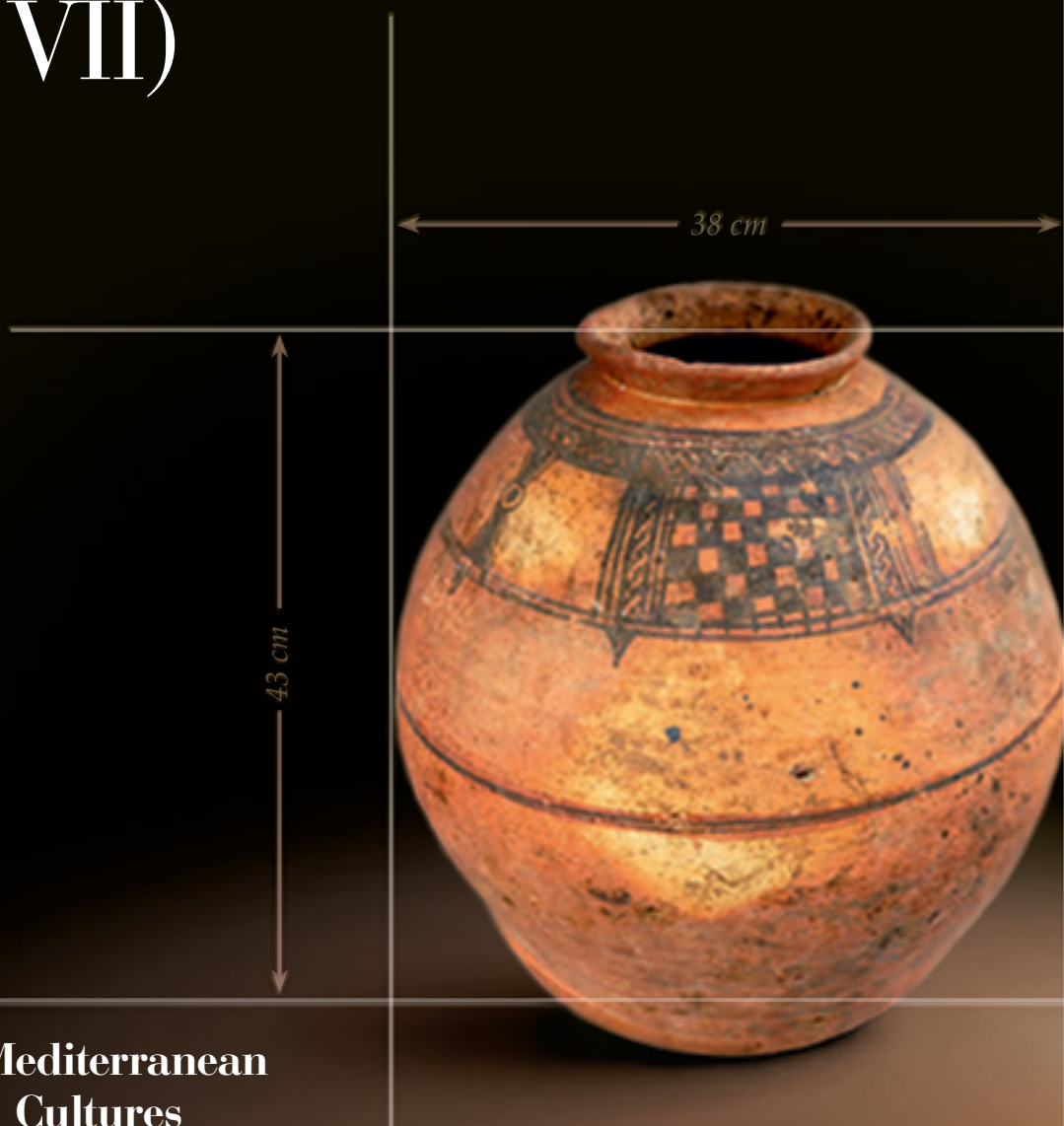


Banganarti Studies I (Nubia VII)

Edited by
Bogdan Żurawski



Institute of Mediterranean
and Oriental Cultures
Polish Academy of Sciences



Banganarti

Studies I

(Nubia VII)



Map of the Middle Nile (Created by Bogdan Żurawski)

Banganarti

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Warsaw 2021



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Front cover
Storage jar inv. no. BA-19-2300,
found in NECH Sector at Banganarti
Photo **Aneta Cedro**

Back cover
Drawing within the circular inscription shows
a pigeon painted on the shoulders of
a spouted vessel inv. no. BNG-45-2010,
found in the SSWCH Sector of Banganarti
Ink copy **Aneta Cedro**

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Plan of Banganarti site combined with
orthophotomap (Created by Roman Łopaciuk)



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However, the list of people and institutions to whom thanks are due is longer. It is a truism, the first and last in this volume, that the publication is the final stage of research, involving many anonymous contributors, from excavation workers to laboratory technicians. Naturally, I could never list them all, but I cannot fail to mention some.

An old maxim says that it is best to start from the beginning if you do not know where to start. At Banganarti, as in the Bible, in the beginning, was the word..., and soon after, many more words were discovered, written in Greek on the walls of the upper church of St Raphael the Archangel. The biblical precedent was duly fulfilled as Adam appeared on site soon after – Professor Adam Łajtar, of course. He came, called in from Old Dongola, for his assistance as a Greek epigraphist. Thus began the most crucial chapter in my life – excavations at Banganarti.

The inscriptions that Adam masterfully compiled and published last year (2020) were the greatest treasure we could have dug up at Banganarti. His article about the authors of these inscriptions is the highlight of this volume. I have thanked him many times in many places and will probably thank him many more times, including *hic et nunc*.

A special tribute is due to the mastery and excellence of the field research carried out at Banganarti by Michał Dzik. His detailed examination of the site's stratigraphy has brought as much information on Banganarti's history as the inscriptions from both Raphaelions. Special thanks go to Joanna Then-Obłuska and her American co-workers for the excellent study of our second, after the inscriptions, treasure so far: a collection of 2,500 beads found in a clay pot in the monastery's bakery.

Marta Osypińska has earned undying gratitude from the team through her archaeozoological research, which has brought a wealth of valuable new information to the research on Banganarti in the broader context.

The study of 100,000 potsherds and complete vessels recovered during the *Archangels and Locusts* project carried out by Aneta Cedro also deserves the highest praise. Finally, thanks should be extended to the other authors who accompanied us in the field during the last campaigns, which coincided with a turbulent period in contemporary Sudan: Sylwia Wajda, Agata Momot and Roman Łopaciuk. Their contributions to the project in words and deeds enabled significant progress towards understanding the complicated history of the Locust Island. Furthermore, their

findings augmented the Banganarti database. Last but not least, the *Archangels and Locusts* grant enabled a group of students from the University of Rzeszów to participate in the research under the supervision of Michał Dzik.

Thanks are also owed to those of my collaborators who carried out the *Archangels and Locusts* project in the field but have not contributed an article to the first volume of *Banganarti Studies*. Their studies are expected to appear in the second volume. The great absentee from the pages of the first volume is Andrzej Gołębniak. His article will be a highlight of the second volume. Nevertheless, he has done enough to be high on the list of Banganarti benefactors. He was my guide through the *terra incognita* of computer programmes and technologies, which make modern archaeology genuinely modern. He also inspired Roman Łopaciuk to write his excellent essay on applying computers to the geodetic study of the sacred and profane.

The fieldwork would not have been possible without the excellent cooperation developed with the local community, many of whom were employed at the excavation site. Dafalla Awad, Atiyat Djadu, Arwa Ali Hassan Muhammad, Abdul Wahab Ahmed are members of our Polish-Sudanese family who share everyday worries and joys with us. Our dig house and the Banganarti Museum, next door, have become a meeting place that very many of the local community visit. I am incredibly grateful to the participants in these events, during which I practised my Arabic for graciously pretending to understand everything.

The *Archangels and Locusts* project was smoothly carried out in the field thanks to the excellent relationship with the National Corporation of Antiquities and Museums (NCAM), led successively by Abdelrahman Ali, Hatim al-Nour Mohamed Saeed and Ghalia Gar en-Nabi. In the field, NCAM was represented by Tamadur Ali Ebeid, Abdel Raouf Jubara and Amel Hassan Gismallah Alsaeed, who were dedicated to our shared goal of discovering Banganarti and preserving it for future generations. In addition, restorers Ewa Parandowska and Tadeusz Badowski are to be thanked for their excellent work. All of them were instrumental in successfully bringing Banganarti to life again. Thanks to them, the figures of the Holy Apostles, kings and nobles will remain to look from the walls of the Raphaelion for generations of visitors.

The authors' texts written in English have gained brilliance and appeal after checking by eminent Cantabrigians: Robert Harding, Jacke Phillips, Miranda Semple, Laurence Smith, Pamela Jane Smith and Christopher Tribe. Further advice on wording was provided to Laurence Smith by Michael Mallinson, Grant Chambers, Andrew Powell and John Shimmon.

From individual articles illustrated by photographs and drawings of varying quality, Mrs Katarzyna Dmowska-Usarewicz, an archaeologist and typesetter, has managed to compose a beautiful volume, which we modestly hope will be as interesting to the final word as it is attractive at first glance.

Finally, I would like to express my most sincere gratitude to Mrs Ewa Balcerzyk-Atys, who professionally handled the technical editing of this volume. This was probably the most difficult task in the whole project.



To the People of Banganarti



Plan of Banganarti site combined
with orthophotomap with sectors marked
Created by Roman Łopaciuk

Archangels and Locusts

Bogdan Żurawski

The ultimate goal of the project *Archangels and Locusts*, financed by the National Science Centre and hosted in 2016–2021 by the Institute of Mediterranean and Oriental Cultures of the Polish Academy of Sciences, was to create a new synthesis and present a fresh understanding of the most important pilgrimage centre in Christian Nubia and see its evolution in a broad context. The project brought together scientists from various disciplines and institutions who were committed to producing new findings and, based on new data, testing and verifying old hypotheses. The articles presented in this volume examine Banganarti from different perspectives. This multiplicity of viewpoints allows the reader, I do hope, to gain a deep, complete and insightful perception of this unique site.

Five years of excavations conducted as part of this project introduced a fundamental change in fieldwork methodology at Banganarti (Locust Island, in Nubian). First, issues hitherto neglected were taken up. Then, with the completion of the restoration of the Raphaelion, conservation of its murals, decipherment of the inscriptions, and publication of the excavations at both churches in two bulky volumes, a new research programme addressed the secular aspects of the *locus sanctus*, such as the daily life of visitors and residents, their diet, occupations, and habitats, both temporary in pilgrim hostels and permanent.

The twentieth anniversary of the Banganarti excavations was celebrated in 2021. However, my first encounter with the site happened earlier than 2001. I first climbed the *kom* at Banganarti in 1984, as a member of the Canadian mission,. Neither myself nor other members of the Royal Ontario Museum Expedition to Nubia had any idea what secrets were buried inside the *kom*.

The local villagers called it *kom el-kenissa* ('church hill'), but many similarly named places in Sudan had nothing to do with church architecture. Thus, in 1998, when I returned to Banganarti as the head of the Polish archaeological mission, I did not know what to expect. A church? Monastery? A fortified settlement? At that time, the answer to these questions was not necessary because the mission's primary purpose was to register all archaeological sites between Old Dongola and Ez-Zuma.

In 2001, after completing the survey and excavations project, I returned to Banganarti again. The site was chosen for rescue research as there were numerous threats to its integrity. A kite photo taken in 1998 showed a large caldera dug by the local villagers on a slope of the *kom*, while from the east and west, newly planted palm groves kept extending towards the site. In March 2001, after the first excavation season, it appeared that inside the *kom el kenissa* were the ruins of a vast building.

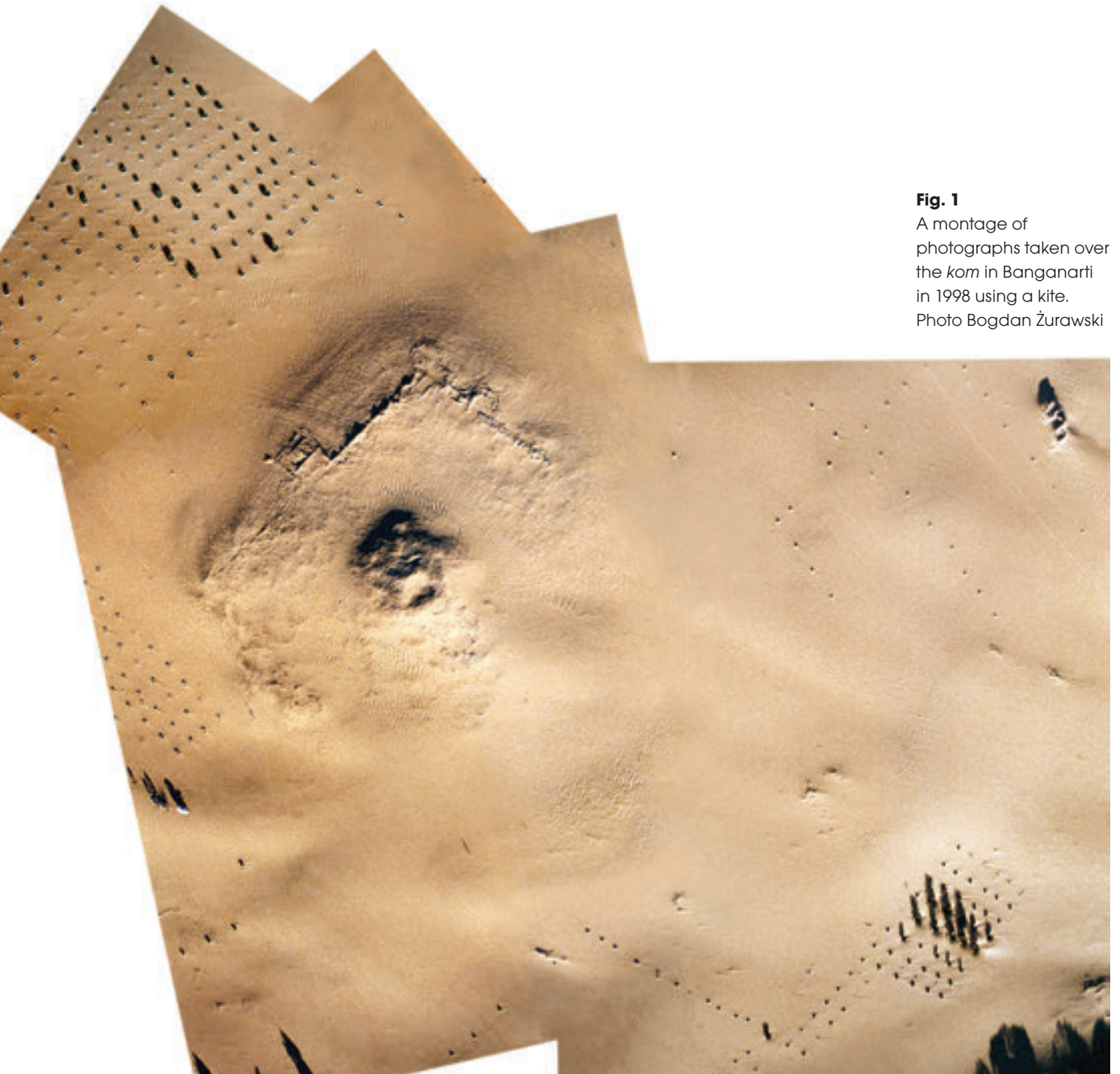


Fig. 1
A montage of
photographs taken over
the *kom* in Banganarti
in 1998 using a kite.
Photo Bogdan Żurawski



Fig. 2
Trenches on the *kom*
buried with sand and
covered by a bricked
protective mantle.
Photo Bogdan Żurawski

The nature of this building is still controversial today. Fortunately, there is no controversy about its patron saint. It was undoubtedly the Archangel Raphael. The cognitive value of the paintings and inscriptions found on the walls is also undeniable. Unfortunately, they survived in a lamentable state of preservation due to the fragile plaster and weak, water-soluble paint binder used by medieval painters. Therefore, after conservators secured the paintings and inscriptions, this part of the Raphaelion, unearthed in 2001, was backfilled and covered with a mantle of bricks cemented with mud mortar. (Fig. 2)

The measures taken to secure the site provoked an unexpected reaction from the local population; they assumed that this was the end of the excavation and their

high expectations invoked by the extraordinary find made in their neighbourhood. I was told that after we left for Poland, a delegation of young Banganartians, studying at universities in Khartoum, went to the headquarters of the Sudan Antiquities Service, asking its Director to influence me not to backfill the Raphaelion which they believed was a discovery that could attract tourists and help the local economy. Their assessment of our discovery was very kind, although greatly exaggerated. However, the situation was highly uncomfortable for me. On the one hand, I wanted to do something useful for the local community, but reconstructing the Raphaelion was out of the question for critical reasons. The prohibitive cost aside, the building had been built on the ruins of an older church that was razed to the ground and backfilled with sand and rubble. Such negligence on the part of medieval builders caused a disaster. When the high flood of the Nile caused the groundwater level to rise, the Raphaelion began to subside, unfortunately unevenly. The walls raised on sandy backfill subsided under the weight of the 12 m high building, while those built on the walls of the lower church stood firm. Vertical cracks soon developed, and part of the building caved in. The disaster could have been repeated if the building had been rebuilt in its original shape.

Unable to rebuild the Raphaelion conventionally, we looked for unconventional ways. Although the building did not stand the test of time well, at least the ground floor survived in a pretty good shape up to the springings of the vaults. Therefore, it was possible to reconstruct the first storey on a computer. Several versions of the overall view were considered, but the height of the building remained constant; the cross above the central dome was placed in the late eleventh century 12 m above the ground.

Of course, it would be madness to rebuild such a massive structure in a conventional way on unstable ground that changed its plasticity depending on the rise in groundwater level after the high flooding of the Nile. Moreover, visitors to the site and experts working on the paintings and inscriptions would be exposed to mortal danger. Therefore, the only solution to this seemingly hopeless situation was the Philadelphian reconstruction. The construction of a steel skeleton made of steel pipes on a scale of 1:1 would give those looking at it from outside an idea of what the building once looked like and provide those working inside with a sense of security. This was the perfect solution from all perspectives. (Figs. 3, 4)

The 1:1 scale model was made of steel pipes one and a half-inch in diameter. The corner domes were welded in a local workshop and carried to the site. The central dome, 4 m in diameter, also locally welded, was moved by 16 workers to the site, lifted and fixed in place. Moreover, by applying the Philadelphian reconstruction principles, it was possible to brace the upper part of the building with steel ties that prevented the walls from buckling. It also enabled the interior to be roofed quickly. The inside plasterwork was thus protected, and the work of conservators, iconologists and epigraphers made possible without filling the building with sand and digging it up again every year. For safety reasons, dozens of inscriptions on the walls in the eastern part of the Raphaelion, that were in danger of collapsing, were pasted into the rebuilt western part; this created a mirror reflection of the eastern part. Three paintings were transferred to the Banganarti Museum, and one mural depicting the Virgin Orans was sent to the Sudan National Museum.

Fig. 3

Raphaelion II topped by a steel model of the upper floor and domes, seen from the west.

Photo Roman Łopaciuk

Fig. 4

Raphaelion II topped by a steel model of the upper floor and domes, seen from the south.

Photo Roman Łopaciuk



The uniqueness of Banganarti has many facets. It is the only known Christian pilgrimage centre in the Middle Nile. Consequently, various structures related to its function, such as the pilgrimage church, baths and *ksenodocheia*, have no parallel in Nubia. The corpus of wall inscriptions left by pilgrims on the walls of this building proves that the Christians of the Middle Nile, around the mid-fourteenth century, were confronted with a misfortune that made them seek help from the Archangel Raphael, an intercessor with God and patron of human health. This episode coincides with the occurrence of the Black Death in the Nile Valley.

Research carried out under the *Archangels and Locusts* project has shown that over time Banganarti became an increasingly specialised pilgrimage settlement whose economy gradually focused on serving pilgrims. This process culminated

with the completion of the Raphaelion II when the popularity of the site grew, and crowds of pilgrims had to be catered and accommodated. In addition, discoveries made in recent years have profoundly revised the previous definition of Banganarti based on information obtained during the exploration of the sacral buildings only.

An important discovery occurred in 2018, ending 20 years of debate about the alleged monastery at Banganarti. It was found buried under later layers on the northern and southern sides of the lower church surrounded by a mud brick *peribolos*.

The excavation carried out in 2016–2021 also reassessed some of the older theories made at the beginning of the fieldwork at Banganarti. After revisiting the old *chantiers* and comparing the results with discoveries made elsewhere in the Nile Valley and at oases, it became clear that early Banganarti was home to two bath complexes, consistently named the eastern and western, which served visitors to the site long before Banganarti became a well-known pilgrimage centre. Excavations financed by the *Archangels and Locusts* project have filled a significant void in our understanding of daily life at Banganarti. In 2018, a complete *xenodochion* was found glued to the eastern curtain wall. Late baths found in this complex helped reconsider some previously misinterpreted structures.

A great deal has been accomplished, yet there is much still to learn. The amount of work required to fill in the gaps in the site's history has been and continues to be enormous. We endeavoured to confirm or deny many hypotheses. The reader will find thorough, clear answers and more questions in the following chapters. The 800 years of Banganarti cover the entire period of the Christian Kingdom of Makuria. We might confront the history of Banganarti based on archaeological finds against the political history of Nubia. Both narratives meet at the end of the eleventh century when the expansion of the national pilgrimage centre, highlighted by the erection of the Raphaelion I and the establishment of the cult of local rulers there, marked the high point of the nationalisation process of Nubian life and culture.

The story of the most important pilgrimage centre in Christian Nubia, written and painted on the walls of the most important pilgrimage centre in Makuria, reflects the good and bad fortunes of the Kingdom of Makuria. More than a thousand inscriptions and almost a hundred paintings left on the walls of upper and lower Raphaelions, and thousands of objects arranged stratigraphically into hundreds of layers, have created a massive base of unbiased information on Nubian life, religion, administration, topography, iconography, epigraphy, kingship, ecclesiastical and secular hierarchy.

The first volume of *Banganarti Studies* gloriously opens with a chapter by **Adam Lajtar** on the inhabitants of Banganarti. Based on inscriptions found in the upper church, he presents an orderly description of the ethnic and social patchwork of visitors and residents of Banganarti. It is also an exposition of the topography of the three kingdoms, as pilgrims and wanderers came to the shrine of Archangel Raphael from all over the Nile Valley and beyond.

Marta Osypinska's in-depth analysis of the Banganarti faunal remains confirms extensive contacts of Banganarti with the south via the trade route along Wadi el-Melik. Banganarti was a right-bank bridgehead of this track. In the early history of the settlement, herds of cattle grazing in the savanna zone of Kordofan and Darfur were moved northward along this road. The relocation of cattle along

Wadi el-Melik only stopped in the nineteenth century due to drying wells in western Bayuda. The large number of camel and donkey bones found at Banganarti, compared to other sites, provides further evidence of the vital role of the Locust Island in the caravan movement along Wadi el-Melik.

The only treasure found in Banganarti so far, a clay pot filled with over 2,200 beads, the most extensive collection ever unearthed in Sudan, has found its way into able hands. After scientific analysis of the collection by **Joanna Then-Obłuska, Laure Dussubieux, Jonathan Mark Kenoyer and Randall Law**, the hoard is even more valuable than we first realised and has provided a plethora of precious information. The beads found in the Banganarti and Ghazali monastery prove that the trade with India, which supplied the Mahdists with chainmail in the nineteenth century, supplied the Sudanese market with beads as early as the ninth century or even earlier.

In 2001–2015, the fieldwork was concentrated in the central part of the site, where between the seventh and fifteenth centuries, a sequence of five churches was built, one on the ruins of its predecessor. The *Archangels and Locusts* project broke with this tradition. The excavations went beyond the sacred space of the pilgrimage centre, mainly to the northeast of the Raphaelion II, where a large residential complex was located. I entrusted the supervision of the excavations there to the experienced field researcher **Michał Dzik** from the University of Rzeszów. It was one of the best decisions I ever made. His excavations were of the highest standard and created a new chronology based on radiocarbon dates and precise stratigraphy with extraordinary 627 layers distinguished.

Importantly, this stratigraphy does not coincide with the epigraphic dating of the site built on epigraphic material. The excavations in House A prove that, in the second half of the thirteenth century, secular life in Banganarti died down. Judging by the amount of graffiti left by visitors to the Raphaelion II, which include the names of kings and royal officials from the fourteenth century, the pilgrimage settlement was at its peak fame for another hundred years. This discrepancy only confirms the thesis that, in the thirteenth century, the site lost its residential function, becoming a pilgrimage settlement whose life was concentrated in shelters designed for the temporary residence of pilgrims. Traces of such buildings have been found in the neighbouring House B.

The unquestioned success of Michał Dzik's excavations would not have been possible without the help of the mission's geodesist and computer scientist, **Roman Łopaciuk**. His precise measurements and knowledge of advanced computer programs brought the excavations to the highest standards of modern archaeology that can be accomplished in the field without paper notes. The introduction of paperless archaeology on excavations in a country with so few trees and so much sand deserves the highest praise.

Aneta Cedro, the mission's ceramologist, between 2016 and 2021 documented over 100,000 potsherds. Most important were pottery fragments laboriously retrieved from House A and assigned each to one of 600 layers identified during excavations; this analysis provided a unique opportunity to systematise the ceramic industry in Upper Nubia between the seventh and thirteenth centuries. Moreover, her cursory presentation of Banganarti ceramic materials is a harbinger of a more extensive study of ceramics from Banganarti, which will be published in the coming years.



Fig. 5
Banganarti Museum.
Photo Bogdan Żurawski

Apart from the patron saint, St Raphael the Archangel, the lower church differed from its successor in almost everything. The differences were due to the various purposes the two buildings were built for and the contrasting styles of church architecture prevailing at the time of their construction. Window grilles, made of terracotta in the lower church and stucco in the upper church, are an excellent example of these differences. **Agata Momot** has created typologies of both. This was a laborious task, considering the vast number of fragments collected. Nevertheless, her research convincingly proves that there must have been other representative buildings besides churches in Banganarti.

Sylwia Wajda's research, based on the 120 glass objects that mainly survived in fragments, confirms the findings of other studies. If economic prosperity is measured by the capacity of import, which had to be balanced by export, then Banganarti enjoyed a golden age between the seventh and tenth centuries. It was then that the most significant amount of glassware flowed in. Imports from afar were necessary because local production was insignificant. A surprise was the relatively large number, ten fragments, of windowpanes. Previously only one fragment of a windowpane had been recognised.

Since our stay in Banganarti, we have maintained an interactive dialogue and cordial relations with the local community. After constructing the museum with its cinema hall, we managed to increase the attractiveness of these meetings with films made during the excavations. (**Fig. 5**) After the last meeting on 2 March 2020, a delegation of Tanqasi (the administrative name of Banganarti)

residents unexpectedly presented me with a framed diploma. It was written in English that leaves a lot to be desired in terms of grammatical correctness. However, it would have lost its authenticity and sincerity if it had been proof-read and edited like the other texts in this volume. In its original content and form it is, let us admit, a touching "diploma of appreciation" addressed to a certain Bogdan Zarafosky. Although the name suggests that the authors had me in mind, however, the praises and paeans contained in the text clearly do not concern me. I took the liberty of enclosing this document because it is an expression of gratitude and appreciation for my collaborators in the field and at the Institute of Mediterranean and Oriental Cultures of the Polish Academy of Sciences in Warsaw.



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Oblique aerial photograph of Banganarti (in the middle) and its surroundings, looking upriver towards Old Dongola seen in the upper right (Photo Roman Łopaciuk)

The People of Banganarti

Adam Łajtar

Abstract:

The paper gives the characteristics of the public of the upper church at Banganarti using the data contained in the visitors' inscriptions, which are found on the church walls. The author discusses the onomastics of the visitors, their geographic origin, social standing, and the titles of offices held by them in either state or Church structures. Finally, these characteristics are considered against the broader background of the social and cultural history of Makuria in the period corresponding with the functioning of the upper church at Banganarti (eleventh–fifteenth centuries).

Keywords: Christian Nubia, Kingdom of Makuria, Banganarti, pilgrimage, graffiti, onomastics, Christian Nubian society.

The title of the paper is somewhat misleading. It suggests that the paper will deal with the people who inhabited the fortified site of Banganarti, whereas I intend to write only about the people who are mentioned on the wall inscriptions in the so-called upper church of Banganarti.¹ Among those people indeed were inhabitants of Banganarti, but also visitors coming from nearby or more distant areas of the Middle Nile Valley. In that sense, this paper will deal with the society of the Christian Kingdom of Makuria during the period of functioning of the upper church, and, more precisely, the part of this society to which the visitors to Banganarti belonged.

The upper church at Banganarti was most probably built in the second half of the eleventh century.² It featured a central plan inscribed within a square with sides of 25 m (**Fig. 1**). The centre of the square was a vast space covered with a dome reposing on four massive piers consisting of a pillar with two engaged columns. This central, tabernacle-like element was surrounded by a series of small rooms or chapels: seven in the east row, five in the west row, and four in the north and the south rows. Rooms of the eastern row terminated in apses; the remaining ones were square in plan. Porticos were attached to the church from north, west and south. The church was accessible from the porticoes through transitional Rooms 11, 19 and 15.

The upper church was constructed partly on the ruins of the so-called lower church that existed between the late sixth and the early eleventh centuries³ and partly on the surrounding dunes. This caused instability of construction and necessitated repairs and modifications during the period when the church was in use. The first modifications took place early in the first half of the eleventh century and consisted of blocking spaces between the columns of the western portico and closing the western entrance. Another modification, structurally the most important, occurred in the second half of the thirteenth century and involved covering the tops of the walls separating the rooms around the central space with massive mud-brick pillars. In addition, numerous spots in the church received a new layer of plaster on that occasion, and the floor, which had caved in numerous places, was levelled out with a layer of unbound bricks and stones laid on a sand bed. At approximately the same time, screen walls were constructed in the apses of Chapels 5 and 6, thus giving them the shape of regular rectangles. The last element of change was introducing blockages between the eastern piers of the central space and the walls separating, respectively, Rooms 7 and 8 on the northern side and 1 and 22 on the southern side.

The church was rich in painted decoration, which came into being successively from the late eleventh until as late as the end of the thirteenth / beginning of the fourteenth century.⁴ The most characteristic element of the decoration were representations of a Makurian king (or rather, kings) under the protection of an archangel placed among the apostolic college, decorating all seven chapels of the eastern row.⁵ Other representations include Jesus with doubting Thomas, the saint

1 For the fortified site of Banganarti, excavated by the Polish Joint Expedition to the Middle Nile under the direction of Bogdan Żurawski since 2001, see ŻURAWSKI 2014: 90–105.

2 For the upper church at Banganarti, see ŻURAWSKI 2014.

3 For the lower church at Banganarti, see ŻURAWSKI 2012.

4 For the painted decoration of the upper church, see ŻURAWSKI 2014: 121–215.

5 For the portraits of the kings of Makuria in the eastern chapels of the upper church at Banganarti, especially with regard to their chronology, see WOŹNIAK 2016.



Fig. 1
Plan of the upper
church at Banganarti.
Drawing Roman
Łopaciuk

anargyroi Cosmas and Damianos, Mary with Child, individual representations of saints and (arch)angels, portraits of kings and bishops, and an ornamental cross.

The church was most probably dedicated to the Archangel Raphael, considered an intermediary between humans and God and a helper of men in all troubles, including health problems. Bogdan Żurawski believes that miraculous healings were procured in the church by the Archangel through the medium of incubation: the sick person sleeping in the church in the expectation of a dream appearance of the supernatural healer. Another aspect of Raphael's cult practised in the church was the patronage over Makurian kings, both living and dead. At least one king of Makuria was buried here, as shown by an epitaph in Greek that, although found

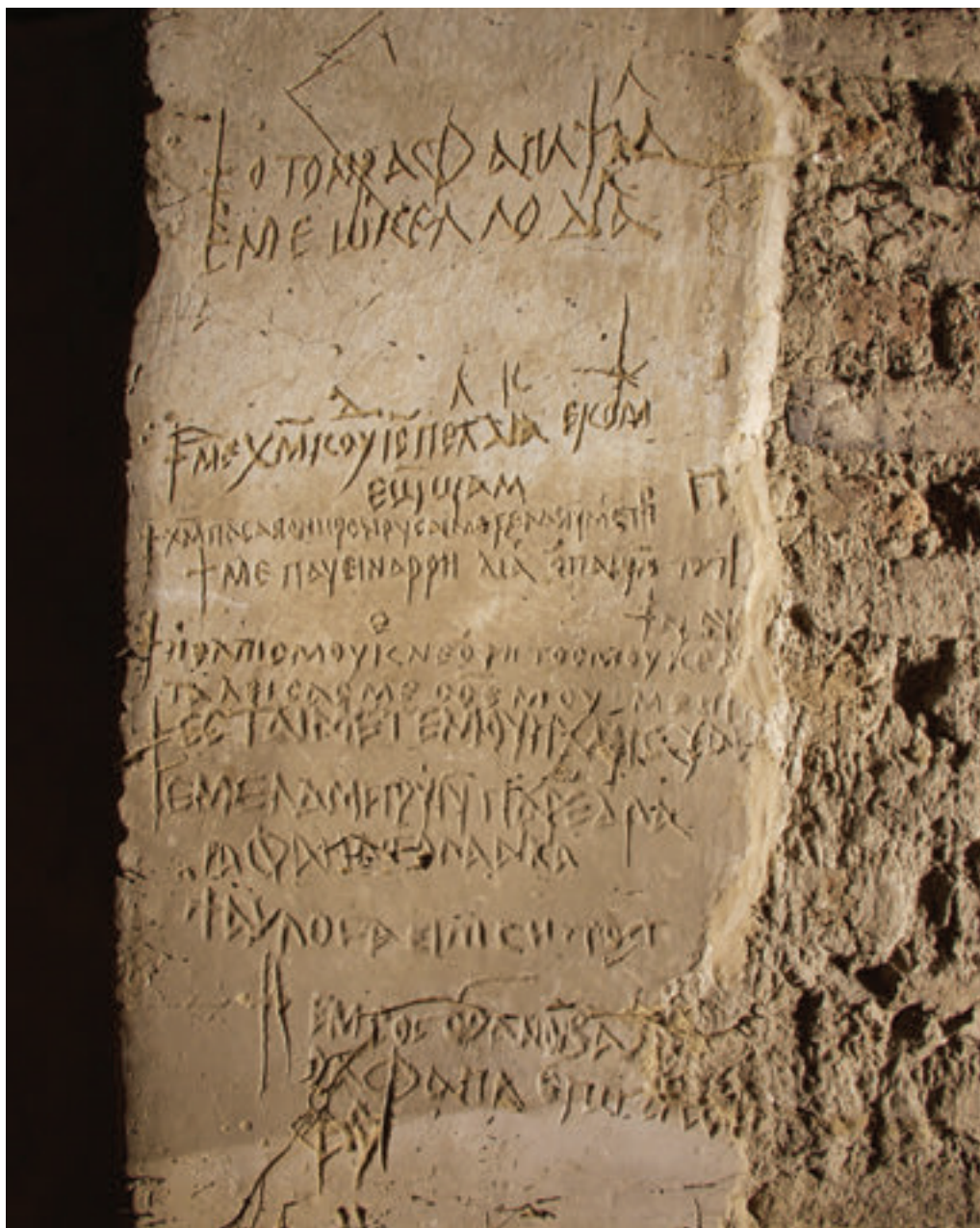


Fig. 2
Inscriptions on the west
side of the entrance to
Room 21. Photo Bogdan
Żurawski

in a secondary context, could not have been brought from afar.⁶ Żurawski supposes the church also boasted some important relics displayed to believers on an *analogion* situated in the middle of the central space, under the dome.

The church continued to function without interruption as a cult place until approximately the end of the fifteenth century, even if some architectural elements (e.g. the dome) might have been in ruins during the last stage of its use.

The church walls carry an unusually large number of inscriptions left by visitors who frequented this cult place.⁷ My documentation of the inscriptions,

⁶ For this epitaph, see ŁAJTAR 2003: 169–174. The king commemorated in the epitaph was probably named David. It might be the David who occupied the throne of Makuria in the mid-eleventh century (until c. 1155).

⁷ For a complete publication of the inscriptions, see ŁAJTAR 2020.

Fig. 3

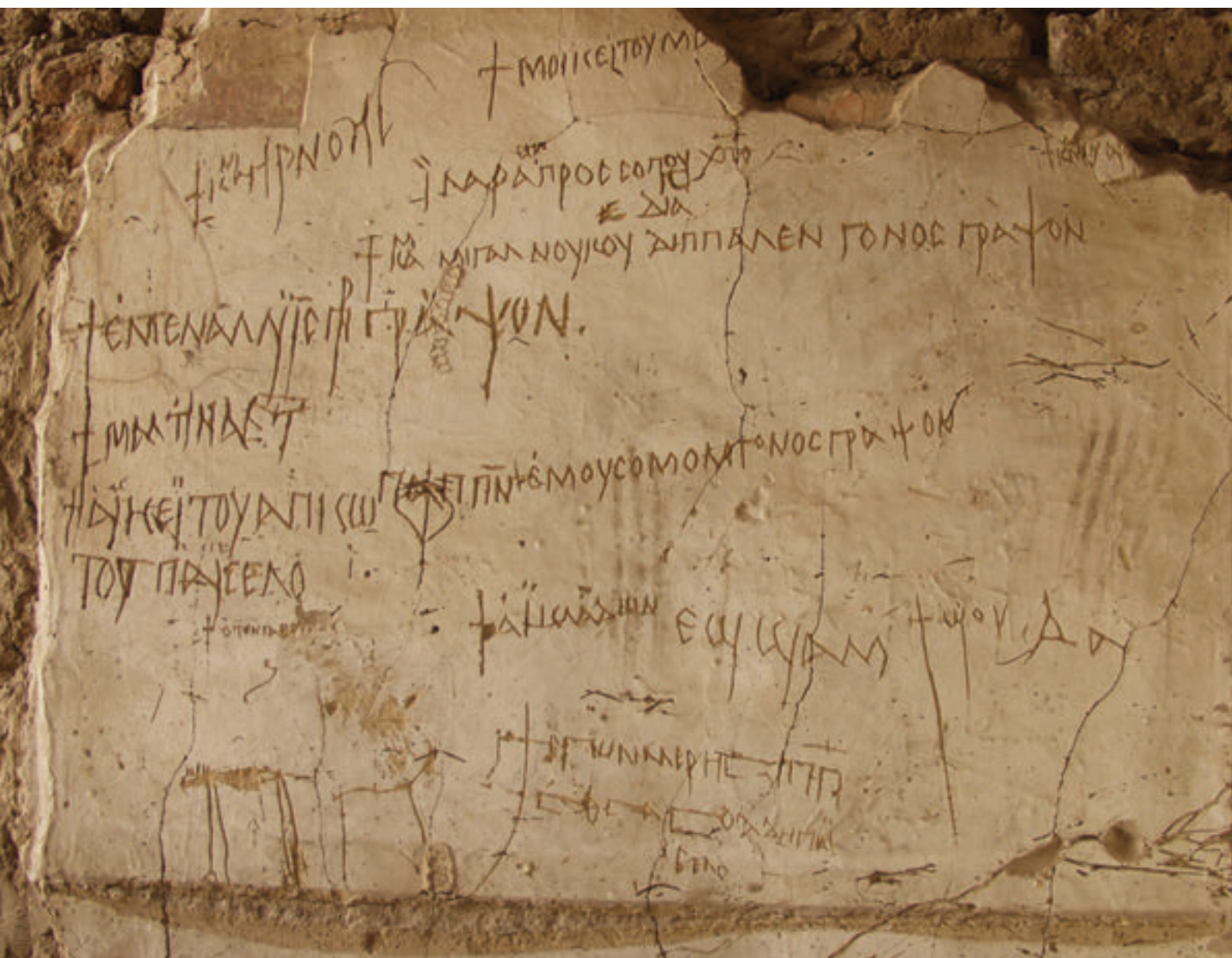
Inscription on the east face of the north-western pier and the neighbouring blockage. Photo Bogdan Żurawski



carried out between 2002 and 2006, revealed 957 items.⁸ Originally the number of inscriptions was certainly much greater and might have even approached 2,000. Some inscriptions became invisible during the functioning of the church, being covered by a new layer of whitewash (see below); others were lost in the destruction of the architectonic substance postdating abandonment of the church.

Inscriptions are found in the entire internal space of the church and also in the external porticoes. In some areas, e.g. pillars at the entrance to chapels (Fig. 2), central piers with neighbouring blockages (Fig. 3), and sidewalls of some secondary rooms (east wall of Room 21, north wall of Room 14, south and north walls of Room 13 (Fig. 4), west and east wall of Room 11), inscriptions occur close to one another,

⁸ In addition to visitors' inscriptions, there are ten inscriptions belonging to the original 'decoration' of the church. These inscriptions are not discussed in this paper.



densely covering the most desirable space, which is a band c. 1 m high at eye level. In some areas, a kind of system can be observed. One would have started in the upper left-hand corner of the available surface and continued with new inscriptions to the right and downward, attempting not to cross over already existing texts. When the area was completely covered with inscriptions, it was whitewashed, thus refreshing the surface for further writing. For these areas, one can speak of a true 'graffiti industry' connected with the pilgrimage to the church.

With the exception of a very few items executed in black paint, the inscriptions were scratched with a sharp tool into the plaster covering the walls of the church, i.e. they are graffiti in the proper sense of the word. The letters of the inscriptions are majuscules, mostly round and inclined to the right, resembling the so-called Nubian-type majuscules, sometimes upright, close to the epigraphic majuscules. The language of inscriptions, when identifiable, is Greek and/or Old Nubian.

Fig. 4

Inscriptions on the south wall of Room 13. Photo Bogdan Żurawski

A common phenomenon is code-switching, which is 'the use of more than one language in a single communicative episode'.⁹ Mainly, it occurs in inscriptions constructed following the pattern: 'I, so-and-so, wrote (this)' (for the form of inscriptions, see below). In them, the personal pronoun (the subject) in one language (Greek ἐγώ, Old Nubian ḏī, ḏīoγ) may be connected with a verb form (the predicate) in another (Greek ἔγραψα, Old Nubian πᾱίσελο). Two inscriptions are in Arabic, one written in Arabic script and the other in the Greek alphabet, and one probably in Coptic. Strangely, there is also one graffito inscribed with Latin minuscules with Gothic elements in a Romance language, probably Langue d'Oc. It testifies that the church at Banganarti was visited by someone who came from the area of present-day southern France.

As far as the form of inscription is concerned, several types can be distinguished. The simplest inscriptions consist of only the name of an individual, sometimes enriched by additional elements of personal presentation, such as the name of the father, place of origin, official title(s), etc. More complicated items add the personal pronoun 'I' before the name. Further development of the latter type produced inscriptions according to the pattern 'I, so-and-so, wrote (this)'. Instead of 'I wrote', other predicates, such as 'I carved', 'I set this up' or 'I was (here)' may occur, even if very rarely. An exciting variant of the 'I' inscriptions is found only in Greek texts. Some have καγώ, 'also me', instead of ἐγώ, 'I', obviously referring to the texts already existent at a given spot. Some inscriptions are constructed as prayers in the name of their authors. A large and rather significant group of inscriptions shows a bipartite composition, in which a presentation of the author, whatever its form, is combined with another, independent text, as a rule of literary character. Finally, one must mention inscriptions lacking information about their authors. This rather heterogeneous group includes names of holy figures, probably functioning as invocations, acclamations, and prayers.

The oldest inscriptions in the upper church at Banganarti may be dated to the first half of the twelfth century. They are found on the columns and pillars of the western portico, which were enclosed during the first attempt to improve the stability of the church. Isolated items occurring on the first layer of plaster in different parts of the church may come from the second half of the twelfth and the first half of the thirteenth centuries. However, most inscriptions which came into being in the 'graffiti industry' frame discussed above can be dated to the end of the thirteenth and the first half of the fourteenth centuries. This date is suggested by the archaeological context of the inscriptions: they occur on structures which were added during the last rebuilding of the church in the second half of the thirteenth century, and respect the existence of the latest paintings. It is confirmed by the mention in several inscriptions of King Siti, of whom we know that he ruled over Makuria in the thirties of the fourteenth century (see below).

The function of the inscriptions is obviously leaving an everlasting memento of an individual in front of God. They may be designated as private prayers to which the written format grants permanence. They perpetuate an individual before the divinity to establish his/her eternal worshipful presence in the cult place and ensure that he/she will be granted God's blessing.

⁹ HELLER 1988: 1.

The large number of visitors' inscriptions in the upper church at Banganarti and their high technical and formal standards raise the question of the authorship of the inscriptions: were they the work of the individuals mentioned in them, or were they made by someone else? It is my impression that the latter situation occurred more often. It must have happened mainly in the case of longer texts, displaying an elaborate composition and sophisticated language, and those executed in paint. They must have been inscribed by professionals, most probably clerics attached to the cult place in Banganarti. On the other hand, the persons commemorated by the inscriptions might have executed only simple graffiti (in the proper sense of the word), containing just proper names. Even if this was so, the essential fact remains unquestionable: for reasons unknown to us, Christian Nubians, especially those living in the thirteenth and fourteenth centuries, were eager to communicate their religious sentiments in casual inscriptions left in a cult place or, in other words, Christian Nubia in this late period knew the phenomenon of 'epigraphic habit' as defined by the American historian Ramsay McMullen.¹⁰

Already a cursory presentation of the formal side of inscriptions offered above clarifies that most texts contain some elements of the personal presentation of their authors. These data mainly referred to the authors themselves, more rarely to third parties somehow related to the authors and mentioned as a point of reference: fathers or even grandfathers, immediate superiors, and people of rank worthy of mention for this or another reason. All those people are the 'people of Banganarti' expressed in the title of this paper.

In order to answer the question 'Who were these "people of Banganarti"?', one must first look at their onomastics.¹¹ The collection of inscriptions in the upper church at Banganarti contains 297 names preserved either entirely or to a degree that allows us to establish their formation or linguistic affiliation. Another 104 names are preserved so fragmentarily that reconstruction is impossible; these defective names are omitted from further consideration.

The names occurring in the Banganarti inscriptions can be divided into two groups with respect to their origin: (1) Greek, including Biblical, names; (2) Nubian names, including morphologically Nubian names containing Greek (Biblical) elements. The two groups are unequal in number: Nubian names are much more numerous than Greek.¹² In other words, the onomastics of the community frequenting the upper church at Banganarti is dominated by the local cultural element. This invites the conclusion that the society to which the visitors to Banganarti belonged was tightly bound to its African roots (substrat) in spite of the influence exerted by the Christian cultural tradition (adstrat).

The Nubian onomastics of the Banganarti inscriptions shows some interesting peculiarities. This is clearly visible when one compares the Nubian names of the 'people of Banganarti' with the Nubian names of the people appearing in the Old Nubian documents from Qasr Ibrim, originating from approximately the same time as the Banganarti inscriptions.¹³ The two onomastic collections are

¹⁰ MACMULLEN 1982.

¹¹ For a full discussion of names occurring in the Banganarti inscriptions, see ŁAJTAR 2020: 62–65.

¹² The exact ratio is difficult to establish due to uncertainties as to the function of some names (either personal names or place names) and their linguistic affiliation.

¹³ The documents in question are: BROWNE 1989: nos. 22–29; 1991: nos. 30–62; RUFFINI 2014: nos. 63–124. For important observations and corrections to the onomastic material from Qasr Ibrim, see OCHALA 2019.

totally different from one another but for a few names in common. On the other hand, the names from the Banganarti inscriptions recur in Dongola, especially in visitors' inscriptions in the newly discovered North Church within the monastery on Kom H.¹⁴ Obviously, the onomastic repertoires from Qasr Ibrim and Banganarti represent two different cultural traditions: the Nobadian, connected with the use of Old Nobiin as the spoken language, and the Makurian, associated with the spoken Old Andaandi (Dongolawi).¹⁵

The most characteristic trait of the Nubian onomastics of the 'people of Banganarti' is the frequent occurrence of compounds with -*νογκογτ* as the second element, such as *ιηκογνογκογτ*, *μαριννογκογτ*, *τοσκοννογκογτ*, *τιρνογκογτ*/*τιλνογκογτ*, *τογνογκογτ*, *λογλνογκογτ*, *μιγαλνογκογτ*, *διανογκογτ*. *νογκογτ* is most probably an Old Andaandi word for 'servant, slave', a forerunner of the Modern Andaandi *núgud*, '(male) slave'.¹⁶ Names with -*νογκογτ* are probably a Dongolan counterpart of the much more widespread names ending in -*κογδα*, Nobiin for 'slave, servant',¹⁷ which also occur at Banganarti (and Dongola), probably as an 'import' from the north, from the area where Old Nobiin was spoken. One of the names mentioned above – *τιρνογκογτ*/*τιλνογκογτ* – has the element -*νογκογτ* compounded with *τṛ*-/*τḷ*-, perhaps the Old Andaandi word for 'God', which in Modern Andaandi is replaced by *artii*.¹⁸ The word *τṛ*- may also appear in *τṛκολ*. Several other names can be identified as using Old Andaandi lexical material. The name *αριψοῖ* most probably equates to the Old Andaandi word for 'small bead, especially for necklaces and bracelets' (Modern Andaandi *ariñče*).¹⁹ The personal name *μασḷ* may preserve the Old Andaandi word for 'sun' (*masil* in Modern Andaandi and Matokki [Kenzi]). The name *μαλτιḡαεῖτ* could be derived from *malt(i)*, which in Modern Andaandi means both 'east, right bank of Nile' and 'runnel, irrigation channel for water brought up by water-wheel'.²⁰ *πογττο* is probably the same as *búgdo*, attested in Modern Andaandi as 'potter' and 'large upright post supporting the cross-beam of a water-wheel'.²¹ Another peculiar trait discernible in the Nubian onomastics of the 'people of Banganarti' are names constructed according to the pattern: stem (mostly, if not exclusively, verbal) + -*οεα*, -*αεα*, -*εεα*, -*ιεα* (*αγλοεα*, *ἀφοεα*, *γογρρωεα*, *παροεα*, *κιεαεα*, *κιεεεα*, *μεννεεα*, *γορρεα*, *γογλλεῖα*, *εἰḡαεα*, *ωογḡαεα*). The element -*οεα* (-*αεα*, -*εεα*, -*ιεα*) is morphologically unclear, and the meaning of the names constructed with it is unknown; perhaps they should be understood participially: 'The one who saves', 'The living one', 'The rejoicing one', 'The writing one', etc. Whatever the meaning of these names, they are little known outside of Banganarti and Dongola, suggesting they belong to the local onomastic repertoire. The same holds for the names *παπερ*,²² *επραφ*, *Δογρερη*,²³ and *κερτι*/*κερτη*.

14 Unpublished material known to me from personal examination.

15 For the linguistic situation in Christian Nubia, especially the relationship between spoken and written languages, see most recently ŁAJTAR, OCHALA 2020.

16 ARMBRUSTER 1965: 157, s.v. *núgud*.

17 For names with -*κογδα*, see SATZINGER 1992.

18 See commentary in ŁAJTAR 2020: no. 70.

19 ARMBRUSTER 1965: 19, s.v. *ariñče*. The name *α(ρ)πιψοῖ* has been attested on a late ostrakon found in the citadel of Dongola; for its publication, see ŁAJTAR, VAN DER VLIET 2011.

20 ARMBRUSTER 1965: 136–137, s.v. *malt(i)*.

21 ARMBRUSTER 1965: 41, s.v. *búgdo*.

22 Note that *Paper* was the name of a 'Small King of Dongola town' as explicitly stated in two inscriptions mentioning him, namely ŁAJTAR 2020: nos. 64 and 67.

23 The name *Δογρερη* is attested in the Qasr Ibrim documents; however, it appears there mostly in royal



Fig. 5
Inscription of Ali accompanied by representation of a pilgrim.
Drawing Adam Łajtar

The above observations lead to the conclusion that, for the most part, the public of the upper church at Banganarti originated from Dongola and its nearer or wider locale, including Banganarti itself.

Greek names of the ‘people of Banganarti’ are just as interesting as the Nubian ones. In addition to names common in the entire Christian world (Biblical names, names of Christian saints) and Christian names proper to Nubia (compound names with the element -φόρου [= φόρος], such as Ἀγγιμουφόρου [perhaps a corruption of Ἀγγελοφόρου], Γαβριηλφόρου, Θεουφόρου, Ἰησουφόρου, Μαρτυροφόρου, Ραφαηλφόρου, and Φόρου [perhaps a shortened form of one of the names from the above list]), one has a group of names that are rare or even unattested outside Banganarti. The group includes such names as Ἀγαπος, Δόξος, Κλάδων, Πένης, Πτωχός, Ράβδων, Σέλας, and Ζωόδοτα. None of these names carries a clear Christian stamp, although all may be interpreted in a Christian way. Their rarity and sophisticated character is testament to the high cultural standards of the society to which their bearers belonged.

In addition to Greek and Nubian names, the onomastics of the ‘people of Banganarti’ contains several names recognisable as Arabic. Here one should

protocols, meaning it belongs to people from Dongola.

mention first of all ἀλῖ (*Alī*) on record in an Arabic inscription in Greek letters belonging to the earliest stratum of the Banganarti epigraphic production (**Fig. 5**).²⁴ Further on, one can cite: ἀλατῖ (*Alā al Dīn*), λογογῑρρατῖ (*al-ḥuḡḡiratī*), and σογκῑ (*Šukrī*), perhaps also ἰλαλ (*Hilāl?*), ἰλαλῖ (*Ḥālid?*), ἰλαναλ (*Ḥanzala?*), ἰσῑαμ (*Hišām?*), and γαῑκογῑ (*Ġayṭān?*). Also, ἀλλαῖνῑτ and ἐλλενῑλ could be Arabic names given the initial ἀλλα- (transcription of *Allāh*, 'God?') and ἐλ- (transcription of the definite article *al?*) respectively. Finally, one might note that the name λογῑνογκογῑτ may have the Old Andaandi word -νογκογῑτ compound with transcription of the Arabic *al-'ūd*, 'oud', and ἀπῑαῑῑ the Nubian formant -ῑῑ added to the Arabic noun '*abd*, 'servant' (unless it is a transliteration of '*Abd 'Īsā*, 'Servant of Jesus'). Among bearers of Arabic names, only Ali was a Muslim, the others being members of Christian Nubian society as is suggested by crosses at the beginning of the inscriptions left by them. In addition, the bearer of the name ἰλαναλ was a queen mother, ἰσῑαμ and ἀλατῖ were members of the clergy, and λογογῑρρατῖ had both a father and a son bearing Nubian names. These people were either Arabs or Arabic-speakers who converted to Christianity, or Christian Nubians whose parents had given them Arabic names, the latter being much more probable. By accepting this possibility, one must conclude that Arabs and/or Arabic-speakers were a significant element of the ethnic landscape of the Middle Nile Valley in the period corresponding to the functioning of the upper church at Banganarti, and they were important enough to influence the onomastic patterns of its Christian Nubian inhabitants.²⁵ Most probably, the presence of Arabs in the Middle Nile Valley also accounts for the personal name σογλογ, equivalent to the ethno-occupational designation *sulu*, referring to an endogamous group or caste with an Arab share, whose members specialised in the leather industry, which they practised as transient workers.²⁶ The name λογογῑρρατῖ, transliterating a geographical *nisba* known in Yemen, suggests that the Arabic-speaking community in Nubia was at least partially formed by people having South Arabian origins, who reached Sudan from the south through the Bab el-Mandeb straits and present-day Eritrea.

Toponomastics confirms the supposition that the people named in the Banganarti inscriptions originated for the most part from the Dongola area. Place names are rarely mentioned in the inscriptions.²⁷ The most frequently encountered toponym is τογῑρογῑ, sometimes spelled τογῑρῑλ, which, as I have demonstrated elsewhere, is most probably an indigenous Nubian name for Dongola.²⁸ Dongola is also mentioned under its Greek name Τιμικλεος.²⁹ In addition to τογῑρογῑ/τογῑρῑλ/Τιμικλεος, we come across ten or so place names, of which only Sai (σαῖ, ζαῑ), Faras (παχωρας), and Qasr Ibrim (ῑῑῑῑ) can be identified with certainty. The presence of people who were at home in the far north, in the territory of historical Nobadia, shows that the cult centre in

24 ŁAJTAR 2020: no. 952. The inscription is accompanied by a not-unskilled drawing showing a man with a stick and a pilgrim's bag, perhaps a portrait of Ali himself.

25 Arabic names are frequently on record in Old Nubian documents from Qasr Ibrim. They are currently being studied by Grzegorz Ochała.

26 WESCHENFELDER 2015.

27 For a full discussion of the toponomastic material on record in the Banganarti inscriptions, see ŁAJTAR 2020: 65–67.

28 ŁAJTAR 2013. The name τογῑρογῑ can be analysed as τογῑ-ῑ-ρογῑ, 'Place of the belly'. It apparently refers to the location of Dongola in the centre of the Kingdom or the well-defined region known as Debba Bend.

29 For the identification of Timikleos with Dongola, see ŁAJTAR 2015.

A close-up photograph of a weathered, light-colored stone surface. A large, stylized, carved letter 'A' is the central focus. The stone shows signs of significant wear, including cracks, pitting, and discoloration. The lighting is bright, casting shadows that emphasize the texture and the three-dimensional quality of the carving.

The image shows a close-up of a severely damaged, aged parchment or leather surface. The material is heavily textured with numerous scratches, tears, and stains, giving it a mottled brown/tan appearance. Faint, handwritten text in a cursive script is visible, particularly in the upper right quadrant. The text appears to be in a historical language, possibly Greek or Latin, and is partially obscured by the damage. The overall condition is one of extreme age and wear.

Fig. 6

Inscription of King Siti
on the south side of the
entrance to Chapel 6.
Photo Bogdan Żurawski

Fig. 7

Inscription of Paper,
'Small King of the
Dongola Town', on
the west wall of Room
11. The inscription is
accompanied by
drawing showing two
men on horseback,
perhaps illustration of
an event that involved
Paper. Photo Bogdan
Żurawski

Banganarti, even if serving mainly the local population, was known in wider circles of Christian Makurian society. The validity of this observation is not weakened by the fact that all visitors from the north were local officials and could have visited Banganarti on the occasion of their business trips to the capital town of Dongola.

An interesting phenomenon is the quasi-absence of women among the 'people of Banganarti'. There is only one person who can securely be identified as a woman,³⁰ namely a queen mother with the Arabic (?) name $\Delta\text{N}\Delta\Delta\Delta$ mentioned in an inscription on the east wall of Room 11.³¹ In addition, the female sex can be ascribed tentatively to only two further individuals: a person with the name $\alpha\pi\pi\upsilon\phi\delta\iota$ already mentioned above as a representative of the local onomastic stock, as this name, considering its semantics, looks female rather than male, and a certain $\text{no}\pi\pi\epsilon$, the protagonist of an inscription on the east wall of Room 8, because of the prayer addressed to Mary for the birth of a powerful son contained in the text.³² Women are absent from visitors' inscriptions not only at Banganarti but also other cult centres all over Nubia, including the rocky sanctuary of Gebel Maktub near Qasr Ibrim, the Faras cathedral, the church at Sonqi Tino, and the monastery on Kom H at Dongola with its annexes. This invisibility of women in religious contexts is surprising as women occupied a high social position in Christian Nubia, as is demonstrated by legal documents in Old Nubian originating from Qasr Ibrim.³³ It cannot be explained through the lower degree of literacy among women than men, as women could have always asked literate males to write inscriptions for them. Apparently leaving a written memento of one's visit to a cult place was only a men's custom in Christian Nubia.

Concerning the social structure of the 'people of Banganarti', all strata of Christian Makurian society are represented, from commoners to kings. Four kings are mentioned by name: David, Ioêl, Siti, and Paper. The first two are referenced only indirectly: David in a prayer authored by a certain Arouase,³⁴ and Ioêl in the presentation of his official (name not preserved).³⁵ Two other kings are the protagonists of inscriptions, which means they visited the Banganarti cult place in person.

30 It should be observed that the identification of women in the epigraphic material at Banganarti (and in visitors' inscriptions from Nubia in general) is highly impeded by linguistic phenomena. Old Nubian did not know the category of grammatical gender, which means that the sex of a person is not recognisable on the basis of grammar. Neither are personal names of help in the identification, for the same names could have been borne by both sexes. The only secure way of identifying women is through lexical terms relating to them ('mother', 'daughter', 'sister', etc.).

31 LAJTAR 2020: no. 44. Note the inscription may also mention a king with the name Akdeskol (see below).

32 LAJTAR 2020: no. 108.

33 RUFFINI 2012: 126–127.

34 LAJTAR 2020: no. 570. King David is also recorded in two inscriptions belonging to the original 'decoration' of the church: the titulus of the painting of Jesus with doubting Thomas on the eastern wall of Room 21 (LAJTAR 2020: no. 667) and an inscription of an unknown character painted in black in a very formal hand on the southern face of the southwestern pier (LAJTAR 2020: no. 933). It is further possible that he was the donor of the painting of a king on the southern wall of Room 1, as may be inferred from the accompanying inscription (LAJTAR 2020: no. 515). We are aware of two kings of Makuria with the name David. The first occupied the throne in Dongola in the mid-twelfth century, the second ruled at the end of the 1260s and the beginning of 1270s. It is probably the earlier of these two Davids who is at issue in all these inscriptions.

35 LAJTAR 2020: no. 584. Note that the preserved part of the inscription does not contain explicit information to the effect that Ioêl was a king. His royal status may only be guessed from his name being a modifier for the term *epirshil*, which seems to designate a royal official (see below). We are aware of two Makurian kings with the name Ioêl. One ruled Makuria in the last years of the thirteenth century or the first years of the fourteenth century, another in the second half of the fifteenth century. For references, see LAJTAR 2020: commentary to no. 584. The Ioêl in the inscription under consideration should probably be identified with the earlier Ioêl. The later Ioêl ruled over Makuria restricted to the area around the Second Cataract, which makes his presence in Banganarti problematic.

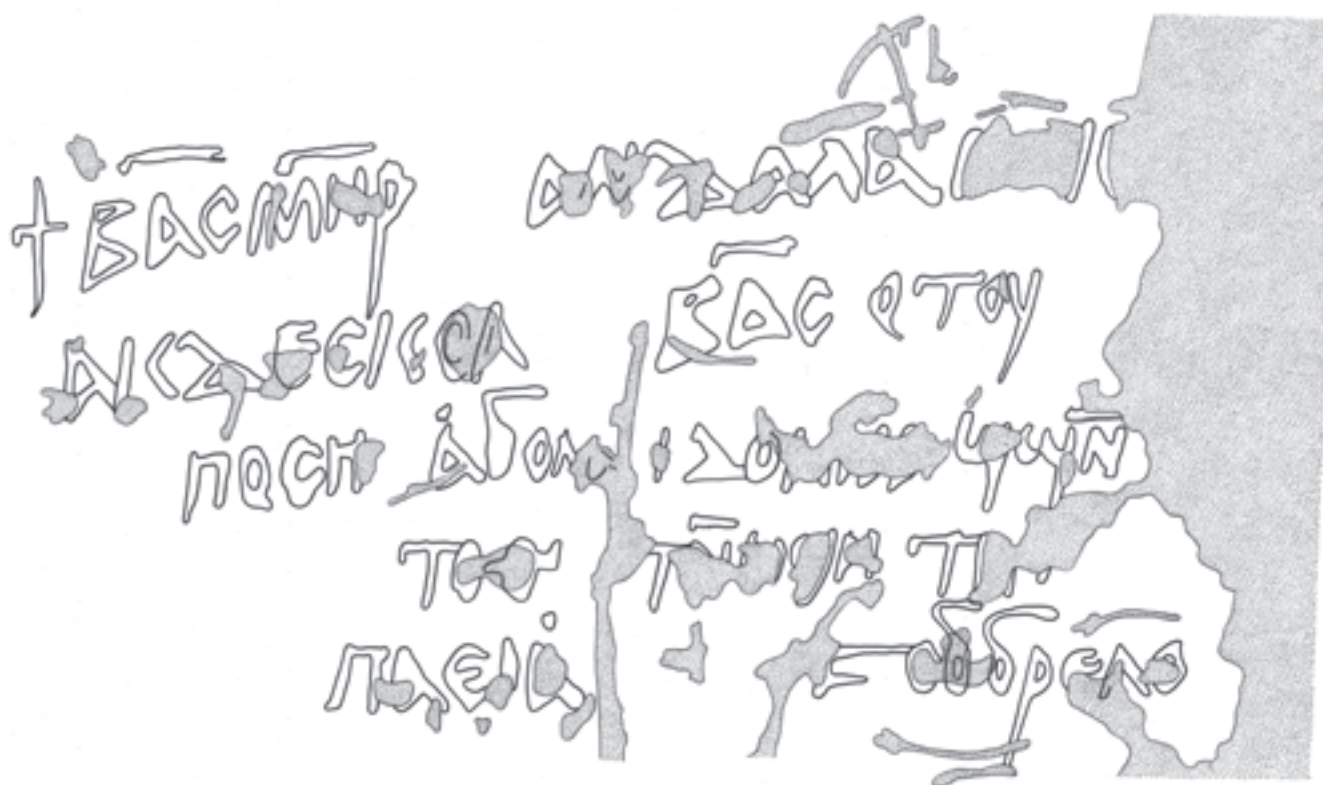


Fig. 8
Inscription on the
east wall of Room 11
with the mention of
King (?) Akdeskol and
Queen Mother Andala.
Drawing Adam Łajtar

A very modest inscription of Siti reading $\sigma\tau\tau\iota \sigma\upsilon\pi\sigma\upsilon$, ‘King Siti’, perhaps executed with his hand, is located in the lower part of the pillar at the entrance to Chapel 6 (Fig. 6).³⁶ Siti is also a point of reference in two inscriptions of his official Dourerê,³⁷ and appears, in an unknown context, in an inscription of another man.³⁸ Siti is listed as King of Dotawo (= Makuria) at the head of the protocols of two legal documents in Old Nubian dating from the 1330s found at Qasr Ibrim.³⁹ He is on record in a graffito on the rocks of Abu Negila in northern Kordofan⁴⁰ and a dipinto in the church at Sonqi Tino.⁴¹ He is reportedly also mentioned in two Arabic (?) documents seen and perhaps discovered at Edfu in Upper Egypt.⁴² From these sources, one may infer that Siti was king of a still-undivided Makuria, occupying waste tracts of land in the Middle Nile Valley, and that he was still Christian when the royal house of Makuria was partly Islamised.

Paper is the protagonist of three inscriptions, of which two are located in close proximity to each other in the southwestern corner of Room 11 (Fig. 7),⁴³ and

³⁶ ŁAJTAR 2020: no. 276. One wonders if the modesty of the inscription is not an expression of the modesty of the king in front of God. Occasionally, the modesty of a believer towards the supernatural is expressed explicitly by a replacement of one’s name with the anonymous formula ‘whose name God knows’ (thus in inscriptions ŁAJTAR 2020: nos. 416 and 853).

³⁷ ŁAJTAR 2020: nos. 9 and 554.

³⁸ ŁAJTAR 2020: no. 99.

³⁹ RUFFINI 2014: nos. 66 and 68.

⁴⁰ OCHALA 2011.

⁴¹ Unpublished. The publication of this and other wall inscriptions in the church at Sonqi Tino is in preparation by an international team headed by Vincent Laisney.

⁴² MONNERET DE VILLARD 1938: 220.

⁴³ ŁAJTAR 2020: nos. 64 and 67. The second of these inscriptions is accompanied by a (rather crude) drawing showing two men on horseback riding to the left. The man on the left probably holds a sword in his right hand and a round shield in the left that he rests on the back of the horse. The man on the right holds the reins in his hands. He wears a headdress resembling horns or a crescent. His horse is apparently being led



Fig. 9
Inscription of Douréré,
epirshil of the king, on
the arcade of the north
entrance to the church.
Photo Bogdan Żurawski

the third not very far from them on the southern engaged column of the north-western pier.⁴⁴ The first two inscriptions present Paper as *τοῦτοιοῦ πόλεως βασιλεὺς βρέφος*. The term *βρέφος* found in Paper's presentation is puzzling. It means 'babe in the womb, foetus', 'newborn babe', but it is rather improbable that it has the same meaning here. It is my impression that it is a counterpart of the Nubian *nek-*, which primarily meant 'to be small',⁴⁵ but was also used as the title of rulers of petty kingdoms that emerged in the Middle Nile Valley after the fall of the once-great Makuria. Providing this reasoning is correct, Paper, 'Small King of Dongola Town', should be regarded as a ruler of one such kingdom, centred in the north part of the Debba Bend around the former capital of Makuria, and known to have existed until the beginning of the nineteenth century. Therefore, he should probably be placed somewhere in the second half of the fourteenth or the first half of the fifteenth century, not long after the creation of this kingdom. Interestingly, like kings of Makuria preceding him, he was Christian, and maintained contact with the local holy place in Banganarti that played such an important role in Makurian royal ideology.

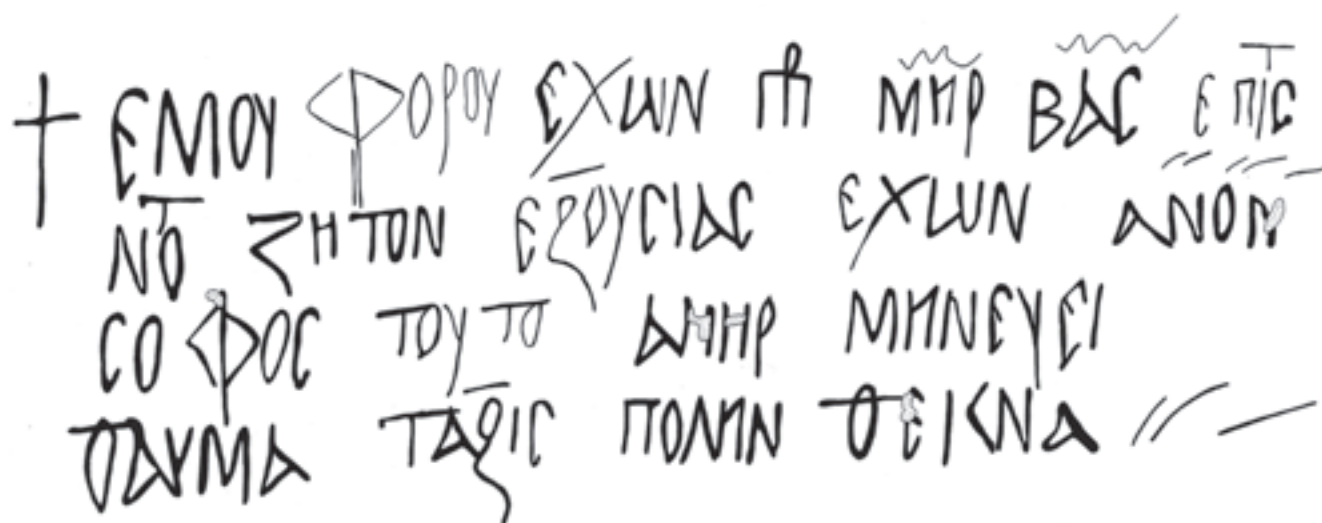
An inscription on the west wall of Room 22 has the words *μαρτυροφωρῶ*, 'Martyrophoros', and *οἶνον*, 'King', positioned near one another.⁴⁶ Given the hopelessly entangled syntax, it cannot be ascertained whether the text spoke about a king with the name Martyrophoros. If yes, Martyrophoros supplements

on a tight rein by the man on the left. It is tempting to recognise the portrait of Paper in one of the riders, perhaps the one on the right. For the drawing, see also Żurawski 2014: 179–180, with fig. 9.

⁴⁴ ŁAJTAR 2020: no. 886.

⁴⁵ BROWNE 1997: 114, s.v. *nek-*.

⁴⁶ ŁAJTAR 2020: no. 635. It should be observed the inscription neighbours a painted portrait of a king whose identity cannot be established due to lack of a caption. For this mural, see Żurawski 2014: 213.



royal Makurian *fasti* of the late thirteenth and early fourteenth centuries. An inscription on the east wall of Room 11 displays the sequence ακδεσκολ βασιλεύς, 'King Akdeskol' (Fig. 8).⁴⁷ Here again, the context is too unclear to assume the existence of an otherwise unknown king Akdeskol. The same inscription mentions a queen mother with the name Andala. An unnamed queen mother is on record in two inscriptions left by the same man, a certain Outi, who presents himself as a 'deacon of the queen mother'.⁴⁸ Under 'deacon', one should probably understand 'steward', a layman fulfilling ancillary services by the side of a royal woman, and not a Church official.

The circle of royal officials is represented by *epirshil* (ἐπῤῃλ) and the epistolary scribe of the king (βασιλέως ἐπιστολογράφος). The office of *epirshil* is attested for the first time in the Banganarti inscriptions, and its nature is entirely unknown to us except for the fact that it was related to the king. Of the two *epirshils* on record in the Banganarti epigraphic material, one, named Dourerê, had King Siti as his superior (Fig. 9),⁴⁹ the other (name not preserved) was subordinate to King Ioêl.⁵⁰ The office of the epistolary scribe of the king was held by a certain Phorou (= Phoros), the protagonist of an inscription on one of the pillars in the western portico (Fig. 10).⁵¹ He combined this function with that of a priest, νοτάριος ζητῶν (= ζητούντων?), perhaps 'notarios of those who are searching for justice', and *thegna* of the Town (= Dongola). Obviously, his career, which developed in both Church and state structures, was based on his being a man of letters. Phorou appears to have had a very high opinion of himself, as he boastfully declares in his inscription that he acted wisely while exercising power over people, and calls himself 'marvel' (θαῦμα) and 'order' (τάξις). Another inscription in the western portico, authored by a certain Adelph(), was left [ὑπέρ] ἀναψύξεως νοταρίου μεγάλου, 'for the refreshment (i.e. eternal

47 ŁAJTAR 2020: no. 44.

48 ŁAJTAR 2020: nos. 462 and 772.

49 Dourerê is on record in two inscriptions, namely ŁAJTAR 2020: nos. 9 and 554.

50 ŁAJTAR 2020: no. 584.

51 ŁAJTAR 2020: no. 958. The name Phorou is suspect, as it is not attested elsewhere and is meaningless. Perhaps we are dealing with a hypocoristic of a compound name with -φόρος as the second element (see above).

Fig. 10

Inscription on one of the pillars of the western portico left by Phorou, apistolary scribe of the king. Drawing Adam Łajtar

rest) of the great *notarios*'.⁵² This 'great notarios', apparently an alternative for *archinotarios*, 'chief notary', coined under the influence of Old Nubian, was probably the Phorou discussed above. Also Papasa from the *titulus* of the painted representation of Jesus with doubting Thomas on the eastern wall of Room 21 was a royal official; however, only the initial Δ has been preserved from his title.⁵³ The character of the office of the eparch held by a certain Symeon, the protagonist of an inscription on the pillar between Rooms 20 and 21, is uncertain as this title was indicated without a modifying object.⁵⁴ Symeon could have been an official at either the central level (as eparch of the palace or protoeparch) or a local one (e.g. eparch of Nobadia). On the other hand, a *tricliniari(u)s* (ορχορ), the author of an inscription on the northwestern pier (name only partly preserved), was probably an official of the level below the central one, as the term ορχορ was modified by a place name in his case.⁵⁵ The same holds true for a 'potentiary' (ιρτι) on record in an inscription on the northeastern pier.⁵⁶

The level of the local administration yielded a considerable number of officials designated as τοτ, θερνα, or γόνος. These three terms are probably just language variants, respectively Old Nubian, Graeco-Nubian, and Greek, of the same office. τοτ/θερνα/γόνος is a common word meaning 'son, child'. When designating an office, it is modified by a place name or the word 'town', most probably referring to the local urban centre (Dongola in the case of the Banganarti inscriptions). These 'sons of the village/town so-and-so' were probably local administrators with duties resembling mayors in modern western societies or *sheikh al-balad* or *omda* in Sudanese society. Settlements administered by those people are primarily unidentifiable; they should probably be looked for in the Dongola Reach. There are also three 'sons' of Sai⁵⁷ and one 'son' of Qasr Ibrim (Silmi).⁵⁸

Other individuals frequently encountered among the 'people of Banganarti' are those designated as ρορτιεοααε (the spelling varies).⁵⁹ The compound ρορτιεοααε should probably be translated as 'lord of elders'. 'Elders' (ρορτι) occurring as a modifier in the designation ρορτιεοααε might tentatively be identified as chiefs of lineages or the most influential families in the Kingdom of Makuria. They apparently formed a corporate body, a kind of a council, headed by a 'lord' (εοαα). The relatively high number of 'lords of elders' suggests that there were many councils of this kind, perhaps organised on a geographical basis. Similar councils might have also accompanied the most important officials.⁶⁰ Some visitors bear the title of 'lord' without any further

52 ŁAJTAR 2020: no. 960. The abbreviated name Adelph() should probably be expanded as Adelph(ios).

53 ŁAJTAR 2020: no. 667.

54 ŁAJTAR 2020: no. 698. It should be observed the same Symeon is on record, with slightly different titles, in an inscription on the western wall of Room 8 of the church at Sonqi Tino.

55 ŁAJTAR 2020: no. 906.

56 ŁAJTAR 2020: no. 156.

57 ŁAJTAR 2020: nos. 295, 348, and 879. For the office of *tot / thegna* of Sai, see ŁAJTAR 2006: 94–101.

58 ŁAJTAR 2020: no. 257. Note that the man, named Nalsê, was also a priest.

59 They are on record in inscriptions ŁAJTAR 2020: nos. 36, 154, 359, 559, 573, 578, 580, and 655.

60 In fact, we are aware of the title 'Lord of King's Elders'. It is on record in a wall inscription in the North-Western Annexe of the Monastery on Kom H in Dongola commemorating a group visit of some important officials of the Makurian state (ŁAJTAR, VAN DER VLIET 2017: 36–38, no. XVI, ll. 7–8) and an inscription on a wall at Deir Anba Hadra (St Simeon's Monastery) near Aswan authored by Joseph, an archbishop of Dongola (?) (ŁAJTAR forthcoming). The first of these inscriptions probably dates from the 1270s, the second from 1322.

modification,⁶¹ or modified by another object than ‘elders’.⁶² These ‘lords’ are mysterious figures to us, with only one possible exception: $\alpha\lambda\epsilon\lambda\phi\omicron\iota\ \epsilon\omicron\alpha\lambda\lambda\eta$, literally ‘lord of brothers’, who might have been the head of a monastery.

Several individuals were men of letters. We have already encountered the epistolary scribe of the king ($\beta\alpha\sigma\iota\lambda\acute{\epsilon}\omega\varsigma\ \epsilon\pi\iota\sigma\tau\omicron\lambda\omicron\gamma\rho\acute{\alpha}\phi\omicron\varsigma$), who was also a $\nu\omicron\tau\acute{\alpha}\rho\iota\omicron\varsigma\ \zeta\eta\tau\omicron\nu$, undoubtedly a scribe even though the word modifying the term *notarios* to indicate the sphere of activity of this official is not fully comprehensible. Two other scribes are attested, of which one indicated his title in Greek ($\gamma\rho\alpha\mu\mu\alpha\tau\acute{\epsilon}\upsilon\varsigma$),⁶³ the other in Old Nubian (coḡntoḡṛe).⁶⁴ We also have a chief-scribe, $\acute{\alpha}\rho\chi\iota\nu\omicron\tau\acute{\alpha}\rho\iota\omicron\varsigma$, apparently the head of chancery.⁶⁵ Eparch Symeon, already mentioned above, was also a *chartouarios*, the keeper of an archive.

Non-literary professions are represented by only one man, a builder ($\omicron\iota\kappa\omicron\delta\omicron\mu\omicron\varsigma$) with the name Goussi, whose inscription is found on the northern side of the entrance to Room 14.⁶⁶

As far as men of the Church are concerned, one observes an almost total absence of bishops among the ‘people of Banganarti’. Only once an archbishop, most probably of Dongola, is mentioned in the presentation of the protagonist of an inscription on the north side of the entrance to Chapel 4, i.e. the main chapel of the church.⁶⁷ This man, an epideacon named Papi, was $\acute{\omicron}\ \tau\omicron\upsilon\ \omicron\iota\ \pi\rho\acute{\omicron}\delta\omicron\iota\ \acute{\alpha}\rho\chi\iota\text{-}\epsilon\pi\iota\sigma[\kappa](\)$, probably ‘one of the members of the archbishop’s clergy’.⁶⁸ The silence of the Banganarti epigraphic material about bishops contrasts with the frequent mentions of other prominent members of Makurian society, especially kings (see above). It is all the more surprising as the Makurian Church seems to have retained its vitality and internal organisation in the period corresponding to the activity of the Banganarti cult place, as is attested by the significant number of priests and deacons among the ‘people of Banganarti’.

