II, p.7, fig.9).

This is what occurs in the Northern Urban Church, where there are two recesses per side on the northern and southern elevations. Their symmetrical position with respect to the main room is aligned planimetrically with the trace of the inner thickness of the transversal foundation walls dividing the central room from the *nartex* and from the *pastophoria*. In the same church, the recess in the middle of the eastern side is located in conjunction with the internal walls forming the apse and would support the force of vertical loads of the apse itself.[38]

Paribeni, whose interest was understanding as much as possible the general topography of ancient Adulis,[39] focused on the knowledge of refined buildings, but also and especially of the urban residential area. He conducted many test digs to understand the various levels of frequentation, to identify the typological matrices of the buildings and their connections, and to understand the relationships between open and built spaces. In the excavations indicated as no. 14 to the north of Adulis[40] and no. 8 to the south along the banks of the Haddas,[41] Paribeni identified houses with generally square residential rooms, with outer walls displaying the characteristic recesses described for monumental buildings.[42]

In addition to the recesses along the exterior elevations - which, being corner reinforcements should be intended as multiplied resistance points - one finds also angle brackets, masonry devices enabling strong junction of the perimetral walls.

Given the important static role played by the angle brackets, and their intrinsic vulnerability as well, these were made with great attention, using the largest stones that were worked precisely, squared, and overlapped orthogonally (fig. 8).

At Adulis, the architectural structures show continuity between the foundations, possible *podia*, and upper walls. This is evident by reading scientifically the layers of the palimpsests of the buildings examined.

The floors of the houses were made of beaten earth, while the floors of refined buildings were paved with schist slabs. External staircases gave access to the floor at the top of the podium.

The stonework techniques for the upper walls might have been made with the so-called 'simple band' stonework or 'listed' structure (fig. 9),[43] and with the 'monkey head' structure (fig. 10); both cases involve plasterwork and a lime topcoat. A graphical description of the architectural details of this construction technique is reported by the *DAE*, depicting elevation and cross-section of a 'simple band' wall of a building at Qohayto, where the bands are about 54 cm high, while the thickness of the wall is 55 cm.

As described by Carlo Conti Rossini, the 'simple band' stonework implies the construction of walls of stones mixed with mud mortar in bands of various heights, without insertions in wood, bands that also continue to stand out in the finished construction, and he refers to the upper walls of the Cathedral at Aksum as a refined example.[44]

While no standing upper wall with wooden monkey head elements has been found in Adulis, this

[38] *Ib*.

[39] PARIBENI 1907, c. 444. *"Obtain the largest amount of information possible on the general topography of ancient Adulis, its richness and conservation, and therefore the well-placed reasonable hope in the complete excavation of the city"*.

[40] *Ib.,* p. 452.

[41] *Ib.,* pp. 514-515, particularly the 'plan' of the excavation in fig. 37.

[42] ANFRAY 1974, pp. 745-765.

[43] *DAE*, Band II, fig. 210, p. 96.

[44] CONTI ROSSINI 1928, p. 230.

technique is well represented in stylized form on the large Stele no. 2 at Aksum (figg. 11, 12),[45] where decorative reliefs sculpted in granite depict the architectural elements of a residential tower building of 10 stories made of stone and wood; it also bears reproductions of the doors and windows with their relative frames and overlying stonework bands, the latter alternating with schematic horizontal trusses on which short circular protrusions depict the 'extremities' or 'heads' of small beams situated orthogonally, the famous 'monkey heads'. Note that the 'recesses' are also present in the two main elevations.

In addition to the stele at Aksum, in another historical period, the same technique is also seen in the Church of Enda Abunä Arägawi,[46] the foundation of which is traditionally dated to the fifth-sixth century, at the Debre Damo Monastery. Since the monastery is located on a bristly fortified *amba* (i.e. round-shaped elevation) in the Tigray region in present-day Ethiopia, this place long remained inaccessible. Although rebuilt and restored, the building still shows 'monkey head' elements on the walls (fig. 13). The feature of this stonework actually implies bands made with courses of non-squared small-sized stones bound with very little mortar, alternating with a wooden framework consisting of longitudinal beams (olive wood) in which small cross beams are embedded depending on bond stones.[47] The circular extremities of the small beams, extending from the surface of the wall are called 'monkey heads' (*re'esa hebug*), giving rise to 'monkey head stonework'. Carlo Conti Rossini's description of the same stonework *apparatus* is the following: *"il muro è a doppia fascia. La fascia inferiore, notevolmente più alta (circa mezzo metro di regola), consta di pietrame impastato con mota. Sui margini esterni ed interni di questa prima fascia dispongonsi delle longarine di legno, riempiendo lo spazio intermedio di sassi e fango; poscia, ad intervalli, trasversalmente al muro e alle longarine, dispongonsi tronchi d'albero preferibilmente squadrati, lunghi quanto è largo il muro o poco più, tronchi che incastransi nelle longarine non lasciando sporgere fuori dal muro se non i loro due capi, cui gli Abissini danno il nome di re'esa hebug 'testa di scimmia' donde la denominazione di siffatto tipo di muro. Appunto questo insieme di legno - longarine e traverse - forma la parte superiore della doppia fascia. Così procedesi a doppie fasce sino al tetto"*.[48]

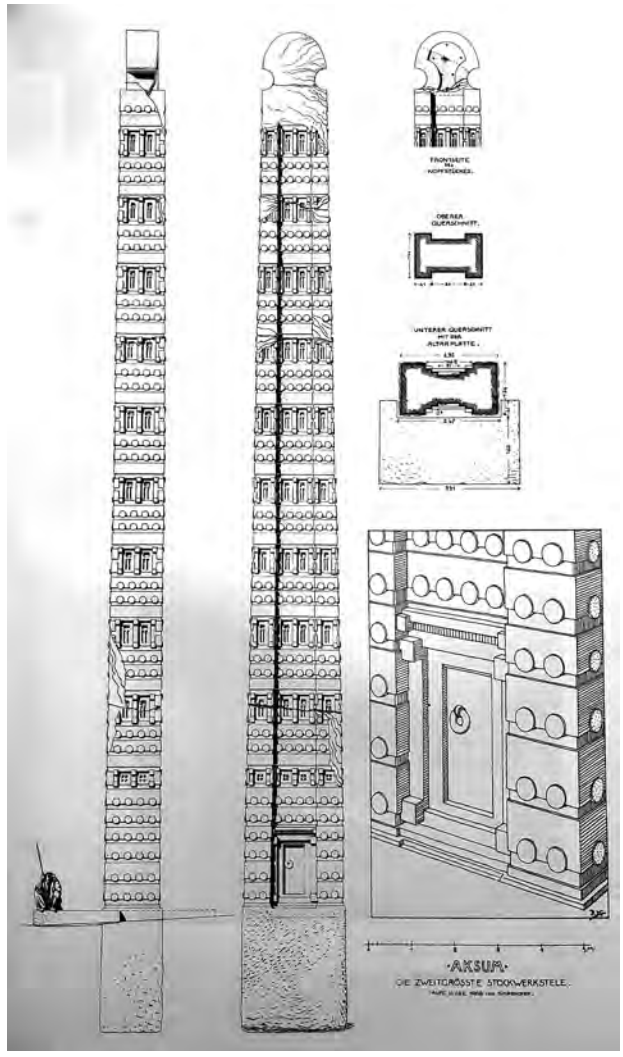

Fig. 11 - The so-called 'monkey head' technique is reproduced also in stelae; in this case in the 'Aksum Obelisk', built between the 1st and 4th centuries AD (*DAE* Band II, Table VII).

[45] *DAE* 1913, Band II, Table VII.

[46] T.B.G.Libanos, *Däbrä Damo*, in *EAe*, vol. 2, *ad vocem*; *DAE*, Band II, pp. 168–198.

[47] Matthews 1949.

[48] Conti Rossini 1928, pp. 229-230: *"The wall has a double band. The lower band, notably higher (about half a metre as a rule), consists of stones mixed with mud. Wooden stringers are placed on the outer and inner edges of this first band, filling the intermediate space with stones and mud. Then, tree trunks, preferably squared and as long as the width of the wall or a little longer are arranged at intervals, perpendicular to the wall and stringers. The trunks are slotted into the stringers, leaving only the two ends protruding from the wall, which the Abyssinians call re'esa hebug 'monkey heads', hence the name of this type of wall. Precisely this wooden assembly - stringers and cross beams - forms the upper part of the double band. These double bands proceed thus up to the roof"*.

Fig. 12 - Detail of the ‘ground floor’ of the ‘Aksum Obelisk’ or Stelae 2, with the door (photo S. Bortolotto).

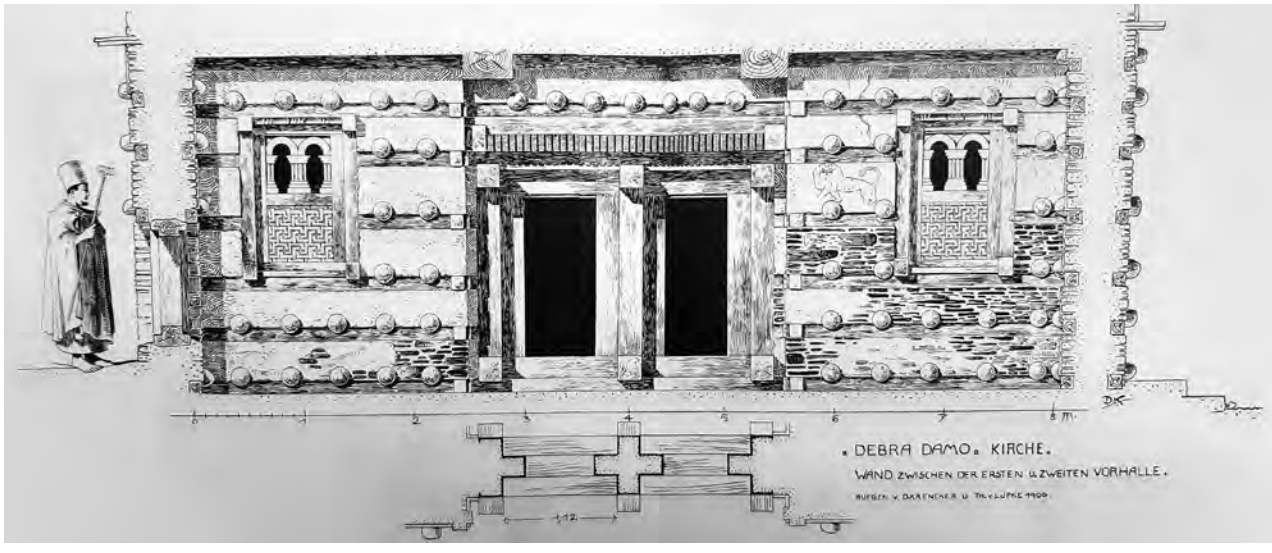

Fig. 13 - Debre Damo Monastery: ‘monkey head’ elements on the walls (*DAE* Band II, Table XXV).

Fig. 14 - 'Biet Christian' Church in Asmera. The original church - whose forms are known to us thanks to the drawings by Theodor von Lüpke (*DAE* Band II, Table XXVI) and also to black and white photos - was a *hedmo*, that is, it took up the forms of a traditional highland house with porch called *gebela*.

The solidity of the walls was also supported by the wooden frames of the doors and windows, with their robust system of jambs and shutters.[49] These frames on the four sides of the openings have protruding cross beams with square cross sections orthogonal to the wall. The Debre Damo Church, with monkey head stonework made of stones, mud mortar, and clay, and a wide use of wood and significant angle brackets made of well-squared stones, also shows recesses in the elevations. This type of stonework - different with respect to the recesses and timber frame system connected to the door and window frames - behaves more than adequately in the event of earthquakes.

It is possible to identify the same technique also in the ancient Biet Christian church at Asmera (fig. 14), well documented by the *DAE*[50] and demolished in the early twentieth century to erect a new church based on a design by the Architect Gallo (1920) in the 'Aksuma style' on the same land.

At Lalibela, the stylistic traces of the rock-hewn churches - dating to around the twelfth century - recall the buildings with band and 'monkey head' stonework. The study of these buildings, shaped as negative evidence using the rock-cut technique in imitation of architectural models built of stone and wood, enables us to understand how the reference to traditional construction forms, without structural but rather formal purpose, is aimed at guaranteeing continuity in conveying recognizable identity values (fig. 15).

Thanks to these 'indestructible' buildings hewn from bare rock and also to the surviving churches built in caves in Ethiopia, like *Makina Madhane Alam* and *Yemrehanna Krestos* (fig. 16) on Mount Abuna Yosef not far from Lalibela as the oldest ones, we have sound references - despite the absence of elevations of the reference models - for the forms of religious architecture and construction techniques that, starting in the fourth century AD, probably remained unchanged because they were functional to the existing construction materials available in the area, and also because their stylistic features gained significant value in terms of cultural identity.

At Adulis, 'band' stonework is mainly seen in residential buildings; the individual bands can easily be detected thanks to a schist course.[51]

In religious buildings, the stonework parts currently remaining above the *podia* are just frag-

[49] *DAE*, Band II, p.7, fig. 9.

[50] Drawings by Theodor von Lüpke (*DAE*, Band II, Table XXVI).

[51] Anfray 1974, pp. 745-765.

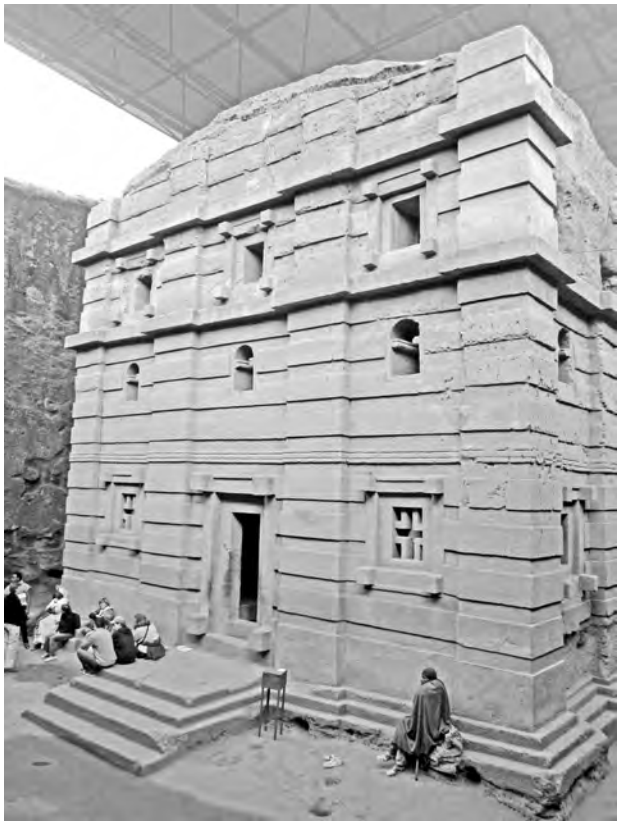

Fig. 15 - Lalibela, Biet Amanuel (photo S. Bortolotto).

ments that do not allow us to describe the construction techniques used for the upper walls. The question then arises: why did they not last over time? Does the fragility of this stonework consist in its vulnerability to one possible event or to multiple events? Or does the fragility depend on its design, built structure, geometries, materials, and/or their state of conservation/maintenance in the long term?

What is certain is that the texture of these building devices was intrinsically fragile. If such refined stonework was, as cannot be excluded, in the 'monkey head' style, the wood (juniper, olive, palm?), i.e. the organic material constituting the delicate timber-frame system, could have been easily destroyed by xylophagous insects over time.

In addition to seismic events, floods, fires, and/or periods of abandonment, the intrinsic material fragility of wood, of rubble masonry using clay as bounding material, and of wall surfaces made with small stones bound with thin mortar layers were probably the causes of their ruin.

What traces of this stonework remain in the archaeological stratigraphy? The presence of phases of collapse of many buildings, or at least of their upper parts, with evidence of accumulation of stones with many roughed out and worked schist and basalt blocks, and the remains of charcoal on the floors and in areas around the structures, all give us a sense of the ancient elevations of the buildings at Adulis, which were obliterated as they were covered over by the wind and the floods of the Haddas, raising the level of the soil significantly.[52]

Many remains are still unknown. The continuity of archaeological research in the field in the coming years will implement this initial classification and correct the current chronological range with new diagnostic findings.

Columns and pillars

Continuing to describe the construction elements of the buildings at Adulis, it is important to dwell on the form of the columns and pillars in their relation to the construction of ceilings and roofs.

The probably wooden pillars and capitals, resting on the circular subfoundations found in the interior rooms of residential buildings, are no longer present. By means of a wooden cantilever, these particular pillars and capitals might have supported the ends of the horizontal roof beams.

Many basalt blocks from columns and pillars have been found in the excavation sectors at Adulis, some of which still show a lime topcoat and colouring, with no evidence of lead clamps to hold the drums together. *DAE* mentions two cases of clamps used to assemble the stone blocks, specifically in relation to the durability of pieces of a basin,[53] and the assembly of angular steps at the palace of *Ta'akha Maryam*, both of which are at Aksum.[54]

[52] Paribeni 1907, c. 570.
[53] *DAE*, Band II, p. 76, fig. 160.
[54] *DAE*, Band II, p. 118, fig. 257.

Fig. 16 - The cave church of Yemrehanna Krestos (photo A. Pellegatta).

In describing the excavation of the Cathedral carried out by the British, Roberto Paribeni mentions a parallelepiped basalt block with a small rectangular hole (0,19 cm x 0,24 cm) saying that the cavity could not be considered for a lead clamp that must hold multiple stones together, and corresponds in fact to the threshold.[55]

Conti Rossini mentions that round columns were practically unknown; examples were noted in the medieval church at Asmara, but the type was probably introduced due to Greco-Roman or Byzantine influence, *"il tipo importato dall'Arabia meridionale è a sezione quadrata con gli spigoli smussati [...]. Di analoga foggia è sostanzialmente il capitello quadrato a due, tre o più scalini i quali, come nelle basi, possono essere la sopravvivenza della pristina sovrapposizione di lastre di pietre piatte o squadrate"*.[56]

In the case of Adulis, there are columns and/or pillars with square-based drums with smooth, straight-cut bevelling. This would not seem to confirm what is indicated by the *DAE*, which refers to typification of the column drums near Aksum; for Adulis they mention the columns with concave bevelled or octagonal corners.[57]

In addition to a few remains of six pillars pertaining to the central nave of the Northern Urban Church and the remains of the four columns, still with a square base, of the *portico* to the east (both with sides of 44-45 cm with bevels of about 10-12 cm), there are still two drums to the south-east of the octagonal colonnade in the Eastern Church.

From the Eastern Church Paribeni mentions that only a few drums from seven out of eight columns remained: three of those to the East were 65 cm large and the four to the West were 47 cm. In his view, the latter ones could have come from previous buildings.

[55] Paribeni 1907, c. 441.

[56] Conti Rossini 1928, pp. 234–235. *"The type imported from Southern Arabia has a square cross section with bevelled corners ... The square capitals with two, three, or more steps essentially have a similar appearance; as with the bases, they may represent the survival of the pristine overlapping of flat or squared stone slabs"*.

[57] *DAE*, p. 101, fig. 218.

Fig. 17 - Column drums. Left aisle of the Cathedral.

The most important preexisting elements today are in the Cathedral. In fact, numerous blocks have been found in this building (fig. 17). Among these it is possible to remark the different heights of the base ashlar blocks, drums, capitals, and slabs presumably upper constituents of the pillars, whose final height - useful for supporting the attics and roofs - must have necessarily been uniform. This causes us to reflect that in creating the blocks, the driving aspect - in their quarrying and processing - was the suitability of the basalt stone. Realizing this, the stonemason, after roughing and profiling the bases, drums, capitals, and upper stone slabs, knew well that after assembly, everything would be plastered such that the different heights of the various pieces, and especially the porosity and the different roughness of the stone itself (vesicular basalt) would no longer be perceived.

The square bases and the capitals are 'stepped'. As mentioned above, the drums have a square cross-section with slightly bevelled corners; the slabs hypothesized to be upper elements (squared as well) look like 'tray slabs' with raised edged on two sides, whose thickness should probably have been of the right size to reach the height of the final impost. These slabs were probably also used to connect the beams aimed at assembling the horizontal and upright parts of the roof.

Of the 26 blocks found in the Cathedral (including 6 stepped bases, 19 drums, and only one upper slab), the measurements - coinciding with those mentioned by Paribeni in 1907 - indicated:

- *bases and capitals* (with two steps): base with a 65-69 cm side of the first step, height from 22 cm to 60 cm;[58]
- *drums*: sides of 47-50 cm and three height classes (70-88 cm, 50-67 cm, 22-45 cm);[59]
- slab above the capital: 70 cm x 66 cm sides (with raised edges), height 10 cm.

All measurements refer to the unembellished elements, i.e. without plaster.

The three height classes for the drums could also anticipate the arrangement of the positions of the blocks: the taller and heavier ones below, the shorter and lighter ones above.

A 'complete' column was found during the 2024 fieldwork. As a result of its collapse, the col-

[58] Paribeni mentions eight, while there are currently six on site. In Paribeni 1907, c. 441.

[59] Paribeni mentions 16, while 19 have been found, Paribeni 1907, c. 441.

Fig. 18 - An extract of the visual handbook for the programmed maintenance of the excavation areas in Adulis (Cocuzza *et Al*. 2013).

umn, which was part of the pilastrade of the church, was laid down in an underground room with entrance on the south side of the Cathedral. The measurements of this find (11 pieces in total, including a base and stepped capital) yielded a possible height of the pillar of about 3,6 m in the central nave. This column preserved intact the traces of a coating of two layers of white plaster painted red in places, leading to the hypothesis of a striped decoration.[60]

Another new element is the large entrance stairway of the Cathedral found with the deposition of column drums at the foot.

In the near future - once the archaeological research has been concluded, the 'chain foundations' underneath the pillars have been stabilized, and the correct floor has been identified (references of the schist flooring are still present) - it will be possible to reposition in the Cathedral part of the pillars of the central nave by means of *anastylosis* to display the elevation of the imposing building made even more monumental by its entrance stairway with columns.[61]

With respect to the pre-existence of columns and pillars documented by the famous iconography of the Cathedral[62] during the British Expedition in 1868, and those described by Roberto Paribeni as numerous drums of fallen columns at the Northern Urban Church,[63] few basalt stone blocks from the pillars/columns of these prestigious buildings remain on site at present. In addition to the general despoliation of stone material that occurred during the long phase of abandonment - making Adulis primarily a quarrying site - the re-

[60] Lampugnani, in this volume.
[61] Lampugnani, in this volume.
[62] *L'Illustrazione Italiana* 1884, p. 419; Massa, in this volume, Chapter 8.
[63] Paribeni 1907, c. 470; cc. 471-472, fig. 12; cc. 475-476, fig. 13; cc.481-482, fig. 16.

Fig. 19 - Northern Urban Church. Preservation intervention: 'Scuretto'.

used material was also partly employed to build the most illustrious tombs of the two indigenous necropolis:[64] in citing the cemetery of Šek Mahmud, Paribeni describes the tombs appearing as light elevations with a rectangular plan surrounded by a dry-stone wall built with stones from ancient buildings, and outside the enclosure of the noble tombs there were numerous ancient remains, i.e. a column drum, a capital with a tabular shape and cut corner, and two basalt pillar drums.

Recent reconnaissance in the village of Zula also showed the reuse of these drums as effective mortars (*moogorh*) for crushing and pulverizing grit, the very common grinders for *dura* (sorghum).[65]

Roofing materials and techniques

At the top of the perimeter walls, connected to columns and pillars of wood or basalt stone, there were wooden architraves that supported attics - it is not possible to exclude even ceiling coffers for prestigious buildings - and roofs that were most likely also wooden, with a protective mantle made of different layers, probably similar to the traditional *hedmo*[66] roof, which is made of wooden beams, strips/branches/fronds forming a compact plane on which earth is applied up to a thickness of a few dozen centimetres. No presence of roof tiles has been detected.

[64] Paribeni 1907, cc. 440-441; Larentis, in this volume.
[65] With respect to this reuse, see Paribeni 1907, c. 529.
[66] Cipriani 1940, p. 144.

Fig. 20 - The northwestern wall of the podium of the Northern Urban Church shows significant deformations: therefore the soil has not been completely removed.

Concerning the roofs of houses, Paribeni suggests: *"certo dovevasi trattare di coperture leggere e che non hanno lasciato tracce: sono da escludere in ogni modo tegole, di ciò non si trovò neppure un frammento, si può pensare a un piano di tavole su cui fosse steso uno strato di terra, come è in uso attualmente e in alcuni luoghi d'Eritrea e d'Abissinia e in parecchi d'Oriente (isola di Creta, Egitto) o a una più semplice copertura di legni e paglia"*.[67]

For religious buildings, hypotheses have been developed based on the results of the excavations. As regards the Northern Urban Church, Paribeni suggests that it is not improbable that the roof and upper parts of the church structure were made of wood. Regarding the roof, he confirms that no remains of roof tiles are found here or in any other place, and he states that even assuming that the collapsed material may have gone missing, the accumulation that covered the floor of the church when he started his archaeological investigation was too scarce to represent material fallen from a wall or roof.[68]

Going further, as regards the Eastern Church, Paribeni hypothesizes that the superstructures were made of wood. To validate this, he ascertains that the column drums have no bases or subgrade suitable for supporting a masonry construction; just a few centimetres of earth were raised above them and there was no trace of the accumulation of ruins that would have been produced by the collapse of a stonework *cupola*.[69]

The references for hypotheses regarding the roofs of buildings at Adulis - specifically, the *hedmo* for residential buildings and the wooden roofs of the naves of Debre Damo and stone churches in

[67] Paribeni 1907, c. 545: "*they certainly must have been light roofs that left no traces; roof tiles must be excluded in any case, not even a fragment thereof was found, one could think of a surface of boards on which a layer of earth was laid, as is the custom at present and in some places in Eritrea and in Abyssinia and in many places in the East (Crete, Egypt), or a simpler roof of wood and straw"*.

[68] *Ib.*, cc. 504-505.

[69] Paribeni 1907, cc. 530-531.

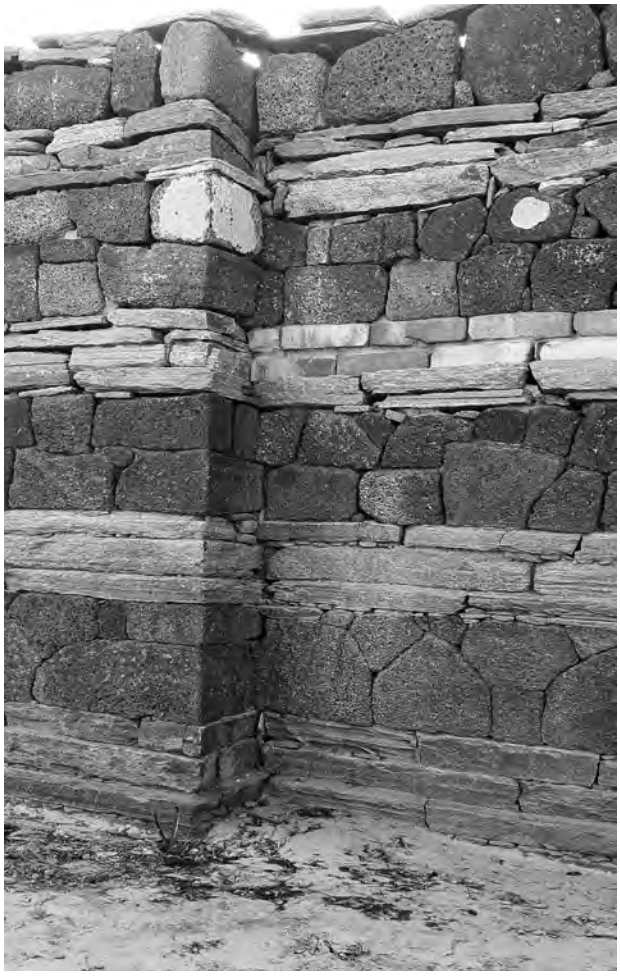

Fig. 21 - Northern Urban Church. Preservation intervention: reconstruction of a necessary new structural part with schist and basalt (altar retaining wall, east side) clearly evident with the insertion of a different material: a brick course that indicates the intervention.

Fig. 22 - Cathedral. Preservation intervention: Anastylosis.

the Tigray for religious buildings - represent important possible links, still to be fully investigated, between archaic architecture and the later medieval churches that still exist today.

The characterization of natural and artificial stone

The characterization of a proper amount of material samples taken from the archaeological site of Adulis made it possible to establish a sound initial database as a suitable support both for recording the provenance of the materials, and for identifying and validating certain indications for conservation interventions. This operation highlights some further aspects to implement the ongoing cognitive process and has therefore made it possible to direct future research activities that might answer certain yet latent or unexpressed questions.

The evaluations outlined above on construction techniques and restoration methods with suitable, effective and durable materials were confirmed and validated thanks to the results of the chemical analyses for the characterisation of mortars, plasters and other materials on some samples found or taken during the excavation campaigns in Adulis and conserved at the Politecnico di Milano with the permission of the Eritrean Commission of Culture and Sports. In this programme, the selection of material sampling points was fundamental to the success of the research: the areas to be sampled were selected and the fragments were collected based on a proper project. One of the first steps in this planning was to

assess where, which and how many samples should be taken, and their location was marked on the plans of the individual artefacts.

When it was not possible to recover already detached or fallen fragments or sporadic material suitable for the analyses, the proper spots were identified for the removal of small parts of natural stone material (schist, basalt, alabaster, coral), sands, 'clays', lime, as well as mortars and plasters, the latter taken in the original stratigraphic sequence (thick layer and surface finish).

Samples were taken with the utmost care not to damage the artefact being analysed by applying the principle of minimal invasiveness and destructiveness of the action.

Samples were taken in compliance with the indications contained in the "Normal 3/80 Recommendation" and the "EN 16085 guidelines of the European Committee for Standardisation CEN TC 346".

The analyses carried out include both stone materials - with this term we mean natural stone materials (rocks) - and artificial stone products (mortars, stuccos, ceramic products, etc.).

The sampling of minimal quantities, but sufficient to conduct the analyses correctly, was carried out dry, when necessary also with the use of scalpels, and photographically documented on site with a sequence of shots taken from the context to the sampling point with the aid of markers and tags for the registry.

Separately, the individual samples were then documented photographically with a metric reference (metric scale) and packaged in sealable transparent envelopes with identification.

A descriptive sheet was prepared for each sample, useful for recognizing and locating it, accompanied by a photographic repertoire.

Using the technical equipment listed in Table 1 and referring to the standards at Table 2, the company DIARTLAB at Luigi Soroldoni & C. S.A.S. was commissioned to perform the following analyses:

- granulometric analysis of the aggregate;
- chemical analysis (presence of soluble salts, carbonate binder, aggregate binder ratio, ratio of calcium, magnesium, silicon and aluminium in the carbonate binder);
- optical microscopy on fragments and cross sections;
- point analyses and X-fluorescence maps by energy-dispersive electron microscope.