Thirty-nine attestations of the title of ‘priest’ are found in the epigraphic material at Banganarti, including thirty-three in Greek ($\pi\rho\epsilon\sigma\beta\acute{\upsilon}\tau\epsilon\rho\omicron\varsigma$) and six in Old Nubian (coṛto). Yet another priest might have been a man designated as $\acute{\iota}\epsilon\rho\epsilon\acute{\upsilon}\varsigma$, on record in an inscription on the eastern wall of Room 8.⁶⁹ In two cases, both referring to the same man, a priest is designated with the descriptive term $\pi\acute{\alpha}\rho\epsilon\delta\rho\omicron\varsigma$, ‘one who sits by (during the liturgy)’.⁷⁰ The title of ‘deacon’, be it in Greek ($\delta\iota\acute{\alpha}\kappa\omicron\nu\omicron\varsigma$) or Nubian (ḏiakōn), is on record 77 times. In the group of deacons, one should probably also include people designated as $\mu\epsilon\lambda\delta\omicron\upsilon/\mu\epsilon\rho\delta\omicron\upsilon$, ‘servant, slave’ (six attestations), as well as $\theta\epsilon\rho\acute{\alpha}\pi\omega\nu$ (two attestations) and

61 ŁAJTAR 2020: nos. 65, 491, 653, and 831.

62 Thus in ŁAJTAR 2020: nos. 97 ($\alpha\lambda\epsilon\lambda\phi\omicron\iota\ \epsilon\omicron\alpha\lambda\lambda\eta$), 175 ($\acute{\alpha}\pi\omicron\epsilon\omicron\alpha\lambda\lambda\eta$), 488 ($\varsigma\alpha\epsilon\iota\omicron\epsilon\omicron\alpha\lambda\lambda\eta$), and 838 ($\epsilon\omicron\epsilon\alpha\epsilon\omicron\alpha\lambda\lambda\eta$). Note that the grammatical interpretation of the last three cases is uncertain.

63 ŁAJTAR 2020: no. 645. Note that the man, whose name is only partly preserved, was also a deacon.

64 ŁAJTAR 2020: no. 294. The man had the name Raphaelkouda, literally ‘servant of (Archangel) Raphael’, alluding to the patron of the Banganarti church.

65 ŁAJTAR 2020: no. 647. $\nu\omicron\tau\acute{\alpha}\rho\iota\omicron\varsigma\ \mu\acute{\epsilon}\gamma\alpha\varsigma$ mentioned indirectly in the inscription ŁAJTAR 2020: no. 960 may be an alternative designation of $\acute{\alpha}\rho\chi\iota\nu\omicron\tau\acute{\alpha}\rho\iota\omicron\varsigma$.

66 ŁAJTAR 2020: no. 647.

67 ŁAJTAR 2020: no. 347.

68 Note that each of the two Church titles of Papi is followed by a genitival attributive expression with $\omicron\gamma\alpha\tau\alpha\phi$ as the second element. I consider these expressions to be honorary titles connected with holding ecclesiastical offices (see below).

69 ŁAJTAR 2020: no. 107.

70 ŁAJTAR 2020: nos. 90 and 663. The man bore the rare Greek name $\Sigma\acute{\epsilon}\lambda\alpha\varsigma$, which equates to the substantive $\sigma\acute{\epsilon}\lambda\alpha\varsigma$ ($\tau\omicron$), ‘light, brightness, flame’.

δοῦλος (four attestations), the two latter designations being most probably back translations of μελδογ/μερδογ into Greek.⁷¹ If so, the number of attestations of deacons increases to 89. It is unclear to which group one should assign people with the non-technical terms κληρικός (41 attestations), λειτουργός (1 attestation), and λευίτης (6 attestations). The terms in question could have been used concerning all clergy members, even if they are mostly found in relation to deacons and members of lower orders.⁷² The exact position of λατρευτής (1 attestation) within the ecclesiastical hierarchy is uncertain. The term generally means ‘believer’; however, in the Banganarti inscription, it must have had a technical or quasi-technical meaning referring to a member of the clergy, a priest or deacon, as it is connected with the name of a church. Finally, several men are described quite generally as ‘belonging’ to a church, without specifying what exact function they fulfilled.⁷³ There are five attestations of the title of epideacon, ἐπιδιάκονος, once provided with the epithet ἔμμονος, ‘steadfast’ (?), and three attestations of archdeacon, ἀρχιδιάκονος. The title διάκονος μέγας, ‘great deacon’, on record in an inscription on the western side of the entrance to Chapel 1,⁷⁴ may be an alternative designation for ἀρχιδιάκονος, created under the influence of Old Nubian. Epideacons and archdeacons apparently were high ecclesiastics, closely related to the bishop and entrusted with the administration of the Church.⁷⁵ This supposition is confirmed by the fact that one epideacon, Papi, referred to in the previous paragraph, is described as a member of the close entourage of the archbishop in his inscription.

The high number of deacons among the ‘people of Banganarti’, over twice as many as priests, is worth stressing. It probably corresponds with the high percentage of deacons in the entire Makurian Church of the thirteenth–fourteenth centuries, as it is difficult to imagine that the upper church in Banganarti was particularly attractive for only one of the two main groups of clergy, or that only one group of clergymen was especially inclined to leave written mementos of their visits. The high percentage of deacons in the Makurian Church is surprising, especially when compared with the situation in the Late Antique Church, also mirrored in the Church canons, according to which each local community should have had only seven deacons following New Testament tradition. One has to remember, however, that canons restricting the numbers of deacons were not universally followed, and some Churches, especially in later times, nominated as many deacons as possible. Moreover, the Church needed deacons not only for liturgical service, but also for its administration and charitable activity. Further, lower Church ordinations were frequently bestowed upon respected members of society as a token of their piety and high social standing (see below). Under such circumstances, having two deacons for every priest does not seem particularly excessive.

Except for deacons, no other representatives of lower orders, neither subdeacons, nor lectors, nor cantors, occur among the ‘people of Banganarti’. This invisibility

71 That μελδογ/μερδογ is the same as διάκονος/διακον is confirmed by inscriptions LAJTAR 2020: nos. 71 and 320, both commemorating a certain Agapos, who is designated as ραφαηλ μελδογ in the first inscription and Παφαιλ διάκονος in the second.

72 Note the protagonist of inscription LAJTAR 2020: no. 404, a certain Papi, is designated as διάκονος λευίτης.

73 Thus in LAJTAR 2020: nos. 36, 168, 501, 621, and perhaps also 414 and 697.

74 LAJTAR 2020: no. 519.

75 In fact, epideacon and archdeacon may be alternative designations for the same function or office.

is possibly explicable by the fact that members of lower ordinations are hidden under the non-technical term ‘clerics’ (κληρικοί). An additional factor could have been their lower level of literacy compared to the higher clergy. Subdeacons, whose tasks consisted mainly in caring for liturgical equipment, would not necessarily have been literate.

Two titles relate to Church administration, namely *κειμηλιάρχης* (spelt *κοιμηλιάρχης* or even *χοιμηλιάρχης*), ‘church treasurer’,⁷⁶ and *μειζ* (), either *μείζ(ων)* or *μειζ(ότερος)*, ‘steward’ (of a church). Among the three *keimeliarchai*, one was an archdeacon,⁷⁷ one a deacon and *thegna*,⁷⁸ and one a layman, as suggested by the lack of any clerical title in his presentations.⁷⁹ A similar situation is observable with *meiz* (). In two cases, the *meiz* () was a clergyman,⁸⁰ and in one a layman who additionally held the office of the chief of a village/town, here designated as γόνος.⁸¹ One cannot rule out the possibility that the ζάκορος on record in an inscription on the northeastern pier⁸² was also involved with church administration. The pagan term ζάκορος, not used in everyday language in the Christian world, designated a temple attendant, but ζάκορος from the inscription in question must have been someone of greater importance as he combined the function of ζάκορος with that of πρεσβύτερος. It is worth noting he is described as ‘second *zakoros*’, ζάκ(ορος) δεύτ(ερος), suggesting the existence of an internal hierarchy among this group of churchmen.

It appears the otherwise unknown term ροδῶιμ attested in two inscriptions⁸³ also designated a clergyman, or at least a person rendering services for a church. This is suggested by one of these inscriptions, found on the southern side of the entrance to Chapel 3, in which the protagonist is presented as ραφαῆλ᾽ [ροδῶιμ, ‘*gojjim* of (the Church of) Raphael’. Thus, ροδῶιμ was either an Old Nubian counterpart of a Greek term referring to an institution known in the universal Church or designated an institution which existed only in the Nubian Church and had no Greek term for it. Another Church title of Nubian origin might be κω[.]Δ, on record in an inscription also carved on the southern side of the entrance to Chapel 3, whose protagonist (name not indicated) was ‘*ko[. .]d* of (the Church of) Raphael’.⁸⁴

An inscription on the northern wall of Room 13⁸⁵ commemorates a slave of a Church of Raphael (name not preserved), unless the term οὔρω, ‘slave’, was used figuratively to designate a deacon (as a counterpart of *μερδογ/μελδογ*?). Another Church slave is on record in a fragmentary and somewhat cryptic inscription on the eastern wall of Room 11.⁸⁶ The text seems to indicate the slave was taken

76 On *keimeliarchai* in Christian Nubia, see ŁAJTAR, OCHALA 2018.

77 ŁAJTAR 2020: no. 370. The man bore the name Marikouda.

78 ŁAJTAR 2020: no. 616. The man bore the name Adojurê, unattested outside the Banganarti inscriptions.

79 ŁAJTAR 2020: no. 623. The same man, named Gabriel(in)kouda, also signed inscriptions ŁAJTAR 2020: nos. 589, 619, and 624, all situated in and near the entrance to Room 22. None of these inscriptions mentions his title of *keimeliarches*.

80 ŁAJTAR 2020: nos. 89: πρ(εσβύτερος) μειζ() (without a name), and 363: διδνογκ(ογτ) Ι(ησοῦ)ς μειζ() λατρευτ(ής).

81 ŁAJTAR 2020: no. 775: ἀλλογιμᾶ Ι(ησοῦ)ς μειζ() κ(αί) πάλλ(ιν) α, () γόνος.

82 ŁAJTAR 2020: no. 160. The man bore the name Tottina.

83 ŁAJTAR 2020: nos. 351 and 473.

84 ŁAJTAR 2020: no. 453.

85 ŁAJTAR 2020: no. 858 (name not preserved).

86 ŁAJTAR 2020: no. 37.

over by priest(s) of a Church of the Four Living Creatures (literally: Church of the Living Ones) from the church in Banganarti. Why this happened can only be guessed. Perhaps the Church of the Four Living Creatures recuperated a fugitive slave from the church in Banganarti or the church in Banganarti passed over one of its slaves to the Church of the Four Living Creatures.

The clergymen who left their inscriptions in the upper church at Banganarti frequently also indicated, alongside their church title, their affiliation to a specific church. With 92 attestations, the most frequently mentioned church name is the 'Great Church of Jesus', Ἰησοῦς μέγας, with no further qualification. Forty-four inscriptions mention a 'Church of Jesus', Ἰησοῦς, with no further qualification. These two names may refer to the same church, the largest and most important church in the Dongola area in the thirteenth/fourteenth centuries. Indeed, three inscriptions specify that the Great Church of Jesus is in Dongola (called Timikleos).⁸⁷ Over 30 years ago Włodzimierz Godlewski put forward the hypothesis that the name 'Jesus-Church' had been applied to the so-called Cruciform Church, excavated by the Polish Mission in the 1970s/1980s.⁸⁸ Located in the northern suburbs of Dongola, next to the Church of Granite Columns, identified as the cathedral of Dongola, it was the largest of the Dongolan churches known at that time. However attractive, Godlewski's hypothesis needs further evidence to be positively proven, the more so as recent excavations on the citadel in Dongola have brought to light a church with still more impressive dimensions than those of the Cruciform Church.

After the (Great) Church of Jesus, the second most frequently mentioned church name is the 'Church of Raphael', with approximately 30 attestations.⁸⁹ Three inscriptions speak about the Church of Raphael in Dongola (Toungoul/Timikleos).⁹⁰ The majority of attestations of the name 'Church of Raphael' very probably refer to this very structure. The Church of Raphael in Dongola was recently identified with the so-called Church B.V.⁹¹ The church in question, excavated by the Polish Mission between 2005 and 2016, is located in the south-western part of the mediaeval town, south of a large residential building (B.I), probably the royal palace, and a small cruciform building of commemorative character (B.III) transformed into a church at a later stage of its existence. According to the hypothesis of Godlewski, all three buildings could have formed a single complex connected with the state and royalty,⁹² which goes hand in hand with the role of Raphael as the protector of Makurian kings. Some attestations of the name 'Church of Raphael' may refer to the upper church at Banganarti, which also must have been dedicated to Raphael (see above). Such a situation may be encountered in an inscription on the east wall of Room 11, provided my interpretation of the initial ρωϊκέ ραφαηλ as 'I came to (the Church of) Raphael' is correct.⁹³

87 ŁAJTAR 2020: nos. 850, 953, and 960.

88 GODLEWSKI 1990: passim, especially 136; for the Cruciform Church, see also GODLEWSKI 2013: 39–41.

89 An exact number is impossible to establish because of the ambiguity of texts.

90 ŁAJTAR 2020: nos. 168, 317, and 387.

91 For the Church B.V, see GODLEWSKI 2018. Its identification as a Church of Raphael is based on an unusually large number of representations of archangels, of which some can safely be recognised as Raphael due to accompanying inscriptions, and repeated occurrence of priests of a Church of Raphael as donors of paintings in the north pastophorium of the church.

92 GODLEWSKI 2013: 25.

93 ŁAJTAR 2020: no. 35 (with commentary).

Other churches mentioned in the inscriptions have considerably poorer evidence. Their list includes (Great) Church of Jesus at Jagje,⁹⁴ Church of Jesus at Dang(),⁹⁵ Church of Jesus at Dang[. Jon,⁹⁶ Church of Jesus at Jauge,⁹⁷ Church of Jesus at Mukdako,⁹⁸ Church of Jesus of Pell(),⁹⁹ Church of the Holy Trinity,¹⁰⁰ Church of (Three) Youths,¹⁰¹ Church of Mary,¹⁰² Church of Michael,¹⁰³ Church of Mother (of Jesus?),¹⁰⁴ Church of Iob,¹⁰⁵ Church of Christ,¹⁰⁶ Church of Four Living Creatures,¹⁰⁷ Church of Gabriel at Edi,¹⁰⁸ Church of Jacob,¹⁰⁹ Church of Marc,¹¹⁰ and Church of Sergius.¹¹¹ None of these churches can be identified with known structures, except for the Church of the Holy Trinity. A Church of the Holy Trinity, sometimes given the epithet ‘Great’, is mentioned several times in visitors’ inscriptions in the newly discovered North Church within the monastery on Kom H in Dongola, dated to more or less the same time as the Banganarti inscriptions.¹¹² It is probably also on record in a graffito in the Northwest Annexe of the same monastery, commemorating a visit paid by a group of high-ranking officials of the Makurian state.¹¹³ It is also possible that the name ‘Holy Trinity’ repeatedly occurring in the dossier of Georgios, archbishop of Dongola between 1063 and 1113, refers to a church and not a monastery as was previously thought.¹¹⁴ If so, ‘Holy Trinity’ must have been the patrocinium of the cathedral of Dongola, commonly identified with the Church of Granite Columns excavated by the Polish Mission in the 1960s/1970s.¹¹⁵ Considering the Church of the Holy Trinity has far fewer attestations than the (Great) Church of Jesus in the Banganarti inscriptions, one has to hypothesise that the cathedral of Dongola played a less important role than the Cruciform Church in the religious life of the Makurian capital in the twelfth/fourteenth centuries.

Interestingly, members of monastic orders are very poorly represented among the ‘people of Banganarti’. We can identify only three ἀρχιμανδρίται, i.e. heads of monasteries, whereby one was an archimandrite of an otherwise unattested

94 ŁAJTAR 2020: nos. 53, 349, 559, and 573.

95 ŁAJTAR 2020: no. 578.

96 ŁAJTAR 2020: no. 654. Inscriptions 578 and 654 may in fact refer to the same church.

97 ŁAJTAR 2020: no. 181.

98 ŁAJTAR 2020: no. 718.

99 ŁAJTAR 2020: no. 686. The abbreviated word πελλ() may be an epithet of the church in question or the name of a place in which the church was located, or perhaps even the name of a hierarch who was somehow related to the church.

100 ŁAJTAR 2020: nos. 66, 442, and 831.

101 ŁAJTAR 2020: nos. 176, 409, and 621.

102 ŁAJTAR 2020: nos. 319, 362, and 367.

103 ŁAJTAR 2020: nos. 604, 655, and 718. In the last of these inscriptions, the ‘Church of Michael’ is given the geographical epithet ‘of the West’. Whether or not the other two inscriptions refer to the same church is not known.

104 ŁAJTAR 2020: nos. 423 and 958. This church is probably different from the Church (or Churches) of Mary.

105 ŁAJTAR 2020: nos. 237 and 308.

106 ŁAJTAR 2020: no. 350.

107 ŁAJTAR 2020: no. 37.

108 ŁAJTAR 2020: no. 718.

109 ŁAJTAR 2020: no. 849.

110 ŁAJTAR 2020: no. 307.

111 ŁAJTAR 2020: no. 395. A ‘Church of Sergius’, perhaps identical with the present one, is on record in an unpublished wall inscription in the Church B.V on the citadel hill of Dongola.

112 Unpublished; known to me from personal examination.

113 ŁAJTAR, VAN DER VLIET 2017: 36–38, no. XVI.

114 ŁAJTAR 2002: 189; repeated in ŁAJTAR, VAN DER VLIET 2017: 25.

115 GARTKIEWICZ 1990.

monastery of St Steven,¹¹⁶ the second was active as an archimandrite of an unknown monastery and a priest,¹¹⁷ and the third combined the functions of archimandrite of an unknown monastery, deacon, and yet another office difficult to identify.¹¹⁸ It is possible that a man described as ‘lord of brothers’, ἀδελφοὶ ἐοῦδα, ¹¹⁹ also was the head of a monastery, but this cannot be proven positively due to lack of parallels. One man, otherwise a member of the clergy of a church of Jesus, bears the title of ἄββα, ¹²⁰ suggesting he was a monk. An inscription on the southwestern pier, with the sole word ἀδελφίην, ¹²¹ might commemorate a member of a female convent. The lack of monks among the ‘people of Banganarti’ could be due to their more restricted mobility than the clergy, or perhaps might be associated with the desire to remain anonymous in front of the Lord.

An interesting and frequently attested phenomenon among the ‘people of Banganarti’ is that one person holds several offices/titles. The combined offices/titles may be either (1) all civilian or (2) all ecclesiastical or (3) both civilian and ecclesiastical. The first scenario is rare and unquestionably represented only by Symeon, the protagonist of an inscription on the pillar between Rooms 20 and 21, eparch (or protoeparch), *chartoularios*, tot of Boul(), who also held yet another unidentified office or function.¹²² The second scenario is more common and is exemplified by Ouarioskouda, levites of the Great (Church of) Jesus and deacon of (the Church of) Raphael;¹²³ Dollê, deacon of the Great (Church of) Jesus, deacon of (the Church of) Raphael, and servant of (the Church of) the Holy Trinity;¹²⁴ Gabrielkouda, deacon of (the Church of) Jesus and also deacon of (the Church of) Jesus of Marianos;¹²⁵ Theouphorou, great priest of (the Church of) Jesus and also priest of (the Church of) Raphael of Timikleos.¹²⁶ Apparently, all these men were clergymen in different churches simultaneously, meaning the churches must have been situated close to one another, in order for the men to be able to fulfil their church obligations properly,¹²⁷ unless one assumes that at least some of these Church functions were honorary. A slightly different situation is evident in the case of Marikouda, archdeacon and treasurer,¹²⁸ and Tottina, priest of the Great (Church of) Jesus and second (church) attendant.¹²⁹ They were most probably appointed as treasurer and attendant in the same churches where they held the office of archdeacon and priest. The same holds for Gourrônga, priest and archimandrite;¹³⁰

116 LAJTAR 2020: no. 408. The man bore the name Ôkold().

117 LAJTAR 2020: no. 674. The individual in question, who bears the typically Dongolan name Gourrônga, is attested twice in wall inscriptions in two different places of the monastery on Kom H at Dongola, namely the commemorative complex in the north part of the North-Western Annexe (LAJTAR, VAN DER VLIET 2017: 33–35, no. XIII), and the commemorative church of St Anna (unpublished; preliminarily see LAJTAR 2014: 289, with fig. 2 [drawing]).

118 LAJTAR 2020: no. 849. The name of the man has not been preserved.

119 LAJTAR 2020: no. 97. The name of the man has been preserved only in part: [- - -]erê.

120 LAJTAR 2020: no. 964. The name of the man has not been preserved.

121 LAJTAR 2020: no. 940.

122 LAJTAR 2020: no. 698, and see further above, p. 37 with n. 54.

123 LAJTAR 2020: no. 323.

124 LAJTAR 2020: no. 442.

125 LAJTAR 2020: no. 506.

126 LAJTAR 2020: no. 387.

127 All were likely Dongolan churches. In fact, the Church of Raphael, to which Theouphorou was attached, is described as being in Timikleos (= Dongola).

128 LAJTAR 2020: no. 370.

129 LAJTAR 2020: no. 160. The presentation of Tottina contains also the mysterious element ⲭⲱⲡ.

130 LAJTAR 2020: no. 674. In addition to these two ecclesiastic titles, he is also designated as ⲁⲗⲗⲏⲁⲗⲓ () (most probably another title or name of an office otherwise unknown to us).

he must have been a priest in the same monastery he headed. The most commonly attested scenario is to combine civilian and ecclesiastical functions. Attestations are: Phorou, the owner and priest of (the Church of) the Mother (of Jesus?), epistolary scribe of the king, *notarios*, *thegna* of the City (= Dongola);¹³¹ Dourerê, deacon of the Great (Church of) Jesus, *epirshil* of King Siti;¹³² Jurou [- - -], priest of (the Church of) Jesus, and [- - -] priest of (the Church of) Raphael, [- - -] *irti*, and [- - -];¹³³ Adojurê, deacon of the Great (Church of) Jesus, *keimeliarches*, *thegna*;¹³⁴ Nalet, deacon of the Great (Church of) Jesus of Jagje, servant of (the Church of) Jesus, *thegna* of Jagje;¹³⁵ Nalsê, priest and *tot* of Silmi;¹³⁶ Okkesê, deacon of (the Church of) Jesus, *tot* of Toungoul;¹³⁷ Papa, of the people's Church of Jesus of Jagje, *thegna* of [- - -] of Michael;¹³⁸ Papa, deacon of (the Church of) Jesus at Dang(), *thegna* of the town of the Island of Michael, Lord of Elders;¹³⁹ D[. .]olt(), deacon (and) scribe;¹⁴⁰ Abbam, priest of (the Church of) Michael, and Lord of Elders;¹⁴¹ Tirnoukout, deacon of (the Church of) Jesus at Jagje, servant of Jesus, Lord of Elders;¹⁴² Shadau, deacon of the Great (Church of) Jesus, *thegna* of Apat(t)e, and Lord of Elders;¹⁴³ Tidnoukout, servant of the (Church of the) Holy Trinity, Lord.¹⁴⁴ To this group, one could also probably assign a certain Outi, who was the (second) deacon of the queen mother and deacon of (the Church of) Jesus,¹⁴⁵ assuming that deacon of the queen mother was a civilian function rather than an ecclesiastical one. It is easy to observe that the most frequent combination is that of a deacon (of a church) + *tot/thegna* of a village/town, or deacon (of a church) + Lord of Elders. Due to being literate, either deacons were entrusted with civilian functions of administrative character¹⁴⁶ or middle-rank civilian officials were honoured with a lower Church ordination.

Several people bear titles ending in -(ε)κ(α) (or similar). The list includes Mêna, archdeacon of the Great (Church of) Jesus and *Khoiakeikshê(l)*;¹⁴⁷ Metanoia, priest of (the Church of) Mary, son of Toko Mariako (or: *tot* of Toko Mariako), *Eugieikshil*;¹⁴⁸ Selas, priest (?) of (the Church of) Jesus, *Doug()eikshil*;¹⁴⁹ Ti[. .], deacon of the Great

131 ŁAJTAR 2020: no. 958.

132 ŁAJTAR 2020: nos. 9 and 554. The same Dourerê may be on record in three further inscriptions, namely ŁAJTAR 2020: nos. 507, 564, and 890. The first mentions Dourerê, deacon of the Great Church of Jesus, the second – Dourerê, cleric of the Great Church of Jesus, and the third – Dourerê, a deacon. Dourerê, a member of clergy of the Great Church of Jesus, also is on record in a wall inscription in the North Church within the monastery on Kom H in Dongola (unpublished; known to me from personal examination).

133 ŁAJTAR 2020: no. 156.

134 ŁAJTAR 2020: no. 616.

135 ŁAJTAR 2020: no. 349.

136 ŁAJTAR 2020: no. 257.

137 ŁAJTAR 2020: no. 267.

138 ŁAJTAR 2020: no. 53.

139 ŁAJTAR 2020: no. 578.

140 ŁAJTAR 2020: no. 645.

141 ŁAJTAR 2020: no. 655.

142 ŁAJTAR 2020: no. 573.

143 ŁAJTAR 2020: nos. 45, 549, and 580. Each of three inscriptions gives a slightly different presentation of Shadau.

144 ŁAJTAR 2020: no. 831.

145 ŁAJTAR 2020: nos. 462 and 772.

146 Profane activity of members of the clergy is a phenomenon well attested in the late antique and early mediaeval Church. Egyptian attestations of this phenomenon are discussed in WIPSZYCKA 1972: 154–173 and Schmelz 2002: 203–318.

147 ŁAJTAR 2020: no. 672.

148 ŁAJTAR 2020: no. 362. I mistakenly read the name of the man as Metamia (μεταμία). The reading Metanoia (μετανοία) was established by Alexandros Tsakos (personal communication). Note the name Metanoia equals the Greek word μετάνοια, 'repentance'.

149 ŁAJTAR 2020: no. 90.

(Church of) Jesus and also [. . .] *loupeikshil*;¹⁵⁰ and Kouda, *Têrieikishshil* (?).¹⁵¹ In addition, texts from Christian Nubia inform us of two other titles with the element -(ḗk)ⲱⲗ, namely ḗkⲱⲗ and ḏⲟkḡⲱⲗ. The exact meaning of these titles and their function within the system of Makurian nomenclature are unclear. My impression is they were honorary titles rather than names of offices. Some could have been connected with given offices and essentially could have been borne by persons holding these offices. Such was probably the case with *eikshil*, apparently attached to the office of the eparch of Nobadia.¹⁵² Others might have had a wider use or have been related to fulfilling a specific task that could have been carried out by both laymen and ecclesiastics. Such a possibility was suggested for *Khoiakeikshil*, who might have been a person somehow connected with the celebration of the Nativity feast, which falls in the month of Khoiak in the Coptic calendar.¹⁵³ Also ⲁⲣ[- - -] ⲟⲩⲁⲧⲁⲫ and ⲟⲩⲣⲁⲛ ⲟⲩⲁⲧ[ⲁ]ⲫ, on record in an inscription on the north side of the entrance to Chapel 4,¹⁵⁴ could be honorary titles as they are attached to two different ecclesiastical offices held by the same person, a certain Papi.

Next to nothing can be said about daily activities and concerns of the ‘people of Banganarti’, except what can be gleaned from these people’s titles. Only one inscription, situated on the south wall of Chapel 5, may be referring to a real-life situation.¹⁵⁵ Here, an anonymous author asks God through the intercession of Raphael to save his son for him, perhaps due to this son’s illness or some other danger that had befallen him. Otherwise, the people in the inscriptions expressed only their spiritual concerns, in requesting from God guarding, help, guidance, blessing, protection, pity, forgiveness, salvation, especially from the traps of the enemy (= devil), or instruction in the proper way of living, etc. Obviously, they left their earthly affairs behind in their homes while visiting the cult place of Raphael in Banganarti and had only their salvation in sight.

In terms of anthropology, the ‘people of Banganarti’ with their religious behaviours, including a pilgrimage to the cult place in Banganarti and leaving a written memento of the visit on its walls, can be described using the concept of *communitas*, coined by Victor Turner.¹⁵⁶ They can be viewed as Turner’s normative *communitas*, a permanent and well-organised social system whose members, irrespective of their position in society, experience a strong feeling of religious and cultural brotherhood and fellowship while participating in religious activities such as a pilgrimage to a holy place. This type of *communitas* might have been particularly attractive during a time of crisis, which Makuria experienced in the thirteenth/fourteenth centuries, torn by internal dynastic unrest, armed interventions from neighbouring Egypt, and a constant influx of a foreign population that slowly but continuously brought a change in the ethnic, religious and cultural landscape of the Middle Nile Valley.

150 ŁAJTAR 2020: no. 143.

151 ŁAJTAR 2020: no. 402.

152 This is suggested by commercial letters in Arabic dating from late Fatimid times, found at Qasr Ibrim. In them, the eparch of Nobadia is addressed with either his Arabic title, ‘Lord of the Mountain’ (*sahib al-Gebel*), or the Nubian title *ikshil*. The letters remain unpublished. For a general presentation, see Sartain 1993.

153 RUFFINI 2012: 46–56. Magdalena Woźniak believes she recognises a portrait of Doukasi *Khoiakeikshil* clad in a ritual garment in an illustration accompanying the so-called Griffith’s Stauros Text in MS. Or. Quart 1020 in the Staatsbibliothek in Berlin (WOŹNIAK 2018).

154 ŁAJTAR 2020: no. 347.

155 ŁAJTAR 2020: no. 309.

156 TURNER, TURNER 1978.

On the other hand, the ostentatious show of accumulated titles and literacy in Greek, the language of the highest symbolic status among Christian Nubians, suggests an element of competition may also have been at work among this group of inhabitants of Makuria.¹⁵⁷ Such competition may have taken more political forms beyond the church walls and contributed to the final disintegration of Makuria, a fact coinciding more or less with the end of the epigraphic production in the upper church at Banganarti.

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¹⁵⁷ For pilgrimage as a space for playing out competing interests, see EADE, SALLNOW 1991.

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BANGANARTI

Animals in Banganarti

III

Marta Osypińska

Abstract:

Between 2003 and 2018, approximately 18,000 animal bones were discovered at Banganarti and subjected to comprehensive archaeozoological analyses. They provide an essential source of knowledge about patterns of animal husbandry, meat consumption and the environment, the mobility of human populations, the economic model, and the extent of influence of cultural patterns. Banganarti is the only medieval site with faunal data from all phases of Makuria's history, from the sixth to the fourteenth century. Archaeozoological studies have made it possible to determine the socio-topographical diversity of the pilgrimage centre and the economic basis of its functioning. Diet and livestock economy patterns reflect the influence of both sub-Saharan and Coptic-Egyptian cultures in each period. An essential element of Banganarti's economy was long-distance transport associated with its location on an important trade route linking the Nile Valley with Kordofan and sub-Saharan Africa. A distinguishing feature of the archaeozoological data from Banganarti is the unusually high proportion of pork in the diet and the rearing of pigs on a scale not seen in other Nubian centres.

Keywords: livestock economy, animals husbandry, African cattle, pig farming, animals in Nubia.

Introduction

In northeastern Africa, animal remains discovered in archaeological contexts are often the only evidence for models of meat production and consumption, the environment, the mobility of human populations, the economic model and the range of influence of cultural patterns. The Banganarti faunal collection has become an essential source of information. The archaeozoological data even prompted the inclusion of interdisciplinary Nubiological studies in the current scientific debate. Several works presenting archaeozoological data from various stages of the research at Banganarti have been published.¹ Due to the comprehensive nature and the chronological and topographical diversity of the data, the results of archaeozoological analyses of the animal remains discovered in the religious and settlement complex at Banganarti became the basis for synthetic research. This concerned animal husbandry traditions in Christian Nubia and consumption models, demographic processes and climate and environmental changes in the Middle Nile Valley.² The study of the importance of animals for the community of Makuria also led to more in-depth research, which shed light on the broader context of the role of animals in the communities of sub-Saharan Africa, from prehistory, through the Kushite civilisation (i.e. the phases preceding the functioning of Makuria), until after the Middle Ages with the early modern Funj Sultanate.

Banganarti is so far the only site in medieval Nubia that has been the subject of such comprehensive archaeozoological research (**Fig. 1**). It was also the first Makurian settlement site where systematic analyses and research were undertaken



Fig. 1

The state of preservation of animal remains from Banaganarti (photo M. Osypińska)

¹ OSYPIŃSKA 2003; 2010a; 2010b; 2014.

² OSYPIŃSKA 2018.

Fig. 2

Species distribution of animal remains from Banganarti, Early Christian period

TAXONS	n	%
<i>Cattle (Bos taurus)</i>	842	43.7
<i>Sheep/Goat (Ovis aries/Capra hircus)</i>	737	38.2
<i>Pig (Sus scrofa f. domestica)</i>	255	13.2
<i>Donkey (Equus africanus f. domestica)</i>	46	2.4
<i>Dog (Canis familiaris)</i>	1	0.05
<i>Dorcas gazelle (Gazella dorcas)</i>	3	0.1
<i>Dromedary (Camelus dromedarius)</i>	40	2.0
<i>Fish (Pisces)</i>	3	0.1
N I S P	1927	66.7 / 100
Unidentified	962	33.3
TOTAL	2889	100

in domestic archaeology, bioarchaeology in the broad sense and environmental archaeology. The data from the Raphaelion, and especially from the surrounding settlement, are therefore a kind of benchmark for further analyses of the human-animal or human-environment relationship in the medieval Middle Nile Valley.

This chapter's central empirical part is based on data from the analysis of faunal materials discovered at Banganarti, both in the area of the successive churches and in the settlement surrounding the sanctuary.

In order to present the specificity of the animal use model in Banganarti, the research additionally draws on the results of analyses of faunal material from the following sites: Soba, the capital of the kingdom of Alwa, during the Early Christian period (seventh–tenth centuries);³ and Old Dongola, the nearby capital of Makuria, in the Early Christian and Late Christian periods.⁴

All archaeozoological collections presented in this work come from the Makurian Middle Ages. At Banganarti, no faunal remains have been found that could be associated with other periods. This is an excellent help in analysis. The Banganarti collections constitute a relatively homogeneous data package representing a specific cultural, demographic and functional context.

Results of Archaeozoological Research

Animal remains dated to the oldest settlement phase (Early Christian: sixth–ninth centuries) totalled 2,889 fragments of bones and teeth (**Fig. 2**). They came mainly from the southwestern, southern and southeastern parts of the settlement and, to a lesser extent, from the northeastern area of buildings surrounding the upper church (= Raphaelion II).

The most numerous and varied material in terms of its topographical origin was dated to the Classical Christian period. In total, it consisted of 5,712 animal remains from the southeastern, northeastern and eastern parts of the

³ CHAIX 1998.

⁴ OŚYPIŃSKA 2018.

TAXONS	SETTLEMENT SE PART		SETTLEMENT NE PART		FORTIFICATIONS		TOTAL	
	n	%	n	%	n	%	n	%
Cattle	707	41.71	849	43.31	949	46,13	2505	43.85
Sheep/Goat	752	44.36	721	36.78	621	30.18	2094	36.65
Pig	209	12.33	330	16.83	414	20,12	953	16.68
Donkey	4	0.23	14	0.71	3	0,14	21	0.36
Equids	0	-	1	0.05	31	1,50	32	0.56
Dog	0	-	0	-	5	0,24	5	0.08
Dromedary	20	1.17	36	1.83	22	1,06	78	1.36
Dorcas gazelle	0	-	1	0.05	5	0,24	6	0.10
Oryx	3	0.17	1	0.05	0	-	4	0.07
Bushpig	0	-	1	0.05	0	-	1	0.01
Hare	0	-	0	-	1	0,04	1	0.01
Rodent	0	-	1	0.05	0	-	1	0.01
Fish	0	-	2	0.10	4	0,19	6	0.1
Oyster	0	-	3	0.15	2	0,09	5	0.08
NISP	1695	69.29	1960	52.9	2057	66.63	5712	61.84
UNIDENTIFIED	751		1743		1030		3524	
TOTAL	2 446	100	3703	100	3087	100	9236	100

settlement, and from the vicinity of the fortifications surrounding the Raphaelion II and the buildings around it (Fig. 3). In addition, a very small assemblage of animal remains was also discovered in the backfill of the lower church, the first Raphaelion, which was deposited during the levelling and preparation of the site for the construction of the upper church.

The youngest animal remains discovered at Banganarti were dated to the Late Christian phase. They totalled 4,291 fragments of bones and teeth. They were discovered in the southeastern and northeastern parts of the settlement and in layers located at the very bottom of the Raphaelion II backfill (Fig. 4).

Comparative analysis of the proportions of the remains of the main domestic animal species showed interesting socio-topographical and chronological differences, allowing observations to be made about the dynamics of economic and demographic development in Banganarti over nearly 1,000 years of occupation.

The first observation concerned differences between the models of meat consumption in two areas roughly corresponding to the southern and northern parts of the Banganarti settlement.

In the Early Christian period in Banganarti, two models of consumption preferences can be observed. The first one is found in the zone south of the lower church. It is characterised by the dominance of average proportions of all meat categories consumed, so the diet was not distinguished by a specific type of meat. Only in the southeastern zone was a high proportion of beef consumed (the highest proportion of all the foodstuffs analysed from Banganarti) and a low proportion of pork (Fig. 5).

Fig. 3

Species distribution of animal remains from Banganarti, Classical Christian period

TAXONS	SETTLEMENT SE PART		SETTLEMENT NE PART		TOTAL	
	n	%	n	%	n	%
Cattle	622	48.59	958	31.84	1580	36.8
Sheep/Goat	466	36.40	1337	44.44	1803	42.0
Pig	162	12.65	490	16.28	652	15.2
Donkey	4	0.3	19	1.63	23	0.5
Dog	0	-	19	0.63	19	0.4
Dromedary	20	1.56	36	1.2	56	1.3
Dorcas gazelle	0	-	31	1.03	31	0.7
Egyptian mongoose	0	-	3	0.09	3	0.07
Bat	0	-	24	0.79	24	0.5
Oryx	0	-	2	0.06	2	0.04
Rodent	1	0.07	7	0.23	8	0.2
Ivory	1	0.07	3	0.09	4	0.1
Chicken	0	-	43	1.42	43	1.0
Crocodile	1	0.07	0	-	1	0.02
Fish	1	0.07	13	0.43	14	0.3
Eggshell	1	0.07	0	-	1	0.02
Nile oyster	1	0.07	24	0.79	25	0.6
Cypraea grayana	0		2	0.06	2	0.04
NISP	1280	100 / 61.21	3008	100 / 86.21	4291	100 / 76.85
UNIDENTIFIED	811	38.78	481	13.78	1292	23.14
TOTAL	2091	100	3489	100	5583	100

Fig. 4
Species distribution
of animal remains
from Banganarti, Late
Christian period

The model of meat consumption seen in the zone to the northeast and north of the church in the same period is entirely different. Here pork and the meat of small ruminants dominated the diet. In contrast to the southern zone, the share of beef in the diet was low.

Thus, two different socio-topographical zones can be identified in the settlement surrounding the lower church. First, there was a zone of buildings located south of it, where either beef was dominant on the table or all available types of meat were eaten in similar proportions. Second, in the part of the settlement located north and northeast of the lower church, there was a clear preference for pork, which at that time was an absolute novelty and was most likely a factor of identification with the Byzantine-Mediterranean cultural sphere.

The archaeozoological data suggest that an inevitable unification of food preferences in meat consumption took place over time. This was probably a reflection of the general processes taking place in Banganarti in the socio-cultural field. Consumer preferences are a very permanent element of the cultural package, often relating to identity. However, changes in this field are extremely slow and limited, if they occur at all. Drastic and rapid changes in consumption preferences can only occur due to disasters: climatic, social and political. Therefore, analyses of consumption models,

CONTEXT (part of settlement) / PERIOD	CATTLE	SHEEP/GOAT	PIG
SW (Early Christian)	2	2	2
SE (ECh)	3	2	1
NE (ECh)	1	3	3
SE (Classical Christ.)	2	2	1
NE (CCh)	2	1	2
Fortification (CCh)	2	1	3
SE (Late Christ.)	3	1	2
NE (LCh)	1	3	2
	(1)	(2)	(3)
Cattle	34%–40%	41%–47%	48%–56%
Sheep/goat	31%–37%	38%–45%	46%–53%
Pig	6%–12%	13%–19%	20%–26%

Fig. 5

Models of meat consumption in terms of topography and chronology, based on frequency categories of animal remains, presented based on the numerical cypher method ((1) – low percentage; (2) – average percentage; (3) – high percentage listed in Banganarti)

of which meat consumption is an essential element, are a good indicator for research on specific communities' ethnic, demographic, and cultural backgrounds.

There is no sign of any violent processes that could have affected the Banganarti community during the lower church's operation period and in the post-reconstruction phase. In the Classic Christian period, as in the oldest phase, two emerging consumption models can be identified, although their differences had become more subtle. The main feature of the diet of the Banganarti people during this period was its relative uniformity of the level of beef consumption. The differences now concerned the proportion of small ruminants and pork in the diet. While in the southern zone, as in the early period, interest in pork was low and mutton consumption was average, in the northeastern part of the settlement and in the fortifications, pork was a very important component of the diet. A noticeably low proportion of sheep and goat remains was found in northeastern Banganarti and around the perimeter walls. Thus, there was a continuation of the consumption patterns observed already in the early period, although the differences between the diets of the inhabitants of individual parts of Banganarti were somewhat blurred.

However, the unifying trend in consumption preferences was reversed in the Late Christian period. At that time, apparent, sharp differences between the models of meat consumption in the southern and northern zones of the settlement reappeared. In the households situated southeast of the Raphaelion, beef dominated the diet as in the early period, while the meat of ovicaprids and pigs was eaten little. In contrast, the latter types of meat predominated on the tables of the inhabitants of northeastern Banganarti.

Models of Meat Consumption in Banganarti

Archaeozoological analysis of the animal remains from Banganarti reveals the socio-topographical diversity of the settlement in terms of its inhabitants' consumption patterns. Throughout the operation of the pilgrimage centre

in Banganarti, two zones can be distinguished, the inhabitants of which differed slightly in meat consumption preferences.

In homes south of the Raphaelion, the diet model appears to be more traditional and elite, according to the current state of knowledge about animal use in the Middle Nile Valley and the characteristics of meat consumption during the Meroitic period, for instance.⁵ From late prehistory through the entire Kushite civilisation, the proportion of beef in the diet seems to be closely correlated with the social or religious status of consumers. Archaeozoological data from numerous Napatan and Meroitic centres in the Middle Nile indicate that the higher status of the inhabitants of a given centre is reflected in the diet model and a high or very high proportion of beef in it. Only cattle remains have been discovered in major religious centres (e.g. Jebel Barkal, Muweis, Sonyat). Therefore, it seems reasonable to infer that cattle breeding and beef consumption constituted an essential and very permanent element of the traditional cultural model of the Middle Nile Valley civilisation.⁶

The people living in the southern part of the Banganarti settlement preferred beef in their diet throughout the entire period of functioning of the centre. There are contexts (e.g. part of the southeastern zone in the Early Christian period) where the proportion of bovine remains in the bone material was very clearly dominant. Interestingly, in the material from this zone, the remains of cattle varieties were discovered that differed from the local population – long-horned cattle and zebu-type cattle. In contrast, people in northern and northeastern Banganarti ate much more mutton and pork, whereas the share of beef in their diet was relatively low.

Based on the results of archaeozoological analyses, various hypotheses can be proposed to account for the socio-topographical diversity of the Banganarti inhabitants' diets, which also persisted throughout the existence of both Raphaelions, although to a varying extent.

The first hypothesis concerns the socio-ethnic diversity of the Banganarti people. Based on our knowledge of the cultural elements that are typical and traditional for Nubia, we can assume that in the southern sector lived mainly local people, cultivating a rather traditional diet for Upper Nubia. In this scenario, the northeastern zone would be inhabited mainly by people enjoying a different diet, one that was foreign to Nubia but somewhat similar to the dietary models of the Byzantine-Coptic civilisation. They may have been pilgrims, people coming from the north (e.g. Egypt or Nobadia), or a part of the community that strongly emphasised Byzantine cultural patterns. Interestingly, the remains of game animals were also noted much more often in the material from the northeastern part than in houses on the southern side of the church. Though much less pronounced, this is another factor that distinguishes the traditional Nubian diet model, in which game animals were a negligible element.

The second hypothesis explaining the variation in consumption patterns is that it resulted from differences in social and economic status. In this respect,

⁵ OSYPIŃSKA 2018.

⁶ CHAIX 2010; 2011; OSYPIŃSKA 2018.

	ALWA	MAKURIA	
	Soba	Old Dongola	Banganarti
Cattle	55,0%	35,01%	43,7%
Sheep/goat	42,4%	45,91%	38,2%
Pig	-	13,02%	13,2%
Dog	0,1%	0,02%	0,05%
Donkey	0,04%	0,02%	2,4%
Dromedary	0,1%	0,05%	2,0%
Cat	0,02%	0,57%	-
Domestic animals	97,9%	98,39%	99,8%
Giraffe	0,04%	-	-
Large antelopes	0,01%	0,03%	-
Dorcas gazelle	0,02%	0,45%	0,1%
Gazelle	0,03%	-	-
Warthog	0,01%	-	-
Lion	0,01%	-	-
Fox	0,1%	-	-
Carnivores	0,01%	-	-
Hare	0,04%	-	-
Mikrofauna	0,3%	-	-
Birds	0,07%	0,51%	-
Crocodile	0,01%	-	-
Reptiles	0,03%	-	-
Fish	0,3%	4,34%	0,1%
Mollusc	0,9%	0,02%	-
Wild animals	2,1%	1,6%	0,2%

Fig. 6

Species distributions of animal remains from early medieval centres in Alwa (Soba, after CHAIX 1998) and Makuria (Old Dongola and Banganarti)

a part of southern Banganarti may have been inhabited by people of relatively higher social status, with easier access to prestigious goods and foodstuffs. Current knowledge about the economy of Makuria indicates that cattle breeding and the mass turnover of large herds fell within the ruler's competence and constituted an essential resource for the state's wealth and power. This was a continuation of the traditional economic model of the Middle Nile civilisation since the end of prehistory.

During periods of a limited supply of goods, such as during state formation or decline, resources would be accessible mainly to the elite. Such a picture would explain the temporal levelling of differences in consumption during Makuria's greatest prosperity (the Classical Christian period), and the differentiation in the early and declining periods. However, the possibility that both hypotheses proposed above could have impacted the socio-topographical differences of Banganarti cannot be ruled out.

In more general terms, analysis of the sanctuary's economy reveals the specificity of its inhabitants' cultural and social composition and its visitors or pilgrims.

Fig. 7

Proportions of domestic animal remains in early medieval assemblages

	CATTLE	SHEEP/GOAT	PIG/OTHER DOM.
Soba	56.2%	43.4%	0.3%
Old Dongola	37.2%	48.8%	13.86%
Banganarti	46.4%	39.3%	14.24%

Fig. 8

Economic models in Nubia's early medieval centres based on frequency categories of animal remains, presented based on the numerical cypher method ((1) – low percentage; (2) – average percentage; (3) – high percentage listed in Nubia)

	CATTLE	SHEEP/GOAT	PIG/OTHER DOM.
Soba	3	1	1
Old Dongola	2	2	3
Banganarti	3	1	3

Cattle:	Sheep/goat:	Pig/other dom.:
(1) 21.6%–33.2%	(1) 33.1%–46.5%	(1) 0%–5%
(2) 33.3%–44.9%	(2) 46.6%–60.0%	(2) 6%–12%
(3) 45.0%–56.6%	(3) 60.1%–73.5%	(3) 13%–19%

Banganarti was very clearly a meeting point of cultures: the traditional Nubian model on the one hand and, on the other, cultural patterns arriving from the north together with the new religion and the civilisation package in which it was embedded.

Animal Use in Banganarti Compared with Other Early Christian Centres

For a fuller understanding of the economic specificity of Banganarti in terms of animal use, a comparative analysis was performed on the available archaeozoological data from other centres with analogous chronology. Data from the royal residence at Old Dongola, the capital of Makuria, and from Soba, the capital of Alwa, were used (**Fig. 6**).

The results of the analysis based on frequency categories of animal remains led to some interesting observations. Soba and Banganarti proved to be more similar in animal use than Banganarti and nearby Old Dongola. Cattle remains predominated in the osteological material from Banganarti and Soba. Only in the palace of the early rulers of Makuria in Old Dongola were there fewer bones of cattle than sheep and goats (**Fig. 6**). A clear difference between the Makurian centres and Soba concerned pigs, which have not been recorded at all in Alwa. The data indicate that dogs and donkeys lived in all the Nubian centres analysed; interestingly, their remains occurred in the highest proportions in the materials recovered from Banganarti. The same was the case with dromedary remains: at both Soba and Old Dongola, camel bones accounted for a negligible percentage, while at Banganarti the percentage of camel bones was relatively high (**Fig. 6**). Cat bones were found only in the two state capitals. Other elements connecting the osteological materials from Soba, Old Dongola and Banganarti were the presence of dorcas gazelle remains and the negligible proportion of fish material. Only at Old Dongola was the frequency of fish bones slightly higher due to many remains of tiny fish.

**Fig. 9**

A herd of cattle in the vicinity of Sennar, Gezira. Photo by Marta Osypińska

More strikingly, contrasting animal management models are expressed in the percentage data for domesticated animals (**Fig. 7**). The main difference between the Makurian centres and Soba was the greater diversification of husbandry in Makuria. Despite the traditionally prominent role of ruminants there, other breeding species, especially pigs, were also important. On the other hand, Soba in the early Middle Ages appears to have followed a very conservative economic model, simply mapping Meroitic patterns (**Fig. 7**).

The osteological material from the period of the formation of the Christian kingdoms suggests that the factor in which the economic models of Makuria and Alwa most resembled each other was the comparable level of small ruminant consumption and probably breeding. The main differences concerned other species, especially cattle and pigs. Interestingly, in terms of the role of cattle in the economy, Banganarti is comparable to the capital of Alwa rather than to nearby Old Dongola. It seems that generally, in Makuria, the slightly lower importance of cattle in the diet was counterbalanced by the significant proportion of pork. In Soba, however, breeding and consumption were limited to ruminants only. Relevant in this respect is the hypothesis that the traditional Meroitic economic model, mainly based on the prestigious importance of cattle in the economy, was continued to some extent in Alwa, located near the centre of the former kingdom of Meroe. Favourable ecological conditions in the Gezira, the area at the fork between the Blue and White Nile, allowed ruminant farming to be conducted on a much larger scale than in the desert further north. The green belt is limited to a narrow strip no more than a few hundred metres wide along the river in the Southern Dongola Reach.

Analysing economic models based on frequency categories of animal remains confirms the previous observations (**Fig. 8**). Two distinct economic models are formed here, one for Soba and Banganarti and another for Old Dongola. In the palace of the rulers of early Makuria, a 2-2-3 pattern is found, i.e. average proportions of both cattle and small ruminant remains and a large proportion



Fig.10

(A) Cattle on pasture, Old Dongola area, Southern Dongola Reach; **(B)** cattle grazing near Banganarti. Photos by Marta Osypińska

of pigs. In contrast, the second model – 3-1-3/1 – is observed at Soba and Banganarti. A high proportion of cattle characterises the remains, a low proportion of small ruminants and a low (Soba) or high (Banganarti) proportion of other farm animals (here pigs). Therefore, the Banganarti assemblage essentially represents a model of animal use close to the traditional Nubian pattern, which is also observed at Soba. However, the Banganarti model also had an element in common with the Dongola model: an important economic role for the pig.

The factors determining the diversification of the role of animals in the economies of medieval nations in the Middle Nile Valley were undoubtedly complex. However, an attempt can be made to identify at least some of them. One of the most important factors influencing the pattern of animal use were the ecological conditions of each region. Both 1,500 years ago and today, these conditions are markedly different in the Southern Dongola Reach and the Gezira area. The possibility of breeding large ruminants like cattle – a species traditionally important in the economies of Nubian civilisations – seems to be of crucial importance here. In the Gezira, both the higher annual rainfall⁷ and the geomorphological and ecological conditions have been conducive to the large-scale development of ruminant breeding for centuries (**Fig. 9**).

Interestingly, these are also contemporary factors. South of the Nile confluence, a diametrically different model of ruminant breeding from that implemented between the Third and Fourth Cataracts can be observed.

Large herds, sometimes consisting of hundreds of small ruminants and cattle, are widely grazed in the Gezira area (**Fig. 9**). In contrast, north of the Nile confluence, cattle are bred much less frequently, either individually or in small groups (**Fig. 10**), while small ruminants are kept in small herds at home. There is virtually no practice of nomadic grazing. The only region north of Khartoum where the economy is based on nomadic grazing of large herds of sheep and goats is Bagrawiyah, in the former

⁷ IRELAND 1948.

Island of Meroe. However, outside this region up the Nile from the Fifth Cataract, cattle farming is home-based, stationary, and occasional.

Pig farming may have been introduced in Makuria to eliminate severe shortages in meat supply for the new centres being formed, given the environmental unsuitability of the area for grazing. Pigs must initially have been imported, since the species was not previously bred in Upper Nubia. They are ideally suited to this type of undertaking due to their fertility, fast growth and tasty, fatty meat. Additionally, religious and cultural factors could have had a significant, perhaps decisive, influence.⁸ Pork consumption was a significant feature of the diet in the Byzantine Empire, which undoubtedly inspired the emerging kingdom of Makuria. In addition, keeping pigs and eating pork may have been an essential element in building a distinct cultural identity in an area where Islam was rapidly spreading, as was also the case in Egypt and other areas of North Africa. The possibility cannot be ruled out that the specifically different model of meat consumption in the palace of the early Makurian rulers could have had a cultural or ethnic origin. There was likely a large group of people associated with Byzantine culture at the court in the early period, for whom pork was a vital part of the diet. Such a pattern of consumption could have then spread among the aspiring elites of early Makuria.

Good ecological conditions for raising ruminants in Alwa did not necessitate the introduction of new species. The location of Alwa, the most distant of the medieval kingdoms of the Middle Nile from the zone of Coptic-Egyptian influence, may also have had some bearing on the pig's failure to be adopted there. On the other hand, conditions in Alwa were favourable for the continuation of the traditional economic model for this part of the Nile Valley, based solely on the breeding of ruminants, mainly cattle.

However, the ecological and environmental factors identified above that determined the contrasting economic importance of cattle breeding in Baganarti and Soba did not account for the differences in the consumption models between the individual Early Makurian centres.

Meat Consumption in Baganarti Compared to Other Early Christian Centres

Due to the methodology used by L. Chaix in his research, the technological division of the Makurian cattle carcass was modified for the needs of the analyses (Fig. 11). The main change was the combined consideration of the numerical data for the distal limb bones and phalanges.

The results of comparative analyses of the anatomical distribution of the remains proved to be very interesting. It was observed that the split model

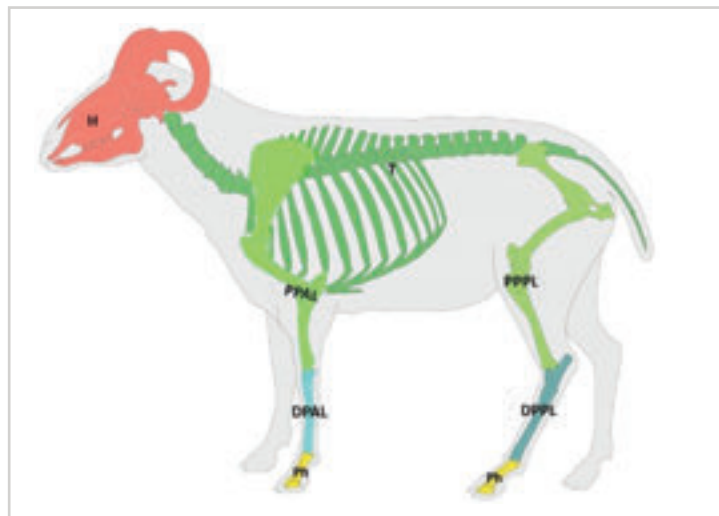


Fig. 11

Elements of the animal carcass analysed in this work: H – head, T – thorax, PPAL – proximal part of anterior limb; DPAL – distal part of anterior limb; PPPL – proximal part of posterior limb; DPPL – distal part of posterior limb, Ph – phalanges

⁸ OSYPIŃSKA, ŻURAWSKI 2020.

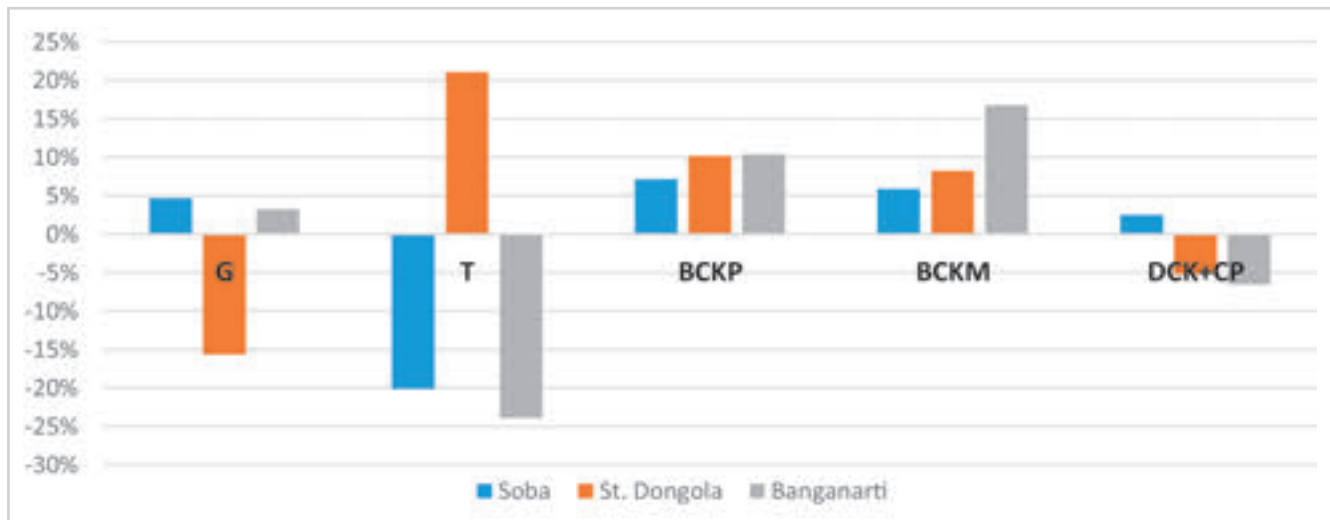


Fig. 12
Proportions of cattle carcass elements in individual centres from the Early Makurian period

of bovine carcasses was very similar at Soba and Banganarti, whereas the anatomical distribution of the cattle remains from the palace at Old Dongola was utterly different (**Fig. 12**).

The main differences concerned the proportions of head and trunk elements in the assemblages. In the material from Soba and Banganarti, slight surpluses of the head remains, i.e. skull bones, teeth and horn cores, were observed in relation to the standard skeleton (**Fig. 12**). However, in the deposit discovered in the rulers' palace at Old Dongola an apparent deficit of such remains was noticeable. A different situation applied to bone fragments from the trunk, i.e. ribs and vertebrae. A significant deficit of such remains – approximately 20% less than expected – was observed in the assemblages from Soba and Banganarti. In contrast, the deposit from the Old Dongola palace showed a 20% surplus of cattle trunk remains (**Fig. 12**).

The differences seen in the methods of dividing beef carcasses between Banganarti and Soba on the one hand and Old Dongola on the other are very similar to the differences recorded in the Banganarti area at different times. The fundamental differences in the exploitation of beef carcasses concerned parts of the head and trunk and the intensity of their processing.

Analysis of the functional aspect of the locations where the remains were discovered at the three sites examined suggests that it may be of major importance in accounting for the identified differences. The osteological material from Soba and Banganarti came essentially from sedimentary strata. They contained waste from various stages of dividing the animal carcass. It appears that the consumption of beef heads was a common practice in Nubia. On the other hand, the vertebrae and ribs were usually not broken down after filleting the meat.

Small, comparable surpluses of bone fragments from the most attractive parts of the beef carcass were recorded (**Fig. 12**). These concerned the remains of both the thoracic and the pelvic limbs. Such a picture seems to indicate that the pattern of using the shoulders and legs of the beef carcass was very similar in both Makuria and Soba. The only difference identified in the division and use of cattle carcasses due to geopolitical reasons involves the proportions of bones

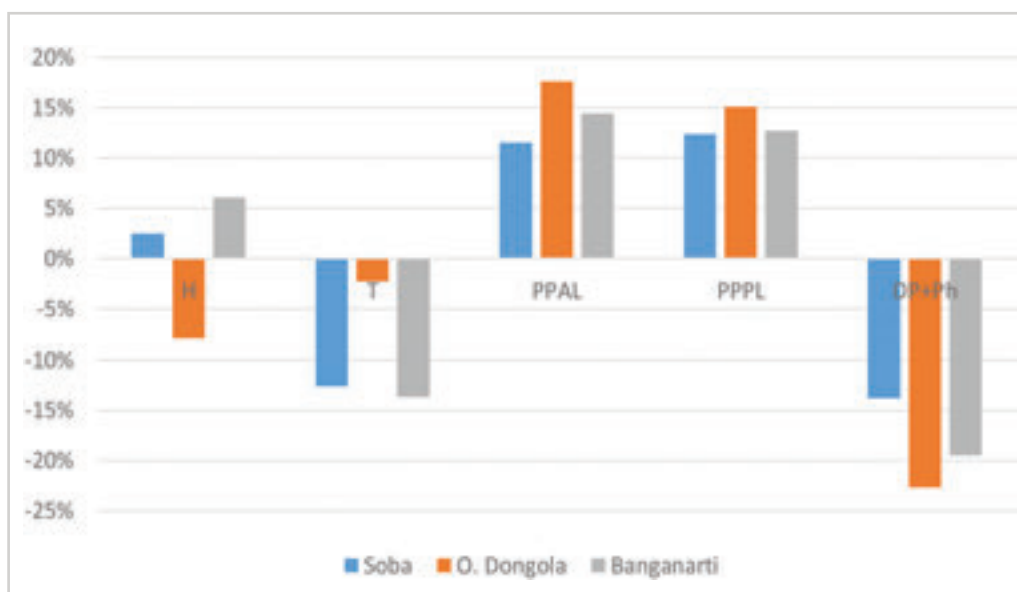


Fig. 13
Surpluses and deficits
of sheep and goat
carcass elements from
Soba, Banganarti and
Old Dongola (sixth–
ninth centuries)

from the least attractive parts of the cattle carcass. At Soba, there was a slight surplus of remains from the distal parts of the limbs and the phalanges, while at both Banganarti and Old Dongola there were noticeable deficits of these parts of the carcass (**Fig. 11**). Such variation may result from various factors. First, there is a possibility that archaeological research at Soba covered locations where waste from the early stages of cattle carcass division was deposited. Considering that the Old Dongola citadel and Banganarti covered a limited area, the bulky waste from the initial stages of carcass division could be thrown outside the city walls. Second, it is also possible that the distal parts of the limbs were to some extent used for consumption in the Soba area. Finally, a third possibility may be related to the state of preservation of the osteological material from Soba. As Chaix mentions several times, it was in deplorable condition.⁹ Many years of research experience in Africa show that small bones – carpals, talus and calcaneus bones, and phalanges – survive better than other, more frequently fragmented skeleton elements. Additionally, bones from metapodial segments are relatively easy to identify, even when considerably fragmented. Perhaps, therefore, the research conditions at the time of assessing the animal remains from Soba were not without significance.

The small ruminant carcass division model was comparable at the Makurian and Soba sites. Nevertheless, more parallels can be observed between the Soba and Banganarti data than the two Makurian centres. Comparative analysis shows that the anatomical distribution of small ruminant remains from the deposit discovered in the palace at Old Dongola was the most different. It was deficient in head remains, while at Banganarti and Soba there was a surplus of this part of the skeleton. In contrast, the shortage of trunk elements was very slight compared to the Banganarti and Soba materials (**Fig. 13**). The remaining carcass elements of sheep and goats were very similar in all three early medieval sites. The bones from the proximal limbs were the most fragmented and modified during the preparation of meat for consumption (**Fig. 13**).

⁹ CHAIX 1998.

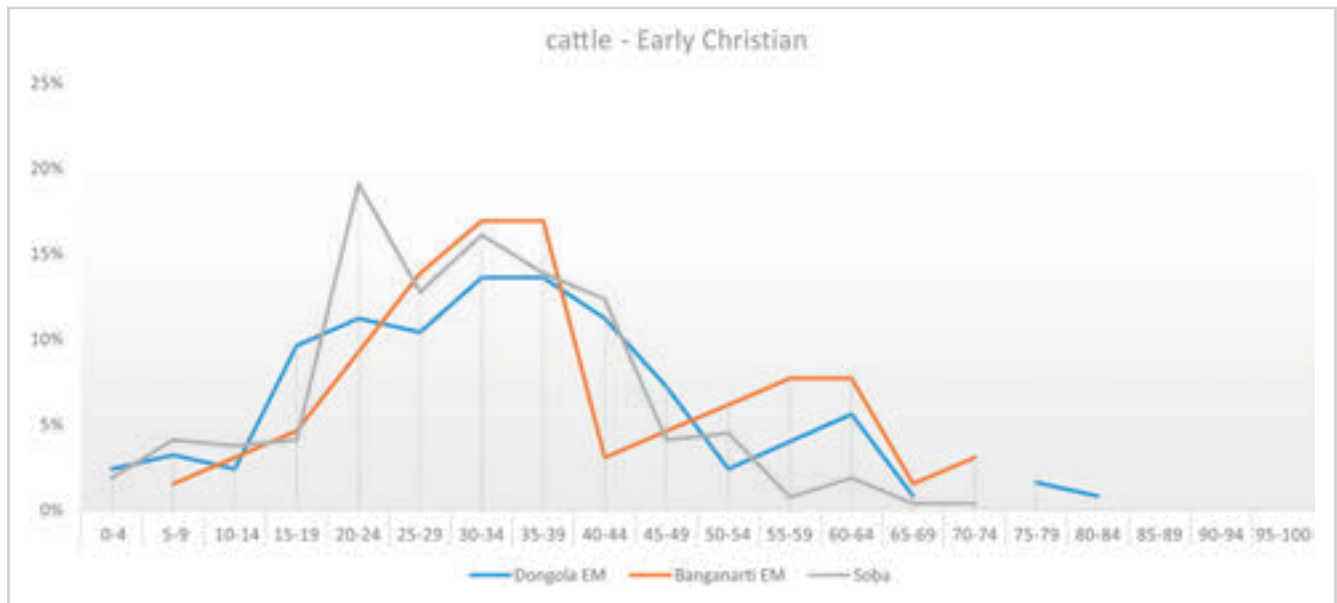


Fig. 14

Summary of cattle osteometric data transposed to point scales, from the early medieval sites of Old Dongola, Banganarti and Soba

Data on the frequency and percentage of remains of immature individuals from Soba are unavailable. Nevertheless, they indeed constituted a prominent part of the cattle remains there.¹⁰ The vast majority of them originated from individuals killed as sub-adults between two and three years of age. Similarly, cattle were selected by age in Makuria, where the frequency of bones of very young animals was negligible. Summary data on the percentages of young animal remains for individual species show differences between the materials from Old Dongola and Banganarti.

It should be noted, however, that in both locations, juvenile meat formed a tiny part of the diet. Juvenile beef was eaten more often in Banganarti than in the residence of the Dongola rulers. Interestingly, the percentages of immature sheep and goat remains are identical in both early centres, although they are lower than in the case of cattle. However, in the palace in Old Dongola, pork from young animals was eaten much more than in Banganarti.

Animal Husbandry in Banganarti Compared to Other Early Christian Centres

The state of preservation of the animal remains from the early medieval sites, especially Soba, and their processing for meat consumption resulted in considerable fragmentation. Consequently, despite many items, relatively few data were obtained that could be used to address the animals' morphology. However, careful statistical analysis provided scientifically valuable data on the populations of animals kept in Alwa and Makuria. In the early period, cattle in both areas were slaughtered when they reached a similar height at the withers, approximately 120–140 cm. However, some morphological differences were found between the populations of the Southern Dongola Reach and the Gezira. Bone widths of Soba cattle, particularly in the acropodium, were equal to or slightly

¹⁰ CHAIX 1998.



Fig. 15

(A) Large modern sheep varieties from the Gezira area;
(B) a modern variety of sheep from the Banganarti area

greater than those of Makurian cattle. Banganarti cattle, on the other hand, had higher values for the length and width of bones from the distal parts of the limbs: the metapodium and zeugopodium. Therefore, it can be assumed that the cattle of Makuria were more slender and longer-legged than those of Soba. Such features are typical of native African cattle. The cattle from the palace at Old Dongola were the most morphologically diverse of the assemblages from the early medieval centres analysed: both very small-bodied individuals and animals significantly larger than those recorded at the other early medieval sites were exploited.

The Soba cattle remains represented a relatively small to average-sized and homogeneous cattle population (**Fig. 13**). Generally speaking, the breed was slightly smaller and stockier than the cattle of Makuria. However, larger animals were also present at Old Dongola and Banganarti, apart from the predominant average-sized stock. Therefore, there are indications that early Makuria exploited both local, small cattle and imported cattle from populations larger and smaller than native Southern Dongola Reach cattle (**Fig. 14**).

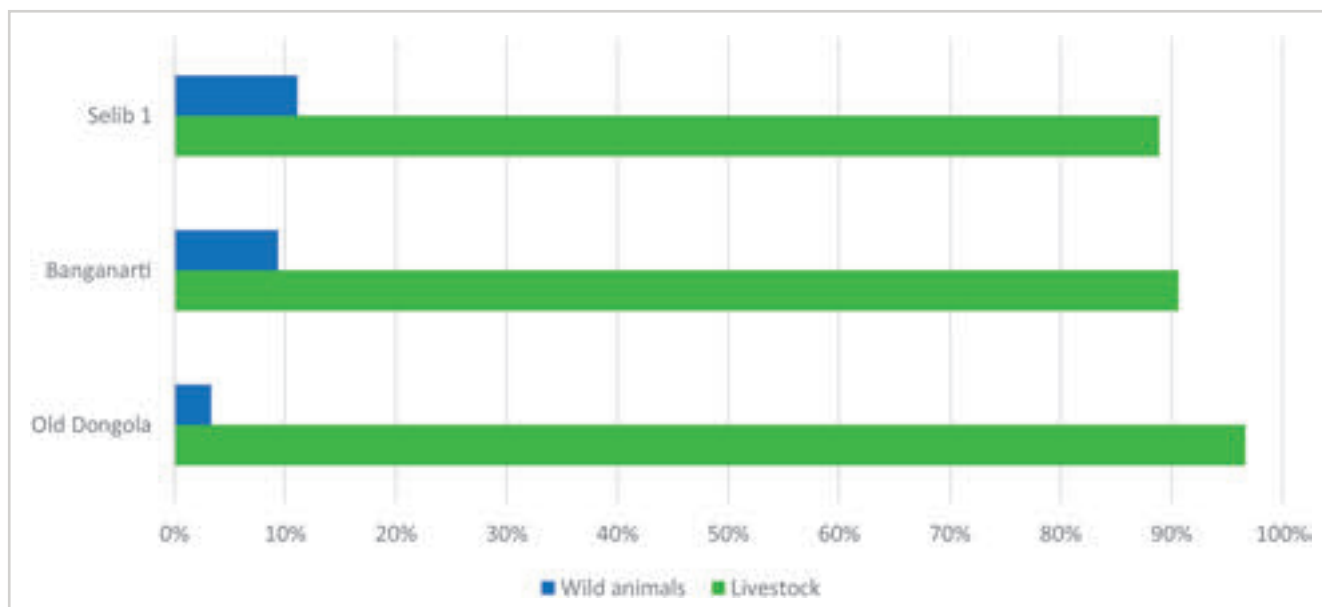
The results of a comparative analysis of the morphotype of the cattle population in the early medieval countries in the Middle Nile Valley allow for the formulation of preliminary hypotheses. The first of these assumes that the traditional model of local cattle breeding continued in Alwa in the sixth–ninth centuries, most probably with animals morphologically similar to Meroic cattle. These were relatively stocky, short-horned cattle, with solid bodies and not very tall.¹¹ The second hypothesis suggests a dynamic process of cattle breeding in the area of Makuria, which was forming simultaneously. In the Southern Dongola Reach, between the sixth and tenth centuries, local cattle were used as well as imported cattle from other regions with a slightly different morphology – larger and longer-legged than the local stock.

There was also a specific diversity in the sheep reared in the early medieval centres in the Middle Nile Valley. Comparative analysis showed that Soba sheep were slightly larger than those exploited in Makuria. The differences are pretty straightforward. Notably, the sheep population of Old Dongola was higher, also considering data from the earlier post-Meroitic period for the Dongola Reach border region near the Fourth Cataract and the cataract itself. On the other hand, the sheep used in Banganarti were slightly smaller than in the capital itself (**Fig. 15**).

Although there were no diametric differences between the sites, the morphological diversity of the cattle and sheep populations reared in Makuria and Alwa was noticeable. Instead, there was a kind of ecological or regional dissimilarity within the broadly understood populations of traditional ruminant breeds in North-East Africa.

The main conclusion that can be drawn from comparing the importance and economic role of animals in these early medieval centres is that there was greater dynamics and diversity in the Makurian centres than in Alwa. This was especially true of Banganarti, where elements typical of both Soba and Old Dongola can be seen. The data from Soba seem to indicate a continuation in this region of breeding traditions from the earlier Meroitic and Kushite periods. It also appears that at the end of the first millennium A.D., the Gezira region was more demographically stable and somewhat remote from the dynamic processes taking place at that time further north in Nubia. These processes were reflected in breeding models and the scale of dynamic morphotype changes in domestic animals and the adaptation of species new to this region. The leader in this aspect was the Makurian capital, Old Dongola, which witnessed the most significant morphological diversity of ruminants and the earliest presence of the pig as a farm animal.

11 CHAIX 2011.

**Fig. 16**

The proportions of domestic and wild animal remains at the late-Makurian sites

	CATTLE	SHEEP/GOAT	PIG
Old Dongola – citadel	3	1	1
Old Dongola – monastery	3	1	2
Banganarti	2	1	3
Selib s. 1	1	3	1

Cattle:	Sheep/Goat:	Pig:
(1) 21.6%–33.2%	(1) 33.1%–46.5%	(1) 0%–5%
(2) 33.3%–44.9%	(2) 46.6%–60.0%	(2) 6%–12%
(3) 45.0%–56.6%	(3) 60.1%–73.5%	(3) 13%–19%

Fig. 17

Models of the economy at late-Makurian sites based on frequency categories of animal remains, presented based on the numerical cypher method ((1) – low percentage; (2) – average percentage; (3) – high percentage listed in Nubia)

Interestingly, Banganarti in the early period shows features both of traditional Nubian models, as seen in Soba, and of the progressive changes that are most clearly visible at Old Dongola. Thus, despite many analogies pointing to a shared tradition of animal management, in the period between the sixth and tenth centuries, Makuria appears to have been influenced by dynamic processes. At the same time, Alwa was a conservative area without the pressures of geopolitical, demographic or climatic changes. Against this background, Banganarti, with its unique functional specificity, seems to have been a centre where the encounter of different traditions of animal use took place. Its specificity was additionally strengthened by animals associated with transport – donkeys and camels – unlike the other centres of that period.

Animal Use in Banganarti Compared to Other Late-Makurian Centres

Material providing evidence for the economic role of animals in the Late Christian period in Nubia is currently only available from Makuria. These data

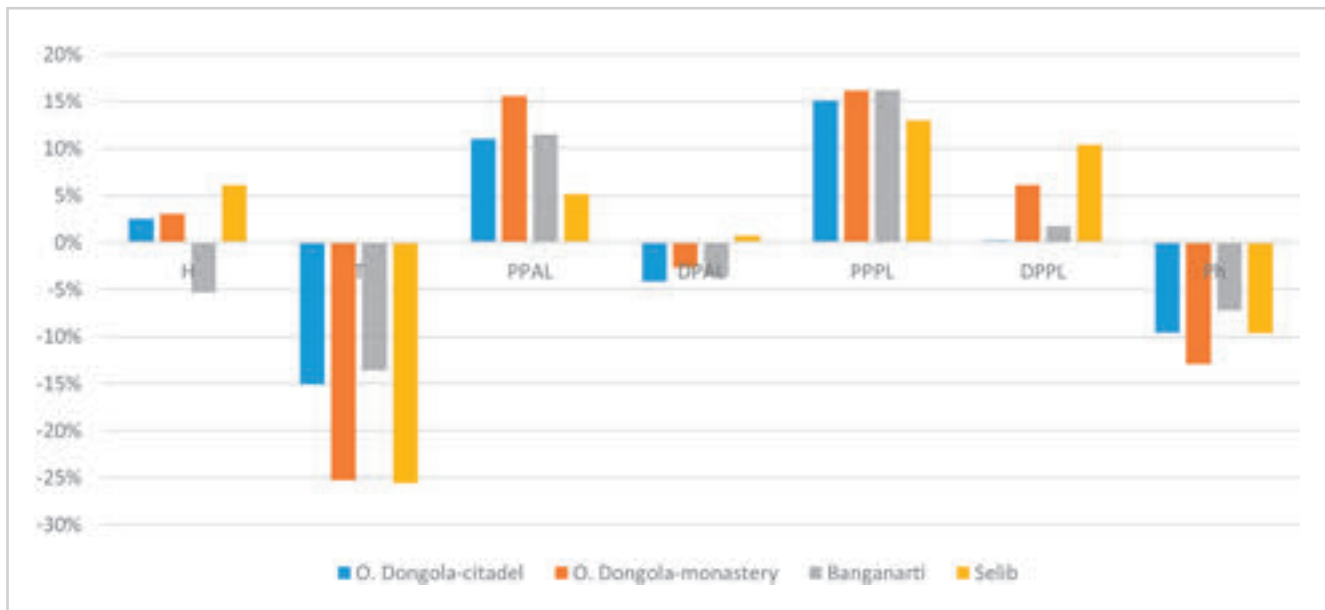


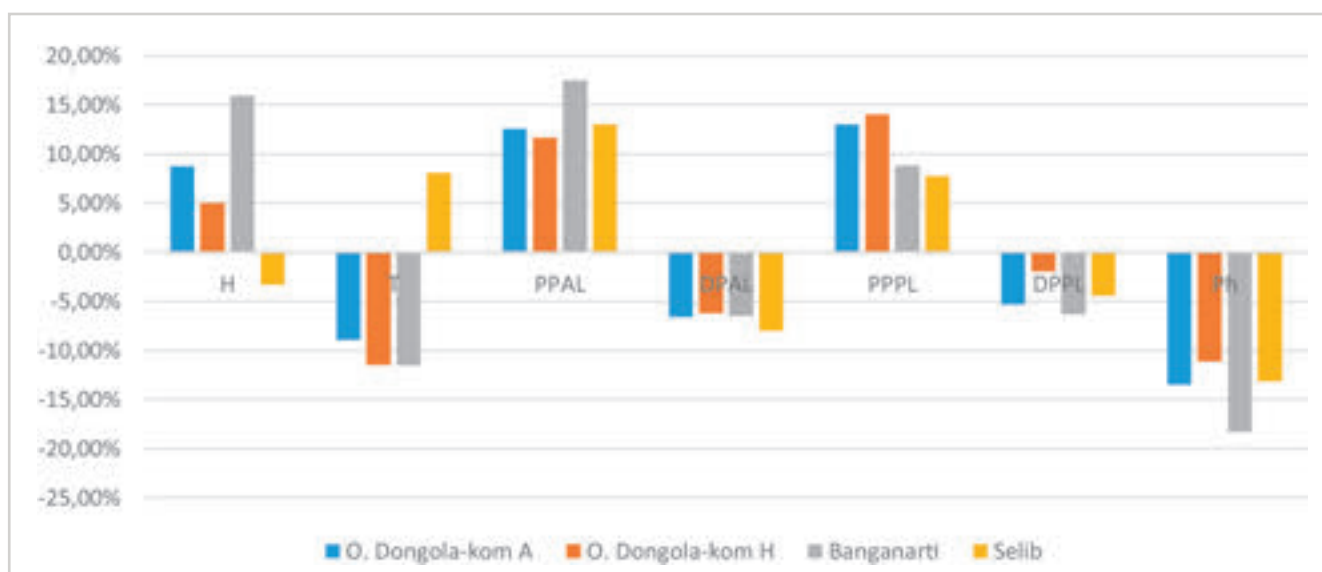
Fig. 18
Surpluses and deficits of individual parts of the beef carcass in osteological material from late-Makurian sites (H – head, T– thorso, PPAL – proximal part of anterior limb; DPAL – distal part of anterior limb; PPPL – proximal part of posterior limb; DPPL – distal part of posterior limb, Ph – phalanges)

come from four functionally differentiated sites: the citadel at Old Dongola, the monastery at Old Dongola, the settlement and church at Banganarti, and the settlement and church at Selib.

Models of Meat Consumption in Late Christian Makuria

Although the medieval locations analysed are topographically close to each other, their specificity was revealed by their patterns of meat consumption and animal management. One of the significant differences between Old Dongola, Banganarti and Selib is the proportion of domestic and wild animal remains in the material recovered (**Fig. 16**). The most extreme example is the osteological assemblage from the monastery area at Old Dongola, where, apart from fish and oysters, the recorded remains were almost exclusively of farm animals. In the late-Makurian fauna collections from the citadel, the proportion of wild animal remains was negligible. A similar pattern occurred at Banganarti, where although several species of game animals were recorded in the material, their share in the total number of bones from the late stages of settlement was meagre. However, at Selib, game animals constituted a prominent part of the faunal remains collected (**Fig. 16**). The critical correlation here appears to be between the political and social rank of a given centre and the proportion of wild animal meat in the diet: the lower the locality's status, the greater the pressure to supplement the diet with game meat.

Osteological material from the citadel area and Banganarti stood out from the rest regarding the number of animal species recorded from Late Christian contexts. In both locations, remains of mammals, birds, reptiles, and fish have been identified. Furthermore, the list of game animals at Banganarti (bushpig, oryx, hare, dorcas gazelle) was extensive. In addition, at both Late Christian Dongola and Late Banganarti, bones of domestic hens were recorded for the first time. In contrast, almost exclusively mammalian remains have been discovered at the monastery at Dongola and the small church settlement at Selib.

**Fig. 19**

Surpluses and deficits of individual parts of the ovicaprid carcass in osteological material from late-Makurian sites, (H – head, T – thorso, PPAL – proximal part of anterior limb; DPAL – distal part of anterior limb; PPPL – proximal part of posterior limb; DPPL – distal part of posterior limb, Ph – phalanges)

A comparative analysis of individual models of animal management at the different sites showed interesting regularities. The models of animal use at the monastery on Kom H at Old Dongola and Banganarti were the closest (**Fig. 16**). There was also a very marked difference between the economies of the Old Dongola citadel and Selib. The animal use model for the citadel area at Old Dongola was characterised by the predominance of cattle and the lesser role of other animals: sheep, goats and pigs. At the sites that can be described as important political and religious centres (Banganarti and Old Dongola), the importance of sheep and goats was low (**Fig. 17**).

In contrast, in the small, provincial village of Selib, small ruminants dominated the economy. Pig rearing was also important there, while cattle rearing played the most minor role among all the late-Makurian centres included in the research.

Interestingly, in the late period, pigs played their most significant economic role in Banganarti. Again, as was the case with the importance of wildlife in the economy, the political function and status of the site seem to have been the most critical factors in this context, determining the economic model of a given centre. In this light, the hypothesis assuming a correlation between the status of the centre and the importance of cattle breeding (the higher the status, the more significant the role of cattle in the economy and diet) seems to be justified. Greater economic importance of small ruminants would indicate a lower-rank centre, such as a rural settlement. It is noteworthy that a very similar relationship is suggested by analyses of economic models in the Meroitic period.

An interesting phenomenon related to meat consumption in the late period is the variation in the importance of pork. It was greater outside the Makurian capital in Banganarti and Selib. Considering the nature of the deposits from Old Dongola, it seems reasonable to think that they may have come from the episodic stays of the Mamluks and the growing Muslim population in the capital. The Old Dongola pig remains, discovered in contexts from the fourteenth century, do not have consumption characteristics. As in the early period, eating pork may have become an element of cultural and religious identity.

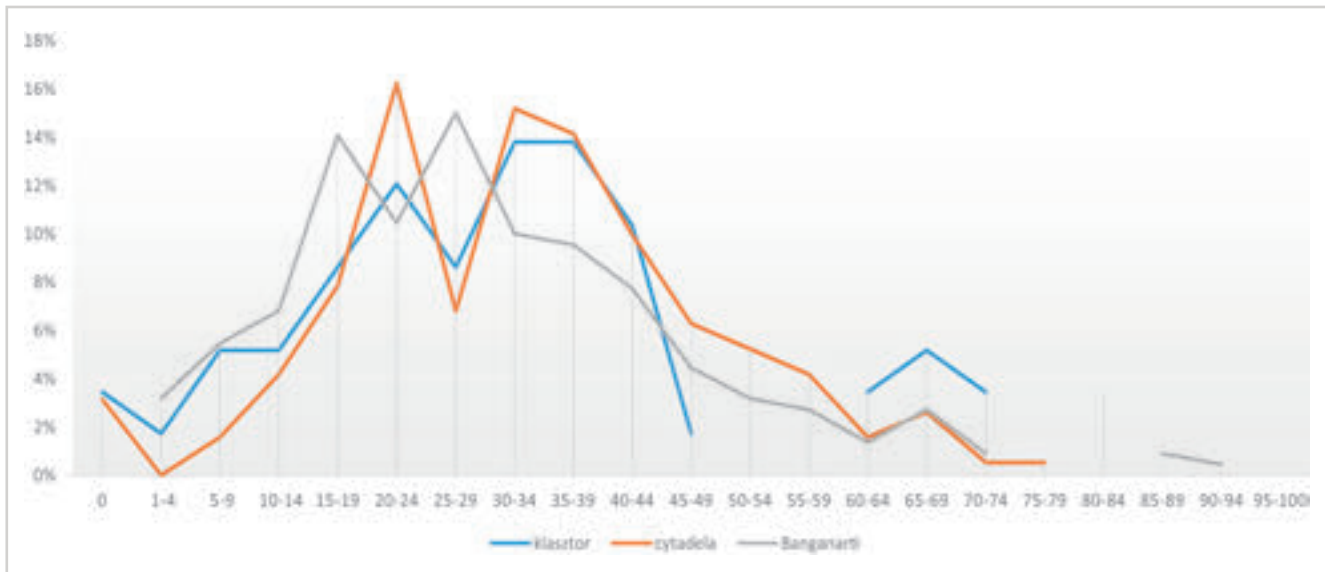


Fig. 20

(A) Cattle size based on osteometric data transferred to point scales from late-Makurian sites;
(B) horns of long-horn (primigenic) cattle discovered in the citadel of Old Dongola, thirteenth–fourteenth centuries



Comparing the treatment methods and use of beef carcasses in the late period in Makuria shows a reasonably uniform pattern (**Fig. 18**). In most of the osteological assemblages examined, there was a noticeable surplus of the head remains and distinct bones from the proximal parts of the limbs (**Fig. 18**). Only at Banganarti was there a small deficit of head remains.

A feature linking the three large late-Makurian assemblages was a significant shortage of trunk elements, especially in the bone material from the Old Dongola monastery and Selib. However, at Banganarti and the citadel, the deficits were smaller and comparable (**Fig. 18**).

**Fig. 21**

(A) The bipartite spinous process of Banganarti thoracic vertebra, typical of zebu cattle;

(B) contemporary zebu-type cattle. Photo by Marta Osypińska

However, the research showed greater between-site diversity in the methods of splitting sheep and goat carcasses (**Fig. 19**). The differences concerned especially the head and torso. In the material from Old Dongola and Banganarti, there was a noticeable surplus of the head remains, while at Selib there were fewer such bone fragments than in the reference skeleton. The Selib ovicaprid bone complex was also the only one with an apparent surplus of trunk elements, while at the remaining sites fragments of ribs and vertebrae were deficient.

Due to the low frequency of pig remains, except at Banganarti, it is much more difficult to compare the methods of dividing the pig carcass at the late-period sites. The common feature of all of these osteological assemblages was the relatively high frequency of remains of the head, torso and proximal part of the thoracic limb. Bones from the other parts of the pig carcass were recorded in minimal numbers, or no remains were recorded in a given category. Nevertheless, the available data suggest that a standard split model was also used for pig carcasses.

A comparative analysis of the age profiles of animals intended for consumption at the various late-Makurian sites indicated that the largest proportions of young sheep, goats, cattle and pigs were slaughtered in Banganarti. A relatively high percentage of young animal remains was also noticeable at the Old Dongola monastery. Was this a characteristic feature of osteological materials from religious centres, providing insight into the consumption model? The answer to such a question requires further research and a larger number of locations from the late period, but it is certainly a possibility worth considering. Interestingly, in the area of the Old Dongola citadel, the remains recorded were mainly of mature animals. Moreover, young animals in Selib were intended for consumption the least frequently. In relation to the above data, the hypothesis that both the monastery

and Banganarti exploited herds of animals raised mainly for the purpose of providing meat seems to be justified. This would apply to all ruminant species as well as to pigs. In contrast, taking into account the specificity of the settlement at Selib compared with other centres from the late period, the observations again seem to confirm the rural model of the economy at this site. Cattle were raised there most probably for their value alive as draught animals. The rearing of pigs to adulthood suggests the intention was to obtain meat that was more calorific and full of fat. Also, the slaughter of mainly mature sheep and goats indicates that these animals were exploited while alive.

Animal Husbandry in Banganarti Compared to Other Late Christian Centres

Undoubtedly, cattle breeding was a dynamic branch of the economy in late-period Makuria. Data from Banganarti, the Old Dongola monastery and the citadel indicate the presence of a morphologically diverse bovine population in the capital at that time. It included both short-horned cattle, which were probably slightly smaller, and long-horned cattle. Finds at Banganarti suggest that zebu cattle may have appeared at this time as well (**Fig. 21**). The results of osteometric analysis seem to indicate that in the late period, the cattle used in Old Dongola and its vicinity were morphologically quite diverse, but to a comparable extent regardless of the site (**Fig. 20**). At least two varieties appear to have coexisted at that time: smaller cattle, probably corresponding to the local short-horned breed, and larger, most likely long-horned, cattle with features of native African cattle. Only in Selib has no evidence of the presence of long-horned cattle yet been found. The size characteristics of the cattle from the Raphaelion and the settlement surrounding it indicate that a slightly smaller cattle breed was exploited there than the modern one found at Old Dongola.

Although the number of measurements did not allow for a complete analysis, the Selib cattle appear to have had the characteristics of short-legged cattle with relatively small bodies.

These observations on late-period cattle farming in Makuria are preliminary, although based on reliable data. New assemblages from additional locations will allow these hypotheses to be verified in the future. Preliminary isotope data indicate that in Banganarti, some non-Nile cattle were used in addition to the predominant local cattle.¹²

We have much less information on the morphological diversity of the sheep population in central Makuria in the late period. The results of osteometric tests are so few that they cannot be used as a basis for in-depth analysis. Sheep bred at that time measured from 54 cm to roughly 75 cm at the withers, so the range was quite comprehensive. In addition, of course, size differences resulting from sexual dimorphism have to be taken into account. However, the compilation of the size ranges of some osteometric data (the widths of the distal epiphysis of the humerus and the proximal epiphysis of the radius) showed interesting

¹² OSYPINSKA et al. *forthcoming*.

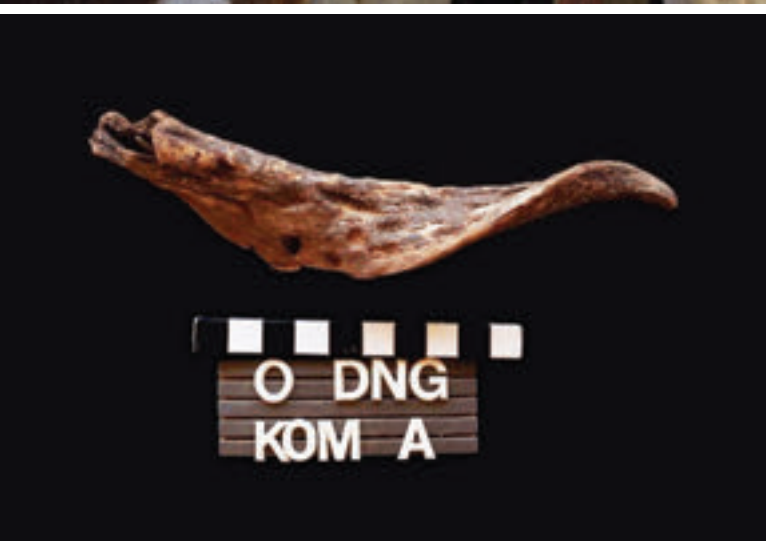


Fig. 22.

Various forms of horns from late-Makurian sheep and modern varieties with analogous horn shapes. Photo by Marta Osypińska

regularities. The largest size ranges and the highest modal values in both cases were recorded from sheep whose remains were discovered in the area of the Old Dongola citadel. The size range of sheep from the monastery area was less significant. The variation may result from differential use, such as preferences regarding the sex of animals intended for slaughter (e.g. in the citadel, males were slaughtered more often, and in the monastery more females or young animals were used for slaughter). However, the difference may also result from the wider base of animal populations used in the citadel.

Unambiguous evidence confirming this hypothesis is the variety of horn cores and horn sheaths in the material from the citadel (**Fig. 22**). This is evidence that animals were used in the late period that were morphologically diverse and must have originated from distant regions. Further conclusions from the comparison of the metric data are that the sheep from Banganarti and Selib were smaller than animals from the capital of Makuria. Furthermore, neither at Banganarti nor at Selib has any evidence been found for the consumption of sheep other than the type found locally in this region since antiquity, which had backwards-curving horns.

A similar relationship is observed for goats. In the late period in the capital of Makuria, goats with both sabre-like and twisted horns – clearly twisted several times around the axis – were found. On the other hand, no macroscopic morphological differences were observed between the pig populations of the late-medieval Makurian sites. Likewise, no differentiation in donkeys and camels has been recorded so far.

Even at the scale of the Southern Dongola Reach microregion alone, osteological material from the Late Christian period shows interesting differences resulting from various factors. Diverse models of meat consumption were identified, most likely conditioned by sociological differences and the status and social rank of consumers in a given centre. The specific function of each centre appears to have played a role in this respect. Interestingly, the variation in consumption patterns was very much analogous to the situation in the ancient kingdom of Meroe more than 1,000 years earlier. Both in the late phase of the kingdom of Meroe and Late Christian Makuria, there is evidence for a correlation between the status of the location and the proportion of beef consumed in relation to mutton and goat meat. In both cases, the diet of the elite was based to a greater extent on beef, and this was taken to the extreme in the exclusive consumption of beef in Kushite temples. Therefore, the hypothesis that in late-period Makuria, as in Meroe, the elite meat for people of higher rank was beef seems to be justified.

A phenomenon that deserves special attention in relation to the late-Makurian material is the presence of animal varieties that have not been recorded in historical times in Upper Nubia: long-horned cattle and sheep like the native breeds of the Sahel, and morphologically diverse goats. The diversity of the livestock population is evident in the capital of Makuria and also at Banganarti. Such diversity of as many as three livestock species could only result from their having a variety of geographical origins. The archaeozoological data currently provide the most complete and scientifically valuable evidence for Makuria's far-reaching economic influence and contacts, which extended far beyond the Nile



Fig. 23
Modern long-horned
cattle from the area of
Nyala (Kordofan). Photo
by Marta Osypińska

Valley. The varieties of farm animals alien to Upper Nubia in the late Middle Ages demonstrate long-range commercial and cultural contacts between the Dongola rulers and Sahelian communities in Kordofan (**Fig. 23**) or even further away in central and western Africa.

Due to its favourable location at the mouth of the great wadis flowing from the west, the central part of Makuria, which includes both Old Dongola and Banganarti, had to play a role as a coordinating centre for multifaceted contacts between the Nile Valley and Sahelian communities. The concentration of the faunal sources attesting to the diversity of animal populations unequivocally indicates that the exchange and trade in live animals was the exclusive domain of the central authority – the king. A problem that requires in-depth study is the nature of non-Nile animals at both Old Dongola and Banganarti. The main issue seems to be whether they came to Makuria as tribute, through trade, or with communities migrating from Central and Western Africa. Perhaps the archaeozoological data could be the basis for research on previous migratory movements and contacts with relatively nearby regions, such as Kordofan or Darfur, and much more distant ones, such as the Niger Basin and West Africa. Obtaining additional sources and zoological data to shed light for the first time on the scale and extent of Makuria's influence in sub-Saharan Africa would be an essential line of research and vital for many fields of science dealing with the history of this part of Africa.

CONCLUSIONS

In light of archaeozoological research, Banganarti appears to be a unique and valuable scientific and cognitive site in many respects. It is the only Makurian settlement site of importance. It has yielded a collection of fauna covering the complete chronological sequence from its founding in the sixth to the seventh century, through the Classic Christian period, to its decline and abandonment in the sixteenth–seventeenth centuries.

The results of archaeozoological research suggest that Banganarti was a centre, an embodiment of the interface between civilisation and cultures, throughout its existence. This is, moreover, a feature that would be expected of a pilgrimage site that attracted visitors from a vast area. However, it is currently the only place in Sudan where such broad conclusions can be drawn based on data from faunal assemblages.

Research at Banganarti has revealed the socio-topographical differentiation of the centre, which is likely to reflect the complex processes underlying its formation. Banganarti was never a rural settlement whose people earned a living by farming. Models of meat consumption, livestock use and breed morphology show elitism and reliance on an economy based on resources other than crops. It is not easy to assess to what extent the central government supported the sanctuary and to what extent it depended on its income. However, access to ‘central’ resources – which cattle undoubtedly were, especially cattle imported from areas far from the Nile Valley – proves that the sanctuary was a significant beneficiary of the central ‘treasury’ resources.

Based on the archaeozoological data, at least two socio-cultural and possibly also ethnic-cultural categories of the inhabitants or residents of Banganarti can be identified. On the one hand, there was a population with a relatively traditional consumption model, whose cultural and economic preferences were focused on cattle – a traditional determinant of economic status and prestige for Middle Nile communities. On the other hand, there are reasons to believe that the community inhabiting the Banganarti zone preferred a model of consumption alien to Nubia, which appeared together with Christianisation. Evidence of this is the presence of the pig and the great importance of pork and the meat of small ruminants in the diet. Archaeozoological data also seem to indicate other elements of this different pattern, such as the tendency to exploit wild fauna and to use dishes previously unknown in this region, such as a kind of *garum* – paste made of tiny pickled sea fish.¹³

Banganarti is the only known centre that displayed this type of socio-topographical differentiation, which continued with varying intensity throughout the settlement’s functioning.

The hypotheses and observations presented here will be the basis for further, in-depth analyses, which will also consider other categories of the material culture of the Banganarti inhabitants. We hope that such in-depth studies in domestic archaeology, animal studies and economic archaeology will become standard in future explorations of large settlements. The results of archaeozoological research from Banganarti prove to have an extensive and still underestimated cognitive potential not only in the field of animal management but also in demography, sociology and the dynamics of cultural processes.

13 In Egypt and Sudan a paste made of fermented, salted and dried fish is called *fesikh*; cf. VAN NEER, DEPRAETERE 2005.

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Beads and pendants

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Laure Dussubieux
Jonathan Mark Kenoyer
Randall Law

Abstract:

Of the more than 2,150 beads and pendants examined in this article, the overwhelming majority come from a ceramic vessel found on the northern side of the lower church at Banganarti, in a layer dated to the eighth to tenth centuries. The remaining objects were collected from other Banganarti contexts dated between the sixth/seventh and fourteenth centuries. The beads and pendants were made of organic and inorganic materials (resin, ostrich eggshell, stone, faience, glass) using diverse techniques. Combined macroscopic and chemical compositional analyses show raw sources in India and possibly Yemen for carnelian and rock crystal beads. While the glass of some specimens was sourced in Egypt and the Levant, most beads were made of glass produced in the Middle East.

Keywords: beads, pendants, material studies, medieval Nubia.

This chapter presents the results of a macroscopic study of over 2,150 beads (centrally perforated objects) and pendants (objects with off-centre perforation) excavated at the Banganarti site between 2006 and 2020. Additionally, results of chemical compositional analysis of selected glass and carnelian objects are briefly reported.

No traces of beadwork have been recorded, the beads being individual (i.e. loose specimens). However, many were found clustered, perhaps implying a link between the specimens. An assemblage of over 2,000 beads, found in a ceramic pot in one residential room in a layer dated to the eighth-tenth centuries (BNG-18-656), is the overwhelming majority of the beads found at Banganarti so far, which calls for a separate presentation of their types (Figs. 1–19). This presentation is followed by a description of specimens from other contexts, i.e. in rooms attached to the enclosure wall, rooms of the residential building, and layers of the lower church (Figs. 20–21). Details referring to find contexts and dating of all beads and pendants are listed according to excavation season and inventory number (Table 1).

Methods

Although made of various materials – organic (resin, ostrich eggshell), stone and faience – most beads under discussion are of glass. The presentation below follows this order, stipulating the beads' method of execution for each material, their shapes and sizes, and comparanda.

Discussion of the specimens' length and shape (e.g. spherical, oblate, barrel, cylinder, biconical) follows the classification introduced by Horace Beck.¹ The length ratio indicates the relation between bead length and diameter. Depending on their length, beads can be classified into five categories: discs (less than one-third of the diameter), short (more than one-third and less than nine-tenths of the diameter), standard (equal or almost equal to the diameter), long (more than one and one-tenth of the diameter and less than twice the diameter), and very long (more than twice the diameter). Therefore, e.g., a 'disc cylinder' is a cylinder, the length of which is less than one-third of its diameter.

Several measurements (diameter, thickness, width, length, hole opening diameter) are given for some bead types. Length is measured along the perforation. Other measurements (thickness, width, height, hole opening diameter) are given for pendants.

Parallels for bead types are quoted from Northeast Africa, Levant, Scandinavia, and the Baltic region. The latter two have already proved their usefulness in dating mediaeval beads found in Africa.² Also, objects from Nubia, including beads and pendants from the Ghazali monastery discovered on a bench in the *dormitorium* and dated within the tenth–twelfth centuries,³ as well as those found at the Makurian capital site of Old Dongola,⁴ constitute useful parallels for certain Banganarti types.

A selection of six carnelian beads has been laboratory analysed by Jonathan Mark Kenoyer and Randall Law (University of Wisconsin, Madison, USA). In addition, the

1 BECK 1928.

2 WOOD 2018; THEN-OBLUSKA, PLEŞA 2019.

3 THEN-OBLUSKA, WAGNER 2018.

4 THEN-OBLUSKA 2013.

Find/Inventory no.	Context	Context details	Context dating	Figure no.	Number of beads or fragments	Bibliography
BNG-2006-15W	Sector NNECH-1, locus A	Eastern corner of locus A in the northeastern tower of enclosure wall	12 th – 14 th c.	Fig. 20D	2	DRZEWIECKI 2006: Fig. 3; ŻURAWSKI 2006: Fig. 10
BNG-2006-16W	Sector NNECH-1, locus A	Eastern corner of locus A in the northeastern tower of enclosure wall	12 th – 14 th c.	Fig. 20F	2	DRZEWIECKI 2006: Fig. 3; ŻURAWSKI 2006: Fig. 10
BNG-2006-17W	Sector NNECH-1, locus A	Eastern corner of locus A in the northeastern tower of enclosure wall	12 th – 14 th c.	Fig. 20H-I	3	DRZEWIECKI 2006: Fig. 3; ŻURAWSKI 2006: Fig. 10
BNG-2006-18W	Sector NNECH-1, locus A	Eastern corner of locus A in the northeastern tower of enclosure wall	12 th – 14 th c.	Fig. 20J	12	DRZEWIECKI 2006: Fig. 3; ŻURAWSKI 2006: Fig. 10
BNG-2007-19	Outer wall N, sector IV, part W, 1 st arbitrary level	Enclosure wall area	-	Fig. 20B	1	
BNG-2008-01	Sector S/2008, Space 6	Space/room attached to inner side of the enclosure wall	mid-9 th – 11 th c.	Figs. 20E, 21G	2	
BNG-2008-18	Bang 1, Lower Church	Niche in the prothesis of the Lower Church	7 th – 10 th c.	Fig. 20G	2	
BA-15-352	Sector NECH, area 5, layer 84	House, clay floor in space/room 5,	11 th – 12 th c.	Fig. 21A	1	
BA-18-1409	Sector SECH, area 1, layer 24, 29, 32, 33, 34, profile cleaning	Residential building, occupation layer in space/room 1	7 th – 9 th c.	Fig. 20A	1	
BA-18-1565	Sector NECH, area 29, layer 281	House, occupation layer in space/room 29	12 th – 14 th c.	Fig. 21E	1	
BA-18-1799	Sector SECH 1, layer 34	Residential building, occupation layer in space/room 1	6/7 th – half 9 th c.	Fig. 21F	1	
BNG-18-656	Sector NCH/B, area 14, layer V	Residential building, occupation layer in space/room 14	8 th – 10 th c.	Figs. 1-19	about 2122	
BA-18-1912	Sector SECH, area 12, layer 1	Residential building, layer in space/room 12	11 th – 14 th c.	Fig. 21B	1	
BNG-19-01	Sector WCH-4, to N from area 21	Residential building	-	Fig. 20C	1	
BNG-19-723	Sector NCH, area 14, layer 31	Residential building, occupation layer	10 th – 11 th c.	Fig. 21C	1	
BA-19-2543	Sector NECH, area 43, layer 418	House, occupation layer in space/room 43	11 th – 12 th c.	Fig. 20K	1	
BNG-20-57	NNWWCH-7, Room 1/19, from cleaning	Space/room attached to inner side of the enclosure wall	9 th – 11 th c.	Fig. 21D	1	

Table 1.

A list of bead finds from Banganarti, seasons 2006–2020, arranged according to season and inventory number



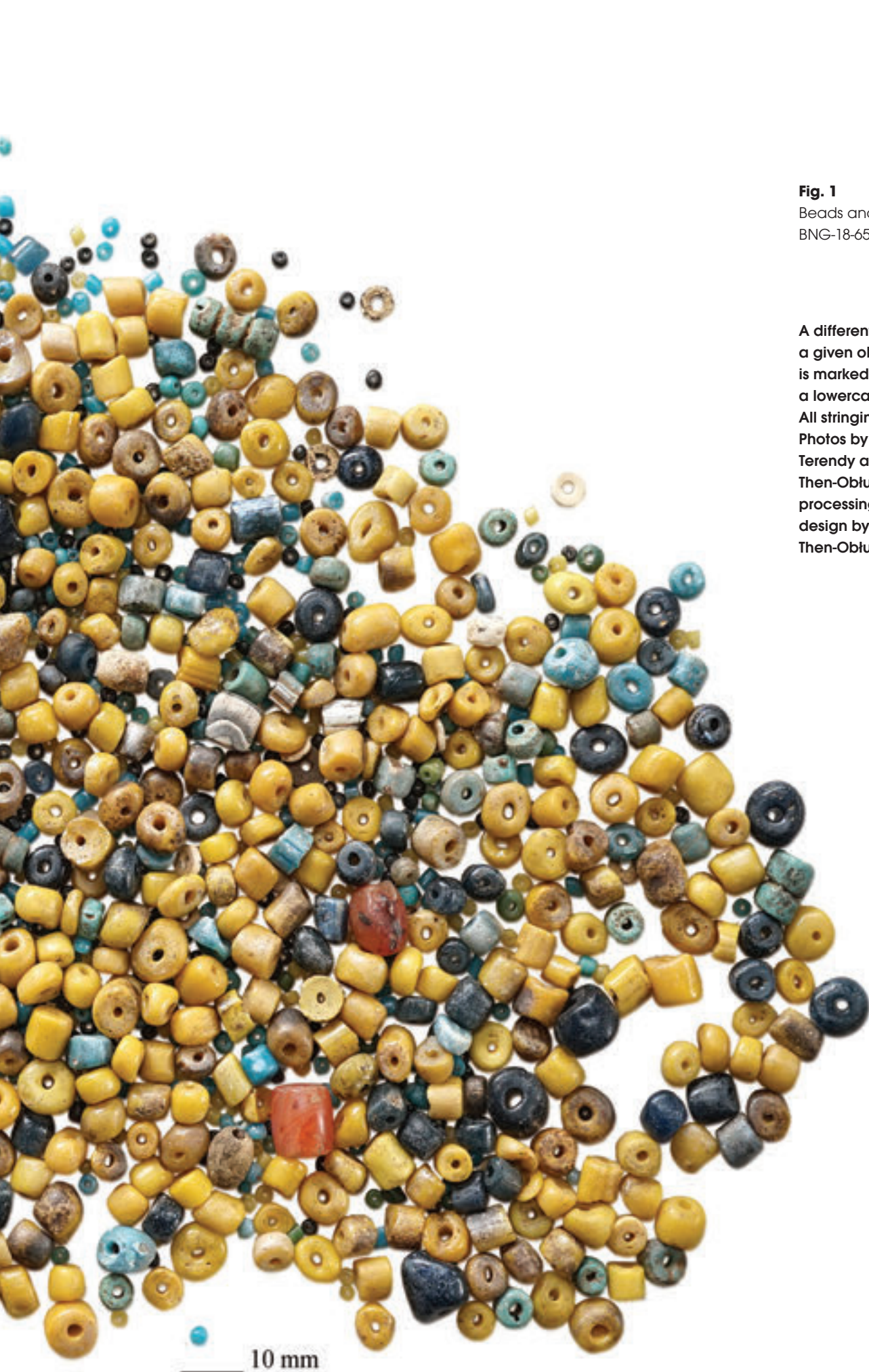


Fig. 1

Beads and pendants,
BNG-18-656 (870)

A different view for
a given object, if any,
is marked with
a lowercase letter.
All stringing is modern.
Photos by Paulina
Terendy and Joanna
Then-Obluska. Photo
processing and figure
design by Joanna
Then-Obluska.

six carnelian beads and twenty glass samples have been analysed under Laure Dussubieux at the Field Museum of Natural History in Chicago, USA, using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to determine their chemical composition and trace the provenance and chronology of the materials.

Beads and Pendants from a Ceramic Pot

A spectacular find of a ceramic pot filled with beads and pendants and their fragments ($n = 2,122$ according to the find label) was found in the tenth–twelfth-century context, the occupation layer of Room 14 in the residential building discovered in the 2018 season (Figs. 1–19).

These specimens (inventory no. BNG-18-656), apart from a few fragments of metal and resin pendants, include mainly beads of glass, while others of faience ($n = 42$), ostrich eggshell ($n = 42$), and stone ($n = 9$) were found in smaller quantities (**Fig. 1**). They are described below according to material (organic, inorganic, man-made) and techniques of their execution.



Fig. 2 (a–d)

Resin pendant,
BNG-18-656 (798)

RESIN

A resin pendant, most probably amber, is a long cylinder with its tubular loop preserved only in fragments (**Fig. 2**). Its base is ca. 15 mm thick and 22 mm long. Glass pendants of this shape were pretty popular in the ninth–eleventh centuries.⁵ A necklace probably made in Iran and dated within the eleventh–twelfth centuries⁶ comprises trailed decorated glass pendants in the same shape. Fragments of resin wrapped in a piece of textile have been recorded at the Ghazali monastery, where they were found associated with a metal cross and beads⁷ resembling those at Banganarti (compare below). Generally, amber beads and pendants are recorded in Egypt in the Late Roman and Early Islamic periods, but no exact analogy could be traced so far.

OSTRICH EGGSHELL

Forty-two very regularly shaped short cylinders of ostrich eggshell measure 4–6 mm in diameter (**Fig. 3**). They all feature perforation in the shape of short cylinders and, judging by the blackish dirt at their ends (surface around hole opening), they could have been threaded together initially. Some of the edges of the cylinders are worn.

⁵ DUBIN 2009: Timeline, nos. 532–533.

⁶ JENKINS-MADINA 1986: 54–55, fig. 77, MET 1973.347.

⁷ THEN-OBŁUSKA, WAGNER 2018: fig. 1E.



Fig. 3 (a–b)
Ostrich eggshell beads,
BNG-18-656 (745);
modern stringing
and arrangement

Beads like these have also been recorded at the Ghazali monastery, where they were found strung together with yellow and dark-blue glass beads (compare below for similar types) and with resin fragments and a cross-shaped pendant of metal sheet.⁸

STONE

Nine stone beads, in carnelian ($n = 3$), banded agate ($n = 1$) and quartz ($n = 4$) and possibly amazonite ($n = 1$), are recorded.

A carnelian short-barrel bead with a battered exterior has traces of the original flaking and grinding and measures ca. 7 mm in diameter (**Fig. 4A**).

Another specimen is a banded carnelian long barrel bead (**Fig. 4B**). It measures ca. 10 mm in diameter. The surfaces have traces of the original flaking and grinding, but overall the bead has been polished and worn. The edges are battered. It was drilled using a double diamond drill from two sides. The carnelian of the bead sources most closely relates to carnelian from western India / Gujarat (compare below).

Still, another carnelian bead is ellipsoid in shape and measures ca. 10 mm in diameter and 13 mm in length (**Fig. 4C**). It is made of mottled carnelian with traces of the original nodule surface still preserved. Flake scars from the original shaping

⁸ THEN-OBŁUSKA, WAGNER 2018.

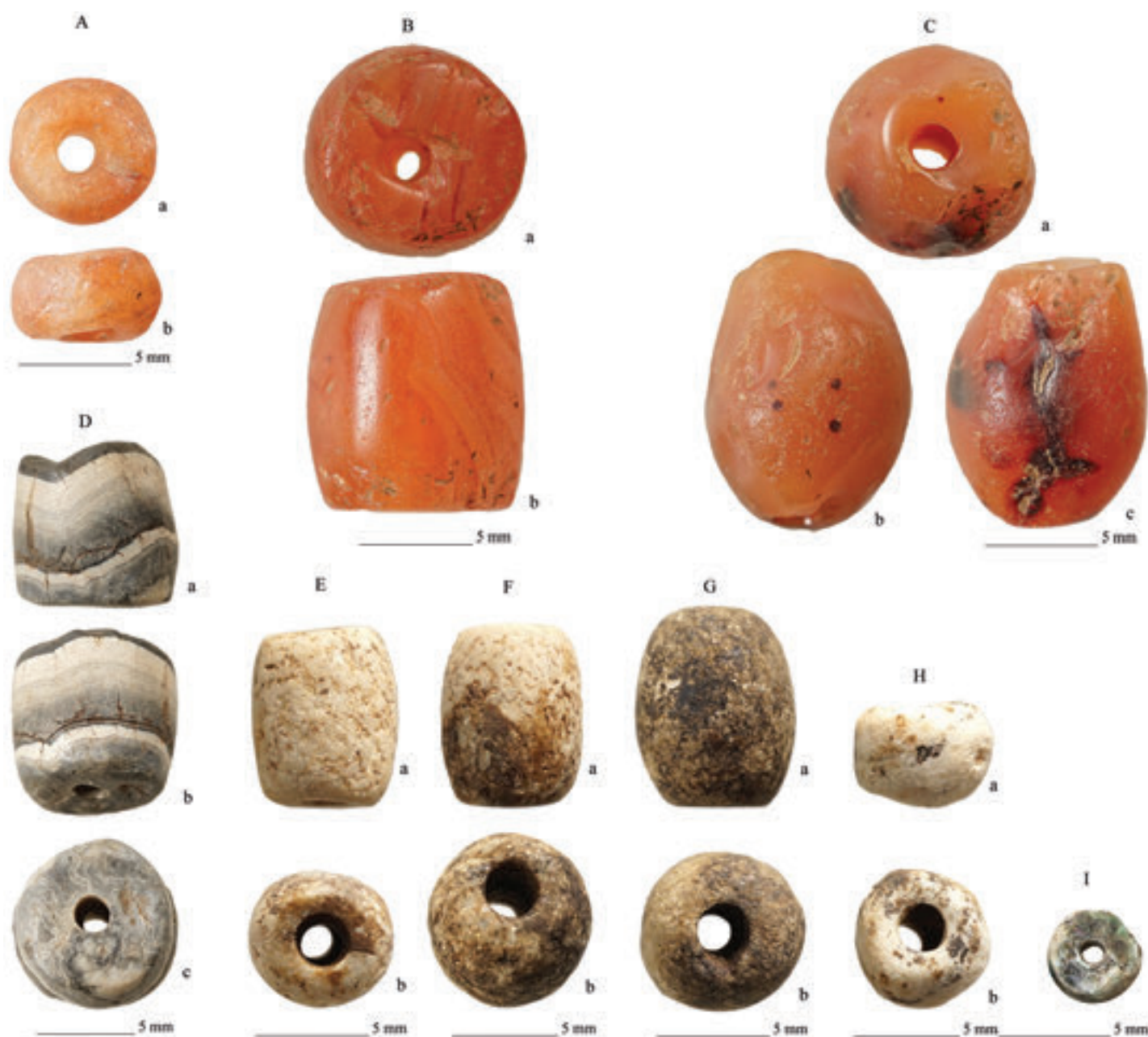


Fig. 4 (A-I)
Stone beads,
BNG-18-656 (335)

are still visible on the surface, but the shape has been made by grinding and low-lustre polish. There is heavy use wear on one end and battering on the ends.

A banded agate standard barrel measures ca. 9 mm in diameter and length (**Fig. 4D**). It has probably been dyed to make the colour black and white. The surface is smooth and worn but also appears to have been burned and weathered. It was drilled from both ends and the perforation is in the shape of a double cylinder.

Four whitish beads, a short oblate (**Fig. 4H**) and three long barrels (**Fig. 4E–G**) are possibly of quartz. The latter measure ca. 6 mm in diameter and 9 mm in length.

Whether the tiny short cylinder with greenish traces (**Fig. 4I**) actually is amazonite remains uncertain.

Fig. 5 (A-E)
Faience and other
beads, BNG-18-656 (260)



Fig. 6
Drawn yellow glass
beads, BNG-18-656
(498); modern stringing
and arrangement





Fig. 7
Drawn blue glass
beads,
BNG-18-656 (687)



Fig. 8 (A-C)
Drawn green glass
beads, BNG-18-656 (715)



Fig. 9
Drawn black glass
beads, BNG-18-656
(639); modern stringing
and arrangement

Fig. 10 (A-D')
Drawn glass beads of
diverse colorse, BNG-18-
656 (549)





Fig. 11 (a-b)

Large drawn yellow
glass beads,
BNG-18-656 (34)



Fig. 12 (A-D)
Large drawn dark blue glass beads, BNG-18-656 (106); modern stringing and arrangement



**Fig. 13**

Large drawn blue glass beads, BNG-18-656 (210)

FAIENCE

Faience beads have a greenish to turquoise glaze and whitish cores and measure ca. 5–8 mm in diameter. These are short and standard cylinders (**Fig. 5A**) and long cylinders, the latter segmented on moulds into double- (**Fig. 5C**) and multiple-segments (**Fig. 5B**). Segmented beads are standard in the post-Meroitic assemblages.⁹ However, the Banganarti single-segments are larger than the post-Meroitic specimens.

Unlike the beads mentioned above, one long tubular specimen, 5 mm in diameter, has a blue glaze (**Fig. 5D**). Blue-glazed beads of this type are known from post-Meroitic assemblages in the Fourth Cataract region.¹⁰

GLASS

Some colours dominate the glass beads: yellow (ca. 860), black (ca. 660 beads and fragments), light-blue (ca. 430) and dark-blue shades (ca. 45), while beads in green shades (ca. 65) and dark purple which are nearing black (ca. 19) are less numerous. A few beads are of colourless, orange, white, and polychrome glass.

While the overwhelming majority of beads are drawn glass, a few are of wound, rolled up, and joined glass. The presentation of glass beads below, including further divisions based on the technique of finishing and size, follows this order.

⁹ E.g. THEN-OBŁUSKA 2018a; 2018b.

¹⁰ E.g. THEN-OBŁUSKA 2014: pl. 2.

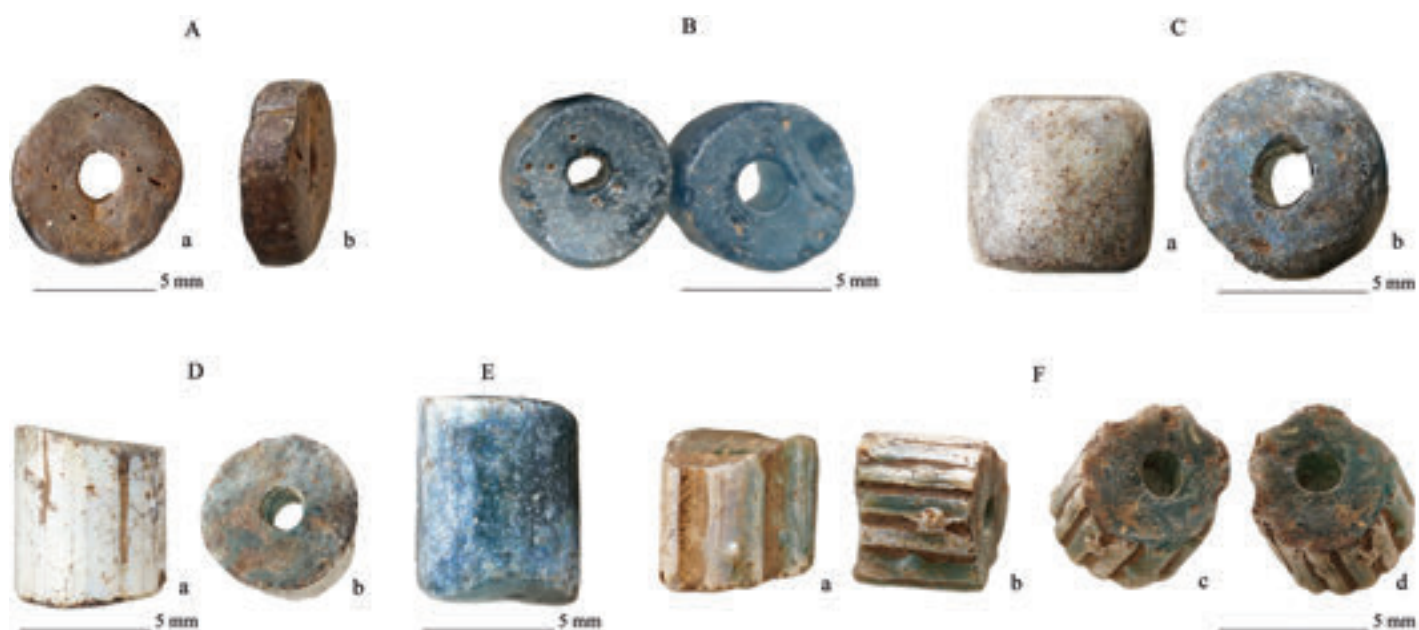


Fig. 14 (A-F) Drawn and cut glass beads, BNG-18-656 (448)



Fig. 15 (A-G) Drawn and segmented glass beads, BNG-18-656 (363)



Fig. 16 (A-B) Wound glass beads, BNG-18-656 (516)



Fig. 17 Rolled up glass beads, BNG-18-656 (725)

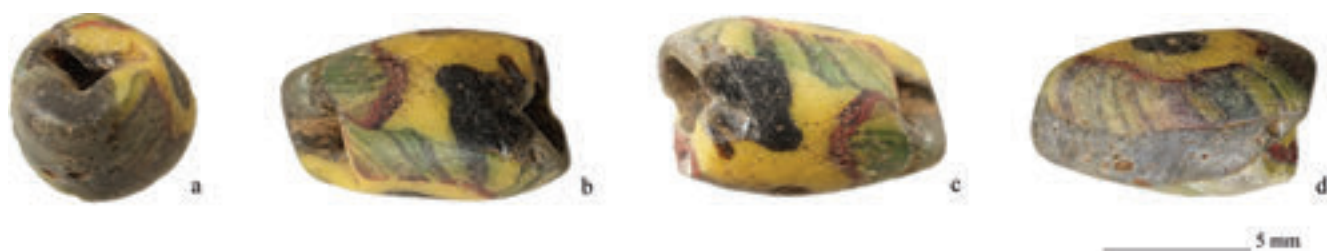


Fig. 18 (a-d) Mosaic glass bead, BNG-18-656 (340)

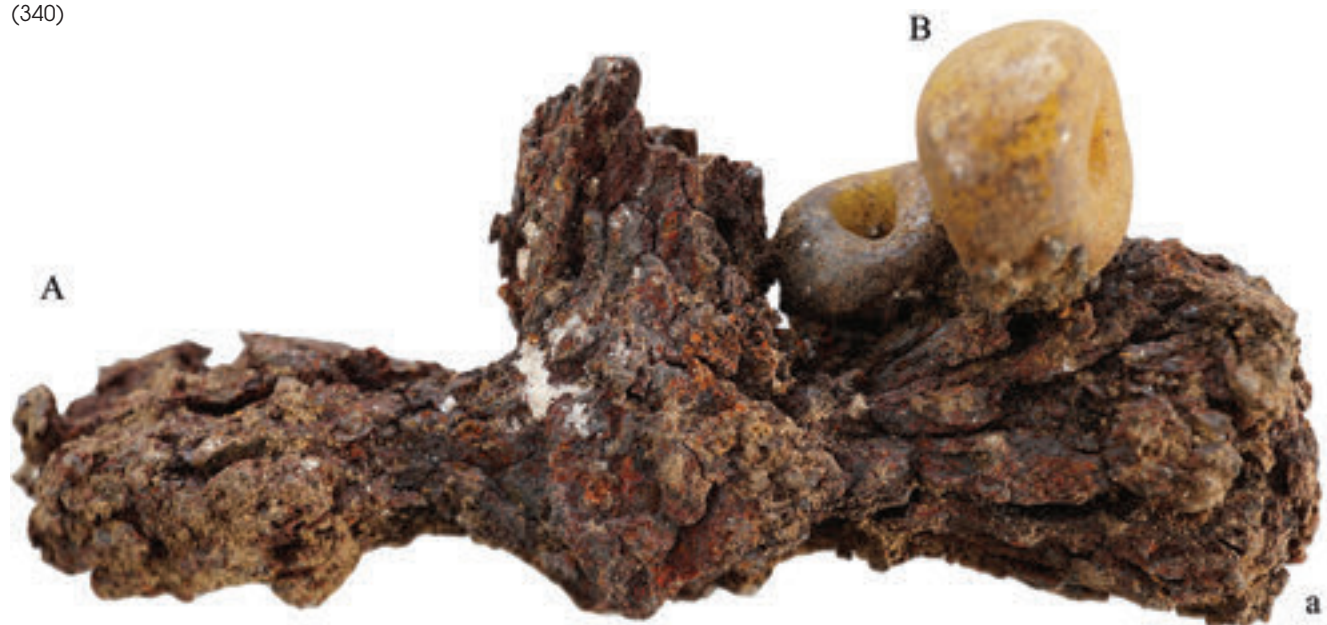


Fig. 19 (A-B) Metal fragment (A) and two large yellow glass beads (B), BNG-18-656 (781)

Drawn and cut glass

The majority of beads found in the pot are drawn and rounded glass. Some drawn and rounded beads may have been made using a method resembling the traditional ‘lada’ technique, used until recently in Papanaiduphet, Andhra Pradesh, India, and employing a large-scale drawing of tubes.¹¹ Several dozen kilograms of glass are introduced into a furnace and, when the correct temperature is achieved, a large gob of glass is pierced through with a tool and drawn out from the opposite side of the furnace with the aid of another tool until all the glass has been used up. The tubes are cut into sections when cold. The sharp ends of the drawn glass sections are smoothed by mixing with ash and heating up while being stirred in a pan. The ash prevents the beads from sticking together, and in this way, prevents the holes from closing up due to the heat that, in turn, makes the beads come out with more or less rounded ends. This method of rounding drawn beads has been considered an Indian technique, hence their name, ‘Indo-Pacific’, in the literature¹² However, the technique of rounding sections of drawn glass tubes could have been transferred in Islamic times, meaning that such beads may have been produced from non-Indian glass outside South Asia.¹³

The drawn and rounded beads from the assemblage are small, measuring 2–4 mm in diameter. They can be both translucent and semi-translucent: in pale yellow (Fig. 6, ca. 295), light blue (Fig. 7, ca. 325) and dark blue (Fig. 10B, ca. 2), green (ca. 65), including leaf green (Fig. 5E, 8A), dark green (Figs. 8B, 10C), and light green (Fig. 8C), as well as opaque: black (Fig. 9, ca. 640) and light blue (Fig. 10A, ca. 55). While most are oblate in shape and short or standard in length, some light-blue and dark-green beads are long oblates. One short bead is opaque orange glass with one end rounded and the other truncated (Fig. 10D, D’).

Other Banganarti drawn beads are large, measuring 5–8 mm in diameter. Some have rounded tubular sections. A few have their ends left simply cut off or heat-polished. Others are flattened at one end and rounded at the other. The latter method would indicate the sections of a drawn glass tube were rounded in a flat-base pan, a feature already noticed for plant-ash soda beads found in southern Africa, the East Coast and West Africa.¹⁴ Large drawn beads found in the pot are opaque yellow (Figs. 11, 19B, ca. 570?), opaque and semi-translucent light blue (Fig. 13, ca. 25), and semi-translucent dark blue and dark purple (Fig. 12A, ca. 65). These are short to long beads. Some opaque yellow beads have colourless inclusions visible on the glass surface. Similar yellow and dark-blue beads have been recorded at the Ghazali monastery, found on one of the *dormitorium* benches, and dated within the late tenth–twelfth centuries. Laboratory chemical compositional analysis (LA-ICP-MS) has confirmed they are of Islamic plant-ash soda glass.¹⁵

Some Banganarti specimens are short oblate beads (Fig. 12B), while others are slightly flattened oblates with an oval cross-section (Fig. 12D). Among the

¹¹ FRANCIS 2002.

¹² FRANCIS 2002.

¹³ E.g. THEN-OBŁUSKA, DUSSUBIEUX 2016.

¹⁴ WOOD 2019.

¹⁵ THEN-OBŁUSKA, WAGNER 2018: fig. 1H – yellow, 1I – blue.

Fig. 20 (A–K)

Stone and faience beads from diverse Banganarti contexts; modern stringing and arrangement



former, a semi-translucent light-blue disc cylinder bead is decorated with four longitudinal red-on-white stripes (**Fig. 12C**).

Some sections of the drawn tubes bear no visible traces of heat-rounding, their ends having been simply heat-polished. These are a purple disc cylinder (**Fig. 14A**) and short cylinders of translucent blue glass (**Fig. 14B**), as well as standard cylinders of blue glass covered with a whitish patina (**Fig. 14C**).

Other sections have their ends left unworked, and these are long cylinder beads, bluish and covered with a whitish patina (**Fig. 14D–E**). A transparent light-green cylinder segment of the irregular cogwheel-shaped section is also covered with a white patina (**Fig. 14F**). Its ‘grooved’ shape may be the result of lost stripes.

Drawn and segmented glass

A few beads from the Banganarti pot are of drawn and segmented glass. These are a white quadruple segment (**Fig. 15A**) and possibly also a metal-in-glass single-segment (**Figs. 15B, C?, D?**). Small drawn-glass tubes would be heated and segmented by rolling on open moulds with grooved or crenellated surfaces. Tubes segmented in this way were then cut or snapped at specified intervals to produce single- or multiple-segment beads. Their ends were either left sharp or hot-finished. As a result of segmenting on moulds, the perforations are more or less oblate in shape, and the bead openings are contracted. Some heated tubes seem to have been segmented differently by pinching the tube at regular intervals to form a bead. Segmenting the drawn-glass and metal-in-glass tubes is an Egyptian technique¹⁶ reasonably common in the ancient world. Although the white colour found at Banganarti (**Fig. 15A**) is unusual in Meroitic and post-Meroitic assemblages in Nubia, the segmenting technique continued into medieval times and such beads have also been recorded at medieval sites in Northeast Africa, e.g. Fustat¹⁷

A short melon bead of dark-blue glass has six lobes (**Fig. 15E**) and resembles beads dated to the tenth century from Scandinavia and the Baltic region,¹⁸ despite the latter having more lobes.

Other drawn glass

The manufacturing technique of two short beads is uncertain. One (**Fig. 15F**) might have been pinched off a tube segment. The other, a translucent light-green bead, has heat-polished and slightly concave ends (**Fig. 15G**).

Wound glass

Wound-glass beads are made by winding the molten glass around a mandrel into globular or oblate forms. Two wound beads are of translucent dark-blue glass. One is long (ca. 13 mm in length) with an oval cross-section (**Fig. 16A**), while the other is a long (9 mm) bicone with one truncated end (**Fig. 16B**).

¹⁶ For segmenting moulds and leftovers in bead production at Alexandria, Egypt, see KUCHARCZYK 2011; RODZIEWICZ 1984.

¹⁷ FRANCIS 2002: 15.

¹⁸ CALLMER 2003: fig. 4.4.B17–18.

Rolled-up glass

About 15 beads (preserved as 12 complete beads and some fragments) consist of a strip of dark purple, appearing black, glass rolled up round to form a tubular bead (**Fig. 17**). They are ca. 3.5 mm in diameter.

Joined glass

Beads of this type are formed of two glass strips joined around a mandrel (most probably a metal rod) to form one long, tapered bead (**Fig. 18**). The strips are sections of a mosaic cane having a yellow centre and black pupil, bordered with a red ring and radial stripes in translucent dark-green and opaque yellow. Similar Early Islamic cane sections,¹⁹ used in joined-glass beads and found in Egypt and Europe, are dated within the eighth–ninth centuries.²⁰

METAL

An eroded elongated iron piece is ca. 48 mm long, with one end enlarged. In the middle, another long fragment is attached perpendicularly, perhaps seen as a fragment of a cross pendant (**Fig. 19**). A few opaque yellow drawn-glass beads remain attached. They are of the type described above, with parallels at Ghazali (compare above, **Fig. 11**).

Beads from Other Banganarti Contexts

The remaining 33 beads from another residential building and other Banganarti contexts, including a locus in the northeastern tower of the enclosure wall where a deposit of 4 carnelian and 15 rock crystal beads was found and dated within the twelfth–fourteenth centuries (**Figs. 20D, F, H–J**), are described below. This section presents all beads according to material and production techniques (**Figs. 20–21**). Some might be dated thanks to parallels known in the literature.

STONE

The stone beads of steatite ($n = 1$), carnelian ($n = 7$) and rock crystal ($n = 16$), are described below in this order.

Steatite

A truncated cone of black steatite bears the trace of a saw mark across the larger hole opening (**Fig. 20A**). It measures 8.6 mm in diameter, 7.6 mm in length and 2.5 mm in hole opening diameter. Beads of this type were typical of the late

¹⁹ The black spot is on a white, rather than yellow, background of the Banganarti bead.

²⁰ THEN-OBLUSKA, PLEŠA 2019 and references.

post-Meroitic period and have already been identified in the Fourth Cataract region, including the El-Zuma site.²¹ They are also known from many post-Meroitic sites in Lower Nubia, including the royal cemeteries of Qustul and Ballana.²² White, red and black beads were found strung alternately at the latter site.

Furthermore, truncated conical beads made of various stones were found on the neck of a king buried in Tomb 80 at Ballana.²³ They seem to have been in use also in later times since a white conical bead appeared at Old Dongola.²⁴ The Banganarti specimen was found in the seventh–ninth-century context.

Carnelian

A small spherical carnelian bead was drilled from one side and popped out, leaving a concave surface at one end (**Fig. 20B**). It measures 6.8 mm in diameter. This bead was made by chipping, but traces of the original nodule surface and some flake scars are still visible. No grinding striae are visible on the surface, but grinding was probably responsible for the rough bead shape. The bead was bag-polished before being drilled,²⁵ which resulted in a rounding of the traces of original flaking that had not been removed by grinding. The drilling was done with a double diamond drill after polishing, as demonstrated by the sharply chipped edge of the drill entry hole and the sharp edges of the spall where the drill popped out from the opposite surface. Some slight string wear is visible at the edge of the drill hole. This spherical bead type was made in large quantities in workshops throughout Western and Peninsular India very quickly, the reason why it is drilled only from one side and not well polished or finished. The carnelian stone most closely relates to the carnelian from Gujarat, India (compare below). A similar bead was recorded at Old Dongola in a sixteenth–seventeenth-century A.D. context.²⁶

The long, ellipsoid bead with an oval section (**Fig. 20C**) is of orange carnelian. It measures 10.6 mm in width, 8.5 mm in thickness, and 20.3 mm in length. The original flaked surfaces are only partly ground and polished, with traces of the flake scars still visible. The carnelian shows traces of the crystalline geode, and the colour is a mottled light yellow to red-orange. The drilling is a combination of single and double diamond drilling. The single diamond drill, called ‘tekni’, is used to start the drill hole, and then the main drilling is done with a double diamond drill.²⁷ The carnelian stone most closely relates to the carnelian from Gujarat, India.

Two long octagonal cylinders are slightly tapered and thinner at one end than the other (**Fig. 20D**). One measures 18.8 mm in length, 10.1 mm in max. width, and 9.1 mm in max. thickness. The faceting is done very precisely and symmetrically with coarse longitudinal grinding and diagonal finer grinding. The grinding lines are still visible after polishing. The ends are slightly bevelled, but some chipping

21 THEN-OBŁUSKA 2017b and references.

22 EMERY, KIRWAN 1938: pl. 43, types 53–54 = JE [= Egyptian Museum, Cairo] 80899, 70264, 70275, 70260, personal observation.

23 EMERY, KIRWAN 1938: 211, cat. no. 152, pl. 46C = JE 70258.

24 THEN-OBŁUSKA 2013: 683, fig. 3: 29.

25 KENOYER, VIDALE, BHAN 1994.

26 THEN-OBŁUSKA 2013: fig. 3: 109.

27 KENOYER, VIDALE, BHAN 1994.

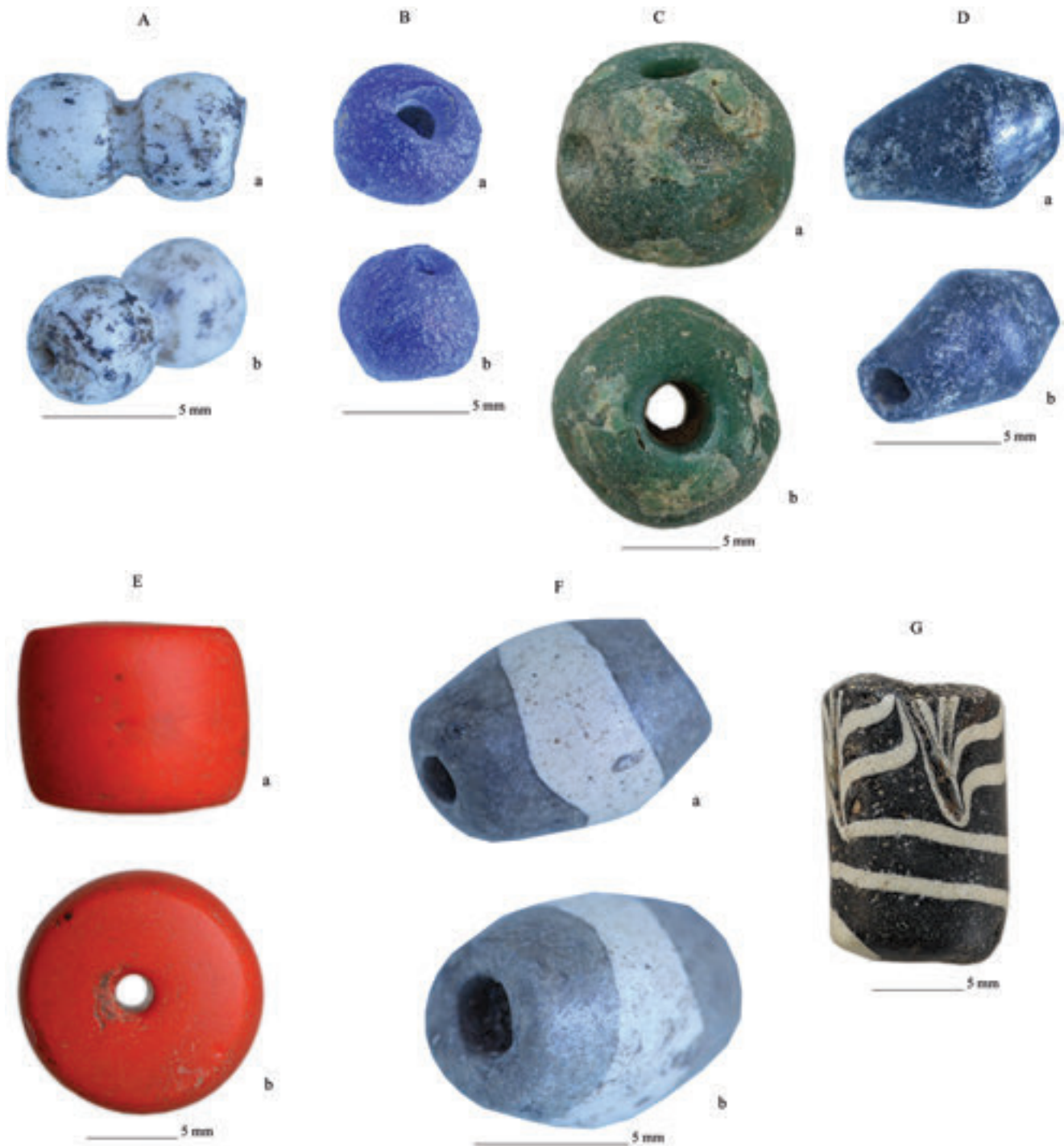


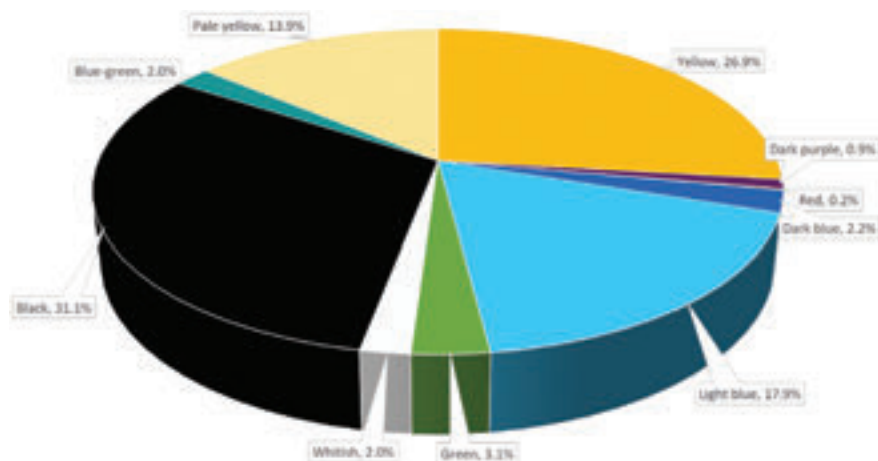
Fig. 21 (A–G)

Glass beads from diverse Banganarti contexts (see Table 1 for concordance)

scars are visible on some facets and the ends. The drilling is done with double diamond drills, and one sample studied shows a slightly twisted pattern of drilling that is occasionally seen in beads produced in workshops in Western India (J. M. Kenoyer, personal observation). The carnelian stone most closely relates to the carnelian from Gujarat, India.

Long faceted cylinders from Scandinavia and the Baltic region sites are dated to ca. tenth–eleventh centuries.²⁸ Beads of this type have also been found in Iran,

²⁸ CALLMER 2003: figs. 4.3.B37, 4.4.C9.

**Fig. 22**

Shares of bead colors found in a pot at Banganarti. By J. Then-Obluska

probably Nishapur, and dated within the ninth–twelfth centuries.²⁹ In Nubia, they have been found at Soba,³⁰ while a long polygonal cylinder, less regular in shape, has also been recorded at Old Dongola and dated within the thirteenth–fourteenth centuries.³¹ The Banganarti specimens were found in the twelfth–fourteenth-century context.

A broken possible faceted short octagonal bead, 12.5 mm in max. width and 6.3 mm long, has chamfered sides (**Fig. 20E**). This bead was made from a small nodule, and traces of the original nodule surface and flake scars are still visible after the faceting and polishing. The faceting is not done very symmetrically, and the coarse and fine grinding striae are still visible after polishing. The facets are battered from use and the drill-hole edges have some string wear. The drilling was done from two sides using double diamond drilling that meets almost perfectly in the centre. The carnelian stone most closely relates to the carnelian from Yemen, but it is possible that another source of carnelian somewhere in India has yet to be explored (compare below).

Two long heptagonal bicones are recorded (**Fig. 20F**). The larger one is 10 mm wide, 9 mm thick and 25.8 mm long. This bead is heavily worn, and the ends battered and worn. Traces of the original flaking are still visible after faceting, and the edges and surfaces of all facets are heavily worn and polished. The faceting is not done symmetrically. The drilling was done from both sides with double diamond drilling, and traces of what might be a single diamond starter drill are visible on one side. The carnelian stone most closely relates to the carnelian from Gujarat, India (compare below). Similar long bicones (hexagonal and octagonal) have also been found at Soba,³² in the eleventh-century Fatimid hoard at Caesarea,³³ and in Bilyar in the Middle Volga Region at the very end of the twelfth and the beginning of thirteenth centuries.³⁴ The Banganarti specimens were found in the twelfth–fourteenth-century context.

Generally, the six Banganarti carnelian beads that were laboratory studied (**Fig. 4B, Fig. 20B–F**) represent many distinct morphologies and manufacturing

²⁹ JENKINS-MADINA, KEENE 1983: 30–32, MET 48.101.70.

³⁰ SHINNIE 1961: fig. 28.22.

³¹ THEN-OBŁUSKA 2013: fig. 3: 149.

³² SHINNIE 1961: fig. 28.24 – octagonal bicone.

³³ KATZ et al. 1968: colour pl., p. 128.

³⁴ VALIULINA 2016a: fig. 21.2.

technologies, suggesting they were made at different times and possibly for different markets. However, the drilling was all done using diamond drilling technology, precisely the single and double diamond drilling characteristic of workshops in Western and Peninsular India during the medieval period. A more detailed discussion will be presented in a future article, but it is important to note that all the carnelian beads studied were made using double diamond drilling technology.³⁵ Diamond-tipped drills were first developed in ancient India as early as ca. 600 BC.³⁶ The use of diamond drilling technology did spread to other regions³⁷ but, as will be noted below, the carnelian of all but one bead most closely relates to carnelian from India, so it is highly likely that all were made in India and acquired through long-distance trade.

Rock crystal

Some beads found at Banganarti are made of rock crystal. A large oblate, 25 mm in diameter and 18.5 mm long, is preserved in two halves (**Fig. 20G**). Compared with other stone beads, its hole opening is very large – ca. 7 mm in diameter. The bead was drilled from both ends, 6 and 12.5 mm of the drilling length. Much smaller, ca. 12.5 mm in diameter, rock crystal oblates were found in Early Christian contexts at Old Dongola.³⁸ The Banganarti specimen was found in the seventh–tenth-century context.

Three beads are long faceted barrels (**Fig. 20H, I**). One (13 mm wide, 11.5 mm thick and 20.6 mm long) probably has six facets (**Fig. 20H**). It was perforated from both ends. The long cylinder shape of the first drilling is 1.5 mm in diameter. The other drilling is slightly conical in shape and measures 3.4 mm in hole opening diameter. Similar beads from Scandinavia and the Baltic region sites are dated within ca. tenth–eleventh centuries.³⁹ In the Middle Volga Region, they were found in a Tankeevka burial dated within the ninth–tenth centuries,⁴⁰ while carnelian ones found in Nishapur are dated within the ninth–twelfth centuries.⁴¹ A transparent faceted barrel has also been recorded in the thirteenth–fourteenth-century context at Old Dongola.⁴² The Banganarti specimens were found in the twelfth–fourteenth-century context.

Twelve short heptagonal truncated bicones (**Fig. 20J**), some with chamfered sides, measure about 15 mm in diameter and 10 mm in length. They were drilled from both ends and are 2 mm in hole opening diameter. Similar crystal and carnelian beads have been found in the Bilyar workshop of an alchemist, jeweller, and glassmaker operating in the centre of Bilyar at the end of the twelfth or beginning of the thirteenth century.⁴³ Heptagonal beads, although made of carnelian, have also been recorded at Soba.⁴⁴ At Dangeil, they were found in two sizes,

35 KENOYER 2017a; 2017b.

36 KENOYER 2003: 17–18.

37 GORELICK, GWINNETT 1988; MOOREY 1994: 82; BELLINA 2003; CARTER 2013.

38 THEN-OBLUSKA 2013: fig. 3: 1.

39 CALLMER 2003: fig. 4.3.B39.

40 VALIULINA 2016b: fig. 3a.

41 JENKINS-MADINA, KEENE 1983: 30–32, MET 48.101.70.

42 THEN-OBLUSKA 2013: fig. 6: 168.

43 VALIULINA 2016a: fig. 21.6–7.

44 SHINNIE 1961: fig. 28.23.

20–25 mm and 10–15 mm in width, in temple tombs ET5, Tomb 2 and Tomb 8 that were AMS-dated within the late twelfth–early thirteenth centuries A.D.⁴⁵ At Gabati, located upstream of Dangeil, beads of this type found in Tomb 13 (Type XVB2bf) were dated to the Christian period.⁴⁶ The Banganarti specimens were found in the twelfth–fourteenth-century context.

Rock crystal in Africa was exploited and traded from Northern Madagascar, Comoros, in medieval times (i.e. ninth–thirteenth centuries). The prosperity of Dembeni, Grand Comoros, was possibly linked to the lucrative rock crystal trade, which accounts for the ubiquity of goods imported from China and the Islamic world at the site.⁴⁷ However, all rock crystal beads found at Banganarti appear to have been made in India (J. M. Kenoyer, personal observation). Further study should provide more details of their provenance.⁴⁸

FAIENCE

One small oblate bead, 7 mm in diameter and 4.8 mm in length, has traces of bluish glaze (**Fig. 20K**). Like the faience beads found in the treasure pot (compare **Fig. 5**, above), its perforation surface is glazed. The Banganarti specimen was found in the eleventh–twelfth-century context.

GLASS

Drawn and segmented

One white bead is a double-segment (**Fig. 21A**). It measures 4.8 mm in diameter and 8.8 mm in length and 1 mm in diameter of the hole opening. Beads like this, usually shaped with the use of a crenellated mould, are attested in Meroitic and post-Meroitic Nubia, and their production continued into medieval times (compare above, **Fig. 15A**). The Banganarti specimen was found in the eleventh–twelfth-century context.

Wound

Six beads are made of wound glass. These are a globular dark-blue bead (**Fig. 21B**; 6.7 mm in diameter) found in the eleventh–fourteenth-century context, and a large globular opaque green bead (**Fig. 21C**; 11.8 mm in diameter, 9.9 mm in length, 2.8 mm in hole opening) and a black bicone (**Fig. 21D**; 5.9 mm in diameter, 8.7 mm in length) found in the ninth- and eleventh-century contexts. However, the last appears to be a modern intrusion (compare below, section on glass bead chemistry).

⁴⁵ ANDERSON, KHIDIR ELRASHEED, BASHIR 2017: 164, pls. 12–13, 164.

⁴⁶ EDWARDS 1998: 117, 233.

⁴⁷ PRADINES 2019.

⁴⁸ Verifying the provenance of rock crystal artefacts by scientific analyses is challenging and would require building up a reference database sufficient to translate subtle compositional signatures into provenance.

Another wound-glass bead is a large short-barrel bead of coral red, measuring ca. 14 mm in diameter, 11.6 mm in length and 2.6 mm in hole opening diameter. One end is more convex than the other (**Fig. 21E**). Although found in the twelfth–fourteenth-century context at Banganarti, it is a modern intrusion (compare below, section on glass bead chemistry).

Two other wound-glass beads are decorated. One black barrel bead, 6.7 mm in diameter and 7.3 mm in length, 1.5–1.9 mm in hole diameter, has a white band applied centrally (**Fig. 21F**), found in the context dated to between the sixth or seventh century and ca. 850 AD. The other, a long cylinder fragment of wound black glass, has a white trail applied spirally and dragged/combed up and down into a feather/zigzag pattern in the centre (**Fig. 21G**). The preserved fragment is 10.9 mm in diameter and 17.7 mm in length, with a 3.5 mm hole opening diameter. It was found in the mid-ninth–eleventh-century context. Trail-decorated beads belong within the ninth–fourteenth centuries,⁴⁹ and those with a similar dragged pattern in the centre are dated within the eleventh–twelfth centuries.⁵⁰ In Nubia, they are also recorded at Soba.⁵¹

Chemistry of Glass and Carnelian Beads

LA-ICP-MS analysis of 20 glass beads has identified three compositional groups related to different production centres and different trade routes. While a detailed discussion of the compositions will be presented separately,⁵² the preliminary results are provided here. Among the samples selected from these beads, found both in the pot (**Figs. 6, 7, 9, 10B, 10C, 11–14F, 15G, 17, 18**) and other contexts (**Figs. 21A–G**), two are of the mineral-soda-lime glass produced in Egypt and the Levant before the ninth century (**Figs. 15G, 21C**). One sample (**Fig. 17**) is of a lead-soda-silica glass of uncertain provenance, although a high lead glass is present in the Islamic world within the ninth–eleventh centuries. The majority of the analysed beads ($n = 14$), from the pot (**Figs. 6, 7, 9, 10B, 10C, 11–13, 14F, 18**) and other contexts (**Figs. 21A, 21B, 21F**) are of plant-ash-soda-lime glass produced east of the Euphrates (North Syria, Iraq or Iran) within the eighth–tenth centuries. One sample (**Fig. 21G**) is of plant-ash-soda-lime glass produced in Egypt or the Levant after the tenth century. Additionally, chemical compositional study confirms one bead is modern glass (**Fig. 21E**) and the provenance of the glass of another bead could not be estimated (**Fig. 21D**).

The six carnelian beads from the pot assemblage (**Fig. 4B**) and other Banganarti contexts (**Figs. 20B–F**) were analysed using a Thermo ICAP Q Inductively Coupled Plasma – Mass Spectrometer connected to an ESI-Elemental Scientific Laser – NW213.⁵³ A more detailed discussion of this analysis will be presented in another future article,⁵⁴ but preliminary results indicate all but one bead (**Fig. 20E**) appear to be derived from carnelian sources in the region of Gujarat, India.

49 SPAER 2001: 103.

50 DUBIN 2009: Timeline, no. 537.

51 SHINNIE 1961: fig. 28.7. The white trail in beads at Soba illustrated in ALLASON-JONES 1991: fig. 70. 252–4 are combed in one direction.

52 THEN-OBLUSKA, DUSSUBIEUX, *forthcoming*.

53 CARTER, DUSSUBIEUX 2016.

54 KENOYER *et al.*, *forthcoming*.

The one exception matches the carnelian from Yemen in the current database. This does not mean the bead was made in Yemen, but rather the carnelian most closely matches the carnelian from Yemen as studied to date. Additional sources of carnelian from India may be found that could change the pattern.

Bead Colours in the Tenth–Twelfth-Century Banganarti Pot

By assigning each bead to a generic colour group and performing a quantity analysis, it is possible to determine how the tenth–twelfth-century owners of the Banganarti pot perceived and used colour (**Fig. 22**). The majority of beads are of yellow shades (glass; 41%). Black (glass) accounts for 31% and light blue (glass) for 18% of the assemblage, while green (glass) is only 3% of the hoard, and whitish (ostrich eggshell), blue-green (faience), and dark blue (glass) constitute merely 2% each. The colours dark purple (glass), opaque orange (glass), and red (carnelian) are represented by only one or a few specimens.

CONCLUSIONS

The hoard of over 2,000 beads of glass, faience, stone and resin, as well as metal pendants found in the ceramic pot in the Banganarti residential building, is the largest assemblage of beads discovered in medieval Nubia. The beads are made in a variety of materials, mainly glass of the plant-ash-soda-silica type primarily of Middle Eastern (Iraq, Iran, North Syria) provenance. The carnelian of tested bead sources most closely relates to carnelian from Western India/Gujarat. Although their find context is dated with the tenth–twelfth centuries A.D., the glass used for their production is dated within the eighth–eleventh centuries.

Very probably, at least some yellow and dark-blue large beads, ostrich-egg-shell beads, resin fragments, and the metal cross in the hoard previously could have been, at least partly, prayer beads. The metal cross pendant, associated with 126 beads of yellow and dark-blue glass, stone, and ostrich eggshell, and also resin fragments wrapped in textile, found in the late tenth–twelfth-century context in the Ghazali monastery during the 2015 excavation,⁵⁵ were probably used as prayer beads. The ostrich-eggshell and large yellow and dark-blue glass bead types from the Banganarti hoard find analogies in the Ghazali specimens. Moreover, just like the Banganarti specimens, the Ghazali beads are laboratory-verified as of Islamic plant-ash soda glass.⁵⁶

Earlier finds of bead deposits associated with ceramic pots are attested in Early Makuria tombs⁵⁷ (strings of beads hung on jar necks) and are interpreted as foundation deposits in churches (e.g. the seventh-century ceramic pot with beads in an Old Dongola church).⁵⁸ Nevertheless, the Banganarti pot beads

⁵⁵ THEN-OBŁUSKA, WAGNER 2018: fig. 1.

⁵⁶ THEN-OBŁUSKA, WAGNER 2018; THEN-OBŁUSKA, DUSSUBIEUX, *forthcoming*.

⁵⁷ THEN-OBŁUSKA 2014.

⁵⁸ ŻURAWSKI 1994.

found in the tenth–twelfth-century residential space are mostly of glass produced within the eighth–eleventh centuries, and their interpretation remains a matter of speculation.

The remaining 33 beads from Banganarti, found in the lower church, the residential building and rooms attached to the enclosure walls, represent various materials, techniques and shapes. The presence of two large rock crystal oblate beads in the seventh–tenth-century context in the niche in the prothesis of the lower church (**Fig. 20G**) and a few Early Christian specimens from the ‘Church with Granite Columns’ at Old Dongola⁵⁹ might imply their votive character. The clarity and transparency of this material were especially valued in religious contexts as a symbol of purity.⁶⁰ Beads left as votive offerings in ritual places is a custom already recognised in ancient Egyptian temples devoted to the goddess Hathor⁶¹ and most probably continued in Late Antiquity, as can be observed in the Isis temple at Berenike.⁶²

Still, faceted carnelian beads, sourced mainly in India and possibly Yemen, and faceted rock crystal beads, as found in the twelfth–fourteenth-century dated deposit, are the most distinguishable types. They usually find parallels in the ninth–fourteenth-century medieval Northeast Africa, Levant and Europe. Banganarti was a pilgrimage centre, where visitors from southern France and Yemen left traces of their presence on its walls.⁶³ Some might have also brought their beads with them.

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⁵⁹ THEN-OBLUSKA 2014.

⁶⁰ E.g. DUBIN 2009: 77; TAIT 2006: 208; Metropolitan Museum of Art, MET 08.202.27b.

⁶¹ PINCH 1993.

⁶² E.g. THEN-OBLUSKA 2017a.

⁶³ ŁAJTAR, PŁÓCIENNIK 2011.

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House A in the Northeastern Domestic Quarter

Michał Dzik

Abstract:

A complex stratigraphy of layers and walls reaching up to 6 m below the contemporary surface has been researched within the ensemble of rooms distinguished as House A. Its documentation and analysis became the basis for the reconstruction of changes taking place in the period from the ninth to the thirteenth century, in the house's layout, the features of building, and the function of particular parts of the house. The discussion of these issues is broken down into 12 periods – phases and sub-phases – distinguished based on the stratigraphy analysis of layers and architecture. The paper also presents radiocarbon-dating results, adopted here as the primary basis for the absolute dating of individual phases.

Keywords: Banganarti, medieval house, Nubian house, household archaeology.

One of the more extensively explored parts of the Banganarti site is the northeastern residential quarter. In 2014–2020, during the excavation work carried out by the archaeological expedition from the Institute of Mediterranean and Oriental Cultures of the Polish Academy of Sciences led by Bogdan Żurawski, the research covered a total of approximately 14.5 ares within three sectors: ECH, NECH, NNECH.¹ The remains of densely concentrated buildings were exposed, probably filling the entire area between the church and the surrounding defensive walls. The area was investigated to varying degrees. Some of the visible remains of buildings were explored only to the levels of the most recent cultural layers, but a few of them were excavated to the level of sterile sand. One of the more fully explored was a complex of buildings distinguished as House A, which is the focus of this paper.²

The research methodology and the general characteristics of the buildings exposed and the stratigraphy have already been described elsewhere and, therefore, will not be discussed in detail.³ However, the rules adopted for the numbering of archaeological contexts require clarification. The excavation trench has been divided into areas (**Fig. 1**). The basis for distinguishing between them was the layout of the walls visible after removing the top layer of aeolian sand with a thickness of up to 0.5 m (**Fig. 2**). Continuous numbering of layers and features was carried out for the whole trench. In addition, documentation of the stratigraphy of architecture was made in each of the areas. During the course of the recording, the following elements of the architecture were documented as separate stratigraphic units: the phases of the wall construction, plasters, door and window openings, recesses and other architectural elements. Each stratigraphic unit number consists of three elements: an area number, a section number, and an appropriate unit number (e.g. 13.D.1; **Fig. 3**). An essential supplement to the descriptions of stratigraphic units is photo-drawing documentation of sections of walls and layers (**Figs. 4–14, 16**). Of course, the described method of documentation means that one stratigraphic unit can receive two or more numbers, e.g. a partition wall between several rooms. Much more critical than this inconvenience is, however, the advantage of systematising the observations. This is of great importance, especially considering the multiphase nature of the site.