The sampling plan for each excavation sector is explained below.

In the case of the Northern Urban Church, the diagnostic analyses were intended to validate certain hypotheses regarding some fragments of compact mortar (see sample 1). The result of these analyses confirmed that the fragment taken was of cement-based mortar. This sample is in fact what remains of a protective layer placed on the wall crests in the early twentieth century by Roberto Paribeni. Cementitious mortar, as a material not compatible with the supporting substrate (basalt), gave poor proof of durability over time. However, this material evidence is worthy of interest because it enables us to understand the Italian archaeologist's intention to preserve the masonry of the church brought to light, by protecting its top. Paribeni used an amalgam of hydraulic lime and cement, an experimental material at the forefront of archaeological restoration at the time, which unfortunately proved to be unsuitable only later. The attention to the principle of reversibility - posed by the 1964 Venice Charter, and for Italy more explicitly by the 1972 Restoration Charter - led to questioning the damage caused to archaeological artefacts by modern materials, including cement. Due to the relative ease of the working process, cement has been one of the most widely used materials for restoration in archaeology since the early twentieth century. Today archaeological restoration, however, has long since come to a critical definition of this material, consciously designing interventions with materials that are not only durable, but also chemically-physically compatible with the existing original mortars and supports.[70]

Given that there are still traces of some mortar fragments on the elevations of the basement of the Northern Urban Church, the question arose as to what its finish and exterior appearance could have been.

The samples removed - namely 2, 3, 5 and 6 - proved conclusive. The external plaster consisted of mortar made of aerial lime and medium-fine sand applied with a curl layer of approximately 20 mm (with the function of clinging to the basalt and

[70] Bortolotto, Frigo 2003, pp. 85-92.

schist substrate), followed by a finish (layer of fine mortar of approximately 10 mm) and a final white lime glaze. The same technique can be seen on the rubble of a column now *in situ* (sample 4), which is part of the pillars of the church, thus also giving an indication of the appearance of the nave.

Evident traces of interior finishing mortars were found in the Eastern Church - specifically on the wall between the narthex and the central hall (samples 7a, 7b, 11), on the preparation wall of the altar area, north side, (9, 10) and of the baptistery, south side, (8); these samples provided us with further information regarding the mortars used for the elevations, internal part, and for the construction of the walls of relevant architectural parts. These aerial lime-based mortars share the common characteristic that they have brick dust granules and an abundant presence of salts, and lastly, that the mortars of the two samples 7a and 10 - light straw-coloured finishing layers - are very similar. We must now explain why brick dust is present in these mortars and what causes the presence of soluble salts.

The Eastern Church is the closest to the sea (probably around 2.5 km in antiquity and 4,4 km at present). Both the properties of *cocciopesto* mortars as well as its production were known, as evidenced by the floor of the baptistery of the Cathedral: the presence of brick dust in the lime-based mortar mixtures can therefore be attributable to a conscious desire to have greater breathability and hygroscopic regulation of the interior, with an improvement in the pozzolanic requirements and in the mortar durability.

In a saline environment such as that of Adulis - close to the coast - the presence of salts could be attributable to the proximity of the sea, but this hypothesis should have some correspondence in the data of the mortar analyses of the other artefacts as well, yet this is not the case. On the other hand, it could be attributable to the preparation of the mortars with the addition, instead of fresh water, of brackish water in the eastern church, which was probably closer to the sea than to the Haddas.

In the case of the Cathedral, the stratigraphic section of the baptistery floor was brought to light, due to an erosive action of the water that obliterated the south-eastern perimeter of the basin. It consisted of a surface layer of *cocciopesto* mortar (paving, sample 13), a layer of draining basalt gravel (sample 14) and one of lime mortar as an interface with the underlying beaten earth preparation layer (samples 15 and 16).

For the exterior, the presence of lime-based fragments on the basement (sample 17) is confirmed here as well, so it is assumed that this church had also been entirely plastered.

For the interior, thanks to a substantial number of fragments of sporadic material (plaster), it is assumed that the walls had been finished with lime (sample 19).

Of interest in the altar area is sample 18 (sporadic material), a gypsum-based mortar mix with traces of celestine (*strontium sulphate*). This sample, an important *unicum*, can be considered a marker, i.e. it highlights an extraordinary event in relation to the use of this mortar, justified by its special location in the altar area, where celestine was probably used for the symbolic properties of its crystals, which give off light. As for defining its provenance (Egypt, Tunisia, Morocco, Madagascar or neighbouring areas of Adulis) the field of research is still open.

Finally, in Sector 5 'Workshops', along the Haddas, sample 22 was taken to test the lime-based mortar present as internal plaster. The aim was to find out whether this amalgam was the same as or different than those used for the interior cladding of churches. The result is that, with the comparative reading of the ratio of calcium, silicon and aluminium oxides, the sample under examination, which is comparable to samples 15 and 17 from the Cathedral, can be described as a weakly natural hydraulic mortar with clay silicates.

The mineralogical petrographic evidence of the building materials (basalt, schist and coral stone) made it possible on the one hand to identify the lithotype and indicate their possible origin, and on the other it was the starting point for understanding the compatible relationship between the new mortars for future restoration and the existing substrates.

As for the coral stones, very few have been found *in situ* and are mostly located in a room added to the apse of the Cathedral.

Analyses were also carried out on sand samples from the Haddas and pseudo-clays that later turned out, according to laboratory diagnostics, to be a slurry sedimented over time of very fine sands. Particle size analysis with extraction and salt analysis was performed on these samples.

The two samples of sand and one of pseudo-clay consisted of alluvial sand from medium-long transport, resulting from the disintegration of volcanic, metamorphic and to a lesser extent sedimentary rocks, with differences in grain size scale. The first, medium sand (sample 12A) has a good grain size selection, with granules up to 5 mm (less than 4%), suitable for the preparation of curling and bedding mortars. The second sample (12B) is screened sand with granules of less than 2 mm and abundant presence of silty-clayey material of less than 0.0162 mm (15%-16%). The third sample, named 'clay' (12C) is sand similar to 12B, but with a maximum grain size of 1 mm and the same percentage of clayey material.

The outcome of this work was then compared with existing quicklime samples produced in Eritrea. These were analysed to see if they were suitable for the preparation of lime mortars for restoration.

"The calcium-magnesium ratio and the presence of clayey silicates refer to the use, for firing, of impure limestone (marl) with a minimal presence of magnesium, from sedimentary rocks of marine origin (the precise provenance has to be verified). These data can be related, with minor differences, to those obtained from the mortar samples from the site, even though they have a more or less dark straw colour (marl from more clayey sedimentary layers). Extinguishing with water is highly exothermic and produces powdered hydrated lime and then a lumpy mortar that is difficult to disperse and therefore inadvisable for direct use on the building site".[71]

In view of the outcome, reference was therefore made to restoration limes already in production, ready for use, with characteristics compatible with the material substrates of Adulitan constructions. With the Haddas sands and local clays in the laboratory, lime mortars were prepared on schists and basalts with the specific aim of using them as bedding mortars for a sealing layer on wall crests.

The composition, expressed in parts per volume, of the bedding and finishing mortars to be used for conservation purposes in Adulis is presented in Table 3.

This amalgam was used in the conservation yard on the Cathedral in 2023, only on one wall under restoration to test its durability before extending its use on the top parts of the walls of the architectural artefacts in Adulis.

The interventions on the wall crests at Adulis are mainly aimed at protecting against the infiltration of rainwater, as a 'cap' to defend the underlying work.

The methodology adopted started from the contribution of the study of ancient materials and mortars, as well as from the understanding of the construction techniques of historical buildings and led to the formulation of compatible amalgams of mortars that, after being tested *in situ* for their durability, might be the proper solution in the field of conservation and planned maintenance.

Types of damage/decay, maintenance and conservation interventions

The maintenance and conservation of monuments and archaeological emergencies is one of the main objectives of the management, protection and enhancement of the heritage of Adulis. It is a complex process involving skills, stakeholders and decision makers at different levels and requiring commitment and resources.[72]

Before describing the operations on the conservation yard, it is appropriate to introduce some preliminary considerations. The reasons and the choice of appropriate solutions for an archaeological restoration yard must consider many factors:
- assessment of the specifics of each case;
- congruence with the diagnostic analysis;
- respect for the materials and construction techniques of the historic buildings;
- compliance with minimum intervention and maximum reversibility;
- awareness of the limits of the intervention, its ageing processes over time and its durability;
- possible degree of optimization, upgradability;
- importance of documentation procedures of the conditions preceding the intervention and subsequent monitoring;
- evaluation of the merits and possible defects;
- relative cost-effectiveness of the intervention and its strategic evaluation.

Moreover the actions must respect a protocol that implies three main points:

[71] Soroldoni, in this volume.

[72] ICAHM 1990, see, specifically, Article 6 'Maintenance and Conservation'.

- the new interventions must be clearly distinguishable from the original parts of the structures;
- locally available resources must be privileged;
- the results must minimize maintenance work and consider durability as a requirement.

Operations in the conservation yards of the ruined architecture of Adulis complied with the 'guidelines' indicated above in the awareness of securing the archaeological ruins and handing them down to posterity, and at the same time of being able to train restoration technicians in the field.

At the opening of each mission, the work team is called upon to initiate assessments of the current state of the sites and undertake maintenance and conservation activities of the site and excavation areas.

Every year, the Adulis Archaeological site is, in fact, affected by adverse weather events causing damages that modify its characteristics.

During the 2012 and 2014 fieldworks, a set of actions concerning the Conservation and Programmed Maintenance of the artefacts were carried out; these actions have been collected in a "*Programmed Maintenance Handbook*",[73] which provides short guidelines for interventions to be periodically repeated (fig. 18). This handbook was tested in the 2015 fieldwork, during the activities involved in verifying and restoring the disrepair that occurred during the year and later implemented. These activities were conducted together with local operators so that they could be replicated and transmitted and must be carried out every year.

The handbook is schematic, mainly visual and easily accessible and when used as a checklist, it can be employed as a test to verify the damages that have occurred. The conservation yard of Adulis is in progress and can be considered as a case study, but the guidelines can also be used for the Programmed Maintenance of other archaeological sites in Eritrea.

The actions listed in the handbook are as follows:

1. *Context Maintenance*

1.1 *Removal of the weed vegetation in the context area*: manual removal of the spontaneous vegetation that has grown in the excavation sector is envisaged.

1.2 *Drainage and regulation/direction of rainwater*: creation of barriers preserving the trenches from flushing rainwater also by using juta sacks filled with soil collected in situ in order to divert the water away from the site including with slope adjustment.

1.3 *Maintenance of the fence*: should the fence around the excavation site have been damaged by natural events or due to other causes, its restoration using branches and bushes according to the local traditional techniques is envisaged.

1.4 *Reshaping of the excavation perimeter (banks and steps)*: the trench around the excavation site should be reshaped in case the soil on the edge has been flushed away or collapsed. The steps are created to reduce the impact of the difference in height between the actual walking surface and the excavation level. The use of 'stone box' gabions is proper for reinforcing the structural parts and for the embankments of the excavation perimeter as a preparatory intervention to counteract the erosion caused by seasonal rains.

2. *Artefact Cleaning*

2.1 *Removal of the weed vegetation present on the artefact*: wild vegetation that has grown on the structure must be removed manually, taking care not to damage any portion of the artefact itself.

2.2 *Brushing of the walls and cleaning between the stone layers*: by using soft brushes is intended to remove sand and dust from the walls, this action is useful for checking the joints and any crack patterns.

2.3 *Removing of the clay deposits at the bottom of the walls*: in case of heavy rains creating clay mounds at the bottom of the artefact, they must be removed using shovels and the material taken outside the excavation site.

2.4 *Cleaning of the floor level*: after the excavation activities and before any maintenance or preservation interventions, the upper surface of the walking surface and the wall crests of the building must be cleaned using brushes and soft brooms.

3. *Consolidation*

3.1 *Creation of top-frames for precarious portions of walls*: to prevent any stones from collaps-

[73] COCUZZA *ET AL*. 2013.

ing, especially the ones constituting the elevations, the creation of frames made of new bricks (or stones) is envisaged, in order to hold these stones. To respect the aspect of the artefact, only the bricks will be covered by a layer of local clay mortar. On the top of the wall, both the bricks and the stones will be placed backwards to emphasise, with the partition of this space, the old and the new.

3.2 *Creation of a sacrifice-layer in 'clay' on the edges of the walls*: realization of 'sacrifice - layers' on the edges of the walls, and around them to keep all the parts together by using clay mortar after the stones have been brushed in order to create a protective layer against natural events.

3.3 *Refilling of the stone joints of the surface of the walls with clay mortar*: because of natural events, the walls may lose the original clay mortar between the stones, thus facilitating the loss or collapse of specific portions. In such cases, a 'sacrifice layer' must be created to protect these wall portions by filling with clay mortar.

3.4 *Creation of a new layer with shist slabs on the top wall surface*: the interventions on the wall crests and the top wall in Adulis are mainly aimed at protecting from infiltration of rainwater as a 'cap' to defend the underlying work. The observations on the wall crest protection solutions adopted so far have made it possible to test them in a useful manner. It enabled the verification over time as to which of these solutions were validated and which were optimised. Therefore, after an initial clay-based mortar and subsequent experimentation of a traditional mortar (also clay-based) called '*cicca*', a new lime-based mortar was studied in the laboratory and adopted in 2023. All these mortars are bedding for a row of shist slabs placed as the final horizontal protection and capping of the elevations of the walls.

3.5 *Consolidation of the floor-level*: creation of the correct slopes at floor level to remove water from the walls and preserve them. After the archaeological investigations, the fillings of the floor levels must be made with draining material and the last layers with levels of rammed earth in order to prevent rainwater from damaging the upper part of the architectures.

3.6 *Consolidation of shist slabs (paving surfaces) with ethyl silicate*: the shales are treated with ethyl silicate as a stone consolidant. The surface must be absorbent, dry and clean; the temperature between +10°C and +25°C. The surface to be treated must not be under direct sunlight, and the treatment should not be carried out during the hottest hours. It is applied with a brush.

The major critical issues of the site are attributable to the winter rains: rainwater, depending on the slopes, collects in *wadis* and, unfortunately, some of them run near the excavation sectors. Therefore, the initial works in the field are all aimed at checking and renewing the barriers, slopes, embankments and preferred water disposal directions. The same operation undertaken for the site is also carried out in the excavation areas.

Poor or bad water management in the archaeological area and excavation sectors, together with a lack of maintenance, can trigger very serious chain effects.

The ground levels of the ruins of Adulis in the post-excavation phase are located well below the level of the current state. Water stagnation, infiltration, possible capillary rises, percolation or condensation are all effects and causes of future significant decay and structural disruption.

Another variable to keep under control - closely linked to rainy or dry periods - is the presence or absence of weed vegetation.

In this case, maintenance serves to mitigate the coexistence between nature and architecture, not only regarding biological attacks, such as micro and macroflora, but also the presence of animals/insects. In this sense, the conditions of the perimeter fences, made specifically to ensure the protection of the excavation areas, are checked and the removal of camel and goat pastures from the area is guaranteed on an annual basis. Finally, the maintenance program includes cleaning and consolidation activities of the archaeological artefacts, in particular the top parts such as the wall ridges and floor levels.

The archaeological conservation approach to artefacts reduced to a state of ruin consists in investigating the causes and effects of the types of decay to be removed thanks to a future conservation and/or maintenance intervention by evaluating the artefact as a whole and estimating its interfaces and interferences with the conditions in the context, both anthropic and environmental.

Specifically, a series of operations were carried out which give the wall facings sufficient and necessary mechanical properties for its continuous conservation, focusing, therefore, primarily on structural damage, missing parts, material decay

and break-up, alteration of surface layers, humidity and biological attacks.

The structural damages in the ruined buildings of Adulis include disruptions, disconnections and instabilities. Interventions to secure the ruins already during the archaeological excavation operations are important to contain the structural damages.

An example among all: to contain a specific structural decay in the Northern Urban Church, it was decided not to remove part of the soil because this soil - acting as a support - would have helped to keep in balance a part of the north front, an elevation that showed significant deformation (fig. 20). During the excavation, special attention is also given to protecting the wall ridges.

When necessary for static and conservative structural purposes, the missing parts were integrated. The integrations were made according to two different strategies, both making the intervention distinguishable: with '*scuretto*' parts, i.e. with an offset distance from the original parts (fig. 19), or with clearly different materials (fig. 21). Finally, for some imploded wall parts, disassembly and reassembly by *anastylosis* have been carried out (fig. 22), operations documented before and after recomposition. Soon, this method will be applied, when possible, to reconstruct the church columns of the Cathedral. At the end of the archaeological fieldworks, when closing the excavation yard, the architectures are covered with geotextile protection, and the areas are protected from surface water, sometimes with jute sacks filled with sand (figg. 23-27).

Conclusions

The multidisciplinary methodological approach used to define the strategic conservation plan for the Adulis archaeological site aims to provide a range of integrated solutions for sustainable development, enhancement and enjoyment of the cultural heritage and a better quality of life in the neighbouring villages of Afta and Zula by implementing processes and training related to the realization of Adulis Sustainable Archaeological and Natural Park.[74] A key strategy for site management is community involvement in sharing the land conservation plan (large area) and in partnerships for preventive maintenance and conservation with sustainable materials and techniques. Thanks to the support from local authorities, the project will increase the impact of interventions on the territory, strengthening its status and offering the opportunity to trigger new lines of action, considering its improvement, replicability and scalability in other contexts.

Fig. 23 - Sector 2, Northern Urban Church. Preservation: waterproofing for exposed surfaces with 'cicca', a traditional organic mortar consisting of clay, animal hair, and manure.

[74] 'VITAE' Project: "Sustainable Valorisation of the Eritrean Heritage Adulis Archaeological Site Project" of the Politecnico di Milano with funds from the AICS Italian Agency for Development Cooperation (2020-2025).

Fig. 24 - - Sector 6, Cathedral: South perimeter wall reconstruction with anastylosis.

Fig. 25 - Sector 6, Cathedral: schist consolidation with ethyl silicate.

Fig. 26 - Sector 6, Cathedral: South wall, consolidation with stone box.

Fig. 27 - Sector 4, Eastern Church: geotextile protections.

Table 1 - *Technical equipment used for laboratory analysis*

Microscopy
- Polarising optical microscope, trinocular, OLYMPUS BX51
10x and 20x eyepieces - transmitted and reflected illumination (visible, UV and IR)
2.5x, 5x, 10x, 20x and 2x objective lenses
Peltier-cooled OLYMPUS DP70 microcamera.
- Optical microscope, trinocular, LEICA DMLS
10x and 20x eyepieces - transmitted and reflected illumination (visible, UV and IR)
Objectives 4x,10x,20x ,40x, 100 x
Peltier-cooled OLYMPUS DP70 microcamera
- OLYMPUS SZ40 trinocular stereomicroscope
Eyepieces 10x, 20x -zoom lens 0.67x-4x
Peltier-cooled OLYMPUS DP70 microcamera

FT-IR spectrophotometry
Nicolet-iN10 micro-FT-IR spectrophotometer (5000 -400 cm-1)

X-Ray Fluorescence Spectrometry (XRF)
XRF analyser - DELTA PROF -OLYMPUS
4 W X-ray tube and 200μA max. - 40 kV beam - SDD detector for Mg to U elements - Sensitivity 1-10 ppm. - micro centring camera - Minimum analysis area radius of 2 mm

Electron microscopy (SEM-EDS)
HITACHI TM3030PLUS with EDAX microanalysis OXFORD micsF+ X-stream-2

Ion chromatograph
Metrohm -881 Compact IC Pro
Metrohm 863 Compact Autosampler
ICP-OES: Agilent Technologies - 5100VDV
Autosampler: Agilent Technologies - SPS 4
ICP-MS: Agilent Technologies - 7900
Autosampler: Agilent Technologies - G4567A

Table 2 - *Reference standards for 'Conservation of Cultural Heritage'*
NorMal 08/81
Examination of Morphological Features under a Scanning Electron Microscope (SEM).
NorMal 12/83
Artificial Clastic Aggregates and Non-Clay Binding Matrix: Outline Description.
UNI 11087:2003
Natural and artificial stones - Water soluble salts determination.
UNI 10924:2001
Mortars for building and decorative elements - Classification and terminology.
UNI 11088:2003
Ancient mortar and mortar for restoration - Chemical characterization of a mortar - Determination of siliceous aggregate and of some soluble analytes content.
UNI 11089:2003
Ancient mortar and mortar for restoration - Estimate of the composition of some kind of mortars.
UNI 11139:2004
Historical mortar - Determination of free lime and free magnesia.
UNI 11140:2004
Historical mortar - Determination of carbon dioxide.

Table 3 – *Composition, expressed in parts per volume, of the bedding and finishing mortars to be used for conservation purposes in Adulis.*

components	**A-bedding**	**B-Finishing**
Hydrated lime	2	2
Fine sand (0,1-0,5 mm) ADULIS	1	2
Medium sand (0,1-5 mm) ADULIS	5	3
Coarse sand (0,1-8 mm) ADULIS	1	-
River clay ADULIS	1	1
Dark clay ADU 20-B (sample from the database by Dr Abraham Zerai for his PhD thesis)	-	1
Water	0,2-0,5	0,2-0,5

ADULIS: DIAGNOSTIC INVESTIGATIONS ON BUILDING MATERIALS

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Analyses for the characterisation of mortars, plasters and other materials were carried out on various samples found during the excavation campaigns in Adulis in order to validate assessments regarding construction techniques and restoration methods with suitable, effective and durable materials.

The analyses carried out include both stone materials - with this term are meant natural stone materials (rocks) - and artificial stone products (mortars, stuccos, ceramic products, etc.).

Specific assessments of the structural, mineralogical-petrographic composition were carried out on the mortar samples with optical microscope observations of the cross sections[1] to highlight cracks and microporosity, selection, and to visual estimate of the aggregate ratio in the limestone matrix, prevailing rocks, orientation, rounding and sphericity of the aggregate granules.

Furthermore, always on the cross section, observations and photographic documentation were made with a scanning electron microscope and energy dispersive spectrometric analysis with X-ray fluorescence maps.

Furthermore, from intact fragments, after disintegration, chemical analyses were carried out and determined in succession: soluble salt content with relative ionic analysis; binder-aggregate ratio with analysis of the carbonate binder by acid attack[2] to highlight the relationships between the oxides of calcium, magnesium, silicon, aluminum and iron; possible presence of hydraulic binder and grain size analysis of the residual aggregate.

On the sand samples, particle-size analyses with extraction and analysis of salts were performed, and on the stone fragments, mineralogical-petrographic analyses under a polarising optical microscope on thin sections (Figg. 1-4).

Chemical analysis of mortar samples soluble salts

The presence of soluble salts is particularly abundant (7.5% to 13%) only in the mortar samples taken in the Eastern Church (7A and 7B, interior, south wall; 9 and 10, interior altar and 11, narthex area) and the Cathedral (B14, erratic brick and 16, baptisimal font, east side).

The salts consist of sodium chloride (1.2-2%), gypsum (5-8%) and potassium nitrate (0.6-1.7%).

In all other mortar samples, the presence of salts is less than 5% (sodium chloride less than 0.2%, potassium nitrate absent and gypsum from 0.8% to 4%).

In specific, the presence of sodium chloride in the mortars, later confirmed by electron microscopic analysis of the polished cross-sections, may be due either to exposure to sea mist or to the use of water or sand collected near the sea during construction.

Analyses carried out on the sand and clay samples, collected near the Haddas watercourse, excluded the presence of nitrates and indicated only a minimal chloride content of 0.05-0.1% (see analysis of samples 12 A, B, C).

[1] MacKenzie *et Al*. 2017; Pecchini *et Al*. 2018; Pecchini *et Al*. 2020.

[2] Charola *et Al*. 1981; Dupas 1981.

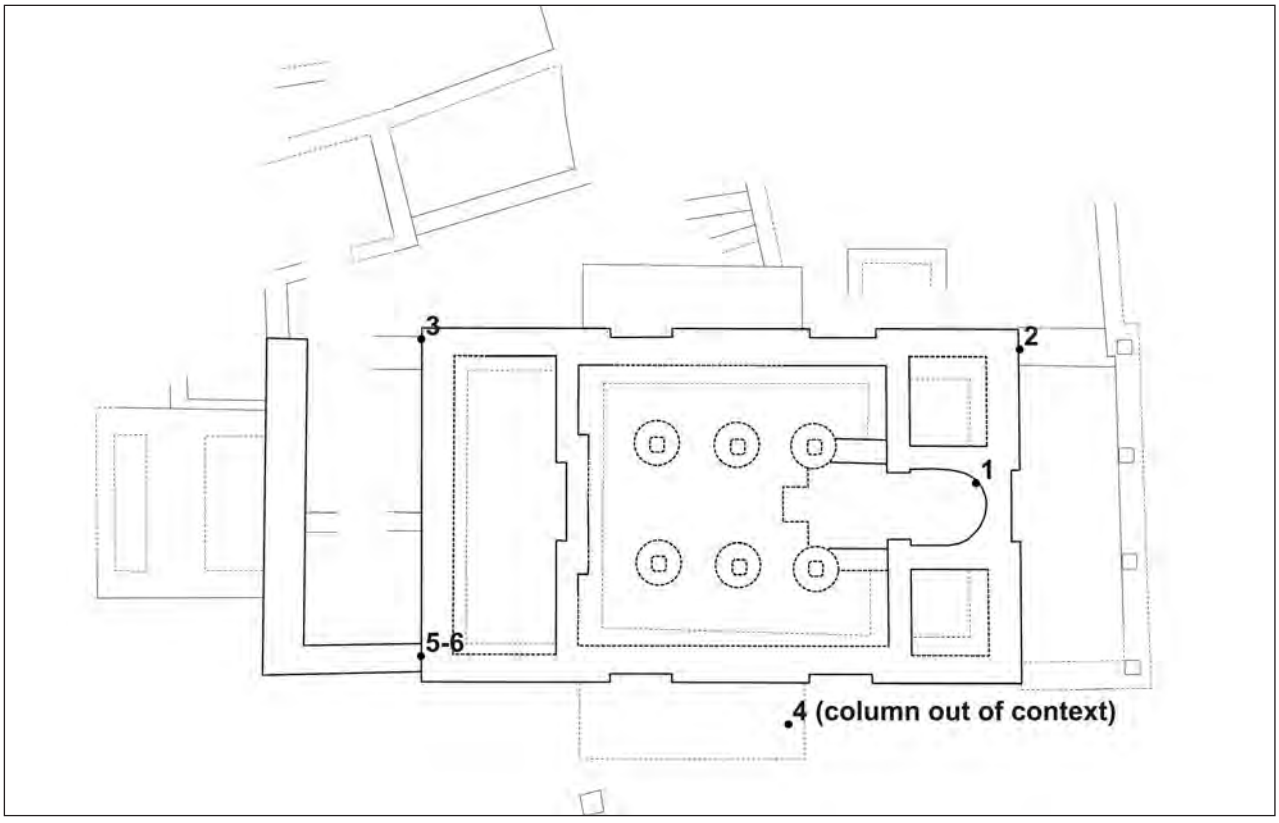

Fig. 1 - Northern Urban Church (Sector 2) with positioning of the samples: Sample 1 - cement mortar; Sample 2 - mortar with traces of white paint from the eastern wall base; Sample 3 - fragment of mortar with traces of white paint from the western wall base; Sample 4 - mortar on basalt from a column out of context; Sample 5 - fragment of mortar from the western wall base; Sample 6 - fragment of finishing mortar from the western wall base.

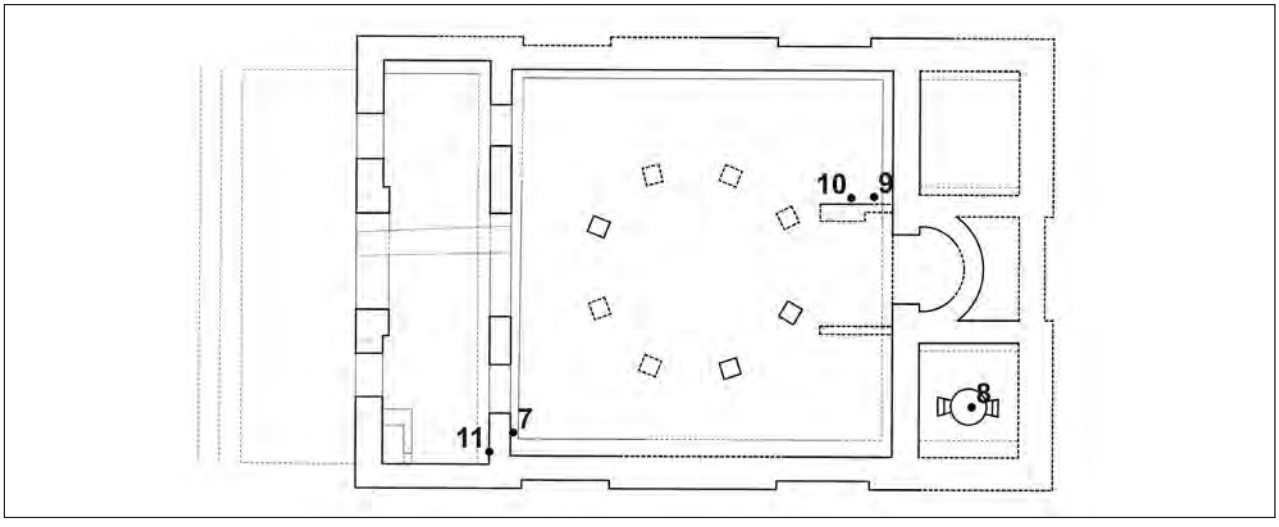

Fig. 2 - Eastern Church (Sector 4) with positioning of the samples: Sample 7A - mortar fragment (D) from interior, southern wall; Sample 7B - mortar fragment (D) from interior, southern wall;
Sample 8 - fragment of bedding mortar from the baptisimal font; Sample 9 - fragment of mortar from the interior, altar area; Sample 10 - fragment of mortar from the interior, altar area; Sample 11 - accumulation of bedding mortar from the southern part of the narthex area.