At the level of the tops of the most recent of the preserved walls, House A was visible as a nearly rectangular building, with dimensions of 11.1 × 7.8–8.8 m and an area of 93 m² (**Fig. 3**). The house was surrounded—except for Area 13—by adjacent buildings with which it shared the perimeter walls. The entrance was on the eastern side, where a fragment of the street leading to the house was also revealed (Area 13).

1 ŻURAWSKI 2016: 354–357; ŻURAWSKI, CEDRO, DRZEWIECKI 2017: 268–270.

2 A part of the site was explored in 2015–2020 under the supervision of the author of this text, within the framework of scientific cooperation between the Institute of Mediterranean and Oriental Cultures of the Polish Academy of Sciences (hereinafter: IMOC PAS) and the Institute of Archaeology of the University of Rzeszów (hereinafter: IA UR). Archaeologists: Katarzyna Mich, MA (2015) and dr Piotr Kotowicz (2017, Historical Museum in Sanok), as well as archaeology students: Martin Grzymski (2016, Institute of Archeology of the University of Warsaw), Karolina Wenc (2018, IA UR), Piotr Bańdur (2019, IA UR) and Katarzyna Niemczewska (2020, IA UR) all participated in the work of documentation in different seasons. Geodetic measurements and some aerial photographs were provided by Roman Łopaciuk, MA (IMOC PAS). The ceramics were analysed by Aneta Cedro, MA (IMOC PAS). Here, I would like to thank all participants for their work and fruitful cooperation.

3 DZIK 2017: 287–294.



Fig. 1
House A and its surroundings, excavated in 2015–2020. A – numbers designating areas distinguished at the level of the tops of the walls; B – numbers designating areas distinguished at a lower level; C – tops of the walls; D – trench boundary. Photo by Roman Łopaciuk, Michał Dzik; prepared by Michał Dzik

The areas within House A were examined to a varying degree, to a depth ranging between approximately 2.5 m and 6.0 m from the modern ground surface. In each area, a complex stratification of the architecture and soil layers was documented, which made it possible to recognise changes in the layout of buildings and sometimes also the functions of the spaces over several hundred years. The level dating from before brick buildings was reached in three areas – nos. 4, 5 and 33.

At the beginning of the research, the regularity of the arrangement of rooms distinguished as House A suggested that it was one household. However, during the work, it became clear that not all the areas identified as House A constituted one household at some stages of development. Sometimes it was also difficult to determine unequivocally whether the rooms belonging to a given house had changed or not. Doubts in this respect have been indicated in the descriptions of individual phases.

Traces of significant reconstructions, changes in the layout of walls or communication routes were adopted to distinguish the phases in respective areas. In most cases, it was possible to correlate the construction activities documented



in different areas with each other and combine them with the stratigraphy of the layers. This made it possible to reconstruct the main phases of using the space referred to as House A.

The earliest layers, which can be dated to the Early Christian period, were identified as Phase I. However, these were not the oldest traces of human activity exposed. Some older layers were excavated, but only on a modest scale – over an area of up to approximately 12 m². The layers were composed mainly of the sand fraction and were characterised by a low degree of cohesiveness. The differences in the content of the grey silt fraction are noticeable. In Area 33, it was significant in layers from levels around 146.10–146.50 m above sea level, slightly lower in layer 625 (approximately 146.50–146.80 m) and very low in layers 501, 610 (approximately 146.80–147.00 m; **Fig. 14**).

The oldest traces of human activity were discovered within Area 33, where the exploration was carried out to approximately 146.00 m, up to around 1 m below the medieval layers and around 6 m below the current ground level. Two features were discovered within the layers of yellow sand with an admixture of grey. The older one, no. 183 (a posthole?), was dug from the level of 146.23 m. The younger feature, no. 172 (a pit), was dug from level 146.79 m (**Fig. 13**). In the latter, a few small pieces of charcoal were discovered, which were radiocarbon-dated. According to the results, these features can be dated to the fourth–third centuries B.C. (see below).

Phase I

Beneath the accumulation of yellow aeolian sand, from the level ranging from around 146.85 m (northern part of Area 33) to 147.40 m (southern part of Area 5), came a distinct intensification of human activity. Apart from a few sherds and

Fig. 2 (on the left)
NECH sector, view from
the southwest, February
2018. Photo by
Michał Dzik



Fig. 3 (on the right)
Designations of areas
and walls. The extent of
House A is marked with
a red line. Prepared
by Michał Dzik

charcoals in the layer mentioned above, its oldest trace was a fireplace with an ash layer – no. 264 – 1.75 m long and 0.09 m thick.

Layers related to this phase were discovered in Areas 4, 5 and 33. They had the most significant thickness in Area 33 (approximately 0.2 m). They were mainly characterised by a high and very high saturation of the grey silt fraction mixed with yellow sand, and some of them also by the presence of small fragments of mud and fired bricks. The latter undoubtedly indicate that construction activities were carried out in the vicinity.

Further evidence of settlement activity were numerous pits. E.g. in Area 33, on a surface of around 10 m², as many as ten features from this period were revealed. In three cases, it can be presumed that these were postholes (features 179, 180, 181). The other two were presumably storage pits (features 178, 175).

In Area 33, at the level of 147.1–147.2 m, there was a layer several centimetres thick – no. 517a – containing mainly mud-brick debris. This context can be interpreted with high probability as a construction layer. The structure associated with it was observed in section B of Area 29, adjacent to Area 33. It was a wall, exposed over a length of 2.6 m, with a preserved height of up to 0.7 m. The foundation level – 146.85–146.95 m – fell to the east.

Phase II

The beginning of Phase II is determined by the construction of a regular building, which was partly recognised. The construction work was carried out from the level of approximately 147.35–147.45 m and covered an area of at least 61 m², with dimensions: 9 × 6.8 m.

The largest room was built in the northwestern part of House A – Area 33 (**Fig. 15**). Its dimensions were approximately 7.9 × 2.8 m, with an area of 22 m² and a maximum height of 2.1 m. The thickness of its walls has not been established.

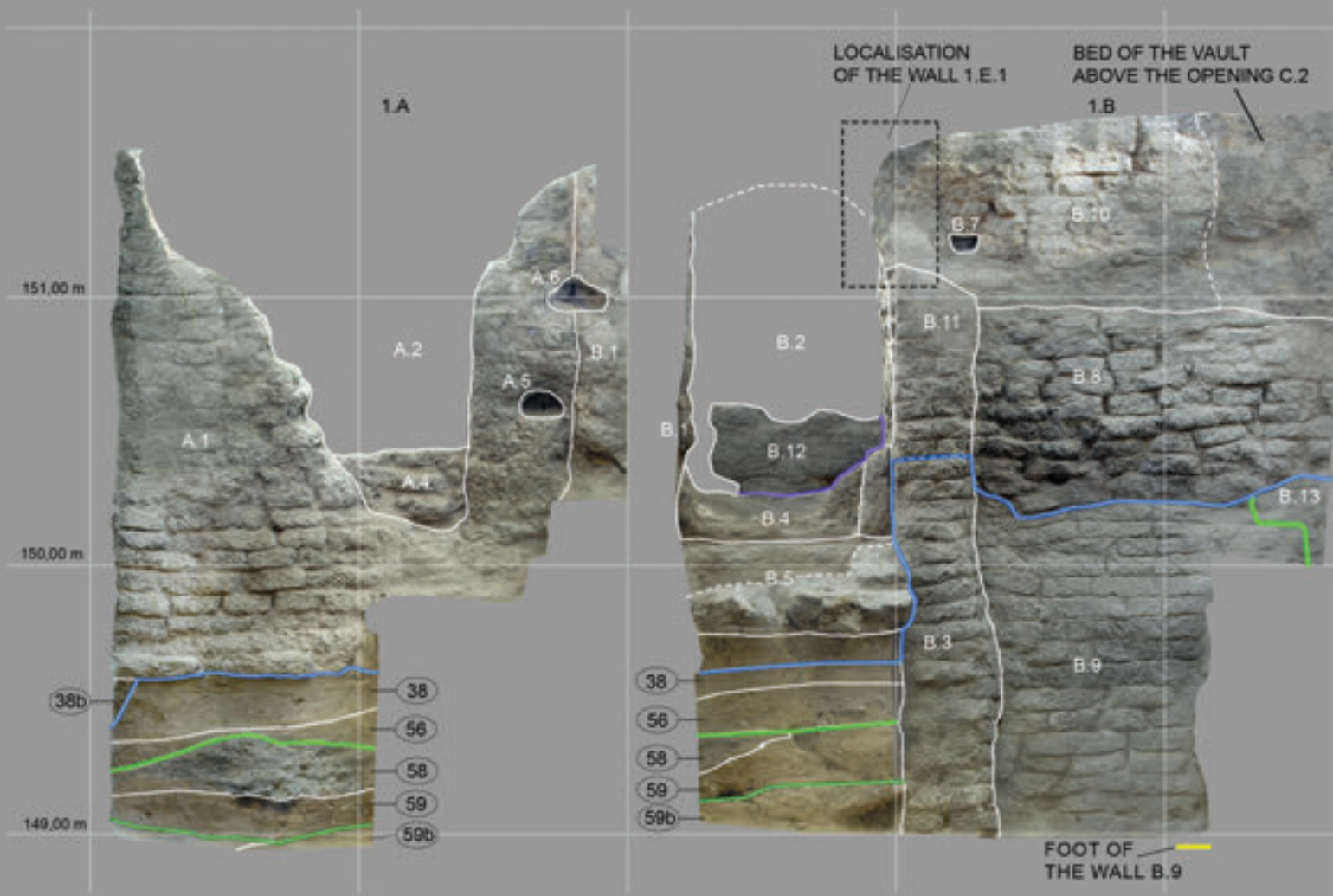


Fig. 4 Photo-drawing documentation of sections A-D of Area 1, with phases highlighted. Prepared by Michał Dzik

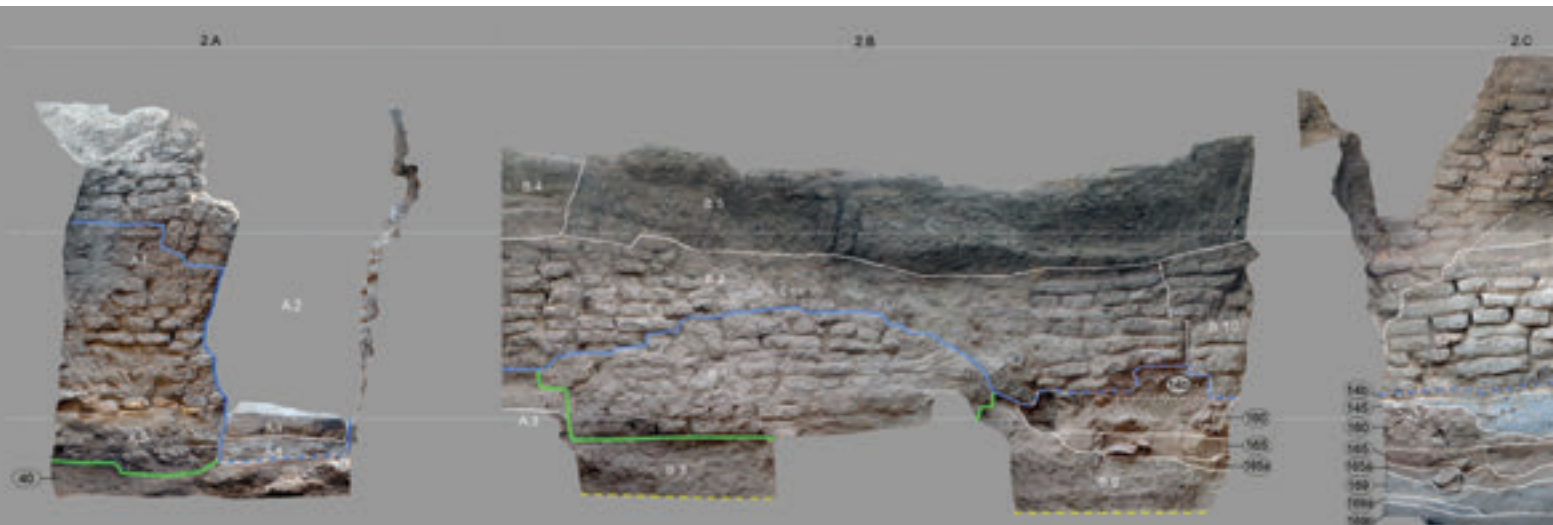
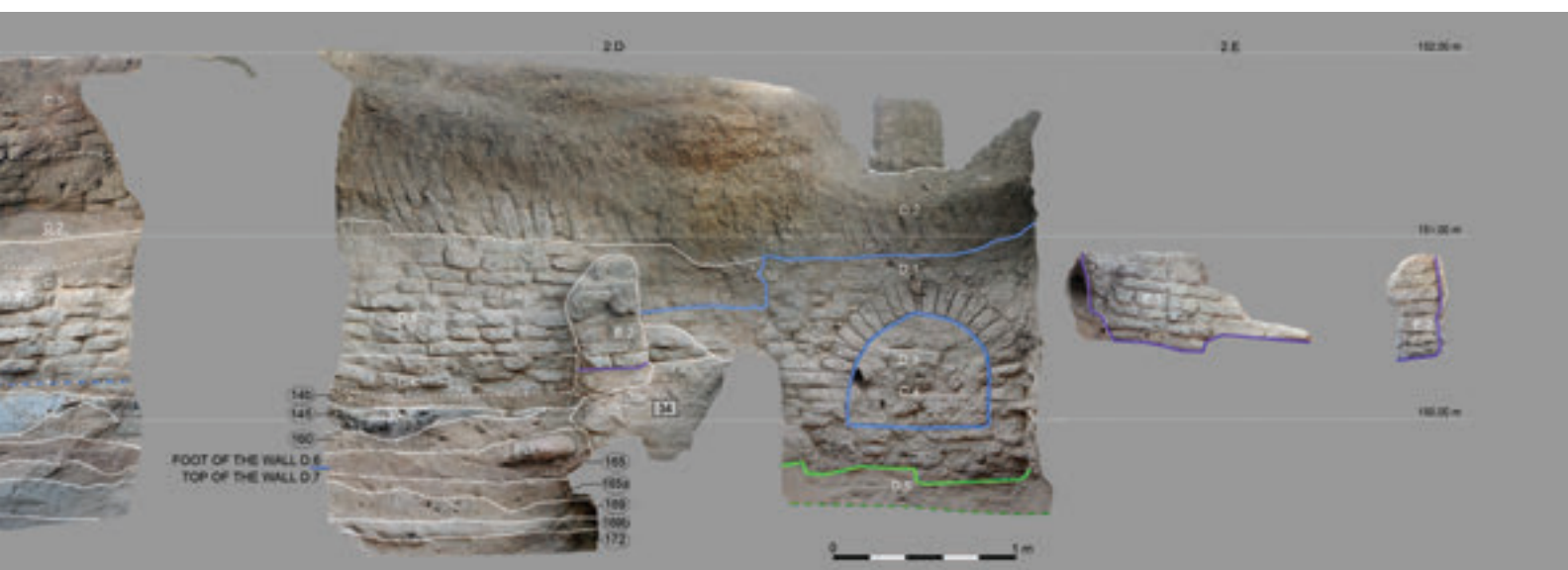
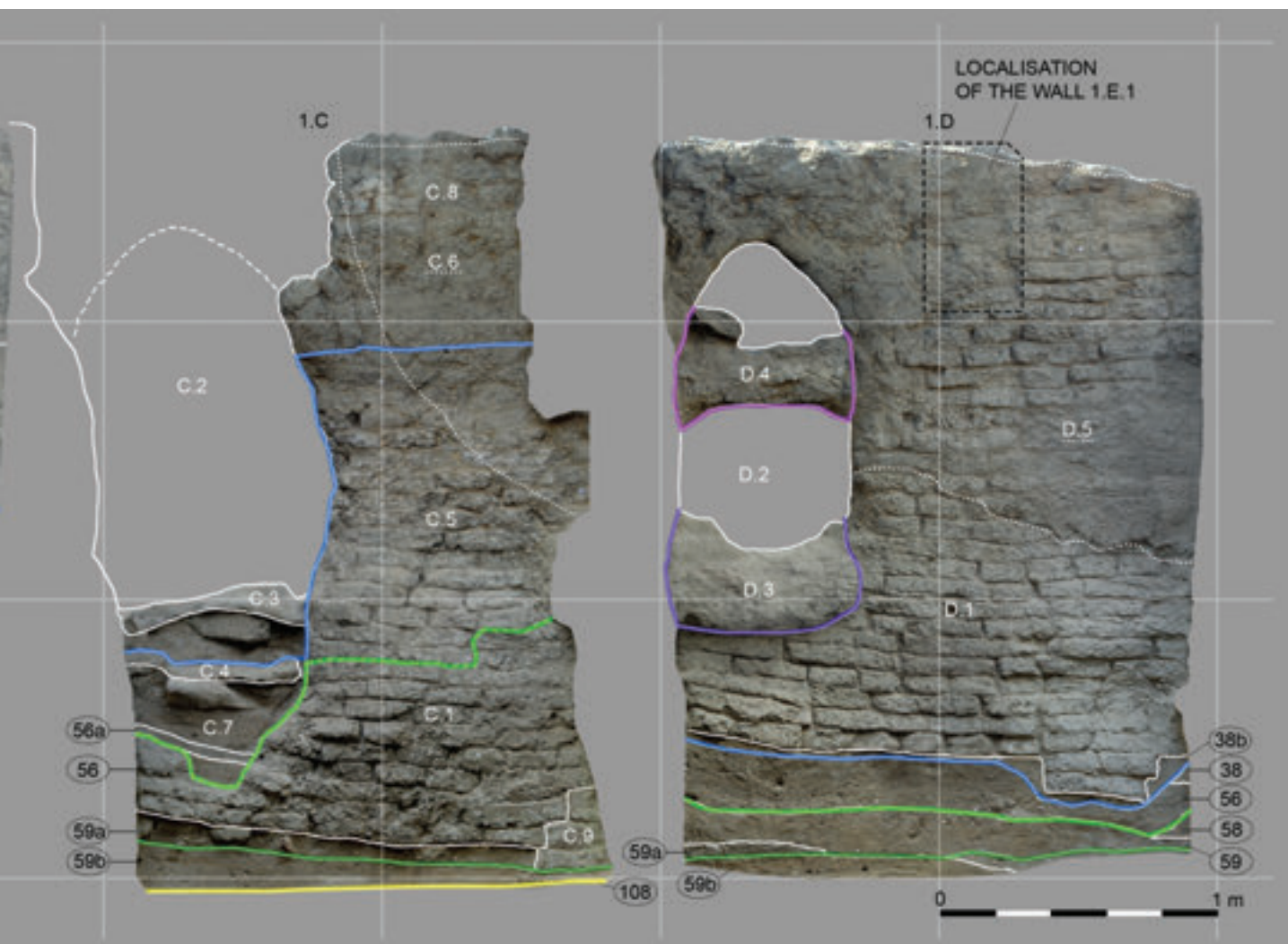


Fig. 5 Photo-drawing documentation of sections A-E of Area 2, with phases highlighted. Prepared by Michał Dzik



Based on the data collected, it can only be assumed that this was in the range of 0.5–0.6 m. The whole structure was covered with a barrel vault and was accessible through a passage in wall 33.B.

During the same construction activity, walls were erected within Area 4, adjacent to those mentioned above. Their contemporariness is indicated by the bond of the walls observed in Area 5 (stratigraphic units 5.A.7 and 5.D.11). Only the width of the room is known, which was approximately 2.45 m. Traces of the wall delimiting the building on the northeastern side have not been found in Area 4 or in Area 25, where the exploration was ended at the level of 148.15 m. However, the face of the wall on line 4.F was revealed, reaching feature 55. Therefore, the following course of closing the room from the northeastern side is possible: (a) below feature 55 in Area 25; (b) to the northeast from the exposed face of wall 25.A, on the extension of wall 33.A. Theoretically, the second possibility is challenged by the lack of the continuation of wall 4.F in Area 25 at the level of 148.15 m (under wall F.1, to the east of feature 55, there were only earth layers). However, it cannot be ruled out that this discontinuity was caused by the location of the door opening in this very place (see Phase III). Thus, the room length could be from 3.5 m to 5.0 m, and the area from 8.6 m² to 12.3 m². It was accessible through at least two doorways documented in walls 4.F and 5.A. It could also be connected with Area 33. The thickness of the walls of this room was determined only for wall 4.F; this was 0.36 m.

Shortly after completion of the construction just described, a thin wall (5.F) was erected from the level of approximately 147.50 m (with the thickness of the mud-brick header, i.e. approximately 0.17 m), on the extension of the wall 4.F. Considering its thickness, it seems likely that it was a light partition wall, maybe a low fence, which probably delimited the space from the southwest side as well.

Nothing is known about buildings from this phase within the southeastern part of the space under discussion. Theoretically, its existence may be indicated by the stratigraphic unit 5.A.21 observed in the section of wall 5.A, directly to the southeast of wall 5.F. It was a compact layer of silt, deposited at the level of the foundation of wall 5.F, with a thickness up to 0.35 m and length of over 1.2 m. One fired brick was visible within it. It could be an overturned wall, nrecognisable due to the erosion of the mud bricks, or a layer of building waste.

The room in Area 33 was finished with mud plaster, well preserved on the vault. Plaster residues were also found on the walls in Area 5. In the first of these, a mud-brick floor was laid, at the level of 147.31–147.35 m (layer 595; **Figs. 13, 14**). However, the course of the floor was not recognised due to the extreme erosion of the bricks. In turn, in Area 5, a hard mud floor with a thickness of 4–8 cm was documented at 147.43–147.48 m (layer 257a). The differences in the height of the foundation are a function of the then ground level, the highest being in the southern part of the discussed space, falling towards the north, northeast and northwest.

In Area 4, no layers were discovered that could be unequivocally interpreted as a hard mud floor. However, at the level at which the rebuilding commenced, there was a layer several centimetres thick, probably constructional, consisting mainly of mud-brick fragments and dense concentration of silt, which could have acted as a hardening for the floor (layer 296a; **Fig. 9**).

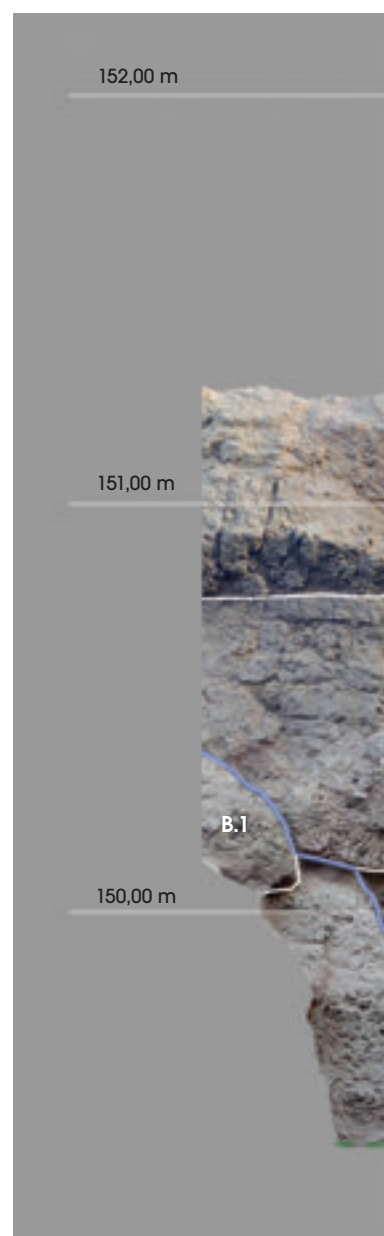
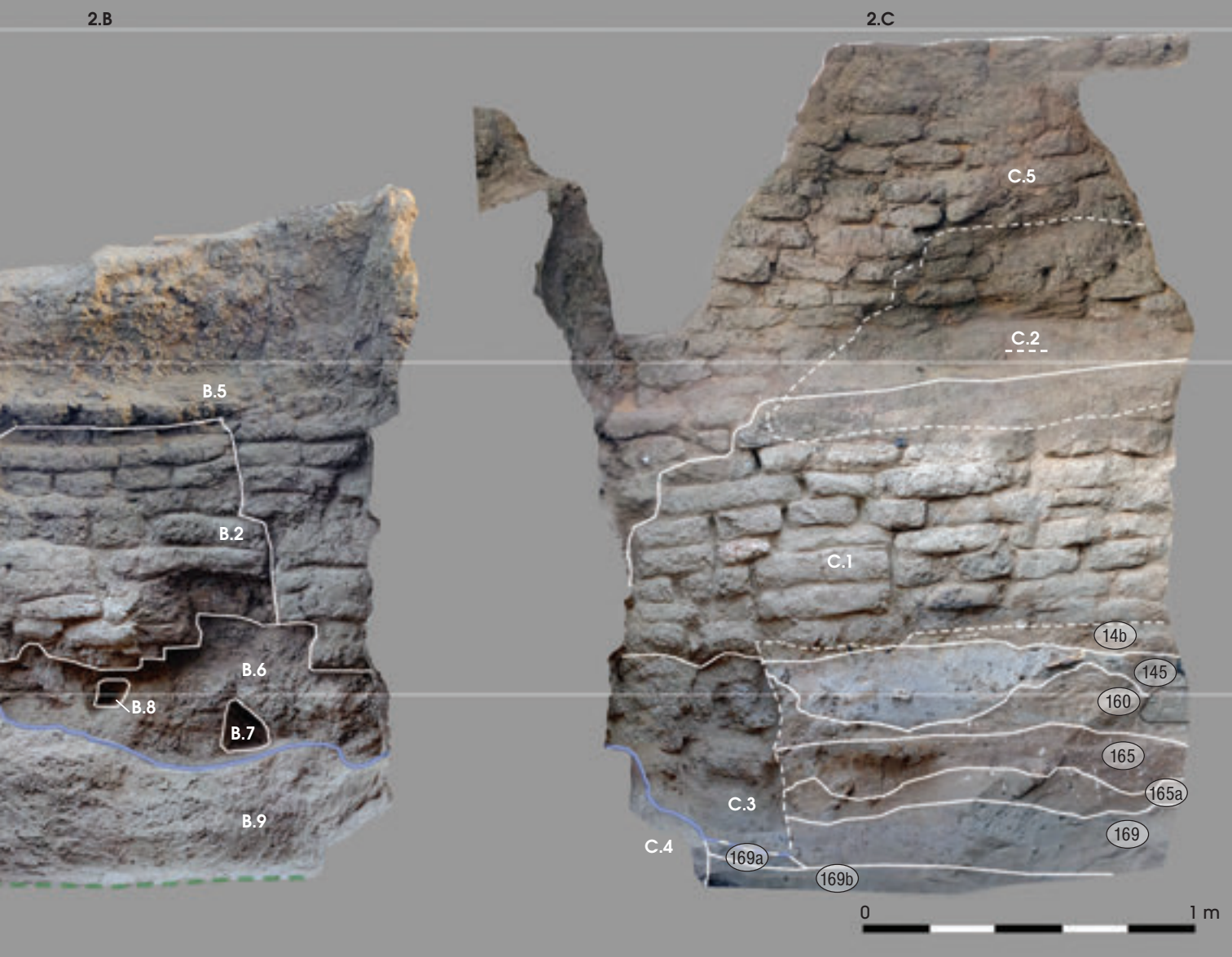


Fig. 6
Photo-drawing documentation of sections in the southern corner of Area 2 after partial removal of adjacent layers, with phases highlighted. Prepared by Michał Dzik



Three door openings were documented: 4.F.9, 5.A.23 and 33.B.25. Their width was 0.70–0.75 m; it is more difficult to determine their height. Concerning the first two, based on the height of the preserved walls, it can only be stated that it exceeded 1.2 m. The remains of a wooden beam discovered above the opening 33.B.25 are probably the remains of a lintel beam. If they were located at a level similar to the original, the height of the entrance did not exceed 1.5 m. At each of the entrances, single pilasters (buttresses) were discovered on one side, constituting a part of the door openings framing and performing a structural function related to fixing or closing the unpreserved door. Based on their presence and location, it can be concluded that the separate rooms were closed with inward-opening doors in each of the three areas. It is possible that the room in Area 33 had a second entrance, which could have been in one of the uncovered gable walls. Indeed, such entrance existed in Phase IV (see below).

The room in Area 33 was lit and probably ventilated with two openings in wall 33.D, located about 1.2 m above the floor, 2.1 m from each other (units 33.D.13, 33.D.14). They were 0.26–0.30 m high and 0.16–0.18 m wide, with a sloping top and base, rising towards the outside of the building.

The preservation of the exposed walls in Area 4 did not allow the roofing method to be determined. In Area 5, structures from this phase were preserved in walls 5.A and 5.D to a height of nearly 2 m, but no traces of beam slots were found. Considering the thinness of wall 5.F, it seems that this space, if it was covered, had a light roof at most. It could have been supported on posts at the side of the wall 5.F. This interpretation is reinforced by discovering two postholes by this wall, located approximately 2 m from wall 5.A (features 75, 75a).

In Area 33, the springing of the vault was from walls 33.B and 33.D, from a height of about 0.5 m from their foot. It was made from mud bricks laid vertically stretcher-wise, slightly slanted. The height of the ceiling from the level of the springing up to the bottom of the gable was 1.52 m with a span of up to 2.85 m. The voids above the vault were filled to a height of 0.5 m with a dense layer of silt and rubble of mud and fired bricks, covered by regularly arranged bricks, mainly mud bricks. They were then covered with a layer of brown soil with numerous pieces of pottery (layers 277, 277b; **Figs. 16, 17**). The whole structure was covered with a 5–8 cm thick hard mud layer (no. 285; **Figs. 16, 18**).

Phase II earth layers were discovered in Areas 4, 5 and 33, on a surface of around 24 m². They were noted to the greatest extent in Area 33 (approximately 14m², 64% of the room surface). For safety reasons, the southwestern part of this area and layers against the walls of the building were not excavated. Nevertheless, the work carried out gives a basis for general conclusions about the function of the vaulted room.

After the period of use, in which the 2–20 cm thick earth layer was deposited on the floor (layer 592), a brick bench and hearth were erected (features 90 and 166; **Fig. 19**). The first structure was rectangular in plan, with 1.4 × 2.1 m in size and 0.3 m in height. Its walls, 0.17 m thick, were made of four layers of fired and mud bricks, cemented with mud mortar. The backfill was a brown layer with ash inclusions and numerous sherds, brick fragments and several stones. The whole structure was covered with a layer of silt. Taking into account the size of the structure, it was probably a sleeping place.

The base of the hearth mentioned above was situated in a place previously used for burning fire. It was an oval structure with dimensions of 0.67 × 0.56 m and a height of 7–10 cm. Its edges were fragments of fired bricks, with a stone in the centre, and the whole thing was covered with silt. This hearth was covered by the accumulation of cultural layers. From the level of its top, traces of burning, without any additional structures, were documented at various levels along wall B (layers 511, 596; **Fig. 13**). In Phase II, due to the accumulation of cultural layers, the level of use of the room in Area 33 was raised from 0.1 m (southwestern part) to 0.2 m (northeastern edge).

In Area 4, layers related to Phase II were excavated only between walls 4.E and 4.F, on a surface of 1.8 × 0.85 m (1.5 m²; **Fig. 20**). On this modest basis, it is difficult to define the function of the room. Soon after the construction of wall 4.F,

with an entrance (4.F.9), wall 4.F.5 was erected within the latter. There are two possible interpretations of its function: (a) blocking the door opening in wall F; (b) raising the sill level by about 0.7 m. The second option seems less likely due to the height to which the sill was raised. However, such an action could be justified, e.g., by climate factors (see below). It is also worth noting that in another area, traces of construction were documented, which were undoubtedly connected with raising the level of entrances by a similar amount (cf. Area 13, walls C, D in Phase VI; **Fig. 11**).

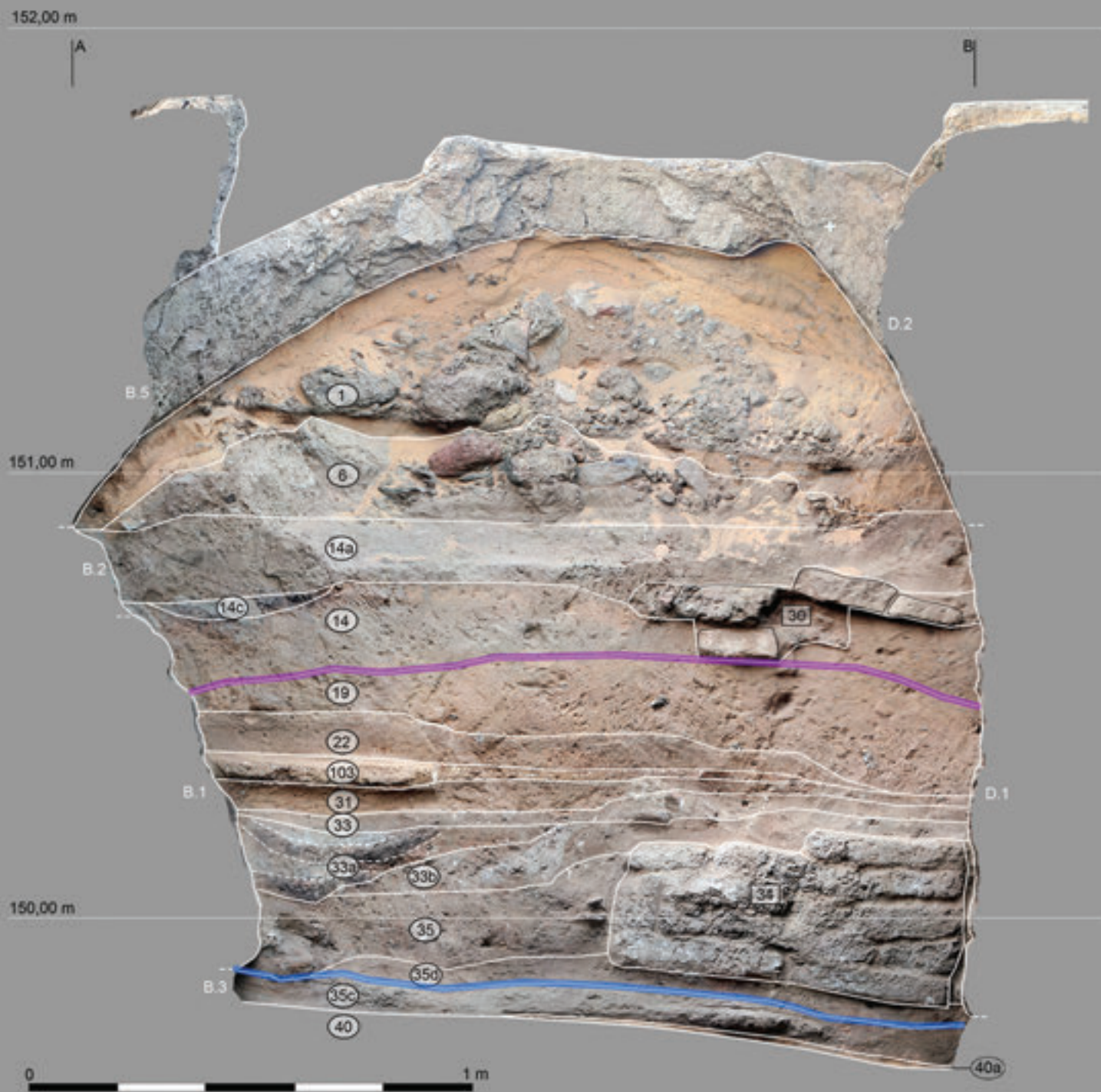
After the accumulation of the 0.15 m thick occupation layers, from the level of around 147.55 m, a wall over 1 m long and 0.16 m thick was added perpendicularly to wall 4.F (feature 71). It was preserved in four rows of bricks. Stratification at the northeastern side of this wall was not thoroughly investigated, as the exploration was finished at the level of approximately 147.75 m, i.e. 0.2 m above the foot of this wall. Up to this level, the features of the layers on both sides of the wall had similar characteristics, which excludes the possibility that it was a wall of a bench, analogous to the one exposed in Area 33. The presence in wall 4.F, above feature 71, of the alleged chimney recess (unit 4.F.2; see below) would theoretically support the hypothesis that the wall of feature 71 could be part of a hearth or an oven, similar to those documented in Area 5. However, this recess might have been made in Phase III, in which the fire was used in this place. At present, it seems most likely that it was a partition wall within the room.

In Phase II, due to the accumulation of cultural layers, the room level in the excavated portion of Area 4 was raised approximately 0.4 m. In Area 5, in part surrounded by walls 5.A, 5.D and 5.F, directly on the hard mud floor, a light brown layer was laid, a few centimetres thick, with a high concentration of a grey silt fraction with laminations of yellow sand, very cohesive (layer 257b).

The oldest construction – feature 80a – had been erected in the western part of Area 5, from the level of 147.50–147.55 m. It was observed in the section under the hearth or oven – feature 80 – which copied its shape. These features were separated by a layer of ash with a thickness of approximately 8 cm. The appearance and the shape of feature 80a, similar to younger and better-documented constructions, allow us to interpret it as the base of a hearth or an oven. Therefore, we can conclude that, from the top of the above-mentioned layer 257b, this space was related to the use of hearths or ovens throughout the rest of Phase II.

During the use of features 80 and 80a the whole space limited by walls 5.A, 5.D, 5.F gradually filled up to the level of around 147.90 m with very cohesive, light-grey and light-brown layers, with high content of the silt fraction, with yellow sand laminations (layers 253, 257). In Phase II, due to the accumulation of cultural layers, the ground level of the space limited by walls 5.A, 5.D, 5.F was raised by about 0.55 m. The second part of Area 5, southeast of wall 5.F, was at that time an open space. Layers connected with Phase II accumulated there to the level of 147.75–147.85 m.

Almost all earth layers from Phase II, as well as part of the layers from Phase III, were characterised by a high content of the grey silt fraction and consequently a high degree of cohesiveness, which distinguished them in comparison with most of the layers from Phase III and all the later phases.



It seems that the only explanation for this fact is the effect of water washing away the walls and bringing the river mud during the Nile floods. The circumstances supporting this hypothesis were also documented in the remains of buildings. They are as follows:

- a) Area 4 – high degree of erosion of the face of the wall F, precluding the distinction of single bricks in almost all stratification units. The exception here was wall 4.F.3 – the blockage of a doorway, made from the level of around 147.90 m (**Fig. 9**). It was constructed after the factor causing the destruction of the wall face ceased. It is worth noting that the foot of wall 4.F.3 is congruent with the top of the layers very extremely saturated with silt and the bottom of the layers having a smaller proportion of this fraction.

Fig. 7
Photo-drawing documentation of the layers section in the middle part of Area 2, with phases highlighted. Prepared by Michał Dzik

- b) Area 4 – clear defects in the lower part of wall 4.F – units 4.F.5, 4.F.6 (**Fig. 9**). They are about 0.3 m high, triangular in cross-section, widening downwards at an angle of 22–25°. In the lowest part, i.e. on the level of 147.50 m, the cavities extend 0.13–0.14 m back from the wall face. The most likely cause of these traces appears to be the dissolving of the walls by stagnant water. This is indicated by the cavities' shape and the high proportion of the grey silt fraction in the layers at their level.
- c) Area 4 – the risk of the flooding of the rooms would explain the walling up, perhaps only in the lower part, of passage 4.F.9 shortly after the building was erected. In turn, the rubble within the 4.F.9 entrance (unit 4.F.4) could have arisen from flood damage to wall F.5 (or it could have arisen gradually as a result of damaging part of wall F.5 during the use of the passage).
- d) Area 5 – a high degree of erosion of the face of wall 5.F.1 and a clear inclination of the wall towards the northwest (ceiling 148.06–148.17 m), with no similar features in its reparation – unit 5.F.2 – made from the level of the top of wall 5.F.1. At the same time, from level of 147.54 m to 147.80 m, a mud layer (164c) by wall 5.F.1 was documented; this could have arisen precisely as a result of the run-off of a part of the wall face.
- e) Area 5 – a cavity in the lower part of the wall, separated as feature 29, from the level of 147.97 m. It was 8 cm deep and 15 cm high, and its shape was similar to the cavities in walls 4.F.5 and 4.F.6, described above. At the same height was layer 157 – the youngest of the layers intensely saturated with river silt in Area 5.
- f) Area 33 – evident damage to and erosion of the face of walls 33.B and 33.D, below the level of 147.80 m. At the same time, the accumulation of layers having a high concentration of the silt fraction near the walls and the gradual slope of their upper surfaces towards the centre of the room (layers 593, 593c; **Fig. 14**).
- g) Area 33 – evident cavities in the lower part of wall 33.B and the pilaster at the door opening (33.B.25) – units 33.B.21, 33.B.22 (**Fig. 13**). They were 0.24 m high, widening downwards in cross-section. In the lowest part, i.e. at 147.36 m, the cavity depth was 6.0–6.5 cm.

Phase III

In Phase III, the rooms that were built in Phase II were still in use. However, the layout of the passages changed, and new structures were built in the southeastern and eastern parts of the area under discussion (**Fig. 21**).

From the level of around 147.90 m, two entrances leading to the room in the northwestern part of Area 4 were bricked up (doorways: 4.F.9, 5.A.23; blockages: 4.F.3, 5.A.10; **Fig. 9**). However, this room was still in use, so it had to be accessible from the side of Area 25 (see below).

In Area 5, from the level of around 147.90 m, a mud-brick wall was erected, approximately 0.5 m long and 0.3 m thick (feature 29). It was the end of the wall running into baulk 4.C/5.A, which, however, was thinner – up to 0.2 m. This difference, and above all the lack of traces of the continuation of the wall

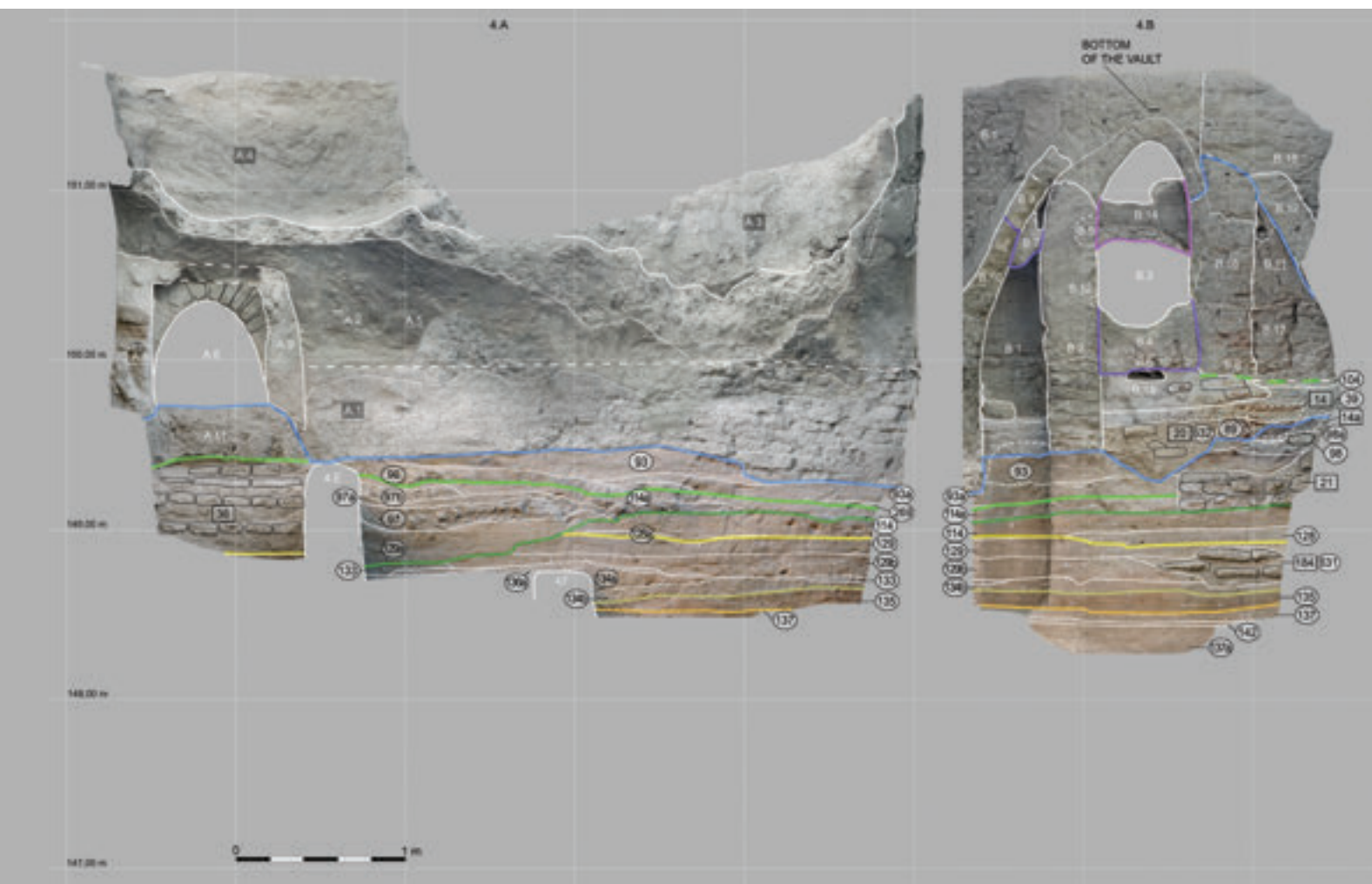
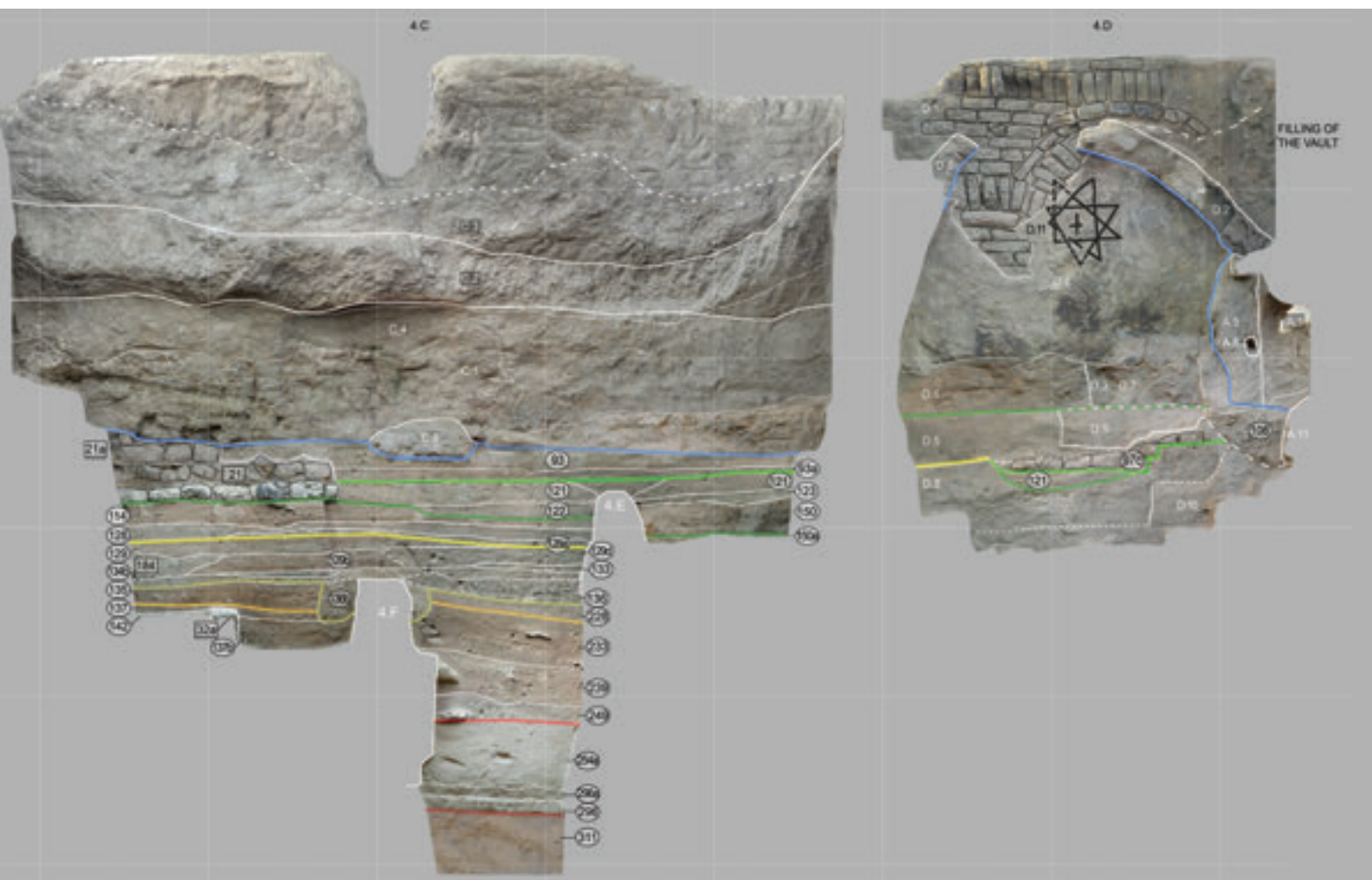


Fig. 8
Photo-drawing
documentation
of sections A–D
of Area 4, with phases
highlighted. Prepared
by Michał Dzik

distinguished as feature 29 within Area 5, allow us to assume that it was a pilaster flanking the door opening created at that time between walls 5.F and feature 29. Such a doorway was confirmed by the presence of at least three levels of thresholds made of mud and fired bricks with visible signs of wear (units 5.A.15, 5.A.27, 5.A.28).

In Area 4, during Phase III a few thin walls were erected from the level of approximately 148.20 m (features 32, 32a; **Figs. 20, 21**). Considering their thickness – 0.15–0.17 m – it is possible that they were partitions of a low height. It is worth noting the presence of a row of three fired bricks with a worn surface in the preserved top of one of these walls. It seems very likely that it was the threshold of the door opening (feature 32b). This hypothesis is reinforced by the presence of a floor made of mud and fired bricks (layer 630). This floor continued in baulk 4.C/5.A, but not to the northeastern part of the space between the walls described and wall 4.F. Therefore, it was located in the space between entrances 5.A.24 and feature 32b. To sum up, during Phase III a kind of a corridor with dimensions of approximately 2.5×0.6 m was created in Area 4, leading through two door openings from the southeastern part of Area 5 to the southeastern part of Area 4. The presence of such a corridor suggests that Areas 4 and 5 were separated from each other by a wall running under baulk 4.C/5.A (**Fig. 21**).



The continuation of the wall distinguished as feature 32 was most likely a wall of similar thickness discovered in Area 25 (feature 55). Unfortunately, the level of its foundation is unknown. It is only confirmed that it was below the level of 148.15 m, and therefore lower than the foot of features 32 and 32a (approximately 148.18 m). Nevertheless, provided that the difference was slight, it could have been due to a ground slope. Regardless of whether the walls mentioned above were erected simultaneously or not, they functioned together for some time. All of them were dismantled from a similar level, approximately 148.50 m. Thus, it can be assumed that features 32 and 55 and wall 4.F in Phase III enclosed a small space with dimensions of approximately 1.3×1.0 m and an area of 1.2 m^2 .

In Phase III, the wall distinguished as feature 55 enclosed the room documented in the northwestern part of Area 4 or was a partition wall within it. Considering the lack of door openings in walls 4.F and 5.A, the passage should have been from the side of feature 55. It is theoretically possible that it was located in the northwestern part of this partition, although there is no conclusive evidence. The premises for this hypothesis are: (a) the level of preservation of this fragment of feature 55 was lower more than a dozen centimetres, over the length of 0.88 m; (b) the proximity of the wall 0.36 m wide – feature 55a – which could have been a pilaster flanking the entrance (**Fig. 22**).

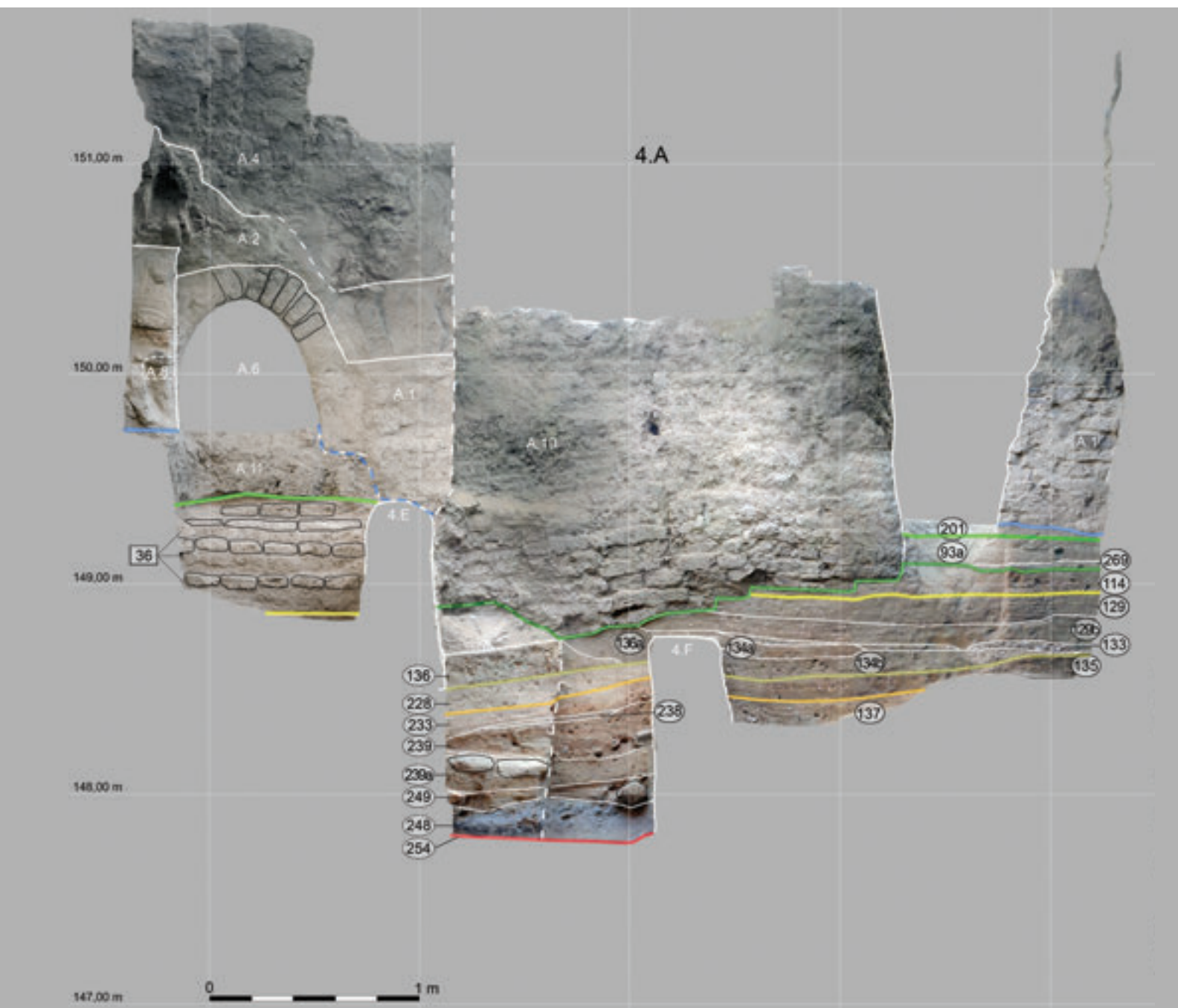
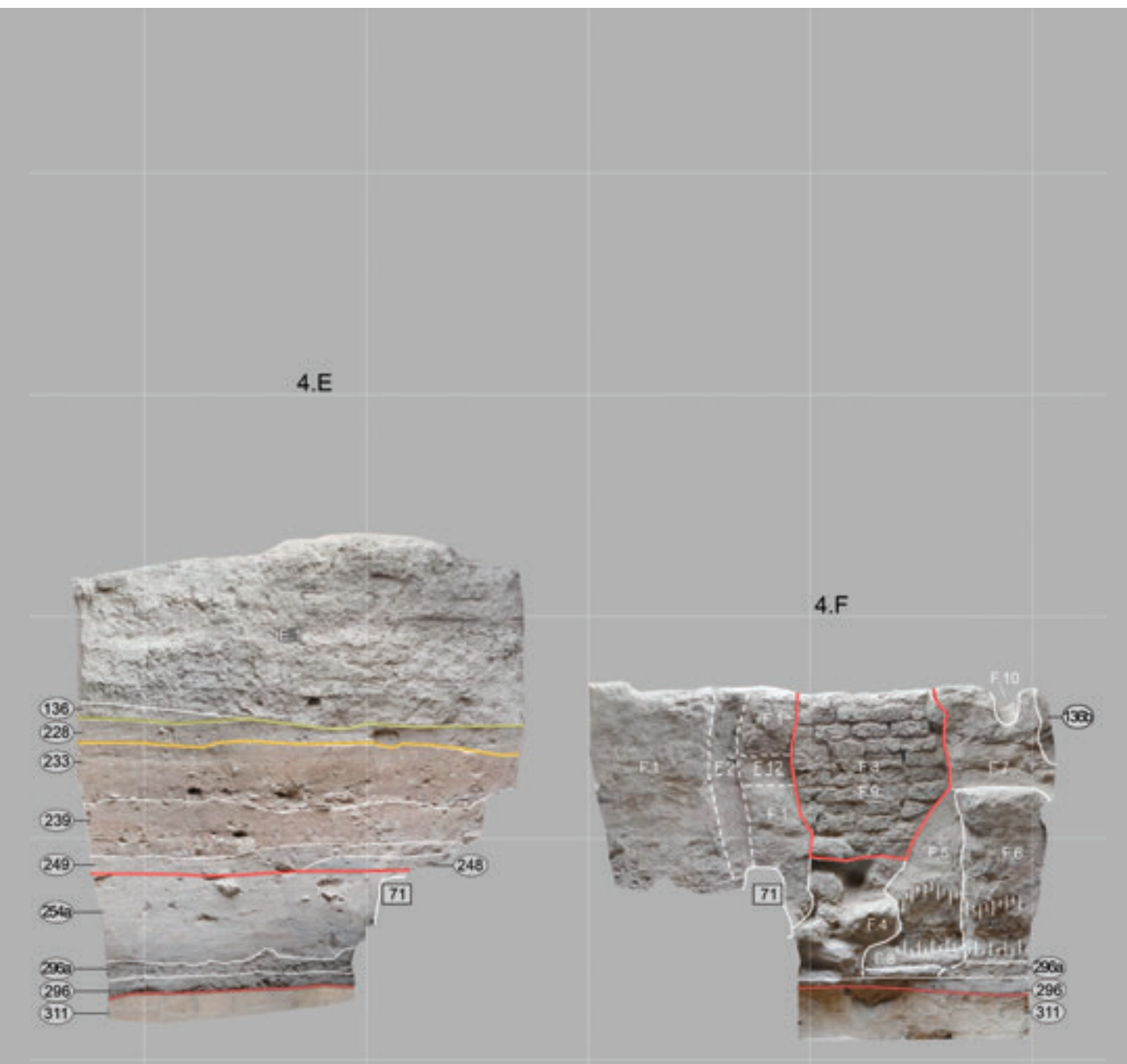


Fig. 9
Photo-drawing
documentation
of sections AA, E, F
of Area 4, with phases
highlighted. Prepared
by Michał Dzik

In the context of the presence of the doorways in the walls of Area 25 one more observation is worth noting. Wall 25.F.1 was built precisely on wall 4.F but only in Phase IV, from the level of around 148.56 m. Nevertheless, the layer of hard mud floor (no. 217), laid by feature 55 at a level of around 148.35 m, ended precisely at the position of the later wall 25.F.1. One of the possible explanations of this fact is the presence of a communication opening here, before the erection of the wall 25.F.1.

The location of the entrance to the fenced area in the northwestern part of Area 5 remains unclear. Due to the lack of traces of door openings in walls 5.A, 5.D and 5.F, which were quite well preserved at this level, this space had to be accessible from the southwest side. The lack of connection of this space with the



rooms in Areas 4 and 33 suggests that in Phase III it could have been part of the neighbouring household.

In the southeastern part of House A, the excavation was completed at the level of about 149.00 m; hence, the extent of its development in Phase III was not determined. However, in Area 13 the top of a wall that could have come from this period was documented (unit 13.D.1; **Fig. 11**). It was revealed in section 13.D, at the height of 149.03–149.28 m. The structure was built along the northeast–southwest axis, on the area’s border defined as House A. Comparing the condition and height of wall 13.D.1 with wall 13.D.7 erected in Sub-Phase IVa or IVb, it seems probable that the first one is earlier (**Fig. 11**). It can, therefore, be assigned to Phase III or Sub-Phase IVa.

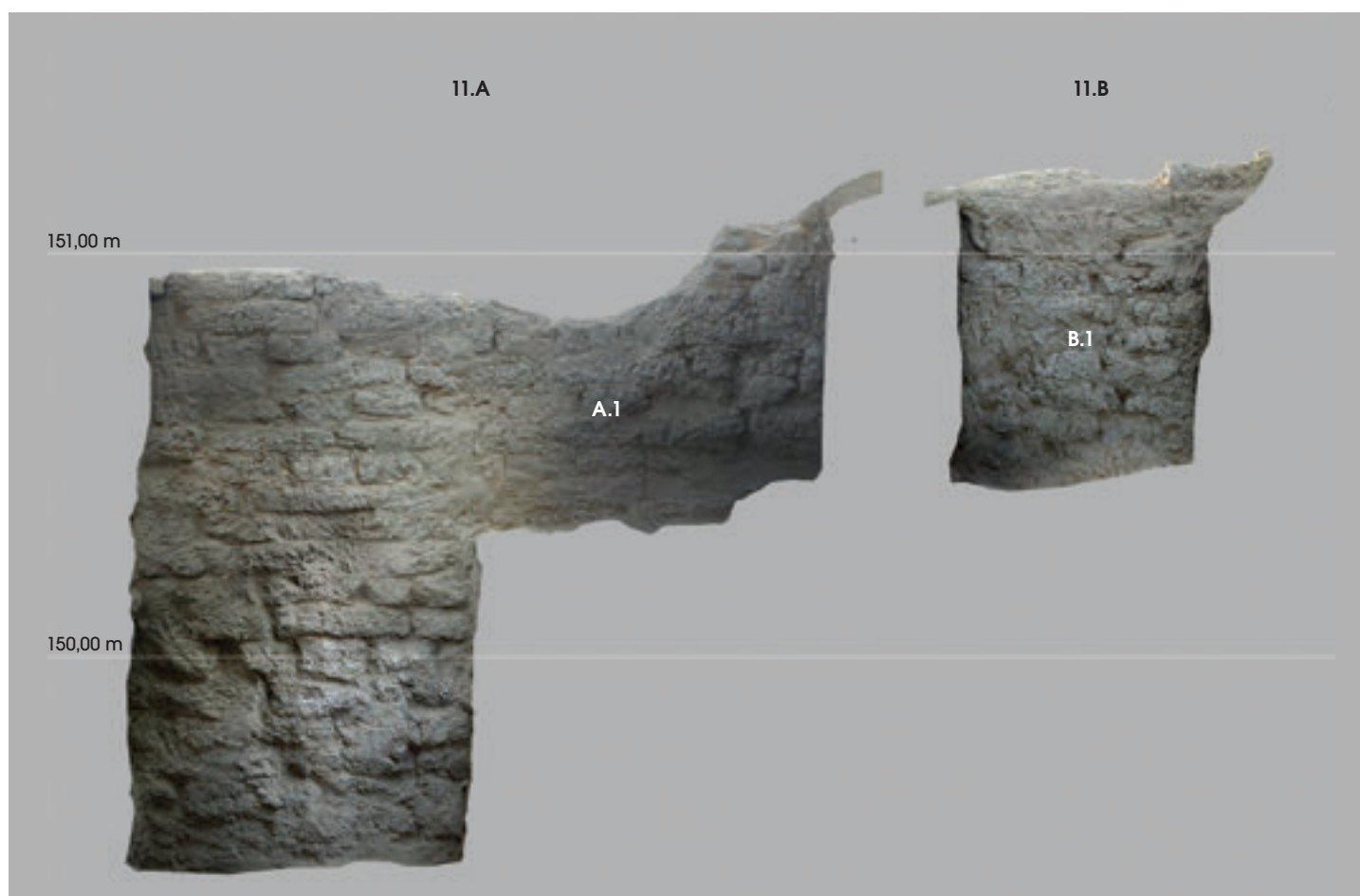


Fig. 10
Photo-drawing
documentation
of sections A–D
of Area 11. Prepared
by Michał Dzik

Layers from Phase III were found in Areas 4, 5, 25 and 33, covering a space of around 30 m². During this phase, there was an apparent change in the characteristics of the layers, i.e. a reduction of their concentration of the grey silt fraction. This change was noticeable in each of the excavated areas. In Areas 4 and 5, it took place at 147.85–147.90 m, and in Area 33 – at 147.45–147.88 m. A significant difference in levels across Area 33 resulted from a slower accumulation of layers in the room's southwestern part.

In Area 4, a furnace was built in the room created in Phase II (feature 70). Traces of fire were uncovered directly near the bricked up passage 4.F.9 and adjacent to section 4.A (Fig. 9). The thickness of the ash layer – 0.2 m – indicates its long-term functioning. It seems that it is possible to associate it with a recess in wall 4.F (unit 4.F.2), cut at 147.84 m, so just above the level of the hearth. It was 0.09 m deep, 0.13 m wide; the preserved height was 0.95 m. The location and shape suggest that it could have been the recess of the chimney flue.

Layers uncovered above feature 70, with a total thickness of up to 0.6 m, were associated with the intensive use of this space. The characteristics of the youngest layer (233) – brown-orange colour, low cohesiveness, an intense concentration of humus, numerous goat droppings – indicate that at the end of Phase III, in the space northwest of wall 4.F, animals were probably kept.

The character of the earth layers in the southeastern part of Area 4 also indicated the intensive use of this space, before the construction of the walls –



features 32, 32a – and after it. After the erection of the above-mentioned walls and accumulation of cultural layers of a thickness of approximately 0.15 m, the space at the southeastern edge of Area 4 was covered with hard mud floor (laid from the level of approximately 148.45 m).

The space in the northwestern part of Area 5 was still used as a kitchen, but at the beginning of this period, the oven was placed in the opposite corner in Phase II (feature 63; **Figs. 21, 23 24**).

In the room in Area 33, from the level of approximately 147.45–147.55 m, a hard mud floor was laid (layers 306, 593a; **Figs. 13, 14**). At the entrance (33.B.25), two-step mud-brick steps were placed. The threshold of this doorway was then at the level of 147.71 m. Sometime later, a brick entrance cover, about 0.3 m high, was erected in front of the steps (feature 89; **Figs. 13, 19**). These actions suggest that the ground level outside the doorway was higher than inside at that time. Near the partly-excavated north corner of the area, the edge of a series of ash layers deposited from the level of approximately 147.55 m to 147.77 m was captured; fired bricks were found near the top of these layers. The latter suggests the presence of some brick structure, maybe a hearth, at least at the end of the use of the fireplace in this location.

To sum up, in Phase III, the room in Area 33 was probably still residential. A room in the northwest of Area 4 could have been used as a kitchen, as was the adjacent room in Area 5. Due to the change in the layout of the passages, the latter could have become part of the neighbouring household. The second possibility

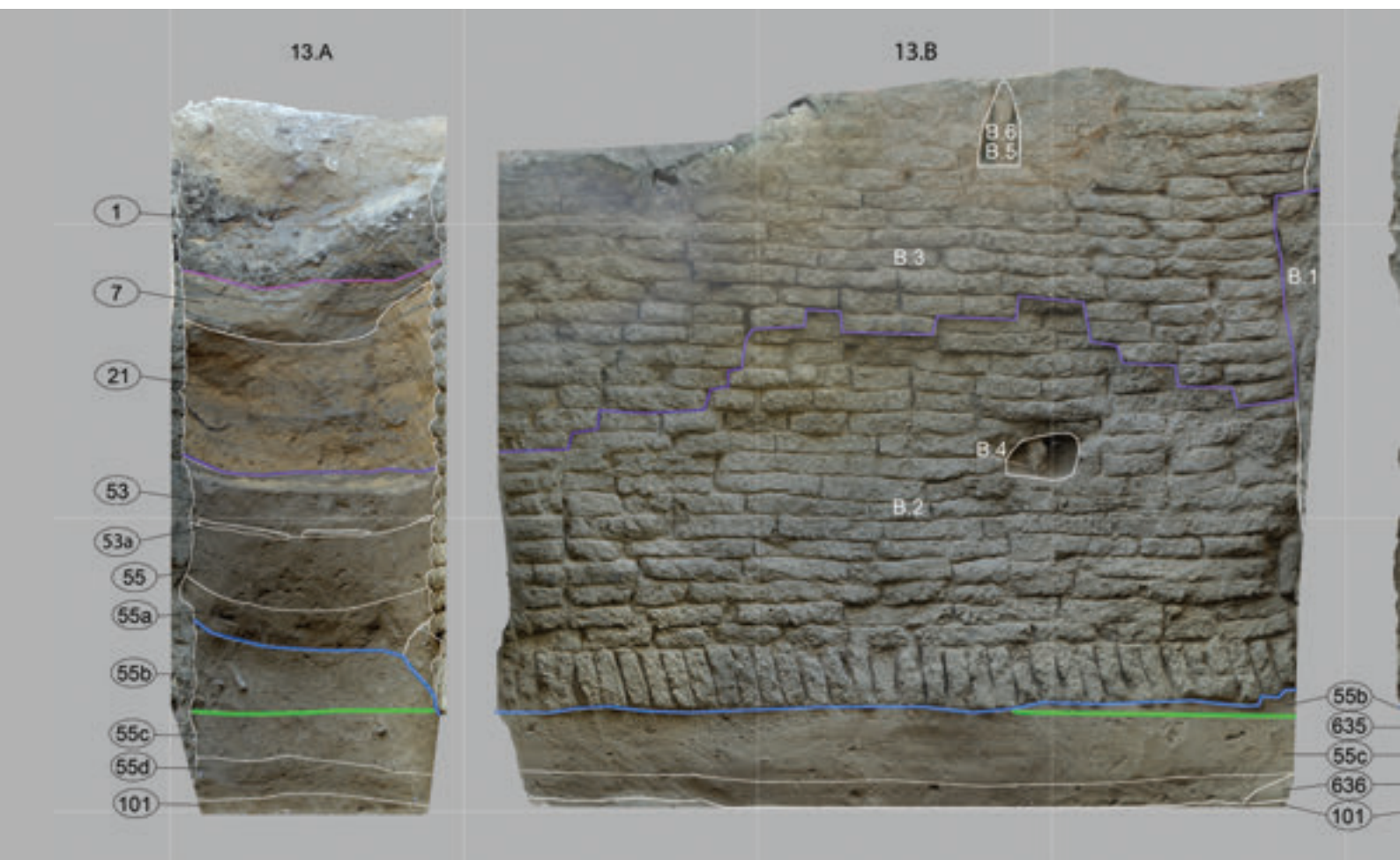


Fig. 11
Photo-drawing
documentation
of sections A–D
of Area 13. Prepared
by Michał Dzik

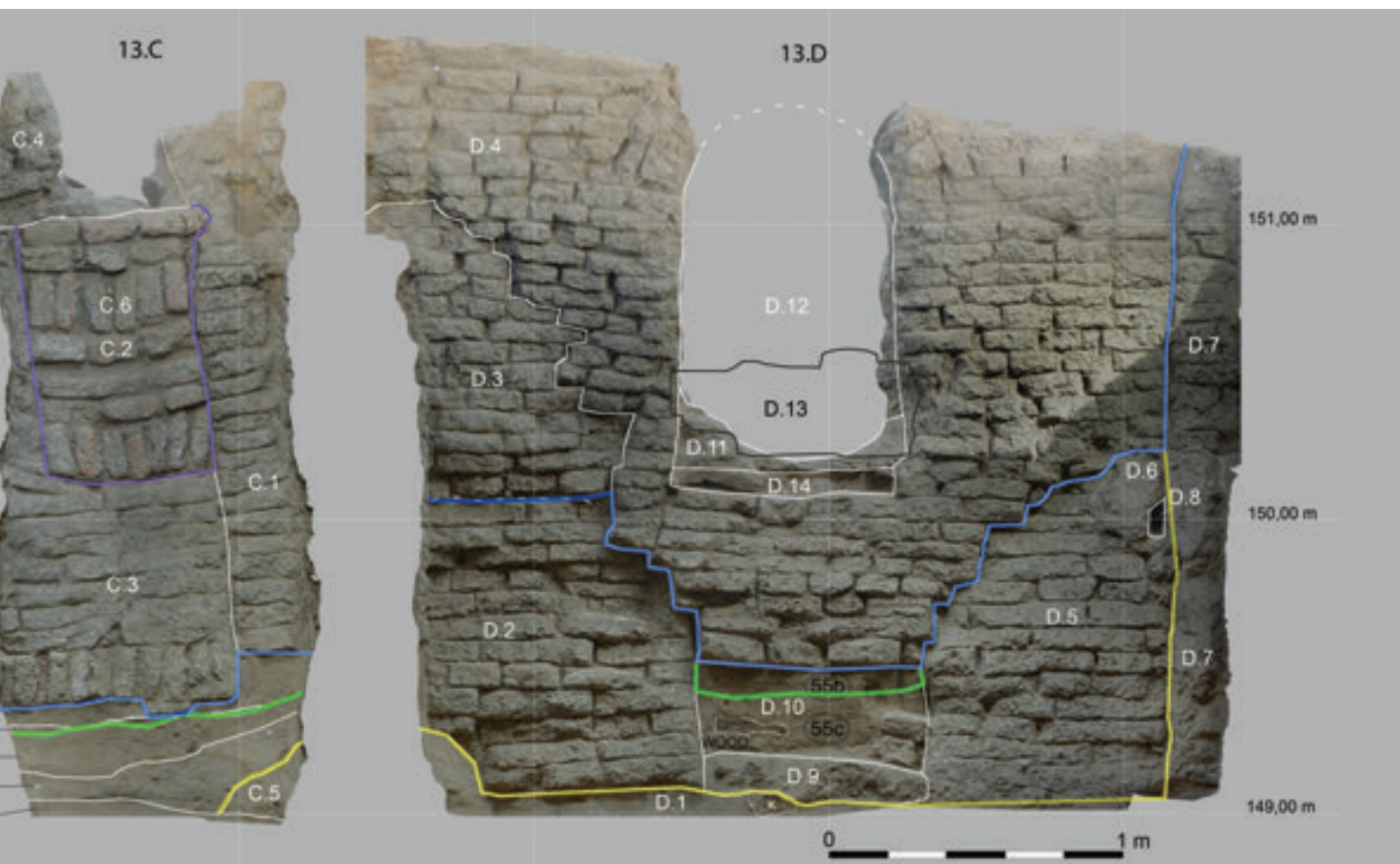
is that this space within the household and the oven inside were used for trade, also explaining its opening to the outside. Clarification of this issue would require buildings from this phase southeast of House A to be found.

Phase IV

The beginning of Phase IV is marked by the construction related to a change in the layout of the rooms, carried out from the level of around 148.50 m. These activities and the accumulated later cultural layers with a thickness of 0.10–0.15 m were classified as Sub-Phase IVa. Traces of the subsequent reconstruction, undertaken from the level of approximately 148.60 m, mark the beginning of Sub-Phase IVb, associated with cultural layers having a thickness of 0.25–0.35 m.

At the beginning of Phase IV, in the range of Areas 4 and 25, the thin walls (partitions) from Phase III were removed (**Fig. 25**). Only their lower parts, already then covered by earth layers, were left. The passage 5.A.24, connecting the southeastern parts of Areas 4 and 5, still functioned. Therefore, there must also have been a wall running southeast from this entrance. This door opening existed throughout Phase IV. At its end, the sill level was raised to the height of 149.13 m (unit 5.A.25).

In Area 33, from the level of 147.97 m, passage 33.B.25, with the height probably around 0.85 m at that time, was walled up. The interesting point is that the blockage



was not made right in the door opening but at a distance of about 0.5 m from it, on the line of the face of the door pilaster (feature 88; **Figs. 13, 19**). This allows assuming that the wall was erected from the side of Area 33, not from Area 25. This is one of the indications of the existence of another, undocumented, entrance to Area 33. Another basis for such a conclusion is the further accumulation of cultural layers in the vaulted room, after passage 33.B.25 had been walled up. This entrance may have been in one of the gable walls, which were not exposed. The thickness of the accumulated layers of Phase IV was more significant on the side of wall 33.A, which suggests a second door opening in it. The question remains, whether this was made in Phase IV, or whether it already existed in the original plan of the building.

In Area 25, the following bonded walls were erected: 25.A.9, 25.C.12 and 25.D.4. They were preserved up to a height of 0.95 m. In the case of wall 25.C.12, on the basis of the header course (visible in some parts), it can be presumed that it had a thickness equal to or greater than the length of the stretcher course. In Sub-Phase IVa there were no traces of the wall closing the room(?) from the southwest side in Area 25. It is possible that the space remained open for some time or was closed with a light, wooden partition.

The function, of the room in Area 25, during Sub-Phase IVa, could be related to feature 51 – a rotten wooden beam with a thickness of 0.10 × 0.14 m and

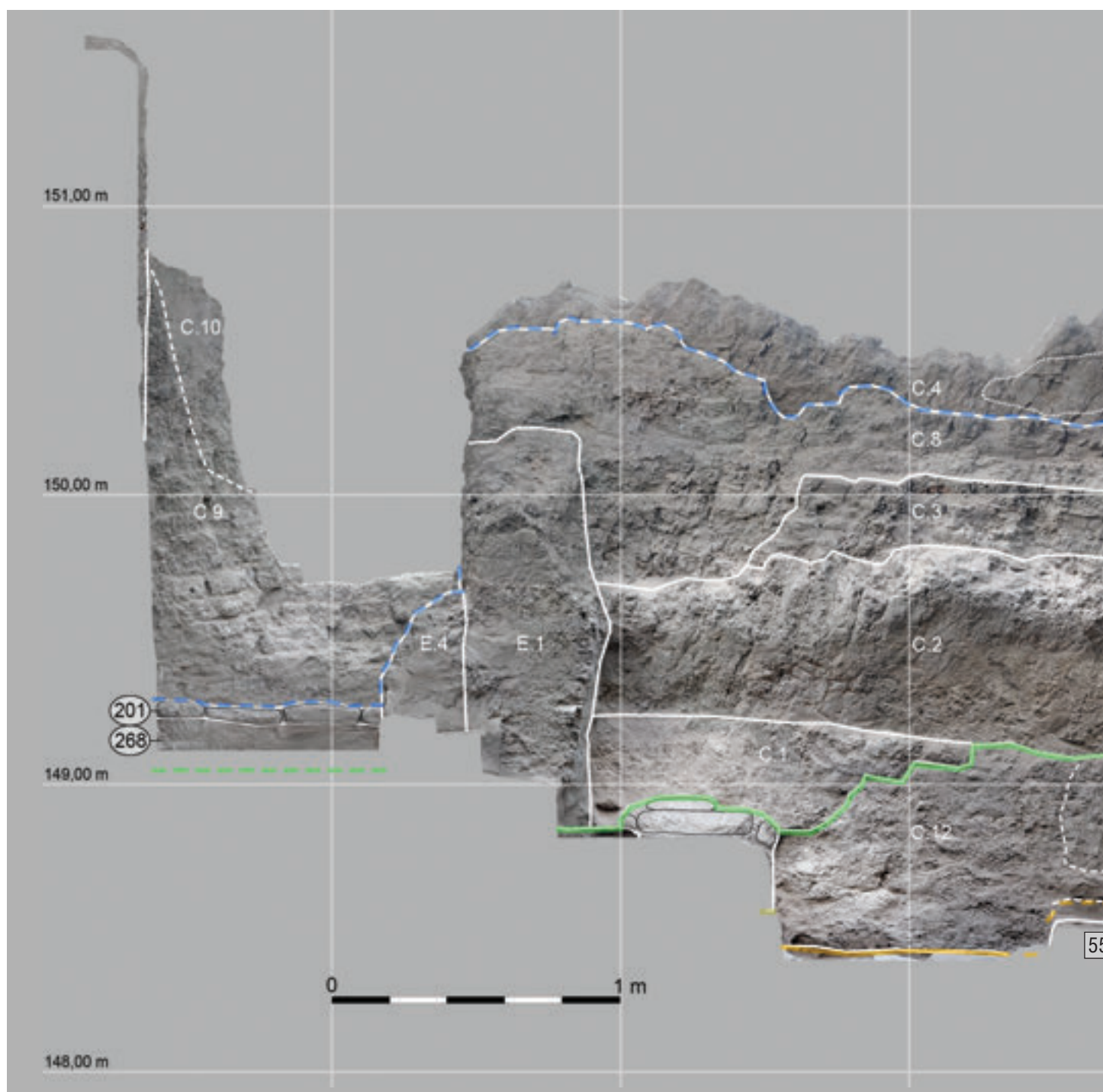
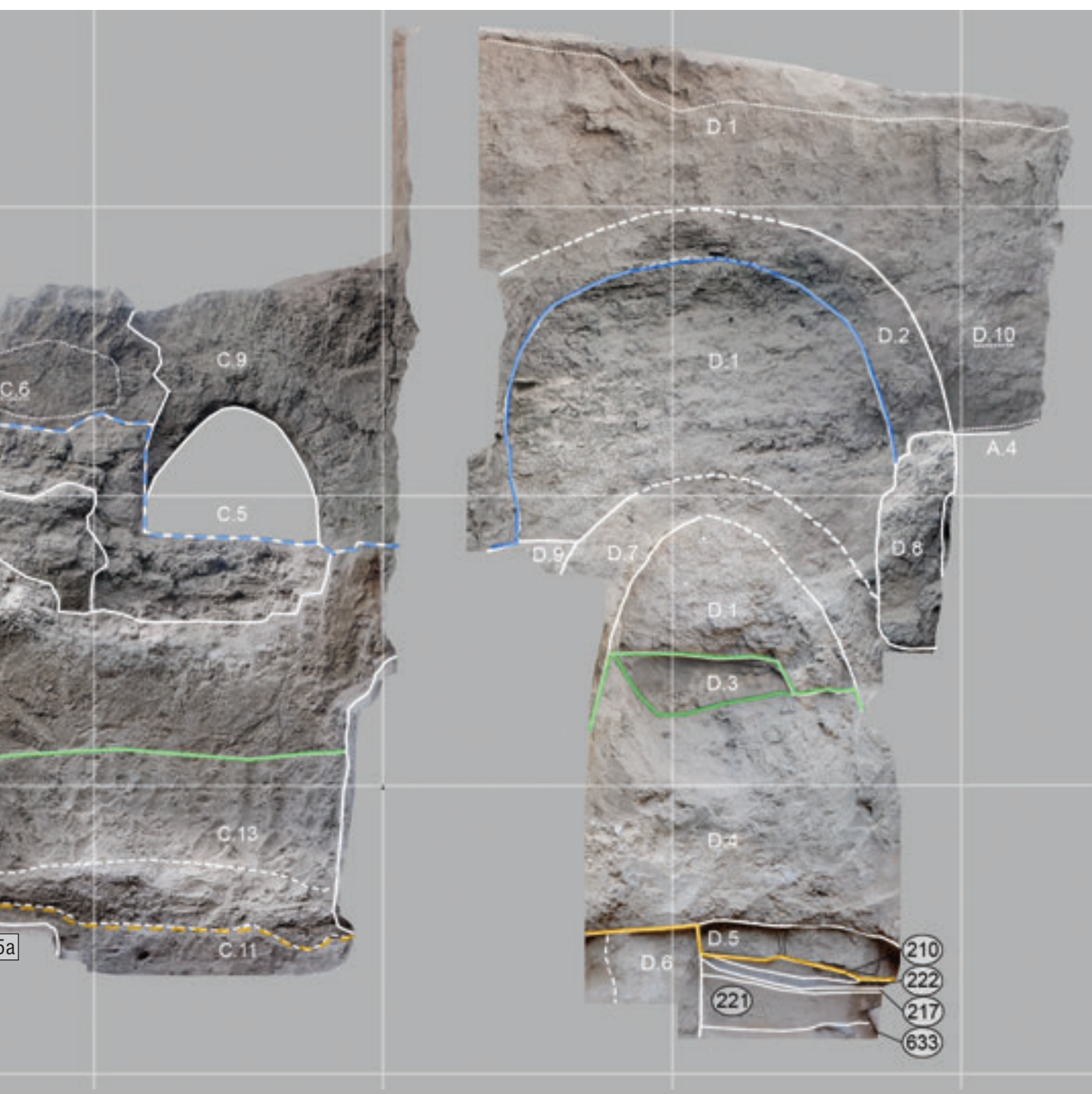


Fig. 12
Photo-drawing
documentation
of sections C, D
of Areas 17, 19, 25.
Prepared by
Michał Dzik

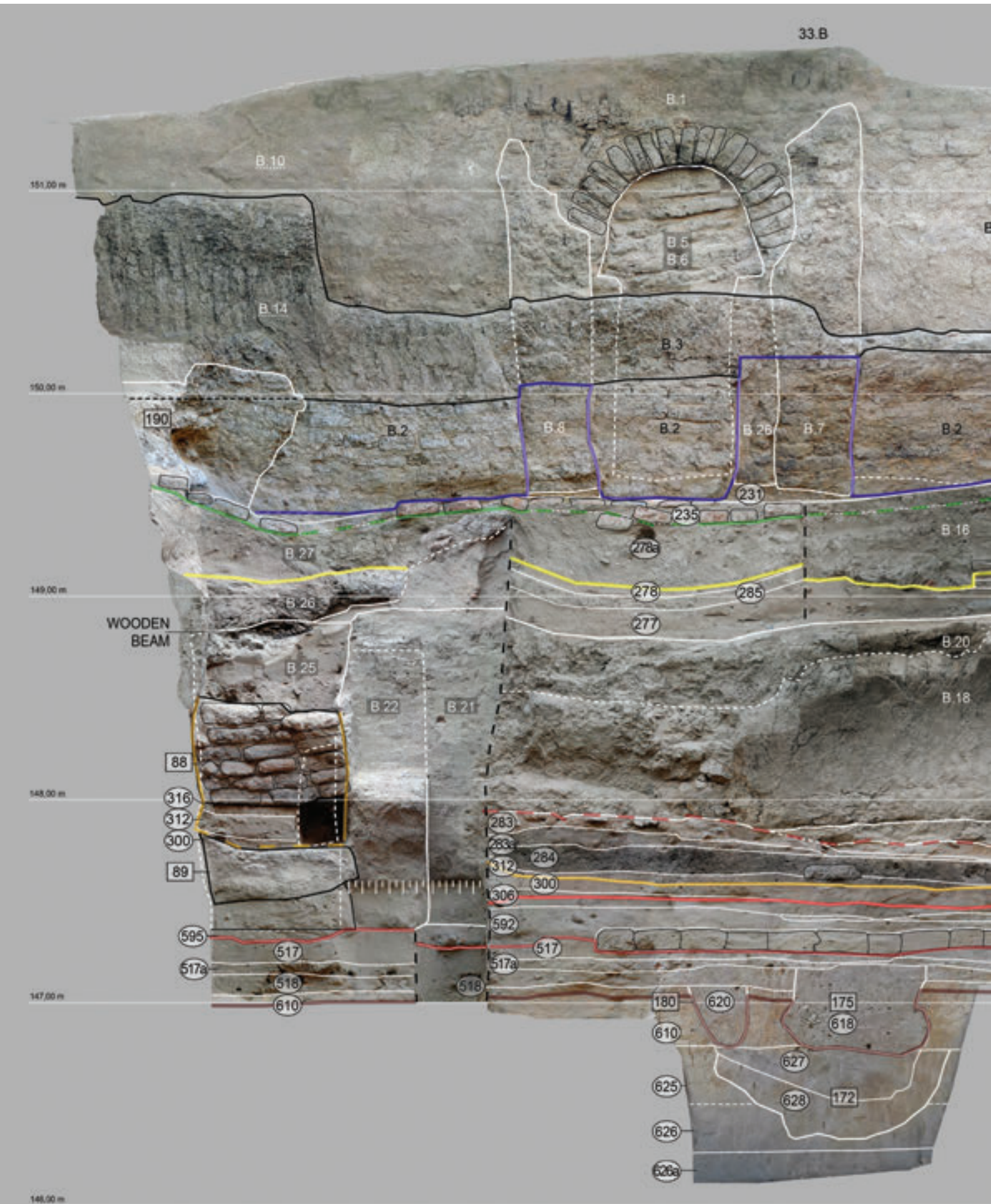
a length of more than 1 m. Most likely, it is the remnant of a wooden structure, e.g. a wall or a threshold. This is indicated by the beam's location, which fits in with the wall layout in Areas 25 and 4.

The structure mentioned above (25.D.4) was a fragment of a brick wall built on the existing wall of a vaulted room in Area 33, on the boundary with Areas 4 and 25. In Area 4, owing to the strong erosion of the face of the walls, and also the depth of excavation at the edge of the northwestern part of the area (approximately 148.90 m), it is difficult to determine whether both the walls



(4.D.8 and 4.D.10) were related to this phase or only one of them. It is possible that the latter was created in one of the previous phases.

During the same rebuilding, the wall separating the northwestern parts of Areas 4 and 5 was rebuilt. The door opening (unit 5.A.29) was made, duplicating the passage location in Phase II. In Area 4, wall 4.F still existed in Sub-Phase IVa, and was a reference point for the construction undertaken. It is not sure whether it was an incompletely preserved remnant serving as a low fence or a wall of an enclosed room. In the second case, it would have to have been partially rebuilt.



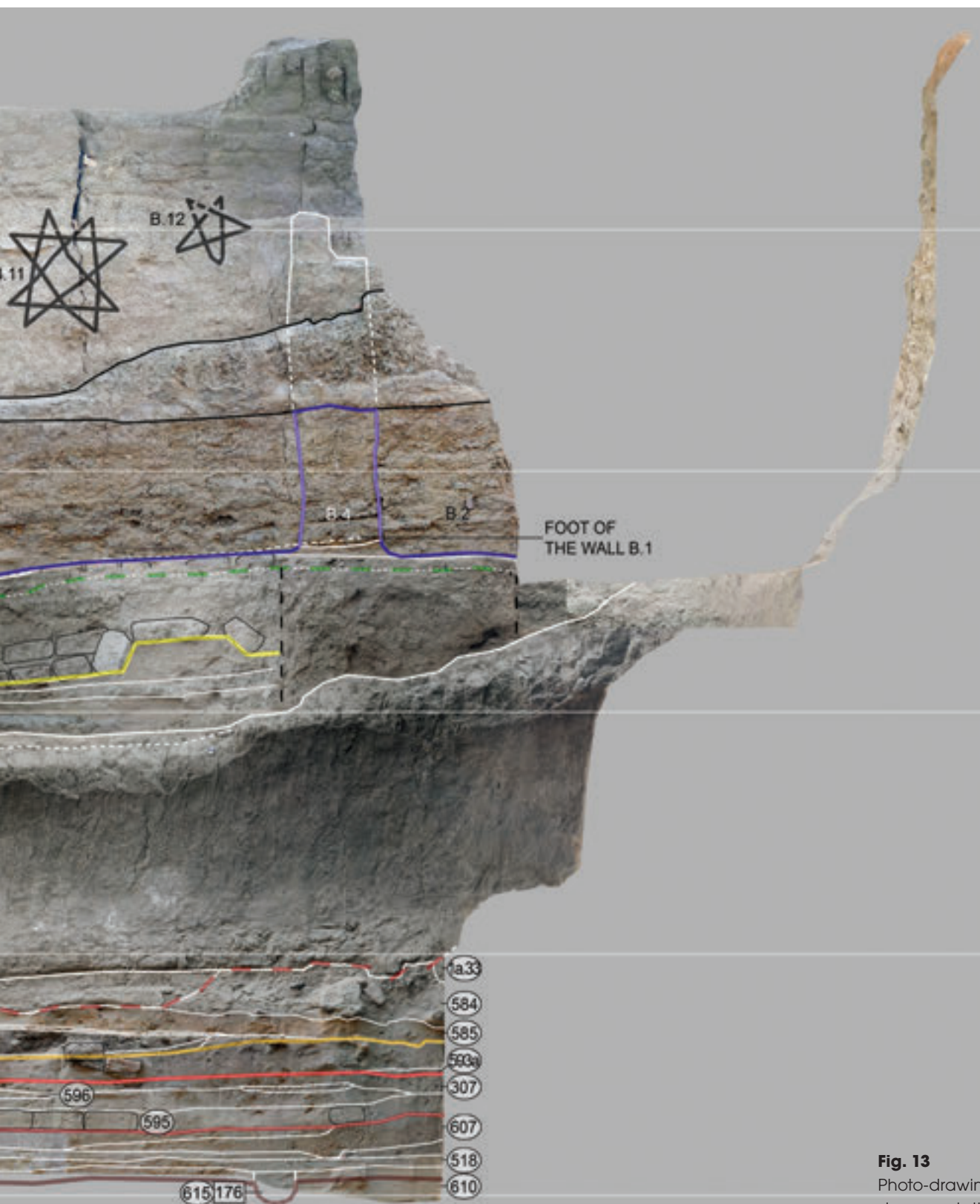


Fig. 13
Photo-drawing
documentation
of section B
of Areas 7, 33.
Prepared by
Michał Dzik

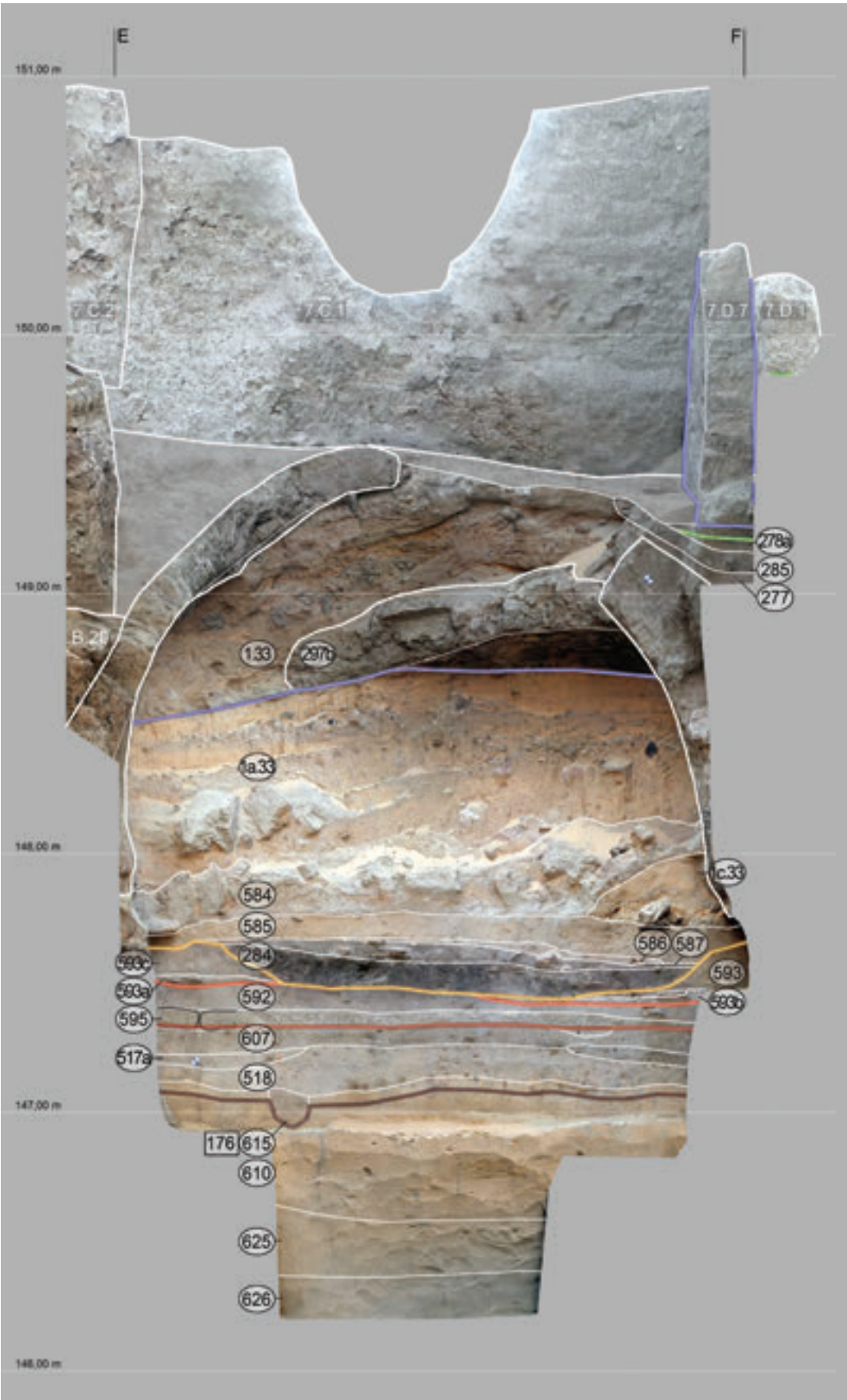


Fig. 14
Photo-drawing
documentation
of the layers section
in the western part
of Area 33, with
phases highlighted.
Prepared by
Michał Dzik

Unfortunately, traces of such work on this enclosing wall have not been preserved, because in the next sub-phase, it was dismantled to the level of approximately 148.67 m. For the same reason, it cannot be determined whether there was a door opening in it.

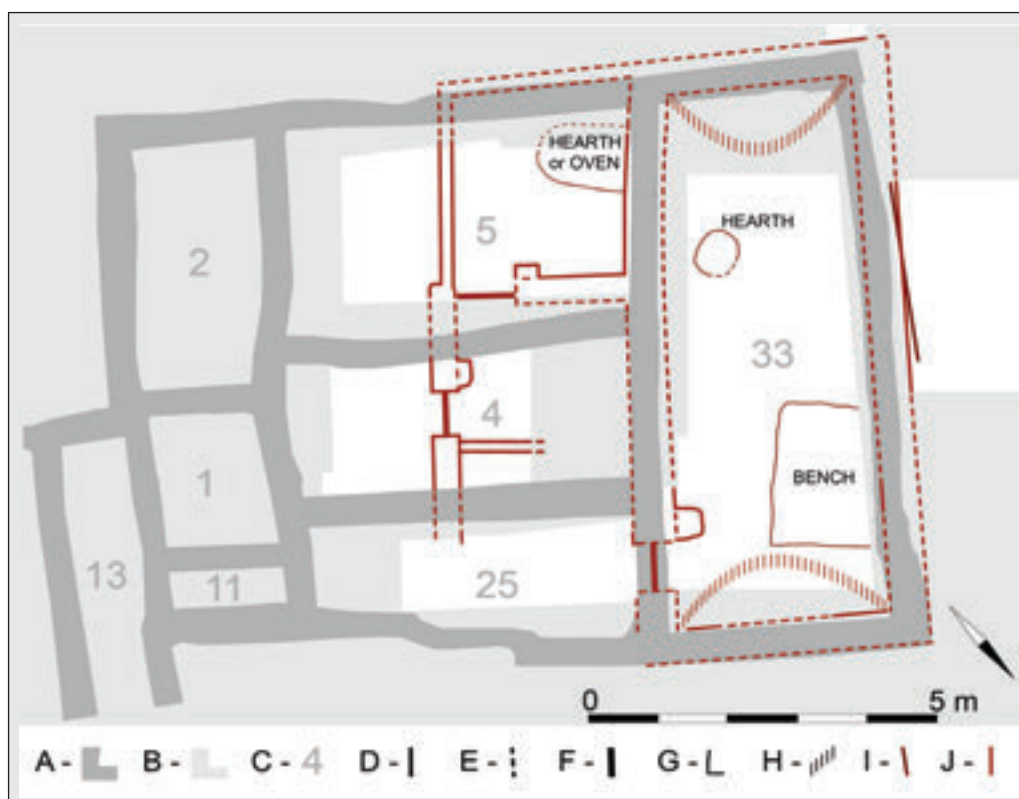
Of course, interconnected closed spaces in the northwest part of Areas 4 and 5 had to be accessible from the outside. There are two places where the passage could be located: (a) in wall 4.F, described above; (b) in the partition in baulk 5.C, similar to the case during Phase III.

At the beginning of Sub-Phase IVb, wall 4.F had been pulled down. The parallel wall 4.F, 0.28 m thick, was erected from the level around of 148.60 m (Figs. 20, 26). In this way, in the northeastern part of Area 4 a space with dimensions of around 3×1 m was separated off. Certainly, in connection with this change, the wall between Areas 4 and 5 was rebuilt. Passage 5.A.29 from Sub-Phase IVa was bricked up. Moreover, the door opening connecting the southeastern parts of both areas since Phase II was shifted by 0.23 m (unit 5.A.25). This was related to the construction of a partition wall within Area 5 (feature 25). The structure was 2.24 m long, 0.15–0.18 m wide and was preserved to the height of three rows of bricks. Its original length is unknown because the southern part was destroyed by a later pit.

The preservation of the walls surrounding the corridor(?) in the northwestern end of Area 4 complicates establishing the location of the openings connecting them with adjacent areas. However, the following locations are likely:

- a) In the wall separating this space from Area 5. The structure built here in Sub-Phase IVb was preserved up to around 149.00 m (unit 5.A.26; relative height 0.24 m), therefore approximately 0.3 m above ground level at the beginning of Sub-Phase IVb.
- b) In the wall separating this space from Area 25. Part of the face of the 25.C wall at this level, on the fragment distinguished as unit 25.D.13, was utterly unreadable (Fig. 12). It is possible that this fragment of the wall was a continuation of wall 25.D.12, undoubtedly created in Sub-Phase IVa. If so, it would exclude the presence of a passage at this point. However, this is not certain, and, theoretically, a part of the wall separated as unit 25.D.13 could have been younger and could have replaced the door opening. The top of the wall, clearly classified as Sub-Phase IVa (unit 25.D.12), was at the height of 148.74 m, i.e. just above the ground level at that time.
- c) On the wall separating this space from Area 25. In Sub-Phase Va the supposed corridor undoubtedly led to the second floor of Area 25, as evidenced by the preserved stairs (see below). It is possible that this communication route functioned earlier but without brick-built stairs.

Of the options listed, the most likely is that the space in the northwestern end of Area 4 was connected with Area 5. It seems that the existence of a corridor connecting – as in Phase V – the space in Area 5 with the utility level above Area 25 would be justified only if this access also led to the space above the vaulted room in Area 33, separated as Area 7. It is not even sure, however, whether it was in use at that time.

**Fig. 15**

House A at the earliest stage of development.
 A – walls delimiting the areas;
 B – unexplored parts of the areas;
 C – numbers designating the areas;
 D – exposed faces of the walls;
 E – reconstructed course of the walls;
 F – doorways;
 G – features;
 H – vaulted room;
 I – Phase I; J – Phase II.
 Drawn by Michał Dzik

In Area 25, a wall (25.F.1) was erected, enclosing on the southeastern side a room with dimensions of approximately 2.3×0.9 m and a surface of 2.1 m^2 . Considering the reconstructed layout of rooms and doorways in Phase IV, it seems likely that from the side of this wall, there was a passage allowing access to the room in Area 25, and maybe to the one in Area 4. However, no traces of the door opening were found, but this could have been because wall 25.F.1 was preserved to a height of only about 0.2 m (approximately 148.80 m).

It is worth noting that wall 4.E was erected along an axis similar to the wooden beam from Sub-Phase IVa (feature 51; **Fig. 25**). This could be caused by an analogous reference point for both structures, e.g. the position of the passage in wall 25C, or the elevation of wall 4.E on the axis of a previous wooden partition.

Due to the extent of investigation of the southeastern part, it cannot be determined to what extent it was built up in Sub-Phases IVa and IVb. In Area 13, however, walls have been documented that may belong to this period. Therefore, theoretically, wall 13.D.1, which closed House A on the southeastern side and became the wall's foundation in Sub-Phase Va, could be dated to this period. However, it is more likely that it was earlier (see the description of Phase III). In contrast, it seems justified to connect wall 13.D.7/11.A.1 with Sub-Phases IVa and IVb, delimiting the northeastern boundary. This is so firstly because a wall from Sub-Phase Va was added to its corner; secondly, it was erected from a level below 149.06 m (where the exploration was completed in Area 13), therefore lower than the wall from Sub-Phase Va. Thirdly, there is apparent convergence of the face of this wall and the wall of Area 25 from Sub-Phase IVa (unit 25.A.9; **Fig. 25**).

The layers from Sub-Phases IVa and IVb were investigated over an area of approximately 30 m^2 . The area of the stratification examined from Sub-Phase IVc

is larger – approximately 39 m². The exploration of the layers related to this period was ended in Areas 1, 13 and the northwestern edge of Area 4.

In Sub-Phase IVa, in the southeastern part of Area 4, cultural layer 135 accumulated, with a thickness of up to 0.16 m (**Fig. 8**). This was a brown layer with orange laminations, characterised by low cohesion, an intense humus concentration, and numerous goat droppings. Most likely, the space was used to keep animals at that time.

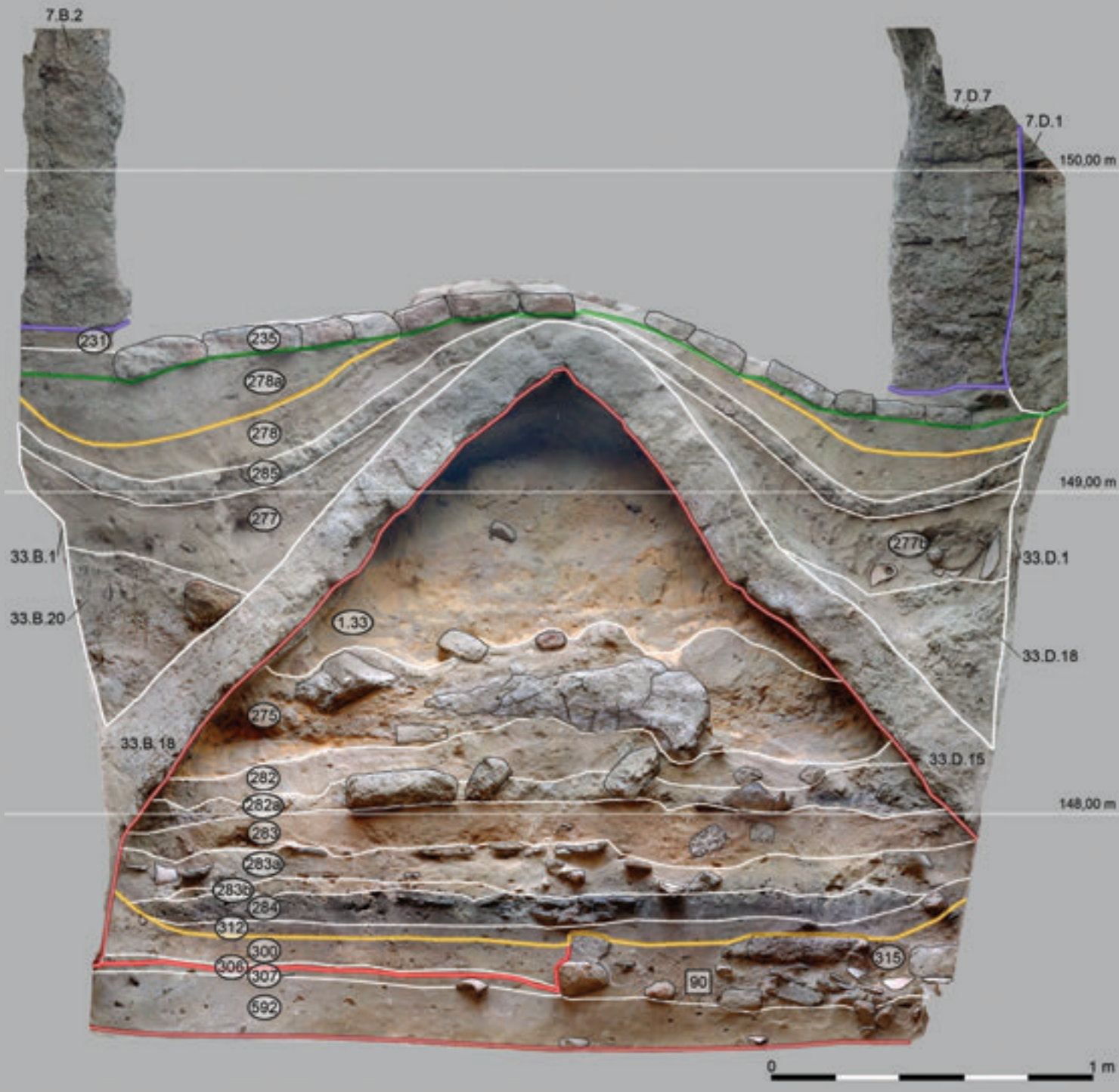
In Sub-Phase IVa, the northwestern part of Area 5 was still used as a kitchen. The hearth or oven was moved back to the western corner of this space (feature 54). A kitchen pot was placed near this structure during this sub-phase, buried up to the neck (feature 56). Layers of grey ash were also captured in the section in the eastern corner of the area, behind the wall distinguished as feature 29. Due to the small area over which they were distinguished, it is difficult to determine whether they were layers related to the existence of a second hearth or oven nearby, or were ash coming, e.g., from the use of a feature in the western corner of the area.

During Sub-Phase IVb, in Area 5, the floor was hardened with a mud layer (nos. 125, 125a, 125b). Another oven or hearth was also built; its location in the western corner was renewed (feature 49; **Fig. 27**). Another kitchen pot was placed in a pit as deep as before (feature 50). In the eastern corner of Area 5, layers of ash were still deposited.

During Sub-Phase IVb, in Area 4, the entire space southeast of wall 4.E (layer 133) was provided with a mud floor. The features of the cultural layers from that period accumulating above this floor suggest that it was not a roofed space at that time. It is possible that at that time it was already a yard. Such a function can be attributed with high probability to this space in Sub-Phase IVc. At the beginning of this period, it was again hardened with mud. Its remains were discovered in Areas 4 (layer 128a) and 1 (layer 108). At the end of Sub-Phase IVb, the location at wall A, above feature 50 (already covered with cultural layers), was allotted for a fireplace (feature 26). It was bounded only on the entrance site to the corridor in Area 4, by a row of three bricks. The ash layers remaining were approximately 0.75 × 0.85 m, with a thickness of up to 0.11 m (layers 118, 124).

In Area 33, from the beginning of Phase IV comes the accumulation layer 312 with a thickness of up to 0.12 m, related to intensive use of this room. After walling up the passage in wall B, the space between the blockage (feature 88) and the door opening was covered with a layer of garbage (277a; **Fig. 28**). Among the layers of Area 33, layer 284 was especially interesting, being related to *in situ* burning. It was an intense, dark-grey and black ash layer, relatively cohesive with a high concentration of the grey silt fraction. Its considerable dimensions are noticeable – 1.8–2.4 m wide, over 6 m long, and up to 0.15 m thick. The colour of the layer, with no grey ash, suggests combustion of organic matter with minimal oxygen, at a low temperature.

On the other hand, the concentration of the silt fraction indicates that the organic substance was covered by water for some time. Archaeobotanical analysis showed a large number of cereal remains, mainly barley, in the layer. This information and the features of layer 284 suggest the hypothesis that an organic material deposited here, arguably including grain straw, could have been set on fire (by self-ignition?). It is worth noting that such an occurrence is favoured by poor ventilation and high humidity, i.e. conditions that are highly likely in the room in question.



Subsequent layers in Area 33, related to the use of the vaulted room, were up to 0.55 m thick, the largest by the 33.A section where they accumulated to the level of about 148.35 m. The youngest layers were characterised by relatively low cohesion, and a light-brown and brownish-yellow colour, resulting from the admixture of aeolian sand. Due to the presence of a large number of sherds with a low degree of fragmentation, some of them can be interpreted as garbage layers. It is possible that the youngest of them were related to Phase V.

Phase V

At the beginning of Phase V, construction took place when the level of the ground in Areas 1 and 4 was at a level of about 148.88–148.95 m. Further work, marking the beginning of Sub-Phase Vb, was undertaken after accumulating cultural layers with a thickness of approximately 5–15 cm in Areas 1, 4 and 5.

Fig. 16
Photo-drawing
documentation of
the layers section in
the partially explored
eastern part of Area
33, with highlighted
phases. Prepared
by Michał Dzik



Fig. 17

A broken storage vessel, filled with ash, in a void of the vault of the room in Area 33. Photo by Michał Dzik

At that time, the entire House A was rebuilt. Next, Sub-Phase Vc is determined by construction undertaken after the ground level in the courtyard of the house had risen by another 10–15 cm, to a height of about 149.40 m in its western part and 149.15–149.35 m in the eastern part. The layers from Phase V were exposed in most areas, over a total of approximately 55 m². Investigation of the layers associated with Sub-Phase Va was completed in Areas 1, 13, in the southwestern part of Area 2 and at the northwestern edge of Area 4.

At the beginning of Sub-Phase Va, a wall 0.38 m thick, delimiting the eastern boundary of House A was erected (units 13.D.5, 13.D.2 = 1.B.9; **Figs. 4, 11, 29**). There was a door opening in it (unit 13.D.10), flanked on the side of Area 1 by at least one pilaster (unit 1.B.3). The wall was added to the enclosing wall of Area 24 (unit 13.D.7) and built on the wall, the top of which was visible from the side of Area 13 (unit 13.D.1). Probably its continuation was the wall exposed in Area 2 (units 2.B.3, 2.B.9; **Fig. 5**). This is not certain, however, because the level of foundation of this wall has not been recognised. It could be, therefore, a bit older or come from Sub-Phase Vb.

A significant change compared to the rooms' previous layout was the wall levelling between Areas 4 and 5. The partition wall – feature 25 – in Area 5 was also demolished. Thus, the courtyard of the house was enlarged to an area of approximately 37 m². Wall 4.E and the opening between the corridor at the northwestern end of Areas 4 and 5 were still in use.

In the corridor in the northwestern end of Area 4, stairs made of mud bricks were built, leading to the floor above Area 25 (distinguished as Area 17/19). Four steps have been preserved. Considering their width, as well as the thickness of the 25.C.13 wall, where the stairs certainly ended their course, it can



Fig. 18
Areas 7 and 33 during exploration in 2018, viewed from the northwest. Photo by Michał Dzik

be assumed that there were originally five steps. The two best-preserved, lower, steps were 0.16–0.18 m high. Assuming that the next ones were at least 0.15 m, their top should be at a height of approximately 149.50 m (with four-step stairs) or approximately 149.65 m (with five steps). It can be presumed that at this or a slightly greater height, there was also the unpreserved floor of Area 17/19 in Sub-Phase Va, at least in the vicinity of the stairs. This conclusion is essential for determining the size of the room in Area 25, built in Sub-Phase IVa from the level of about 149.50 m. If it is correct, then the height of the latter was slightly more than 1 m.

Photo-drawing plan
of Area 33 on the level
of the bricked floor
– layer 595. Prepared
by Michał Dzik

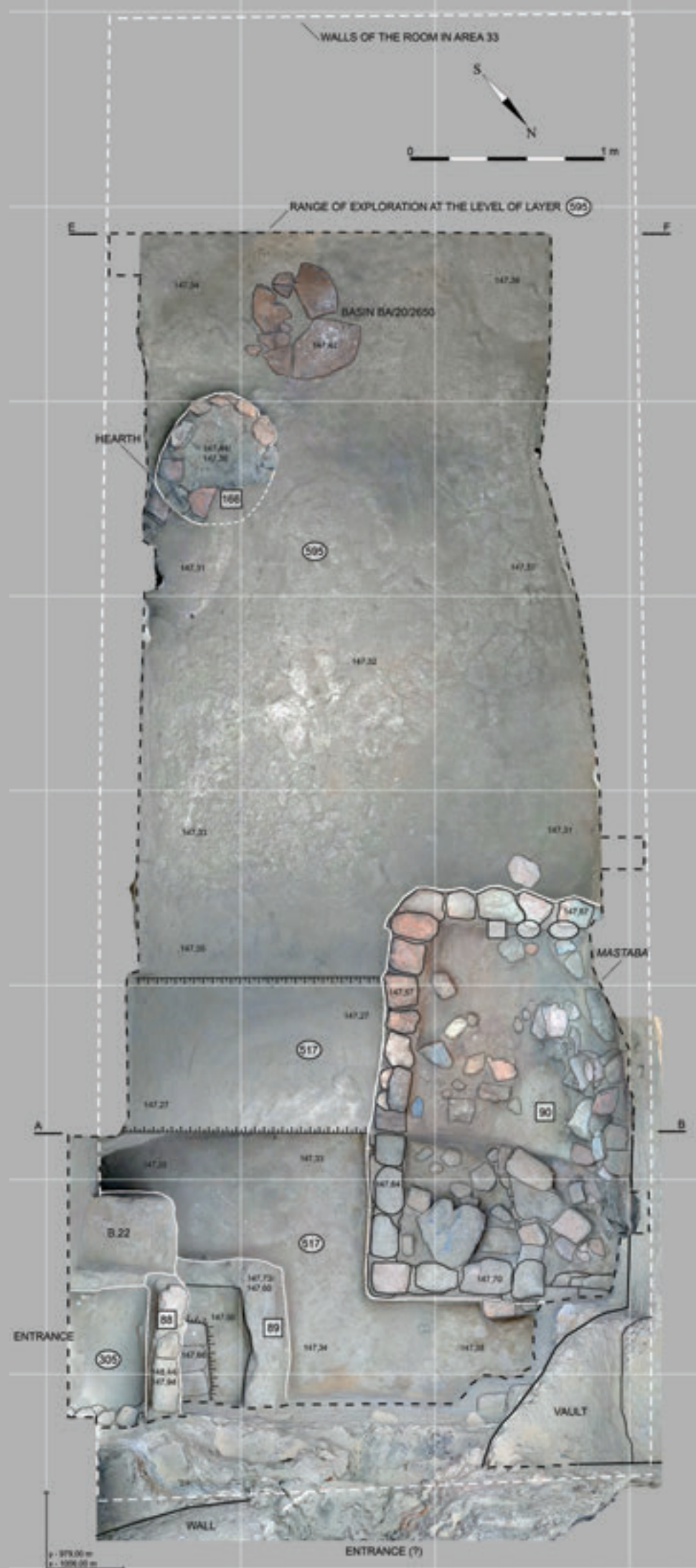
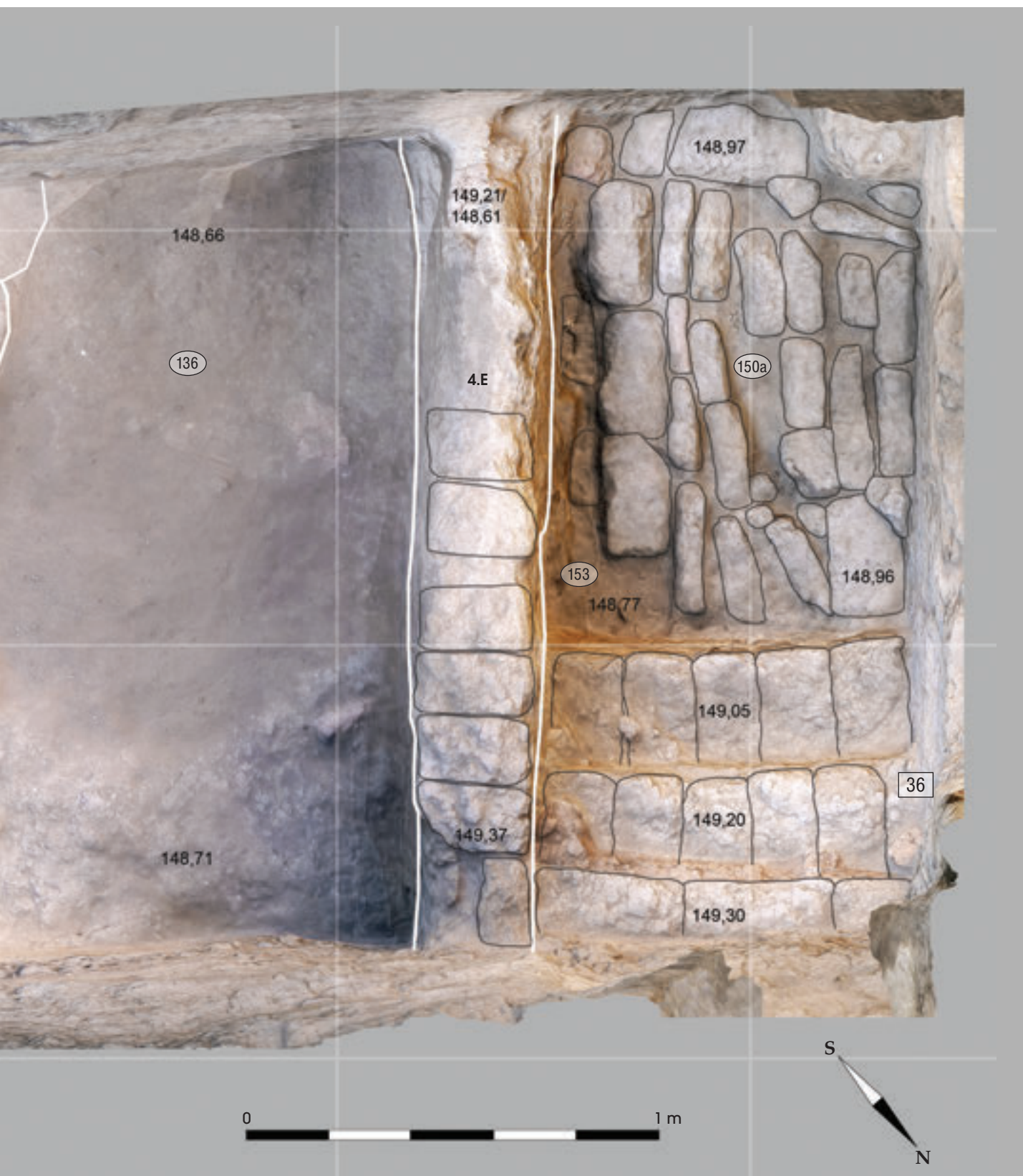
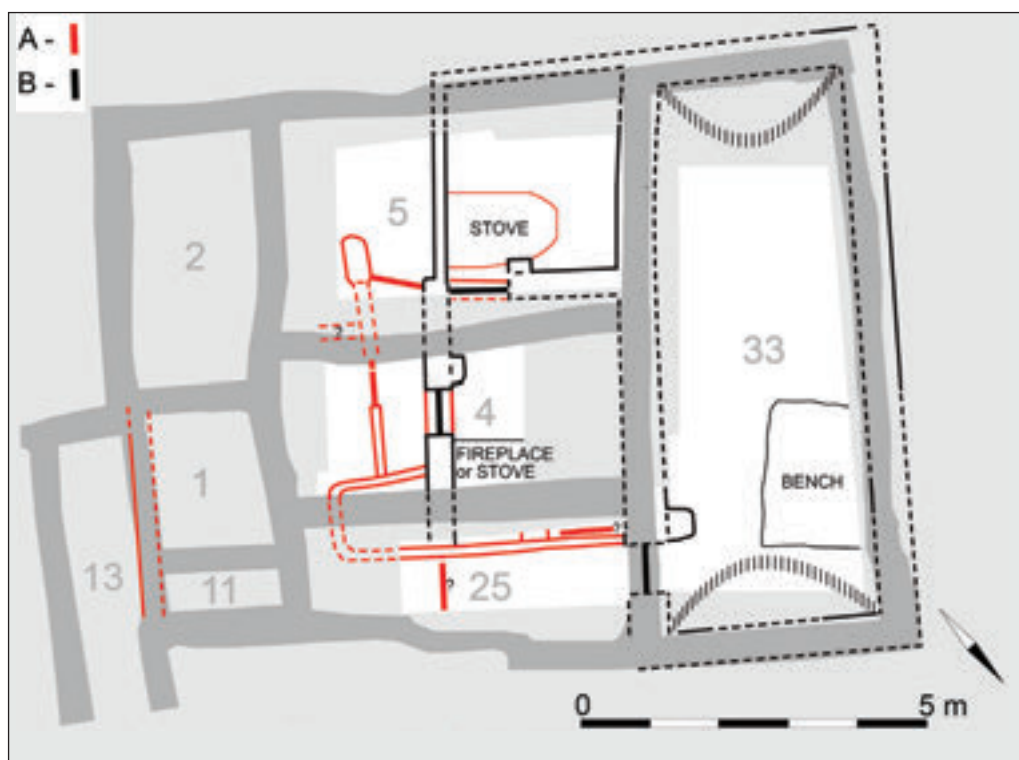




Fig. 20
Photo-drawing plan of Area 4, documented after revealing
features 32, 32a, 32b. Prepared by Michał Dzik



**Fig. 21**

House A in Phase III.
A – walls and features raised in Phase III;
B – older structures, still used in Phase III;
other symbols – see the legend of Fig. 16.
Drawn by M. Dzik

After building the stairs in the corridor in Area 4, a floor made of mud bricks was laid (layer 150a; **Fig. 20**). Its surface was at the height of 148.96–148.97 m. The relatively good condition of the staircase bricks and the floor suggests that the space between walls 4.D and 4.E could have been covered by a roof.

In Sub-Phase Va, construction activities were undertaken in the northwestern part of House A. They could have been related to the use of the space of Area 7, distinguished over a vaulted room in Area 33. First of all, wall B in Area 7, separating it from Areas 4, 5 and 17/19, was erected (units: 4.D.5, 5.D.1, 5.D.11, 33.B.16, 33.B.27). It was about 0.4 m thick, with a preserved height of 0.32–0.73 m. It is noteworthy that its face was moved by approximately 0.15 m in comparison to the wall from Phase IV in Area 4. This wall was erected partly on the older walls, from Phases II–IV, and partly on the occupation layers in Area 7.

Perhaps the wall visible in section 7.C (unit 7.C.7) came from Sub-Phase Va. However, the level of its foundation was not revealed; hence, it is equally probable that it was older. One may wonder why there are no traces of construction activities from that period in the exposed wall 7.D along almost its entire length. For this reason, it cannot be ruled out that the room's construction in Area 7 was not completed. The second possible explanation is the complete demolition of the walls during the rebuilding in Sub-Phase Vc.

The location of a possible door opening in wall 7.B has not been determined unequivocally. Theoretically, its presence can be suggested in the central part of the wall. The premise for this is – stated from the side of Area 4 – a lack of a bond between wall 4.D.5 from Sub-Phase Va and wall 4.D.9 added to it (in Sub-Phase Va or Vb). In this case, however, the door opening would be as much as 0.55 m above the floor level. In the context of the location of the entrance to Area 7, it is worth

noting that it seems unlikely that the stairs were built and, what is more, a brick floor was laid, only to allow access to the small utility level above a cellar(?) in Area 25. So perhaps it was part of the communication route leading over the vaulted room in Area 33, to the space separated off as Area 7. Therefore, the door opening should be in the wall separating Areas 7 and 17/19.

In Area 5, no traces of the use of an oven or hearth from Sub-Phase Va were found. It was a significant change as earlier, i.e. from the beginning of the existence of House A, there was a kitchen in the northwestern part of section 5. The possible presence of a hearth or stove cannot be ruled out in Area 2, in which layers from that period were not recognised.

Traces of use were discovered in the space separated as Area 7. The floor there was a mud floor (layer 375). Above this, the layers relating to the use of this surface accumulated (no. 394). Along wall D, over an area of approximately 0.5×3.0 m, traces of burning were revealed. The layers of grey ash, nos. 510 and 532, were 3–5 cm thick. The traces of the use of this space preceded the building work commencing Sub-Phase Vb and can be associated with high probability with Sub-Phase Va. However, it cannot be completely ruled out that some of them were related to Phase IV.

At the beginning of Sub-Phase Vb, the entire House A was rebuilt (**Fig. 30**). In Area 7, a room was erected, 7.8–8.0 m long, 2.7–3.3 m wide, with an area of approximately 23.5 m^2 (walls 33.A.1, 33.B.1, 33.C.1, 33.D.1). It was accessible through a door opening in wall B, flanked on the inside by two pilasters (units 33.B.8, 33.B.7; **Fig. 13**). There was a small, trapezoidal window opening in wall D (unit 33.D.11, dimensions: $0.14\text{--}0.19 \times$ approximately 0.36 m). The room was covered with a fired-brick floor, supplemented in places with a mud infilling (layers 234, 235, ceiling level 149.57–149.72 m; **Fig. 31**). The walls were covered with mud plaster. The distinguishing feature of the interior were the inscriptions and symbols on walls A and D, made in fresh plaster (**Figs. 13, 32**). On the former, there were two stars, with eight and five points respectively (unit 33.B.11, 0.50×0.56 m; unit 33.B.12, 0.31×0.31 m). On the latter wall, opposite the entrance, there was a two-line inscription preceded by a cross, up to 3.45 m long and 0.31 m high (letters are about 0.11 m high; unit 33.D.8). Based on the legible part of the inscription, it can be assumed that it consisted of the names of the archangels, beginning with Michael. In the incisions forming the symbols and letters, small fragments of white paint have been preserved. They were not found on any other fragment of the plaster; hence, only the symbols and letters were highlighted.

During the use of the room in Area 7, two kitchen pots were put on the floor (features 69, 77). One of them – in feature 77 – was discovered empty, encased with a sherd. The body of this vessel was covered with ash on the inside, which leads to the conclusion that it served as a container for burning some substance (incense?). Perhaps it was significant that the vessel was placed directly below the eight-pointed star symbol on wall B (unit 33.B.11).

In the walls of the room in Area 7, preserved to the level of about 151.8 m, there were no recesses left by the ceiling beams remaining. This allows us to assume that the height of the room was at least 2.3 m.



Fig. 22
Photo-drawing plan of Area 25, documented after revealing
a hard mud floor – layer 217. Prepared by Michał Dzik



Fig. 23
Area 5, feature 63
– an oven from Phase III
during the exploration.
Photo by Michał Dzik

In the corridor in Area 4, opposite the entrance to Area 7, a new floor of dried and fired bricks was laid, which raised the floor's level to approximately 149.23 m (layer 150). This covered the older floor and the lowest step of the stairs leading to Area 17/19; the other steps were still used.

During the same rebuilding, a storage(?) room in Area 25 was rebuilt and enlarged to about 3.1×1.1 m, an area of 3.6 m^2 . It is worth noting that the rebuilding was carried out from the level of approximately 149.10 m, and the floor level of the room was at the height of approximately 149.00 m at the southwestern edge and approximately 148.70 m in the middle and northeastern parts of the area. Its construction undoubtedly involved digging out some older layers, 0.1–0.4 m thick, clearly visible in the 4.AA section (**Fig. 9**). Probably during the same action, the faces of the walls from Phase IV were destroyed. Traces of mechanical removal of a wall face were found on the walls: 25.A.10, 25.C.12, 25.C.13 (the damaged part was marked as unit 25.C.13) and 25.D.4, from the level of 148.70–148.75 m (**Fig. 12**). They were removed to a depth of a few or a dozen centimetres from the plane of the face of the walls from Sub-Phase Vb.

The room in Area 25 was covered with a barrel vault, which explains the considerable thickness of the 25.D wall – 0.50–0.52 m. Its maximum height was from approximately 1.0 m at the entrance (25.E.2) to approximately 1.3 m at wall 25.D. The presence of the 25.E.4 door pilaster on the outside of the 25.E.2 entrance suggests that the basement was closed with a door opened from the outside. In the walls by the entrance, no recesses related to the functioning of the door lock were found.



Fig. 24

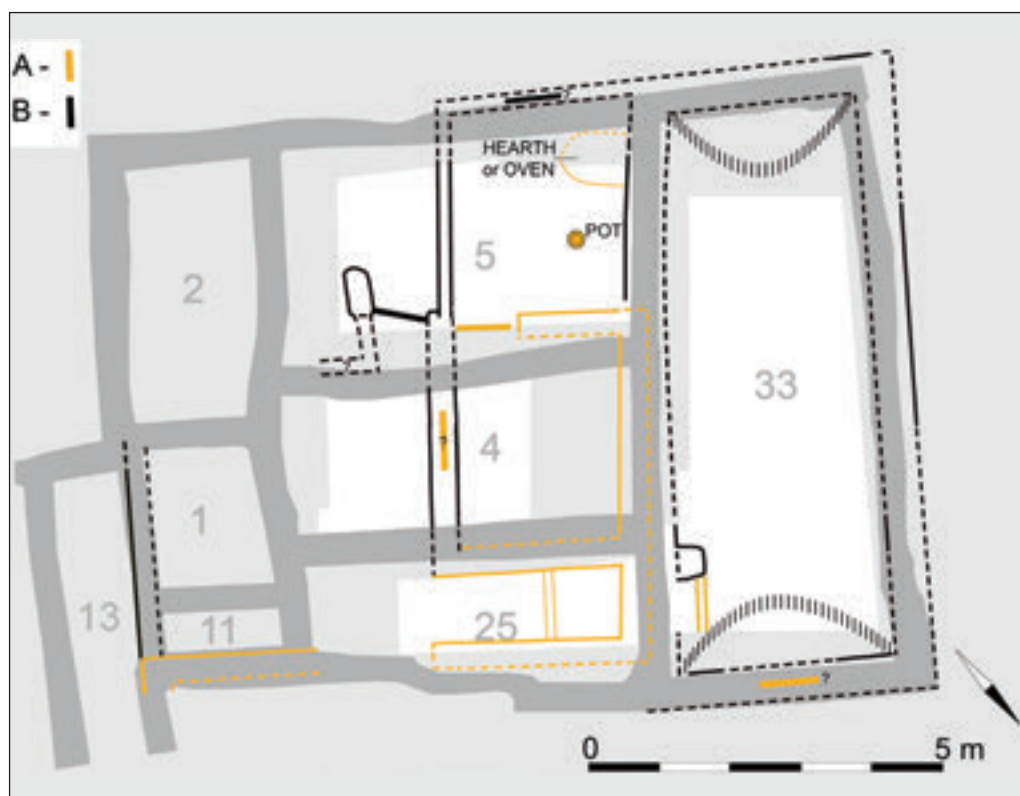
Area 5, the northwest part during the exploration. Feature 63 – an oven from Phase III and feature 62 – an oven or a hearth from Phase IVa. Photo by Michał Dzik

Above the vault in Area 25, a second room was created (Area 17/19), with an entrance from the corridor at the northwestern end of Area 4. It was approximately 3.3×1.2 m in size (4.0 m^2). Its floor was at the level of approximately 150.05 m; only at the very entrance in wall 25.C did it fall to the level of 149.85 m. The height of the room is unknown. Taking into account the lack of recesses for ceiling beams in the best-preserved walls (25.A and 25.D), it can only be concluded that the ceiling was above the level of 151.30 m, so the room was over 1.25 m high.

At the beginning of Sub-Phase Vb, walls surrounding Area 2 on the northeastern and northwestern sides were erected (**Fig. 30**). They were documented in Areas 1, 2 and 5 (units: 1.C.1, 1.C.9, 2.B.3, 2.B.9, 2.D.5, 2.D.7, 5.B.2, 5.B.7; **Figs. 4, 5, 8**). The foundation level was revealed from Area 1. The walls were 0.29–0.32 m thick and were preserved to a height of about 0.25–0.90 m. The structure delimiting the room in Area 2 on the southwestern side was not found. It seems very likely that its remains are in the baulk between Areas 2 and 3. The room in Area 2 was accessible through the passage in the western corner of Area 5, flanked by a partially preserved pilaster.

It is very likely that the wall bounding House A on the southwestern side was also rebuilt. The basis for this conclusion is the layer of destroyed mud brick in Area 5, with the greatest thickness on the side of walls B and C, up to 0.16 m (layer 113).

The hearth was placed in the eastern corner of Area 5 (feature 23). It was a structure made of one layer of dried and fired bricks. Its length was

**Fig. 25**

House A in Sub-Phase IVa. A – walls and features raised in Sub-Phase IVa; B – older structures, still used in Sub-Phase IVa; other symbols – see the legend of Fig. 16.

Drawn by Michał Dzik

approximately 1.95 m long. The remains of this structure were also exposed in Area 4 (separated as feature 21; **Fig. 33**). Based on their range, it can be concluded that the width of the hearth was at least 1.65 m and no more than 2.25 m. The ash layer on the hearth was up to 3 cm thick.

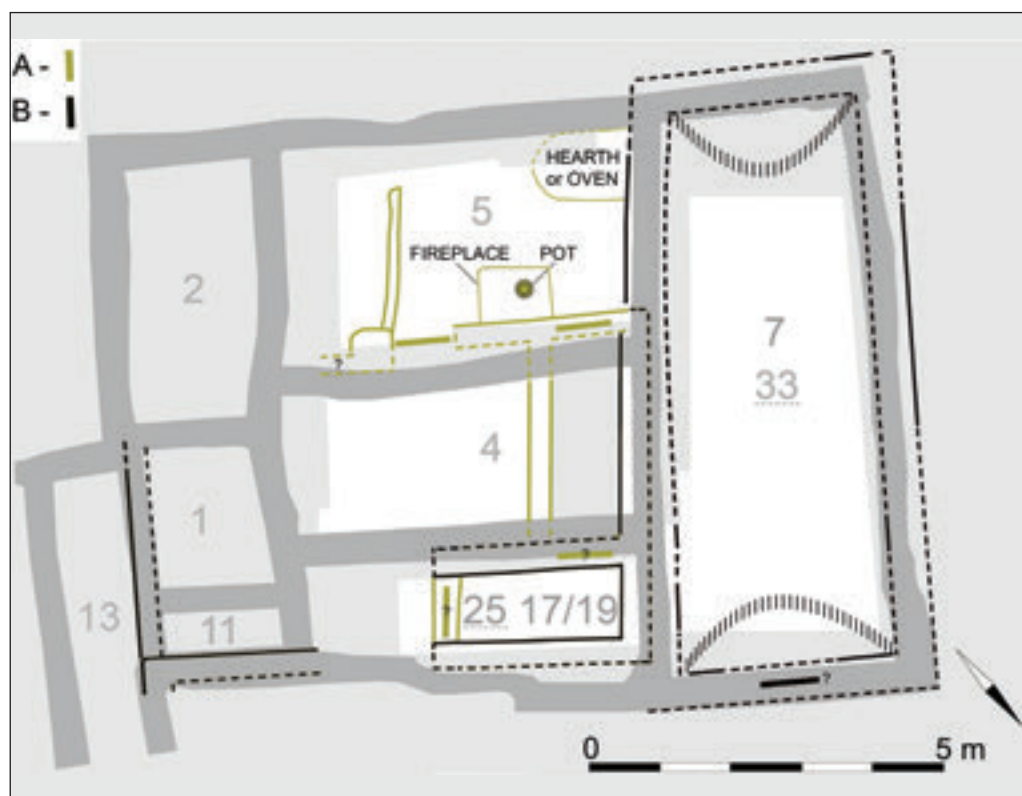
During Sub-Phase Vb, a light construction was built in the western corner of Area 5, delimiting a space of around 2.5 m². The remains of this structure was feature 46 – a row of mud bricks in a stretcher course, 1.22 m long, and features 188, 189 – two postholes with a diameter of up to 0.19 m and 0.24 m and a depth of 0.28 m and 0.45 m respectively. The floor within it was hardened with mud (layer 147).

To sum up, in Sub-Phase Vb, there was a house with an area of approximately 93 m², consisting of a large residential building (Area 7), a corridor leading to it and four additional, probably utility, rooms. If there was a latrine within the household, it could only have been located in the least explored Area 2. The exploration was completed there at the level of the top of the youngest layers of Phase Vb (in the southwestern part of the area) and Vc (in the northwestern part). These did not have the features of latrine layers; however, this does not exclude the presence of such layers at lower levels. The remains of the latrine were not found in other, fully recorded rooms of House A. A significant part of the house, including Areas 1, 11 and parts of Areas 4, 5 and 19, in Sub-Phase Vb comprised a fenced yard with an area of approximately 27 m².

The main change in Sub-Phase Vc in the layout of House A was the rebuilding of the room in Area 2 (**Fig. 34**). It was undertaken when the ground level in this area was at approximately 149.40 m. The walls, 0.32–0.36 m thick, delimited a room with an area of approximately 3.3 m², with an entrance from Area 1

Fig. 26

House A in Sub-Phase IVb. A – walls and features raised in Sub-Phase IVb; B – older structures, still used in Sub-Phase IVb; other symbols – see the legend of Fig. 16. Drawn by Michał Dzik



(walls: 1.B.13 = 2.B.1, 1.C.5, 2.A.1, 2.A.5, 2.D.1, 4.B.16, 4.B.17, 5.B.8; door opening 1.C.7; **Figs. 4, 5, 8**). It is noteworthy that there was an arched opening in wall 2.D, 0.53 m high and 0.75 m wide (unit 2.D.3; **Fig. 5**). This was 0.55–0.60 m above the then floor level in Area 2 and above the hearth's brick base, located directly by the opening from the side of Areas 4 and 5 (features 21, 23). Considering the coincidence of the location of the hearth and the described opening, the conclusion about their functional connection seems reasonable. During Sub-Phase Vc, another brick hearth base was placed at this point (features 21a, 22; **Figs. 8, 35**). It was again composed of one layer of bricks, oval in plan, with dimensions of 1.72 × about 1.40 m. The ash layer on the hearth was up to 2 cm thick.

Given the lack of traces of rebuilding from Sub-Phase Vc in the southwestern part of Area 2, it can be presumed that at that time, this space – with an area of approximately 2.8m² – was surrounded by only partially preserved walls.

In Area 5, the doorway leading earlier from the corridor at the northwestern end of Area 4 was bricked. Two small spaces, about 1.2 and 2.0 m² in area, were constructed adjacent to wall 5.D. The walls delimiting these spaces – units 5.E.1, 5.H.1 – 0.26–0.39 m thick, were preserved to a height of only about 0.17 m; therefore, the location of the communication openings leading into them has not been determined.

In Area 4, wall 4.E was pulled down; thus, the corridor from Phase IV was dismantled. The space in front of the entrance to the living room in Area 7 was laid with mud bricks (layer 97c; **Fig. 35**). On the southeastern side, it was limited by a row of bricks in the rowlock course, exposed over a length of 1.57 m (layer 96a). It is possible that this was the remains of a low wall (or fence) built in front of the entrance to the main building. In Areas 4 and 5, fragments of a mud layer, which was used to harden the courtyard space, were revealed (layers 96, 110).

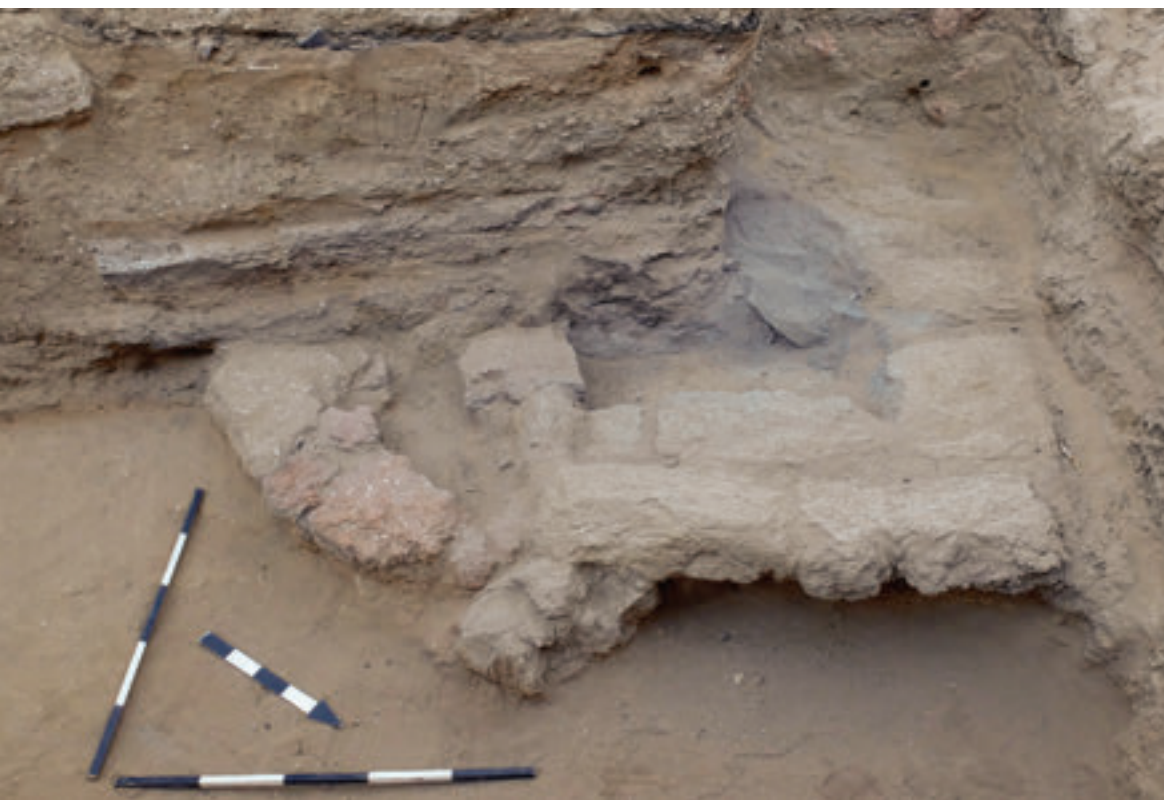


Fig. 27

Area 5, feature 49
– a hearth or an oven
from Sub-Phase IVb
during the exploration.
Photo by Michał Dzik



Fig. 28

Area 33, layer 277a
– a layer of garbage
between doorway
33.B.25 and its
blockage – feature 88.
Photo by Michał Dzik



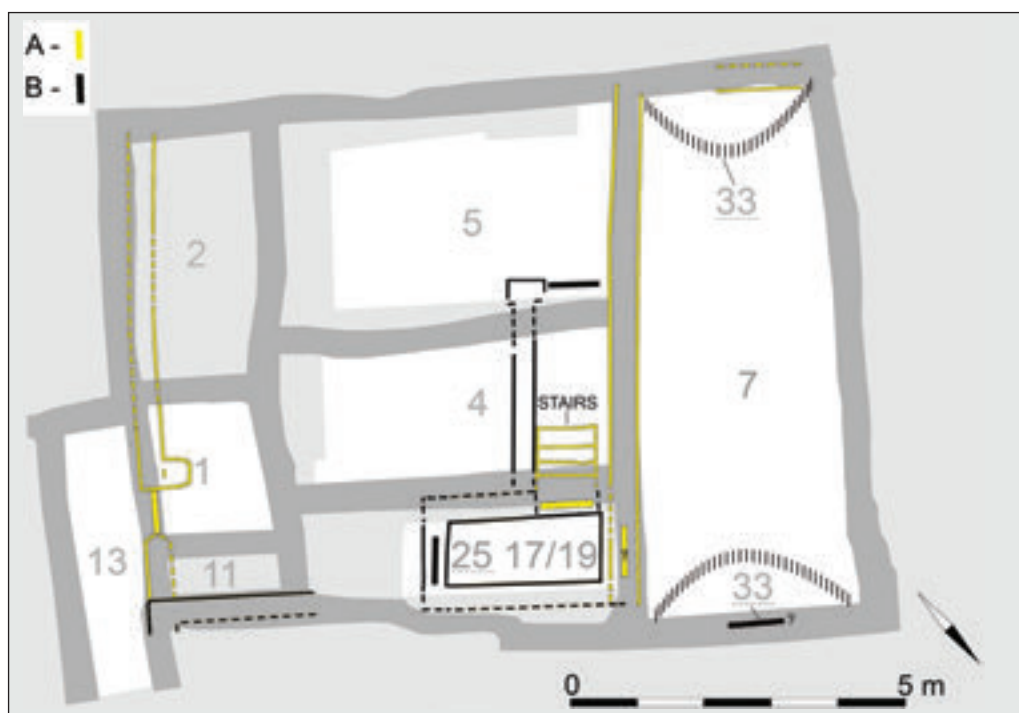


Fig. 29
House A in Sub-Phase Va. A – walls and features constructed in Sub-Phase Va; B – older structures, still used in Sub-Phase Va; other symbols – see the legend of Fig. 16.
Drawn by Michał Dzik

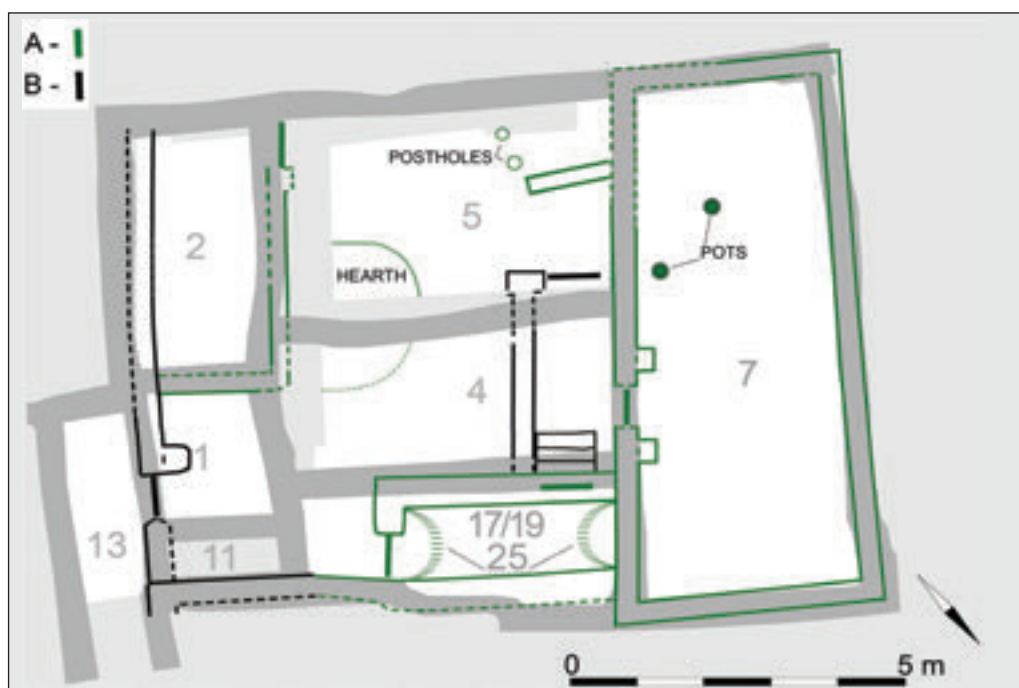


Fig. 30
House A in Sub-Phase Vb. A – walls and features constructed in Sub-Phase Vb; B – older structures, still used in Sub-Phase Vb; other symbols – see the legend of Fig. 16.
Drawn by Michał Dzik

Phase VI

This phase's distinguishing feature was the construction investment covering most of House A. It was undertaken when the ground level was approximately 149.45–149.70 m, the lowest level being on the northwestern edge of Areas 4 and 5. The main change was the complete covering of the courtyard with brick-built rooms (**Fig. 36**). It was then that the layout of the rooms was created, which became the basis for dividing this space into areas.

Fig. 31
Photo-drawing
plan of Area 7
at the level of
the brick floor –
layers 234, 235.
Prepared by
Michał Dzik



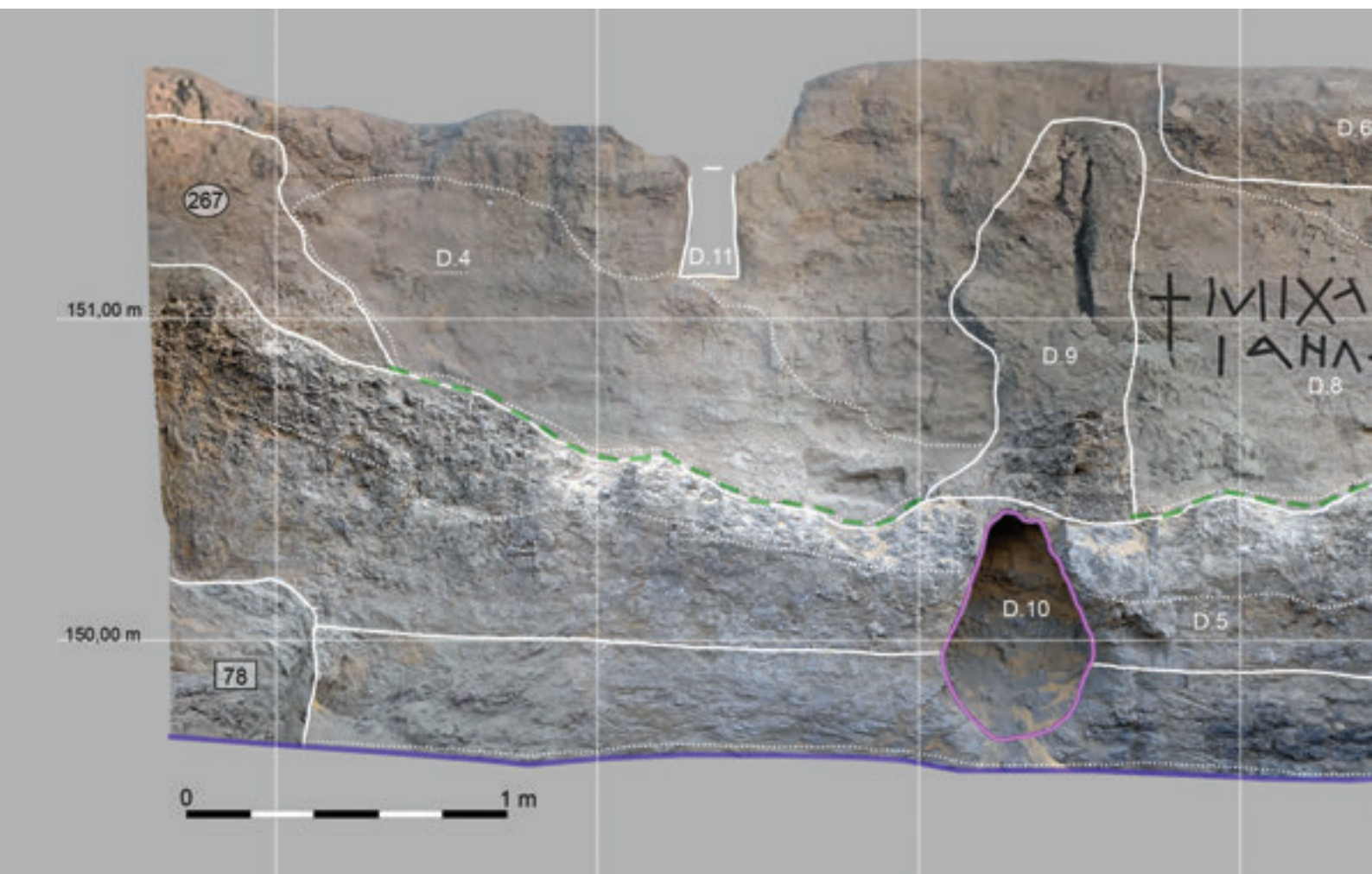
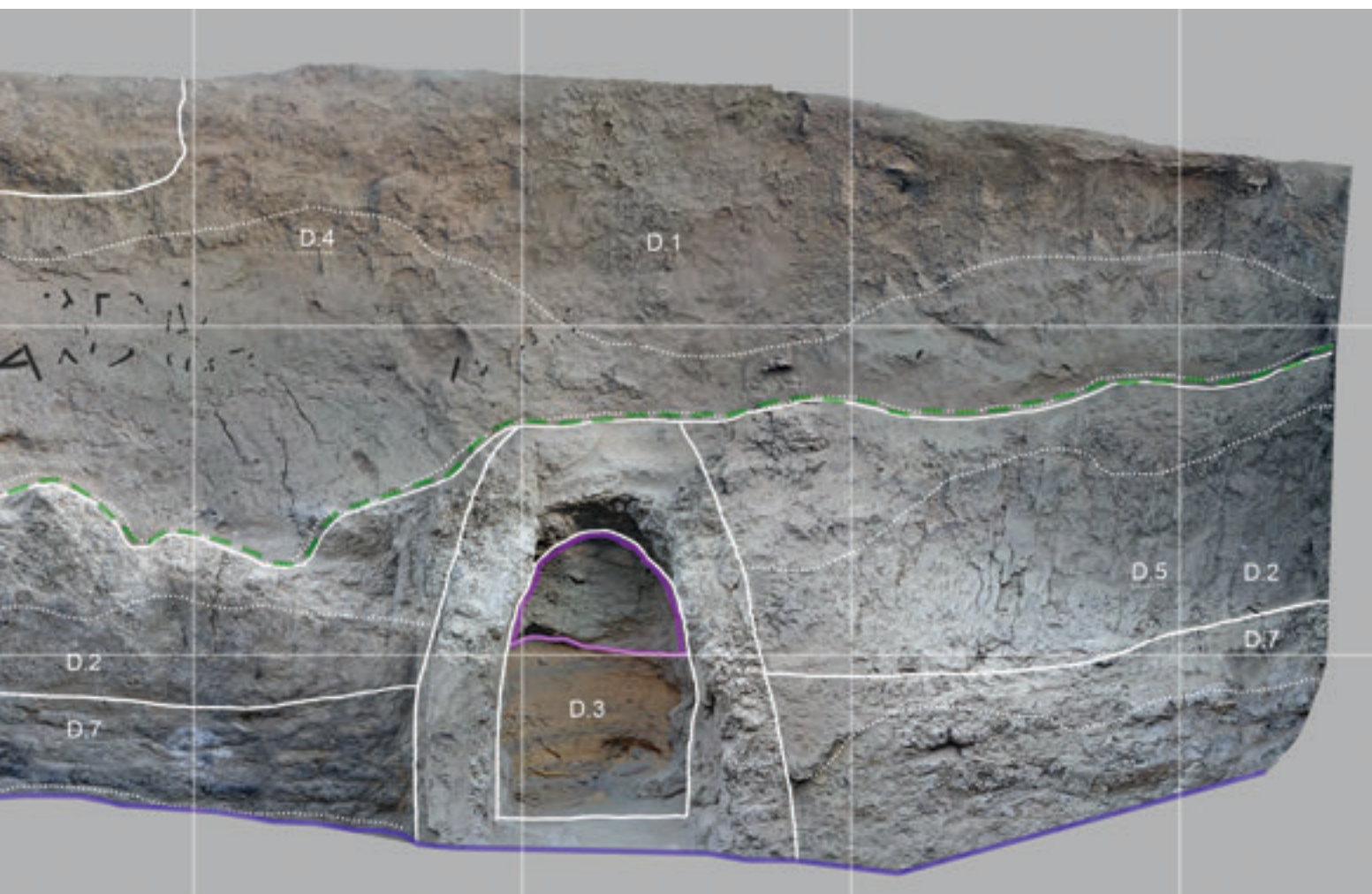


Fig. 32
Photo-drawing
documentation
of section D of Area 7.
Prepared by Michał Dzik

Even before the complete rebuilding of House A, its southeastern wall was overbuilt (units 1.B.8, 2.B.2). This activity was partly related to the works in the neighbouring house (Area 9). The overbuilding of wall 1.B of House A could have been caused by insufficient height or thickness of the existing boundary walls. Such a hypothesis is suggested because the older structures in the northwest wall of House A – units 1.B.9, 2.B.1 – were characterised by the thinness of their upper parts. Wall 1.B.9 in the lower part was 0.38 m, and from a height of about 0.8 m, it was only 0.29 m. The wall erected on it – unit 1.B.8 – was 0.37 m thick.

In House A, from the level of about 149.55 m, walls were erected, delimiting the space of Area 13 on the southeastern and southwestern sides (units 13.B.2, 13.C.1, 13.C.3; **Fig. 11**). They were probably walls of two neighbouring buildings. At that time, at the latest, an alley with a width of approximately 1 m, leading to two houses, including House A, came into existence. It is noteworthy that the thresholds of the two-door openings leading into them were located as much as 0.55–0.65 m above the then ground level (units 13.C.2, 13.D.12; **Fig. 11**).

In Area 1, a room was created with dimensions of approximately 1.9×1.6 m (3.0 m^2), with door openings in each of the four walls. Construction was commenced here from the level of approximately 149.60 m, firstly by overbuilding walls 1.B and C and erecting wall 1.D (units: 1.B.1, 1.B.10, 2.C.8, 1.D.1; **Fig. 4**).



During the same rebuilding, wall A was built (unit 1.A.1). The noticeable difference in the level of the footing of walls D and A results from the erection of the first one in a shallow foundation pit (0.1–0.3 m), and the second one at the then ground level. Wall 1.A.1 was inserted without a bond between walls 1.D.1 and 1.B.1, so it was the last stage of construction in this part of the house. A small space was separated with it, distinguished as Area 11, with dimensions of approximately 1.7×0.6 m (1.0 m^2 ; **Fig. 10**). In Area 1, fragments of plaster have been preserved on walls C and D, which could have been applied in Phase VI or VII. There were no traces of a mud floor from that period, nor of recesses left by possible ceiling beams (the walls were preserved to a height of about 2.1 m from the then ground level).

In the passages leading to Areas 2 and 11 no indications of use of the doors were found. The entrance from the street (Area 13), flanked by a pilaster, was closed with a door. The lock recesses in the left-hand door frames indicate a door hinged on the right(?), opening inwards. The entrance to the room in Area 4 was also closed with a door (see below). Noteworthy is the low height of the door openings. It was established for three passages – 1.B.3, 1.C2 and 1.D.2; it did not exceed 1.35 m.