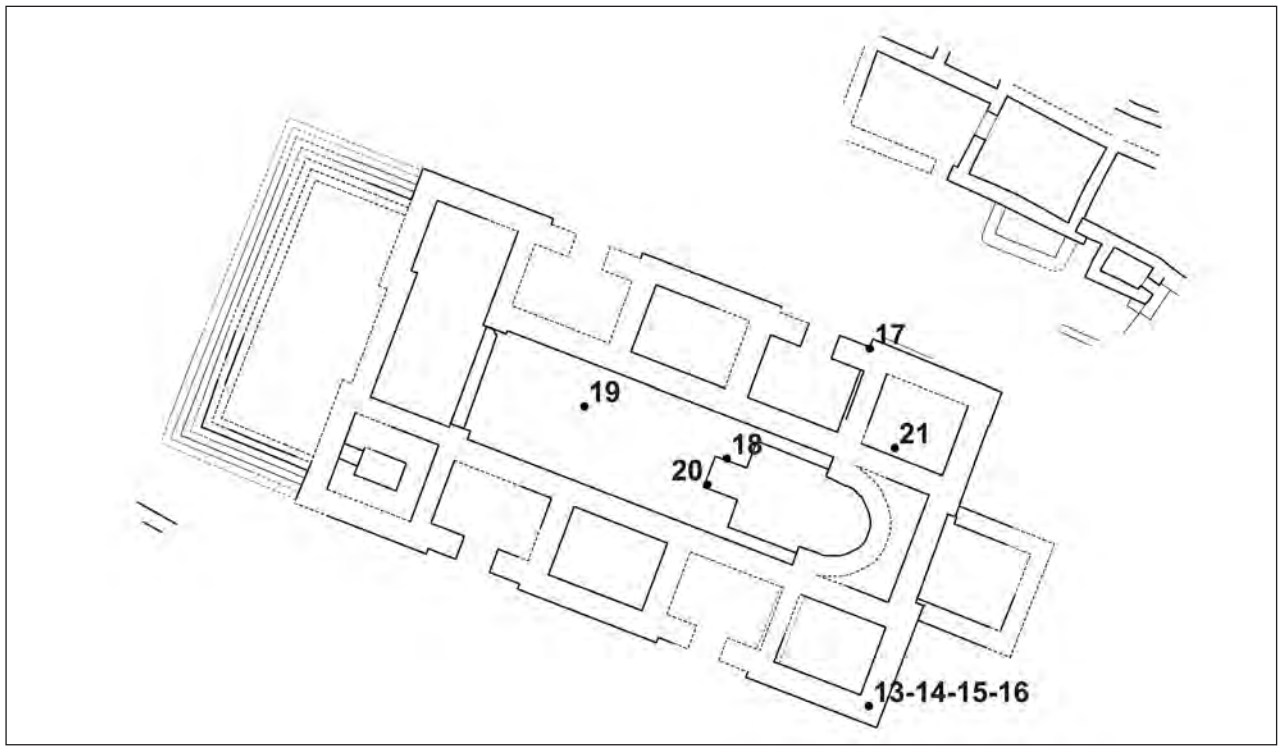

Fig. 3 - The Cathedral (Sector 6) with positioning of the samples: Sample 13 - Cocciopesto mortar from the eastern side of the baptisimal font room; Sample 14 – Basalt gravel from the eastern side of the baptisimal font room; Sample 15 - Lime mortar from the eastern side of the baptisimal font room; Sample 16 - Lime mortar from the eastern side of the baptisimal font room; Sample 17 - Finishing mortar from the northern wall; Sample 18 - Abundant gypsum with chlorides and traces of celestine from the altar area (sporadic material); Sample 19 - Finishing mortar from the central nave (sporadic material); Sample 20 - Alabaster fragments from the altar area (sporadic material); Sample 21 - Coral stone (sporadic material).

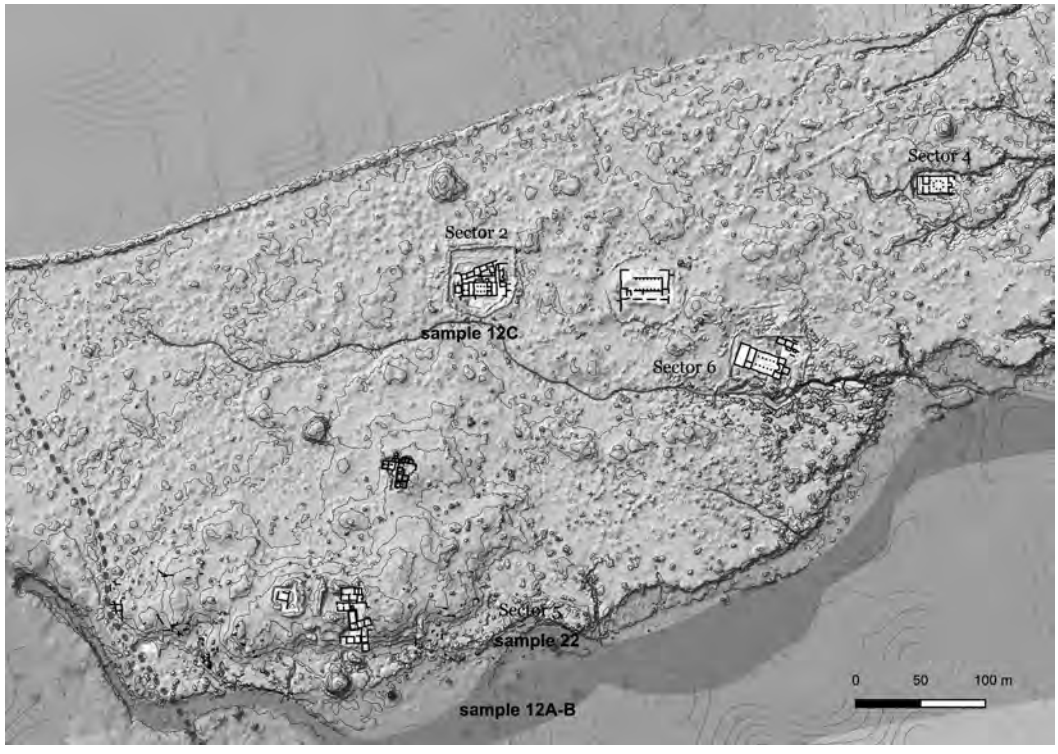

Fig. 4 - Map of the archaeological area with positioning of the samples: Sample 12A-B - medium and fine-grained sand from the Haddas River; Sample 12C - clay from the southern canyon near Sector 2; Sample 22 - mortar from the Eastern wall of the workshops along the Haddas (Sector 5).

CARBONATE BINDER AND AGGREGATE BINDER RATIO

For many samples, the percentage of carbonate binder was between 40% and 45% (2, 4, 5, 6 from the Northern Urban Church; 7B and 9 from the Eastern Church); higher in samples 7A (52%) from the Eastern Church; 15 and 16 (46 - 50% respectively) from the Cathedral and lower in samples 3 from Northern Urban Church (36%); 17 and 19 from the Cathedral (26-24% respectively).

Sample 10 (Eastern Church, altar zone) is a hard and very fine mortar, mainly consisting of lime (83% carbonate binder) with little sand, traces of brick dust and clay silicates, while sample 11 (Eastern Church, narthex) presents a finer and harder outer zone, similar to sample 10 (Eastern Church), on a more arenaceous inner mortar with medium coarse sand.

An exception is sample 18 (Cathedral), consisting of a lime (15%) and gypsum (30%) grout (Tables 1 and 2).

In lime, the calcium-magnesium ratio and the presence of clay silicates are attributable to the use for cooking of an impure limestone (marl) with a minimal presence of magnesium, deriving from sedimentary rocks of marine origin whose quarrying area would be interesting to be verified on local geological maps. The presence of silicon, always abundant, is indicative of a hydraulicity conferred by the firing of a marl and by the presence of clay in the sand. The analysis data showed a good similarity with the quicklime sample (13) in clods brought from Eritrea, confirming the use of a local material. The sample consists of coarse white, gray or pale straw-yellow pieces and blackish impurities with the prevalent presence of calcium oxide (92.77%), traces of magnesium oxide (0.7%), clay silicates (4.5%) and sulfates (1.3%).

Extinguishing this lime with water is highly exothermic and produces powdered hydrated lime and a lumpy slaked lime that is difficult to disperse, making it inadvisable for direct use on the archaeological building site (Table 3).

	First sampling			Second sampling									Third sampling					
Sample n.	1	2	4	5	6	3	7A	7B	8	9	10	11	15	16	17	18	19	22
weight %																		
Humidity	0,05	0,39	0,41	0,85	0,60	0,67	1,70	1,39	0,91	0,87	0,97	0,69	0,65	0,65	0,80	0,54	0,63	0,60
Soluble salts	2,10	1,06	0,93	1,42	3,75	3,16	8,68	12,68	1,15	4,63	6,10	7,37	3,08	7,65	2,73	10,23	4,26	2,68
Carbonate binder	27,60	42,01	42,09	41,36	44,39	35,58	52,38	43,31	38,89	40,65	83,04	55,44	45,80	49,96	26,44	14,79	23,73	24,80
Sol.silicates HCl 1N.	25,09	4,13	3,44	6,09	4,86	2,18	3,19	5,89	0,26	0,59	0,93	0,45	5,38	6,94	5,19	0,47	10,43	4,97
Gypsum	0,77	0,00							0,24	0,57						29,61	0,74	0,00
Sol.silicates HCl 20%	4,01	0,39	1,16	0,66	0,45	1,11	0,16	1,41	2,89	3,75	1,69	1,74	19,85	4,96	9,55		7,35	3,04
Loss at 600°C	0,60	0,16	1,27	0,19	0,75	0,52	1,33	1,87	0,62	0,73	0,34	0,09	0,36	0,87	0,48	0,18	0,58	0,32
Residual	40,44	51,85	50,70	49,43	45,20	56,79	32,55	33,45	55,04	48,21	6,92	34,22	24,88	28,96	54,82	44,19	52,27	63,59
Total	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*

Table 1 - Summary tables with the data obtained from the chemical analysis of the different mortars.

	First sampling			Second sampling									Third sampling					
Sample n.	1	2	4	5	6	3	7A	7B	8	9	10	11	15	16	17	18	19	22
salts in weight %																		
NaCl	0,50	0,06	0,09	0,09	0,07	0,07	1,97	1,93	0,14	1,17	1,26	1,48	0,05	1,43	0,07	0,94	0,76	0,20
KNO3	0,33						1,18	1,74	0,10	0,59	0,79	0,59	0,01	0,71				
MgSO4-7H2O	0,08	0,08	0,06	0,12	0,19	0,21	0,21	0,36	0,04	0,09	0,12	0,12	0,06	0,10	0,07	0,21	0,07	0,03
CaSO4-2H2O	1,13	0,92	0,79	1,18	3,48	2,88	5,27	8,60	0,87	2,78	3,93	5,17	2,90	5,38	2,60	9,07	3,43	2,45
Total	*2,06*	*1,06*	*0,94*	*1,40*	*3,75*	*3,16*	*8,68*	*12,68*	*1,15*	*4,63*	*6,08*	*7,36*	*3,02*	*7,62*	*2,73*	*10,23*	*4,26*	*2,68*

Table 2 - Soluble salts - summary tables with the data obtained from the chemical analysis of the different mortars.

	First sampling			Second sampling									Third sampling					
Sample n.	1	2	4	5	6	3	7A	7B	8	9	10	11	15	16	17	18	19	22
Solution HCl 1N Oxides - weight %																		
CaO	13,56	20,90	20,11	20,16	21,71	17,35	25,51	20,71	21,39	19,99	40,38	26,99	25,15	27,50	17,25	3,14	13,04	13,73
MgO	0,75	0,53	0,38	1,67	0,53	0,24	0,15	0,84	0,36	0,49	0,98	0,70	0,44	0,43	0,37	0,16	0,22	0,14
SiO2	14,11	2,55	2,18	2,88	3,01	1,35	1,90	3,38	0,12	0,15	0,62	0,26	2,77	3,86	3,31	0,53	8,22	3,61
Al2O3	9,08	1,21	0,89	2,42	1,53	0,69	1,00	2,16	0,11	0,41	0,27	0,17	1,70	2,11	1,36	0,14	1,26	0,88
Fe2O3	0,90	0,37	0,37	0,78	0,32	0,14	0,29	0,36	0,02	0,03	0,04	0,02	0,45	0,49	0,26	0,19	0,48	0,24
SO3	1,07	0,29	0,30	0,26	0,28	0,13	1,09	1,08	0,65	0,81	1,09	0,68	0,63	0,51	0,34	25,54	1,00	0,21
CO2	13,97	20,74	22,76	20,47	21,82	17,76	25,47	20,93	17,18	19,65	40,68	26,99	20,22	22,04	13,94	2,53	10,47	10,93
Total	*53,45*	*46,59*	*46,98*	*48,64*	*49,21*	*37,66*	*55,42*	*49,46*	*39,84*	*41,53*	*84,05*	*55,81*	*51,37*	*56,94*	*36,83*	*32,22*	*34,69*	*29,74*
Solution HCl 20% Oxides - weight %																		
CaO	2,87																	
MgO																		
SiO2	0,35	0,10	0,32	0,20	0,13	0,33	0,04	0,39	0,70	0,69	0,33	0,51	6,69	1,50	3,46	0,25	2,96	1,27
Al2O3	0,54	0,18	0,52	0,36	0,23	0,45	0,05	0,59	1,93	2,68	1,22	0,94	5,52	1,62	1,90	0,04	1,64	0,57
Fe2O3	0,29	0,11	0,31	0,10	0,09	0,34	0,03	0,43	0,26	0,38	0,15	0,30	7,65	1,84	4,20	0,17	2,75	1,21
Total	*4,06*	*0,39*	*1,16*	*0,66*	*0,45*	*1,11*	*0,13*	*1,41*	*2,89*	*3,75*	*1,69*	*1,74*	*19,85*	*4,96*	*9,55*	*4,68*	*7,35*	*3,04*

Table 3 - Summary tables with the data obtained from the analysis on acid solutions.

AGGREGATES

The sand is of a medium to long alluvial transport nature, resulting from the disintegration of volcanic, metamorphic and to a lesser extent sedimentary rocks, with differences in grain size scale.

In general, the mineral composition of the sand identified in the mortars, similar to that of the samples of sands (12A and 12B) taken from the site near the Haddas riverbed, and clay (12C) taken from the southern canyon near the Northern Urban Church.

Sample 12A, consisting of medium sand, has a good grain size selection, with grains up to 5 mm (less than 4%), suitable for the preparation of curling and bedding mortars. Sample 12B is a screened sand with grains of less than 2 mm and abundant silty-clayey material of less than 0.062 mm (15-16%). Sample 12C (referred to as clay) is a sand similar to sample 12B, but with a maximum grain size of 1 mm and the same percentage of silty-clayey material.

Plant fragments are present in all three samples.

The use of this local sand is therefore advisable, washed and better sorted, also for possible restoration work (Table 4).

The coarser fraction, in the medium and fine sands, has the same mineralogical composition also found in the mortar samples.

There are abundant colourless quartz granules and, to a lesser extent, traces of iron oxides and

GRAIN SIZE		Medium sand	Fine sand	Clay
below 0,0625 mm	%	3,90	15,70	15,40
0,0625 -0,125 mm	%	12,70	45,70	48,20
0,125-0,250 mm	%	24,30	36,20	33,40
0,250 -0,500 mm	%	37,00	1,30	2,30
0,500 - 1 mm	%	17,60	0,10	0,60
1 - 2 mm	%	1,40	1,10	0,00
over 2 mm	%	3,10	0,00	0,00
total	%	*100,00*	*100,00*	*100,00*
max size	mm	5	2	1

Table 4 - Data relating to the grain size analysis of medium sand (sample 12A), fine sand (12B) and clay (12C).

mica, white and light straw-coloured alkaline feldspars and plagioclases, mica muscovite (silvery and colourless), mica biotite (black), chlorite (green and light grey), fragments of magmatic rocks such as basalt (brown and blackish) and metamorphic rocks such as micaschists and gneisses (grey and blackish grey).

Quartz granules, alkaline feldspars and white and light straw-coloured plagioclase predominate in the medium and fine fraction, with muscovite mica and rare biotite and chlorite.

The presence of *cocciopesto* was only detected in the Cathedral samples 15, 16 and 19 (Table 5).

LIGHT MICROSCOPE DOCUMENTATION AND ELECTRON MICROSCOPE ANALYSIS OF THE MORTAR SAMPLES

Intact fragments of the samples were previously observed and documented under the optical

SAND	First sampling			Second sampling									Third sampling					
Sample n.	1	2	4	5	6	3	7A	7B	8	9	10	11	15	16	17	18	19	22
% below 0,0625 mm	3,20	1,55	4,05	3,67	1,39	1,69	3,08	0,00	1,43	4,63	2,50	3,43	1,19	0,50	0,88	3,28	1,94	0,69
% 0,0625 -0,125 mm	12,80	16,49	15,25	4,79	2,44	5,97	6,41	0,00	4,70	6,93	10,63	6,95	4,76	4,02	8,38	5,02	9,07	3,96
% 0,125-0,250 mm	32,80	19,32	18,88	22,36	24,39	28,31	23,97	6,10	18,83	25,81	20,62	20,93	14,05	16,33	32,65	16,70	18,43	19,18
% 0,250 -0,500 mm	40,80	41,91	34,73	41,53	44,60	49,09	50,90	35,73	44,02	40,38	22,50	39,75	27,14	28,39	39,12	34,27	44,81	36,04
% 0,500 - 1 mm	9,87	17,24	24,24	11,66	20,56	14,16	13,72	13,90	22,77	13,74	10,62	21,37	33,57	28,14	13,38	28,47	22,31	21,38
% 1 - 2 mm	0,53	2,52	2,66	6,39	3,14	0,78	1,54	5,71	4,27	3,02	8,75	5,63	10,71	8,04	1,91	4,73	1,94	4,03
% over 2 mm		0,97	0,19	9,58	3,48	0,00	0,38	9,55	3,97	7,99	24,37	1,93	8,57	14,57	3,68	7,53	1,48	14,72
% total	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,00*	*100,00*	*100,00*	*100,00*	*100,00*
max size (mm)	2	3	3	5	3	2	3	5	18	5	5	5	4	4	4	4	4	8

Table 5 - Grain size analysis of the sand in the mortar samples from the site, residues on the sieves in % mass.

microscope, then embedded in resin and appropriately cut and polished for the preparation of transversal sections, used for petrographic mineralogical analyzes and elementary punctual analyzes with X-ray fluorescence maps under the electron microscope which provided further data on the type of binder and aggregate, confirming what was obtained from optical microscope observations and chemical analyses.

Observation of the fragments and cross sections under an optical microscope highlighted a predominantly straw-yellow color in the mortars, more or less dark due to the different presence of clay silicates (clay in the sand).

The presence of white surface traces referring to a lime finish was documented on samples 2, 3 and 6 (Northern Urban Church, base).

On the samples of the Cathedral n. 17 (north wall baptisimal font room) and 19 (threshold, interior of the church, central nave) there is a smooth and clear surface richer in lime.

Sample 10 (Eastern Church, altar area) also has a smooth but light straw-coloured surface, while traces of brownish clay are present on the samples: 1 (Northern Urban Church), restoration cement mortar, 15 and 16 (Cathedral, baptisimal font room, east side).

In the mortar of the samples of the Eastern Church: 7B (southern wall), 8 (baptisimal font) and 9 (altar area) and 2, 5 of the Northern Urban Church there are coarse white lumps (0.5-1 mm) of poorly dispersed lime (fig. 5).

Electron microscopic analyses of the binder, of the lumps of poorly dispersed lime, were important for the characterization of the carbonate matrix.

The X-ray fluorescence maps better highlighted the distribution of the binder and the mineralogy nature of the sand clasts (fig. 6).

Comparison summary

From the data of the various analysis some interesting considerations can be draw.

Samples taken in different sectors:

- Northern Urban Church (Sector 2): samples 1, 2, 4, 3, 5 and 6;
- Eastern Church (Sector 4): samples 7A, 7B, 8, 9, 10 and 11;
- Cathedral (Sector 6): samples 13, 14, 15, 16, 17, 18 and 19;
- Workshops along the Haddas (Sector 5): sample 22.

The binder/aggregate ratios, the grain size curves, and the observations made under the optical microscope on the cross sections confirm the presence of comparable mortars:

- more selected and fine mortars, with high densification and medium-fine grain size corresponding to surface finishing plasters (samples 3, 4, 7A, 10 and 17);
- mortars with medium densification and greater presence of medium grain size, corresponding to more internal layers of arriccio (sample 19);
- mortars with medium-low densification, greater presence of medium-coarse grain size and coarse (samples 2, 5, 7B, 9, 15 and 16) corresponding to layers closest to the stone facing (*rinzaffo*);
- bedding mortar with rare granules up to 18mm (sample 8, probably also sample 11, narthex, which also presents a finer surface layer - sealing - similar to sample 10).

The case of these samples is different: 1 (restoration intervention) consisting of two layers of cement mortar, and 18 which is a mixture of lime and chalk with a little sand.

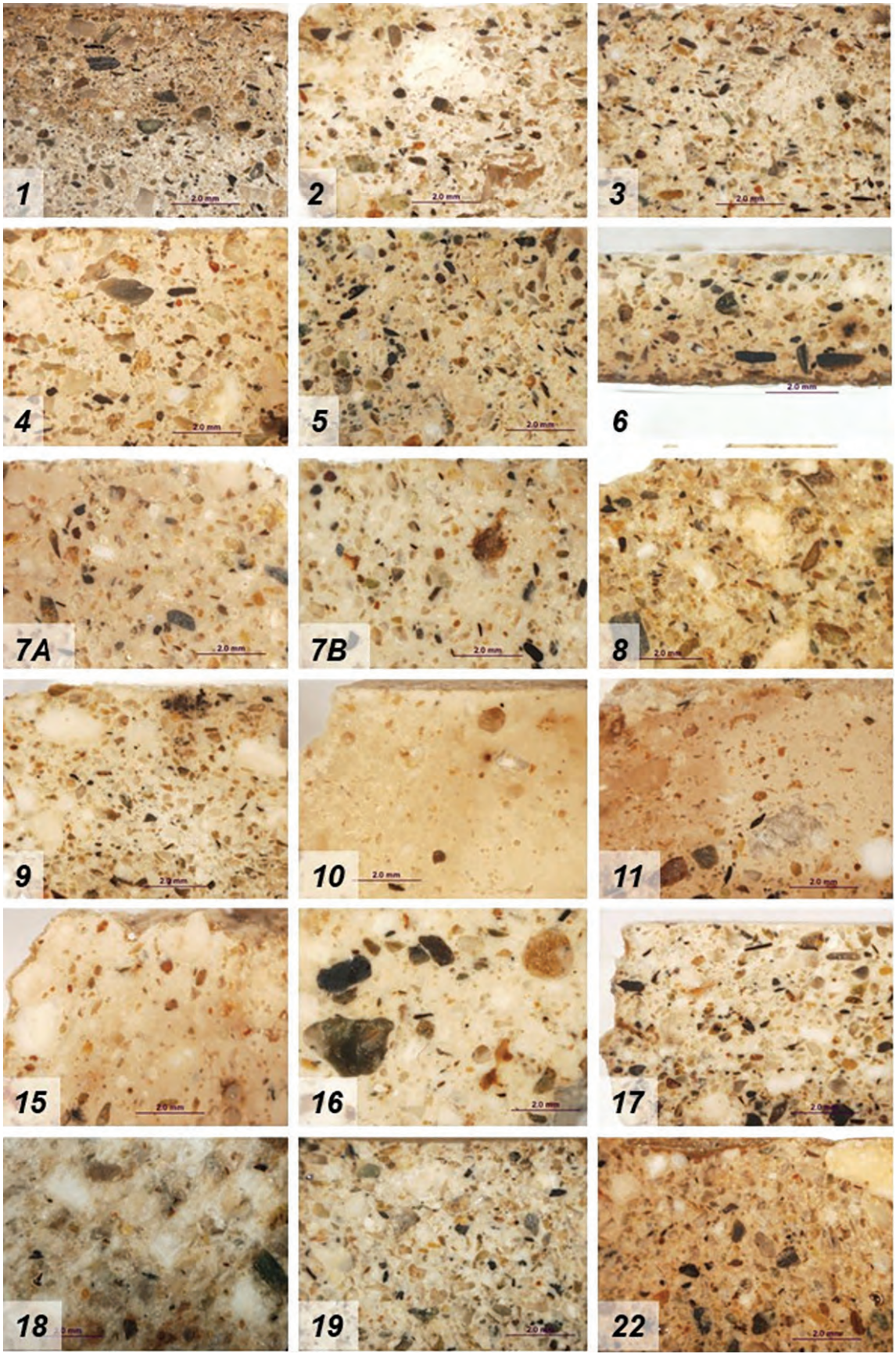

Fig. 5 - Mortar samples. Optical microscope documentation of the polished cross sections.

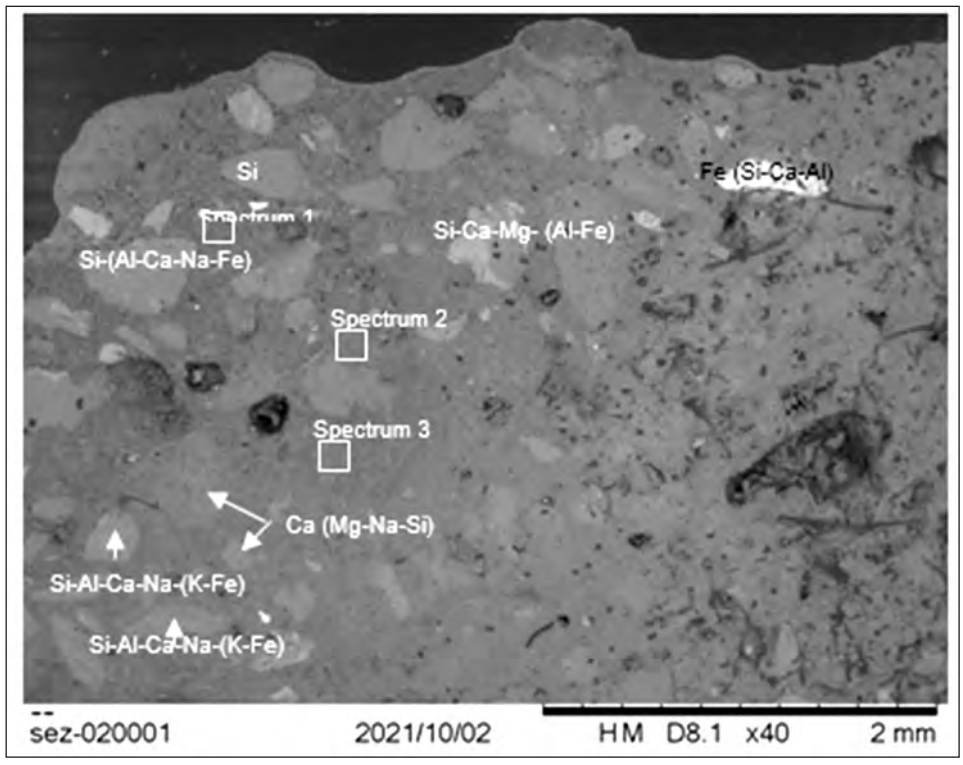

Fig. 6 - Examples of electron microscope analysis (SEM-EDX) (sample 2): Microphotographic documentation.

Chemical analysis showed a different type of degradation, with abundant presence of salts (sodium chloride, potassium nitrate and gypsum), in the samples 7A, 7B, 8, 9, 10, 11 (Eastern Church, Sector 4), B14 (erratic brick), and 16 and 18 (Cathedral).

The ratio of calcium, silicon and aluminium oxides suggests a further subdivision of the mortar samples:

- cementitious (sample 1- restoration intervention in early 1900);
- weakly natural hydraulic with the presence of clay silicates (samples 15, 17 and 22) and with a greater presence of clay (sample 19);
- mixed with gypsum as binder and aggregate (sample 18);
- aerial mortar with a limited presence of hydraulic silicates; all other samples grouped by small differences differences best highlighted by the triangular graphs comparing the different oxides: samples [5, 7B, 16], [2, 3, 4, 6], [7A, 10, 11], [8, 9] (figg. 7 and 8).

By comparing the triangular graphs and other data obtained from chemical analyses, groups with homogeneous characteristics are highlighted (Table 6).

In all the graphs, there are relatable values and very close positions for the samples in the Northern Urban Church, in particular 2, 3 and 6, where there is a light straw-coloured plaster (around 10 mm) of aerial lime and medium-fine sand with traces of a white lime surface finish.

Sample 4 is a much darker mortar with more clay silicates, present on a piece of a basalt column. Sample 5 is a mortar of air lime curl and coarser aggregate.

The same observation can be made for the Eastern Church, where samples 8 and 9 show similar characteristics and consist of a dark straw-coloured plaster of aerial lime, medium-fine sand, clayey material and brick dust also found in samples 7A, 7B, 10 and 11, with light straw-coloured finishing mortars.

In addition to brick dust, abundant salts (sodium chloride, potassium nitrate and gypsum) were found in the mortars of this area.

Sample 8, on the other hand, is representative of a bedding mortar with coarse sand and the presence of 5-18 mm pebbles.

The samples from the Cathedral, 13, 14, 15 and 16 were interesting, representative of a strati-

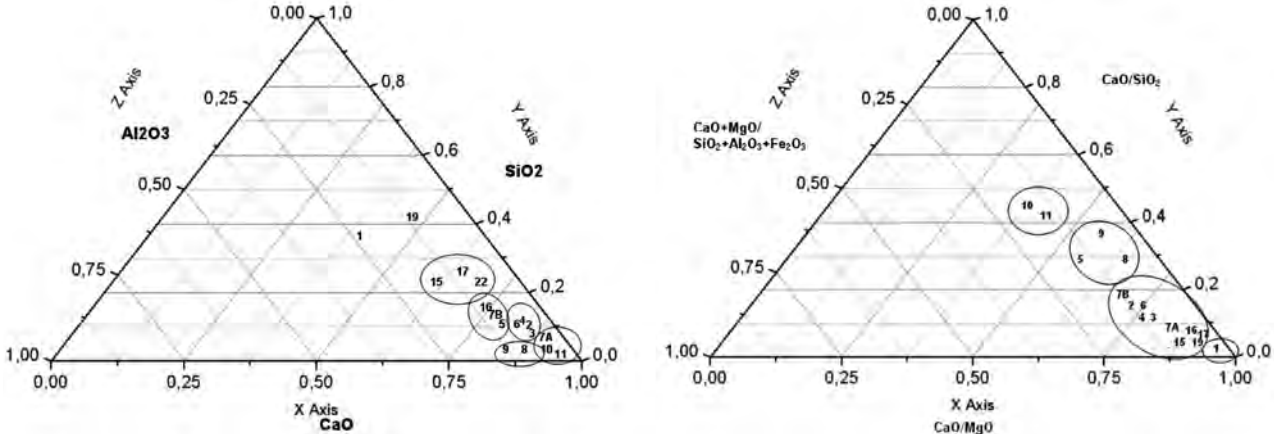

Fig. 7 - Comparison graph between: CaO/MgO, CaO/SiO2 and inverse ratio of hydraulicity.