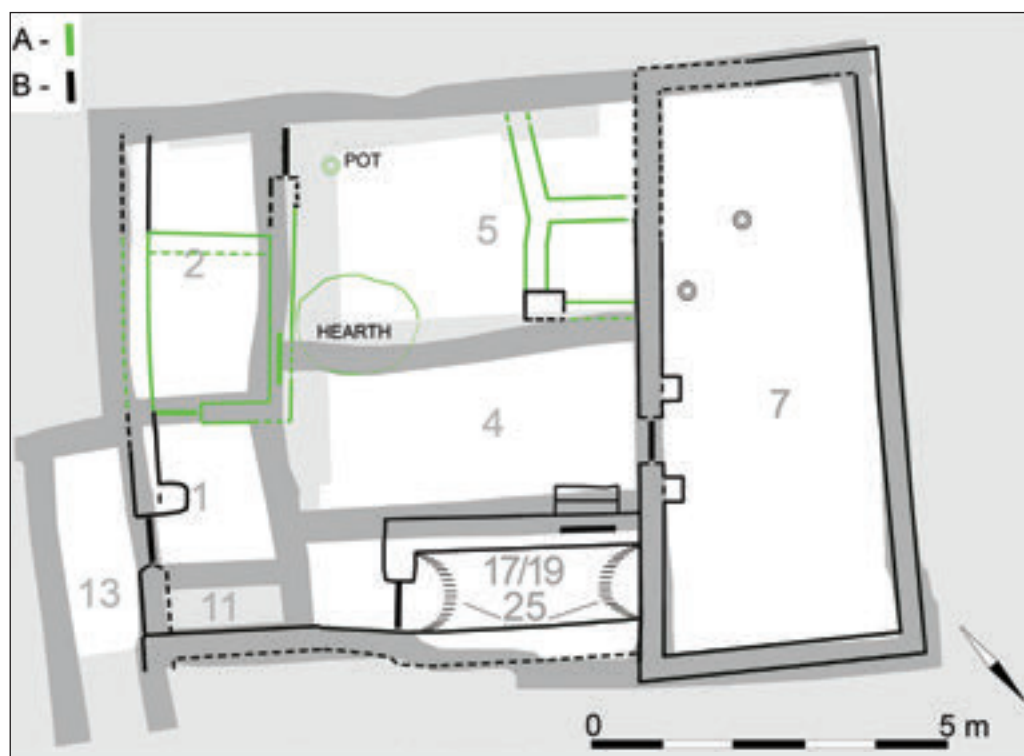
In Area 2, the room was enlarged to approximately 3.6×1.7 m (6.3 m^2), retaining access from Area 1. In addition, the opening in wall D, formed in the

In Area 4, a room with dimensions of approximately 4.90×1.85 m and an area of 8.7 m^2 was 1.95 m high at wall 4.B and 1.80 m at wall 4.D. It had a mud floor. The interior was accessible from Area 1 through the passage flanked by two

158



Fig. 34 (on the top right)
House A in Sub-Phase Vc.
A – walls and features
constructed in
Sub-Phase Vc;
B – older structures, still
used in Sub-Phase Vc;
other symbols – see
the legend of Fig. 16.
Drawn by Michał Dzik



pilasters at the side of Area 4. A trace of the functioning of the door, hinged at the right, opening into this room, was a socket for a door pivot, made in fired brick (unit 4.B.8), and recesses for bolts (units 4.B.5, 4.B.12).

It seems that in Phase VI, the door opening connecting Areas 4 and 7 was still in use (unit 4.D.3). The central premise for this conclusion is the further accumulation of cultural layers in Area 5, which was only connected to Area 7. The latter, therefore, had to be accessible from another area. Admittedly, in Area 7, two communication openings were documented in wall D, but they were created later (units 33.D.3, 33.D.10; **Fig. 32**). The older of them – unit 7.D.3 – was made in Phase VII, as indicated by the binding of its door pilasters to the springing of the vault, which was created at that time (see below). Additionally, access to Area 5 was blocked by the wall and the vault of this rebuilding. The more recent opening – unit 7.D.10 – was broken through when the remains of buildings in this part of the settlement were used only as a temporary shelter.

In the interior in Area 4 there was only one coating of plaster; the fact that this covered the blockage of the door opening (4.D.3) may raise doubts as to the hypothesis presented above about the existence of a passage between Areas 4 and 7 in Phase VI. However, the stratigraphic relationship between the plaster and the hard mud floor was captured in several places. It indicated that the plaster was laid after the covering of the floor with mud layer 39. This was then related to the second period of use of this interior space (see Phase VII).

The third door opening in Area 4 led to the room in Area 17/19. Its low height – 0.63 m – and width of 0.65 m is noteworthy.

The cellar in Area 25 was filled with mud-brick rubble. In front of its entrance, at the level of 149.28 m, a *geseba* with a diameter of 0.60 × 0.55 m and a height of 1.05 m was placed (feature 186; **Figs. 37, 38**). This vessel had no base; at the



Fig. 35
Area 5, feature 22
– a hearth from Sub-
Phase Vc, cut by wall
5.A.2 from Phase VI.
Photo by Michał Dzik

bottom, there was a 2–3 cm ash layer, which might have had an insulating function (layer 197). The space around the *geseba* was filled with mud-brick rubble to the floor level in Area 17/19.

The room in Area 17/19 was enlarged in relation to Phase V, to the dimensions of approximately 4.6×1.2 m and an area of approximately 5.5 m^2 . Its height was only 0.95 m at the northwestern edge and up to 1.25 m at the southeastern end. At the latter end was the *geseba* described above, the rim of which reached at least 8 cm above the floor.

It seems likely that the part closer to the entrance was dismantled even during the same rebuilding of a 1.5 m long section of the barrel vault in Area 17/19. The premise for connecting this rebuilding with Phase VI is the convergence of the length of the dismantled vault with the course of the partition wall (25.G.1; **Fig. 38**). The latter had been placed on the vault of the room in Area 17/10 during the erection of the first floor walls (see below). It was bonded with wall 4.A.4. Around the northwestern part of Area 17/19, walls were erected that increased the height of this part of the room to at least 1.7 m. In wall A, behind the removed vault, a two-level shelf was made of bricks and mud mortar, originally cast on a wooden or reed structure (**Fig. 39**).

The rooms covered with barrel vaults took up approximately 53 m^2 , i.e. 57% of the entire household (Areas 2, 4, 5, 17/19). The use of such structures is one of the premises suggesting the construction of a second floor of the building in Phase VI.

Fig. 36

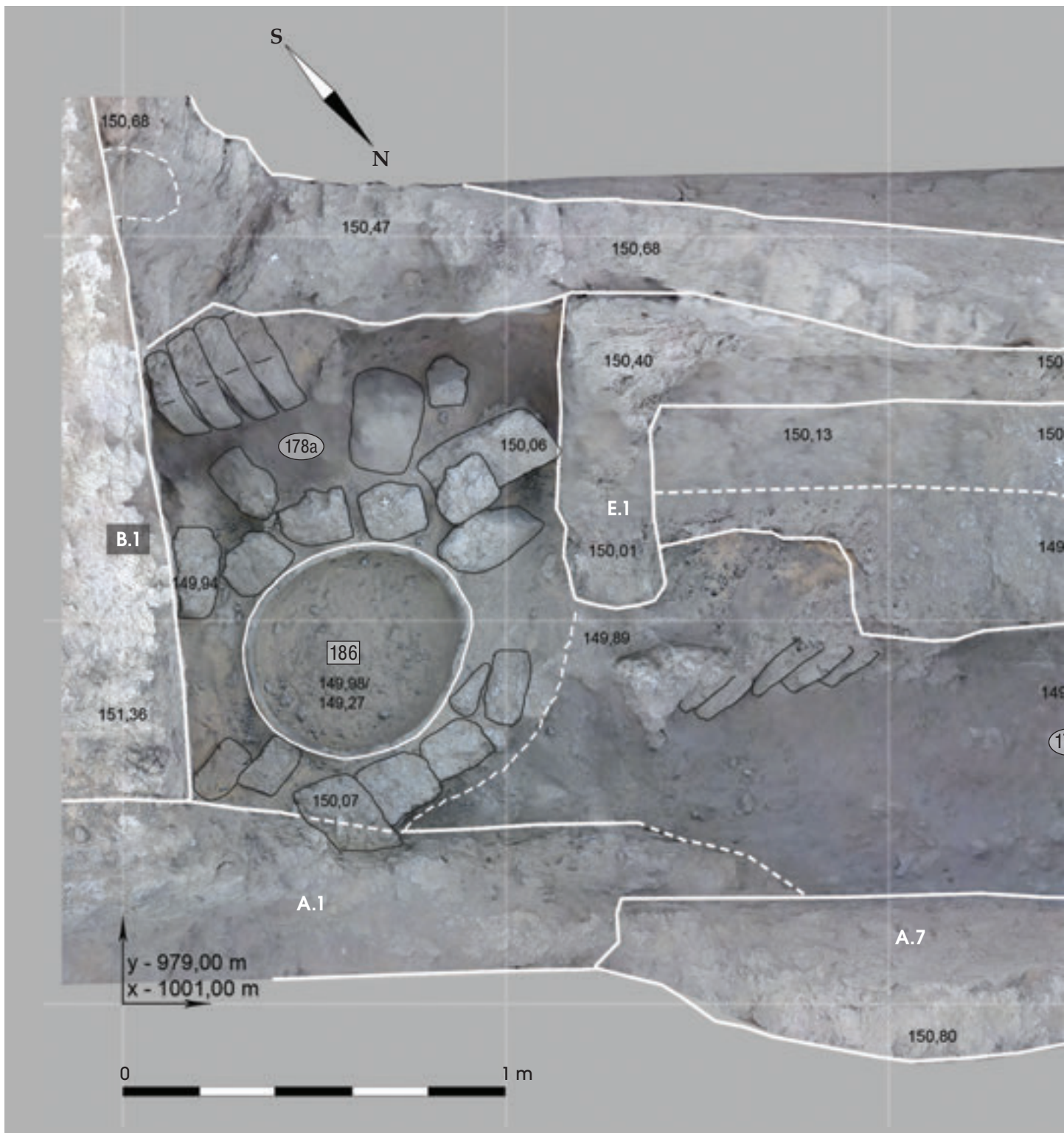
House A in Phase VI.
A – walls and features constructed in Phase VI on the ground level; B – walls built over the vaults of the ground level; C – older structures, still used in Phase VI; other symbols – see the legend of Fig. 16.
Drawn by Michał Dzik



Fig. 37 (below)

Area 17/19, feature 186 – a geeseba from Phase VI.
Photo by Michał Dzik



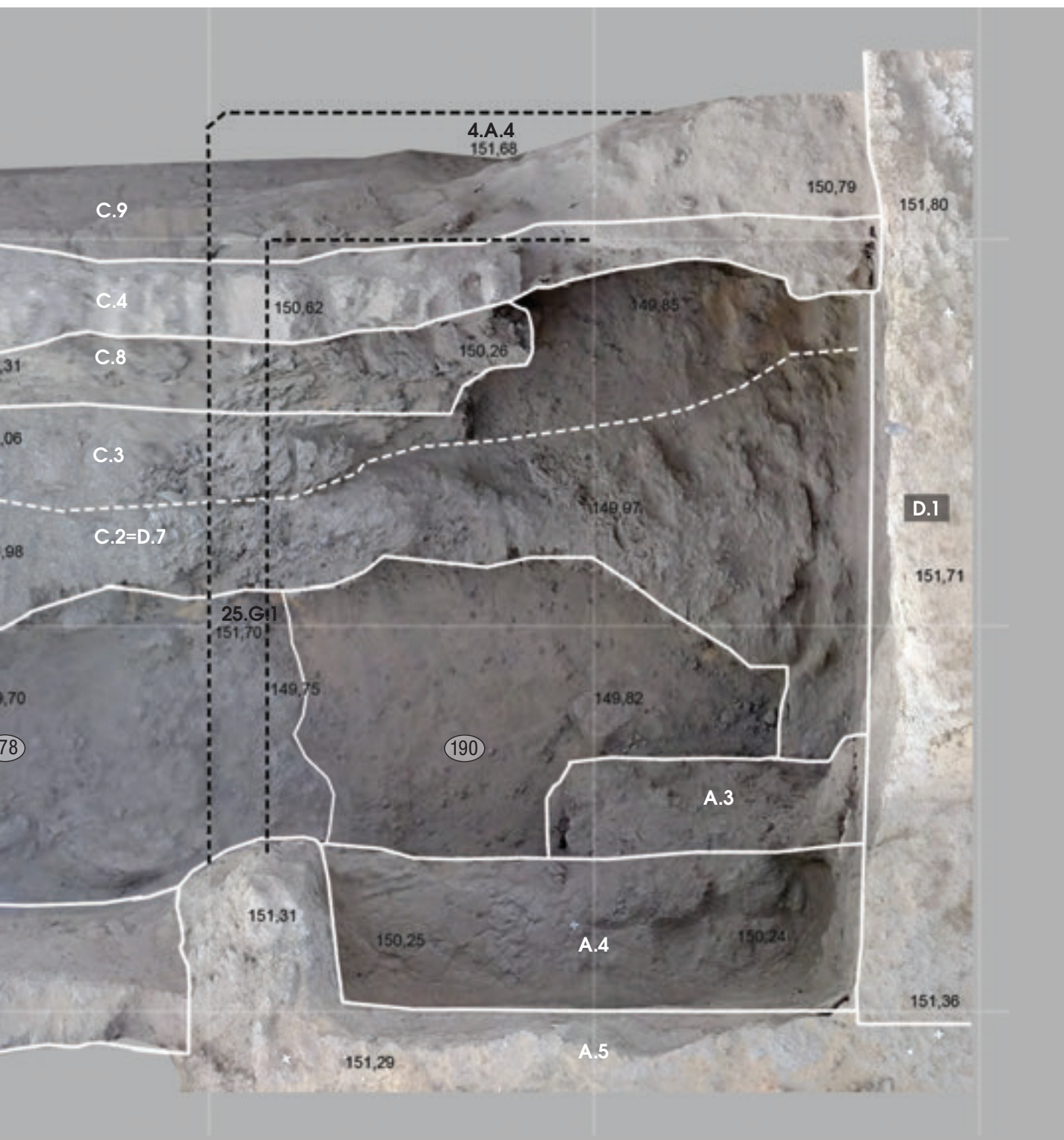


The other indications are as follows:

- Walls were built directly on the void above the vault during the same rebuilding, which could delimitate rooms on the first floor.
- In Area 4, a fragment of a layer of mud was found (layer 637) directly on the preserved fragment of the vault; this could have been the mud floor of a higher level.

Fig. 38

Photo-drawing plan of area 17/19 at the level of Phase VI occupation. Prepared by Michał Dzik

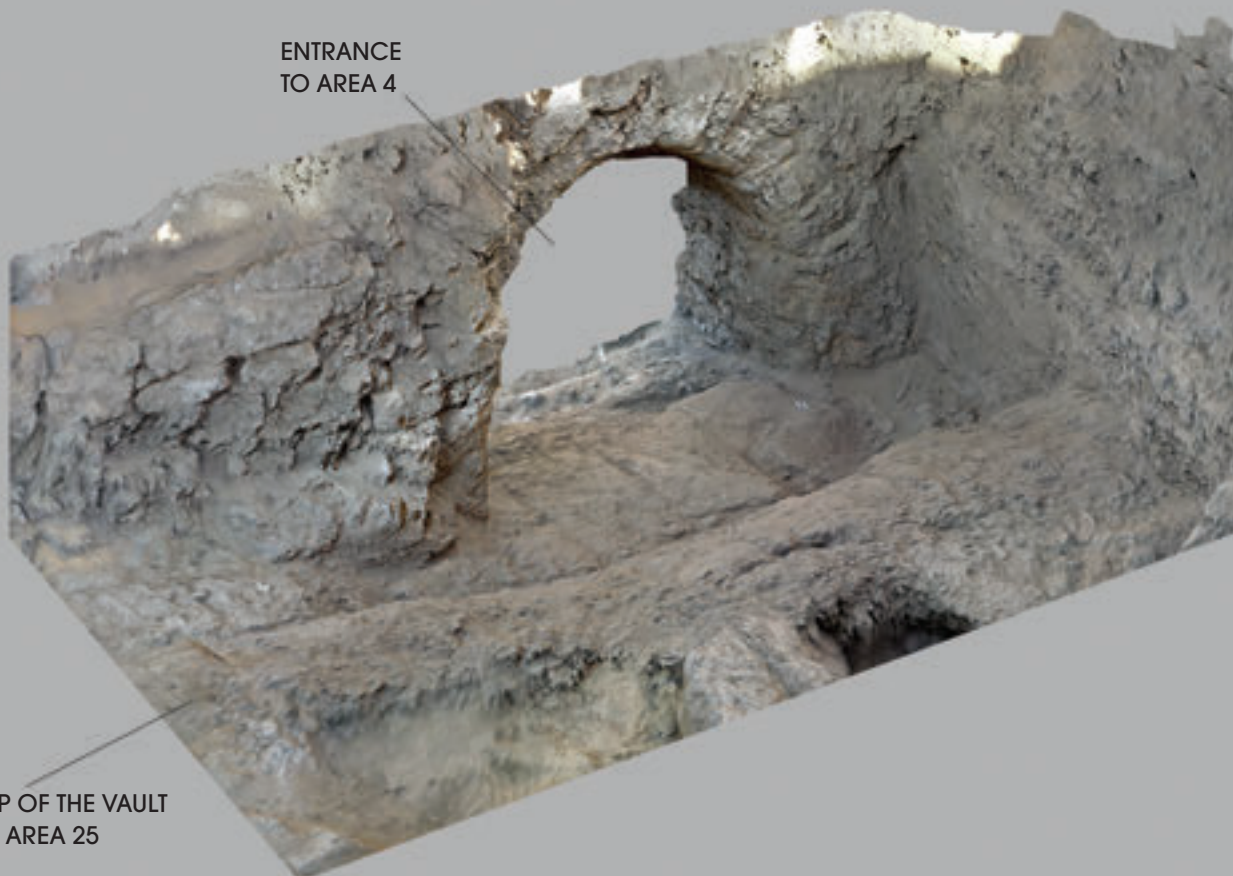


c) On the above-mentioned layer of hard mud and a 7 cm thick layer of aeolian sand, there was an overturned wall – a fragment of wall 4.A.4. Based on the legible number of layers of bricks, it can be assumed that the height of this wall initially exceeded the level of 152.8 m, i.e. about 1.4 m above the roof covering the arch of the vault.

A

ENTRANCE
TO AREA 4

TOP OF THE VAULT
OF AREA 25



B

LEVEL OF THE
HIGHER SHELF

TOP OF THE VAULT
OF AREA 25

ENTRANCE
TO AREA 4

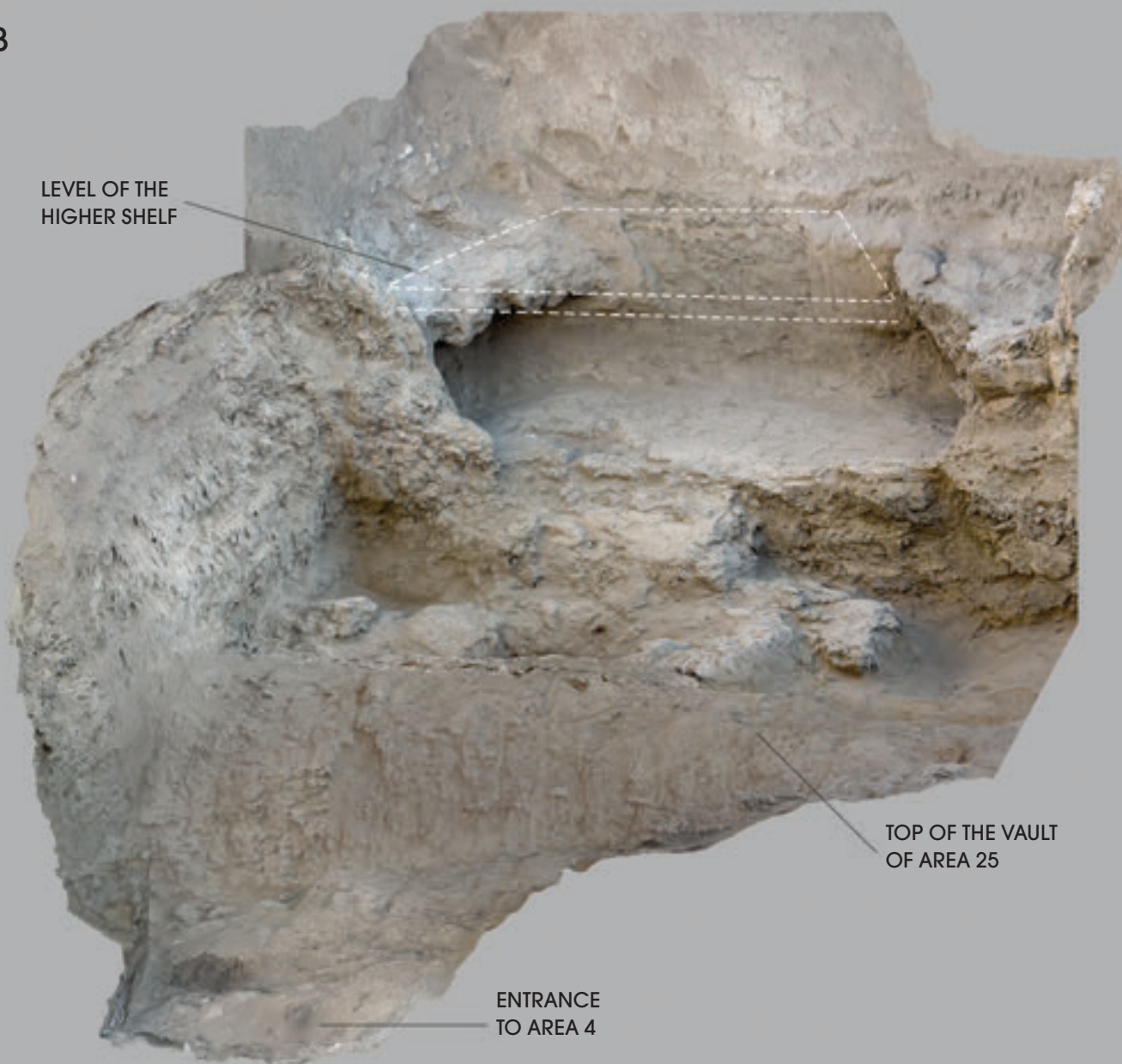


Fig. 39

The northwestern part of Area 17/19 in Phase VI. A – view from the east, towards the entrance to Area 4; B – view from the west, towards the two-level shelf. Views generated from a 3D model. Prepared by Michał Dzik

Layers from Phase VI were exposed in all areas. Each of them was characterised, among other features, by a brown colour, an explicit humus content, and medium cohesiveness. They indicate the intensive domestic use of the space.

Some features help to determine the function of some of the ground-floor interiors. In Area 1, accessible from the street, there was an entryway, from which three communication routes began. The first led to Area 11, which most probably contained stairs to the second floor. The second one connected the entryway with three rooms in Areas 4, 5 and 7. The third passage led to the latrine in Area 2. Traces of long-standing ash layers at this entrance are noteworthy (**Fig. 40**). Given the function of the room in Area 2, it seems likely that these layers could have arisen due to burning odour-neutralising substances.

During Phase VI, in the middle of Area 2, a brick toilet was built on the remains of the levelled wall from Sub-Phase Vc (feature 34; **Figs. 41, 42**). Next to it, a brick partition was placed, dividing the room into two parts, one of which served as a latrine pit. The base of its fill was at the level of around 149.30–149.40 m. Therefore, the bottom was only slightly deepened in relation to the ground level at that time. As a result, the ceiling of the toilet was at the height of approximately 150.40 m.

In Area 2, during the accumulation of layer 35, the kitchen pot, partially dug into the older layers, was placed close to the entrance to Area 1 (**Fig. 41**). Its purpose has not been established. The height of the room at the beginning of Phase VII was approximately 1.6 m.

In Area 4, a mud-brick and mortar structure (feature 13; **Fig. 35**) was built in the western corner of the room. Trapezoidal in plan, it was 1.44 m long, 0.34–0.75 m wide and 0.22 m high. There was a kitchen pot inside it, sunk to one-third of its height. There was a 2 cm layer of ash over the part of the structure closer to the corner of the interior (no. 39a). Below this, on the bricks of feature 13 and on the adjacent wall 4.D, traces of fire were found. This facility can be interpreted as a place to prepare meals.

In Area 5, no brick structures of hearths or ovens were found, but only traces of occasional burning in the eastern corner. On the other hand, an overturned *geseba* with a diameter of approximately 0.50 m, and a preserved height of 0.88 m was found. Initially, it was placed in the northern corner of the room. In Area 5 as many as 16 kitchen pots were found, most of them partially buried in the contemporary floor. Most of them were covered with sherds used as lids. Based on the stratigraphic relationships of the pots with the layers, it was found that they came from different stages of the use of the interior, in Phase VI and maybe Phase VII (**Fig. 43**). Therefore, it seems likely that the room in Area 5 served primarily as a storeroom.

It is more difficult to determine the function of the interior in Area 7, which previously, in Phase V, was a living room. Here, part of the vault of the room in Area 33 caved in, thus destroying about half of the floor in Area 7. It is uncertain whether this was a one-off event or whether it happened in stages. It is also difficult to determine whether it took place in Phase V, or maybe only in Phase VI. In the first case, the interior in Area 7 could have been used, e.g., as a corridor leading to Area 5. In the second, it would probably still have been used as a living room.

The interior in Area 17/19 was probably intended for a storeroom. This is suggested by the presence of the shelves and the *geseba* described above, and the low height of the door opening and the vaulted part of the room.



Phase VII

The beginning of Phase VII is marked by the bricking up of walls and the construction of a barrel vault in the room in Area 7. This was undoubtedly related to changes in the size and layout of House A (**Fig. 44**). The stage in which the accumulation of cultural layers took place, which may be associated with the change in the way the interior of House A was used, was distinguished as Sub-Phase VIIb. It took place when the ground level was at an altitude of approximately 150.00 m.

The new interior in Area 7 was about 7.9×2.6 m and 20.5 m^2 ; the height was up to 1.7 m. There was a ceramic chimney in the vault in the centre of the room (feature 16). It is noteworthy that the voids above the vault were filled mainly with yellow sand and not with the rubble of mud brick and mud mortar, as in the older phases. In this case, the voids above the vault were filled with brick rubble only in the upper part, up to approximately 0.4 m below the hard mud floor, which covered the entire vault. Walls and the vault of the room were covered with mud plaster, and a hard mud floor was laid.

These changes involved blocking door openings leading to Areas 4 and 5. The room had been connected with Area 30, belonging to the adjacent House B. However, the question remains unanswered whether this change in the spatial context of Area 7 also concerned the utility floor above the vaulted room. A newly cut communication opening – unit 7.D.3 – was 0.70 m wide and only 0.87 m high (**Fig. 32**). There were no recesses related to the functioning of the door in the pilasters flanking the opening. Theoretically, this passage could have been related

Fig. 40

Area 1, a section of the fireplace layers by the stone threshold of the entrance to the latrine in Area 2. Photo by Michał Dzik.

Fig. 41 (on the right) Photo-drawing plan of Area 2 at the level of Phase VI occupation. Prepared by Michał Dzik

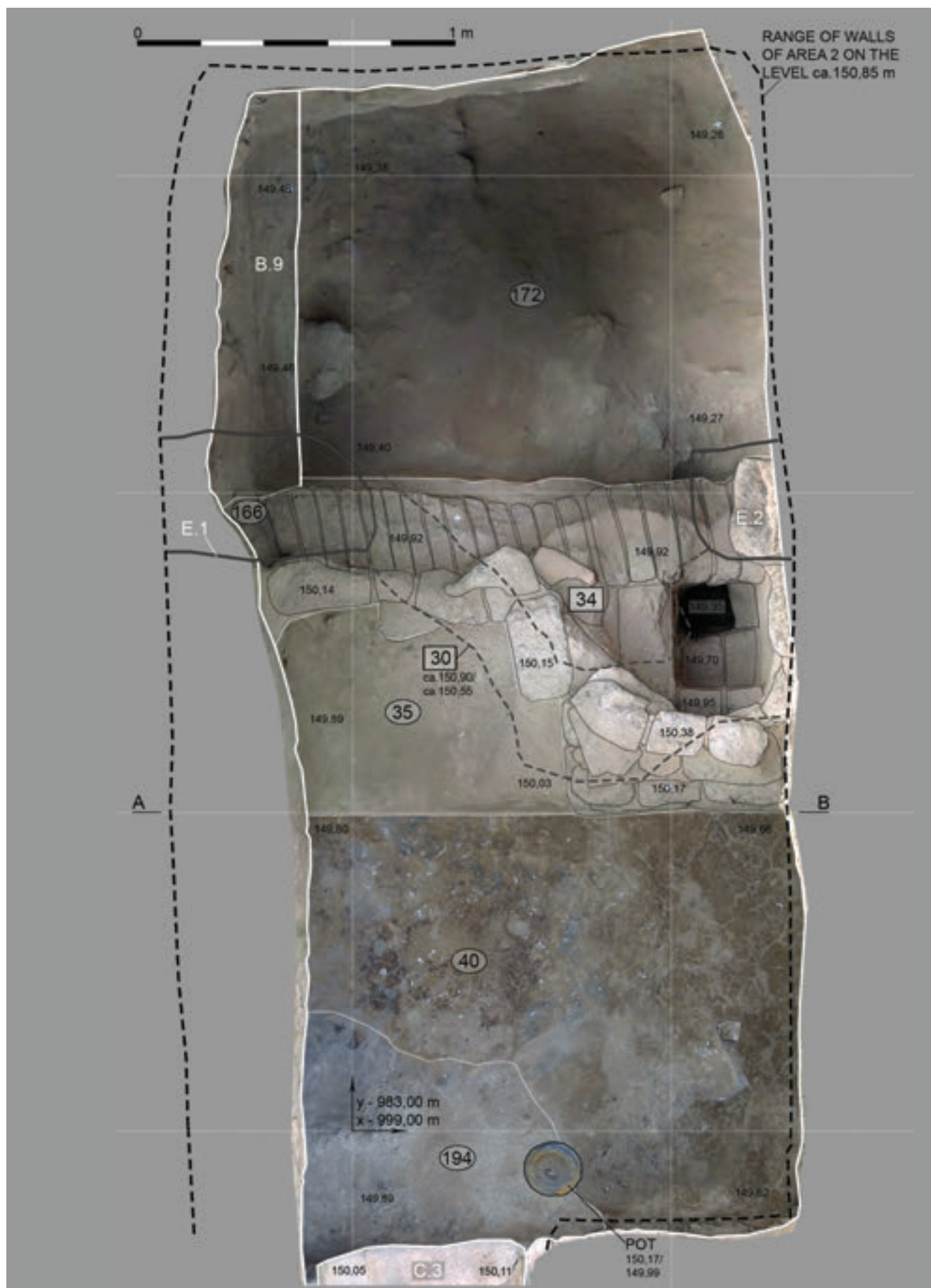




Fig. 42

Area 2, feature 34
– brick toilet from Phase VI, viewed from the side of the latrine pit. View generated from a 3D model. Prepared by Michał Dzik

Fig. 43 (below)

Area 5, kitchen pots in the southeast corner of the room. Photo by Michał Dzik



to a socket for a door pivot, made in fired brick, discovered in the backfill of the robbing pit in the eastern part of the area. This trench partially destroyed the space directly in front of unit 7.D.3.

After this reconstruction, the room in Area 5 was probably no longer accessible. The uncertainty in this matter is related to destroying the walls of the western corner of Area 5 by a robbery pit. Theoretically, it cannot be ruled out that a small communication opening was made thereafter, bricking up the entrance to Area 7, connecting Area 5 with Area 16.

In the remaining areas, no traces of a change in the communication routes or the layout of rooms have been documented. However, minor changes were undoubtedly made in Area 4. After bricking up the passage to Area 7, the walls of the interior were covered with mud plaster and a mud floor was laid (layer 39). On wall 4.D, on the fresh plaster, the symbol of a star and a cross inscribed inside were carved (**Fig. 8**). The opening leading to Area 17/19 was flanked by pilasters. A recess for the sliding bolt – unit 4.A.8 – indicates that it was closed with a right-hand door opening inwards.

The earth layers of Sub-Phase VIIa were characterised by the same features as the layers of Phase VI, which indicates constant use of the space. In the room in Area 7 belonging to House B, in the eastern corner, a fragment of an oven made of mud brick, damaged by a robbery pit, was exposed (feature 190). The layers of ash found there had a thickness of 0.28 m. Traces of fire burning *in situ*, as well as a layer of ash with dimensions of 0.6 × 2.1 m and a thickness of up to 0.17 m, were also found at wall 7.D, next to the entrance to the room (layer 241).

In Area 4, in the central part of the room, a *geseba* was made, with a diameter of 0.52 m and a height of 0.67 m (feature 185; **Fig. 45**). In the southern corner there was a partially buried kitchen pot (feature 14). There was a brick structure in the northern corner, around 0.35 m high (feature 4). Due to the high degree of damage, it was difficult to determine the remaining dimensions. No ash was found inside it, but traces of fire were visible on the bricks forming the top of the feature.

Moreover, a layer of ash with a thickness of up to 5 cm lay on top of the structure (layer 69). On these bases, the feature can be interpreted as a hearth. Traces of sooting on the adjacent wall and the vault were associated with its use.

In the eastern corner of the room in Area 4, was feature 5 – two bricks arranged along the wall, with a pot half-buried next to them (**Fig. 45**). The structure was used as a hearth, as indicated by traces of soot on the plaster covering the adjacent wall and ceiling, as well as a layer of ash lying on it, up to 6 cm thick (layer 70). It is possible that there was a chimney opening in the vault above feature 5 since, in the eastern corner, the vault bore unmistakable traces of a later addition (units 4.B.7, 4.B.9; **Fig. 8**). The basis for establishing a relative chronology between this alteration and feature 5 is, first, no traces of soot on units 4.B.7 and 4.B.9; and, second, the plaster (4.B.11) being covered with soot.

Features 4, 5, 14 and 185 were exposed directly on the hard mud floor from Sub-Phase VIIa (layer 39). This does not mean, of course, that all of them were created soon after the mud floor was laid. Considering the nature of this layer, it is possible that even prolonged use of the interior in Sub-Phase VIIa did not necessarily mean accumulation of cultural layers of considerable thickness. The earth layer above

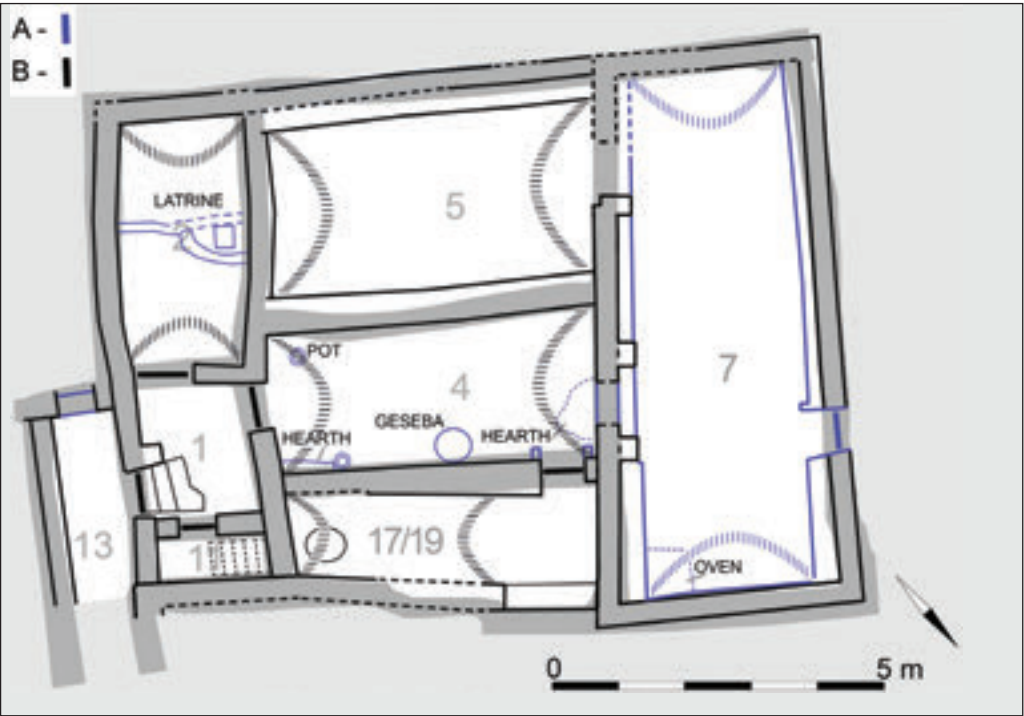


Fig. 44
House A in Phase VII.
A – walls and features
constructed in Phase
VII; B – older structures,
still used in Phase VII;
other symbols – see the
legend of Fig. 16.
Drawn by Michał Dzik

Fig. 45 (below)
Photo-drawing plan of
Area 4 with the facilities
from Phase VI (feature
13) and Phase VII
(features 4, 5, 14, 185).
Prepared by
Michał Dzik

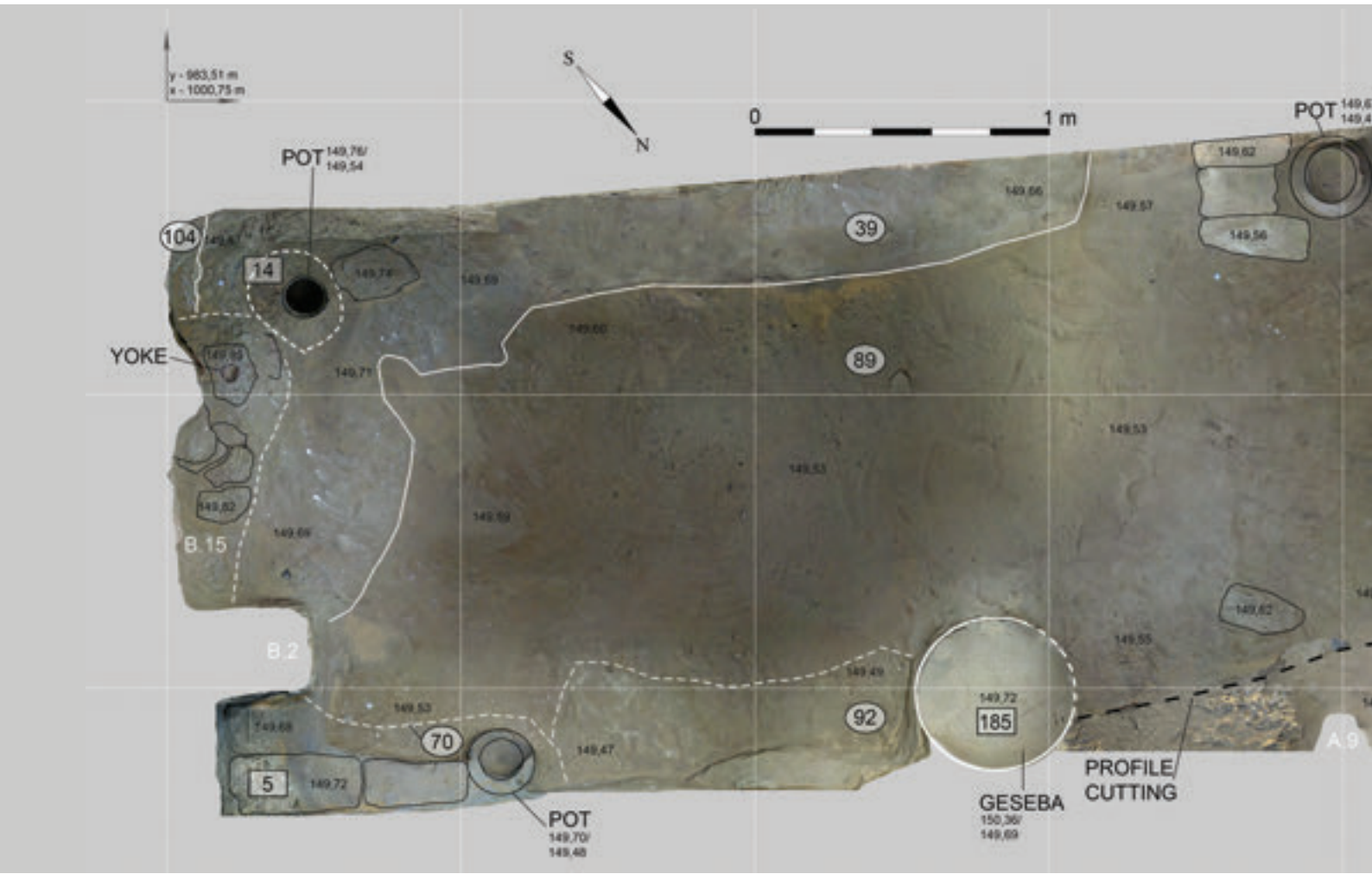


Fig. 46

House A in Phase VIII.
A – layout of walls built
in Phase VIII; other
symbols – see the
legend of Fig. 16.
Drawn by Michał Dzik



the floor, related to the frequent use of the interior, was 2–4 cm thick. During this period, the room was arguably used to prepare meals and as a storage room.

In Area 2, during the accumulation of layer 33b there was a small fireplace (layer 33a; Fig. 7) at the partition (feature 34). However, the room was still used as a latrine. The function of the room in Area 17/19 did not change either.

Changes in the building development, described as Sub-Phase VIIa, were the last significant construction activities recorded within House A. Subsequently, small works were mainly related to raising the thresholds, which resulted from an accumulation of cultural layers.

The beginning of Sub-Phase VIIb is marked by layers 32 and 33 in Areas 1 and 2, the accumulation of which began when the ground level ranged from approximately 150.00 m (northern part of Area 1) to approximately 150.20 m (Area 2). They differed from the older layers by lower cohesiveness, humus content, and a higher proportion of yellow-sand admixture. These changes were also visible in younger layers, characterised by an increasing proportion of aeolian sand. Thus, it seems that they can be read as evidence of a decline in the intensity of use of the interior of the ground floor of House A.

At that time, the level of the thresholds was raised in the door openings connecting the vestibule with Areas 4, 11 and 13 (units 1.A.4, 1.B.4, 1.D.3). Thus, the height of passages to Areas 4 and 13 was reduced to around 1.0 m and 1.15 m, respectively. At the end of this period, due to the accumulation of earth layers, they were approximately 0.8 m and 1.1 m high, respectively. A slight change in the size of the entrance from the street resulted from a significant decrease in the ceiling level of the most recent cultural layer at the passage, by approximately 0.2 m to the rest of the area (layer 26). In the same period, the height of the entrance to Area 2 decreased from about 1.3 m to 0.85 m. At the end of Sub-Phase VIIb, a 0.3 m



Fig. 47
Photo-drawing plan
of Area 11 at the level
of Sub-Phase VIIb
occupation. Prepared
by Michał Dzik

high barrier was erected in front of the entrance, from the side of the street, in a semi-circular plan, probably to protect the interior from blowing sand.

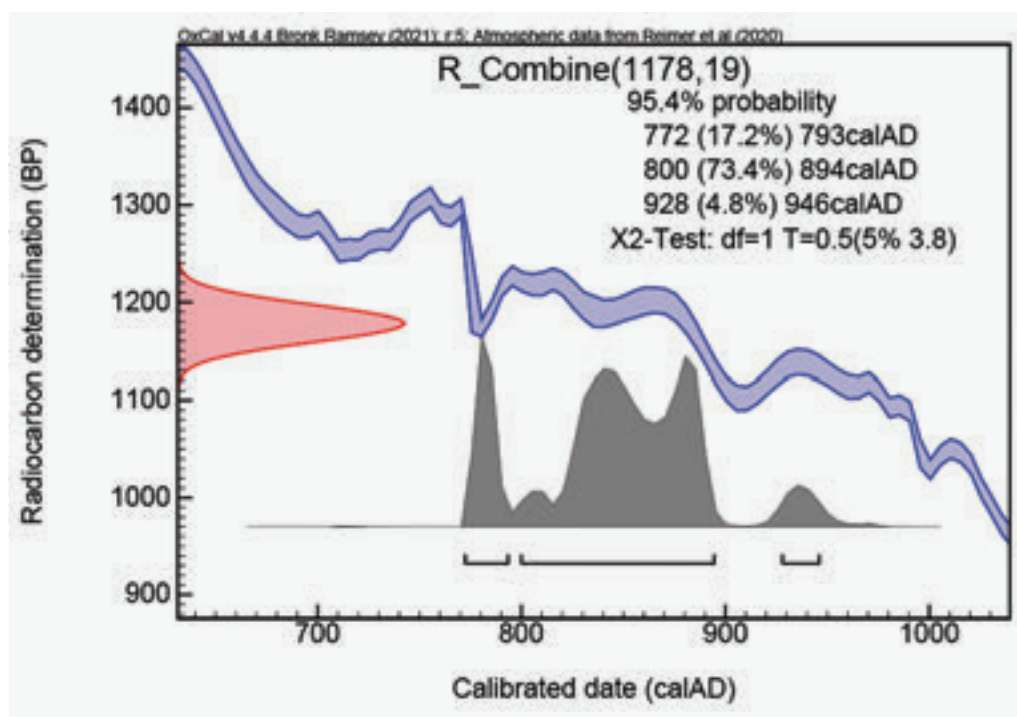
In Area 11, after increasing the level of entry 11.C.2 by about 0.3 m, a brick floor was laid (layer 83d). However, it is essential that it covered only half of the area's surface, at the entrance from the vestibule (**Fig. 47**). This allows us to guess that there was no need or it was impossible to lay the floor in the other part of this space. Indirectly, this conclusion strengthens the hypothesis about the presence in Area 11 of wooden stairs leading to the first floor.

Sub-phase VIIb is associated with layers of yellow aeolian sand in the area, with a slight admixture of brown-grey humus and sparse brown laminations containing goat droppings (layers 28, 28a, 29). At the height of one of these laminations, at the levels of 149.74 m and 149.77 m (8 and 11 cm above the hard mud floor – layer 39), two kitchen pots were placed against wall 4.C. The layers, accumulating mainly against wall 4.B, undoubtedly resulted from sand blowing from the side where the entrance into Area 1 was situated.

In Sub-Phase VIIb, the use of fireplaces was discontinued in Area 4. It is possible that this interior and the one in Area 17/19 were still used as a magazine. Nevertheless, numerous goat droppings in the layers suggest that the room could have been intended primarily for keeping animals. Its low height also speaks for this use. At the end of Phase VII, it was approximately 1.05 m high (measured from the top of layer 28 to the bottom of the vault in the middle of Area 4).

Fig. 48

Single plot of two combined radiocarbon dates from sample Ba-16-P47. Area 5, layer 131, turn of Phases III and IV (prepared using OxCal 4.4; IntCal20 atmospheric curve)



Referring to Area 2 it is worth noting that the brick toilet, used from Phase VI, has survived in its complete state. This is in contrast to the partition separating the latrine pit, where only the bottom part remained. Above it, and a several centimetre layer of brown humus (layer 33), there were remains of another brick partition with a similar course (feature 33). This fact can be interpreted as evidence that the wall was dismantled and then rebuilt. The most likely reason for such an action seems to be the necessity of cleansing the latrine pit. Similar works were undertaken after layers 31 and 103 had accumulated, and the utility level was raised by about 0.15 m, to the level of about 150.35 m (**Fig. 7**). At that time the partition (feature 33) was almost wholly demolished, and in its place another wall was erected, documented as units E.1 and E.2 (**Figs. 5, 41**).

At the beginning of Sub-Phase VIIb, the room's height in Area 2 was about 1.3 m, and at its end – 1.1 m (measured in the centre of the room).

In the latrine pit, eight layers were distinguished, the accumulation of which took place during Phases VI and VII (layers 14b, 145, 160, 165, 165a, 169, 169a). However, while their stratigraphy was clear, there were insufficient grounds to assign them to the distinguished time intervals. The reason is the high probability that the cloaca was cleaned several times, which was associated with the destruction and rebuilding of the brick partition wall.

In the street, in front of the entrance to House A, opening 13.C.2 leading to the neighbouring house was bricked up. This could have happened during or at the end of Sub-Phase VIIb. A wooden beam can be associated with this action, which is at the level of approximately 150.15 m and was laid perpendicular to walls 13.B and 13.D; it was additionally fastened in recess 13.B.4 (**Fig. 11**). It could be the threshold of a small utility room in the southwestern part of the street, with an area of about 1 m².

Inventory number	14C age (BP)	Calendar age (95.4% probability)	Phase	Area	Context	Lab	Remarks
Ba-20-P155	2190 ± 30	368 (95.4%) 165 B.C.		33	F. 172, l. 628	PRL	Charcoal
Ba-20-P154	2120 ± 30	343 (5.9%) 322 B.C. 201 (89.6%) 49 B.C.	Before Phase I	33	F. 172, l. 627	PRL	Charcoal
Ba-20-P157	1230 ± 30	681 (27.7%) 745 A.D. 760 (67.7%) 885 A.D.	I	33	L. 624	PRL	Charcoal
Ba-20-P141	1220 ± 30	687 (17.7%) 743 A.D. 771 (77.8%) 888 A.D.	II	33	L. 592	PRL	Charcoal
Ba-20-P135	1250 ± 30	674 (61.3%) 779 A.D. 785 (26.0%) 837 A.D. 846 (8.1%) 877 A.D.		33	F. 166, l. 594	PRL	Charcoal
Ba-19-P32	1255 ± 30	671 (68.2%) 779 A.D. 786 (21.5%) 834 A.D. 849 (5.8%) 876 A.D.		33	L. 511	PRL	Charcoal
Ba-16-P54	1175 ± 30	772 (78.6%) 900 A.D. 917 (16.8%) 973 A.D.	III	5	L. 140	PRL	Charred date seed
Ba-20-P138	1155 ± 30	772 (9.1%) 791 A.D. 820 (86.4%) 987 A.D.		33	L. 593a	PRL	Charcoal
Ba-20-P136	1130 ± 30	774 (3.0%) 786 A.D. 831 (3.5%) 851 A.D. 875 (88.9%) 994 A.D.		33	L. 593	PRL	Charcoal
Ba-19-P35	1150 ± 30	773 (7.5%) 789 A.D. 824 (88.0%) 988 A.D.		33	L. 300	PRL	Charred seed
Ba-16-P47	1195 ± 30	707 (2.9%) 726 A.D. 771 (88.6%) 895 A.D.		5	L. 131	PRL	Charred twigs
Ba-16-P47	1168 ± 23	772 (14.4%) 793 A.D. 800 (61.5%) 900 A.D. 918 (18.6%) 960 A.D. 966 (1.0%) 972 A.D.		5	L. 131	ADL	
Ba-16-P44	975 ± 60	978 (95.4%) 1217 A.D.		5	L. 131	ADL	Charred palm seed
Ba-16-P38	1185 ± 30	710 (0.2%) 712 A.D. 771 (86.5%) 899 A.D. 919 (8.7%) 957 A.D.	IVb	5	L. 119	PRL	Charred palm seed
Ba-16-P36	910 ± 50	1027 (95.4%) 1224 A.D.		5	L. 118	ADL	Charred seed
Ba-20-P134	1055 ± 30	895 (13.7%) 925 A.D. 949 (81.8%) 1033 A.D.	IV	33	L. 587 (284)	PRL	Charred palm seed
Ba-20-P122	990 ± 30	993 (44.3%) 1053 A.D. 1077 (51.1%) 1155 A.D.		33	L. 587 (284)	PRL	Charcoal
Ba-20-P127	925 ± 30	1033 (91.4%) 1179 A.D. 1190 (26.0%) 1206 A.D.		33	L. 283	PRL	Charcoal
Ba-20-P140	900 ± 30	1042 (34.9%) 1108 A.D. 1116 (60.5%) 1219 A.D.	Vb	7	C. 33.D.1	PRL	Charcoal
Ba-16-P53	995 ± 45	977 (95.4%) 1165 A.D.		5	L. 107	ADL	Charcoal
Ba-16-P57	890 ± 30	1045 (23.1%) 1086 A.D. 1092 (2.8%) 1105 A.D. 1120 (69.6%) 1223 A.D.	V	2	L. 172	PRL	Charcoal
Ba-16-P33	30 ± 1175	.A.D 900 (78.6%) 772 .A.D 973 (16.8%) 917	VI	5	C. 5.A.4	PRL	Charcoal
Ba-19-P28	30 ± 1185	.A.D 712 (0.2%) 710 .A.D 899 (86.5%) 771 .A.D 957 (8.7%) 919	VII	7	L. 241	PRL	Charcoal
Ba-16-P37	60 ± 820	.A.D 1085 (7.7%) 1045 .A.D 1105 (1.2%) 1093 .A.D 1289 (86.6%) 1121	VIII	2	L. 14a	ADL	Charcoal

Abbreviations: c. – context, f. – feature, l. – layer, PRL – Poznań Radiocarbon Laboratory in Poznań, ADL – Absolute Dating Laboratory in Cianowice.

Table 1.

Results of radiocarbon dating of samples from the Banganarti site, House A

Phase VIII

In the parts of House A described above, a layer of yellow aeolian sand was documented above the layers of Sub-Phase VIIb. In Areas 1 and 2, it was 0.1–0.3 m thick (layers 18, 19). It preceded the layers that could be linked to the further use of this space and which were assigned to Phase VIII. A few layers were revealed in Areas 1, 2 and 13, testifying to the further use of the space.

In Area 1, at the level of about 150.60 m to 151.10 m, a brown, moderately cohesive layer was found (layer 2). However, during its accumulation, the former door opening leading to Area 4 was blocked (unit 1.D.4 / 4.B.14). Therefore, the room was finally decommissioned, as was the magazine in Area 17/19.

At the beginning of Phase VIII, the passage between Areas 1 and 2, which was then 0.7 m high, was still in use. The height of the entrance to the vestibule from the street side (Area 13) was similar. Area 1, however, was also accessible from Area 11, i.e. from the upper storey, and it is rather this communication route that may be related to further use of the space in Areas 1 and 2.

In Area 2, a new brick toilet was erected (feature 30). This was when the ground level was about 150.55 m, and the height of the room was about 0.95 m. The toilet was placed at walls 2.E.1 and 2.E.2. It was made of dried and fired bricks and a stone *spolium* (quern), without mortar. With its semicircular shape, it roughly duplicated the extent of the older toilet (feature 34; **Fig. 41**). Layers 14, 14c and 19 were associated with its use (**Fig. 7**). The last two are layers of soot and ash, which are traces of a fire. Initially, it took place in the northern corner of the latrine (layer 19), then at the partition wall (layer 14c).

The brick toilet in Area 2 was used until the maximum height of the latrine was about 0.8 m. Then the way of using this vaulted interior was changed. It can be assumed with high probability that from that time the toilet room functioned above the vault, and the toilet was above the western corner of area 2. This is indicated by the following evidence:

- a) Latrine layers nos. 6a and 14a, which covered the last brick toilet (feature 30), filled the whole surface of Area 2.
- b) At the base of layer 6, containing rubble of a partially destroyed vault, in the western corner of the area, there was a broken ceramic toilet at the level of 151.20–151.25 m. The arrangement of its fragments indicates that they were in the place of their discovery due to a collapse of a part of the vault and the floor of an upper storey.
- c) Sediment, analogous to the one covering the inner body of ceramic toilets, was on the walls of the west corner of Area 2, to the level of the vault.

At the end of Phase VIII, in the middle of Area 1, wall 1.E.1 was built – 0.36 m thick and up to 0.6 m high (**Fig. 46**). It was placed 5–10 cm below the top of layer 2, partially blocking the door opening in wall 1.B.

The cessation of the use of the ground floor of House A was not therefore tantamount to the abandonment of the house itself. It continued to function, but only at the level of the first floor (**Fig. 46**). Unfortunately, the walls and floor layers above the ground-floor vaults have hardly survived, so little can be said about the layout and size of the house at that time. In Area 13, i.e. in the street that once led to House A, the last layer that can be linked to the functioning of the settlement

Name	(Unmodelled (AD			(Modelled (AD			,Indices Amodel = 101.4 Aoverall = 100.6	
	From	To	%	From	To	%	A	C
Boundary Start	–	–	–	581	866	95.4	–	97.8
Phase I								
Ba-20-P157	681	885	95.4	683	860	95.4	100.4	99.3
Boundary I–II	–	–	–	707	870	95.4	–	99.4
Phase II								
Ba-20-P141	687	888	95.4	729	885	95.4	113.7	99.7
Ba-20-P135	674	877	95.4	723	882	95.4	76.1	99.7
Ba-19-P32	671	876	95.4	721	881	95.4	65.4	99.8
Boundary II–III	–	–	–	789	949	95.4	–	99.7
Phase III								
Ba-20-P138	772	987	95.4	836	977	95.4	109	99.8
Ba-20-P136	774	994	95.4	873	990	95.4	107.1	99.9
Ba-19-P35	773	988	95.4	835	979	95.4	111.1	99.7
Boundary III–IV	–	–	–	894	1024	95.4	–	99.7
Phase IV								
Ba-20-P134	895	1033	95.4	965	1035	95.4	119.7	99.9
Ba-20-P122	993	1155	95.4	990	1113	95.4	109	99.9
Boundary IV–V	–	–	–	993	1107	95.4	–	99.8
Phase V								
Ba-20-P127	1033	1206	95.4	1030	1168	95.4	106.2	99.6
Boundary End	–	–	–	1031	1300	95.4	–	97.6

Table 2.

Calibrated radiocarbon dates and Bayesian modelled dates, analysed in OxCal 4.4.

was exposed at a level of approximately 150.90 m (layer 7; **Fig. 11**). Above, as in other areas, there was only aeolian sand mixed with brick rubble.

Dating of Building Phases of House A in the Light of Radiocarbon Analyses

The results of radiocarbon analyses were obtained for 24 samples from the stratification of House A (Table 1).⁴ Whenever possible, charred seeds, grasses, and branches were collected for these studies. Theoretically, they give the best chance that the results obtained will correspond to the formation period of the layers in which they were discovered. Unfortunately, numerous samples of animal bones submitted for analysis turned out to be useless for dating, owing to the washing away of the collagen.

Most of the samples were taken from Areas 5 and 33, because in these areas the vertical and horizontal stratification was most widely recognised. It was also assumed that obtaining more analyses from a single room would allow better use of information from the stratigraphy to determine the correct sequence of samples. In

⁴ The analyses were performed at the Absolute Dating Laboratory in Cianowice and the Poznań Radiocarbon Laboratory in Poznań.

addition, this procedure reduces the risk of error resulting from a possibly incorrect correlation of layers from several rooms.

The results of radiocarbon analysis were obtained for two samples from the pre-Phase I layers. They came from layers 627 and 628, which were the fill of feature 172, found in Area 33. The results obtained allow the feature to be dated to the fourth–third centuries B.C. However, such a chronology should be approached with caution, as it cannot be ruled out that the charcoal recovered came from older layers cut by this pit, even from the level of about 146.33 m. Feature 172 may, therefore, be younger. Nevertheless, considering that in its immediate vicinity, a posthole was discovered, dug from the level of 146.23 m (feature 183), it can be assumed that traces of human activity extending at least from the third century B.C. are confirmed for this site.

One sample was taken from Phase I, from the large fireplace found at the level of the oldest layers that can be associated with the Christian period (Area 33, layer 624). This sample was included in the model presented below, based on which it is dated to the years 683–860. This result is in line with the chronology of the ceramics recovered from the layers and features of Phase I, established by Aneta Cedro. The material from layer 624 was dated to the eighth and ninth centuries; from slightly later features nos. 176, 177 and 181 – to the seventh and eighth centuries; and from the youngest layers of Phase I – to the period from the turn of the eighth and ninth century to the end of the ninth century (layer 607). On these grounds, it can be assumed that the *terminus a quo* of human activity during the Christian period in the areas examined falls in the eighth century.

Seven samples were taken from the Phase II layers. One of them came from layer 140, accumulated around one of the ovens used in the northwestern part of Area 5. The others were collected in Area 33. As their stratigraphic position was unequivocally defined, in order to narrow down the dating, a model of the chronology of the stratification of Area 33 was made, based on Bayesian statistics (Table 2).⁵ The modelling also used the results of analyses of samples from other phases, starting with the sample from layer 624 (Ba-20-P157) described above. The sample obtained from the bottom of the cultural layer 592 (Ba-20-P141) comes from the oldest period of use of the building in Area 33, i.e. from Phase II of House A. The charcoal samples from fireplaces are stratigraphically slightly younger – layers 511, 594 (Ba-19-P32, Ba-20-P135). The next three come from Phase III, in which the room was slightly reconstructed. One was taken from the mud layer which formed the floor (layer 593a; Ba-20-P138), and two from the accumulated cultural layers, nos. 593 and 300 (Ba-19-P35, Ba-20-P136). The next two samples, including the seeds, come from Phase III, from the intense layer of burning, no. 284, interpreted as the probable residue after burning the organic material stored in the room, including cereal straw (Ba-20-P122, Ba-20-P134). It is combined with Phase IV of House A. Finally, one sample was taken from the

⁵ BRONK RAMSEY 2009. Statistical analyses were made using OxCal software, version 4.4, with the use of atmospheric curve IntCal20 (REIMER et al. 2020).

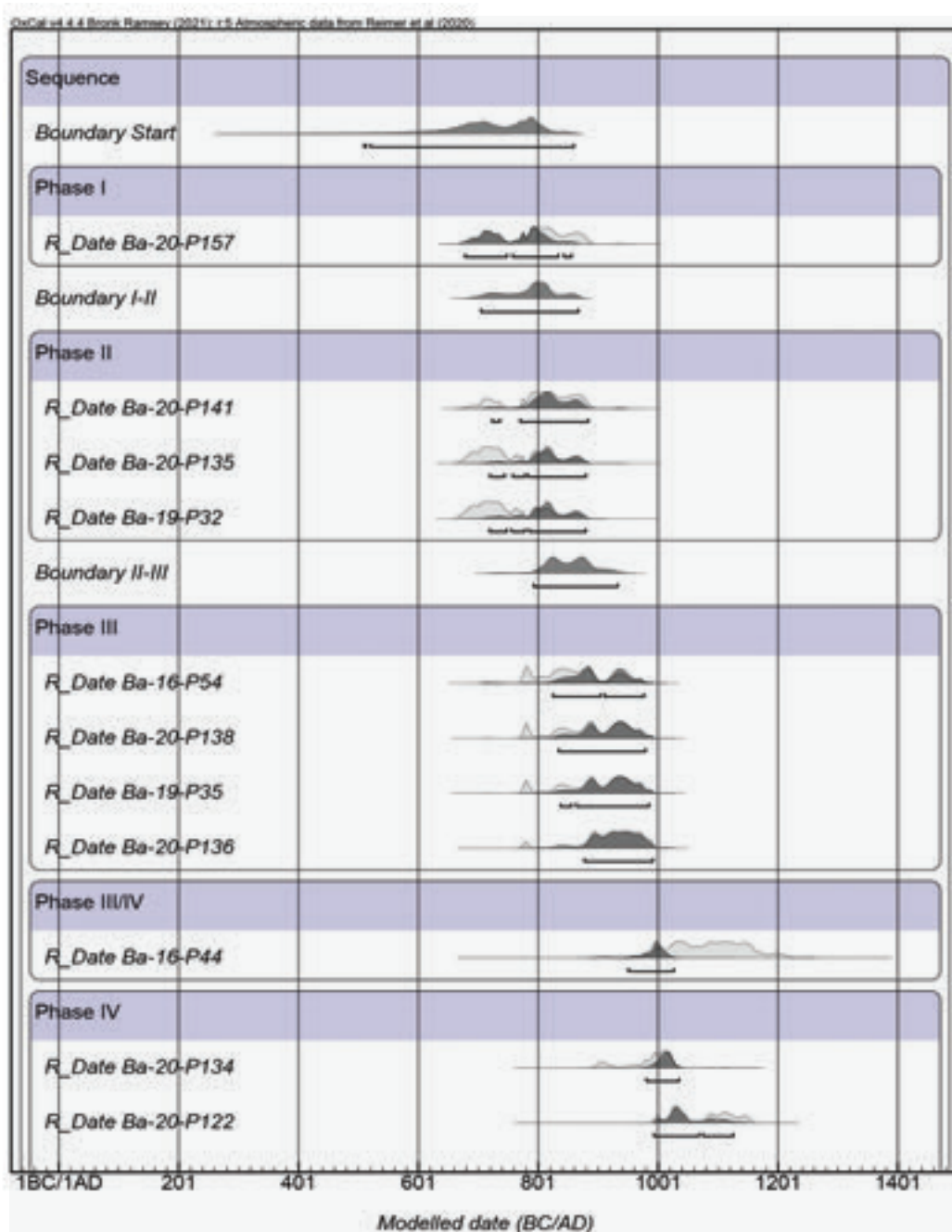


Fig. 49a
Statistical model of the chronological sequence of calibrated dates of samples from Phases I–V and VIII (prepared using OxCal 4.4; IntCal20 atmospheric curve)

garbage(?) layer 283, associated with the last stage of using the vaulted room (Ba-20-P127). This layer could have accumulated in Phase IV or Phase V.

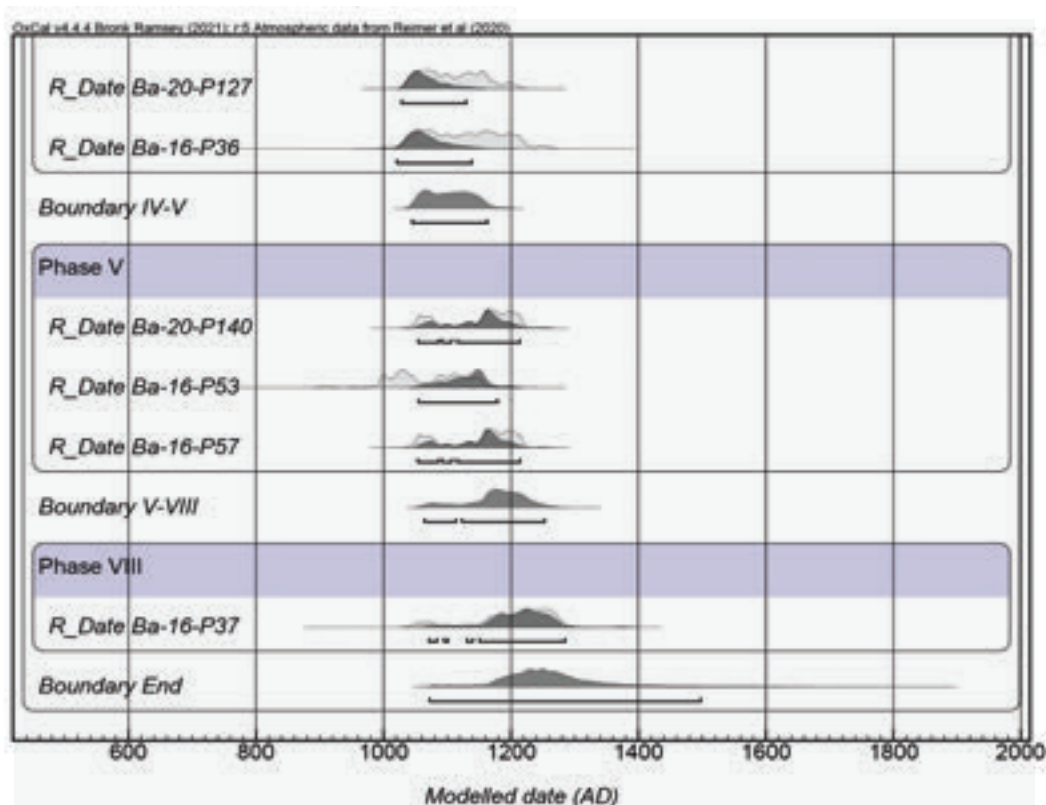
The samples were sequenced based on their stratigraphic position. As a result, the model obtained is characterised by high coefficient compliance (Table 1). This allows us to treat the dating sequence from Area 33 as a reliable basis for establishing the chronology of the layers themselves and the oldest phases of House A.

The range of modelled dates from the lifetime of the room in Area 33 is very wide, as it covers 579 years (721–1300). Nevertheless, the results obtained allow us to slightly narrow down the probable time of the use of this interior space.

Dating the three samples from Phase II allows us to hypothesise that the vaulted room was constructed between the second quarter of the eighth and

Fig. 49b

Statistical model of the chronological sequence of calibrated dates of samples from Phases I–V and VIII (prepared using OxCal 4.4; IntCal20 atmospheric curve)



the third quarter of the ninth centuries. The results obtained do not make it possible to narrow down this chronology, but this can be accomplished thanks to the dating mentioned above of the ceramic material from the youngest layer of Phase I (layer 607, eighth/ninth–ninth centuries). Based on both premises, the most likely time for the building to have been constructed is between the first and third quarter of the ninth century.

The reconstruction marking the beginning of Phase III could have taken place in the ninth century or in the first half of the tenth century. All three samples from Phase III indicate the last quarter of the tenth century as the *terminus ad quem* for this stage of use of the room.

Analyses of the two samples from layer 587 (284), presumably the remains of a short-term event, yielded slightly different results (Ba-20-P122, Ba-20-P134). The Ba-20-P122 sample obtained from the top of the layer was stratigraphically younger. Their dating ranges overlap in the years 992–1035. Therefore, the period from the end of the tenth century to the first third of the eleventh century is the most likely time of the formation of the layer. According to the dating of the youngest sample, the end of the use of the room occurred at the earliest in the second quarter of the eleventh century and at the latest in the second half of the twelfth century. Summing up, the vaulted room in Area 33 was used for a minimum of about 175 years and a maximum of about 400 years.

From the turn of Phases III and IV come two samples taken from layer 131 – brown humus mixed with black ash, with grey ash lenses. It was related to the next stage of using ovens in the northwestern part of Area 5 and the end of the use of wall 5.F. Two analyses were performed on one of the samples from this

Phase	Beginning (A.D.)	End (A.D.)
I	Eighth century	First-third quarters of ninth century
II	First-third quarters of ninth century	From second half of ninth century to first half of tenth century
III	From second half of ninth century to first half of tenth century	Second half of tenth century
IV	Second half of tenth century	From middle of eleventh century to end of eleventh century
V	From middle of eleventh century to end of eleventh century	From first half of twelfth century to first quarter of thirteenth century
VI–VIII	From first half of twelfth century to first quarter of thirteenth century	Fourth quarter of thirteenth century

Table 3.
Dating of House A

layer to be combined before calibration (Ba-16-P44; **Fig. 48**). It is noteworthy that this result differs significantly from the dating of the second sample from this layer, taken from the charred palm seed (Ba-16-P44). When both samples were combined in the chronological sequence model of House A (see below), the date agreement ratio of the older sample was only 23.2%, and for the whole model – 57.9%. Thus, while there are no grounds for undermining the stratigraphic position of the Ba-16-P44 sample, it is possible that the Ba-16-P47 sample ended up in a secondary context. This is because a pit was exposed directly under layer 131 in section 5.C (feature 191). It cut, among others, layer 140 from which the sample – Ba-16-P54 – came that gave similar results to Ba-16-P47.

It seems that the problem of radiocarbon dates appearing to be too early also applies to the three samples from the younger layers: Ba-16-P44, Ba-16-P33, Ba-19-P28. In each of these cases, the result ranged from 1175–1185 ± 30 BP, indicating the ninth century as the most probable time of their origin (Table 1). These dates deviate from the permissible chronology of the contexts from which they originate, especially as regards Phases VI and VII. The sample from Phase VI came from the filling of the groin of the barrel vault in Area 5 (unit 5.A.4). However, there was ceramic material from the Post-Classic Christian Period in the layers that accumulated after it was erected. Fragments of the similarly dated vessels were also found in the fireplace from Phase VII, in Area 7 (layer 241), from which radiocarbon analysis also gave a surprisingly early result. Due to the high probability of a significant chronological difference between the four samples mentioned above and the strata they came from, they were omitted from the statistical model of the chronological sequence of House A.

In the model constructed, the basis for ordering dates within the phases distinguished was the stratigraphic position of the contexts from which the samples came (**Fig. 49**). Archaeological evidence shows that the phases followed one another. If there was an interruption in the use of the house, it was between Phases VII and VIII, and it was relatively short. Therefore, the model reflects the assumption that the phases were contiguous. The modelling of dates for the whole of House A does not change the conclusions drawn regarding the chronology of Phases I–III, based on the analyses of samples from Area 33. Dating the samples

of Phases III and IV allows us to assume that the beginning of the latter phase occurred in the second half of the tenth century. It ended at the earliest around the middle of the eleventh century. Two stratigraphic arguments suggest a relatively long duration for this phase. The first one is that there were several episodes of rebuilding at different times, which became the basis for distinguishing the three sub-phases. The second is the relative thickness of the cultural layers from Phase IV, amounting to approximately 0.5 m in Areas 4 and 5. The total thickness of the analogous layers of Phases II and III was 1.0–1.1 m, and they accumulated for 100–200 years. Taking this as a basis and being fully aware of the limitations of such reasoning, it can be assumed that Phase IV lasted several dozen years, but rather not longer than a century.

For this reason, it seems unlikely that the beginning of Phase V would have been later than the turn of the eleventh and twelfth centuries. Stratigraphically the youngest sample from Phase IV came from layer 118, with a high ash content, related to the hearth used in the northwestern part of Area 5 (feature 49; Ba-16-P36). The dating of this sample covers the period from the twenties of the eleventh century to the thirties of the twelfth century.

Phase V samples came from the following contexts: wall 33.D.1 (Ba-20-P140) erected at the beginning of Sub-Phase Vb; a fire layer, no. 107, in a small room in the northwestern part of Area 5 (Ba-16-P53); a cultural layer, no. 172, in Area 2 (Ba-16-P57). The thickness of the accumulated cultural layers from Phase V was slightly less than in Phase IV. Therefore, it can be assumed that Phase V lasted several dozen years, at least. The dating of the samples indicates that the *terminus ad quem* of the phase was in the first quarter of the thirteenth century. However, it is more likely that it ended in the twelfth century.

Due to the lack of reliable dating from Phases VI and VII, construction and the associated layers from this period can be generally associated with the period from the twelfth century onwards. The youngest sample analysed comes from the latrine layer, no. 14a, which accumulated in Phase VIII. This allows the phase to be dated to the fourth quarter of the thirteenth century at the latest. Based on this result, it can be assumed, in the first instance, that the end of Phase VII was no later than the third quarter of the thirteenth century. A summary of the chronology of phases I–VIII is presented in Table 3.

CONCLUSIONS

The research, including stratigraphic analysis, allowed us to distinguish eight phases. Thus, including sub-phases, there are 12 stages of development in the area defined as House A. Concerning the oldest five stages (Phases I–IV), the layout of buildings and stratification have been only partially understood due to the limited range of exploration in the southeastern part of the site. Nevertheless, these studies seem to give rise to several conclusions relevant to our knowledge of the history of the Banganarti dwellings.

First of all, it can be hypothesised that during at least 500 years of development of the northeastern part of the Banganarti settlement, some elements of the original layout, both of the settlement and the houses, have remained (**Fig. 50**). In

the case of House A, the layout of the walls from the ninth century influenced the location, orientation and (partly) the size of the rooms up to the thirteenth century. This happened even though the detailed plan of the house changed several times, and quite significantly.

It seems that throughout this period, the main point of reference for the layout of House A was a large living room located in the northwestern part of the dwelling (Areas 33 and 7). Other, smaller rooms were added to it on the southeastern side.

Initially, in Phase II, the house consisted of two rooms – one covered with a barrel vault and the other with a flat roof – and a kitchen space surrounded by a light partition (fence) and possibly also roofed. Thus, it seems that it was a three-room development of the concept of a house referred to in the literature as a ‘double house’,⁶ typical of Early Christian Nubia.⁷

Perhaps the most significant change in the layout of House A took place in Phase VI, when the courtyard was filled. At that time, a building, perhaps of two storeys and divided into three alignments at ground level, was erected. The middle alignment consisted of three rooms perpendicular to the largest one in Area 7. This solution is characteristic of the so-called Type I of ‘unit houses’ characteristic of the Classic Christian period.⁸ However, these were usually smaller, double-alignment houses, in contrast to the more elaborate House A from Banganarti.

In Phase VI, the entrance from the street to the vestibule (Area 1) on the house’s ground floor was still the main entrance to the dwelling. In Phase VII, along with the rise of the ground level in and around the house, the ground floor began to consist of additional basement utility rooms for the house, the living quarters of which – currently not preserved – were on the first floor. It is possible that the main entrance to the house was located in a different place at that time.

Considering the features of the cultural layers of Phase VIII, it can be hypothesised that there was a decrease in the intensity of settlement in Banganarti at that time. In the light of radiocarbon analyses carried out for House A, it seems that it can be dated to the second half of the thirteenth century. Therefore, it is possible that in this century, House A was abandoned. However, this does not mean that the area was completely uninhabited. Within the neighbouring House B, traces were uncovered indicating that the buildings were still inhabited, but at that time functioned as a temporary shelter rather than a permanent dwelling. They will be described elsewhere.

This research, thanks to the use of the stratigraphic method and a relatively large number of radiocarbon analyses, provides a new basis for the verification of the relative chronology of changes in material culture and the economy. As a result of excavation, nearly 30,000 pottery sherds, over 9,000 ecofacts (mainly animal bones) and 941 other items, including stone tools, ceramics, glass and metal objects, have been obtained.

Significant for studying the history of settlement in the area is the documenting – for the first time at Banganarti – of strata that can be interpreted as traces

Fig. 50

House A, the layout of walls from Phases I–VIII. Drawn by Michał Dzik.

LEGEND TO FIGURES

- phase I
- phase II
- phase III
- sub-phase IVa
- sub-phase IVb
- sub-phase Va
- sub-phase Vb
- sub-phase Vc
- phase VI
- phase VII
- phase VIII
- 517 - layer
- 90 - feature
- 147,33 - level (in meters)
- 147,33/ - level of top and bottom
- 147,21 of feature or artefact (m)

⁶ HAJNÓCZI 1974: 349.

⁷ ANDERSON 1996: 18.

⁸ ANDERSON 1996: 61–62, pl. 129.



of multiple floods.⁹ Given the site's locality, it is reasonable to suppose that they were caused by the floods of the Nile. Moreover, in the light of stratigraphic analysis, it can be assumed that they took place until Phase III of House A; that is, – as the results of radiocarbon dating suggest – until the tenth century, or only to the first half of this century. It is worth noting that this coincides with observations at other sites in the Nile Valley in Nubia.¹⁰ Considering the importance of climatic phenomena for economic and social development, an important future task seems to be to clarify the chronology of observed environmental changes.

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⁹ The presence of such layers within House A had been signalled in DZIK 2017: 299.

¹⁰ E.g. GARDBERG 1970: 15; ANDERSON 1996: 19–20 – further literature there.

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Pottery in Its Domestic Context: Use of Ceramic Vessels in the Medieval Houses of Banganarti

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Abstract:

This paper presents ceramics excavated from the medieval dwellings of Banganarti, dating from the sixth/seventh to the fourteenth century. The analyses focused on the functional aspects of the earthenware, with particular emphasis on the technological variables of the pottery and their relationship to its use. More than 100,000 fragments and complete vessels collected during four years of excavations prove that ceramics was an essential part of daily life in the settlement, necessary for almost all food-related activities, such as storage, cooking, serving and eating, but also for hygienic activities and agriculture.

Keywords: medieval Nubia, Banganarti, pottery function, cooking pots, storage vessels, tableware

Introduction

Pottery is the most common find on every medieval Nubian settlement site, and Banganarti is no exception to this rule. Ceramics dominate by far other artefact groups. The first excavations 20 years ago (February 2001) in the central part of the *kom* brought to light the monumental architecture of the upper church, the so-called Raphaelion, but delivered a relatively modest amount of pottery. A few seasons later, only when the excavations shifted more to the surrounding residential buildings and fortifications was the actual volume of pottery concealed at the site revealed. Each following season has delivered from several to tens of thousands of potsherds. Unfortunately, no comprehensive study of this material has yet been presented, and only a small quantity of ceramics studied and published, mostly in report form.¹ Such assessment can only be made now, after 20 years of research.

During these years at Banganarti, several collection procedures were implemented by the ceramologists and other specialists working with ceramics in the field.² This creates a particular challenge when trying to take a holistic view of the pottery from areas excavated so far and makes statistical analysis of material distribution within the site quite tricky. Therefore, this chapter does not attempt to present an overall view of Banganarti pottery³ but instead concentrates on selected well-stratified material collected during the most recent seasons. However, when required, better preserved and/or better-contextualised examples from early seasons are included, as they unquestionably provide additional data and complement issues discussed.

The ceramic assemblage presented and discussed in this chapter results from research conducted at Banganarti between 2017 and 2020 within the project *Archangels and Locusts: Everyday Life in Banganarti, the Pilgrimage Centre on the Middle Nile between the Sixth and the Sixteenth Century*. Its main objective is to reconstruct the daily life of the medieval Nubian community formed in Banganarti by the local inhabitants and pilgrims. One main research subject focuses on dietary habits, food-preparation methodology and consumption when pottery played a crucial role. Having this goal in mind, this paper aims to concentrate on the functional aspects of Banganarti ceramics rather than typological analyses.