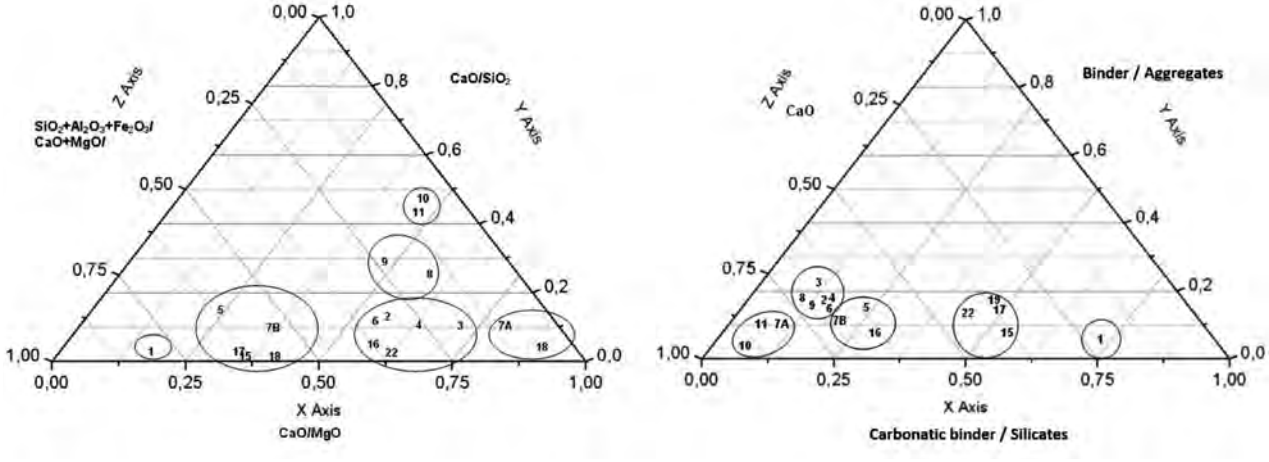

Fig. 8 - Comparison graph between: CaO, L/A and Carb/ Sil.

[2_3_4_6] [7A_7B] [5_16_17_18_19_22] [8_9] [10_11]	Samples presenting similar ratios between carbonate binder oxides are grouped within parenthesis: (CaO - MgO - Al_2O_3) (CaO/MgO) - (CaO/SiO_2) - (CaO+MgO)/(SiO_2 + Al_2O_3+Fe_2O) (CaO - B/A - Carbonates/Silicates) (CaO/MgO) - (CaO/SiO_2)
[2_4_6] [7B] [5] [9]	Samples with 40-45% of carbonate binder
[3] [7_19]	Samples with carbonate binder below 40%
[7A] [15_16]	Samples with carbonate binder over 45%
[7A_7B] [9] [10_11] [16]	Samples with abundant presence of soluble salts (7,5-13%), Chlorides (1,2-2%), nitrates (0,6-1,7%) and sulphates (5-8%)

Table 6 - Summary of similar characteristics

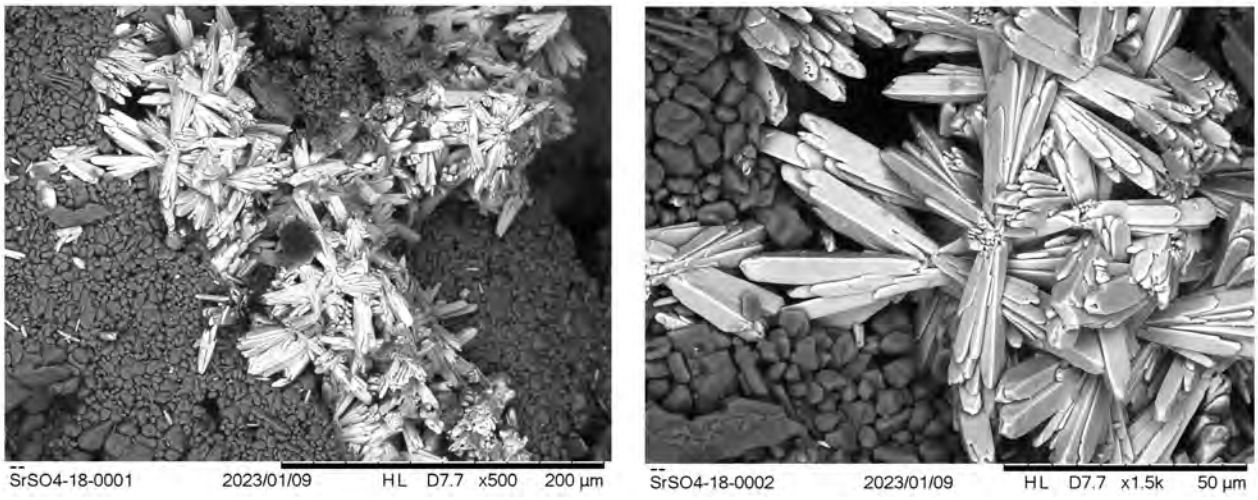

Fig. 9 - (SEM-EDX) Electron microscopy - Celestina crystals in the sample of gypsum n.18.

graphic succession and respectively: a layer of disaggregated mortar with little lime, sand and abundant brick dust (beaten earth), a layer of basalt gravel and two layers of mortar, rich in lime with sand and brick dust.

Relatively close positions in the graphs, although not always corresponding, are found for sample 17 from the Cathedral, and for samples 18, 19 and 22 from the workshops (Sector 5), indicative of the presence of lime and sand-based plaster on the wall structure.

Sample 18 - Cathedral (altar area, large sporadic fragments) - is a mortar unlike any other, consisting of lime with little fine sand and gypsum with traces of celestine. The presence of celestine (strontium sulphate) is an interesting indicator of the origin of the gypsum, which would require research into the geological configuration of Eritrean and other territories (fig. 9).

Sample 1 - is a strongly hydraulic (cementitious) restoration mortar.

The traces of finish are white in samples 3, 6 and 9, light straw coloured (2-3 mm) in samples 7, 10 and 11.

Sample 19 presents a smooth surface without a real finish.

Other samples present brownish clayey traces on the surface (sample 4, 15, 16 and 22).

Finally, sample 22 from the workshops (Sector 5), is a weakly hydraulic natural mortar with clayey silicates comparable to samples 15 and 17 from the Cathedral.

On the stone samples from the Cathedral, mineralogical-petrographic analyses were carried out on thin sections under the polarising microscope, which allowed the identification of the lithotype and will provide information to identify its possible geological formation.

Sample MP15A is a biotitic (metamorphic) gneiss from high grade Precambrian metamorphites.

Sample MP15B is an ignimbrite, an effusive magmatic rock saturated in silica, from Miocene-Pleistocene volcanites.

Sample MP15C is an alkaline basalt, effusive magmatic rock, from Pleistocene lava flows.

Sample MP15D is a quartzite, metamorphic rock, from Precambrian high-grade metamorphites.

Sample MP20 (threshold, inside nave) consists of three sporadic fragments of carbonate alabaster, a crystalline concretionary limestone, a sedimentary rock of chemical origin, with a heterogeneous structure of calcite crystals (2 mm to 0.05 mm).

Sample MP21 (grainstone) is a calcarenite (biosparite - grainstone) from a nephritic depositional environment, of Eocene-Oligocene age.

Abundant allo-chemical components are present (benthic foraminifera - order Rotaliida, genera Asterigerina and Nummulites - calcareous algae, echinoderm plates).

Laboratory tests

In the need to intervene for the appropriate/suitable conservation of the site's masonry, various mortars were formulated in the laboratory using Haddas sand and local clay with hydraulic

lime, given the objective difficulty of using local quicklime, achieving good adhesion on some basalt and shale samples from the site.

The recipes as a bedding or curling mortar and as a finishing mortar with the best characteristics were then recommended for a first pilot intervention on the site in 2023 (tests in figg. 10-11):

- Recipe A (bedding and curling): natural hydraulic lime (NHL3-5) - 2 parts by volume, fine sand (0.1-0.5 mm) - 1 part, medium sand (0.1-5 mm) - 5 parts, coarse sand (0.1-8 mm) - 1 part, light local clay 1 part and water 0.2-0.5 parts, for 1-2cm thicknesses.
- Recipe B (finishing): natural hydraulic lime (NHL3-5) 2 parts by volume, fine sand (0.1-0.5 mm) 2 parts, medium sand (0.1-5 mm) 3 parts, light local clay 1 part, dark local clay 1 part and water 0.2-0.5 parts, for thicknesses of 0.5-1 cm. Average chemical characteristics of the NHL 3-5 natural hydraulic lime used: CaO 66% - MgO 0.5% - SiO2 12% - Al2O3 0.6% - Fe2O3 0.2% - K2O 0.1% - Na2O 0.05% - SO3 0.6% - CO2 6% - p.f. 14%.

Fig. 10 - Restoration mortar A (bedding and curling).

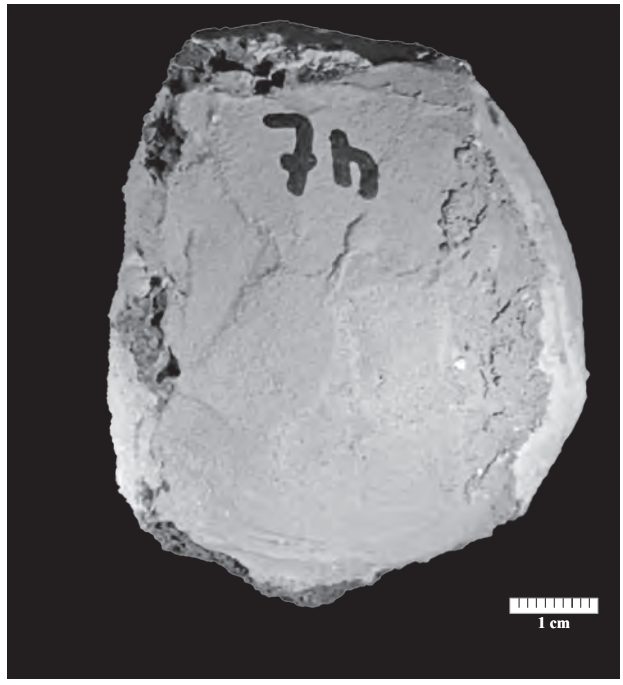

Fig. 11 - Restoration mortar B (finishing) with darker clay.

GEOMETRY AND MEASUREMENTS OF THREE MONUMENTAL BUILDINGS IN ADULIS

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Observing the plans of the palaces and churches in Adulis and in the coeval archaeological sites on the plateau in current Eritrea and Ethiopia, it is evident that the architectural layout of the stone buildings of monumental character presents recurrences of construction and appearance. The aim of this brief contribution is to infer, albeit with many limits, some of the rules regarding the form, measurement and proportion of these architectural layouts, referring in particular to the well-preserved parts of the Adulis buildings on which it was possible to make direct observations. These observations were supported by bibliographic references, particularly the texts, surveys and photographic images produced during the 1906 excavation campaign in Adulis by Roberto Paribeni,[1] which in some cases describe construction details that have now disappeared.

The amount of data acquired directly is obviously limited compared to the vastness of the built landscape present in the sites in the current territories of Eritrea and Ethiopia, so no general assumptions can be made. However, it is possible to propose some first observations also based on the contents of another important series of publications, edited in 1913 by Enno Littmann and with the drawing by Daniel Krencker,[2] on the artefacts surveyed during the Deustche Aksum-Expedition (DAE) of 1906. Littmann's campaign produced documentation of great importance due to the extent of the area examined and to the state of the artefacts, recorded at the beginning of the twentieth century. These documents, net of some possible accidental errors, graphics errors (which alone in some cases examined exceed 10 cm) and some plausible printing deformation, are sources of considerable accuracy.

While offering questions rather than answers, the following analysis investigates two closely interrelated issues concerning the architectural layout and the role that geometry and measurement may have played in the design and construction phases: firstly, the use of geometric figures and modules and of proportional ratios between the parts, in other words the *regula*, both in plan and elevation; secondly, the use of one or more units of measurement.

Regarding the first point, the recurrence of the square as the most used geometric figure is immediately evident by observing the plans of the monumental buildings. As is well known, the use of the square in the plan layout of buildings was so recurrent and versatile in antiquity that it gave rise to the Latin term *ad quadratum* to indicate a range of ways of composing rectangular plans with the sides in defined proportional ratios, precisely starting from the square.[3] Geometrical constructions *ad quadratum* include not only the doubling or creation of rectangles with sides in finite ratios to each other (2:3, 3:4, 3:5, 4:5 etc.), but also increases according to golden ratios, which cannot be quantified with finite numbers and can only be obtained geometrically: for example, the square root of 2 per the side of the square, equal to its diagonal, or the square root of 5 per the side, equal to the line connecting a vertex of the square with the midpoint of the opposite side (fig. 1).

[1] Paribeni 1907.
[2] Littmann 1913, Krencker 1913.
[3] Giuliani 2006.

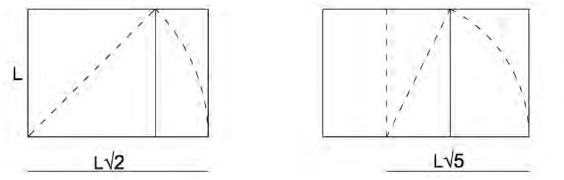

Fig. 1 - Rectangles obtained geometrically from irrational ratios of the square side.

Designing *ad quadratum*, by its very nature, can use a grid, not only to simplify the design through modularity, but also to control the proportioning of the parts and the overall size. In fact, this method, already in use in ancient Egypt and in the classical world,[4] simplifies the passage from the design drawn on a small modular grid based, to the 1:1 tracing of the plan on the ground by scaling the module, i.e. the square. The relation between the drawn module to a real measurement to be used on the building site also made it possible to prefigure and manage the proportion between plan and elevations with relative ease.

Below are two examples taken from Littmann-Krencker, which concern monumental buildings on square *podia*. The choice of these two examples serves to point out two possible ways of setting up the module: it can define the length and width of the podium at ground level, or it can define the building's measurements standing out from the podium's summit level, which, due to the restriction of the steps, is narrower. Or again, it could determine the internal profile of the building's perimeter walls, a choice that, in the case of churches, could also have a precise symbolic meaning, since the internal space, like the soul, is where salvation occurs.[5]

From a first observation of the plan of Enda Mikael in Aksum surveyed by Krencker during the DAE (fig. 2 on the left), the recurrence of the square is evident, and the building seems to be set on a macro-module of over 9.27 ± 0.1 m (which, as will be better examined later, could be equivalent to 18 cubits of 0.51-0.52 ± 0.005 m). According to the alignments it generates, the module defines the size of the podium's base at ground level and the position of the two main longitudinal walls, which are the continuous walls from one front to the opposite.

In the second case, the palace of Enda Sem'on in Aksum (fig. 2 on the right), there is a possible main module of approximately 6.5 ± 0.1 m (equivalent to 13 cubits of 0.50 ± 0.008 cm), set on the outer edge of the rearmost perimeter wall, thus allowing the thickness of the less rearmost walls to be governed more by constructional than proportional reasons.

From these two cases, a first useful deduction is that the module is not necessarily made up of a set number of measurements units, and that the cubit might not have a standard length.

The regula of three monumental buildings in Adulis

The last remarks seem to be confirmed also by the three monumental buildings surveyed in Adulis during the current archaeological fieldwork: the Northern Urban Church (called the 'Ara del Sole' by Paribeni, corresponding to Sector 2 of the excavations begun in 2011) and the Cathedral (known as the 'Church of the British Museum', Sector 6) are examined first, as they show a common layout type, despite a different orientation; an interpretation of the Eastern Church (Sector 4) follows.

Given their possible dating between the fifth and sixth centuries, it should come as no surprise that these buildings show a similar construction logic as that of the palaces built in this region of the Horn of Africa in the same cultural context: it is unanimously recognised in current architectural historiography that, in the Palaeo-Byzantine period, building types already in use locally were utilised in the construction of churches, i.e. buildings with a novel function.[6] Therefore, local building traditions regulate these buildings from a compositional and formal point of view. As was the case in the Roman Empire, also the palaces of this region, although still largely to be investigated, lent themselves well to being used as a type for newly built churches, or, due to their monumentality and large interior spaces, to be used as adapted existing buildings.

Not unlike what occurred in the peripheral regions of the Byzantine Empire, the decorative ap-

[4] Sainz 1988, Clerc 2020.
[5] Vidulli Torlo 1984.
[6] Krautheimer 1986, Korač, Šuput 2016, Mango 1999.

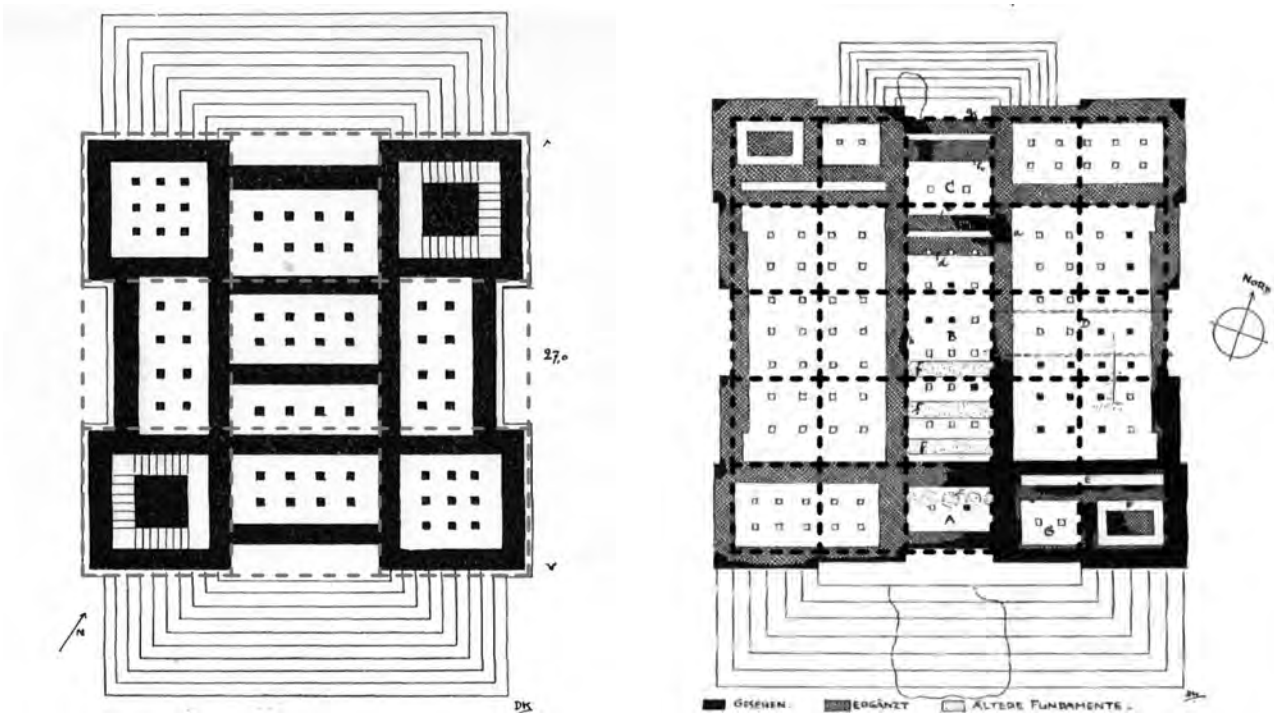

Fig. 2 - On the left Enda Mikael, on the right Enda Sem'on in Aksum, as recorded during the Deutsche Aksum Expedition of 1906 (Littmann 1913, p. 111).

paratuses characterising the interior of the church and liturgical spaces could in many cases consist of very precious and refined elements, not necessarily manufactured *ad hoc* but imported already finished from the Mediterranean area, and thus only juxtaposed to the structure. On the other hand, the accesses and pathways, due to their symbolic and liturgical role, were placed or inserted specifically to serve the new religious function.

In the first two Adulitan buildings under examination, an *ad quadratum* plan layout based on a 3:5 ratio can be identified (fig. 3). The hypothesis on the geometric generative process of the plan proposed here, which, however, may not be the only possible one, is as follows: the main square of 3:3 modules includes the rear part of the church and defines the fundamental partitions; its centre coincides in both cases with the probable position of the altar area, thus assuming an important symbolic value. The three modules on the eastern side identify the triple sanctuary, i.e. the apse and the two side chambers (*pastophoria*), one of which, in the Cathedral, housed the baptismal font (fig. 4).

The church hall design is completed by one more module in length and therefore its plan is based on the 3:4 proportion. The tripartition of the width determines the central nave and the two side aisles. The alignment of the inner, outer or midsection of the wall with the module is sufficient to allow the widths of the compartments to vary; for example, the width of the inner nave in the Cathedral coincides with the main module, while the side aisles are narrower as they are net of the perimeter wall and the columns (fig. 5 shows the stringcourses of the columns).

The *narthex* occupies the length of a further module, making the entire building based on a 3:5 ratio.

The process defining the layout of the Oriental Church (Sector 4) seems to be different (fig. 6). Various hypotheses have been made, none of which can be taken for certain; however, one is presented below that, due to its simplicity and compliance with metric, numerological and alignment requirements, is the most convincing.

In this case, too, there is a main square consisting of 3:3 modules. The centre of the main square, however, coincides with the centre of the columned octagon and not with the probable position of the altar (fig. 7). The centrality of the layout of this *aula ecclesiae* supports the hypothesis that

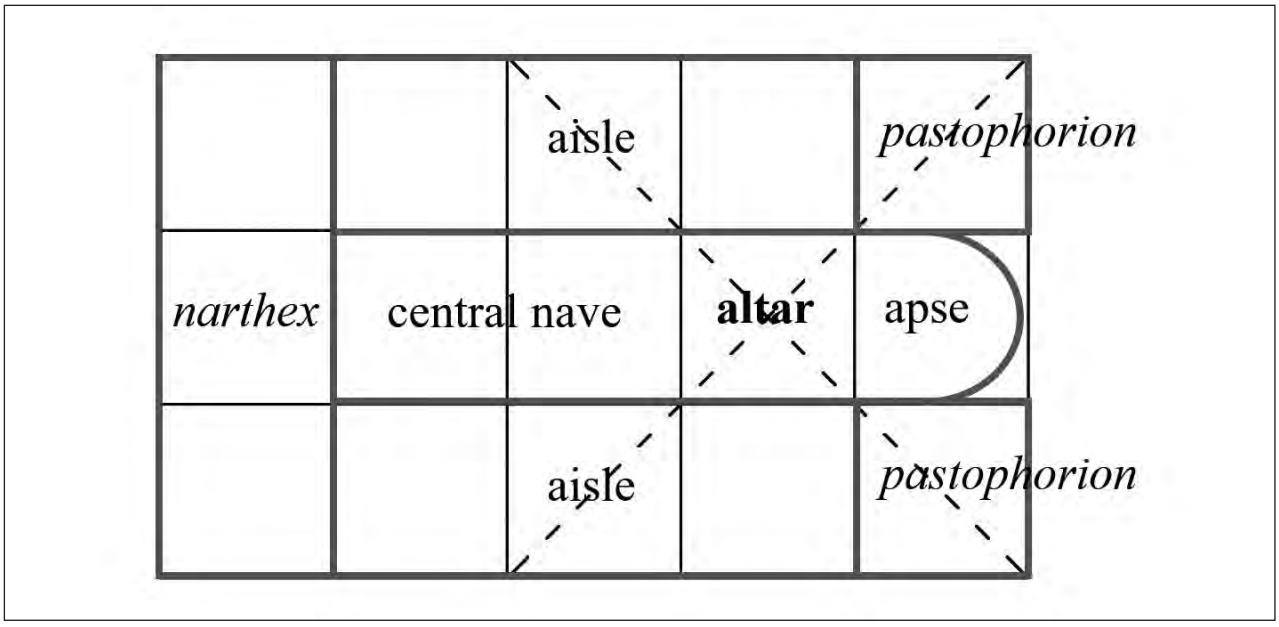

Fig. 3 - Scheme of the design ad quadratum of the Northern Urban Church and the Cathedral in Adulis.

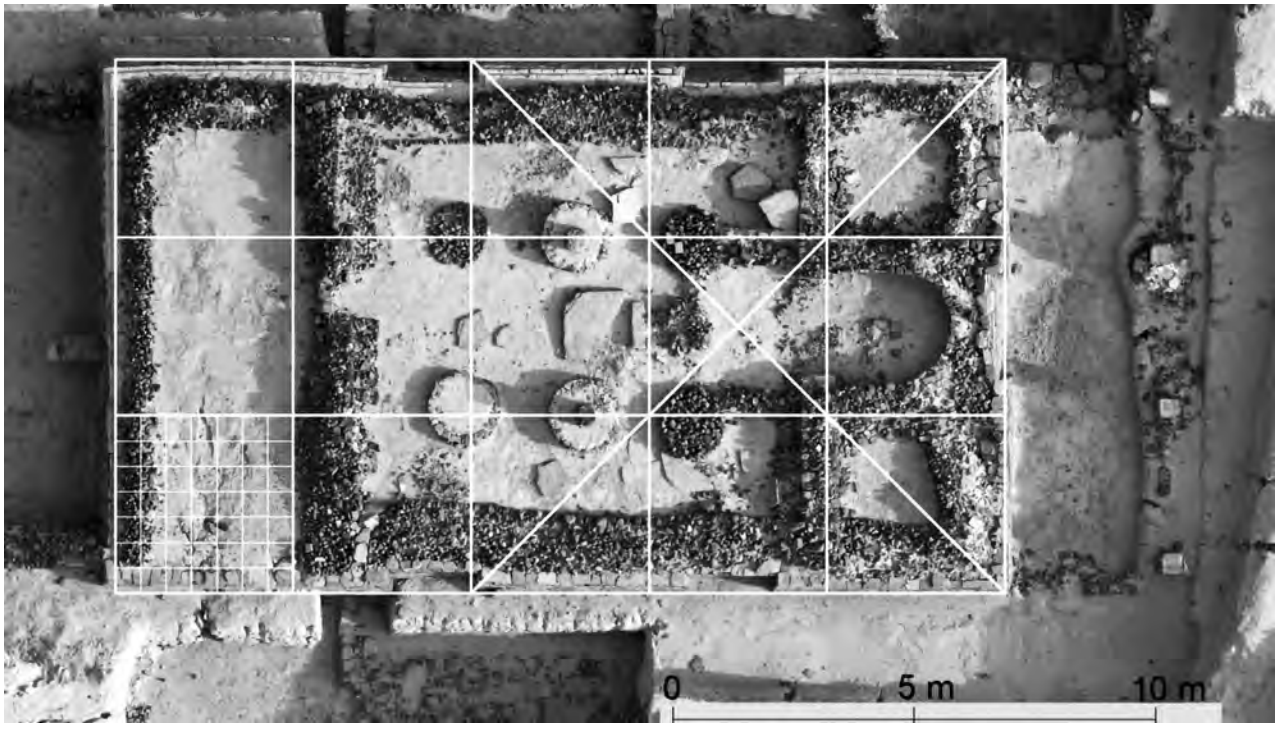

Fig. 4 - Orthophoto of the Northern Urban Church with the module grid and detail on its possible division in cubits.

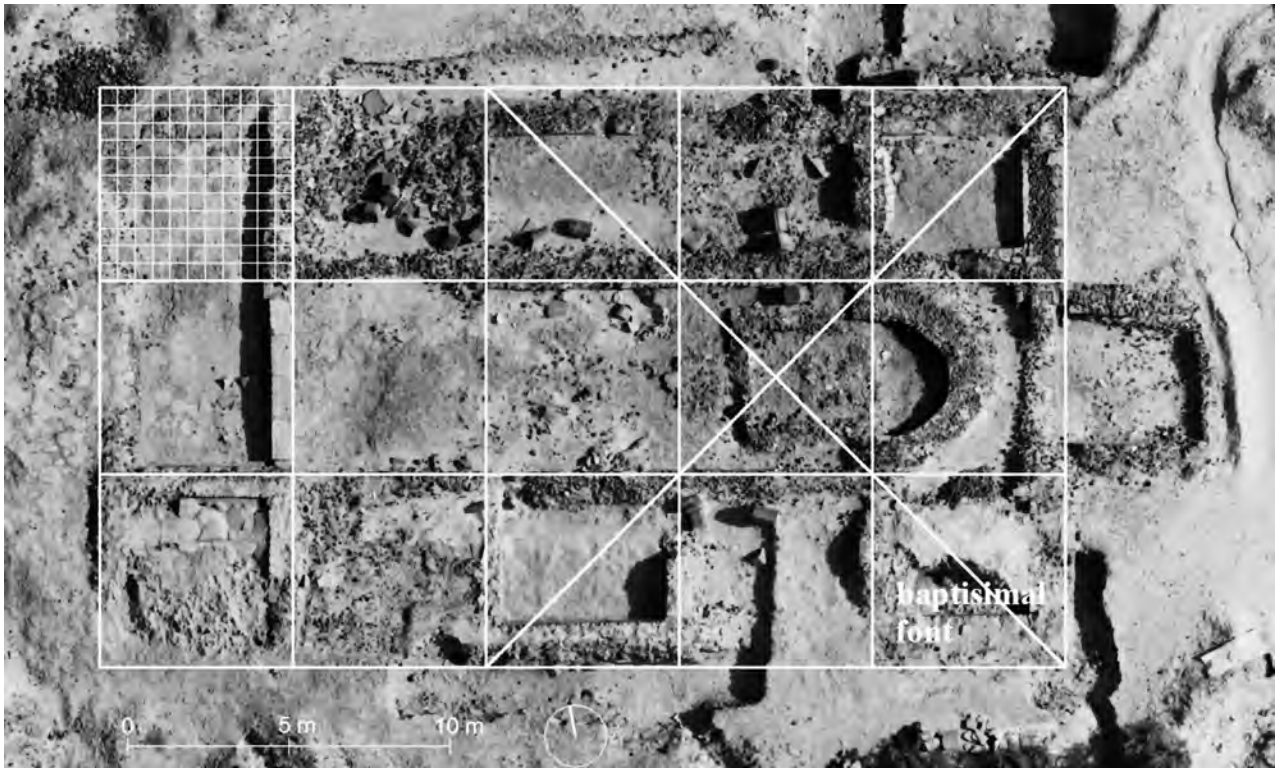

Fig. 5 - Orthophoto of the Cathedral with the module grid and detail on its possible division in cubits.

this centre was also the generating point of the general plan and where the roof reached its highest elevation, i.e. the closest to the sky. Even though a novelty and a rarity in the regional built environment of the time, the columned octagon could have been part of the original design. This could only be confirmed by further excavation. What can be affirmed, also on the basis of Paribeni's observations,[7] is that the roof was a light structure, probably made of wooden beams creating an octagonal-based dome.

The main square determines the position of the outer edge of the rearmost perimeter walls and the transverse walls separating the *aula* from the *narthex* and the *pastophoria*. It would not be surprising if the position of the pillars had not been defined according to proportional rules but rather to technical necessities such as the maximum length of the beams or entablatures, of which there are no finds or sources.

The apse seems to end at the distance defined by the circle circumscribed by the main square. Due to the collapses, it is not possible to establish the exact position of the perimeter walls of the *pastophoria*; however, assuming that the baptismal font was positioned in the centre of the small south-eastern room, the rectangular shape of the latter is at least confirmed. In this case, a simple geometrical process could be to use simple ratios of the module utilising the cubit: a first hypothesis is that the length of the *pastophoria* corresponds to 8/10 of the module, which is, as we will see, 8 of the 10 cubits making up the module.

The *narthex* also appears not to derive from the addition of an entire module, but of a module less one cubit (i.e. in this case 9/10 of the module). The partition dividing the *narthex* into two parts clearly belongs to a phase after the building's construction; therefore, it does not add any metrological information.

Here too, placing the thickness of the walls inside or outside the gridlines makes it possible to regulate variations in measurements and proportions within the schematic *ad quadratum* rule.

[7] Paribeni 1907, c. 531.

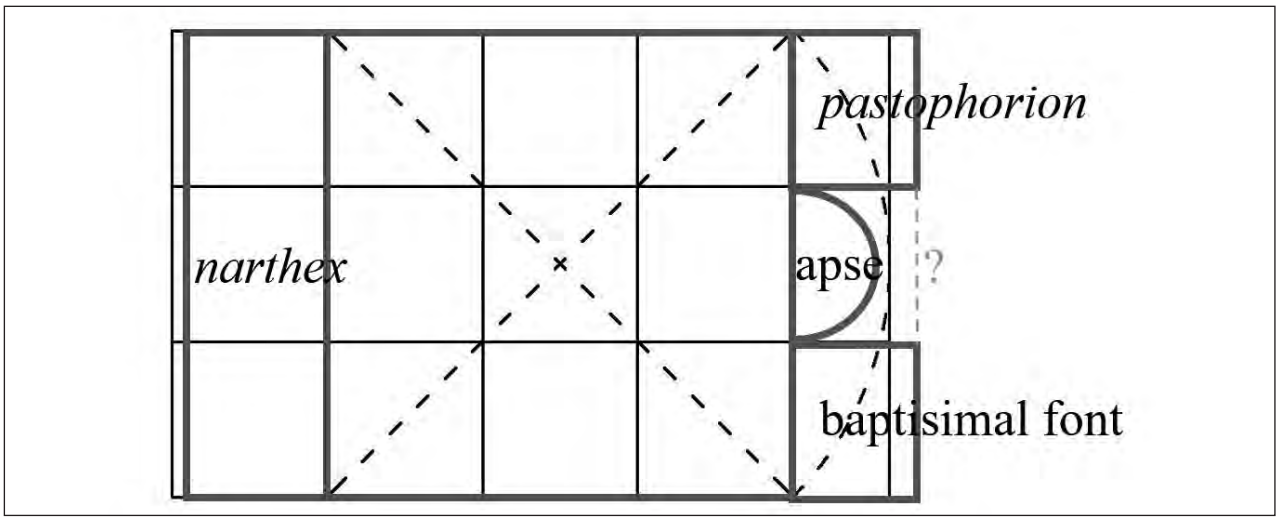

Fig. 6 - Scheme of the design *ad quadratum* of the Eastern Church.

MEASUREMENT UNITS IN ADULIS

It remains to be clarified whether the main module has a length that can be traced back to a unit of measurement, or whether length and width were determined by the terrain available for the building, and thus the final measurements simply depended on how to optimise it.

The units of measurement in use in Adulis are, of course, anthropometric. As far as we are aware, the measures used in this part of the African continent have not been studied by leading scholars of ancient metrology. Dieter Eigner refers to an 'Aksumite cubit'[8] as a unit of measurement of 48 cm, derived from the surveys and data collections reported by DAE,[9] however it is not clear to which components of the buildings it is referred. It is well known that the same anthropometric measurement could vary even in particularly homogeneous and structured cultural systems: with the exception of the Egyptian royal cubit, which established a 'standard' measure rigorously transmitted through the use of non-deformable samples,[10] it must be assumed that the most common architectural measures, i.e. the cubit, with its sub-multiples the palm and the foot, could undergo slight variations even within the same region and in the same period, as evidenced by Segre's studies in both the Roman and Byzantine empires.[11]

In the case of Adulis there are undoubtedly recurring measurements: the steps of the podiums measure relatively consistently between 52 and 53 cm and although the measure of 52,7 cm is recurrent, it will be possible to refer to it only after statistical systematic study. This is a measurement that can probably be attributed to the local cubit and that is very close to both the Egyptian royal cubit of 52.36 cm and the Judaic and Syriac cubit reconstructed by Segre based on the data of Julian of Ascalon, which would be 52.5 cm, and longer than the Attic (44 cm) and the Roman cubit (44,4 cm). The cubit, therefore, and not the foot (approximately 30 cm) as was frequently the case in the Roman world, is likely to be the measure in use. The base of the pillars may instead refer to the use of the palm and the fist, both sub-multiples of the cubit. The ratio of cubit to palm is not constant in the ancient world: in the case of the Egyptian royal cubit the palm is equivalent to 1/7, but in other documented cases the ratio is 1/5.[12] The chiselling of the basalt probably did not allow for millimetric precision and there are variations of several centimetres (from 43 to 49 cm) in the sections of the pillars. It is therefore not possible at present to propose, even on a hypothetical level, any indications of the size of palms and fists.

In the case of the Northern Urban Church (L 18,45 ± 0.05 m, W 11,07 ± 0.05 m), the module on

[8] D. EIGNER, *Architecture of the Aksumite period*, in *EAe,* vol. 3, *ad vocem*.

[9] LITTMANN 2013, II, p. 136 ff.

[10] MONNIER *ET AL*. 2016.

[11] SEGRE 1928.

[12] *Ib*.

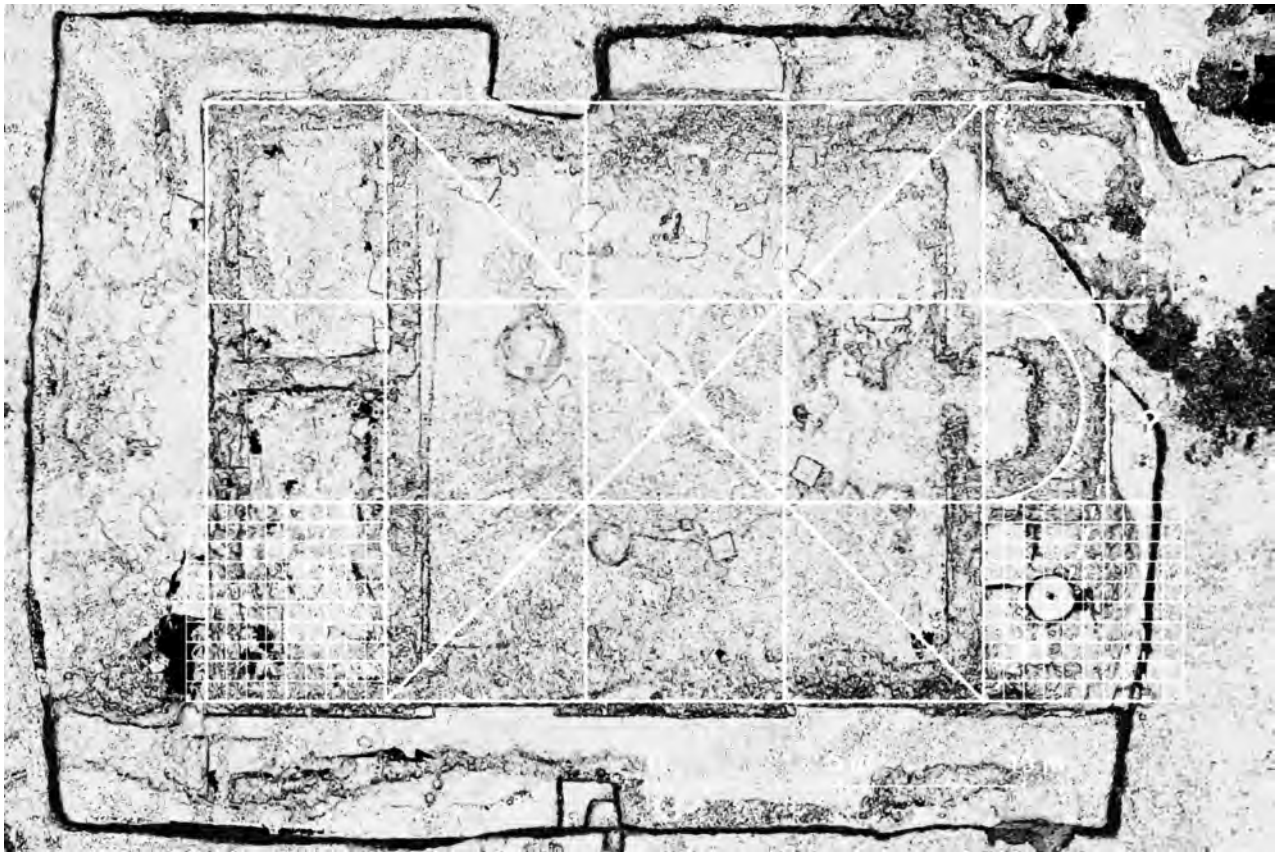

Fig. 7 - Orthoimage of the Eastern Church with the module grid and detail on its possible division in cubits.

which the plan is built, according to the proposed *regula,* measures 3.69 ± 0.05 m, equivalent to 7 cubits of 0.5257 ± 0.007 m. In the case of the Cathedral (L 30 ± 0.05 m, W 18 ± 0.05 m), the module is 6 ± 0.05 m long corresponding to 12 cubits of 0.50 ± 0.004 m or 11 cubits of 0.545 ± 0.004 m. In the case of the Eastern Church (L 25,44? ± 0.05 m, W 16,24 ± 0.05 m) the module measures 5.41 ± 0.05 m, corresponding to 10 cubits of 0.541 ± 0.005 m. Despite this quite convincing correspondence, we cannot completely exclude that the cubit was used in elevation and the foot in plan, but it is not possible to speculate at present in this regard. The possibility of passing from drawing to construction by referring the same measurement unit, i.e. the cubit, to both the plan and the elevation through the 'standard' height of the podium steps, certainly guaranteed a better control of the proportions. The use of the same unit was a facilitating condition for prefiguring the final proportions of the building. To guarantee the monumentality of the architecture, it was necessary to maintain a balanced ratio between the height and width of the façade, preventing the podium from looking like a simple base. The smallest (Northern Urban Church) and the largest (Cathedral) of the three buildings, present in fact two *podia* of different height. An excavation test on the northern side of the latter revealed a total of seven steps, while in the smaller church, two similar essays revealed a total of five steps, commensurate with the smaller size of the building.

Conclusions

What is presented here is the result of a preliminary work that does not so much intend to delve into detailed issues of ancient metrology, for which specific expertise is needed, but rather to build on this to proceed in understanding the architectural heritage of Adulis. Besides adding new cases to validate the hypotheses outlined herein, for example by dealing with the so-called Sundström Palace, during the future fieldworks it will be necessary to also consider the access staircases

to the top floor of the podium, since these structures were built at the same time and contributed to the monumentality of the whole architectural complexes. Furthermore, it will be necessary to create a metric repertoire of the elements found on the excavations (column ruins, steps, etc.) and to set up a comparative metric table on both a geographical and a chronological basis.

MULTI-SCALE 3D SCANNING OF THE ADULIS SITE AREA AS A SUPPORT FOR ARCHAEOLOGICAL ACTIVITY: CHALLENGES, STRATEGIES AND RESULTS

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Fig. 1 - The alignments of basalt stones providing information on the probable position of a stone wall, in many occasions can be detected only during a fieldwalking survey.

Fieldwalking has been an essential activity for understanding the morphology of the urban settlement of Adulis. It makes it possible to detect the presence of walls emerging to the surface by looking at the aligned stones, helping to comprehend the ancient urban layout avoiding wide excavations. Beside the orientation of the wall, also the thickness of the walls can be measured if both edges are found, providing useful information.[1]

Aerial photogrammetry, increasingly in use in the fields of Archaeology and Cultural Heritage,[2] can be seen in our case as a support for the fieldwalking activities. The orthoimage, once georeferenced, is used to position and record the observation of surface finds, detected during the

[1] Waagen 2019.

[2] Magnani *et al*. 2020; Marín-Buzón *et al*. 2021.

fieldwalking. It must be remarked that aerial photos, even if acquired at high resolution, cannot substitute fieldwalking in detecting structures and finds, because most of them would not be clearly visible (fig. 1). They optimize instead the collection and the record of survey data. In fact, the use of small markers to emphasize the presence of aligned stones during the fieldwalking phase helps the subsequent localization of such alignments in the orthoimages. On the other hand, the orthoimages processed during the fieldwork represent the first complete map of the site at a resolution of 2 cm/pixel, together with the complete 3D model, the Digital Elevation Model (DEM) and the Digital Terrain Model (DTM). From the map it is therefore possible to assess the alignment of the buildings on larger distances.[3]

Where excavations had already brought the ancient structures to the surface, a detailed 3D reconstruction, obtained with a handheld 3D scanner, is able to capture, like a photograph, the current state of conservation and enables a thorough and detailed analysis of the geometries and deformations of the walls, away from the harsh conditions of the site and without the particular time limitations for a traditional survey.

The availability of a 3D photogrammetric model of the whole site, together with local models with higher accuracy and level of detail, makes it possible to study the site at different scales, supplementing and supporting the classical archaeological activities, and providing a georeferenced base to use in the GIS environment.

During the March 2022 field activities, in addition to the traditional Terrestrial Laser Scanner, a Handheld 3D Scanner and a drone were used to obtain the detailed reconstruction of the walls of the several exposed structures and the photogrammetric reconstruction of the whole site, respectively.

The aim of the field activity was not only to scan the required site sectors, but also to run in the survey methodologies in the challenging environment of the Adulis archaeological site. High temperatures, sudden gusts and the presence of dust were the main critical environmental factors to consider. Battery availability was also a major constrain in scheduling the activities.

Handheld 3D Scanner

The Handheld 3D Scanner selected for the survey allows to capture the geometry and texture of objects by exploiting stereo vision and structured light, together with an RGB camera. The scanner tracks its position in space while scanning using the acquired images and an inclinometer. This makes it possible to stitch all the acquired frames in a single set of points describing the geometry of the surveyed object. This set of points is called point cloud. Measurement accuracy ranges between 0.5 at a distance of 1 from the surfaces to be surveyed, and 5 at the maximum distance of 5.

During the field campaign, the exposed walls and structures of Sectors 2, 3, and 6 were completely acquired with the handheld scanner. A total surface area of approximately 660 was acquired in Sector 2 (fig. 2), and 960 in the contiguous Sectors 3 and 6. In Sector 8, only newly discovered walls needed to be acquired, so single and independent scans were performed.

Scanning such vast areas requires the scans to be acquired in several distinct parts that later need to be aligned together with a registration procedure. In order to enable the alignment of the scan parts, dedicated coded targets were used in the overlap regions between the different scan parts. The registration process relies on the automatically recognised coded targets shared between partial scans, and later optimizes the alignment based on the content of the pre-aligned point clouds.

Coded targets were used also in the single scans of Sector 8 to help the scanner in tracking its position in space, thus enhancing the scan quality. In this case the registration procedure is not required, since there is only one scan to describe the whole object.

Ambient light and heat proved to be challenging for the instrument. Scanning was carried out in the morning or in the evening since light intensity is lower, hence making it possible to acquire properly a higher number of points per second of acquisition. Under the sunlight, it was necessary to pay particular attention to the abrupt changes in the surface illumination due to projected shadows.

High temperature also caused overheating of the PC, but only after prolonged use. In fact, no

[3] Carvajal-Ramírez *et Al*. 2019.

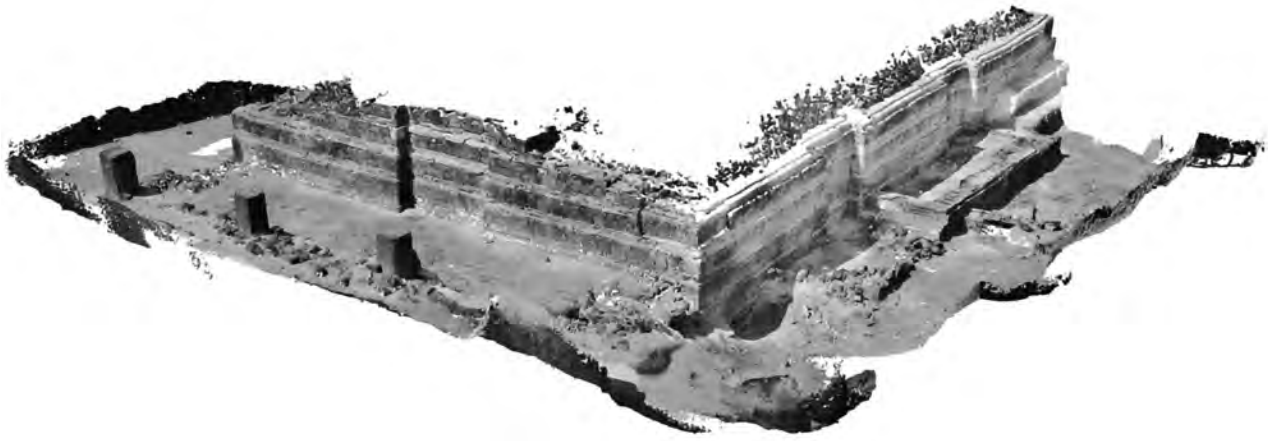

Fig. 2 - Northern and eastern sides of Sector 2, acquired with a handheld 3D scanner.

particular issue resulted when scanning small wall portions. Battery life proved to be enough for a single morning/evening scanning session.

Raw data processing proved to be relatively short compared to photogrammetry, despite the significantly denser point cloud and higher accuracy that aerial photogrammetry is not able to provide. On the other hand, photogrammetry offers a more flexible processing procedure.

Drone Photogrammetry

Photogrammetry is a technique that allows to reconstruct the 3D point cloud of an object/structure and the like by means of photographs taken from various positions with a significant overlap between each photograph. The technique pipeline consists of various subsequent steps: prepare the area to be photographed with targets and take the pictures; find correspondences between the pictures based on the strong graphical features (control points) they present in common; estimate iteratively the camera roto-translation between each picture, the camera calibration parameters and the coordinates of the control points in space; calculate the position in space of all available points, obtained by exploiting triangulation pixel by pixel, once the relative position of the cameras has been determined.

The main aim of this survey session was to obtain orthophotos and orthomosaics of the main site Sectors with a better Ground Sampling Distance (GSD) with respect to the satellite images. The available DigitalGlobe imagery, dated 2012, has a GSD around 40 cm, corresponding to a 1:1.000 nominal scale map, which does not allow the detection of single masonry stones.

The GSD can be defined as the distance between the centres of two consecutive camera pixels projected on the ground. For a given camera, the GSD is proportional to the flight altitude. The possibility of flying at different altitudes made it possible to select the GSD for every set of pictures while maintaining the lowest possible number of images, so as to limit the processing time. Each photo has an overlapping area with the next one of at least 60%.

The GSD, determined by the flight altitude, was changed based on the requirements: orthomosaics with a GSD of approximately 7 were obtained on Sectors 1, 2 (fig. 3), 3, 6, 7, 8.

The whole site was reconstructed in its entirety with a larger GSD of 20 . Flying at 65 of altitude, the survey of the entire site required 428 photos in a grid pattern. Single Sectors, acquired at a lower altitude, required between 90 and 150 photos in order to cover the area of interest with sufficient overlap (fig. 4).

Since the single pictures do not carry any information on the absolute dimensions of the photographed object, the result of the 3D reconstruction is not scaled. A set of external references, such as distances between distinguishable points or GNSS (Global Navigation Satellite System) coordinates of known points, needs to be introduced in the model for proper scaling. The need to have easily recognizable points with a known position leads to

Fig. 3 - Photogrammetric reconstruction of southern and western sides of Sector 2.

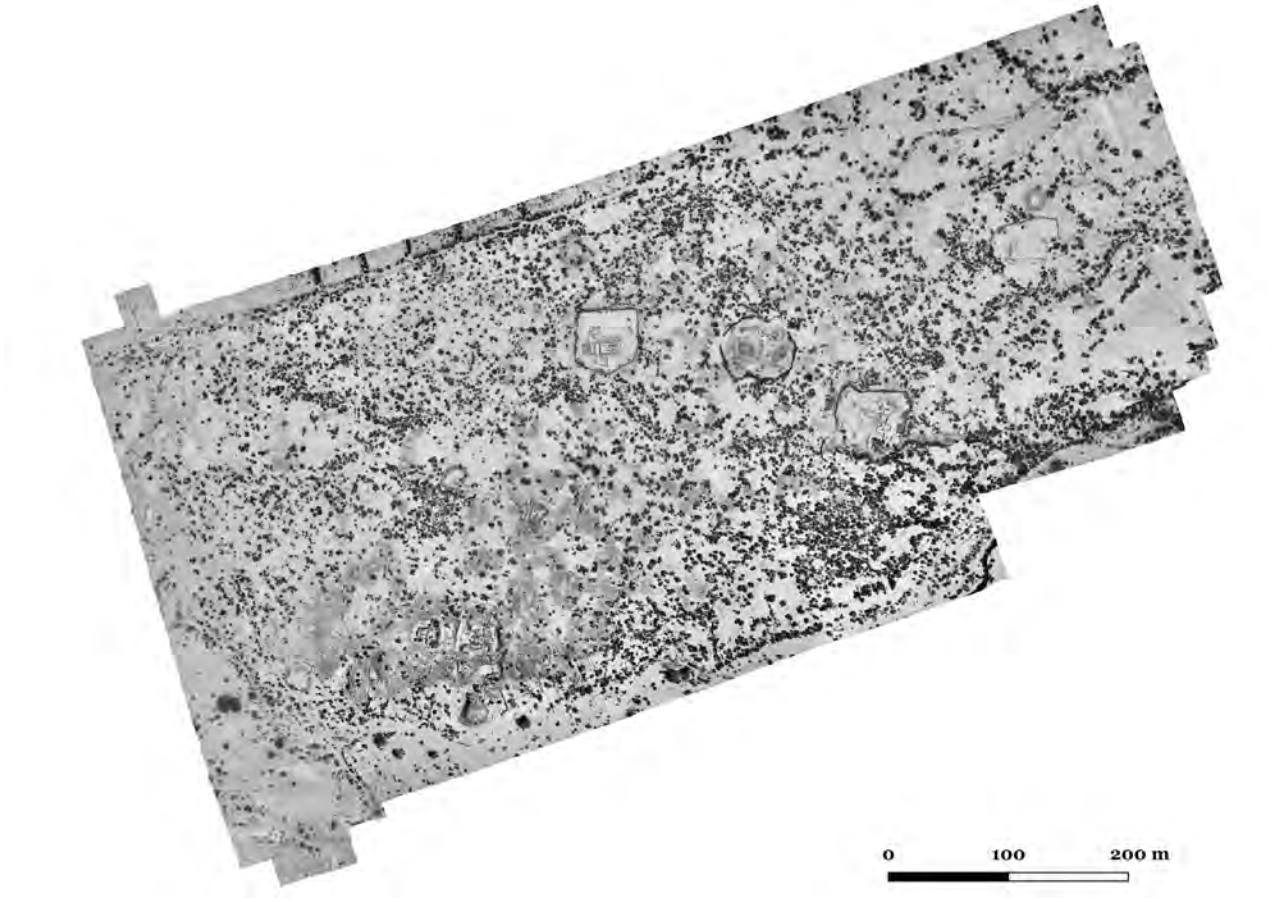

Fig. 4 - Orthomosaic of the whole archaeological site area obtained with drone photogrammetry.

the use of coded targets whose GNSS position is acquired at the time of the acquisition.

After a first phase that consists in distributing coded targets over the area to be scanned and acquiring their GNSS position, the drone is flown at the selected altitude and pictures are taken looking downwards with sufficient overlap between each photo. The images obtained are imported into a dedicated software and the key features that the pictures share are automatically recognized. The location and orientation of each picture is found, and the 3D point cloud is computed by exploiting the principle of triangulation. The GNSS coordinates of the targets are used to scale and georeference the cloud. The required outputs can be computed and exported. These include the dense point cloud, DEM, orthomosaic and textured mesh. Several hours of processing may be required based on the size of the image set and the desired level of detail of the output.

Coded targets were placed on the surface to be photographed and their GNSS coordinates were acquired with an RTK GNSS system. These enable the correct positioning and scaling of the 3D point cloud, since the GNSS coordinates provided by the drone are not suitable for accurate georeferencing, and the resulting point cloud needs to be geometrically scaled using known dimensions. Three sets of GNSS points were acquired during the survey. The photogrammetric reconstruction of the entire site posed challenges in the photo alignment phase. With a vast area, eventual inaccurate estimations of the camera calibration parameters can cause error accumulation producing the so-called 'dome effect', where the central part of the point cloud has a significantly higher (or lower) altitude with respect to the borders.[4] A deformation in the horizontal plan was also evident after a first camera alignment. Moreover, the different GNSS acquisitions presented reliable data regarding longitude and latitude, while the elevation was not consistent among the different datasets, but only within the same dataset.

In order to solve these problems, all available photos were included in the first alignment phase, including those taken at a lower altitude. These photos increase the robustness of the alignment but are disregarded when computing the output results. After the alignment, points with an excessively high reprojection error were removed from the set of the control points. The remaining points were used to perform an optimization of the camera calibration parameters and the camera positions and orientations in space. In the end, GNSS points shared by the three acquired sets were forced to be at the same elevation, hence reducing the error introduced by wrong elevations.

The mean residual error between the input target coordinates, acquired with the GNSS, and the estimated target coordinates, obtained after the camera alignment, is around 30 for each coordinate in the case of the reconstruction of the entire site, while it is around 10 for the closer acquisitions of single sectors. The error in the entire site model comes from both the photogrammetric reconstruction and the use of separate sets of GNSS points that needed altitude corrections. The two effects are not separable.

A mesh can be generated and textured from the point clouds obtained. This is particularly useful for a digital representation of the data, since a mesh presents surfaces that can interact with digital light sources in a digital environment, while dimensionless points of a point cloud cannot.

The 3D reconstruction of the Adulis archaeological site obtained by aerial photogrammetry not only makes it possible to inspect the site virtually at any time but also enables the development of research activity aimed at providing quantitative information on the site that can assist the archaeological analysis. For example, DTM permits the automatic identification of the regions with high density of stone, can provide the location of isolated stones and reveal masonry alignments. All this information needs to be analysed by experts; however, it can be a useful tool to automatically draw the attention of researchers on features that are likely to be relevant.

[4] Roncella *et Al.* 2021.

FROM UNDERSTANDING TO PLANNING: THE ARCHAEOLOGICAL SITE OF ADULIS WITHIN ITS CONTEXT

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The site of Adulis is internationally known for its relevant scientific value, which is bringing new knowledge both in the fields of trade and cultural networks of the ancient and late ancient period, and in the study of the earliest urban forms in Sub-Saharan Africa and their organisation for the exploitation and management of natural resources.

Through archaeological research, this site is testifying to the material outcomes of a complex culture, made prosperous by the exchange with different cultural spheres over several centuries, by a balance between supra-local relations and local autonomy, and by the ability to make the most of a territorial context in which every feature (accessibility, water, wildlife, etc.) could prove to be either an advantage, if well managed, or a vulnerability. What has been brought to light by current and past excavations describes a thriving and technologically advanced urban centre, as evidenced by the monumental buildings, built with stone masonry of great precision and complexity.

Adulis represents important identity values also in contemporary times both on a local and a national scale, and it is no coincidence that the monthly magazine of the EPLF's Central Bureau of Foreign Relations founded in 1984 was given the name Adulis, acknowledged as *"the centre of commerce and the meeting place of the old civilisations of the time* [; it] *symbolises civilization, that is, the ancient era, the origin of our people"*,[1] i.e. a link between a flourishing past and a future of freedom and prosperity.

In order for this heritage to be protected, valorised and handed down to future generations both in its materiality and in the set of identity values it conveys,[2] a process has been set in motion that, starting from the understanding gained in these years of excavation, transdisciplinary research and territorial surveys, will lead to the future formulation of a management plan. The research started in 2011 by Alfredo and Angelo Castiglioni[3] has been implemented along the years with the contributions from different areas of expertise in cooperation with archaeologists, including palaeontologists, architects, geologists, physical anthropologists, civil, hydraulic and environmental engineers, agronomists and other professionals.

Objectives of the management plan for Adulis

The overall objective of the plan is to protect and manage the site by implementing the following strategies and action plans:

[1] *Adulis*, vol n.1, 1984, 'Why Adulis?', p.1.
[2] Bortolotto, Cattaneo, Massa 2022.
[3] Massa 2023.

- increase knowledge among Eritrean citizens and scholars and international researchers;
- preserve the material aspects of the site while ensuring its accessibility to visitors;
- define the most appropriate criteria and methods of protection and proactive interventions for factors that may affect the state of preservation;
- make the context safer by mitigating the effects of environmental hazards;
- valorise those elements, on a local and supra-local scale, that allow an understanding of the multiple networks of relationships woven by Adulis with the ancient and contemporary context;
- give the opportunity to higher authorities and key stakeholders to use the plan for an informed decision-making process in preserving and managing the archaeological site.

If conservation, preservation and maintenance are the actions required to transform this heritage for future generations, making the system in which Adulis was and is embedded understandable is the best strategy to ensure the future protection of the site and its context.

To date, the preliminary phase of analysis and evaluation of the site and its historical, cultural, and natural landscape has been prepared for the future management plan for Adulis.

Understanding the site has required:

- rigorous archaeological research before and after the fieldwork;
- both a diachronic and a synchronic approach, to be able to correctly relate both the artefacts and the components of the current landscape in time;
- a multiscale study from the excavation of the site to the local and supra-local context, in which the functional boundaries of management will be the outcome and not a predefined datum (*ex-ante*) of the analysis;
- a strongly trans-disciplinary approach, which refers not only to the 'sister' disciplines of archaeology (ancient topography, archaeometry, geology, etc.), but also to disciplines related to environmental and spatial engineering and to agro-environmental regeneration. The strategy of trans-disciplinarity, rather than multi-disciplinarity, was adopted to ensure that the management plan will develop a holistic approach.