Several areas were excavated over the four project seasons at Banganarti, although archaeological excavation started earlier in most. Analysed pottery came from a few trenches located across the site, including occupational quarters with domestic houses, residential buildings, streets, and trial pits in the vicinity of the enclosure wall. The majority were recovered in the longest-excavated trench, continuously exposed since 2015 in the northeastern domestic quarter (Sector NECH).⁴ Its architectural remains created a dense mesh of mud-brick houses and streets resulting from subsequent re-buildings and occupation phases spanning the sixth/seventh–fourteenth centuries. The spaces (= Areas) within this sector are numbered at the level of the upper plan revealed after removing the topmost sand layer (see **Fig. 1**, p. 111). This division

1 PHILLIPS 2003; BĄGIŃSKA 2008.

2 During early excavation seasons at Banganarti, archaeologists collected, described and selected potsherds on site following various criteria of which fragments to keep and discard.

3 In-depth analysis of the pottery at Banganarti is planned as a separate volume in the Banganarti monograph series.

4 Cf. DZIK 2017.

became the basis for further excavation, documentation and description of find locations, including pottery. However, room layouts, relationships, and functions changed over several centuries of occupation.⁵ Archaeological excavation was conducted in each area separately, following stratigraphic layers. Work in some areas had to stop at different levels for logistical and safety reasons, although a few reached the virgin layer of yellow sand below traces of medieval occupation (Sector NECH, Areas 4–5, 7/33, 29/30 and 45). These areas are of particular value, providing material for creating a complete sequence of ceramics spanning the oldest periods of the Banganarti settlement through its decline.

Ceramic Assemblage and Methodology

Over the four seasons of the *Archangels and Locusts project*, archaeological excavation within the Banganarti settlement produced over 100,000 potsherds (**Table 1**), the general impression being almost exclusively of local origin. The small amount of imported vessels is quite striking, especially considering that Banganarti was a flourishing religious centre visited for centuries by numerous pilgrims, even from remote areas. Significant pottery groups were identified as products of workshops operating in the nearby capital of the Kingdom of Makuria, Old Dongola. However, pottery kilns discovered there were only partly excavated.⁶ So provenance identification was possible only for the material from limited periods, mostly dated to the Early Christian (sixth/seventh–first half of ninth centuries) and Post-Classic Christian (twelfth century) periods. About a third of the assemblage was hand-made, likely associated with very local household production. Although no pottery workshops or kilns have been found so far at Banganarti, ethnographic examples⁷ show house production could leave very few traces and does not require permanent structures for firing. On the other hand, pottery wasters (vessels misfired or damaged during firing) of some ceramic types, such as the *qawadis* discovered at Banganarti (see **Pl. 20**, BNG-17-107), signify production within the site or in its close vicinity.

The ceramic assemblage contains potsherds in a diverse degree of fragmentation, mainly depending on the character of their deposition layer. The tiniest fragments were primarily collected from strata associated with streets, while the best-preserved came from refuse dumps and subsurface layers. As a result, complete vessels are relatively rare, although a few to a dozen were discovered each season. The majority are hand-made globular pots. An exceptional discovery is a set of over 40 complete pots found sealed under the layer of aeolian sand in one space (Area 43) of Sector NECH in 2019, a rare opportunity to view the arrangement of different vessels in their original context.

Table 1

Number of potsherds and complete vessels collected and analysed by project season

Season	2017	2018	2019	2020	TOTAL
Sherds	20,041	35,784	27,448	17,249	100522
Complete vessels	8	14	55	8	85

⁵ See Michał Dzik's chapter in this volume for the exploration of Sector NECH, pp.109-184.

⁶ PLUSKOTA 1991; 2001.

⁷ Cf. CEDRO, ŻURAWSKI 2019.

While each potsherd carries some information value and none should be omitted during excavation, unquestionably, most fragments will not provide as much information as complete vessels, especially those found *in situ*. This is even more valid for issues concerning functional aspects of ceramics and the reconstruction of daily life. These two ceramic groups deliver data of various quality and potential and require a different approach.

The pottery processing system conducted at Banganarti follows a unified system ironed out at the beginning of the project. The methodology is mainly based on general standard procedures proposed by Anna Shepard⁸ and advanced by Clive Orton, Paul Tyers and Alan Vince,⁹ and Prudence Rice,¹⁰ adjusted to the specific ceramic material of a medieval Nubian settlement.

The working mode is divided into two stages: preliminary processing executed on site and detailed analysis of selected pottery sent to the workroom.

All excavated potsherds were collected and washed on site. Their initial quantification was done by sorting fragments into groups based on technological and morphological features and counting all fragments by type and estimated number of vessels (EVrep). Since most trench excavations used a context-based recording system, each pottery group relating to one stratigraphic unit was kept and analysed separately. However, total quantification, including estimated vessel numbers represented (EVrep) and counting by type, could not be applied to trenches excavated by arbitrary level (Sector SECH), and only a primary count of three main technological groups was done. The initial quantification process included estimations of potsherds chronology and indirect dating of the strata from which they came.

Diagnostic sherds (rims, bases, handles, fine wares and foreign wares) were selected in the second stage of pottery analysis and sent for further study. Some representative potsherd groups from this assemblage underwent detailed documentation, including photography, drawing and fabric description. Additionally, complete vessels were documented directly on site during excavation.

Pottery Functions in the Household

The ubiquity of potsherds collected at Banganarti indicates the significance of ceramic objects in the everyday life of Nubian households. It is generally accepted that fired clay is incomparably longer-lasting than any other (e.g. organic) material, and in this respect it can be compared only with stone. Medieval house furnishing undoubtedly consisted of many elements of perishable materials, such as palm-leaf baskets, gourds and leather. However, it was clay that was most commonly utilised to produce the essential equipment of Nubian daily life.

One main advantage of ceramics over other materials is its flexibility, manifested on several levels and starting with the preparation of the paste that can be altered in many ways by mixing clay with different additives to obtain desired properties in the final product. A range of manufacturing techniques and surface treatments also influences the functional performance and other fired vessel

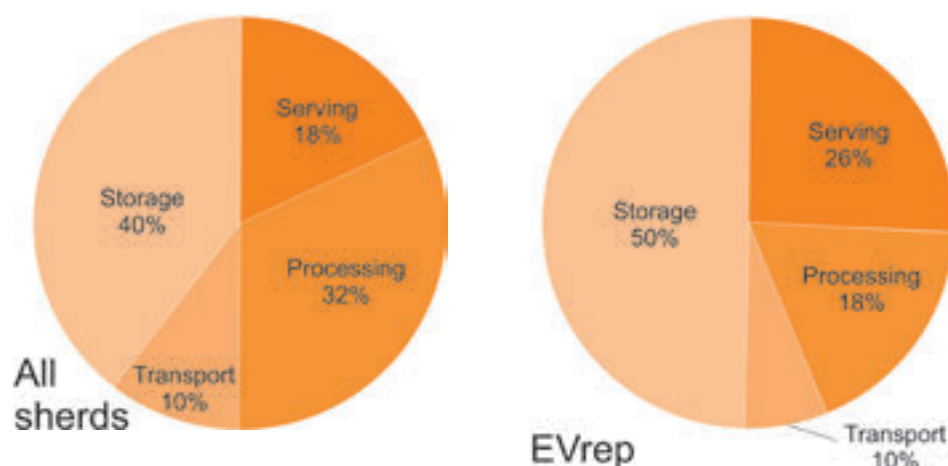
⁸ SHEPARD 1976.

⁹ ORTON, TYERS, VINCE 1993.

¹⁰ RICE 2015.

Fig. 1

Percentage distribution of potsherds in functional groups, based on actual total fragment counts (left), and estimates of vessels represented (right)



characteristics. Clay paste also can be formed into an endless variety of shapes and sizes. Potters can choose from all these options to create vessels best suited to their particular intended function.¹¹ Furthermore, possible uses for ceramic vessels are far more varied and adaptable than containers made of organic materials or stone. The most significant disadvantage of pottery, its brittleness, is recompensed by the cheap materials and relatively fast manufacturing process. This is particularly relevant in the Nile valley, where alluvial silt is virtually unlimited and easily accessible anywhere in the floodplain. Additional clay sources are deposits in the desert and desert margins of the river valley,¹² usually easily obtained not far from the settlements. All these arguments make ceramics an ideal material for the needs of the inhabitants of Banganarti.

Pottery can function simultaneously on several levels in any given community, such as utilitarian, economic and ceremonial.¹³ In this chapter, I will not analyse its symbolic functions, often intangible centuries later, but, following David Braun's¹⁴ apt observation that 'pots are tools', will focus instead on use-related functions most relevant to the primarily domestic contexts of pottery at Banaganarti.

Clay was utilised to manufacture many items to meet various medieval Nubian needs, but its main application was to produce pottery vessels. Apart from some 'technical' uses for ceramics (separately discussed in the last paragraph of this chapter), their functionality most broadly relates to food and can be limited to several general categories: storage, processing, transport, and serving. Vessels are given specific features already during production in order to perform these roles best. Potters' choices, from raw-material preparation to forming the shape, size, and surface finish, are determined by the final product's intended use. So, the planned function of a vessel affects its final form and other variables in several ways.¹⁵ Pottery analysis to determine function is, in a way, a reversal of the manufacturing process. The particular recorded variables of the finished vessel lead to confident technological choices by the potter and result from its intended use and design. However, it must be remembered that pots can be designed to be multifunctional¹⁶ and fulfil multiple roles over

¹¹ SKIBO 2013: 27–28.

¹² ADAMS 1986: 26.

¹³ SOLHEIM 1965.

¹⁴ BRAUN 1983.

¹⁵ SINOPOLI 1991: 84–85.

¹⁶ SKIBO 2013: 4.



Fig. 2
Traces of organic
containers discovered
in Sector NECH, Area 20:
(left) wooden object,
(right) possible basket.
Photos by Michał Dzik

their lifetime. There are many confirmations of vessel reuse and even recycling of their fragments in the Banganarti ceramic assemblage, and also examples where actual vessel use does not correspond to the intended function. Determination of the actual utilisation is possible through observation of use-alteration traces on pottery. James Skibo¹⁷ distinguishes three types: residue, sooting/carbonisation, and attrition. Analysis of such traces, sometimes needing professional laboratory examination, can provide a basis for identifying the actual vessel functions.

This pottery functional analysis at Banganarti is based mainly on vessel morphological and technological variabilities, the interpretative framework being delimited by the context of medieval Nubian society and our knowledge of it. It should be stressed,

¹⁷ SKIBO 2013.

therefore, that the results presented below are still hypothetical, needing further science-based analyses to resolve questions of the actual use of vessels.

In the following sections of this chapter, the Banganarti ceramics are discussed within the main functional groups mentioned above – storage, processing, transfer, and serving (**Fig. 1**). Vessels were assigned to a given group mainly based on their morphology and technological variabilities, and therefore this division relates primarily to their intended functions. However, actual or secondary pottery use also is expounded where such identification was possible.

STORAGE

Food storage is a vital component of economic and social life in all cultures, at all times, and in all places.¹⁸ For agrarian communities such as in Nubia, dependant on the seasonality of crops harvested only once or twice a year, the possibility of stockpiling food to use gradually throughout the year was essential for society to function. Therefore, one can find special constructions at Banganarti created for storing large amounts of supplies, mainly grain.

It was essential to keep a more significant amount of food products to hand on a smaller household scale. Ethnographic data on Nubian traditions indicates that some dry products could be stored in containers made of organic materials, such as gourds, wood, and baskets. Remnants of such objects are recorded archaeologically in Nubian settlements¹⁹ but, unfortunately, at Banganarti only traces of such objects are recorded (**Fig. 2**).

On the other hand, ceramic storage containers are present among the finds in great quantity, including complete and *in situ* vessels. Among the Banganarti ceramic assemblage, 40–50% of potsherds belong to the storage category (see **Fig. 1**). These vessels are highly diverse and may differ in paste composition and manufacturing technology as well as primary and secondary formal characteristics. Variables depend mainly on their intended contents (liquid or dry) and long- or short-term storage duration.²⁰ At one end are examples of large containers – *qussība*, crudely made of unfired clay, thick-walled and in a simple cylindrical shape – and, at the other, small, elaborately decorated wheel-made bottles of fine clay.

Both hand-made and wheel-made vessels were produced for storage. Also, after having cracked or otherwise worn out, many pots of diverse intended functions found secondary uses as containers for various things. Ethnographic studies recording the life cycle of pottery confirm that often, after having been broken, a pot can still be kept where it was initially used. Usually, in a kitchen or storeroom or outside a house in areas adjacent to walls or structures it was reused with a new function.²¹ An illustrative example of such practice at Banganarti is recorded in Area 5 of Sector NECH, where 16 pots – the majority used initially for cooking, confirmed by traces of soot – were left on the floor or set in specially prepared hollows. Pots are recorded at different levels, indicating their installation

18 HALPERIN 1994: 169–190.

19 Cf. ADAMS 2002: pls. 25d, 26.

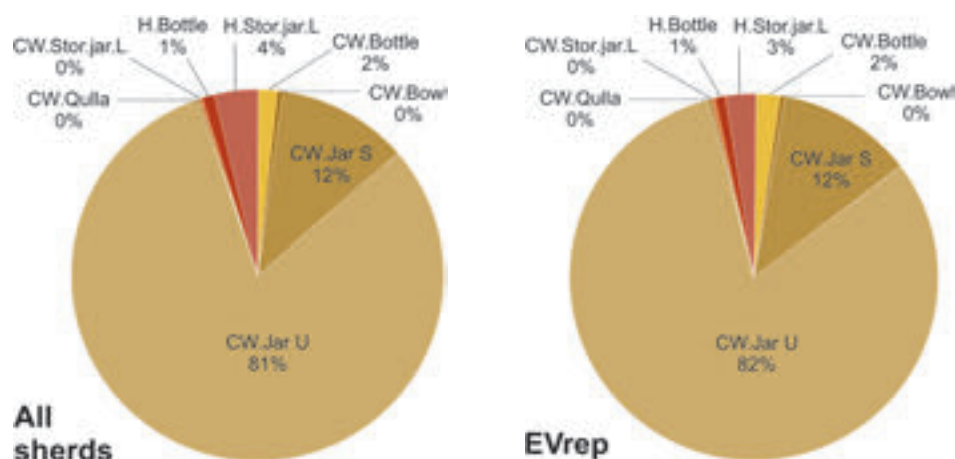
20 RICE 2015: 422.

21 ARTHUR 2009: 36.



Fig. 3 (on the left)
Cooking pots reused
as storage containers
in Sector NECH, Area 5.
Photos by Michał Dzik

Fig. 4 (on the right)
Storage potsherd
distribution by
percentage, based on
the total sherd count
(left), and estimate of
vessels represented
(right)



was not a one-time action but done over time (**Fig. 3**). As the accumulation process gradually proceeded and the floor level rose, vessels no longer suitable for cooking were put aside, where they could be still used as containers for keeping products or other utensils.

Most potsherds in the Banganarti ceramic assemblage catalogued as storage vessels represented different morphological types: hand-made jars (H.Stor.jar.L) and bottles (H.Bottle), and wheel-made coarse-ware jars (CW.Jar S; CW.Jar U), large bowls (CW.Bowl), bottles (CW.Bottle) and so-called *qulla* (bottles with strainers; sing. *qulla*; CW.Qulla). Standard features are their relatively large sizes, resulting from the need to store some larger amount of products. Their greater capacity is reflected in greater wall thickness. Most are also rather crudely made, although many, especially wheel-made bottles and jars, are slipped and richly decorated.

As indicated in **Fig. 4**, storage vessels are dominated by coarse-ware uncoated wheel-made jars (CW.Jar U) at 81–82%, followed by similar slipped jars (CW.Jar S) at 12%. However, these figures should be approached with some caution, as this significant over-representation is partly due to our inability to differentiate between non-diagnostic fragments of different coarse-ware forms, such as *qawadis* and amphorae. As a result, a given body sherd is included and counted as the general coarse-ware jar if it is not possible to identify it specifically.

It is also worth emphasising that the chart does not encompass all vessel types intentionally manufactured for storage. For example, some hand-made bowls very probably were produced and used for storage. However, as this activity leaves few use-alteration traces on the objects and very rarely complete or even larger fragments are preserved, it is impossible to determine their actual function unequivocally. So, all hand-made bowls are analysed together in the ‘Food Processing – Cooking’ section of this chapter. Vessels called ‘basins’ also will be discussed separately, due to similar problems in defining their function(s).

The most oversized storage containers, traditionally called *qussiba*, also are not included in the storage vessel chart above, although, in this case, their functional interpretation is certain. Archaeological finds, ethnographic analogies, and observations of modern Nubian households,²² where similar vessels are still in use, leave no doubt *qussiba* were mainly used to store grains and sometimes other food products.

22 Cf. CEDRO, ŻURAWSKI 2019: 48; GODLEWSKI 2018: 636–637, fig. 14.



Fig. 5
Fired *qussiba* (left)
standing on the lid
with the pentagram
(right) in Sector ECH,
House E2/2013, Space
C. Photos by Agata
Deptuła

It is disputed whether they can be treated as typical pottery vessels or should instead be considered permanent domestic architecture installations and room furnishing elements. *Qussiba* sherds are also not counted in the ceramic assemblage because the storage bins were often removed but only documented and left on site.

Typical *qussiba* are of sandy Nile clay mixed with chaff or other organic additives. Most bins are unfired, only sun-dried, although fired *qussiba* are known in the Early and Classic Christian periods (ninth–eleventh centuries). Two large fired storage bins were discovered in Sector ECH, House E2/2013, one in Space A and the other in Space C-western (**Fig. 5**, left). The latter was found upside-down, standing on a large flat lid with a pre-firing pentagram star (**Fig. 5**, right). Most examples of *qussiba* have a simple cylinder shape with a flat base and thick walls, either vertical or slightly tapering towards the top. The base diameter can vary within 40–70 cm, and they are often more than 1 m in height.

Typically for vessels used for long-term storage, *qussiba* are too heavy to be easily moved, especially when full, so they are often set into the ground or floor or installed on brick benches for stability. Large storage bins are recorded in various contexts at Banganarti, inside houses and in spaces belonging to the enclosure wall.²³ The oldest documented examples dated back to the eighth–ninth centuries and were produced using similar techniques and in similar forms over the following centuries.

As mentioned above, their primary function is grain storage, and such organic remnants are often recorded inside many excavated bins. Their large size also makes them convenient containers for keeping smaller vessels.²⁴ One such set was found in Sector NECH, Area 20, where a complete bowl was uncovered at the bottom of a *qussiba* (**Fig. 7**). This small dish probably was purposely left inside, perhaps used to scoop the container's contents in equal measures (approximately 330 ml) each time it was used. This bowl, usually associated with serving food or eating, can be a good example of pottery's multifunctionality. It reminds us that

²³ DRZEWIECKI 2014: 351, fig. 2.

²⁴ Cf. DRZEWIECKI 2014: fig. 8.



Fig. 6
Qussiba standing near
the entrance in Sector
NECH, Area 20. Photo
by Michał Dzik

our modern classifications and divisions are mainly artificial constructs that allow researchers to organise certain categories, but significantly simplify the natural world's complexity.

Coarse-Ware Jars, Slipped and Unslipped (Plates 1–2)

As already mentioned, wheel-made jars form the most numerous group in the Banganarti ceramic assemblage and represent almost half of its storage vessels. This capacious class of coarse-ware jars contains heterogeneous forms and interconnects with other large pot and bottle classes.²⁵ Like most coarse-ware ceramics here, storage jars are of Nile silt mixed with some organic tempers. Their inner surface is usually left rough with no additional finishing. The inside upper area below the rim may be coated but only when the exterior is also slipped.

The basic shape can be simplified to a restricted globular body formed in various ways, short-necked and more or less elongated or squat. The orifice is usually modified to allow vessel closure, the neck being distinctively bent outwards for this purpose, and sometimes the top of the rim has a slight interior indentation to allow a lid to be fitted. Most jars have simply rounded or flattened bases, although slipped jars can also be footed. Their size and capacity may vary from several to several dozen litres.

²⁵ ADAMS 1986: 105.



Fig. 7
Qussiba in Sector NECH,
Area 20, with a bowl
found inside. Photos by
Michał Dzik

Wheel-made storage jars are very common at Banganarti in all periods. However, characteristic features allowing these vessels to be assigned a specific chronological period are difficult to identify. This could be due to the fact that function was more important than temporary fashion for their creators. Uncoated coarse-ware jars usually are devoid of distinguishing features or decoration. Painted motifs occasionally appear only in the Post-Classic and Late Christian periods, light-coloured bands with dark dots arranged in hanging triangles or circles being popular, with some areas filled with violet paint (Pl. 2, W-BNG-12-13).

Slipped jars are easier to classify chronologically, as more characteristic features can be distinguished. Both shape and the shaping method of the base and/or orifice are modified over time, making these two elements useful dating markers. Slipped jars are often decorated, with two ornamental styles observed: one follows some stylistic trends presented mainly on tableware; the other uses motifs and techniques specific to this particular vessel group. Along with changes in decorative motifs, the slip colour is also modified. Early jars usually are coated red and less often light cream, the decoration being simplified to a few shoulder grooves and/or modest monochrome or bichrome painted motifs usually in black, white and rarely red. Light slips from white to yellow and stamped decoration gained popularity in the Classic Christian period (Pl. 1). Stamped date-pits, small rosettes, crosses, or other motifs usually are arranged in friezes around the vessel shoulder, sometimes bordered by horizontal incised wavy line bands. Alternating black and red dots sometimes are painted on this relief decoration. While stamps disappeared around the eleventh century, this added alternating dot decoration lasted longer, i.e. until the Post-Classic period only the background slip colour changed from light cream into a vibrant orange (Pl. 2).

The main variables of these coarse-ware jars (size, orifice and wall thickness) indicate they presumably were designed for food storage, mostly for dry products, such as grains, seeds and fruits. Moreover, as archaeological finds indicate, they sometimes were utilised as caches for smaller vessels, as with *qussiba* (Fig. 8).

Fig. 8

Storage jar (CB-1019)
from Sector NECH, Area
43, with four tableware
vessels found inside.
Photo by Aneta Cedro



Hand-Made Jars (Plate 3, top)

Large hand-made jars (H.Stor.jar.L) represent approximately 3–4% of storage vessels (see **Fig. 4**). As most hand-made pottery, they can be produced in the local house workshops for a particular need, and therefore the size and shape are unique in some way. Storage jars are of local Nile silt mixed with thick organic temper. Many of these admixtures result in these otherwise large vessels having a very porous body and lighter weight after firing.

Like wheel-made jars, this group's representative vessel shape can be described as a large globular body with a short neck and an everted rim. Larger vessels usually widen towards the base, with wall thickness increasing in proportion to vessel size; the larger the vessel, the thicker the wall. A few examples have a protruding interior neck ledge to keep the lid in position. Another striking feature are the tiny knobs on the upper body or shoulders to allow heavy vessels to be held, lifted or moved more easily.

One group of hand-made jars replicates the shape of typical cooking pots (described below), but in a much larger size. Both shape and surface treatment are copied. The bottom is roughened, a feature mostly found only on vessels in contact with fire or a high temperature (**Pl. 3**, W-BNG-27-11/12).

While the inner surface is usually untreated, the exterior often is slipped, usually in red and occasionally decorated with white paint (**Pl. 3**, CB-1024). Decoration on Banganarti examples is usually found on the neck, shoulders, and upper body, in the form of geometric motifs, such as zig-zags, triangles, cross-hatching and parallel wavy lines. Incised decoration is rare, usually on the everted rim.

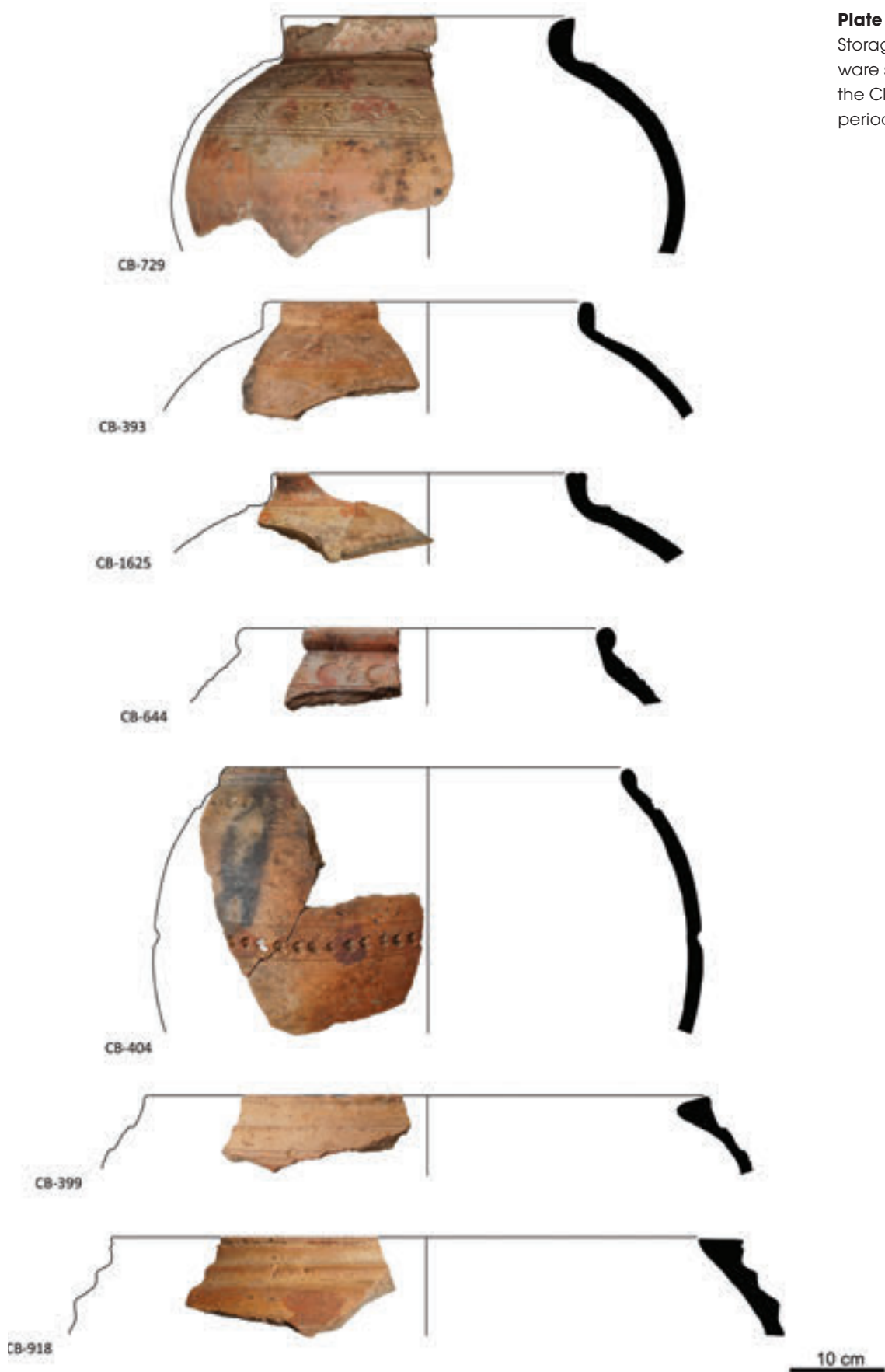


Plate 1.
Storage vessels: coarse-
ware slipped jars from
the Classic Christian
period

Plate 2.

Storage vessels:
coarse-ware slipped
jars from the Post-
Classic Christian
period



CB-1001



W-BNG-12-13

10 cm



CB-1002



CB-1019



Plate 3.
Storage vessels:
hand-made jars
(top) and bottles
(bottom)

Plate 4.
Storage vessels:
coarse-ware
bottles



BNG-19-12



CB-1704



CB-227



CB-1602



W-BNG-09-13



CB-1022



W-BNG-09-13



CB-999



CB-1534

10 cm



Plate 5.
Storage vessels:
coarse-ware
bottles with marks
on the rim



Plate 6.
Storage vessels:
coarse-ware *qulal*



CB-450



CB-1097



CB-105



CB-1763



CB-1884



CB-2096



CB-635

5 cm

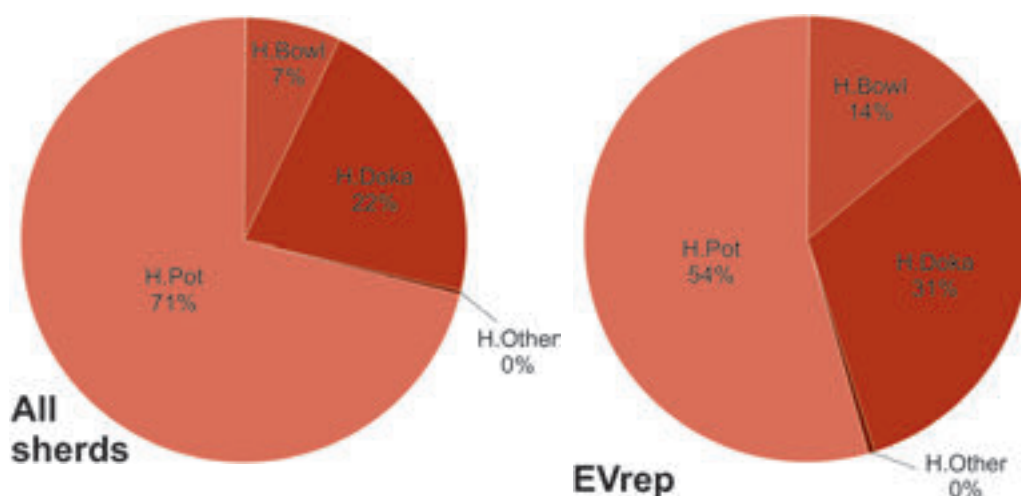


Fig. 9
Food-processing
potsherd percentage
distribution, based
on the count of all
fragments (left), and
estimations of vessels
represented (right)

Hand-Made Bottles (Plate 3, bottom)

Another hand-made storage vessel type is bottles (H.Bottle), accounting for over 1% of this functional class (see **Fig. 4**). Their popularity peaks in the Early Christian period, when they display distinctive features deriving from the older post-Meroitic so-called beer-jar tradition.²⁶ Unfortunately, no complete vessel of this type was recovered in the Banganarti settlement, only small fragments, but numerous reconstructable sherds found in the fill between the lower and upper church pavements²⁷ are perfect analogies. Other parallels known from nearby Old Dongola are similarly dated.²⁸ Early Christian bottles have a characteristically spherical body and are mat-impressed with a red slip. Long, slender necks and flaring rims often have a burnished violet paint on the red slip (**Pl. 3**, CB-826). Occasionally, the flaring rim has painted radial stripes and/or incised motives at the top. Vessels of this type were used for storing beverages, but the final stages of the brewing process also may have taken place in them.

This vessel form begins to decline in number from the Classic Christian period onwards. Significant changes can be observed in the shape of hand-made bottles as they begin to resemble storage jars, differing only in their narrower orifice (**Pl. 3**, CB-156, CB-826), although their rims continue to flare more than those of storage jars, and even painted or engraved decoration may occur.

Coarse-Ware Bottles (Plates 4–5)

More popular than hand-made specimens are bottles formed on a wheel in a coarse-ware fabric (CW.Bottle). They represent more than 2% of all storage pottery recorded at Banganarti (see **Fig. 4**). Vessels of this type are present in all periods, although most of the assemblage analysed date to Post-Classic and Late Christian periods. Coarse-ware bottles' most notable changing feature observed over several centuries is the neck and rim shape that helps to establish their approximate

²⁶ PHILLIPS 2003: 403.

²⁷ BAGIŃSKA 2008: figs. 2b–c, 6, 7f.

²⁸ Cf. DANYS-LASEK 2012: fig. 6; DANYS 2016: fig. 7.

chronology. Early examples have rather slender necks terminating in a protuberant profiled rim. The neck shortens, while the distinctively protruding rim develops an interior indentation during the Classic Christian period (Pl. 4, CB-1704). Finally, the dominant form in succeeding centuries became a spherical body having a short cylindrical neck and flattened rim protruding outwards at the edge (Pl. 4, CB-1022).

Wheel-made bottles are probably the most standardised of all ceramic storage types. Amongst several complete vessels discovered at Banganarti, a group of smaller bottles with flattened rims (Pl. 4, CB-1022, CB-999) have a similar capacity ranging between 11 and 13 litres, while larger examples with flaring necks and ovoid bodies (Pl. 4, W-BNG-09-13, CB-1534) can hold about 19–20 litres. Their main function is storing water and other liquids, but find contexts indicate their use not only for cooking activities but also hygienic purposes.

Decoration on smaller bottles emphasising the neck and shoulder junction is popular throughout all periods, achieved by adding an applied roll or an incised band of narrow grooves; this last is often repeated on the upper and sometimes mid-body. A painted neck is standard, most often in a violet colour (Pl. 4, CB-1602). Painted light-coloured bands with brown or violet dots became popular on smaller and larger bottles in the latest centuries, similar to the decoration on storage jars described above (Pl. 4, CB-1534).

Interestingly, one group of bottles with flattened or protruding rims often have cut marks at the top (Pl. 5). These most often are single or variously grouped radial cuts or crosses, which, however, are not repeated. Nevertheless, they somehow relate to vessel use as they were made post-firing, perhaps marking a date or providing information about the contents.

Qulal (Sing. Qulla) (Plate 6)

Another vessel type used to store liquids is traditionally called *qulla*²⁹ (CW.Qulla), with many variants found among the Banganarti ceramic assemblage. All specimens are wheel-made, bottle-like shaped in a coarse-ware fabric, usually with a plain flat base, bulbous body and cylindrical or slightly flaring neck. Usually two, but sometimes one or three, small loop handles quite often are attached at the neck/shoulder junction. However, the main element distinguishing this type is a strainer placed at the lower part of the neck. These filters, intended to protect the stored liquid from pollution and insects, often have pretty decorative perforation patterns. The neck exterior sometimes also is painted (Pl. 6, CB-450, CB-105, CB-635).

Qulal first appeared at Banganarti in archaeological contexts dating from the eleventh–twelfth centuries onwards and were produced mostly in local fabrics. This specific ceramic form most likely derives from Islamic Egypt, where similar filter vessels are known from excavated contexts dating to the eighth–fifteenth centuries,³⁰ although the Fatimid period (ca. 1000–1200 A.D.) is the high point of strainer development, when some very sophisticated patterns are known. This is precisely when they begin to appear in Nubia. Interestingly, they are known

29 The term *qulla* in modern Sudanese Arabic has a very broad meaning and is used for any ceramic vessel with a globular body and neck. However, academic Nubian ceramic literature limits its definition to a specific vessel type having a filter.

30 SCANLON 1986: 3.



Fig. 10
Cooking space in the northwest corner of the courtyard – Sector NECH, Area 36. Photo by Michał Dzik

in domestic contexts and as grave goods in monks' and bishops' crypts at Old Dongola³¹ and Faras.³² As already mentioned, bottles with filters were used to store liquids, though they were rather multifunctional vessels. Considering their size, they were well fitted not only for storing but also directly for serving drinks. The only example of a complete *qulla* from Banganarti, discovered in Area 23 of Sector NECH, has the lower part covered with black soot, caused by repeating contact with fire (Pl. 6, CB-450). This trace indicates that this vessel was probably used for boiling water or other liquids.

FOOD PROCESSING – COOKING

Food processing is probably the most fundamental household activity, and ceramic vessels in traditional communities are essential utensils engaged in this process. For cooking, which involves a high temperature or even open fire, pottery is irreplaceable. No other material, except perhaps metal, which in medieval Nubia was scarcely available and expensive, has the necessary technical parameters. Vessels designed for cooking must meet a number of conditions in order to best perform their function. Of all ceramic categories, they have the strongest relationship between physical properties and function.

Technological choices in cooking-ware manufacture most importantly must consider two factors: thermal-shock resistance and heating efficiency. The first is a ceramic vessel's ability to withstand sudden temperature changes and repeated cycles of heating and cooling (thermal stress) without cracking. Heating efficiency results from thermal conductivity but, as rapid heating and cooling evoke stronger thermal stress and are undesirable, the ideal vessel has mid-range

³¹ ŻURAWSKI 1996: 127, fig. 8.

³² KOŁODZIEJCZYK 1982: figs. 6–8.

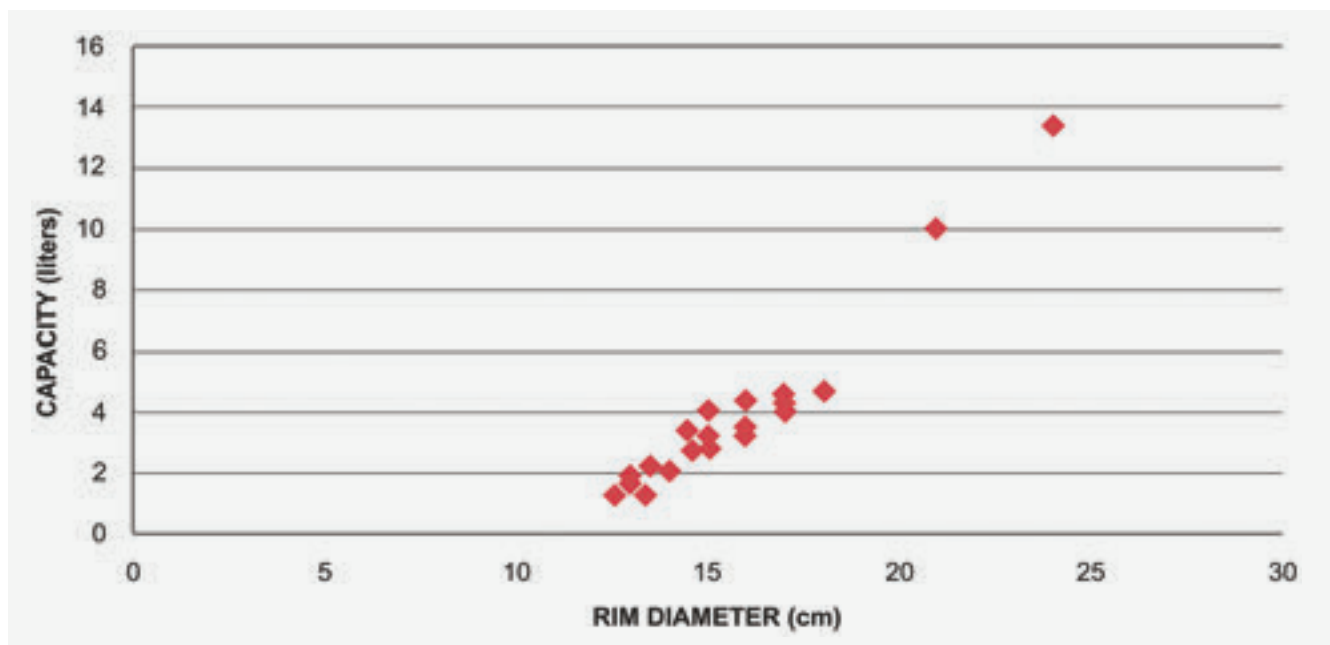


Fig. 11
Capacity and rim
diameter of cooking
pots at Banganarti

heating effectiveness.³³ Both performance characteristics are influenced by various technological choices, such as vessel shape, wall thickness, porosity, the nature of the clay paste and even surface treatment.³⁴ Thus, many interactions among technical choices and performance characteristics must be considered while studying cooking ware.

Food processing pottery represents around 18% of estimated vessel numbers and 32% of potsherds in the Banganarti ceramic assemblage (see **Fig. 1**). All pottery used for cooking is hand-made. However, wheel-thrown vessels and even utensils in other materials, like stone and wood, can also be used for other food processing activities, such as grinding, mixing and soaking. Unfortunately, this second activity group leaves few or ambiguous use-alteration traces on ceramics. Therefore, only vessel types having a specific function are considered in analysing food processing pottery in the Banganarti assemblage. Ultimately, this group consists of three main morphological types: globular pots (H.Pot), *dokat* (H.Doka), and bowls (H.Bowl). The first two are exposed to high temperatures during use, leaving the most apparent use-alteration traces to allow identification of their functional performance. Bowl function can be roughly determined on the basis of morphology, size, surface treatment, and some other physical properties.

Cooking pots (Plate 7)

These are by far the most common vessels preserved as complete objects and discovered *in situ* at Banganarti. They are also the largest food-processing pottery group, representing approximately 54% of estimated vessels and over 70% of potsherds (**Fig. 9**).

³³ SKIBO 2013: 16.

³⁴ SANTACREAU 2014: 157.



Fig. 12
Cooking pots covered
with fragments of a
qadus (top) and bottle
(bottom). Photos by
Agata Deptuła and
Aneta Cedro



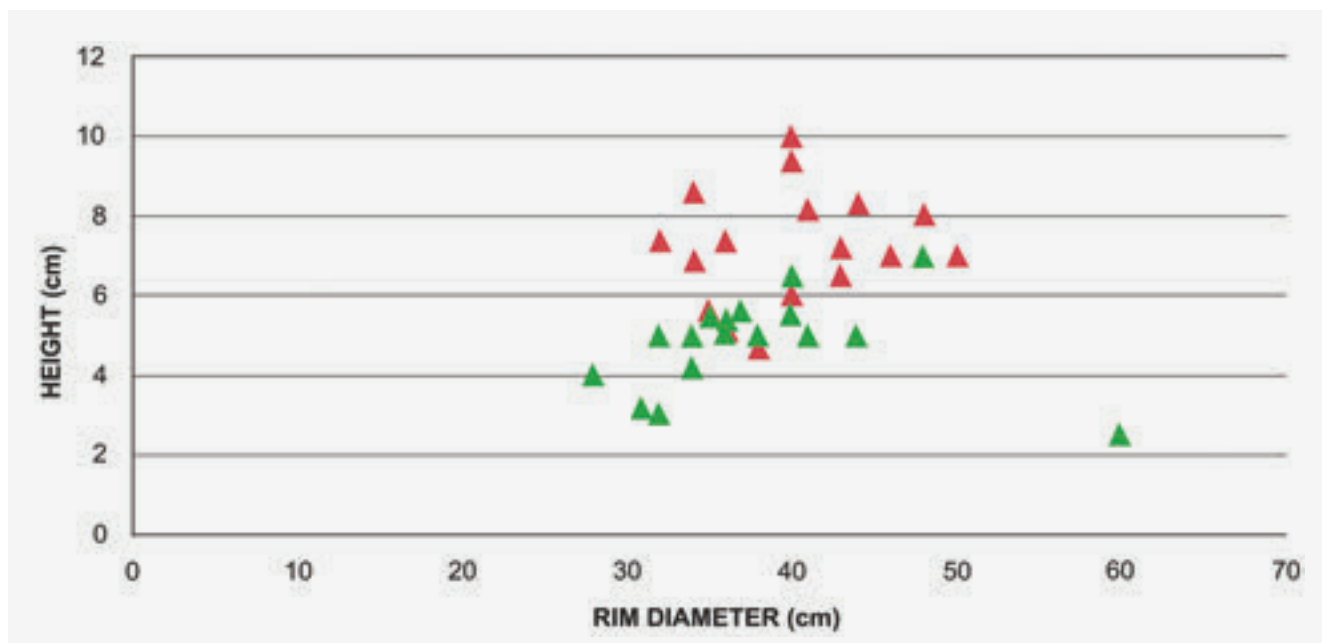


Fig. 13

Doka height and rim diameter range at Banganarti. The early type is in red and the late type in green

The cooking-ware paste throughout all periods is based on Nile silt mixed with organic additives, with another fabric type including mineral temper and grog being identified only in the Late Christian period. Admixtures of organic temper have a significant impact on the performance characteristics of cooking pots. Plant particles disintegrate during firing, creating voids and resulting in high fabric porosity. This open clay texture decreases stress and prevents the propagation of cracks.³⁵ In addition, Nubian cooking ware is fired at low temperatures, another method of increasing thermal shock resistance as it creates a more flexible texture.³⁶ Cooking pots repeat a similar spherical body form with a rounded base, short neck, and everted rim throughout the Early to Late Christian periods, undergoing only slight modifications over these few centuries (Pl. 7). Earlier forms have a more pronounced neck curve, thinner walls, mat-impressed and often red-slipped body exterior, and sometimes the neck and mouth were also burnished. Later types are less carefully made, with uneven and gradually increasing wall thickness and sometimes only slightly emphasised neck. The globular shape provides clay pots with many advantages. Firstly, it imparts strength in both manufacture and use. This shape is the most resistant to excessive shrinkage and cracking during drying, better able to withstand thermal stress throughout the firing process, and, finally, it performs better in contact with high temperature during cooking use.³⁷ Cooking-pot bases at Banganarti always have a roughened exterior surface, achieved by methods such as adding a layer of un even clay pellets, intersecting incised lines, short parallel cut lines, and finger or stick impressions (Pl. 6). Technological studies focusing on corrugation on ancient vessel exteriors prove such surface texturing improves thermal-shock resistance and thus extends vessel use-life.³⁸

³⁵ VOKAER 2010: 118.

³⁶ Cf. PICON 1995: 285–286.

³⁷ SKIBO 2013: 101–102.

³⁸ PIERCE 2005: 141–142, fig. 11.

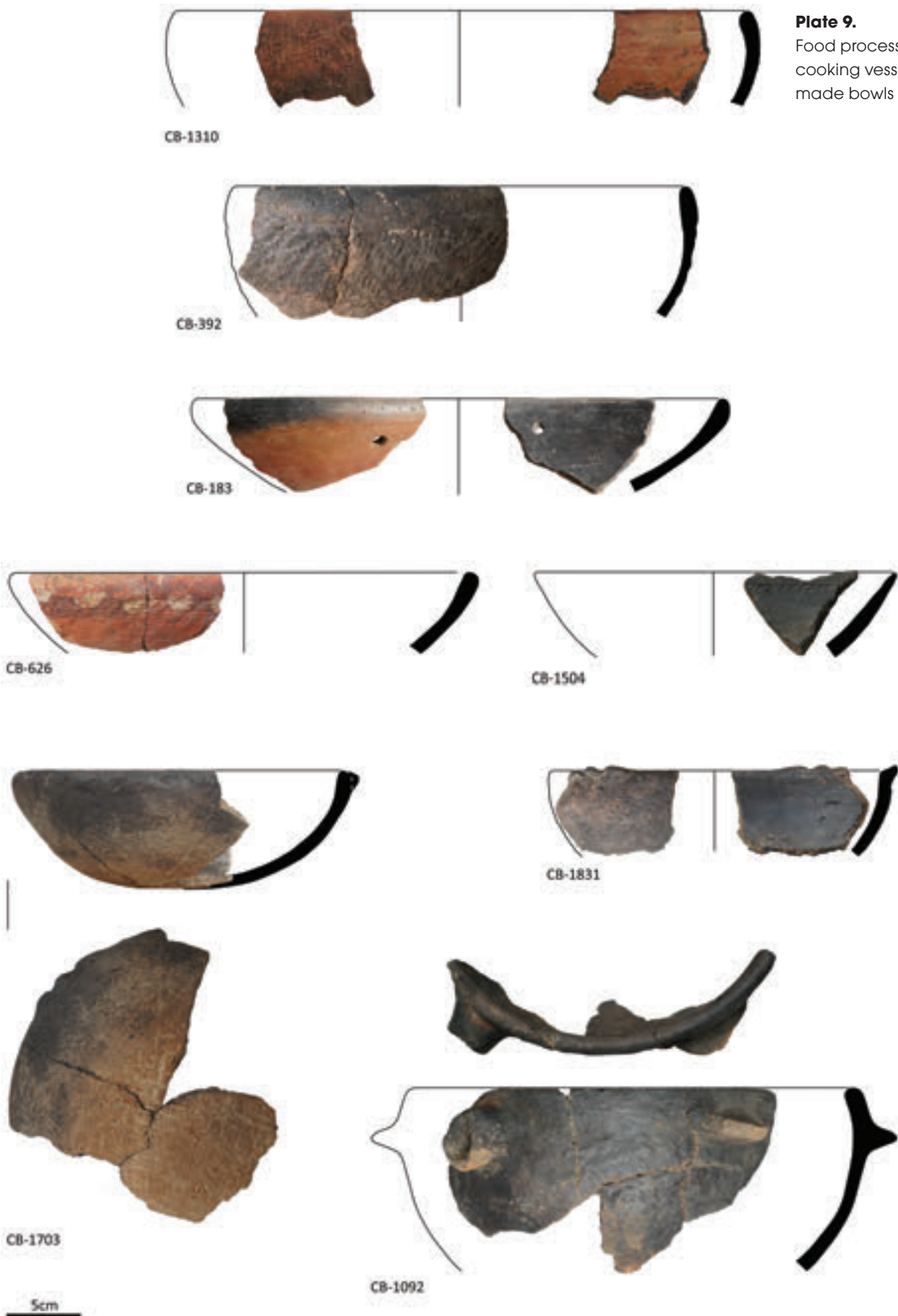


Plate 7.
Food processing
– cooking vessels:
hand-made
globular pots

Plate 8.

Food processing
– cooking vessels:
hand-made dokat





As already mentioned, many complete cooking pots at Banganarti were discovered *in situ*, although only rarely found directly on the hearth (Fig. 10). As ethnographic analogies suggest, most primary-use pots in traditional households are kept in kitchens, often along walls or in corners,³⁹ and are observed within similar spaces at Banganarti. Complete pots are recorded mostly next to walls, in corners or behind some internal structures (see Fig. 6), often near the hearth or cooking spot.

It should be emphasised, however, that hand-made pots were used not only for cooking, but also have several other applications in Nubian houses. Low production costs and easy accessibility could be why they were often chosen to fulfil various needs. Storage has already been mentioned in vessel 'second life' and as the first and only function of individual pots. A cooking pot found intentionally placed on a red-brick floor in Sector NECH, Area 7, probably was used as an incense burner, similar to customs observed in modern Banganarti houses.⁴⁰

Cooking pots in the assemblage vary in size and range from 10 to 20 cm in rim diameter. However, most collected vessels represent medium dimensions, with a 15–17 cm rim diameter and 1–2 litre volume (Fig. 11). Considering this relatively small capacity in the most popular pots, it seems Banganarti households prepared food on a meal-by-meal basis rather than day-by-day.

No separate lid type is included in the Banganarti ceramic assemblage, as they are sporadic finds. Most utensil types are represented by sizeable unfired clay covers for storage vessels, especially *qussība*. This does not mean 'lids' were not in use, as many cooking methods must have required the pot's interior to be sealed. Fragments of other vessels were used, sometimes intentionally cut to fit the size of the pot orifice. *Qadus* bases are best suited for this purpose as their knobs could serve as lid handles, but storage vessel and thick-walled bowl body and base fragments also were recycled in this manner (Fig. 12, top). In one case, a cooking pot was closed by the upper part of a storage bottle, which here fulfilled the double function of lid and funnel (Fig. 12, bottom).

Dokat (Plate 8)

The second most numerous ceramics group in the food processing category is fragments of *dokat* (sing. *doka*), amounting to 22% of potsherds and 31% of the estimated number of vessels (see Fig. 9). The name *doka* refers to the vessel on which traditional Nubian bread (*kisra*⁴¹) is baked. Today, this name also refers to a usually round metal plate that is a basic piece of equipment in Sudanese kitchens. Medieval ceramic *dokat* resemble a pan or wide flat bowl, but their shape and other variables changed significantly from the Early to Late Christian period.

Dokat are hand-made throughout all periods in Nile silt fabric with organic admixtures. The exterior base surface is roughened to provide better resistance against thermal stress, as on cooking pots (Pl. 8, CB-1023, CB-988, CB-827).

39 ARTHUR 2009: 36.

40 Clay pots set in the floor, usually in the vestibules or womens' rooms in Sudanese houses, are used for performing *dukhaan* (pl. *dakhaakhiin*), the traditional smoke bath.

41 Made of fermented sorghum dough and baked in a manner similar to thin pancakes (DIRAR 2015: 13–14).

The early *doka* type often has additional body texturing impressed by the mat on which it is made (Pl. 8, CB-920), and its interior and exterior surfaces are slipped in various shades of red. The later type of *dokat* lacks these features, not being mat-impressed or slipped, but the carefully burnished or polished inner surface was executed over all periods. This procedure provides a smooth, impermeable surface to which the *kisra* dough did not adhere.

The *doka* type produced from the Early Christian period to the beginning of the Classic Christian period (ca. sixth/seventh to mid-tenth century) resembles a bowl with a wide flat base and rounded walls (Pl. 8, CB-920, CB-1324, CB-398). It is slightly restricted in shape by thickening the rim and bending it inwards. The earliest forms also are the deepest, as shown in Fig. 13, where the height of the early *dokat* (red markers) recorded at Banganarti range between 5 and 10 cm, the majority measuring 7–8 cm, and averaging 7.4 cm. Rim diameters range between 30 and 50 cm and the bottom is ca. 20–40 cm in diameter, the latter being the size of the working surface on which *kisra* could be baked. *Doka* depth decreases over time and eventually becomes similar to a pan. The late type is 4.8 cm in average height, but can measure between 2.5 and 6.5 cm (green markers on Fig. 13). While the rim diameter is similar to early forms at 30–50 cm, the working surface is wider since the walls are almost completely reduced and the rim flows smoothly to the base.

Dokat generally are undecorated, the only exception being parallel or intersecting lines incised on the rim top of the early type (Pl. 8, CB-920, CB-1324, CB-398), and rare additional elements, such as lug handles attached to the rim from the exterior.

The primary function of *dokat* defines the type as a vessel for baking *kisra*, but this was not their only use. Especially considering the high walls of the early type, one may assume these vessels could also have been used for other food-processing procedures. Their shape is also well suited to heating dishes and making sauces, and to simple activities such as mixing ingredients or kneading various kinds of dough.

Bowls (Plate 9)

The third type of food processing vessel at Banganarti, at 14% of estimated vessel numbers and 7% of potsherds, are hand-made bowls (see Fig. 9). These are much more versatile in terms of both morphology and functional application than cooking pots and *dokat*, although they have many similarities to the latter. They are of Nile silt with organic admixtures fired in low temperatures, as is most hand-made pottery. However, a new fabric type appears in the Late Christian period, with coarse-grained sand inclusions and mineral admixtures.

The external surface can be finished in various ways. Early Christian period bowls often are mat-impressed and red-slipped (Pl. 9, CB-1310, CB-392, CB-626), similar to pots and *dokat*, although black vessels fired in a reduced atmosphere and frequently with a well-executed burnished exterior also are recorded. Early hand-made bowl forms often repeat, albeit on a smaller scale, elements found on *dokat*, such as a thickened edge or incised oblique or intersecting-line decoration on the rim top. The later types more often had untreated rough surfaces. The interior is smoothed throughout all periods,

Plate 10.
Transportation
vessels: coarse-
ware amphorae



CB-713



CB-1015



CB-1012



CB-990



CB-1096



CB-562

10cm

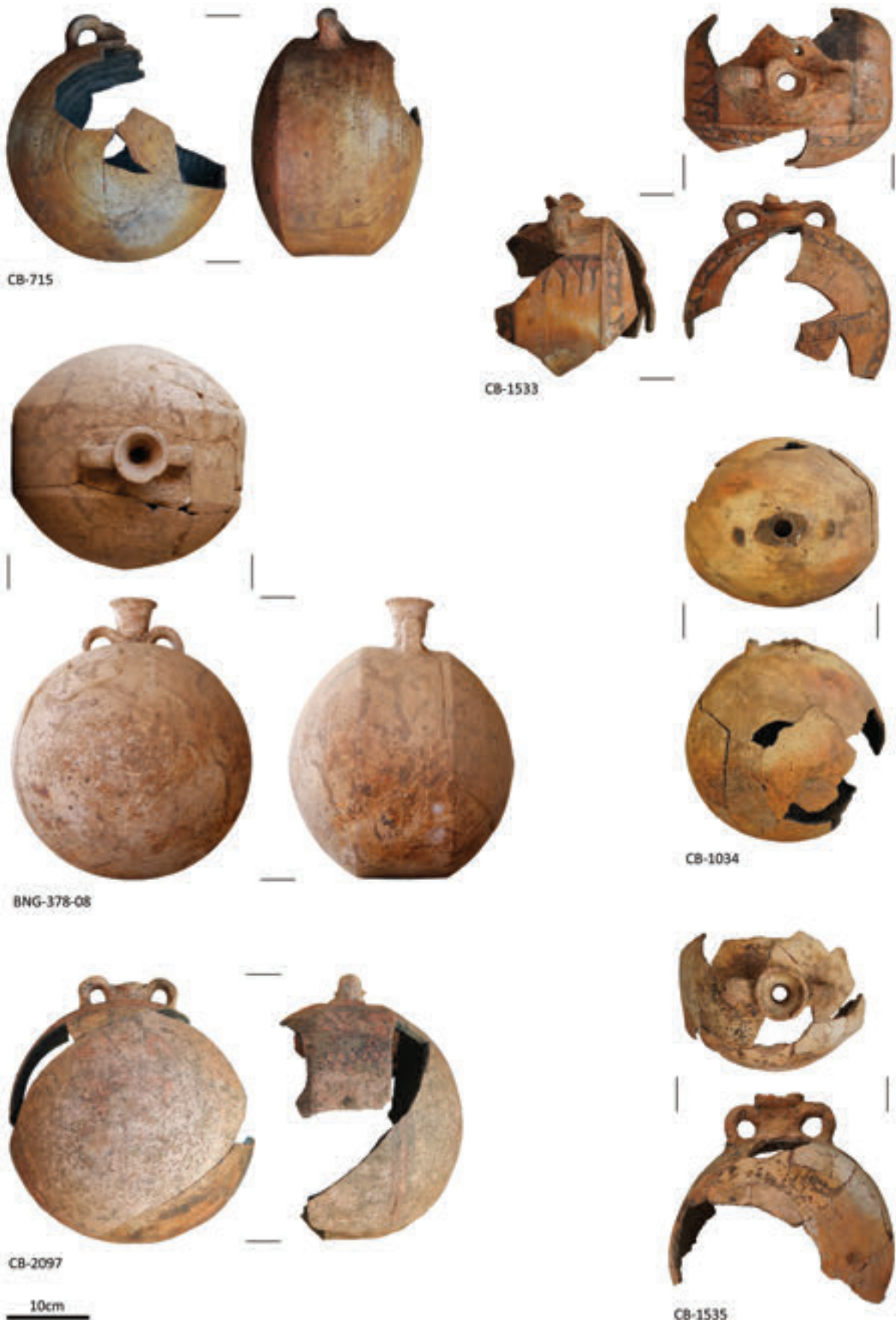


Plate 11.
Transportation
vessels: pilgrim
flasks

usually by carefully executed burnishing, especially on early bowls, resulting in an impermeable surface and making these vessels useful in preparing liquid dishes.

Hand-made bowl shapes are based on various spherical segments, with a rounded base and both restricted and unrestricted orifices (**Pl. 9**). Handles are rarely recorded, other than a few examples of horizontal lugs attached below the orifice (**Pl. 9**, CB-1092) or small bosses added on the rim (**Pl. 9**, CB-1831, CB-1703). Lug handles enable a more solid grip on the vessel, allowing even a bowl full of food to be lifted safely. Another rare modification is the addition of a spout (**Pl. 9**, CB-1092), usually placed just below the upper opening of the vessel, facilitating its liquid contents to be poured from the bowl.

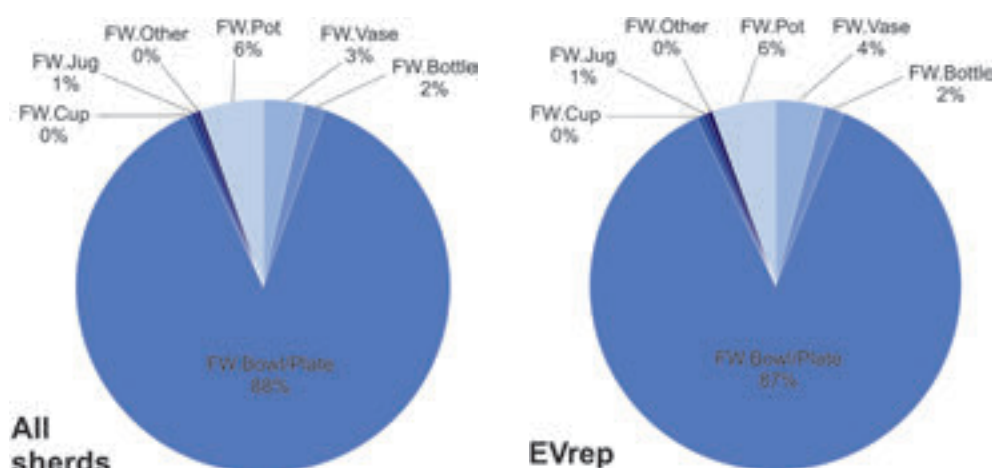
Hand-made bowl sizes vary, with recorded rim diameters ranging from 14 to over 40 cm, the majority 20–30 cm. They fulfilled various kitchen functions: short-term storage of food products or meals, legume soaking, and mixing ingredients for dough or sauces. Unfortunately, these activities leave few use-alteration traces so may only be indicated hypothetically. The best-identified function of some bowls is associated with food processing activities involving heat, easily identified by soot or carbonisation traces on the exterior surface. One such almost complete bowl with a fire-blackened exterior is reconstructed with a roughened base (**Pl. 9**, CB-1703) similar to cooking pots and *dokat*, indicating it was intentionally manufactured for cooking and other uses in contact with fire.

Bowl fragments more often bear traces of repair than other hand-made ceramic types, primarily as small holes near the rim (**Pl. 9**, CB-183). These are most often associated with cracks that made them unsuitable for liquids, but they could still be used in the kitchen for storage or food processing activities using dry ingredients and requiring no heating.

TRANSPORTATION

The smallest group within the Banganarti ceramic assemblage is used for transportation, with 10% of potsherds and 6% of the estimated vessel numbers in this functional category (see **Fig. 1**). They are almost entirely one type: the basic container for long-distance transfer of liquid products – amphorae. The only other transportation vessel type, represented by only 2% of potsherds in this group, are the so-called ‘pilgrim flasks’. The disproportionate quantities of pilgrim flasks and amphorae should come as no surprise since they are associated with two different usage models. Amphorae are involved in the well-organised food production industry, employed to hold wine, olive oil and other liquid substances during passage from producers to consumers. Demand was very high and therefore they were mass-produced and, in Nubia as in the Mediterranean world, in a standardised manner.⁴² Pilgrim flasks, on the other hand, targeted individual users and probably no two identical vessels existed among the Banganarti examples.

⁴² Cf. PLUSKOTA 2005; DANYS 2015.

**Fig. 14**

Serving-pottery percentage distribution, based on the count of all fragments (left), and estimations of vessels represented (right)

Amphorae (Plate 10)

Amphora fragments are ubiquitous in the Banganarti settlement, found in almost every archaeological context and chronological period. The larger amount was retrieved in particular from refuse heaps. They were also abundant in the fill between pavements of the lower and upper church,⁴³ intentionally used to harden the backfill levelling for the new church. This huge quantity of amphorae, and therefore also the wine brought in them to the settlement, testifies to the popularity of this drink throughout the entire Christian period. Their omnipresence throughout the site indicates the wine's recipients probably were both clergymen and lay inhabitants of medieval Banganarti.

Amphorae from the ceramic assemblage are mostly Nubian products, the majority attributable to local Dongolese workshops. Only some individual fragments of amphorae imported from the Aswan region of southern Egypt were retrieved from early contexts, dated to the seventh–eighth centuries.

The most important properties of transportation pottery improve portability, so impact resistance (mechanical strength) and lightness are desirable. Fabric, especially its porosity, can influence both, and their improvement requires the opposite. Greater compactness and hardness are required for mechanical strength and, as a counter-balance, abundant porosity can significantly lower vessel weight. Therefore, the degree of fabric porosity must be well balanced. The seventh–ninth-century amphorae at Banganarti are of a rather dense hard fabric, but interestingly some vessels' parts are made quite porous by adding organic temper to the clay of their handles and neck. The reason behind using two fabrics in one vessel is still unclear, one hypothesis being to facilitate opening the amphora.⁴⁴ However, this practice may have been implemented to reduce vessel weight without lowering the required mechanical strength of its main body. The fabric of Banganarti amphorae post-dating the twelfth century is tempered

⁴³ BAGIŃSKA 2008: figs. 3–4.

⁴⁴ DANYŚ 2015: 119.



Fig. 15
Bowls with a plane
base held in one or two
hands. Photos by Aneta
Cedro

entirely with organic additives and thus is more porous than earlier products, which had the significant impact of reducing their weight. Weight and capacity measurements of some complete and near-complete vessels in the assemblage give the following results: early amphorae weigh about 4.5 kg with a ca. 9–12 litre capacity, while late products are 5–7.6 kg in weight and hold about 20–25 litres. So, statistically, older amphorae hold 2–2.7 litres of wine per kg, while late types hold 3.3–4.5 litres per kg.

The exterior surface of the amphorae is never treated. Early examples often have painted (Pl. 10, CB-713) or pre-firing incised marks of informative rather than embellishment function. Only carved potter's marks and some graffiti were made in later periods. Interpretation of all these marks and inscriptions is ambiguous. We might hypothesise that some may indicate the addressee or the wine producer, and some can be apotropaic, but the real meaning behind these symbols will probably never be explained with certainty. Many examples of Post-Classic Christian period amphorae below the handle have drilled after-firing fermentation holes (Pl. 10, CB-1015, CB-990).

Amphorae as wine containers were part of a more or less long-distance movement and trade of goods. Their primary function extended beyond the daily life of the settlement. In a way, the first life of these vessels ended here, when they finished their journey from the producer to the recipient, ceasing as transport vessels from this point and, usually, their secondary function begins. They become storage containers, at least until the wine is emptied. However, even later they can be refilled with other contents and still be in use. One complete amphora found in a storage space – Sector NECH, Area 43 – shows traces of very long usage (Pl. 10, CB-1012). It even has a hole in the shoulder, possibly cut intentionally, with edges smoothed from use. Examples of amphorae with the neck cut so the upper opening becomes wider, probably being utilised for grain or other dry goods storage, are also known.

Pilgrim Flasks (Plate 11)

The term 'pilgrim flask' should not be taken literally, as it is a purely conventional name given to bottles that, in Nubia, are characterised by a round body shape with asymmetrical profile and short neck with two attached handles. The tradition of this pottery shape of the same name conventionally used by scholars goes deep into the past, at least to the Levantine Middle Bronze Age.⁴⁵ Again, the name should not be taken literally, although, considering the role of the Raphae-lion as a vital pilgrimage centre, it is indeed possible the Banganarti flasks might have been used by pilgrims. Generally, this vessel type is considered to be a water container carried by travellers on journeys.

Most Banganarti vessels are made in a moderately porous fabric caused by adding fine chaff to the clay. Unlike amphorae, the exterior surface is always slipped and the majority have rich painted decoration. The capacity of Banganarti pilgrim flasks varies significantly, ranging between 4.5 and 9 litres.

SERVING

Another indispensable realm of pottery use in Nubian daily life involves serving food, eating and drinking. The Banganarti tableware assemblage accounts for 18% of collected sherds and 26% estimated vessel numbers (see **Fig. 1**). The majority is of local origin and most probably linked to Dongolese production centres, but some imported vessels have been identified. A few examples come from other Middle Nile Valley regions, mostly Nobadia, and areas outside Nubia. The second group of imports includes glazed dishes from Egypt.⁴⁶ These foreign vessels can be seen as prestige objects, emphasising that serving food not only fulfils specific utilitarian functions for pottery but also carries additional symbolic values. Compared to other groups (storage, cooking and transport), tableware's limited and very specific usage also extends beyond strictly utilitarian functions.

From the beginning of the Christian period, Nubian pottery used for serving food, eating and drinking is characterised by a high quality of artistry. Unlike kitchen and storage ceramics, tableware is highly standardised and manufactured in specialist workshops, exclusively on a potter's wheel. Material for their production most often is obtained from good-quality desert clay deposits. Nile silt is rather sporadically used, usually mixed with other clays. Aesthetic values are of great importance in tableware, so potters make a special effort in surface finishing. Both internal and external surfaces of open forms are slipped, but closed forms only on the exterior; sometimes both slipped surfaces are polished to achieve a glossy effect. This treatment improved appearance and reduced fabric porosity, resulting in highly impermeable vessels ideal for serving liquids and drinking.

The most significant influence on the final presentation of tableware is decoration, and the majority of Nubian serving ceramics is embellished.

⁴⁵ AMIRAN 1969: 166.

⁴⁶ Cf. BAGIŃSKA 2008: 418, figs. 8b, 10b.

Painted ornamentation is the most popular, but incised, stamped/impressed and mixed techniques are also found. Decoration sometimes is limited to elementary motifs such as a painted rim stripe or incised grooves. The painting also can be very elaborate and complex, with various arrangements of both geometric and figural designs, especially on Classic and Late Christian period pottery. This pottery group reflects, in a way, the aesthetic trends of its period and their changes over time. Tableware thus is a very good chronological indicator, although bearing in mind that it could be functioning within the household for a long time due to its high value. Traces of surface wear are evidence for this longevity.

Tableware is a useful dating tool in archaeological research and for analysing some social aspects of past communities. Applying quantitative study methodologies to changes in vessel form, size and capacity may contribute to our understanding of ancient eating habits and their changes over time.⁴⁷ Of all pottery types in all functional groups, serving and consuming food vessels are the most often inscribed.⁴⁸ Almost all inscriptions recorded on artefacts at Banganarti are found on ceramics, primarily bowls and cups, made post-firing but mostly during their use-life. Most such graffiti are names of divine Christian entities, such as Jesus Christ, Mary, archangels and the Four Apocalyptic Beasts. Their function is interpreted as apotropaic, supposedly defending the user from evil forces and protecting the consumed meal or drink when eating and drinking from the vessel. Another common inscriptional group consists of personal names, sometimes including the office or title. This raises interesting questions concerning ownership and use of tableware. Was an individual bowl or cup assigned to the one individual user whose name is incised on it, or does the name refer to a particular household? If the latter, the graffiti would mean 'belonging to a given person's house'. Disregarding which answer is the more true, signatures on tableware indicate these vessels were perceived as objects of some value.

Serving pottery represents almost all fine-ware vessels in the Banganarti pottery assemblage, distinguished by form as bowls and plates (FW.Bowl/Plate), cups (FW.Cup), vases (FW.Vase), pots (FW.Pot), jugs (FW.Jug) and bottles (FW.Bottle). Immensely striking in this set is the massive advantage of open over closed forms (**Fig. 14**). This disproportion may seem strange at first glance, but several reasons may explain these differences. Firstly, demand for this smaller vessel group is lower. It can be assumed that the primary function of closed tableware vessels is to fill bowls and cups with a drink, so one jug or bottle is sufficient during a meal, but each participant at the meal requires his bowl or cup.

Moreover, bowls and cups are more prone to damage since they are used and held in the hands throughout the meal, while jugs or bottles are in use only when their contents are being poured. The smaller number of closed tableware vessels may also be because other vessel types could fulfil their functions. For example, drinks may have been poured directly from amphorae or storage bottles, another possible example of vessel multifunctionality.

⁴⁷ Cf. VROOM 2016.

⁴⁸ See Deptuła, Cedro forthcoming

Bowls and Plates (Plates 12–15)

Bowls and plates by far outnumber all other serving vessel types, representing 88% of potsherds and 87% of estimated vessel numbers in the Banganarti ceramic assemblage (**Fig. 14**). Bowls and plates are counted and analysed together as most survive as small fragments and are often difficult or impossible to separate. Nevertheless, plates are quite rare at Banganarti.

Bowls are the most abundant tableware and probably the most versatile of all Nubian pottery types, with striking differences in technology and shape and numerous diverse variants within each chronological phase. These vary in quality and differ in the level of craftsmanship but decrease significantly in the Late Christian period.

Their paste is mainly based on good-quality desert and *wadi* deposit clays, kaolinite clays being especially popular in the Classic Christian period. The final products have a well-sorted and dense fabric. However, the Late Christian period saw a visible change, when use of Nile silts and the addition of organic temper became more common, resulting in a more porous vessel body.

Tableware bowls are always slipped on both surfaces, with either a matte or polished finish and colour changes over time. Red ceramics dominate in the Early Christian period, although black, grey and especially white surfaces also occur. White slip begins to predominate in Classic Christian pottery, red, orange and yellow being less common. White-slipped pottery disappears entirely in the Late Christian period, and red returns to its greatest popularity. Many are further embellished in all these periods, best representing the stylistic tendencies of their epoch. Painted decoration is most common, and can appear on both surfaces. Interior decoration begins to develop from the Classic Christian period, especially on large, wide bowls that become extremely ornamental (**Pl. 13**, CB-525, CB-1013; **Pl. 14**, CB-178, CB-177, CB-2002, CB-540). This form is suitable for both serving and displaying food, and may reflect some social phenomenon of communal eating.

Bowls can be generally divided into two main form groups in all periods. The first is small to medium dishes with a plain base and usually a simple, mostly rounded or tapered rim (**Pl. 12**). The Early to Classic Christian periods see consequential changes to this simple shape. Early bowls are almost semi-spherical, with a rounded bottom. A flat or sometimes slightly convex base with straight flaring walls becomes more popular from the Classic Christian period onwards. The second group of medium and large-size bowls have footed bases and variously formed rims (**Pls. 13–14**).

The first group's transition from round to flat bottoms and general predominance of flat-based bowls from the Classic Christian period onwards is significant as it may be evidence of changes in dining customs. A filled spherical bowl must be held in hand or placed on a soft, adaptable surface such as sand. Flat-bottomed dishes are better suited to flat and relatively hard surfaces. Therefore, it is possible that changes in sitting at the table and feasting are reflected in these modifications of the bowl bottom.

Bowls were produced in various sizes and proportions through all periods. Rim diameters range from 10 to ca. 40 cm at Banganarti. A group of small,

Plate 12.

Serving vessels:
small bowls
with plane
bases





Plate 13.
Serving vessels:
footed bowls from
the Early and
Classic Christian
periods

Plate 14.

Serving vessels:
footed bowls
from the Post-
Classic and Late
Christian periods



CB-178



CB-1986

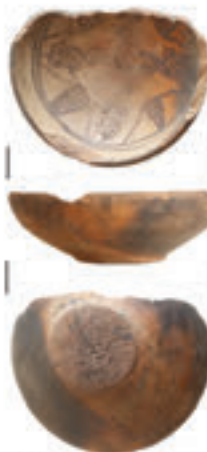


CB-2002

5cm



CB-177



CB-172



CB-540



CB-619



CB-1036



CB-1027

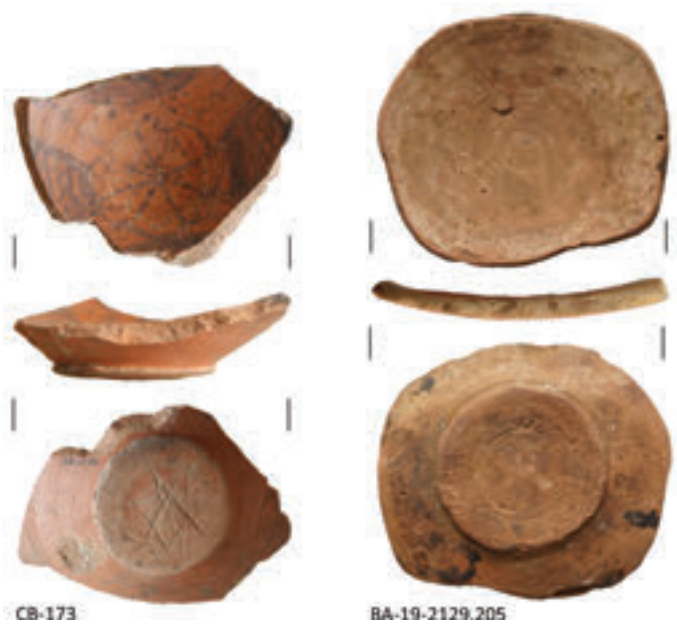


Plate 15.
Serving vessels:
bowls with traces of
repairs and reuse

5cm

Plate 16.
Serving vessels:
cups





Plate 17.
Serving vessels:
vases

Plate 18.
Serving vessels: pots





Plate 19.
Serving vessels:
closed forms,
jugs (top) and
spouted jars
(bottom)



usually plain bowls easily held in hand can be linked to individual consumption (**Fig. 15**). On the other hand, the largest bowls can be associated with displaying and serving food and are connected with collective consumption, similar to modern Sudanese practice where all participants take pieces of the meal from the same dish. Throughout the Christian periods, one can observe quantitative differences between these two groups. Small dishes quantitatively prevail in early Banganarti pottery but become much less frequent in the Late Christian period, when they give way to larger forms. These quantitative differences may indicate changes in eating habits, a transition from individual to more collective consumption.

Many Banganarti bowls bear traces of long usage, especially Post-Classic and Late Christian period vessels. The slip on the interior centre of some bowls is completely worn out (**Pl. 12**, CB-15; **Pl. 13**, CB-525; **Pl. 14**, CB-178, CB-1986, CB-1036), possibly caused by scratching the surface with a spoon or other utensil. Numerous scratches and cuts also are recorded on flat, solid bases (**Pl. 12**, CB-15, CB-106; **Pl. 13**, CB-155; **Pl. 14**, CB-172) and in some cases, ring bases are completely gone.

Bowls are the most common vessel type to show signs of repair (**Pl. 15**). Mending holes, recorded especially on large, richly decorated dishes, suggest their users highly valued them. However, they may not necessarily nor even only have been of material value but indicate the users' attachment to them, also perhaps for emotional or sentimental reasons.

Cups (Plate 16)

A very small group of cup fragments accounts for only 0.4% of Banganarti tableware (see **Fig. 14**). I have defined this type as a vessel having a plain flat or slightly convex base and flaring straight walls, small enough to be held in one hand. The type intergrades with bowls, being distinguished primarily by rim diameter size, fitting to the hand and smaller than the height of the vessels. Bowls and cups have similar variables, such as paste composition, surface treatment and slip colour.

Cup fragments are first recovered in contexts dating to the end of the Classic Christian period at Banganarti, but they are most abundant in the Late Christian period. A few examples are decorated with a painted frieze on the exterior just below the rim (**Pl. 16**, CB-1990, BNG-18-600-59, CB-875). Their style and decorative motifs are similar to those found on contemporary bowls.

Cup rim diameters range from 9.6 to 11.5 cm, with a surprisingly homogeneous capacity of ca. 260 and 350 ml, which we may assume was standard for consumed drinks.

Vases (Plate 17)

Vase fragments account for 3% of Banganarti serving pottery and represent 4% of its estimated vessel numbers (see **Fig. 14**). Most are produced in the finest clays, including kaolinite, and fastidiously executed. This type morphologically lies between bowls and table pots. It is a medium-size constricted vessel with relatively high, nearly straight or intapered walls and always flat-bottomed. It usually has a ring base in the Early and Classic Christian periods, later most commonly a solid base. From the end of the Early Christian period, when it be-



Fig. 16
Ceramic toilet
discovered in situ in
Sector NECH, Area 27.
Photo by Michał Dzik

comes most abundant, it has a distinctive flange slightly below the rim around the upper external wall. This has some decorative value but also a practical application to facilitate grasping and carrying the vessel.

All vase fragments are slipped on both surfaces, although the interior coating is often thinner and less carefully spread. The external surface is always decorated and, as William Adams noted, they are ‘the most consistently and most elaborately decorated vessels of the latter half of the Christian period’.⁴⁹

The rim diameter of Banganarti vases measures from 10 to 25 cm, although the vast majority are 11–16 cm. The capacity of the few vessels sufficiently preserved to reconstruct the complete form measures from 0.9 to 2.6 litres. Although of uncertain function, their shape, relatively tall proportions and volume suggest serving liquids or possibly liquid food.

Pots (Plate 18)

Pots are the second most numerous group of serving pottery, some 6% of all sherds and estimated vessel numbers (see **Fig. 14**), but many of their features can vary considerably. Smaller pots can be of excellent paste, but

⁴⁹ ADAMS 1986: 102.



Fig. 17

Oil lamp discovered in a niche of Sector NECH, Area 43, together with two qadus-knobs, a spindle whorl and a stone. Photos by Michał Dzik and P. Terendy

inferior-quality Nile silt or some organic temper is also used. Their shape is generally characterised as having a rounded or even bulky belly and emphasised rim, most often with a slightly everted or straight short neck. Some examples, however, have convex walls ending in a modelled rounded rim. The base usually is flat.

The exterior is always slipped and often decorated, most popular in painted stripes and friezes, usually with geometric shoulder motifs although sometimes covering the whole body (Pl. 18, CB-07, CB-1956, CB-1665). Decorative bands of stamps or incised grooves also rarely are recorded on the shoulder. The interior surface of smaller pots usually also is thinly slipped, while middle and large sizes usually have rough uncoated interiors, except for streaks and a band below the orifice created when the exterior was coated.

Tableware pots can be quite different in size. Among the dozen or so vessels in the Banganarti assemblage whose capacity can be calculated, the smallest can hold 0.6 litres and the largest over 7 litres. Their function can generally be associated with serving various liquids rather than dry food products and meals. They also could be used for preparing food. Soot traces on the base and lower body of one small pot, of 0.6 litre capacity, found *in situ* in Sector NECH, Area 33, indicates multiple contacts with fire (Pl. 18, CB-1003). It could have been used to cook or heat water, milk, or other drinks, given its size.