At the same time, assessments of the environmental risks exacerbated by the ongoing climate change are being drawn up; strategies for their mitigation have been identified, particularly with regard to hydrological[4] and agro-environmental hazards and what they entail in terms of conservation of the archaeological area, including the risk to the communities of Foro, Zula and Afta and the uncertainty of the resources required for agro-pastoral activities.[5] A valuable and comprehensive risk assessment has been carried out by Eritrean analysts and scholars.[6]

It is well known that socio-economic aspects are a fundamental component in formulating an adequate management plan: here, in particular, the development of visitor circuits must be integrated with the agropastoral development of the area, at the level of the communities that are in charge of the management of the irrigation system of the Zula plain as well as of the constant monitoring of and emergency interventions on the archaeological area.

Agro-climatic and environmental hazards, exacerbated by soil erosion, biodiversity depletion and climatic change, are threatening local communities and the site; therefore, the future plan will also address community-based land regeneration strategies capable of reducing the direct effects of floods and windstorms on the villages, the farmed lands and the archaeological site and of improving the livelihood of the local communities.

As will be noted, the holistic approach guaranteed by the common ground between different disciplines was able to make each strategy resilient: i.e. it ensures that each action achieves specific objectives in more than one sphere simultaneously (e.g. measures to manage water will have to envisage results in the safe water availability sector, in agricultural and environmental benefits, and in site protection), so that the motivations for implementing them are as constant as possible over time.

Analysis and assessment

To better understand this first part of the study, we will divide it by focus area since actions and

[4] Baioni, Porta, Guadagnini, in this volume.

[5] Bortolotto, Cattaneo, Massa 2021.

[6] Ogubazghi, Tsighe 2018.

management strategies may change according to the territorial extension addressed.

The excavation sectors and artefacts

From an archaeological and architectural point of view, the protection strategy of the excavated artefacts aims at both their conservation and comprehensibility on an architectural and urban level.

In terms of conservation, the main problem identified is the perishability of the dry-stone or earth-bound structures that make up the totality of the buildings brought to light by the excavations to date. This construction technique makes not only the wall crests particularly vulnerable to rain and physical actions (passage of animals and people, strong sandstorms), but also the bases of the walls near water stagnation occurring in the excavation trenches after rainfall. The management of rain and runoff water within the excavation areas is, therefore, a critical and fundamental issue to be assessed, and which must be designed specifically for each sector and artefact.

The choice, already operative since the beginning of the activities, to mark the perimeter of the excavation areas with a traditional fence made of branches and vegetable cordage, answers the need to limit the physical actions by wind and animals. At the same time, it makes it easier for visitors to identify a single excavation sector as an area of interest that can focus the narration of the history of Adulis on a single segment.

Concerning the legibility of the buildings, of which a large part of the elevated structures is missing, no reconstruction *à l'identique* is planned, which could, for that matter, be based solely on hypotheses. Only distinguishable, reversible, and compatible additions of missing parts are realized where the existing gap can put the safety, preservation and legibility of the remains at risk. The judicious relocation of certain elements, as in the case of the column ruins found in the vicinity of the excavations, has given good results. These activities generally require preliminary studies on the construction techniques, materials and original architectural geometries. They also envisage the training of local personnel capable of intervening to accomplish programmed and emergency procedures to protect masonry ridges and surfaces subject to runoff. Visitor routes will be designed within the excavation areas to offer the best possible comprehensive view of the artefacts, without interfering with the archaeological remains.

The construction of special superstructures will be studied to assess their technical feasibility, compatibility and economic sustainability. These will include walkways for visitors and roofing to reopen areas particularly vulnerable to rainwater such as the Eastern Church, the structures of which are currently covered with geotextile and soil to preserve them in the medium to long term.

The archaeological site of Adulis

The site of Adulis has an extension of approximately 40 hectares. The ongoing excavations focus only on limited parts of this vast area, as they are planned to ensure the following objectives: 1. understand the ancient city, its urban layout and boundaries; 2. reach strata that can provide relevant scientific data, i.e. not disturbed by previous interventions; 3. optimise the management efforts of the open excavations and the resulting conservation.

The points of interest of the site of Adulis are not limited to the ongoing excavations. In fact, there are traces of the past excavations by the following expeditions: the British Museum in 1868, the Italian archaeologist Roberto Paribeni in 1906,[7] the Swedish missionary Richard Sundström in 1906, and the French archaeologist Francis Anfray in the 1960s.[8] The excavations of and surveys[9] on Adulis also tell the story of archaeology as an evolving disciplinary approach to the ancient world and as a methodological *corpus* for learning from it. It is important to consider this history as a theme of the visitor's itinerary, as it explains aspects of the current state of the site, the different destinations of the finds, and the quantity and quality of information that different methods of excavation and archaeological investigation can yield.

Related to the past excavations are the mounds, several metres high, created near the excavations by the deposit of earthwork material. Their presence may prove useful and be part of the visitor

[7] Paribeni 1907.
[8] Anfray 1964.
[9] Littmann 1913, Peacock, Blue 2007.

routes as they offer a viewpoint at a slightly elevated altitude: in fact, the shrub vegetation and the irregular morphology of the site's current ground level rarely allow the observer to perceive the large space over which it extends.

There are also outcrops of walls in the archaeological area, brought to light by rainfall, which enrich the mosaic of information on the layout of the buildings and the characteristics of the walls.

Finally, there are other mounds, mainly of basalt and schist slabs, originating from collapsed structures, as well as little *cumuli* of pottery sherds with concentrations in specific parts of the site from the top of which the various excavation sectors as well as naturalistic environmental views (the sea, Mount Ghedem, the plateau) can be seen.

Visitor itineraries must be designed to make all these elements, belonging to different phases and sectors of the city, clear to the visitors. The itineraries must also protect from the passage of visitors three burial areas between the centre of the site and its south-eastern edges, where the tombs of Šek Mahmud, Bet Khalifa and their respective family groups are located. These areas are still used by the Zula and Afta communities, and their sacredness must be maintained.

From the point of view of hydrological risk reduction measures, diversion barriers for runoff water coming from the northwest to protect the excavation areas should be implemented in a planned manner by utilising the material from the earthworks of the archaeological excavation activity.

The Zula plain and the supra-local context

Understanding the site through a synchronic and diachronic reading of the historical landscape system, includes analysing the natural resources from antiquity to the present day (water, forests, building materials and thus basalt, schist and perhaps even limestone quarries for producing lime, etc.), the accesses from land and sea, and the past safe-water supply points. Among the ancient caravan routes, the most relevant are certainly those climbing the escarpment of the plateau to Qohayto and Mätära along the Komayle and Haddas riverbeds, but routes that headed north along the coast to reach the plateau closer to Aratu (maybe along the Labqa watercourse) and from there to present-day Sudan cannot be ruled out.

Conclusions

For the site of Adulis, it will be important to define the site boundaries and the relationship with the villages Afta and Zula, and to enact the appropriate conservation measures and development regulations, to establish a management regime, including the assignment of the relevant professional staff, and to fulfil an adequate protective management plan (with a core zone and a buffer zone, but also visitor itineraries, a corridor for caravan road and seasonal animal passages), ensuring a continuous monitoring process and an appropriate coordination of activities and projects. This management plan will serve as a conservation planning tool in the cooperation between the various stakeholders and provide a platform for presenting the guiding principles and for sharing ideas about future development issues.

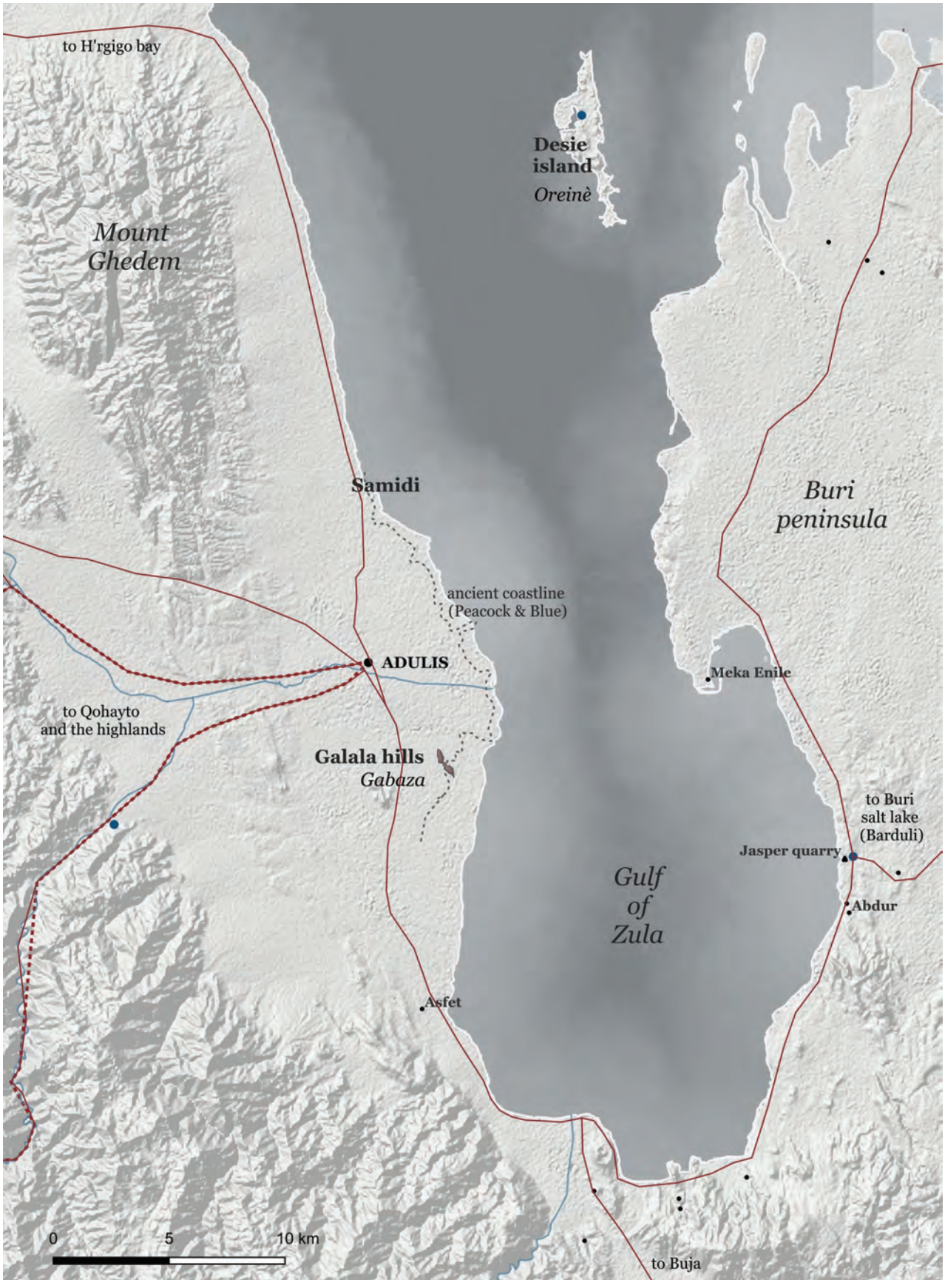
The inclusion of Adulis in a much broader framework makes it possible to appreciate its economic and cultural significance in antiquity and to expand the principles of protection today to a widespread and scattered heritage along ancient routes that is particularly vulnerable and still largely undiscovered.

MAPS AND PLANS

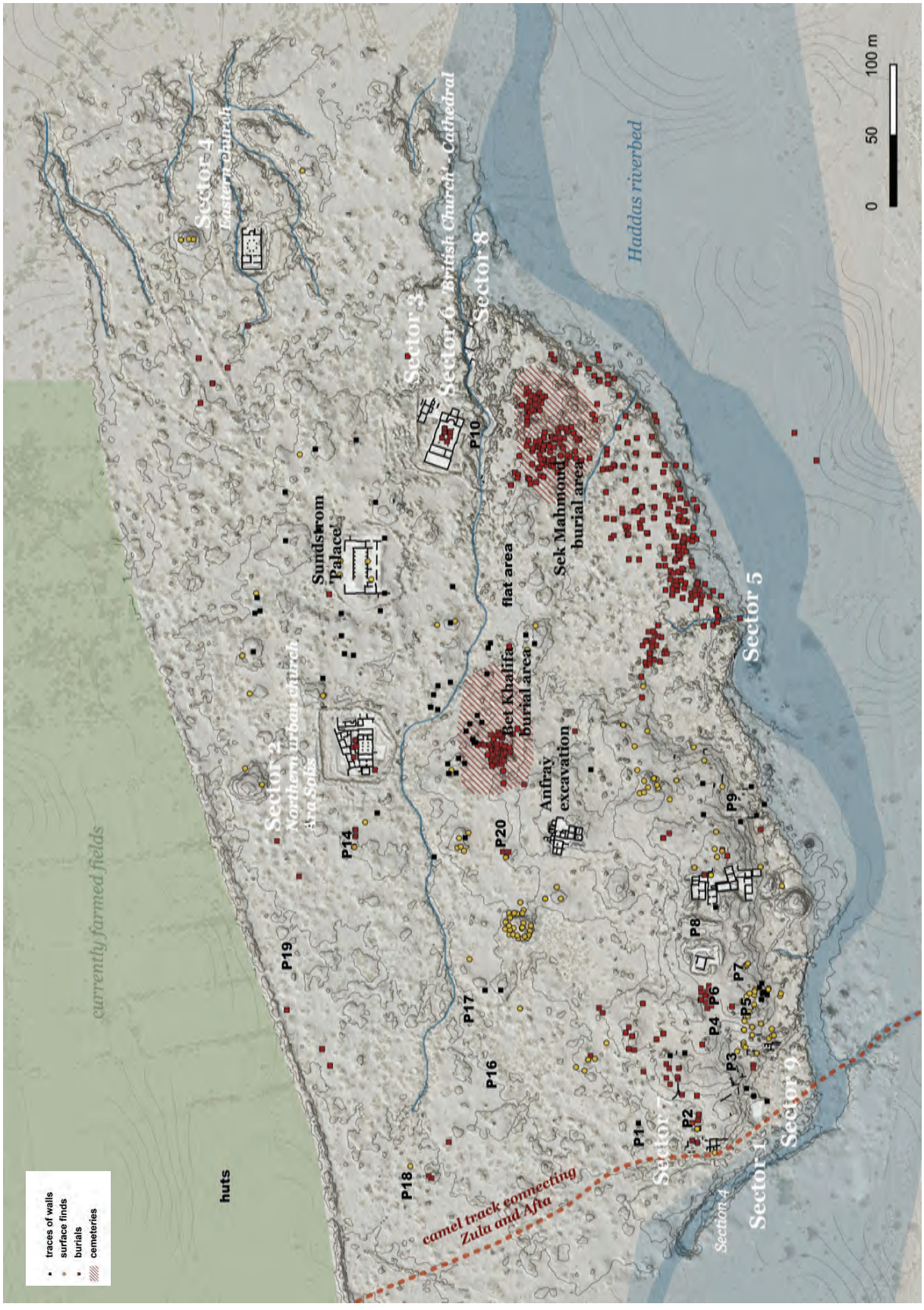
Map 1 - Adulis territorial context today.

Map 2 - Main trade centres in antiquity.

Map 3 - Land routes connecting Adulis, the highlands to Aksum.

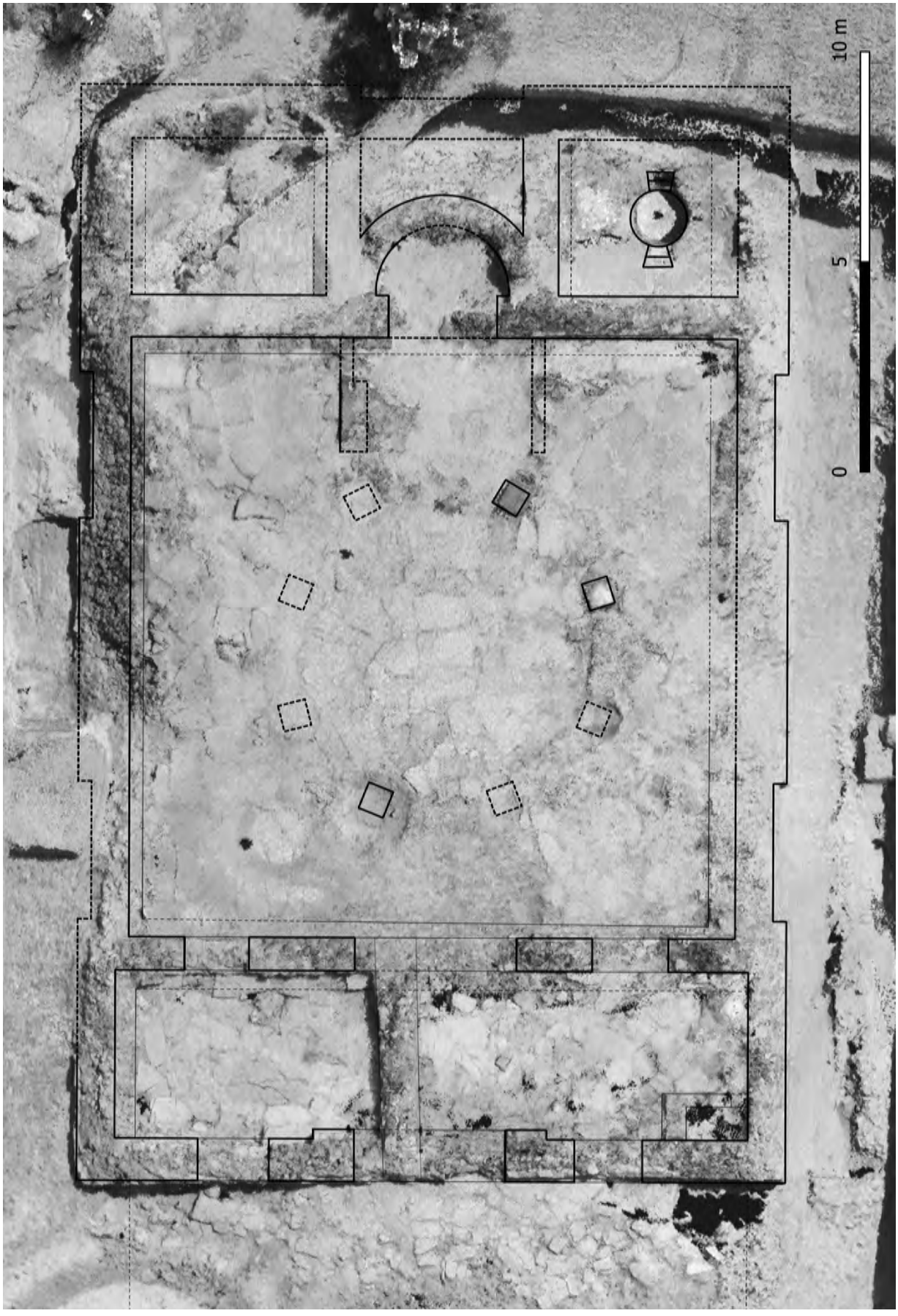


Map 4 - The area of the Gulf of Zula in ancient times.



Map 5 - Adulis Archaeological Site – including past and current excavations, and meaningful features.

Plan of Sector 2.



Plan of Sector 4.

Plan of Sectors 3 and 6

ABBREVIATIONS AND REFERENCES

Abbreviations

CeRDO = Centro Ricerche sul Deserto Orientale (Research Center on Eastern Desert)

DAE = Deutsche Aksum-Expedition, Staatliche Museen zu Berlin Generalverwaltung, E. Littmann, Th. Von Lüpke, D. Krenker, R. Zahn (eds.), 4 vol., Berlin 1913.

EAe = Encyclopaedia Aethiopica. A Reference Work on the Horn of Africa, A. Bausi, U. Siegbert (eds.), 5 vol., Wiesbaden 2014.

ICES = Z. Tsighe, S. Mahmud Idris, Y. Mesfun Asfaha, S. Andemariam, R. Kifle Taddese, G. Ogubazghi (eds.), *International Conference on Eritrean Studies (ICES 2016) Proceedings*, 2 Volumes, Asmara 2018.

References

AAVV 1939 = AAVV, *La costruzione dell'Impero*, Vol.II, Anno II, n. 4, Milano.

AAVV 2017 = *Adulis Project 2017 Report*, Adulis Project Archive.

AAVV 2018 = *Adulis Project 2018 Report*, Adulis Project Archive.

Allacci 1631 = L. Allatius, *Ptolemaei Euergetae III Aegypt. Regis Monumentum Adulitanum*, Romae 1631.

Allen 2022 = M. J. Allen, *Landscapes of scale or scales of landscape: patterns of land use and landscape*, in F. Sulas, H. Lewis, M. Arroyo-Kalin (eds.), *Inspired geoarchaeologies: past landscapes and social change. Essays in honour of Professor Charles A. I. French*, Cambridge 2022, pp. 73-87.

Anderson, Rathbone 2000 = D.M. Anderson, R. Rathbone, *Africa's Urban Past*, Oxford 2000.

Anfray 1963a = F. Anfray, *Une campagne de fouilles à Yeha (Février-Mars 1960)*, in *Annales d'Éthiopie*, 5, 1963, pp. 171-192.

Anfray 1963b = F. Anfray, *Note sur les brule-parfums antiques d'Éthiopie*, in *Bollettino dell'Istituto di Studi Etiopici (Asmara)*, 3, 1963, pp. 1-5.

Anfray 1964 = F. Anfray, *Notre connaissance du passe Ethiopien d'apres les travaux archeologiques récents*, in *Journal of Semitic Studies*, IX, 1, 1964, pp. 246-249.

Anfray 1967 = F. Anfray, *Matara*, in *Annales d'Ethiopie*, 7, 1967, pp. 33-88.

Anfray 1971 = F. Anfray, *Les fouilles de Yeha en 1971*, in *Documents pour servir à l'histoire des civilisations éthiopiennes*, 2, 1971, pp. 31-39.

Anfray 1972a = F. Anfray, *Fouilles de Yeha*, in *Annales d'Éthiopie*, 9, 1972, pp. 45-56.

Anfray 1974 = F. Anfray, *Deux villes Axoumites: Adoulis et Matara*, in *Atti del 4 congresso internazionale di studi etiopici*, vol. 1, Roma 1974, pp. 745-765.

Anfray 1990 = F. Anfray, *Les anciens ethiopiens: siecles d'histoire*, Paris 1990.

Anfray 2012a = F. Anfray, *Matara: enquête archéologique sur une cité antique d'Érythrée*, in *Palethnologie. Archéologie et sciences humaines*, 4, pp. 13-48.

Anfray 2012b = F. Anfray, *Matara: The Archaeological Investigation of a City of Ancient Eritrea*, in *Paléethnologie de l'Afrique*, 4, 12, 2012, https://doi.org/10.4000/palethnologie.5690.

Anfray 2016 = F. Anfray, *Recherches archéologiques à Adoulis (Érythrée)*, Touluse 2016.

Anfray, Annequin 1965 = F. Anfray, G. Annequin, *Matarā. - Deuxieme, troisieme et quatrieme campagnes de fouilles*, in *Annales d'Éthiopie*, 6, 1965, pp. 49-86.

Anzani 1926 = A. Anzani, *Numismatica Axumita*, in *Rivista Italiana di Numismatica*, XXXIX, 1926, pp. 5-96.

ASTM D5777-00 = *Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation*, 2017.

Bailey 2009 = G. Bailey, *The Red Sea, coastal landscapes, and hominin dispersals*, in M.D. Petraglia, J.I. Rose (eds.), *The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*, New York 2009, pp. 15-38.

Baioni *et Al.* 2022 = E. Baioni, G.M. Porta, N. Cattaneo, A. Guadagnini, *Assessment of Hy-*

drological Processes in an Ungauged Catchment in Eritrea, in *Hydrology*, 9, n. 5, 2022, p. 68.

Bard, Fattovich, Manzo 2021 = K. A. Bard, R. Fattovich, A. Manzo, *Harbor of the Pharahos to the Land of Punt II. Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2006-2011*, Napoli 2021.

Bar-Yosef, Beyin, 2009 = D.M. Bar-Yosef, A. Beyin, *Late-stone-age shell middens on the Red Sea coast of Eritrea*, in J*ournal of Island and Coastal Archaeology*, 4, 2009, pp. 108-124.

Bein *et Al*. 1996 = E. Bein, B. Habte, A. Jaber, A. Birnie, B. Tengnas, *Useful trees and shrubs in Eritrea. Identification, Propagation and Management for Agricultural and Pastoral Communities*, Regional Soil Conservation Unit, Nairobi 1996.

Bekele 1984 = E. Bekele, *Analysis of regional patterns of phenotypic diversity in the Ethiopian tetraploid and hexaploid wheats*, in *Hereditas*, 100, 1984, pp. 131-154.

Bent 1896 = T. Bent, *The sacred city of the Ethiopians*, London, New York and Bombay 1896.

Bernand 1991 = E. Bernand, *Recueil des inscriptions de l'Ethiopie des périodes pré-axoumite et axoumite*, Paris 1991.

Bernand 2000 = E. Bernand, *Recueil des Inscriptions de l'Éthiopie des périodes pré-axoumite et axoumite. T. III: Traductions et commentaires. A. Les Inscriptiones grecques*, Paris 2000.

Bertarelli 1929 = L.V. Bertarelli, *Guida d'Italia del Touring Club Italiano - Possedimenti e Colonie*, Torino 1929.

Beyin 2006 = A. Beyin, *The Bab-al-Mandab vs the Nile-Sinai-Levant: an appraisal of the two dispersal routes for early modern humans out of Africa*, in *African Archaeological Review*, 23, 1, 2006, pp. 5-30.

Beyin 2011 = A. Beyin, *Early to middle Holocene human adaptations on the Buri Peninsula And Gulf of Zula, coastal lowlands of Eritrea*, in *Azania: Archaeological research in Africa*, 46 n. 2, 2011, pp. 123-140.

Beyin 2013 = A. Beyin, *A surface Middle Stone Age assemblage from the Red Sea coast of Eritrea: Implications for Upper Pleistocene human dispersals out of Africa*, in *Quaternary International*, 300, 2013, pp. 195-212.

Beyin 2015 = A. Beyin, *Human Origins, Dispersal and Associated Environments: An African Perspective*, in UNESCOEOLSS Joint Committee (ed.), *Ethnology, Ethnography and Cultural Anthropology*, *Encyclopedia of Life Support Systems*, Paris 2015.

Beyn, Bar-Yosef Mayer 2018 = A. Beyin, D.E. Bar-Yosef Mayer, *Prehistoric Settlements on the Red Sea Coast of Eritrea. Implications for assessing early human dispersal across the Red Sea Basin*, in A. Sarathi (ed.), *Early Maritime Cultures in East Africa and the Western Indian Ocean*, Oxford 2018, pp. 1-32.

Bloch 1969 = M. Bloch, *Apologia della storia o Mestiere di storico*, Torino 1969.

Boito 1893 = C. Boito, *Questioni pratiche di belle arti*, Milano 1893.

Boivin, Blench, Fuller 2009 = N. Boivin, R. Blench, D.Q. Fuller, *Archaeological, Linguistic and Historical Sources on Ancient Seafaring: A Multidisciplinary Approach to the Study of Early Maritime Contact and Exchange in the Arabian Peninsula*, in M.D. Petraglia, J. Rose (eds.), *The Evolution of Human Populations in Arabia. Paleoenvironments, Prehistory and Genetics*, Heidelberg 2009, pp. 251-278.

Bortolotto, Cattaneo, Massa 2021 = S. Bortolotto, N. Cattaneo e S. Massa, *Seasonal watercourses as a source of wealth and a cause of destruction: the water management in Adulis (Eritrea) in antiquity and today*, in *LARHYSS Journal*, 47, 2021, pp. 25-38.

Bortolotto, Cattaneo, Massa 2022 = S. Bortolotto, N. Cattaneo, S. Massa, *Heritage values and contemporary cultural landscape in Adulis*, in A. Kouzelis, M. Rönn, H. Teräväinen (eds.), *Compensation in Architecture and Archaeology*, Sweden 2022, pp.150-178.

Bortolotto, Frigo 2003 = S. Bortolotto, A. Frigo, *Le Carte del Restauro e le reintegrazioni in cemento in archeologia*, in M. Boriani (ed.) *La sfida del Moderno. L'architettura del XX secolo tra conservazione e innovazione*, Milano 2003, pp. 85-92.

Bowersock 2013 = G. W. Bowersock, *The Throne of Adulis: Red Sea Wars on the Eve of Islam*, Oxford 2013.

Bramoulle 2022 = D. Bramoulle, *Les ports du pays Beja à l'époque fatimide - un espace de la liminalité*, in C. Durand, J. Marchand, B. Redon and P. Schneider (eds.), *Networked spaces. The spatiality of networks in the Red*

Sea and Western Indian Ocean, Lyon 2022, pp.285-304.

Brandi 1977 = C. Brandi, *Teoria del Restauro*, Torino 1977.

Brandt 2018 = O. Brandt, Strutture architettoniche e mentali nel *DE AEDIFICIIS* di Procopio, in C. Dell'Osso (ed.), PROCOPIO DI CESAREA. *Gli edifici*, Città del Vaticano 2018, pp. 19-69.

Braudel 1967 = F. Braudel, *Civiltà materiale, economia e capitalismo*, *(secoli XV-XVIII),* Torino 1967.

Brogiolo 2012 = G.P. Brogiolo, *Introduzione*, in G.P. Brogiolo, D.E. Angelucci, A. Colecchia, F. Remondino, *APSAT 1. Teoria e metodi della ricerca sui paesaggi d'altura*, Mantova 2012, pp. 5-10.

Brogiolo 2015 = G. P. Brogiolo, *Some principles and methods for a stratigraphic study of historic landscapes*, in A. Chavarria Arnau, A. Reynolds (eds.), *Detecting and understanding historic landscape*, Mantova 2015, pp. 359-385.

Bronk Ramsey 2009 = C. Bronk Ramsey, *Bayesian analysis of radiocarbon dates*, in *Radiocarbon*, 51(1), 2009, pp. 337-360.

Brooks, Suchey 1990 = S. Brooks, J.M. Suchey, *Skeletal age determination based on the os pubis: A comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods*, in *Human Evolution*, 5, 1990, pp. 227-238.

Bruggemann *et al*. 2004 = H.J. Bruggemann, R.T. Buffler, M.M. Guillaume, R.C. Walter, R. von Cosel, B.N. Ghebretensae, S.M. Berhe, *Stratigraphy, palaeoenvironments and model for the deposition of the Abdur Reef Limestone: Context for an important archaeological site from the last interglacial on the Red Sea Coast of Eritrea*, in *Palaeogeography, Palaeoclimatology, Palaeoecology*, 203, 2004, pp. 179-206.

Brůžek *et al*. 2017 = J. Brůžek, F. Santos, B. Dutailly, P. Murail, E. Cunha, *Validation and reliability of the sex estimation of the human os coxae using freely available DSP2 software for bioarchaeology and forensic anthropology*, in *American Journal of Physical Anthropology*, 164 (2), 2017, pp. 440-449.

Buffa 2002 = V. Buffa, *The Sabir cultural sequence in the frame of the archaeology of coastal Yemen and Northeast Africa Bronze Age: a provisional view*, in *BECTHNK APEBHEN NCTOPNN*, 3, 2002, pp. 175-184.

Buffa 2004 = V. Buffa, *Five female figurines from Southwest Arabia and the Horn of Africa*, in A.V. Sedov (ed.), *Scripta Yemenica*, Moscow 20024, pp. 146-150.

Butler 1969 = H. C. Butler, *Early Churches in Syria fourth to eleven centuries*, Amsterdam 1969.

Carannante *et al*. 2015 = A. Carannante, C. Flaux, Ch. Morhange, C. Zazzaro, *Adulis in its regional maritime context. A preliminary report of the 2015 field season*, in *Newsletter di Archeologia CISA*, 6, 2015, pp. 279-294.

Carta del Restauro 1883 = *Carta del Restauro*, *3° Congresso degli Ingegneri e Architetti italiani*, Roma 1883.

Carvajal-Ramírez *et al*. 2019 = F. Carvajal-Ramírez, A.D. Navarro-Ortega, F. Agüera-Vega, P. Martínez-Carricondo, F. Mancini, *Virtual reconstruction of damaged archaeological sites based on Unmanned Aerial Vehicle Photogrammetry and 3D modelling. Study case of a southeastern Iberia production area in the Bronze Age*, in *Measurement: Journal of the International Measurement Confederation*,136, 2019, pp. 225-236.

Casson 1989 = L. Casson, *The Periplus Maris Erythraei*, Princeton 1989.

Castellana, Fernandez 2013 = P. Castellana, R. Fernández, *Chiese siriane del IV secolo*, Milano 2013.

Castiglia 2019 = G. Castiglia, *La cristianizzazione di Adulis (Eritrea) e del regno aksumita. Nuovi dati dal Corno d'Africa d'età tardo antica*, in *Atti della Pontificia Accademia Romana di Archeologia*, Serie III, 2019, Rendiconti XCI, pp. 91-127.

Castiglia 2022 = G. Castiglia, Ph. Pergola, *Shaping a Christian Empire. Early Christianity in the Horn of Africa from Alexandria to Byzantium*, in A. Castrorao Barba, G. Castiglia (eds.), *Perspectives on Byzantine Archaeology: From Justinian to the Abbasid Age (6th-9th Centuries)*, Turnhout 2022, pp. 165-181.

Castiglia *et al*. 2021 = G. Castiglia, Ph. Pergola, S. Massa, S. Bertoldi, M. Ciliberti, O. Larentis, B. Maletić, C. Mandelli, M. Pola, *Un nuovo complesso episcopale nel Corno d'Africa di età tardo antica? Gli scavi del Pontificio Istituto di Archeologia Cristiana*

ad Adulis (Eritrea): 2018-2020, in *Mitteilungen zur Christlichen Archäologie*, 27, 2021, pp. 9-58.

Castiglioni, Castiglioni 2011 = Al. Castiglioni, An. Castiglioni, *Adulis Project Report 2011*, Adulis Project Archive.

CAstiglioni *et Al*. 2013 = Al. Castiglioni, An. Castiglioni, S. Massa, S. Bortolotto, N. Cattaneo, C. Tedeschi, *Adulis, una città-porto tra Mediterraneo e Oceano Indiano: archeologia e restauro*, in *Conservazione e valorizzazione dei siti archeologici: approcci scientifici e problemi di metodo*, 29° Convegno Internazionale Scienza e Beni culturali, Bressanone 9-12 luglio 2013, Venezia, pp. 923-934.

Cattaneo 2022 = N. Cattaneo, *Cartographic Sources*, in S. Massa, N. Cattaneo (eds.), *Connecting Seas. Travellers, Merchants and Soldiers at Adulis (Eritrea)*, Milano 2022, pp. 45-70.

Cattaneo 2024 = N. Cattaneo, *Raccontare mondi diversi: il contributo dell'opera di Alfredo e Angelo Castiglioni*, in M. Castiglioni, S. Conte, S. Massa, G. Salvioni (eds.), *Incontri di Mondi Lontani. Dai viaggi d'esplorazione dell'800 alle ricerche di Angelo e Alfredo Castiglioni*, Genova 2024, pp. 37-44.

Charola *et Al*. 1981 = A.E. Charola, M. Dupas, R.P. Sheryll, G.G. Freund, *Characterizazion of ancient mortars: chemical and instrumental methods*, *Atti del Simposio*, ICCROM, Roma 1981.

Chavarria Arnau 2009 = A. Chavarria Arnau, *Archeologia delle chiese. Dalle origini all'anno Mille*, Carocci, Roma 2009.

Chavarria, Reynolds 2015 = A. Chavarria Arnau, A. Reynolds (eds.), *Detecting and understanding historic landscape*, Mantova 2015.

Checchi 1913 = M. Checchi, *La viabilità tra l'Eritrea e l'Etiopia*, in *L'Eritrea economica*, Novara 1913, pp. 115-157.

Childe 1950 = G. Childe, T*he Urban Revolution*, in *The Town Planning Review*, 21, 1, 1950, pp. 3-17.

Chirikure 2020 = S. Chirikure, *Shades of Urbanism(s) and Urbanity in Pre-Colonial Africa Towards Afro-Centred Interventions*, in J*ournal of Urban Archaeology*, 1, 2020, pp. 49-66.

Cipriani 1940 = L. Cipriani, *Abitazioni indigene dell'Africa Orientale Italiana*, Napoli 1940.

Clerc 2020 = L. Clerc, *The accurate construction of the right angles of the Great Pyramid's ground plan*, in *The Journal of Ancient Egyptian Architecture*, 4, 2020, pp. 97-115.

Clynne *et Al*. 2005 = M.A. Clynne, A.D. Weldell, R.O. Fournier, L. Woldegiorgis, C.J. Janik, G. Kahsai, J.B. Lowenstern, K. Teklemariam, J.S. Smith, T. Tesfai, *A Geological and Geochemical reconnaissance of The Alid Volcanic Center, Eritrea, East Africa*. *Proceedings of the World Geothermal Congress*, Auckland 2005, pp. 1-8.

Coburg-Gotha 1864 = *Reise den Herzogs Hernst von Sachsen-Coburg-Gotha nach Aegypten und den Ländern der Habab, Mensa und Bogos*, Leipzig 1864.

Cocuzza *et Al*. 2014 = S. Cocuzza, C.M. Castagna, L. Minniti, M. Valle, *Per un parco archeologico ad Adulis*. Graduation thesis in Architecture - School of Civil Architecture, Politecnico di Milano, Supervisors: M. Boriani, S. Bortolotto.

Connah 2000 = G. Connah, *African city walls a neglected source?,* in D. M. Anderson, R. Rathbone (eds.), *Africa's Urban Past*, Oxford 2000, pp. 37-51.

Conti Rossini 1900 = C. Conti Rossini, *Ricerche e Studi sull'Etiopia*, in *Bollettino della Società Geografica Italiana*, 37.2, 1900, pp. 104-120.

Conti Rossini 1928 = C. Conti Rossini, *Storia d'Etiopia. Parte Prima Dalle origini all'avvento della Dinastia Salomonide*, Milano 1928.

Couto 2022 = D. Couto, *"All the wealth of the world will be in your hands". A vision of the Red Sea in the early 16th century through the letters of Afonso de Albuquerque (1513)*, in C. Durand, J. Marchand, B. Redon and P. Schneider (eds.) *Networked spaces. The spatiality of networks in the Red Sea and Western Indian Ocean*, Lyon 2022, pp. 19-34.

Curtis 2008 = M. Curtis, *New perspectives for examining change and complexity in the Northern Horn of Africa during the 1st Millennium BCE*, in R. Schmidt, M. C. Curtis, Z. Teka (eds.), *The Archaeology of Ancient Eritrea*, Asmara 2008, pp. 329-347.

D'Andrea *et Al.* 1999 = C. D'Andrea, D. Lyons, M. Haile, A. Butler, *Ethnoarchaeological approaches to the study of prehistoric agriculture in the highlands of Ethiopia*, in M. van der Veen (ed.), *The Exploitation of Plant Resources in Ancient Africa*. New York 1999, pp. 102-122.

D'Andrea *et Al.* 2011 = A.C. D'Andrea, M.P. Richards, L.A. Pavlish, S. Wood, A. Manzo, H.S. Wolde-Kiros, *Stable isotopic analysis of human and animal diets from two pre-Aksumite/Proto-Aksumite archaeological sites in northern Ethiopia*, in *Journal of Archaeological Science*, 38, 2011, pp. 367-374.

D'Andrea *et Al*. 2023 = A.C. D'Andrea, L. Welton, A. Manzo, H.S. Woldekiros, S.A. Brandt, A. Beldados, E.A. Peterson, L.A. Nixon-Darcus, M. Gaudiello, S.R. Wood, H. Mekonnen, S. Batiuk, Y. Meresa, A. Ruiz-Giralt, C. Lancelotti, A. Mengistu Taffere, L.M. Johnson, *The Pre-Aksumite Period: indigenous origins and development in the Horn of Africa*, in *Azania: Archaeological Research in Africa*, 58, 2023, pp. 329-392.

D'Andrea, Haile 2002 = A.C. D'Andrea, Haile M., *Traditional Emmer Processing in Highland Ethiopia*, in *Journal of Ethnobiology* 22, 2, 2002, pp. 179-217.

Dainelli, Marinelli 1912 = G. Dainelli, O. Marinelli *Risultati scientifici di un viaggio nella colonia Eritrea*, Firenze 1912.

Dall'Ora 1937 = F. Dall'Ora, *Intendenza in A.O.*, Milano 1937.

Dawit 2011 = F. Dawit, O*ral Traditions Research in sub zone of Foro (Zula, Afta and Kadra); memorandum of the first season's Archaeological investigation at the Ancient port city of Adulis* (unpublished report), National Museum of Eritrea, 2011.

De Marinis 1984 = R.C. De Marinis, *La città in Lombardia. La sua nascita e la sua evoluzione. Protostoria degli insediamenti urbani in Lombardia*, in *Archeologia urbana in Lombardia. Valutazione dei depositi archeologici e inventario dei vincoli*, Modena 1984, pp. 22-33.

De Rivoire 1868 = D. De Rivoire, *La Baie d'Adulis et ses alenturs*, in *Bulletin de la Société de Géographie*, 15, 1868, pp. 236-267.

De Rivoire 1880 = D. De Rivoire, *Mer Rouge et Abyssinie*, Paris 1880.

De Romanis 1996 = F. De Romanis, *Cassia, Cinnamomo, Ossidiana, uomini e merci tra Oceano Indiano e Mediterraneo*, Roma 1996.

Del Boca 1976 = A. Del Boca, *Gli italiani in Africa Orientale - I. Dall'unità alla marcia su Roma*, Bari 1976.

Delle Donne 2021 = M. Delle Donne, *Cereal ears on Aksumite coins: Reflections between numismatics and archaeobotany*, in *Rassegna di Studi Etiopici,* 5, 3ª series, LII, 2021, pp. 269-311.

Dewing 1914 = H.B. Dewing, *PROCOPIUS. HISTORY OF THE WARS Books I-II*, Harvard University Press, Cambridge, Massachusetts, London 1914 (Loeb Classical Library 48 https://www-loebclassics-com).

Dezzi Bardeschi 2004 = M. Dezzi Bardeschi, *Presentazione. Il lungo viaggio verso l'anatomia della Fabbrica*, in C. Campanella (ed.), *Il rilievo degli edifici: tecniche di restituzione grafica per il progetto di intervento,* Milano 2004.

Dile Yihun 2021 = T. Dile Yihun, R. Srinivasan, Chris G, *QGIS Interface for SWAT+: QSWAT+*, 1-136, 2021.

Doresse 1956 = J. Doresse, *Les premiers monuments chrétiens de l'Éthiopie et l'église archaïque de Yhea*, in *Novum Testamentum*, 1, 1956, pp. 209-224.

Dupas 1981 = M. Dupas, *L'analyse des mortiers et enduits des peintures murales et des bâtiments anciens,* in *Mortars cements and grouts used in the conservation of historic buildings*, Symposium Proceedings, ICCROM, Roma 1981.

Ethica *et Al.* 2006 = F. Eticha, G. Belay, E. Bekele, *Species diversity in wheat landrace populations from two regions of Ethiopia*, in *Genetic Resources and Crop Evolution*, 53, 2006, pp. 387-393.

Farioli Campanati 2008 = R. Farioli Campanati, *Siria. Guida archeologica. Architettura Tardoantica e Protobizantina,* Ravenna 2008.

Fattovich 1977 = R. Fattovich, T*he Contacts between Southern Arabia and the Horn of Africa in Late Prehistoric and Early Historical times: A View from Africa*, in A. Avanzini (ed.), *Profumi d'Arabia*, Roma 1977, pp. 273-286.

Fattovich 1990 = R. Fattovich, *Remarks on the Pre-Aksumite Period in Northern Ethiopia*, in *Journal of Ethiopian Studies*, 23, 1990, pp. 1-46.

Fattovich 2009 = R. Fattovich, *Reconsidering Yeha, c.800-400 BC*, in *African Archaeological Review*, 26, pp. 275-290.

Fattovich 2012 = R. Fattovich *The northern Horn of Africa in the first millennium BC: local traditions and external connections*, in *Rassegna di Studi Etiopici*, 4, 2012, pp. 1-60.

Fattovich *et Al*. 2000 = R. Fattovich, K.A. Bard, L. Petrassi, L. Pisano, *The Archaeological Area of Aksum: A Preliminary Assessment*, Naples 2000.

Feinman 2018 = G.M. Feinman, *The Comparative Investigation of Early Urbanized Landscapes: An Interdisciplinary Reframing*, in D. Domenici, N. Marchetti (eds.), *Urbanized Landscapes in Early Syro-Mesopotamia and Prehispanic Mesoamerica. Papers of a Cross-Cultural Seminar held in Honor of Robert McCormick Adams*, Wiesbaden, pp. 13-33.

Filigenzi 2014 = A. Filigenzi, *An Indian terracotta figurine*, in Zazzaro *et Al*. 2014a, pp. 547-548.

Finlinson *et Al*. 1961 = G.T. Finlinson *et Al*., *Report on Zula Plain Project Eritrea*, unpublished report, 1961.

Fletcher 2019 = R. Fletcher, *Trajectories to Low-Density Settlements Past and Present: Paradox and Outcomes*, in *Frontiers in Digital Humanities*, 6, 2019, pp. 13-34.

Folchi 1898 = T. Folchi, *Commissariato Regionale di Massaua - Brevi cenni storico amministrativi sulle popolazioni, dal suddetto Commissariato Regionale dipendenti*, transcription of the 1898 Manuscript edited by M. Zaccaria, Milano 2009.

Forni 1969 = G. Forni, *Origini dell'agricoltura africana e sua evoluzione sino alla colonizzazione europea*, in *Rivista di Storia dell'Agricoltura*, IX, 4, 1969, pp. 284-347.

Francovich, Patterson, Barker 2000 = R. Francovich, H. Patterson, G. Barker (eds.), *Extracting meaning from ploughsoil assemblages*, *The Archaeology of Mediterranean Landscapes*, 5, Oxford 2000.

Fritsch, Gervers 2007 = E. Fritsch, M. Gervers, *Pastophoria and Altars: Interaction in Ethiopian Liturgy and Church Architecture*, in *Aethiopica*, 10, 2007, pp. 7-51.

Fustel de Coulanges 1864 = N.D. Fustel de Coulanges, *La cité antique: étude sur le culte, le droit, les institutions de la Grèce et de Rome*, Paris 1864.

Genchi *et Al*. 2022 = F. Genchi, M. Ramazzotti, N. Larosa, *The organization of funerary space and arrangement of burials within the corridor-shapedtomb LCG-2 at Dibbāal-Bayah, Musandam, Sultanate of Oman*, in *Vicino Oriente*, 26, 2022, pp. 99-121.

Gerlach 2013 = I. Gerlach, *Cultural Contacts between South Arabia and Tigray (Ethiopia) during the Early 1st Millennium BC. Results of the German Cooperation Project in Yeha*, in *Zeitschrift für Orient-Archäologie*, 6, 2013, pp. 254-277.

Gerlach 2017 = I. Gerlach, *Neue Forschungen zur äthio-sabäischen Kultur*, in B. Vogt, S. Wenig (eds.), *In kaiserlichem Auftrag: die Deutsche Aksum-Expedition 1906 unter Enno Littmann. Band 3, Ethnographische, kirchenhistorische und archäologisch-historische Untersuchungen*, Wiesbaden 2017, pp. 355-390.

Giostra 2016 = C. Giostra, *La Chiesa Orientale*, in C. Giostra, S. Massa, *Dal Mediterraneo al Mar Rosso: la cristianizzazione della città-porto di Adulis e la diffusione di modelli e manufatti bizantini*, in *Hortus Artium Medievalium*, 22, 2016, pp. 101-107.

Girola 2006 = G. Girola, *Monete aksumite: bilancio italiano*, in *Rivista Italiana di Numismatica e Scienze Affini*, 107, 2006, pp. 473-485.

Giuliani 2006 = C.F. Giuliani, *L'edilizia nell'antichità*, Roma 2006.

Goitom *et Al*. 2018 = B. Goitom, J. Hammond, J.M. Kendall, C. Oppenheimer, G. Ogubazghi, *Seismic and volcanic hazards in Eritrea*, in ICES Proceedings, vol. 2, 2018, pp. 691-703.

Grossmann 2002 = P. Grossmann, *Cristliche Architektur in Ägypten*, Leiden, Boston, Köln 2002.

Haarmann 2020 = H. Haarmann, *Culture dimenticate. Venticinque sentieri smarriti dell'umanità*, Torino 2020.

Hahn 2015 = W. Hahn, *Numismatische Betrachtungen zur Geschichte von Aksum*, Wien 2015.

Harrower *et Al*. 2019 = M.J. Harrower, I.A. Dumitru, C. Perlingieri *et Al*., *Beta Samati: discovery and excavation of an Aksumite town*, in *Antiquity*, 93(372), 2019, pp. 1534-1552.

Harrower *et Al*. 2020 = M.J. Harrower, S. Nathan, J.C. Mazzariello, K. Zerue, I.A. Dumitru, Y. Meresa, *Water, geography, and Aksumite civilization: The Southern Red Sea Archaeological Histories (SRSAH) project survey (2009-2016)*, in *African Archaeological Review*, 37, 2020, pp. 51-67.

Harrower, D'Andrea 2014 = M. Harrower, A.C. D'Andrea, *Landscapes of State Forma-*

tion: Geospatial Analysis of Aksumite Settlement Patterns (Ethiopia), in *African Archaeological Review*, 31, 2014, pp. 513-541.

Headrick 1984 = D.R. Headrick, *Al servizio dell'impero. Tecnologia e imperialismo europeo nell'Ottocento*, Bologna 1984.

Heldman 1994 = M. Heldman, *Early Byzantine Sculptural Fragments from Adulis*, in *Études Éthiopiennes*, I, Paris 1994, pp. 239-252.

Holland, Hozier 1870 = T.J. Holland - H. Hozier, *Record of the expedition to Abyssinia compiled by order of the Secretary of State for war*, London 1870.

Hozier 1869 = H.M. Hozier, *The British Expedition to Abyssinia*, London 1869.

ICAHM 1990 = *Charter for the Protection and Management of Archaeological Heritage drawn up by the International Committee for the Management of Archaeological Heritage (ICAHM)*, Lausanne 1990.

Işcan, Loth 1986a = M.Y. Işcan, S. R. Loth, D*etermination of age from the sternal rib in white males: A test of the phase method*, in *Journal of Forensic Sciences*, 31, 1986, pp. 122-132.

Işcan, Loth 1986b = M.Y. Işcan, S. R. Loth, *Determination of age from the sternal rib in white females: A test of the phase method*, in *Journal of Forensic Sciences*, 31, 1986, pp. 990-999.

Jervis 1999 = Jervis G., *Prime lezioni di psicologia*, Laterza, Bari 1999, p. 14.

Juma 2004 = A. Juma, *Unguja Ukuu on Zanzibar. An Archaeological study of early urbanism*, *Studies in Global Archaeology*, 3, Uppsala 2004.

L'Illustrazione Italiana 1884 = *L'Illustrazione Italiana*, 52, 28 Dicembre 1884.

Korač, Šuput 2016 = V. Korač, M. Šuput, *L'architettura bizantina*, Milano 2016.

Krautheimer 1986 = R. Krautheimer, *Architettura paleocristiana e bizantina*, Torino 1986.

Krenker 1913 = D. Krenker, *Ältere Denkmäler Nordabessiniens, mit Beiträgen von Th. von Lüpke und einem Anhang von R. Zahn*, *DAE* Band. II, Berlin 1913.

Larentis 2020 = O. Larentis, *La sepoltura*, in *Le campagne del Pontificio Istituto di Archeologia Cristiana ad Adulis (Eritrea) Scavi 2018 e 2019*, in *Rivista di Archeologia Cristiana*, XCVI, 2020, pp. 179-183.

Larentis 2021 = O. Larentis, *A Muslim Grave: First Evidence of the Ancient Islamic Funerary Practice*, in AAVV, *For an Archaeology of Religious Identity in Adulis and in the Northern Red Sea Region of Eritrea*, in *Journal of African Archaeology*, 19, 2021, pp. 33-39.

Larentis 2021a = O. Larentis, *A Muslim Grave: First Evidence of the Ancient Islamic Funerary Practice*, in AAVV, *For an Archaeology of Religious Identity in Adulis and in the Northern Red Sea Region of Eritrea*, in *Journal of African Archaeology*, 19, 2021, pp. 33-39.

Larentis 2021b = O. Larentis, *Lo scavo: la sepoltura (analisi bioarcheologica)*, in *Un nuovo complesso episcopale nel corno d'Africa di età tardo antica? Gli scavi del Pontificio istituto di Archeologia Cristiana ad Adulis (Eritrea): 2018-2020*, in *Mitteilungen zur Christlichen Archaeologie*, 27, 2021, pp. 25-30.

Leakey 1969 = R.E.F. Leakey, *Early Homo sapiens remains from the Omo River region of south-west Ethiopia*, in *Nature*, 222, 1969, pp. 1132-1133.

Lefebvre 1845 = Th. Lefebvre, *Voyage en Abyssinie: exécuté pendant les années 1839, 1840, 1841, 1842, 1843 par une commission scientifique composée de Théophile Lefebvre, A. Petit et Quartin-Dillon, Vignaud*, Tome Troisième, Paris 1845.

Littmann 1907 = E. Littmann, *Preliminary Report of the Princeton University Expedition to Abyssinia,* in *Zeitschrift für Assyriologie und Vorderasiatische Archäologie*, 20, 1907, pp. 151-172.

Littmann 1913 = E. Littmann, *Resebericht der Expedition: Topographie und Geschichte Aksums, DAE Band I,* Berlin 1913.

Liverani 2023 = P. Liverani, *Monete in fondazione tra tardoantico e alto medioevo*, in Numismatica e Antichità Classiche, 52, 2023, pp. 123-127.

Lovejoy *et Al*. 1985 = C. O. Lovejoy, R. S. Meindl, T. R. Pryzbeck, R. P. Mensforth, *Chronological metamorphosis of the auricular surface of the ilium: A new method for the determination of adult skeletal age at death*, in *American Journal of Physical Anthropology*, 68,1985, pp. 15-28.

MacKenzie *et Al*. 2017 = W.S. MacKenzie, A.E. Adams, K.H. Brodie, *Rocks and Minerals in Thin Section*, London 2017.

Magnani *et Al* 2020 = M. Magnani, M. Douglass, W. Schroder, J. Reeves, and D. R.

Braun, *The digital revolution to come: photogrammetry in archaeological practice*, in *American Antiquity*, 85, 2020, pp.737-760.

Main 1899 = A. Main, *La via alle Indie e Vasco Da Gama*, in *Rivista Internazionale di Scienze Sociali e Discipline Ausiliarie*, January 1899, vol 19, fasc 73, pp. 39-60

Mango 1999 = C. Mango, *Architettura bizantina*, Milano 1999.

Mannoni, Giannichedda 1996 = T. Mannoni, E. Giannichedda, *Archeologia della produzione*, Einaudi, Torino 1996

Manzo 1995 = A. Manzo, *Considerazioni sull'architettura dell'Etiopia antica*, in *Rassegna di Studi Etiopici*, 39, 1995, pp. 155-172.

Manzo 2009 = A. Manzo, *Capra nubiana in Berbere Sauce? Pre-Aksumite Art and Identity Building*, in *The African Archaeological Review*, 26, n. 4, 2009, pp. 291-303.

Manzo 2010 = A. Manzo, *Adulis before Aksum?*, in G. Lusini (ed.), *Current Trends in Eritrean Studies*, in *Annali del Dipartimento di Asia Africa Mediterraneo Università «L'Orientale» di Napoli*, 70, 2010, pp. 29-42.

Manzo 2014 = A. Manzo, *Coins*, in Zazzaro *et al*. 2014a, pp. 552-553.

Maresh 1970 = M.M. Maresh, *Measurements from roentgenograms*, in R.W. McCammon (ed.), *Human Growth and Development*, Springfield 1970, pp. 157-200.

Margariti 2008 = R.E. Margariti, *Mercantile Networks Port Cities, and "Pirate" States: Conflict and Competition in the Indian Ocean World of Trade before the Sixteenth Century*, in *Journal of the Economic and Social History of the Orient*, 51, 2008, pp. 543-577.

Marín-Buzón *et al*. 2021 = C. Marín-Buzón, A. Pérez-Romero, J. L. López-Castro, I. B. Jerbania, F. Manzano-Agugliaro, *Photogrammetry as a new scientific tool in archaeology: worldwide research trends*, in *Sustainability*, 13, 2021, 5319, https://doi.org/10.3390/su13095319.

Marrassini 1990 = P. Marrassini, *Some Considerations on the Problem of the "Syriac Influences" on Aksumite Ethiopia*, in *Journal of Ethiopian studies*, 23, 1990, pp. 35-46.

Martini 1900 = F. Martini, *Relazione sulla Colonia Eritrea del R. Commissario Civile Straordinario onorevole Ferdinando Martini (anni 1898 e 1899) presentata dal Ministro degli Affari Esteri (Visconti-Venosta)*, in *Atti Parlamentari Legislatura XXI Prima sessione 1900* - Camera dei Deputati, Roma 1900.

Martini 1913 = F. Martini, *Relazione sulla Colonia Eritrea per gli esercizi 1902-907*, Vol. I, Roma 1913.

Maspero 2017 = F. Maspero, *Campioni RC520-521: analisi radiocarbonio,* in *Adulis Project Report 2017*, Adulis Project Archive, pp. 78-80.

Massa 2014 = S. Massa, *Glass finds from Sector 1 and Sector 3*, in Zazzaro *et al*. 2014a, pp. 548-550.

Massa 2016 = S. Massa, *«Fertile è Malta, sterile la vicina isola di Pantelleria». Fonti letterarie e archeologia di un paesaggio mediterraneo*, in S. Lusuardi Siena, C. Perassi, F. Sacchi, M. Sannazaro (eds.), *Archeologia classica e post-classica tra Italia e Mediterraneo. Scritti in ricordo di Maria Pia Rossignani*, Milano 2016, pp. 453-461.

Massa 2017 = S. Massa, *La prima chiesa di Adulis. Le origini della cristianità nel Corno d'Africa alla luce delle testimonianze archeologiche*, in *Rivista di Archeologia Cristiana*, 93, 2017, pp. 411-455.

Massa 2023 = S. Massa, *Adulis*, in M. Castiglioni, S. Conte, S. Massa, G. Salvioni (eds.), *Incontri di Mondi Lontani. Dai viaggi d'esplorazione dell'800 alle ricerche di Angelo e Alfredo Castiglioni*, Genova 2023, pp. 262 - 271.

Massa, Cattaneo 2022 = S. Massa, N. Cattaneo, *Connecting Seas. Travellers, Merchants and Soldiers at Adulis (Eritrea)*, Milano 2022.

Massa, Giostra 2019 = S. Massa, C. Giostra, T*he Christianisation of Adulis in light of the material evidence*, in A. Manzo, C. Zazzaro (eds.) *Stories of Globalisation: The Red Sea and the Persian Gulf from Late Prehistory to Early Modernity. Selected Papers of Red Sea Project VII*, Leiden 2019, pp. 314-334.

Massa, Gorla in press = S. Massa, D. Gorla, *Mediterranean goods from the excavation contexts of Adulis (Eritrea)*, in 33D Congress of The Rei Cretariæ Romanæ Favtorvm, *Cultural (Contacts) and ceramic contexts*, Leiden, The Netherlands, 15-22 September 2024.

Matthews 1949 = D. H. Matthews, *The Restoration of the Monastery Church of Debra Damo*, in *Antiquity*, 23, 92, 1949, pp. 188-200.

Mazzieri *et al* 2017 = A. Mazzieri, G. Sottocornola, A. Todeschini, *Un museo per l'area*

archeologica di Adulis. Restauro e ampliamento del Palazzo del Governatore di Massawa. Graduation thesis in Architecture - School of Architecture, Urban Planning and Construction Engineering, Politecnico di Milano, Supervisors: M. Boriani, S. Bortolotto.

Mehari, Ghebru 2005 = T. Mehari, B. Ghebru (eds.), *Irrigation Development in Eritrea: Potentials and Constraints* - Proceedings of the Workshop of the Association of Eritreans in Agricultural Sciences (AEAS) and the Sustainable Land Management Programme (SLM) Eritrea 14-15 August 2003, Asmara 2005.

Michel 2001 = A. Michel, *Les Églises d'Époque Byzantine et Umayyade de Jordanie. Étude de typologie et inventaire*, Turnhout 2001.

Michels 1988 = J.W. Michels, *The Axumite kingdom: a settlement archaeology perspective*, in Gromyko AA (ed.), *Proceedings of the Ninth International Congress of Ethiopian Studies*, Moscow 1988, pp. 173-183.

Ministero Delle Colonie 1918 = Ministero Delle Colonie, *Problemi del dopo guerra. Relazione del Governo dell'Eritrea*, Roma 1918.

Miran 2009 = J. Miran, *Red Sea Citizens. Cosmopolitan Society and Cultural Change in Massawa*, Bloomington 2009.

Monneret De villard 1937 = U. Monneret De Villard, *L'origine dei più antichi tipi di chiese abissine*, in *Atti del Terzo convegno di studi coloniali*, Firenze 1937, pp. 137-151.

Monneret De Villard 1938 = U. Monneret De Villard, *Aksum. Ricerche di topografia generale*, in *Analecta Orientalia*, 16, 1938.

Monneret De villard 1947 = U. Monneret De Villard, *Mosè, vescovo di Adulis*, in *Orientalia Christiana Periodica*, 13, 1947, pp. 613-623.

Monnier *et al*. 2016 = Fr. Monnier, J.-P- Petit and Chr. Tardy, *The use of 'ceremonial' cubit rod as a measuring tool. An explanation*, in *The Journal of Ancient Egyptian Architecture*, 1, 2016, pp. 1-9.

Monroe 2013 = J. C. Monroe, *Power and Agency in Precolonial African States*, in *Annual Review of Anthropology*, 42, 2013, pp. 17-35.

Morris 2006 = I. Morris, *The Growth of Greek Cties in the First Millennium BC*, in G.R. Storey (ed.), *Urbanism in the Preindustrial World Cross-Cultural Approaches*, Tuscaloosa, pp. 27-51.

Morrison 1989 = H.M. Morrison, *The Glass*, in S.C. Munro-Hay (ed.), *Excavations at Aksum. An account of research at the ancient Etiopian capital directed in1972-4 by the late Dr. Neville Chittik*, London 1989, pp. 188-209.

Munro-Hay 1991 = S.C. Munro-Hay, *Aksum. An African Civilisation of Late Antiquity*, Edinburgh 1991.

Munro-Hay 1989a = S.C. Munro-Hay, *Excavations at Aksum. An Account of Research at the Ancient Ethiopian Capital Directed in 1972-74 by the Late Dr. Neville Chittick*, London 1989.

Munro-Hay 1989b = S.C. Munro-Hay, *The British Museum excavation at Adulis, 1868*, in *Antiquaries Journal*, 69, 1989, pp. 43-52.

Munro-Hay 1989c = S.C. Munro-Hay, *Horse-shoe Arches in Ancient Ethiopia*, in *Rassegna di Studi Etiopici*, XXXIII, 1989, pp. 157-161.

Munro-Hay 1991 = S. C. Munro-Hay, *Aksum: an African Civilisation of Late Antiquity*, Edinburgh 1991.

Munro-Hay 1997 = S.C. Munro-Hay, *Ethiopia and Alexandria The Metropolitan Episcopy of Ethiopia*, Warsawa 1997.

Mutunga *et al*. 2012 = C. Mutunga, E. Zulu, R-M. De Souza, *Population dynamics, climate change and sustainable development in Africa*, African Institute for Development Policy (AFIDEP), San Francisco 2012.

Nadel 1944 = S.F. Nadel, *British Military Administration, Eritrea: Races and tribes of Eritrea*, Asmara 1944.

Nappo 2018 = D. Nappo, *I porti romani nel Mar Rosso da Augusto al Tardoantico*, Napoli 2018.

Nardi 2014 = R. Nardi, *The mortar*, in Zazzaro *et al*. 2014a, pp. 540-543.

Nas 2011 = P.J.M. Nas, *Cities Full of Symbols. A Theory of Urban Space and Culture*, Leiden 2011.

Nalesini 2010 = O. Nalesini, Sa*cred Places and Beings of the Red Sea Littoral Societies*, in: *Navigated Spaces, Connected Places: Proceedings of Red Sea Project V held at the University of Exeter*, 16-19 September 2010, Oxford 2012, pp. 77-84.

Ogbazghi 2018 = W. Ogbazghi, *Agro-climatic end Environmental Hazards and Mitigation Measures for the Northern and Southern Red Sea Zone Administrations of Eritrea*, in *Journal of Eritrean Studies*, VIII, n. 2, 2018, pp.85-132.

Ogubazghi, Tsighe 2018 = G. Ogubazghi, Z. Tsighe (eds.), *Assessment of Hazards and Community-based Mitigation Measures for the Northern and Southern Red Sea Zone Administrations of Eritrea,* The *Journal of Eritrean Studies*, special issue. vol. VIII, number 2, December 2018.

Osio 1869 = E. Osio, *La spedizione inglese in Abissinia (1867-1868) - pagine del giornale di viaggio*, Firenze 1869.

Paribeni 1907 = R. Paribeni, *Ricerche nel luogo dell'antica Adulis*, in *Monumenti Antichi*, 18, 1907, pp. 437-572.

Parker 2009 = A.G. Parker, *Pleistocene climate change in Arabia: developing a framework for hominin dispersal over the last 350 ka*, in M. Petraglia, J.I. Rose (eds.), *Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*, Dordrecht 2009.

Peacock, Blue 2007 = D. Peacock, L. Blue, *The Ancient Red Sea Port of Adulis, Eritrea. Results of the Eritro-British Expedition 2004-2005*, Oxford 2007.

Pecchini *et al*. 2018 = E. Pecchini, F. Frattini, E. Cantisani, *Le malte antiche e moderne,* Bologna 2018.

Pecchini *et al*. 2020 = E. Pecchini, F. Frattini, E. Cantisani, *Atlante delle malte antiche in sezione sottile al M.O.,* Rimini 2020.

Phillipson 1997 = D. W. Phillipson, *AKSUM The Monuments of Aksum. Edited and annotated by D. W. Phillipson*, Addis Ababa and London 1997.

Phillipson 1998 = D. W. Phillipson, *Ancient Ethiopia: Aksum, its antecedents and successors*, London.

Phillipson 2000 = D. W. Phillipson, *Aksumite Urbanism*, in D. M. Anderson, R. Rathbone (eds.), *Africa's Urban Past*, Oxford 2000, pp. 52-65.

Phillipson 2009 = D. W. Phillipson, *Ancient Churches of Ethiopia*, New Haven 2009.

Phillipson 2012 = D. W. Phillipson, *Foundations of an African Civilisation. Aksum and the Northern Horn 1000 BC - AD 1300*, Addis Ababa 2012.

Phillipson, Phillips 1998 = D. W. Phillipson, J. S. Phillips, *Excavations at Aksum, 1993-1996: A Preliminary Report*, in *Journal of Ethiopian Studies*, 31, 2, 1998, pp. 1-128.

Pollera 1935 = A. Pollera, *Le popolazioni indigene dell'Eritrea*, Bologna 1935.

Power 2012 = T. Power, *The Red Sea from Byzantium to the Caliphate AD 500-1000*, Cairo - New York, 2012.

Puglisi 1952 = G. Puglisi, *Chi è? dell'Eritrea,1952: Dizionario biografico, con una cronologia*, Asmara 1952.

Reimer *et Al*. 2020 = P. J. Reimer, W. E. N. Austin, E. Bard, A. Bayliss, P. G. Blackwell, C. Bronk Ramsey *et Al*., *The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0-55 cal kBP)*, in *Radiocarbon*, 62, 2020, pp. 725-757.

Reinisch 1885 = L. Reinisch, Zula (Adulis), *Una città scomparsa del Mar Rosso*, *in Bollettino della Società Geografica Italiana*, Serie II, 10, 1885, pp. 584-587.

Reviglio 1954 = P. Reviglio, *Relazione tecnica in merito alle opere occorrenti per la rimessa in efficienza del comprensorio agricolo di Zula*, technical report, unpublished, 1954, in Archivio Privato Matteoda Reviglio, Asmara.

Ricci, Fattovich 1987 = L. Ricci, R. Fattovich, *Scavi archeologici nella zona di Aksum*. *Bieta Giyorgis*, in *Rassegna di Studi Etiopici*, 31, 1987, pp. 123-197.

Robin, de Maigret 1998 = C. Robin, A. de Maigret, *Le grand temple de Yéha (Tigray, Éthiopie) après la première campagne de fouilles de la mission française*, in C*omptes-rendus des Séances de l'Académie des Inscriptions et Belles-Lettres*, 1998, pp. 737-798.

Roller 2003 = D. W. Roller, *The World of Juba II and Kleopatra Selene: Royal Scholarship on Rome's African Frontier*, New York and London 2003.

Roncella *et Al.* 2021 = R. Roncella, G. Forlani, and F. Diotri, *A Monte Carlo simulation study on the dome effect*, in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 43, 2021, pp. 53-60.

Ruiz-Giralt, Beldados 2024 = A. Ruiz-Giralt, A. Beldados, *The development of crop production in the northern Horn of Africa: a review of the archaeobotanical evidence*, in *Azania: Archaeological Research in Africa*, 59, 2, 2024, pp. 183-212, https://doi.org/10.1080/0067270X.2024.2316518.

Rüppel 1838 = E. Rüppel, *Reise in Abyssinien*, Frankfurt am Mein 1838.

Russel 1860 = S. Russel, *Une mission en Abyssinie et dans la Mer Rouge 23 Octobre 1859 - 7 Mai 1860*, Paris 1884.

Sadr 2019 = K. Sadr, *The 'Neolithic' Concept in South Africa*, in *Goodwin Series*, 12, *Towards a History of Archaeology from South Africa*, pp. 69-71.

Saha *et al*. 2014 = S. Saha, S. Moorthi, X. Wu, J. Wang, S. Nadiga, P. Tripp, D. Behringer, Y.-T. Hou, H.-Y. Chuang, M. Iredell, *The NCEP climate forecast system version 2*, in *Journal of Climate*, 27, n. 6, 2014, pp. 2185-2208.

Sainz 1988 = J. Sainz, *Dal corpo al cosmo. Evoluzione delle unità di misura nel mondo reale*, in *Dimensioni del Disegno*, 32-33, 1998, pp. 53-63.

Salt 1814 = H. Salt, *A Voyage to Abyssinia and Travels in the Interior of the Country, Executed under the Orders of the British Government in the Years 1809 and 1810*, London 1814.

Sapeto 1871 = G. Sapeto, A*mbasciata mandata nel 1869 dal Governo francese al Negussié Degiazmate del Tigré e del Samièn*, in *Bollettino della Società Geografica Italiana*, 6, 1871, p. 22-71.

Schmidt *et Al*. 2008 = P.R. Schmidt, M.C. Curtis, Z. Teka, *The Ancient Ona communities of the First Millennium BCE: Urban Precursors and Indipendent Development on the Asmara Plateau*, in P. R. Schmidt, M.C. Curtis, Z. Teka (eds.), *The Archaeology of Ancient Eritrea*, Asmara 2008, pp. 109-161.

Schmidt, Curtis 2001 = P.R. Schmidt, M.C. Curtis, *Urban precursors in the Horn: early 1st-millennium BC communities in Eritrea*, in *Antiquity*, 75, 2001, pp. 849-859.

Schoeller 1895 = M. Schoeller, *Mitteilungen über Meine Reise in der Colonia Eritrea (Nord-Abyssinien)*, Berlin 1895.

Segre 1928 = A. Segre, *Metrologia e circolazione monetaria degli antichi*, Bologna, 1928.

Sernicola, Sulas 2012 = L. Sernicola, F. Sulas, *Continuità e cambiamento nel paesaggio rurale di Aksum: dati archeologici, etnografici e paleoambientali*, in A. Bausi (ed.), *Aethiopica et Orientalia. Studi in onore di Yaqob Beyene*, Napoli 2012, pp. 549-573.

Sernicola 2017 = L. Sernicola, *Ancient settlement patterns in the area of Aksum (Tigray, northern Ethiopia), Ca. 900 BCE-800/850 CE*, Oxford 2017.

Simmons 2022 = J.A. Simmons, *Dire straits. Safeguarding trade on the Red Sea and Gulf of Khambhat (ca - 1-300 CE)*, in C. Durand, J. Marchand, B. Redon and P. Schneider (eds.) *Networked spaces. The spatiality of networks in the Red Sea and Western Indian Ocean*, Lyon 2022, pp. 227-244.

Simon 1885 = G. Simon, *L'Éthiopie; ses moeurs, ses traditions, le négouss Iohannès, les eglises monolithes de Lalibéla*, Paris 1885.

Simon 1989 = R. Simon, *Meccan Trade and Islam. Problems of origin and structure*, Budapest 1989.

Sjoberg 1964 = G. Sjoberg, *The Rise and Fall of Cities: a Theoretical Perspective*, in N. Anderson (ed.), *Urbanism and Urbanization*, Leiden 1964, pp. 7-20.

Smith 2009 = M. E. Smith, *V. Gordon Childe and the Urban Revolution: a historical perspective on a revolution in urban studies*, in T*own Planning Review*, 80, 1, 2009, pp. 3-29.

Smith 2017 = M. E. Smith, *How can Archaeologists identify early cities? Definitions, types, and Attributes*, in M. Fernàndez-Götz (ed.), *Eurasia at the dawn of history*, Cambridge 2017, pp. 151-180.

Smith 2020 = M. E. Smith, *The Comparative Analysis of Early Cities and Urban Deposits*, in *Journal of Urban Archaeology*, 2, 2020, pp. 197-205.

Smith 2023 = M. E. Smith, *Urban Life in the Distant Past. The Prehistory of Energized Crowding*, Cambridge 2023.

Sodini 1989 = J. P. Sodini, *Le commerce des marbres à l'époque protobizantine*, in C. Abadie Reynal (ed.), *Hommes et richesses dans l'Empire byzantine : Tome 1, IVe-VIIe siècle*, Paris 1989, pp.163-186.

Street, Ghebreselassie 2009 = J. Street, A. Ghebreselassie, *Red Sea railway - the history of the railways in Eritrea*, Sheffield 2009.

Sundström 1907 = R. Sundström, *Archaeological Work at the Ruins of Adulis and Gabaza*, in *Zeitschrift für Assyriologie und Vorderasiatische Archäologie*, 20,1907, pp. 171-182.

Tarboton = D. Tarboton, *SOILGRIDS* [Online], available at: https://soilgrids.org/.

Tarpin 2000 = M. Tarpin, *Urbs et oppidum. Le concept urbain dans l'Antiquité romaine*, in V. Guichard, S. Sievers, O. H. Urban (eds.) *Les processus d'urbanisation à l'âge du Fer*, Bibracte, 4, 2000, pp. 27-30.

TauDEM = TauDEM, *David Tarboton* [Online], available at: https://hydrology.usu.edu/taudem/taudem5/downloads.html.

Tedeschi 1969 = S. Tedeschi, *Note storiche sulle isole Dhalak*, in *Proceedings of the Third International Conference on Ethiopian Studies*, Addis Ababa 1969, pp. 49-74.

Tekle 2011 = H. Tekle, *Archaeological excavations of the church of Arbaetu Ensesa Aksum,*

Ethiopia, 2006-2007, in *Annales d'Éthiopie*, 26, 2011, pp. 79-98.

Terrenato 2004 = N. Terrenato, *Sample size matters! The paradox of global trends and local surveys*, in S. Alcock, J. Cherry (eds.), *Side-By-Side Survey: Comparative Regional Studies in the Mediterranean World*, Oxford 2004, pp. 36-48.

Tewolde, Cabral 2011= M. G.Tewolde, P. Cabral, *Urban sprawl analysis and modeling in Asmara, Eritrea*, in *Remote Sensing*, 3, 2011, pp. 2148-2165.

Trigger 1972 = B.G. Trigger: *Determinants of urban growth in pre-industrial societies*, in P.J. Ucko, R. Tringham, G.W. Dimbleby (eds.), *Man, Settlement, and Urbanism*, Cambridge 1972, pp. 575-599.

Trimingham 1952 = J.S. Trimingham, *Islam in Ethiopia*, Oxford 1952.

Tringali 1965 = G. Tringali, *Cenni sulle 'Ona' di Asmara e Dintorni*, in *Annales d'Éthiopie*, 6, 1965, pp.143-152.

Tringali 1981 = G. Tringali, *Note su Ritrovamenti Archeologici in Eritrea*, in *Rassegna di Studi Etiopici*, XXVIII, 1980-1981, pp. 99-120.

Ubelaker 1999 = D. H. Ubelaker, *Human skeletal remains: Excavation, analysis, interpretation* (3rd. ed.), Washington 1999.

Ullendorff 1960 = E. Ullendorff, *The Ethiopians*, Oxford 1960.

Vavilov 1926 = N.I. Vavilov, *Centry proischozdenija kul'turnych rastenij*, Leningrad 1926.

Vidulli Torlo 1984 = M. Vidulli Torlo, *Considerazioni sull'unità di misura utilizzata nella basilica Eufrasiana di Parenzo*, in *Aquileia nostra*, 55, 1984, pp.186-187.

Viollet-Le-Duc 1984 = E. Viollet-Le-Duc, *Restauration*, in *Dictionnaire raisonné de l'architecture Française 1854-68*. Italian translation: E. Viollet-le-Duc, *L'architettura ragionata*, Milano 1984.

Waagen 2019 = J. Waagen, *New technology and archaeological practice. Improving the primary archaeological recording process in excavation by means of UAS photogrammetry*, in *Journal of Archaeological Science*, 2019,101, pp.11-20.

Ward Perkins, Goodchild 2002 = J.B. Ward Perkins, R. G. Goodchild, *Christian Monuments of Cyrenaica*, London 2002.

Weber 1950 = M. Weber, *La città*, Milano 1950.

Weber 2010 = T. M. Weber, *Syrien, Ägypten und Aksum. Das „sanctuaire carré" - eine Sonderform des Altarraumes in der früchristlichen Sakralarchitektur Westasiens un Nordostafrikas*, in D. Kreikenbom, K.-U. Mahler, P. Schollmeyer, T. M. Weber (eds.), *Krise und Kult Vorderer Orient und Nordafrika von Aurelian bis Justinian*, Berlin-New York, pp. 207-254.

White *et Al*. 2003 = T.D. White, B. Asfaw, D. De Gusta, H. Gilbert, G. Richards, G. Suwa, F.C. Howell, *Pleistocene Homo sapiens from Middle Awash, Ethiopia*, in *Nature*, 423, 2003, pp. 742-747.

Whitewright 2007 = J Whitewright, *How Fast is Fast? Technology, Trade and Speed under Sail in the Roman Red Sea*, in J. Starkey, P. Starkey, T. Wilkinson (eds.), *Natural Resources and Cultural Connections of the Red Sea*, BAR International Series 1661, Oxford 2007, pp.77-87.

Will, Scerri 2024 = M. Will, E. Scerri, *The generic Middle Stone Age: fact or fiction?*, in *Azania: Archaeological Research in Africa*, 59, 1, 2024, pp. 4-21.

Wirth 1938 = L. Wirth, *Urbanism as a way of life*, in *American Journal of Sociology*, 44, 1938, pp. 1-24.

Wolde-Kiros 2011 = H.S. Wolde-Kiros, *Stable isotopic analysis of human and animal diets from two pre-Aksumite/Proto-Aksumite archaeological sites in northern Ethiopia*, in *Journal of Archaeological Science* 38, 2011, pp. 367-374.

Wolf, Nowotnick 2011 = P. Wolf, U. Nowotnick, *Ein neuer äthio-sabäischer Fundplatz in Tigray/Äthiopien - Der Almaqah-Tempel von Meqaber Ga (ewa*, in S. Wenig (ed.), *In Kaiserlichem Auftrag. Die Deutsche Aksum-Expedition 1906 unter Enno Littmann, Band 2: Altertumskundliche Untersuchungen der DAE in Tigray/Äthiopien*, Wiesbaden 2011, pp. 203-219.

Wolska-Conus 1968= W. Wolska-Conus, *Cosmas Indicoplèustes Topographie Chrétienne, Tome I (Livre I-IV)*, Paris 1968.

Zaccaria 2007 = M. Zaccaria, *Le note del commissario Teobaldo Folchi e i cenni storico-amministrativi sul Commissariato di Massawa*, in *Ethnorema,* rivista on-line, n.3, 2007.

Zazzaro 2013= C. Zazzaro, *The Ancient Red Sea Port of Adulis and the Eritrean Coastal Region.*

Previous investigations and museum collections, BAR International Series 2569, Oxford 2013.

Zazzaro 2019 = C. Zazzaro, *Traditional Ceramic Manufacturing in the Northern Horn of Africa: the Case of a Tigre Potter in the Foro-Wi'a Subregion (Eritrea)*, in *Rassegna di Studi Etiopici* 3, 3ª serie, L, pp. 39-64.

Zazzaro, Manzo 2012 = C. Zazzaro, A. Manzo, *A preliminary assessment of the pottery assemblage from the port town of Adulis (Eritrea)*, in *British Museum Studies in Ancient Egypt and Sudan*, 18, 2012, pp. 233-246.

Zazzaro *et Al.* 2014 = C. Zazzaro, E. Cocca, A. Carannante, A. Filigenzi, R. Loreto, A. Manzo, V. Perna, C. Durand, S. Massa, C. Mandelli, N. Nardi, D. Nappo (2014a) *The Contribution of the Università degli Studi di Napoli "L'Orientale" to the 2013-2014 Eritrean-Italian Archaeological Field Season at Adulis*, in *Newsletter di Archeologia CISA* 5, 2014, pp. 507-590.

Zazzaro, Cocca, Manzo 2014 = C. Zazzaro, E. Cocca, A. Manzo, *Towards a Chronology of the Eritrean Red Sea Port of Adulis (1st - early 7th century AD)*, in *Journal of African Archaeology* 12, 1, 2014, pp. 43-73.

Zeraebruk *et Al*. 2017 = K. N. Zeraebruk, A. O. Mayabi, J. M. Gathenya, *Assessment of Water Resources and Analysis of Safe Yield and Reliability of Surface Water Reservoirs of Asmara Water Supply System*, in *Environment and Natural Resources Research*, 7, 2017, p. 45.

Zerai 2022 = A. Zerai, PhD thesis, *Comprehensive Archaeometric Study of Ayla-Aksum Amphorae from Adulis, Red Sea Coast of Eritrea*, Doctoral School of the University of Torino, PhD Programme in Technology Driven Sciences for Cultural Heritage: T4C XXXIV Cycle.

Zerai *et Al*. 2022 = A. Zerai, C. Guerrini, J.J. Luckejko, E. Ribechni, A. Piccirillo, S. Massa, C. Mandelli, T. Medin, A. Re, A. Lo Giudice, P. Davit, M. Gulmini, *Organic residues of lining in transport vessels from the Red Sea Coast of Eritrea: a further element to understand commercial relations*, in *Journal of Heritage Sciences*, 10 (162), 2022, https://dx.doi.org/10.1186/s40494-022-00801-7.

Zohary *et Al.* 2012 = D. Zohary, M. Hopf, E. Weiss, *Domestication of Plants in the Old World. The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley*, Oxford 2012.

Zuhair Hasan El-Isa 2015 = Zuhair Hasan El-Isa, *Seismicity and seismotectonis of the Red Sea,* in *Arabian Journal of Geosciences*, 8, 2015, pp. 8505-8525.

Zuiderhoek 2016 = A. Zuiderhoek, *The Ancient City*, Cambridge 2016.

NOTES ON THE TRANSLITERATION OF PLACE NAMES

Nelly Cattaneo, Abraham Zerai

As is well known, the linguistic richness of the Horn of Africa, with its inherently rich writing systems, has posed for Western scholars and researchers the important issue of transliteration, particularly for place names, at the basis of both documents and maps. The different transliteration logics adopted from the earliest scholars (Hiob Ludolf 1624-1704) up to the entire period of colonial occupation, have yielded a variety of names that has often led to difficulties and misunderstandings.

Since the very early 2000s, the Encyclopaedia Aethiopica (*EAe*) has made an enormous effort to address this issue analytically, sharing methodological choices and thus allowing for replicability. Referring to the EA thus guarantees respect for the phonetic richness of the written names, as well as an indispensable basis for international sharing of research.

By using characters typical of the phonetic alphabet in this operation, many transliterations are not immediate for the reader who has some familiarity with names of places and historical figures, but has no specialist linguistic knowledge. Moreover, as far as Eritrea in particular is concerned, the need to standardise the spelling of national place names emerged at the national level in the same years: in fact, the document 'Eritrea Villages and Hamlets Name' issued by the Office of the President of Eritrea (edited by Zerai Abraham) dates back to 2004. With great effort, it reports the names of all the country's towns and villages in Tigrinya and in Latin characters.

For the place names in this publication, preference was given to the last document, as Eritreans are the ideal addressee of this work. Even in this case, however, the transcription in Latin characters sometimes proved difficult to understand (e.g. Mtswaâ for Massawa). The result in the text, achieved thanks to the joint work of the Eritrean and Italian editors, is a compromise, which, at least in its intentions, aims to guarantee as much as possible an immediate comprehension while reading.

In order not to lose the phonetic complexity of the place names, a table with the individual entries in the various available transliterations is given below.

Place names used in this volume	**Tigrinya**	**Eritrean Villages and Hamlets nam**	**Encyclopaedia Aethiopica**
Abdur	ዓብድር		
Àdi Helebo	ዓዲ ሐሌቦ		
Àdi Qheyh'	ዓዲ ቀይሕ	Àdi Qheyh'	ᶜAddi Qäyyəḥ
Àdi Khuala	ዓዲ-ኹላ	Àdi Khuala	ᶜAddi K^{w}ala
Addigrat	ዓዲ ግራት		ᶜAddigrat
Adulis	ኣዱሊስ		Adulis
Adwa	ዓድዋ		ᶜAdwa
Afta	ኣፍታ	Afta	
Agamedda	ዓጋመዳ		
Adi Rosso	ዓዲ ሮሶ		
Aylat/Ailet	ዓይለት	Aylat	ᶜAylät
Akkala Guzay	ኣከለጉዛይ	Akkala Guzay	Akkäla Guzay

Place names used in this volume	Tigrinya	Eritrean Villages and Hamlets nam	Encyclopaedia Aethiopica
Àla	ዓላ	Àla	
Alighede	ዓሊ-ገደ		
Alid	ዓሊድ		
Arba'ete Ens'sa	ኣርባዕተ እንስሳ		
H'rgigo (Arkiko)	ሕርጊጎ	H'rgigo	Ḥərgigo
Àreza	ዓረዛ	Àreza	
Asfet	ዓስፈት		
Asmera	ኣስመራ	Asmera	Asmära
Àseb	ዓሰብ	Àseb	ᶜAsäb
Asaorta	ዓሳወርታ		Asaorta
A'sus	ዓሱስ		
Aussa	ኣውሳ		
Bāb al-Mandab	ባብ ኤል ማንደብ		Bāb al-Mandab
Bada	ባዳ		
Beleza	በለዛ	Beleza	Bäläza
Bet Gyorgis	ቤት ግዮርጊስ		-
Bet Sema'iti	ቤት ሰማእቲ		-
Badi'e	ባዲ		Bādiᶜ
Biet Christian	ቤት ክርስትያን		
Buya	ቡያ	Buya	Buya
Kuaàtit	ኳዓቲት	Kuaàtit	
Coloë	ቆለወ		Coloë
Dahlak	ዳህላክ	Dahlak	
Dandero	ዳንዴሮ		Dändero
Denkel	ደንከል		Dänkäl
Dänkälia/Denkalia	ደንካልያ		Dänkälia
Debre Damo	ደብረ-ዳሞ		
Deqemh'are	ደቀምሓረ	Deqemh'are	
Degdegi	ደግደዲ		
Desset	ደሰት		
Desie	ደሴ	Desie	
Dähono	ዶኾኖ		Däḥono
Edaga Hamus	ዕዳጋ-ሓሙስ	Âdaga H'amus	
Êmberemi	እምበረሚ	Êmberemi	
Intcho (Enticcio)	እንትጮ		
Foro	ፎሮ	Foro	
Galala/Gabaza	ገላላ		
Gelàlo	ገልዓሎ		
Gerhu Sirnay	ገርሁ-ስርናይ		
Ghedem	ገደም		
Ghelti	ገልቲ		

Place names used in this volume	Tigrinya	Eritrean Villages and Hamlets nam	Encyclopaedia Aethiopica
Garar/G'rar	ግራር		Gärar
Gindaâ	ጊንዳዕ	Gindaâ	Ginda^{c}
Grat Beal Gebri	ግራት በዓል ቀብሪ		
Haddas	ሓዳስ		Ḥaddas
Halai	ሓላይ		
Hazemo	ሃዘሞ		
Idharmaz/ Eid Harmaz	ኢድ-ሓርማዝ		
Irafayle	ኢራፋይለ	Irafayle	Iṛāfálo
Kassala	ከሰላ		Kassala
Keren	ከረን	Keren	Käränn
Keskese	ከስከሰ		Käskäse
Klasies	ክላይሲስ ሪቨር(ደቡብ ኣፍሪቃ)		
Koloe	ቆለዉ		Coloë
Komayle	ኮማይሊ		Komayle
Kusrale	ኩስራለ		
Lalibela	ላሊበላ		Lalibäla
Labqa	ላብካ	Labqa	Läbqa
Mekele	መቀለ		Mäqälä
May Àyni	ማይ-ዓይኒ	May Àyni	May ^{c}Ayni
Malkato	ማልካቶ		
Mai Âgada	ማይ-ዕዳጋ		
Mai Shum	ማይ-ሹም		May Šum
Mahrib	ማሪብ		
Massawa	ምጽዋዕ	Mtswaâ	Massawa
Mätära	መጥራ		Mäṭära
Mekane Medhanie Alem	መካነ መድሃኔ ኣለም		
Mekele	መቀለ		
Mendefera	መንደፈራ	Mendefera	Mändäfära
Marsa Fathuma	ማርሳ ፋጥማ	Marsa Fathuma	
Mersa Wadi Gawasis	ማርሳ ዋዲ ጋዋሲስ		
Misse	ሚሰ		
Êmkulu	እምኩሉ	Êmkulu	
Gobo Abuna Yosef	ጎቦ ኣቡነ ዮሴፍ		
Nefasit	ነፋሲት		
H'thmlo (Otumlo)	ሕጥምሎ	H'thmlo	Ḥətumlo
Qohayto	ቆሓይቶ		Qoḥayto
Saati	ሰዓቲት		
Safira	ሳፊራ		Safira
Segeneyti	ሰገነይቲ	Segeneyti	Sägänäyti
Sämhar	ሰምሃር		Sämhar

Place names used in this volume	Tigrinya	Eritrean Villages and Hamlets nam	Encyclopaedia Aethiopica
Senàfe	ሰንዓፈ	Senàfe	Sänᶜafe
Säraye	ሰራየ		Säraye
Shire	ሸረ		
Sawākin	ስዋኪን		Sawākin
Tek'a Maryam	ተኣካ ማርያም		
Tana	ጣና		ṭana
Tenben	ተንቤን		
Tigray	ትግራይ		Təgray
Tekhondaâ (Tokonda)	ተኮንዳዕ	Tekhondaâ	Toḵonda
Tsorona	ጸሮና	Tsorona	
Wi'a (Ua-a)	ዊዓ	Wi'a	
Wekiro	ወቂሮ	Weqhiro	
Wenghebo	ወንጌቦ		
Welqayt	ወልቃይት		
Yeha	ይሓ		Yəḥa
Zula	ዙላ	Zula	
Zayla	ዘይላ		Zayla

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THE RESEARCH PROJECT

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The specific objective of this project - as of the ‘Adulis Project’ - is to improve the impact of long-term archaeological research and link it to the promotion of sustainable development at the local level by building permanent structures at Adulis for research, such as accommodations, laboratories and related facilities.

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