Closed Vessels (Plate 19)

The tableware closed vessel group at Banganarti consists of bottles, jugs and a few singular vessels. Together they represent only 3% of the serving group (**Fig. 14**). However, their closed shape indicates they held liquids and were used for pouring drinks.

More often than other tableware, this group is made of Nile silt paste, especially in the Post-Classic and Late Christian periods. All are slipped on the exterior, and inside only at the upper neck below the opening. The few closed vessel fragments do not form a coherent group of standardised types, but rather a large variety. The only exceptions may be jugs dated to between the Early Christian and the beginning of the Classic Christian periods, characteristically with necks having a narrow collar below the rim and an unusual brownish slip (**Pl. 19**, CB-646, W-BNG-17-11/12) not seen on other contemporary tableware types.

Notable in this group are two almost complete jars, one belonging to the analysed ceramic assemblage (**Pl. 19**, CB-707) and the other (**Pl. 19**, BNG-45-2010) recovered earlier near the Banganarti enclosure wall.⁵⁰ They differ in size, surface colour and decoration, but their form and function seem very similar. Both have an ovoidal body widest in the upper part, set on the ring base. Their most characteristic element is a spout on the shoulders slightly below the upper opening. The first jar discovered is red-slipped with a painted frieze of birds above incised horizontal and wavy lines. The second vessel has a light-orange slip and two red-painted geometric friezes above similar incised lines. The jar with birds seems earlier, possibly ca. ninth century in date, the other no more than a century later. The older vessel is also bigger, its height measuring 44 cm, with a maximum diameter of 42 cm and capacity of almost 25 litres. The rim edge of the smaller jar is completely broken off, but its preserved height of 28 cm probably is near the original, its maximum diameter is 35 cm and it could hold over 13 litres. Their form, especially the spout, suggests they were used for pouring liquids, most likely wine. Their bulky size suggests they probably were not used daily, but rather on special occasions, such as festival meals with a larger number of participants. It can also be concluded they were pretty valuable, as evidenced by the extensive use of the orange jar even after its rim was damaged, which is proved by the wear of the edge. Unique decoration and high-quality craft also indicate such an assumption.

OTHER VESSEL FUNCTIONS

The picture of ceramic use in Nubian households would be incomplete without adding a few words about vessels and clay objects having functions unconnected with food but playing a vital role in the daily life of medieval Banganarti.

⁵⁰ DRZEWIECKI 2013: fig. 13; ŻURAWSKI *et al.* 2014: fig. 2.

Qawadis (Plate 20)

The first type acknowledged here is the *qadus* (pl. *qawadis*), a pot used on the waterwheel (*saqia*) and thus of great agricultural importance and, indirectly, for the whole economy of medieval Nubia. The *saqia* system probably was introduced to the Middle Nile Valley around the fourth century A.D.,⁵¹ but did not spread until the following centuries when it created an agricultural revolution.

Qawadis, together with globular cooking pots and *dokat*, are emblematic of the Christian period, scattered on every settlement site. Their omnipresence is easily explained by their great demand, as one waterwheel needed a few to a dozen *qawadis*, and, additionally, they would wear out and break. They therefore had to be mass-produced and, like amphorae, according to standardised requirements. As a result, they account for more than 2% of all potsherds collected at Banganarti.

Most *qawadis* are of relatively porous fabric to reduce weight, which is achieved by adding organic material to the mostly Nile silt clay. The surface is always untreated. They have a characteristically tulip-shaped body, protruding rim edge and flattened knob at the base (**Pl. 20**). These morphological features are designed to facilitate tying ropes below the vessel orifice and at its base. A chain of pots connected by ropes is placed on a wooden wheel that submerges them into the well or the river when moved. Many *qadus* potsherds at Banganarti, especially rim fragments, show use-wear signs where the rope was attached, confirming these vessels were, indeed, used for drawing water. Some *qawadis*, however, could serve other functions within the settlement, most likely storage but possibly also to keep water cool, like *zir* (pl. *azyar*).⁵²

Toilets, Urinals, Pipes and Basins (Plate 21)

Hygiene is another sphere of Banganarti daily life needing ceramics. Toilets, urinals, pipes and basins are all clay objects connected with sanitation. Toilet seats are maybe not commonly encountered in medieval Banganarti houses, but also not unusual. These consist of a wheel-thrown pipe-like part, usually slightly convex, with an everted upper edge and set on a flat hand-made slab (**Pl. 21**, CB-14, CB-1008). Some examples have an additional elongated low container attached to the pipe and perforations in the base (**Pl. 21**, CB-13). The interior surface of many fragments is covered with a thick layer of residue. A few toilets were discovered in Sector NECH in spaces interpreted as latrines, one still *in situ*, placed on wooden beams, leaving its function in no doubt (**Fig. 16**). All fragments and complete toilets were retrieved in contexts dated from the end of the eleventh to the fourteenth century.

Urinals, on the other hand, were discovered in quarters dating to the Early Christian period. One (**Pl. 21**, W-BNG-29-11/12), set partly into the enclosure wall near its southwestern corner, probably was an element of a communal latrine.⁵³ It is a rectangular basin with rounded edges and a long spout to lead the water and

51 Cf. TRIGGER 1967: 32–33; THOMAS 2008: 66.

52 In modern Sudan, large jars used for storing and cooling water are traditionally set in domestic shaded courtyard areas, streets, cemeteries and in front of public buildings, etc., to provide local residents and visitors with fresh drink.

53 ŻURAWSKI 2015: 372, fig. 3.

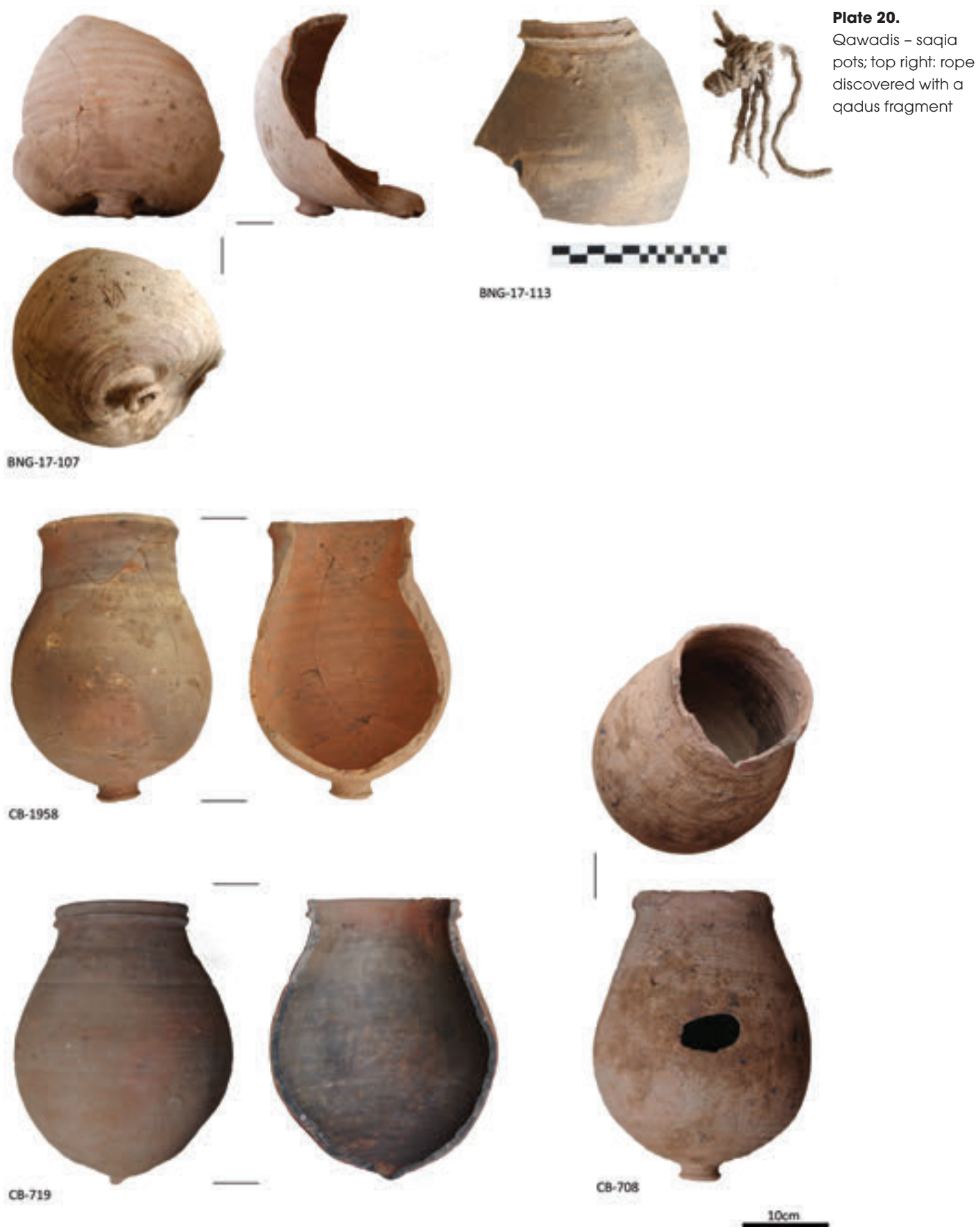


Plate 21.
Ceramic urinal,
toilets and basins



10cm

other liquids outside the walls. The early levels in this part of Banganarti include a sophisticated drainage system installation to dispose of water outside the baths complex in the southwestern corner of the enclosure.⁵⁴ Here, the channels are mostly of red brick, but many houses are equipped with ceramic cylindrical pipes used for drainage and commonly set into walls or vaulting for room ventilation.

The function of ceramic basins is more ambiguous than toilets, urinals and pipes. They also are more numerous than the other related types, accounting for 1% of all collected sherds. All are hand-made, but in a fabric typical of wheel-thrown storage containers. Most Banganarti basins have a flat bottom, with walls perpendicular to it and sometimes widening slightly upwards, and a flattened rim edge (**Pl. 21**, CB-1018, CB-2098). Virtually all basins are red-slipped, in every phase. Any decoration consists only of incised geometric motifs on the rim top. Their thick walls and large size of ca. 50 cm or more make them suitable for storing dry products, although the find contexts of some complete examples suggest they could also be used for washing bodies or clothes.

Oil Lamps

The last pottery type discussed here is the oil lamp. Small clay vessels used for illumination are found in a variety of shapes throughout the Christian period. The most popular is the 'candle-holder' form, a flat dish with a small container in the middle and one or several wick-holes. The other common type is even simpler, a small bowl, either rounded or squared by pinching the rim into four spouts.

Given the number of finds, it seems oil-lamp use inside houses was not common practice at Banganarti. Only 26 lamps have been identified out of 100,000 fragments of analysed pottery in the settlement – barely a third of those found in the upper church.⁵⁵ Oil lamps served as light sources in sacred spaces but perhaps their symbolic meaning and votive function were even more important. Lamps and traces of their use are also recorded in spaces within fortifications, public areas, passages and staircases, but only a few were discovered in their original context in houses. Traces of soot in the niche (**Fig. 17**, left) formed by blocking the window near the entrance (Sector NECH, Area 43/37) where the lamp (**Fig. 17**, right) was discovered indicate this was its place of use. In Area 5 of the same sector, an oil lamp was left on the floor near globular pots set there for storage.

CONCLUSION

The more than 1000,000 potsherds collected during only four years of excavation at Banganarti illustrate the ubiquity of pottery and how deeply it penetrated the lives of medieval settlement dwellers here. It played a critical role in food-related functions. Bringing, keeping, preparing, serving and finally consuming food all involved ceramic containers. Such an important activity in daily life as cooking could not take place without clay pots. Moreover, while some pottery (mostly cooking or

⁵⁴ Cf. Żurawski forthcoming

⁵⁵ CEDRO 2014: 333–335.

storage vessels) is highly conservative and remained unchanged for a long time, other types (especially tableware) underwent many transformations, externalising their time's changing consumption habits and aesthetic trends. The role of ceramics within Nubian households was not limited to food-related activities but involved various spheres of Banganarti life, from irrigation to hygiene.

Their great demand created high specialisation and proficiency in pot-making. Nubian household potters mastered the production of cooking ware, manufactured over several centuries, repeating recipes for clay paste, surface treatment and shapes according to virtually unchanged rules. Centrally organised workshops thrived alongside long-standing traditional pottery production. They created high-quality tableware that constantly shifted, responding to the changing needs of a given time.

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Vessels from the pilgrim
shelter in Sector NECH
stored in the workroom
(Photo Aneta Cedro)

Glass vessels at Banganarti

Sylwia Wajda

Abstract:

Archaeological research carried out since 2001 at Banganarti (the site is located between the Third and Fourth Cataracts, about 10 km from Old Dongola) has led to the discovery of the remains of a church and a fortified settlement surrounding it. Excavations have brought numerous finds, including more than 120 fragments of glass vessels, dating from the seventh to the fourteenth century. Various types of bottles, windowpanes, fragments of vessels with tonged, mould-blown decoration, and marvered glasses can be distinguished. Chemical composition analysis of 58 glass fragments was carried out. Almost all the samples examined can be classified in the sodium glass group. The samples examined were assigned to pre-established glass groups, allowing the chronology of essential changes in glass production in the region to be determined. The results indicate that in the Early Islamic period (seventh to ninth centuries), the glassware that reached Banganarti was mainly produced using natron. Fragments of glass vessels from the period between the tenth/eleventh and fourteenth centuries belong to glasses smelted using the ashes of halophytic plants.

Keywords: Islamic glass, EPMA, glass technology, ash soda glass, natron glass.

Introduction

The assemblage of glass artefacts discovered during excavations at the medieval site of Banganarti comprises over 120 vessels, mainly preserved as small fragments. Vessels were found within the church as well as the surrounding fortifications and living quarters. Although recovered in a fragmentary condition, it is possible to identify their original shape and decoration in some cases. Indeed, they represent many of the well-known vessel types that were used during the Islamic period, such as square-sectioned bottles, molar flasks and vessels with tong-impressed decoration. Glass windowpanes were also found. Unfortunately, most fragments are non-diagnostic bodies of unidentifiable vessel types. A detailed description of the analysed finds is presented in **Table 1**.

Almost all identified vessel fragments are from strata dating to the Abbasid-Fatimid period, based on the pottery that they contained. Those glasses whose dating is uncertain (due to the location of the find) are described and analysed in a broader chronological context (Abbasid-Fatimid to Ayyubid-Mamluk period). Closed vessels are presented first (bottles), then open vessels (bowls, jars) and miscellaneous glasses, such as a wine glass and windowpanes.¹ Finally, the plain glasses are described before the decorated ones.

Elemental composition analyses were carried out for 58 glass fragments. The study presents a fundamental analysis of the research results. In addition, a detailed discussion of the glass compositions will be presented separately.²

TYPOLOGICAL CLASSIFICATION

Bottles with an Infolded Rim (Fig. 1:1–2)

Two glass fragments discovered in the living quarters at Banganarti can be classified as bottles with an infolded rim. They are made rather carelessly in light bluish-green translucent glass. This bottle type is one of the most characteristic of the Umayyad period.³ They are small- to medium-sized vessels, with short necks and globular or elongated bodies. Similar forms have been found at numerous sites in Egypt, at Alexandria,⁴ Tebtunis,⁵ Fustat (seventh–eighth centuries),⁶ and Raya in southern Sinai.⁷ They are also common along the eastern Mediterranean coast. Bottles with an infolded rim from the Umayyad period were found at Ramla, Hammat Gader,⁸ Bet She'an,⁹ Caesarea, Usais,¹⁰ and Jerash (Byzantine-Umayyad period).¹¹

Fig. 1

Glass vessels

1 HADAD 2005.

2 WAJDA, MARCINIAK-MALISZEWSKA *forthcoming*.

3 GORIN-ROSEN 2010: 223.

4 KUCHARCZYK 2005: 31–32, fig. 1:1–4.

5 FOY 2001: 476–480, pl. 6:111.

6 SCANLON, PINDER-WILSON 2001: 40, fig. 15n.

7 SHINDO 2003: 180–181, fig. 2.4.

8 GORIN-ROSEN 2010: 223–224, pls. 10.1:13, 10.2:8.

9 HADAD 2005: pls. 8:150–151, 9:182–184, 10:185–190.

10 POLLACK 2003: 165, fig. 1:6–7.

11 KATSNELSON 2014: 45, fig. 11.6–7.

ГПР₁



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Bottles with a Cylindrical Body (Fig. 1:3–5)

The small bottle with a cylindrical body is made of green-bluish glass, with black and silver weathering visible on the surface. The vessel has a short, cylindrical neck and sloping shoulders. Another fragment that can be classified with this group of vessels is a base of dark green, light translucent glass. Both bottles have almost flat bases and thick walls. This vessel type is widespread in the Early Islamic period, mainly in the tenth–eleventh centuries.¹² Complete specimens were discovered at Ramla,¹³ Bet She'an (Abbasid-Fatimid period),¹⁴ and Tiberias (tenth–eleventh centuries).¹⁵ To the same type probably belongs a flat-base bottle fragment decorated with vertical ribs (Fig. 1:5) of greenish-blue transparent glass. Vessels having a similar decorative motif have been found at Yoqne'am (ninth–twelfth centuries) and are known from the eleventh-century shipwreck at Serçe Limani,¹⁶ as well as at Fustat in Egypt and Tel Lod in Israel (eighth–eleventh centuries).¹⁷

Bottles with a Square-Sectioned Body (Fig. 1:6–11)

Five almost complete and two fragments of small bottles with square-sectioned bodies represent another vessel type at Banganarti. Two are intact, with a short cylindrical neck and angular shoulders. The colour and transparency cannot be determined because its surface is abraded and entirely weathered to silver-grey (Fig. 1:4–5). The other three specimens (Fig. 1:7–9), with little or unpreserved neck, are characterised by curved shoulders and slightly flared bodies. Their surfaces are lightly weathered, but their colours and transparency can be determined as brown, light yellow and dark green. Bottle 11 is probably of the same type, of which only base and body fragments are preserved (Fig. 1:11). Stefano Carboni¹⁸ has published an almost identical specimen in terms of form, dimensions, colour and transparency.¹⁹ All have a thick base and were formed by tooling or blowing the glass into a simple mould. Square bottles appeared during the Umayyad period but became more common during the Abbasid-Fatimid period. Many such finds, including complete examples, come from Fustat.²⁰ In addition, bottles of this type have been recovered on Kom el-Dikka at Alexandria,²¹ Bet She'an (Umayyad period),²² Ramla (probably Abbasid period),²³ Tiberias,²⁴ and Khirbat 'Adasa (Abbasid period).²⁵ However, several fragments of this type described as phials by Helen Morrison²⁶ were discovered at Soba, Sudan, and Debeira West.²⁷

12 LESTER 2003: 161.

13 GORIN-ROSEN 2010: 231, pl. 10.5:3.

14 HADAD 2005: 39, pl. 35:695.

15 LESTER 2003: 161, fig. 3.32.

16 CULLEN 2009: 240–241, type IIIB1–2, fig. 19-2: PF37, 41.

17 KATSNELSON 2020: 152, fig. 6:9.

18 CARBONI 2001a: 155, cat. 3:7a.

19 This is a bottle from the Syrian or Egyptian region, dating to the ninth–tenth centuries.

20 SCANLON, PINDER-WILSON 2001: 66–68, pl. 34e; PINDER-WILSON, SCANLON 1987: 62, fig. 5.

21 KUCHARCZYK 2005: 33, pl. 1:12–13.

22 HADAD 2005: 23, pl. 5:99–100.

23 GORIN-ROSEN 2010: 231, pl. 10.5:4–8.

24 LESTER 2003: 161, fig. 3.

25 GORIN-ROSEN 2008: 128–129, fig. 3:1.

26 MORRISON 1991: 257, fig. 147:79, 81, 83, 85–86.

27 HARDEN 1978: 85, fig. I:31.

Bottles with a Polygonal Body (Fig. 1:12–13)

Two bottle fragments were found in the upper church. Bottle 12 (**Fig. 1:12**) was probably blown into a mould and then cut to form a hexagon. It is of dark purple, non-transparent glass and comes from the eleventh–fourteenth-century stratum. The second specimen, of dark green, non-transparent glass and preserving only the bottom (**Fig. 1:13**) was probably only blown. Both bottles have thick walls (0.4 cm) and a thick, flat base (0.5 cm). This vessel type has been found at Fustat²⁸ and is known at the Israeli sites of Tel Lod²⁹ and Bet She'an,³⁰ and it dates to the Abbasid-Fatimid period (750–1099). Specimens similar to those at Banganarti were also found in the eleventh-century shipwreck at Serçe Limani.³¹

Phial (Fig. 1:14)

One small, thick, elliptical base fragment of green translucent glass is identified as a phial. These vessels may have been used for measuring and probably storing liquids (oils, perfumes) or medicines. The phial was found in a stratum dated between the second half of the twelfth and the first half of the thirteenth centuries. Several specimens in many shades of green colour dating to the Mamluk period were discovered at Quseir Al-Qadim, Egypt.³² Phials dateable to the Islamic period come also from Fustat (tenth–eleventh centuries)³³ and Alexandria.³⁴ A large quantity of this vessel type was found at Tiberias, where they are dated to the eighth–eleventh centuries.³⁵

Toilet 'Molar' Flask (Fig. 1:15)

A small fragment of a toilet cosmetic bottle, the so-called molar flask, was found in Sector NECH in the ninth–twelfth/fourteenth-century layers. The vessel is of dark green (emerald green), slightly transparent glass. Only half of its lower part is preserved, i.e. one foot and two body fragments. This vessel type is blown into a rectangular mould, then decoration is cut in various forms.³⁶ Finally, V-shaped grooves are carved on the two preserved walls of the Banganarti vessel. This bottle type is widespread throughout almost all Islamic countries³⁷ and, according to Carboni,³⁸ it represents the most common Early Islamic glass containers for perfumes and essences, especially in the ninth–tenth centuries.³⁹ 'Molar flasks' have been found at Fustat,⁴⁰ Raya,⁴¹ Quseir Al-Qadim, Egypt (Mamluk

28 SHINDO 2002: pl. 6-15:11.

29 KATSNELSON 2020: 144–145, fig. 3.10–11.

30 KATSNELSON 2014: 42–43, fig. 11:4–5; GORIN-ROSEN 2010: 247, pl. 10.8–9; HADAD 2005: 42, pl. 40:836–837.

31 CULLEN 2009: 240–241.

32 MAYER 1992: 82, pl. 17:444–465.

33 SCANLON, PINDER-WILSON 2001: 40–41, fig. 16.

34 KUCHARCZYK 2005: 33, fig. 1:5.

35 LESTER 2003: 162, fig. 4.

36 CARBONI 2001a: cat. 27.a–c, cat. 2.28.a–p.

37 KRÖGER 1995: 135.

38 CARBONI 2001a: 99–100.

39 KATSNELSON 2020: 146, fig. 6:17.

40 PINDER-WILSON, SCANLON 1987: 68, fig. 16.

41 SHINDO 2003: 182, fig. 3:8.

period),⁴² Bet She'an (Abbasid-Fatimid period)⁴³ and Ramla.⁴⁴ The Banganarti vessel is identical in glass colour and decoration to eleventh-century bottles at Cesarea Martima.⁴⁵

Bottles with a Ridged Neck (Fig. 1:16–18)

Three neck fragments of this type, including two with rims, are of slightly clear, green glass. This bottle type is blown and tooled to create ridges on the neck. Yael Gorin-Rosen⁴⁶ has distinguished two subtypes of such vessels, the first characterised by poor artistry and thin walls, and the second, which should include the three Banganarti fragments – mainly by a thicker rim, neck and walls. The glass is of better quality and the vessel more carefully made, with almost even corrugation (**Fig. 1:16**). This type is also found at many Islamic sites, probably first appearing during the Umayyad period but more common during the Abbasid period.⁴⁷ Ridged neck bottles are known at Aidhab on the Sudanese coast (generally from the ninth to the twelfth century),⁴⁸ and several seventh–ninth-century fragments (including two of green colour) were also recovered at Debeira West in northern Sudan.⁴⁹ Parallels to the Banganarti fragments have been found at Fustat,⁵⁰ Tebtunis (eighth–ninth centuries),⁵¹ Bet She'an, Capernaum (Umayyad period)⁵² and Ramla.⁵³ Others are known from Alexandria (ninth–tenth centuries),⁵⁴ Khirbat el-Thahiriya,⁵⁵ Cesarea (Abbasid period),⁵⁶ Raya⁵⁷ and Qal'at Sem'an (Syria).⁵⁸

Vessel Fragments with Mould-Blown Decoration (Figs. 1:19–20, 2:1)

The Banganarti glass assemblage includes three fragments with mould-blown decoration, one undoubtedly a 'bubble-rim bottle'.⁵⁹ This vessel type has very thin walls, a near-globular body with rounded or sloping shoulders and a tapering or cylindrical neck. The base of the Banganarti bottle has a double six-pointed star motif with the central circle, surrounded by a few dimples. The pattern is carelessly made, with a pontil mark spoiling the design. Very similar motifs appear on many vessels in the eleventh-century Serçe Limani shipwreck

42 MAYER 1992: 83, 199; WHITCOMB 1983: 104, fig. 4:p, r.

43 HADAD 2005: 45, pl. 42:868.

44 GORIN-ROSEN 2010: 232, pl. 10.5:9.

45 POLLACK 2017: 290, fig. 5:20–25.

46 GORIN-ROSEN 2010: 233.

47 FOY, PICON, VICHY 2003: 140, fig. 2:18–19.

48 HARDEN 1955: 73, fig. 42.

49 HARDEN 1978: 84–85, fig. 1:26–27.

50 SCANLON, PINDER-WILSON 2001: 46–47, 49, fig. 20:d–j.

51 FOY 2001: 476, fig. 6:106.

52 KATSNELSON 2014: 42, fig. 11:1; GORIN-ROSEN 2010: 235; HADAD 2005: 24, pl. 11:204.

53 KATSNELSON 2016: fig. 1:2–4; GORIN-ROSEN 2010: 235, pl. 10.6:7–10.

54 KUCHARCZYK 2005: 33, fig. 1:8–11.

55 JACKSON-TAL 2012: 61, fig. 2:28–30.

56 JACKSON-TAL 2012: 61, fig. 2:28–30.

57 SHINDO 2003: fig. 2:4.

58 DUSSART 2003: 177–178, fig. 5:4–4e.

59 ACIEN, BASS 2009: 217.

(B3b – mould 13, B4b – mould 14).⁶⁰ Such vessels have also been found at Fustat⁶¹ and Alexandria.⁶² Unfortunately, the other two fragments are too small for reconstruction of their original forms. Both have thick walls and are of bluish-green translucent glass. One (no. 19) is decorated with a honeycomb motif with rhomboid dimples, very popular during the Abbasid-Fatimid period⁶³ and known at Ramla,⁶⁴ Bet She'an (mid-eighth–eleventh centuries),⁶⁵ and the eleventh-century Serçe Limani shipwreck.⁶⁶

Sprinkler (*QumQum*) (Fig. 1:21)

The fragment of a small glass tube, slightly bluish and very transparent, is probably a fragment of the neck of a bottle type called sprinkler (*QumQum*). Such bottles had a long neck with a narrow mouth and plain rim, with an oblate spheroid body.⁶⁷ Sprinklers of greenish colour are known from Jerusalem. The vessels were decorated with moulded decoration. Naama Brosh⁶⁸ dates them to the thirteenth–fifteenth centuries. Two such vessels, made of light-yellow glass, are also known from Bet She'an and are dated to the Ayyubid-Mamluk period.⁶⁹ In addition, sprinklers have been found at Fustat (the marvered sprinkler is a surface find),⁷⁰ Quseir al-Qadim, Egypt,⁷¹ Beirut (twelfth–thirteenth centuries), Abu Gosh, Hama, Baalbek (thirteenth–fourteenth centuries).⁷²

Wine Glass (Fig. 1:22)

The only wine-glass fragment found at Banganarti is the lower part of a straight foot in dark green, slightly translucent glass. Wine glasses were trendy during the Byzantine and Early Islamic periods, especially in the Syro-Palestinian region.⁷³ They were probably produced in the glass workshop at Apollonia-Arsuf in the fifth–sixth centuries.⁷⁴ Wine glasses dating to the Umayyad period are known from Bet She'an, Tiberias, Pella, Jerash and Fustat.⁷⁵

Vessel Fragment with 'Tongued' or 'Pinched' Decoration (Fig. 1:23)

One unidentifiable fragment (probably a bowl or beaker) is decorated using a tong to form a concentric oval impression on both body faces. This is called

⁶⁰ LLEDO, MATTHEWS 2009: 28, fig. 3:1.

⁶¹ SHINDO 2000: 233–234, fig. 1:5.

⁶² KUCHARCZYK 2005: 35, 37, fig. 4.

⁶³ KATSNELSON 2020: 144, fig. 3:3–5.

⁶⁴ KATSNELSON 2014: fig.10:4–6; GORIN-ROSEN 2010: 247, pl. 10.9:2.

⁶⁵ HADAD 2005: 37, pl. 30:587, 594–596.

⁶⁶ ACIEN, BASS 2009: 216, fig. 17-2–4.

⁶⁷ CARBONI 2001a: 73, fig. 3.

⁶⁸ BROSH 2005: 187, fig. 2.

⁶⁹ HADAD 2005: 59, 61, pl. 53:1090–1091.

⁷⁰ SCANLON, PINDER-WILSON 2001: 106, fig. 44b.

⁷¹ MAYER 1992: 82.

⁷² HADAD 2005: 61.

⁷³ KATSNELSON 2014: 33.

⁷⁴ JACKSON-TAL 2020: 223, fig. 16.6:2–3.

⁷⁵ HADAD 2005: 28, pl. 21:400–412; FOY *et al.* 2003: fig. 1:1–2.

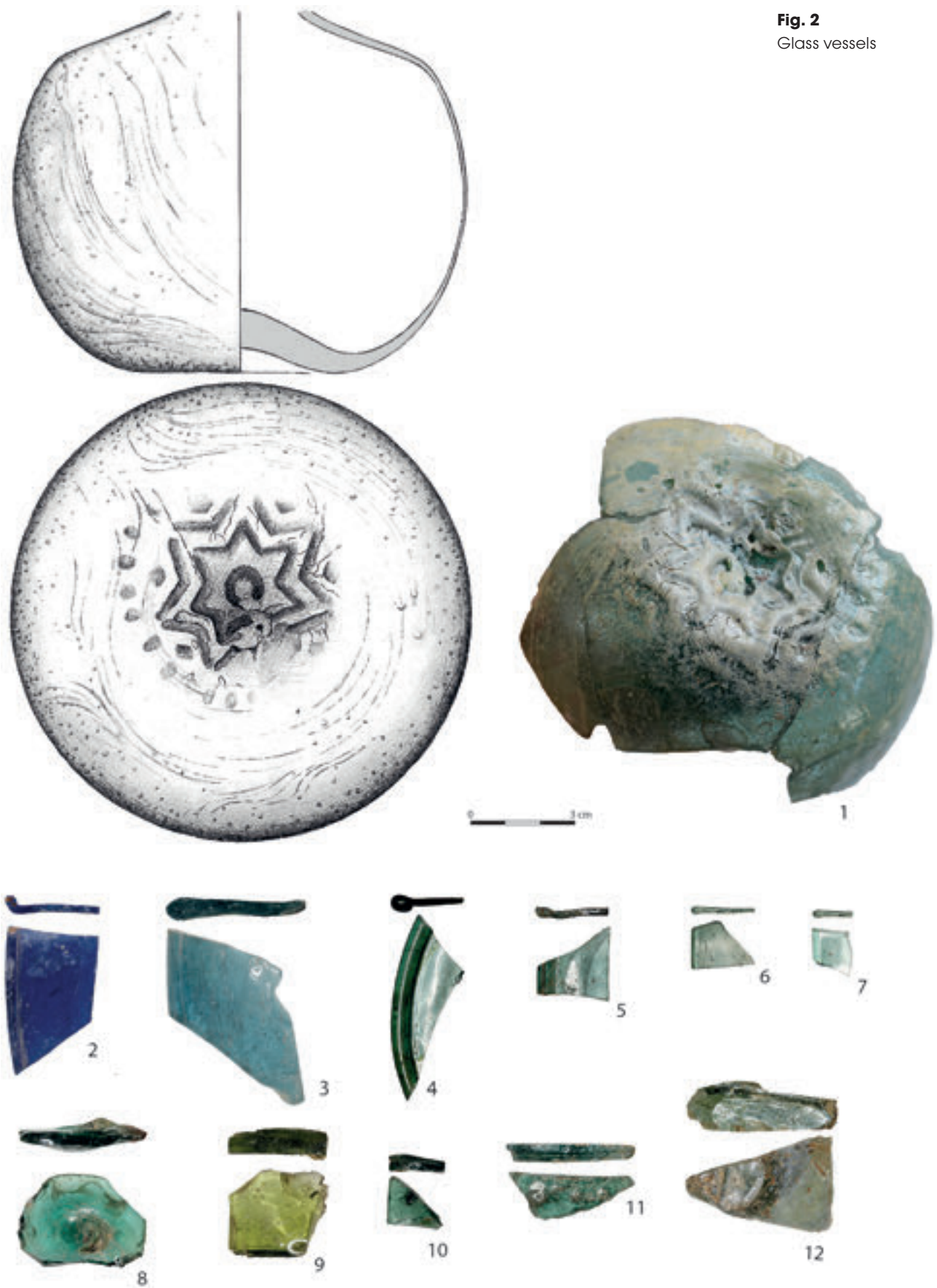


Fig. 2
Glass vessels

‘pinched decoration’ in the literature,⁷⁶ and was common in the ninth–tenth centuries. Glass vessels with different ornamental patterns have been found in a very large number on Kom el-Dikka at Alexandria, where they were probably produced,⁷⁷ although their main production centre is believed to be Fustat.⁷⁸ Vessels with pinched decoration also are known elsewhere in Egypt: at Tebtunis (ninth century),⁷⁹ Ashmunein and el-Tur, Egypt.⁸⁰ An extensive vessel group with tonged decoration was also found at Bet She’an and various locations in the Israeli towns of Ramla, Cesarea and Nishapur,⁸¹ and many other sites.⁸²

Fragments of Marvered Glass Vessels (Fig. 1:24–25)

Two small fragments of marvered glass were found in a ca. 1050–1100 layer of the south portico of the upper church, and the twelfth–fourteenth-century layers of the SSEECH area. Both are of dark brown, slightly transparent glass as revealed in transmitted light only, although the bodies appear almost black in reflected light. Both have added white opaque trails, the smaller fragment in festoon patterns, and the larger as two straight parallel and probably wavy lines (**Fig. 1:24–25**). The trial-marvering technique was used in a wide variety of vessels (bowls, beakers, jars and toilet bottles), but the vessel types represented here are impossible to determine, due to their small scale of preservation. According to Carboni,⁸³ glass vessels with applied and marvered decoration are typical of mainly twelfth–thirteenth-century Islamic glassmaking workshops in Egypt and Syria. Some 276 fragments of Mamluk vessels with marvered decoration of blue, green, black, brown and purple glass dating to the thirteenth century were found at Fustat (Egypt).⁸⁴ Vessel fragments of this type were also discovered at Alexandria, where their production is associated mainly with local Ummayyad to Mamluk glassmaking workshops.⁸⁵ Furthermore, marvered vessels have been found elsewhere in Egypt: at al-Tur in Sinai (fourteenth–fifteenth centuries)⁸⁶ and at Quseir Al-Qadim (tenth–eleventh centuries).⁸⁷ Others were found at ninth–twelfth-century Soba⁸⁸ and seventh–ninth-century Debeira West in Sudan.⁸⁹ The late dating of marvered vessels is indicated by finds from Israel’s Bet She’an (twelfth–thirteenth centuries),⁹⁰ Ramla,⁹¹ Khirbat el Ni’ana,⁹² Giv’at Yasaf⁹³ and Emmaus al-Qubeiba,⁹⁴

76 KRÖGER 1995: 95–99.

77 KUCHARCZYK 2005: 35, fig. 3:3–7.

78 SCANLON, PINDER-WILSON 2001: 79–82, fig. 38.a–j.

79 FOY 2001: 474–475, fig. 5:84–102; 478–480, fig. 7:131, 135–136, 141–144.

80 KUCHARCZYK 2005: 35.

81 KRÖGER 1995: 95–99.

82 GORIN-ROSEN 2010: 243–245; KUCHARCZYK 2005: 35.

83 CARBONI 2001a: 291; 2001b: 105–106.

84 SHINDO 2000: 233–234, fig. 1.1–2; HADAD 2002: 155.

85 KUCHARCZYK 2015: 79.

86 HADAD 2005: 61.

87 WHITCOMB 1983: 103, fig. 2:b, cc–ee, mm–pp; MAYER 1992: 89–90.

88 HARDEN 1955: 64, fig. 37:30.

89 HARDEN 1978: 86, fig. II:40–42.

90 HADAD 2002: 155.

91 GORIN-ROSEN 2009.

92 GORIN-ROSEN, KATSNELSON 2007: 75–76.

93 GORIN-ROSEN 2006: 109.

94 HADAD 2002: 156.

all dated to the Mamluk period. Vessels with marvered decoration can be found all over the Middle East and their popularity was very high, as evidenced by numerous finds in the early medieval Balkans⁹⁵ and middle Volga region.⁹⁶

Windowpanes (Fig. 2:2–12)

Ten small windowpane fragments were recovered in living quarters (Fig. 2:3–12), and one more by the apse in the northern part of the church (Fig. 2:2). Seven fragments belong to the so-called crown or bull's-eye windowpanes, round or oval free-blown windows characterised by thin walls with round and thickened rims (Fig. 2:2–7), and a thicker centre often having a pontil mark (Fig. 2:8). Such panes are produced using the 'cylinder' process, based on free-blowing.⁹⁷ The fragments are of bluish-green (five) and blue (one fragment) glass, including one of cobalt glass. Another four fragments are thick, flat windows of greenish-blue and green translucent glass (Fig. 2:9–12), probably produced by blowing a cylinder and then opening it.⁹⁸

The first type was very common in the Byzantine period, mainly in the East, but also appears in Early Umayyad contexts.⁹⁹ They were found in eighth–eleventh-century strata at Banganarti. They often decorated not only churches and chapels, but also public buildings. According to Gorin-Rosen,¹⁰⁰ they were quite cheap and easily accessible, protecting rooms from inclement weather, sand and dust. Analogous finds dating to the Early Islamic (sixth–ninth centuries) period were found at Soba, including one intact specimen,¹⁰¹ and at seventh-century Debeira West.¹⁰²

GLASS TECHNOLOGY

Materials and Methods

Some 58 vessel fragments were selected for laboratory analysis, from both the church and living quarters areas. Only small fragments were chosen, but they represent almost all macroscopically distinguishable, distinctive features of the studied assemblage. Contextual details and complete analytical data of all samples are given in Table 1.

The chemical composition of the glass fragments was obtained using Electron Probe Microanalysis (EPMA) in the Laboratory of Electron Microscopy, Microanalysis and X-Ray Diffraction (formerly Inter-Institution Laboratory of Microanalysis of Minerals and Synthetic Substances), Faculty of Geology, University of Warsaw. Chemical analyses were carried out using a Cameca

95 SPASIĆ-DURIĆ, JOVANOVIĆ 2018; REHREN, CHOLAKOVA, JOVANOVIĆ 2018.

96 VALIULINA 2016: fig. 21.

97 KUCHARCZYK 2019: 57; GORIN-ROSEN 2000: 238–239.

98 GORIN-ROSEN 2000: 240.

99 HARDEN 1978: 88–89.

100 GORIN-ROSEN 2000: 240.

101 MORRISON 1991: 257, fig. 147:93; HARDEN 1955: 64, fig. 37:34–35.

102 HARDEN 1978: 88–89, fig. III:77–82.

SXFiveFE instrument equipped with five wavelength-dispersive spectrometers (WDS). Samples were embedded in epoxy resin, polished and carbon-coated. The electron microprobe operating conditions were 15 kV accelerating voltage, 6–10 nA probe current and, to minimise loss of Na during measurement, a defocused electron beam (15–35 μm in diameter). The analytical crystals and X-ray lines (in brackets) used were LTAP (F K α , Mg K α), TAP (Na K α , Si K α , Al K α , As L α , Zn L α), LPET (S K α , K K α , Ca K α , Sb L α , P K α , Cl K α , Pb M α , Sn L α , Ti K α , Sr L α , Ag L α , Au M α , Zr L α) and LLIF (Fe K α , Mn K α , Cu K α , Ni K α , Co K α , Cr K α , V K α , Ba L α). The natural and synthetic standards used in the analysis were phlogopite (F), sodalite (Na, Cl), diopside (Mg, Si, Ca), orthoclase (Al, K), celestine (S, Sr), InSb (Sb), YPO₄ (P), PbTe (Pb), cassiterite (Sn), rutile (Ti), Fe₂O₃ (Fe), rhodonite (Mn), cuprite (Cu), NiO (Ni), CoO (Co), ZnAs₂ (As), sphalerite (Zn), Ag (Ag), Au (Au), Cr₂O₃ (Cr), V (V), barite (Ba) and zircon (Zr). The $\Phi(\rho Z)$ correction model (X-PHI in electron microprobe software) developed by Claude Merlet¹⁰³ was used to quantify the chemical composition of the fragments investigated. Energy-dispersive spectra (EDS) and backscattered electron (BSE) images were also collected during observation of the samples.

A total of 370 analyses were carried out, with each glass colour tested to a minimum of 5 points for the presence of 28 constituents. In some cases, glass inclusions that became visible on BSE images were also investigated. The averaged results of the chemical composition analyses are presented in **Table 1**. The hierarchical cluster analysis (HCA) method was used to compare the chemical compositions of the glasses, using Ward's method with Euclidean distances for standardised data.¹⁰⁴ The analyses were conducted using Statistica software (ver. 13.0).

Results and Discussion

Based on analyses results, two main compositional groups are distinguished by the use of different soda fluxes. Sodium glass (depending on the origin of the soda added to the glass batch) is divided into: (a) melted using soda of mineral origin, and (b) melted using soda of ash origin. Following the criteria proposed by E. V. Sarye and R.W. Smith,¹⁰⁵ if the concentration of K₂O and MgO is below 1.5%, we are dealing with mineral soda glass and, if above 1.5%, with glass melted with soda of ash origin (**Fig. 3**). In addition, both glass types are divided into subgroups, depending on the origin of their main glass component(s), such as sand or limestone.

Mineral Soda Glass

Natron sodium glass, constituting the largest group studied (36 samples), is characterised by low potassium and magnesium content (< 1.5%) and quite high sodium content. By using HCA, two main branches are distinguished, and further subdivided into two groups (**Fig. 4**). Oxides representing the mineralogical composition of sands and soda (Al₂O₃, CaO, Fe₂O₃, TiO₂, K₂O, Cl) were selected to form the HCA tree.

¹⁰³ MERLET 1994.

¹⁰⁴ MAREK 1989.

¹⁰⁵ SAYRE, SMITH 1961.

Table 1.

A summary of glass samples excavated from Banganarti (*< - below the limit of detection of metod)

Sample	Form	Colour and transparency	Type of glass	SiO ₂	Na ₂ O	K ₂ O	CaO	MgO	Al ₂ O ₃	Fe ₂ O ₃	MnO	Sb ₂ O ₅	PbO	CoO
5	vessel (fragment of a wall)	greenish-blue, transparent	B1a	70,719	17,845	0,500	2,531	0,875	4,368	1,598	<	<	<	<
7	windowpane	greenish-blue, transparent		70,189	18,588	0,492	2,642	0,853	4,121	1,508	<	<	<	<
12	vessel (fragment of a wall)	greenish-blue, transparent		72,214	15,965	0,528	2,764	0,894	4,233	1,471	<	<	<	<
13	vessel (fragment of a wall)	colourless, transparent		70,174	17,587	0,507	2,946	0,896	4,344	1,564	<	<	<	<
16	vessel (fragment of a wall)	colourless, transparent		71,521	17,179	0,522	2,889	0,894	4,356	1,461	0,020	<	<	<
20	wine glass	green, slightly transparent		70,053	18,599	0,618	2,706	0,868	4,087	1,548	<	<	<	<
21	vessel (fragment of a wall)	light green, translucent		69,565	18,278	0,493	2,562	0,877	4,078	1,550		<	<	<
25	unknown vessel (fragment of a wall)	greenish-blue, transparent		73,949	17,161	0,473	2,933	0,553	3,428	0,764	0,018	<	<	<
34	vessel (fragment of a wall)	blue-greenish, translucent		72,044	17,653	0,411	2,872	0,821	3,800	1,276	0,017	<	<	<
36	windowpane	light green, translucent		70,486	19,114	0,487	2,613	0,876	4,138	1,543	<	<	<	<
43	vessel (fragment of a wall)	colourless, transparent		72,351	15,738	0,528	2,842	0,891	4,278	1,437	<	<	<	<
52	fragment of a trial (?)	greenish-blue, transparent		73,826	17,437	0,286	3,653	0,405	1,806	0,741	<	<	<	<
53	vessel (fragment of a body)	green, translucent		66,831	16,780	0,439	4,601	1,084	4,853	2,694	<	<	<	<
56	windowpane	greenish-blue, transparent		70,659	18,049	0,494	2,480	0,839	4,108	1,555	<	<	<	<
57	vessel (fragment of a body)	greenish-blue, transparent		70,999	17,622	0,498	2,680	0,884	4,404	1,581	<	<	<	<
C.7	windowpane	blue-greenish, translucent		75,509	14,638	0,413	3,594	0,871	3,936	1,093	<	<	<	<
C.8	windowpane	greenish-blue, transparent		70,612	17,921	0,527	2,906	0,904	4,427	1,553	<	<	<	<
C.20	windowpane	light blue, translucent		70,115	18,420	0,499	2,739	0,879	4,153	1,537	<	<	<	<
44	toilet bottle (fragment of a bottom)	dark green, not transparent		61,852	21,105	1,166	2,828	1,484	7,033	3,473		<	<	<
51	vessel (fragment of a wall)	dark green, not transparent		55,795	25,177	1,010	3,079	1,645	7,022	3,873	0,021	<	<	<
4	vessel (fragment of a wall)	colourless, transparent	B1b	69,406	14,950	0,209	8,794	0,478	2,442	0,892	<	<	<	<
8	fragment of a rim	light green, translucent		70,796	16,231	0,511	6,377	0,572	2,865	0,663	<	<	<	<
10	unknown vessel (fragment of a wall)	blue (turquoise), slightly transparent		67,279	16,822	0,448	5,545	1,119	2,714	1,163	0,025	<	0,250	<
11	vessel (fragment of a wall)	greenish-blue, transparent		69,517	15,031	0,436	8,317	0,564	2,941	0,444	<	<	<	<
15	bottle with ridged neck	green, slightly transparent		69,846	14,331	0,300	9,729	0,629	2,506	0,904	<	<	<	<
27	fragment of a small foiled bottle or lamp	green, slightly transparent		67,928	16,975	0,275	9,592	0,440	2,221	0,813	<	<	<	<
28	vessel (fragment of a wall)	greenish-blue, transparent		69,377	14,159	0,246	10,125	0,549	2,342	0,847	<	<	<	<
32	vessel (fragment of a wall)	greenish-blue, transparent		68,664	13,960	0,497	9,795	0,725	2,422	0,942	0,299	<	<	<
42	vessel (fragment of a body) with decoration	light green, translucent		69,560	15,140	0,315	9,732	0,478	2,311	0,861	0,017	<	<	<
C.5	rim	greenish-blue, transparent		70,564	13,596	0,176	10,964	0,277	1,643	0,530	<	<	<	<
C.6	vessel (fragment of a body)	greenish-blue, transparent		69,087	15,182	0,383	8,729	0,686	3,022	0,395	<	<	<	<
C.18	bottle with ridged neck	green, slightly transparent		69,045	13,939	0,327	9,836	0,702	2,622	0,862	<	<	<	<
30	vessel (fragment of a body)	dark brown (black), not transparent	Minor types	66,284	15,160	5,978	3,255	1,041	3,422	1,555	<	0,015	0,032	<
31	vessel (fragment of a body)	dark brown (black), not transparent		66,735	15,681	6,042	3,286	1,030	3,264	1,553	<	0,014	0,020	<
39	vessel with heptagonal (?) cross-section	dark purple (black), not transparent		66,054	14,256	2,135	4,134	1,271	4,332	1,471	3,295	<	<	<
C.2	vessel (fragment of a body)	green, slightly transparent		65,878	16,958	0,982	7,473	1,982	2,780	1,047	0,356	<	<	<

	CuO	BaO	TiO	SnO	NiO	ZnO	As ₂ O ₅	P ₂ O ₅	SO ₃	Cl	Ag ₂ O	ZrO ₂	Au ₂ O	SrO	Cr ₂ O ₃	V ₂ O ₃	F
	wt%																
	<	<	0,612	<	0,017	<	<	0,072	0,149	1,072	<	0,027	<	<	<	<	<
	<	0,040	0,559	<	<	<	<	0,076	0,147	1,145	<	<	<	<	<	<	<
	<	<	0,533	<	<	<	<	0,076	0,088	0,949	<	<	<	<	<	<	<
	<	<	0,622	<	<	<	<	0,085	0,152	1,061	<	<	<	0,043	<	0,016	<
	<	<	0,537	<	<	<	<	0,077	0,088	1,194	<	<	<	<	<	<	<
	<	<	0,607	<	<	<	<	0,065	0,129	1,168	<	<	<	<	<	<	<
	<	<	0,578	<	<	<	<	0,048	0,155	1,085	<	<	<	<	<	<	<
	<	<	0,228	<	<	<	<	0,080	0,074	1,175	<	<	<	<	<	<	<
	<	<	0,359	<	<	<	<	0,034	0,109	1,056	<	<	<	0,028	<	<	<
	<	<	0,598	<	<	<	<	0,064	0,143	1,184	<	<	<	<	<	<	<
	<	<	0,522	<	<	<	<	0,072	0,064	0,950	<	<	<	<	<	<	0,037
	<	<	0,269	<	<	<	<	0,073	0,208	1,037	<	<	<	<	<	<	<
	<	<	0,773	<	<	<	<	0,275	0,208	0,929	<	<	<	<	<	<	<
	<	<	0,603	<	<	<	0,012	0,071	0,124	1,090	<	0,297	0,071	<	<	<	<
	<	<	0,607	<	<	<	<	0,062	0,152	1,069	<	<	<	<	<	<	<
	<	<	0,364	<	<	<	<	0,062	0,025	0,963	<	<	<	<	<	<	<
	<	<	0,611	<	<	<	<	0,080	0,148	1,058	<	<	<	0,020	<	<	0,025
	<	<	0,567	<	<	<	<	0,086	0,151	1,141	<	<	<	<	<	<	<
	<	<	0,830	<	<	<	<	0,525	0,485	0,249	<	<	<	<	<	<	<
	<	0,034	0,997	<	<	<	<	0,443	0,689	0,576	<	<	<	0,046	<	0,025	<
	<	<	0,306	<	<	<	<	0,065	0,072	1,115	<	<	<	<	<	<	<
	<	<	0,191	<	<	<	<	0,053	0,146	0,949	<	<	<	0,053	<	<	<
	1,996	<	0,376	0,080	<	0,101	<	0,111	0,196	1,029	<	<	<	<	<	<	<
	<	<	0,093	<	<	<	<	0,053	0,112	0,920	<	<	<	<	<	<	<
	<	<	0,311	<	<	<	<	0,109	0,045	1,228	0,012	<	<	<	<	<	<
	<	<	0,300	<	<	<	<	0,081	0,070	1,299	<	<	<	<	<	<	<
	<	<	0,326	<	<	<	<	0,084	0,023	1,193	<	<	<	<	<	<	<
	<	<	0,307	<	<	<	<	0,144	0,074	1,095	<	<	<	<	<	<	<
	<	<	0,294	<	<	<	<	0,071	0,068	1,189	<	<	<	<	<	<	<
	<	<	0,205	<	<	<	<	0,081	0,115	1,020	<	<	<	<	<	<	<
	<	<	0,084	<	<	<	<	0,031	0,099	1,009	<	<	<	0,021	<	<	<
	<	<	0,296	<	<	<	<	0,105	0,010	1,078	<	<	<	<	<	<	<
	<	<	0,410	0,055	<	<	<	0,432	0,171	0,797	<	<	<	0,019	<	<	<
	<	<	0,391	0,022	<	<	<	0,469	0,140	0,835	<	<	<	<	<	<	<
	<	<	0,496	<	<	<	<	0,443	0,051	1,203	<	<	<	0,100	<	<	<
	<	<	0,273	<	<	<	<	0,289	0,152	1,201	<	0,022	<	<	<	<	<

Table 1. Continued (*< - below the limit of detection of metod)

Sample	Form	Colour and transparency	Type of glass	SiO ₂	Na ₂ O	K ₂ O	CaO	MgO	Al ₂ O ₃	Fe ₂ O ₃	MnO	Sb ₂ O ₅	PbO	CoO
26	vessel (fragment of a wall) with honeycomb motif	greenish-blue, transparent	B2a	69,483	14,378	2,194	5,103	2,818	3,098	0,907	<	0,012	<	<
30(1)	tubular ring of on interior of wall (?)	light green, translucent		64,009	16,913	2,808	5,601	2,988	2,729	0,847	0,817	<	<	<
30a	trial decoration	white, opaque		52,891	12,178	4,853	7,873	3,182	5,733	1,238	<	<	6,586	<
31a	trial decoration	white, opaque		53,753	13,540	2,801	8,694	3,674	3,725	1,540	<	<	7,408	<
33	bottle (fragment of a neck)	greenish-blue, transparent		63,902	17,636	2,636	6,590	1,754	2,285	0,899	0,317	<	0,641	<
38	vessel (fragment of a wall)	colourless, transparent		64,372	17,167	3,007	4,829	2,241	3,078	0,930	2,604	<	<	<
45	vessel (fragment of a body)	greenish-blue, transparent		68,559	14,077	2,847	6,406	2,833	2,195	0,789	0,559	<	<	<
55	vessel (fragment of a body)	greenish-blue, transparent		65,651	14,352	4,887	5,747	2,876	3,773	0,759	0,093	<	<	<
C.1	vessel (fragment of a body)	dark blue, translucent		69,562	14,212	1,818	4,925	3,208	2,350	0,716	<	<	0,280	<
C.11	vessel (fragment of a body)	light green, translucent		65,623	14,592	1,957	5,676	2,757	3,538	1,277	2,047	<	<	<
C.15	square section bottle	borwn, slightly translucent		63,060	14,809	2,911	7,291	3,501	4,607	1,648	0,021	<	<	<
14	vessel (fragment of a wall)	green, translucent	B2b	66,547	12,776	2,548	9,406	2,948	1,723	0,510	1,045	<	<	<
22	bottle	greenish-blue, transparent		67,293	14,304	1,391	8,851	1,775	2,188	0,817	0,622	<	<	<
29	sprinkler	greenish-blue, transparent		66,498	13,638	2,413	8,695	2,481	1,995	0,665	1,008	<	0,360	<
41	windowpane	cobalt blue, translucent		67,438	14,164	2,200	7,574	3,207	0,829	0,940	0,453	<	0,194	<
49a	uneven winding horizontal trial	greenish-blue, translucent		66,742	12,200	3,142	7,782	2,965	1,233	0,676	0,903	0,018	0,487	<
49b	neck of a bottle (?) decorated with winding horizontal trial	light yellow, translucent		69,103	13,183	2,912	7,512	2,909	1,025	0,440	0,929	<	<	<
50	vessel (fragment of a wall)	greenish-blue, transparent		67,218	12,263	2,351	9,164	2,880	1,711	0,535	1,004	<	0,099	<
53 (1)	vessel (fragment of a body)	light yellow, translucent		66,124	10,355	2,637	9,923	3,861	1,974	0,784	1,130	<	<	<
C.3	vessel (fragment of a body)	greenish-blue, transparent		66,078	15,271	1,595	8,695	2,436	2,399	0,868	0,506	<	0,046	<
C.4	vessel (fragment of a body)	light green, translucent		60,538	15,759	1,985	9,946	3,761	3,019	1,010	0,976	<	<	<
C. 19	bottle with squire section wall	light green, translucent		65,830	15,298	1,452	7,232	2,346	2,855	1,099	0,487	*<	0,257	<

Group B1a

Group B1a, to which 20 samples belong, is characterised by a rather low concentration of calcium oxide (about 2–3%) and a high level of aluminium oxide (3–5%), iron oxide (1–2%), titanium (0.3–0.5%), and silica (about 70%; **Table 1**). Glass groups having this chemical composition are known in the literature as ‘Egypt I’ glass.¹⁰⁶ They are identical to those of Groups 1a and 1b described by B. Gratuze and J.-N. Barrandon,¹⁰⁷ who examined Islamic glass weights and stamps with inscriptions bearing the date of manufacture, and identified a group produced in the eighth century. Additionally, Group B1a is also very similar to Groups 8 and 9 as designated by D. Foy, M. Picon, M. Vichy¹⁰⁸ and also dated to the eighth-century

¹⁰⁶ FREESTONE, GORIN-ROSEN, HUGHES 2000.

¹⁰⁷ GRATUZE, BARRANDON 1990.

¹⁰⁸ FOY, PICON, VICHY 2003: 142.

	CuO	BaO	TiO	SnO	NiO	ZnO	As ₂ O ₅	P ₂ O ₅	SO ₃	Cl	Ag ₂ O	ZrO ₂	Au ₂ O	SrO	Cr ₂ O ₃	V ₂ O ₃	F
	%wt																
	<	<	0,226	<	<	<	<	0,265	0,165	0,689	<	<	<	0,109	<	<	<
	<	<	0,217	<	<	<	0,012	0,395	0,231	0,928	<	<	<	0,026	<	<	<
	<	<	0,248	3,444	<	<	0,014	0,232	0,216	0,542	<	<	<	0,050	<	<	<
	<	<	0,293	3,591	<	<	0,082	0,241	0,244	0,652	<	<	<	<	<	<	<
	1,148	<	0,205	0,096	<	0,036	<	0,377	0,141	1,344	<	<	<	0,032	<	<	<
	<	<	0,213	<	<	<	0,012	0,261	0,310	0,640	<	<	<	<	<	<	<
	<	<	0,202	<	<	<	<	0,309	0,276	0,305	<	<	<	<	<	<	<
	<	<	0,156	<	<	<	0,015	0,253	0,161	0,765	<	<	<	0,075	<	<	0,019
	1,063	<	0,383	0,047	<	<	<	0,182	0,091	0,818	<	<	<	<	<	<	<
	<	<	0,237	<	<	<	<	0,253	0,209	0,675	<	<	<	<	<	<	<
	<	<	0,382	<	<	<	0,038	0,300	0,079	0,450	<	<	<	0,073	<	<	<
	<	<	0,092	<	<	<	0,023	0,271	0,181	0,762	<	<	<	0,027	<	<	<
	<	<	0,205	<	<	<	<	0,201	0,161	0,931	<	<	<	<	<	<	<
	<	<	0,137	<	<	<	<	0,393	0,120	0,902	<	<	<	0,032	<	<	<
	0,189	<	0,082	0,010	<	0,047	0,011	0,247	0,172	1,101	<	<	<	<	<	<	<
	1,690	<	0,181	0,196	<	<	0,046	0,379	0,236	0,740	<	<	<	0,039	<	<	<
	<	<	0,183	<	<	<	0,012	0,310	0,221	0,855	<	<	<	<	<	<	<
	<	<	0,101	<	<	<	0,011	0,355	0,173	0,893	<	<	<	0,033	<	<	0,061
	<	0,029	0,323	<	<	<	0,038	0,314	0,246	0,773	<	0,030	<	<	<	<	<
	0,046	<	0,214	<	<	<	0,011	0,166	0,161	0,861	<	<	<	<	<	<	<
	<	<	0,170	<	<	<	0,025	0,304	0,235	0,726	<	<	<	0,022	<	<	<
	<	<	0,268	<	<	<	0,011	0,379	0,190	1,007	<	<	<	<	<	<	<

period. N. Kato, I. Nakai and Y. Shindo¹⁰⁹ also distinguished glass with a similar composition, as Group N2-a2, when examining glass at Raya in the Sinai Peninsula in Egypt. Their samples included glass also dated to the eighth century.

Undoubtedly, this type of glass was produced in Egyptian glass workshops using available sands, as evidenced by their high Fe₂O₃ and TiO₂ content.¹¹⁰ Glass produced in Egypt typically has a high concentration of soda oxide. Ian Freestone, Yael Gorin-Rosen and Michael Hughes¹¹¹ suggested that the natron of 'Egypt I' glasses probably comes from deposits in the Wadi el-Natrun.¹¹² Most vessel fragments in this Group are greenish-blue and green in colour, due to a relatively high iron oxide

¹⁰⁹ KATO, NAKAI, SHINDO 2009: 1705.

¹¹⁰ NENNA 2014: 179; Foy *et al.* 2003: 45.

¹¹¹ FREESTONE, GORIN-ROSEN, HUGHES 2000: 72.

¹¹² As confirmed by both written sources and archaeological research, but referring to the Roman period, glassmaking workshops using natron as a silica flux primarily used the raw material mined in Egypt (e.g. in Wadi Natrun and Beheiri, in modern Al-Buhajra province), but also from Lake Van (modern Turkey) and deposits in Macedonia (HENDERSON 1985: 273; SHORTLAND *et al.* 2006: 524; SHORTLAND 2004: 501).

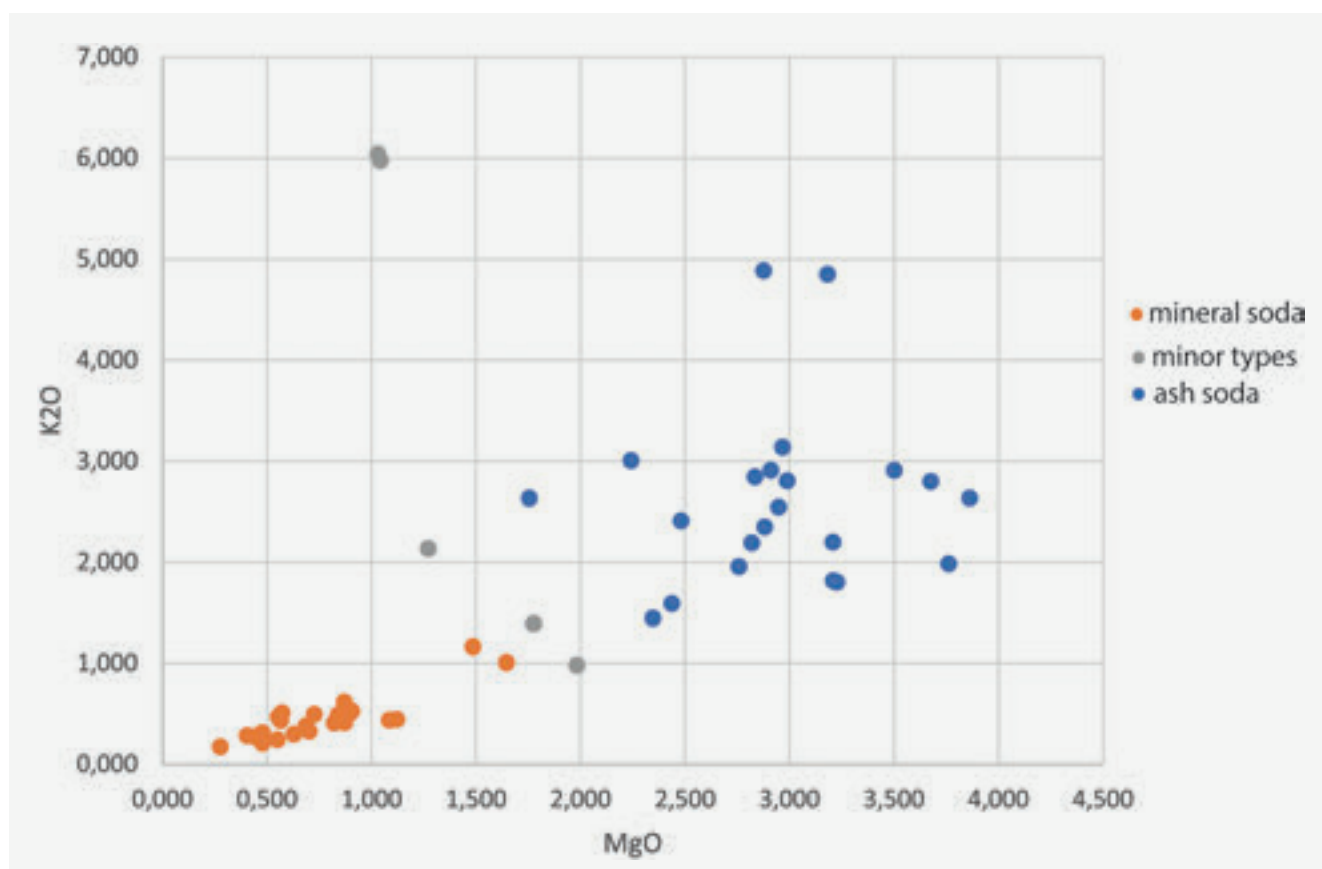


Fig. 3
MgO against K₂O for
the identified groups

content, but whether this was intentionally added to the glass set or in the natural sand is unknown.¹¹³ Vessel types using this group include seven windowpane fragments (samples 5, 7, 36, 56, C.7, C.8, C.20; Fig. 2:3–8, 10), a wine-glass stem (Fig. 1:22), and non-diagnostic vessel-body fragments (Table 1). Only a few air bubbles have been detected on BSE images of two samples, C.20 (windowpane fragment of blue glass; Fig. 2:3) and 53 (slightly yellowish, translucent glass), which also have inclusions of sand components iron oxide (sample C.20) and alumina (sample 53) (Fig. 5:C.20, 53). Its dating corresponds well with vessel types discovered in the seventh–eighth-century contexts. Group B1a glasses were melted in Egypt, probably at a coastal location, using locally available sand and mineral soda deposits. According to the findings of Nadine Schibille *et al.*,¹¹⁴ ‘Egypt I’ glass was produced until the first half of the eighth century, probably in the Delta area.¹¹⁵

Group B1b

Thirteen vessel fragments can be distinguished as melted using mineral soda, being characterised by high-oxide-content calcium (about 8–9%), low iron oxide (about 0.3–1%), and an Al₂O₃ content ranging between about 2.5–3 wt% (Table 1). This composition is similar to the Group 7 glasses separated by Foy,

¹¹³ KATO, NAKAI, SHINDO 2009.

¹¹⁴ SCHIBILLE *et al.* 2019.

¹¹⁵ PHELPS *et al.* 2016: 62.

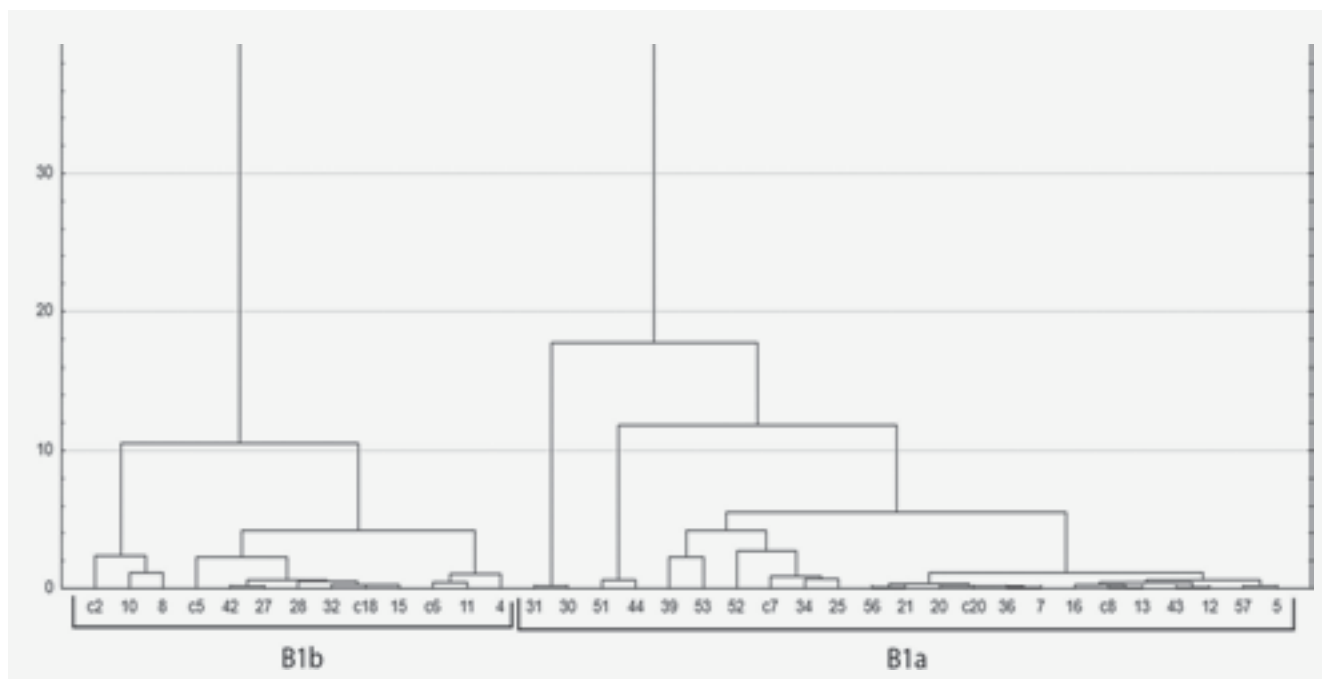


Fig. 4
Labelled dendrogram displaying the results of the hierarchical cluster analysis by Ward's method. Oxides used are Al_2O_3 , CaO , Fe_2O_3 , TiO_2 , K_2O , Cl

Picon and Vichy¹¹⁶ dated to the mid-eighth–ninth centuries. Kato, Nakai and Shindo¹¹⁷ also described glass of similar composition at Raya as 'N2-b type', dating to the ninth century. Like the Banganarti samples, their fragments are of a pale greenish-blue or green colour influenced by low iron oxide content (**Table 1**). Sands low in heavy elements, such as iron oxide and titanium, but relatively high in aluminium were used to melt 'Egypt II' glasses, predominant in the Levant during the eighth and ninth centuries. The high concentration of calcium oxide likely results from the addition of marine sand (which contains silt) to the glass bath.¹¹⁸ Written Roman sources confirm this practice.¹¹⁹ Calcium oxide reduces the melting temperature and tackiness of glass, while increasing chemical resistance and mechanical persistence.¹²⁰

One tiny turquoise, slightly transparent fragment in this group may be a windowpane. Its intense hue undoubtedly is due to its high copper oxide (1.996%) and iron oxide (1.163%) content, both used as glass colourants and probably intentionally added.¹²¹ The lead oxide and tin oxide (which are opacifying glass components) contents in this particular sample are also slightly increased.¹²² Glass of similar composition has also been discovered at Fustat,¹²³ and on the glassmaking site at Ashmunein, Middle Egypt, dating to the eighth–ninth centuries.¹²⁴

Vessels in this glass include a bottle fragment with an infolded rim (**Fig. 1:1**), two bottle fragments with a ridged neck (**Fig. 1:17–18**), a phial fragment (**Fig. 1:14**),

¹¹⁶ FOY, PICON, VICHY 2003.

¹¹⁷ SHINDO 2009: 1705–1706.

¹¹⁸ PHELPS *et al.* 2016: 60.

¹¹⁹ HENDERSON 2000: 28–29.

¹²⁰ HENDERSON 2013: 64.

¹²¹ HENDERSON 1985.

¹²² PUROWSKI 2012: 164.

¹²³ SHINDO 2000; FOY *et al.* 2003.

¹²⁴ BIMSON, FREESTONE 1987.

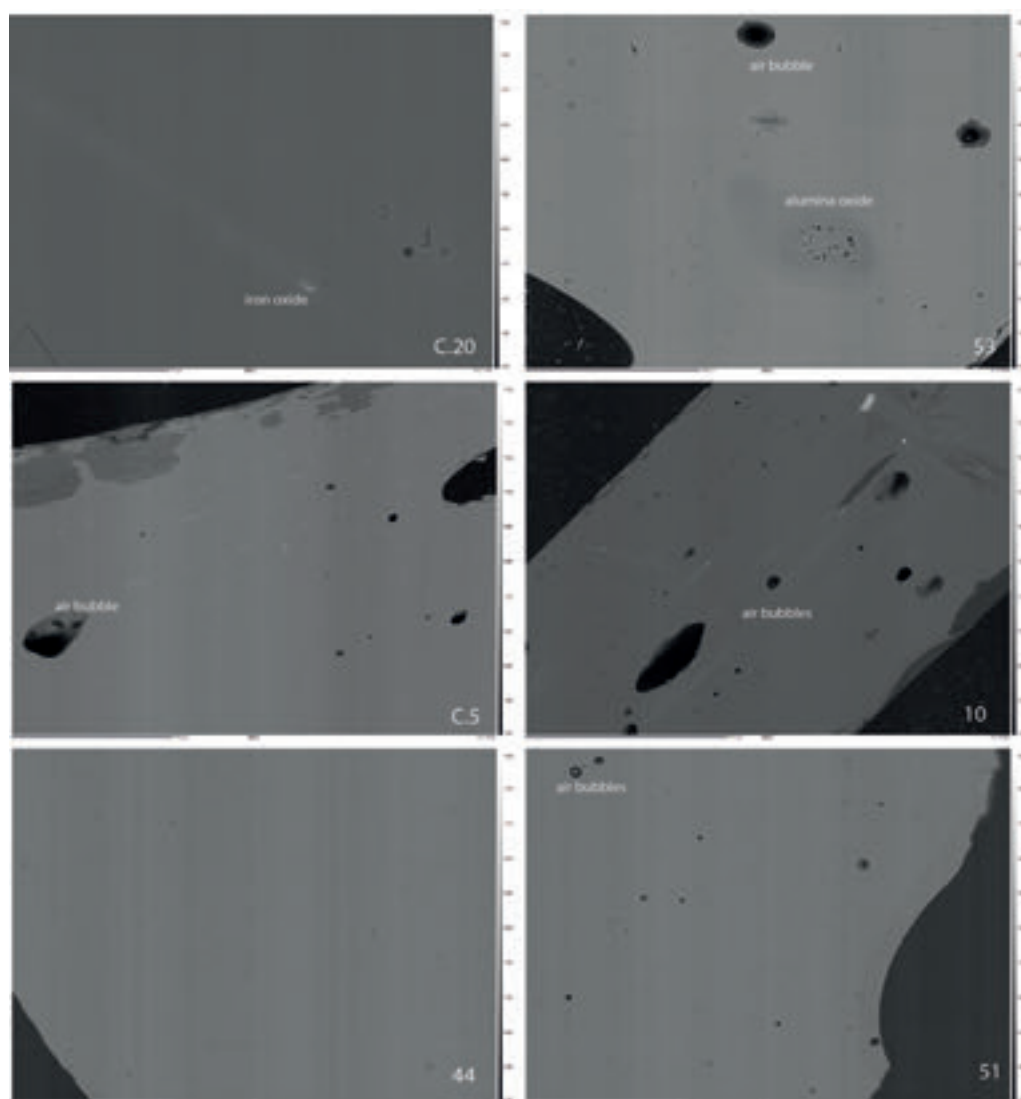


Fig. 5
Backscattered electron
images of the tested
glasses

a vessel fragment with tong decoration (**Fig. 1:23**), and eight vessel-body fragments (**Table 1**). BSE images indicate their glass mass is well clarified and contains few gas bubbles (**Fig. 5:C.5, 10**). These vessel types and this chemical composition are common in the eight–ninth centuries.

Minor Types

Four samples should be distinguished. Three (30, 31, 39) contain elevated potassium oxide (over 1.5%) but low magnesium oxide (about 1%) levels. The fourth, sample C.2, has a magnesium oxide content of 1.92% (above average for natron glass), and a 0.982% K_2O content (**Table 1**). They cannot be considered mixed alkali glasses because they have similar levels of both components.¹²⁵ They appear to have been melted from soda of mineral origin but from poor-quality raw materials. The increased amount of MgO in sample C.2 may be due to the addition of sand contaminated with this component. Roman period Western European glass

¹²⁵ HENDERSON 2013.

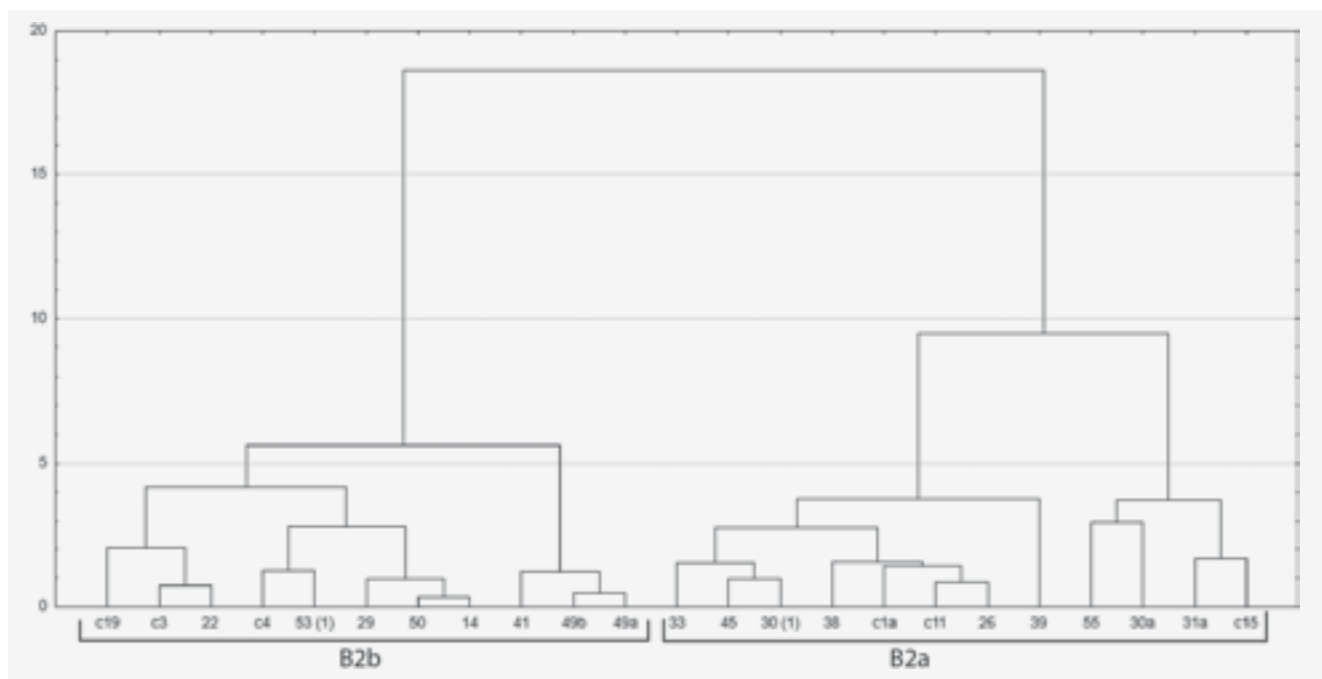


Fig. 6
Labelled dendrogram displaying the results of the hierarchical cluster analysis by Ward's method. Oxides used are K_2O , P_2O_5 , MgO , CaO , Fe_2O_3 , Al_2O_3 , TiO_2

chemical composition study results demonstrate that provincial glassmakers often used locally available raw materials.¹²⁶ It can be speculated that, in samples having higher concentrations of K_2O , this component also entered the glassmaking suite in sand possibly contaminated with potassium feldspars,¹²⁷ or from either crucibles or wood-fired kilns.¹²⁸ One sample (39) contains an increased level of manganese oxide (3.295%), a component added to colour the glass a dark purple (almost black) colour, probably in the form of pyrolusite (MnO_2),¹²⁹ a widespread and frequently encountered mineral.

Two fragments included in this group are of marvered glass with white ornamentation, most popular and widely distributed during the twelfth–fourteenth centuries (samples 30, 31; **Fig. 1:24, 25**). Unfortunately, with few exceptions,¹³⁰ this type of glass has not been studied technologically. The dark, almost black colour of two fragments at Banganarti is probably due to an increased concentration of iron oxide (above 1%). In addition, small amounts of antimony, lead, and tin oxides are recorded to have been used for glassblowing.¹³¹ These constituents probably entered the bath accidentally through the white glass of the ornament, perhaps while the vessel was being formed. The very similar values of these impurities may indicate that the two vessels are from the same glassmaking workshop.

Plant Ash Glass

Twenty two glass samples were melted using soda ash (**Table 1**). All vessel fragments are from strata dated to the period from the second half of the eleventh

¹²⁶ ŠMIT *et al.* 2013: 9, table 1; SILVESTRI, MOLIN, SALVIULO 2008; WEDEPOHL, GAITZSCH, FOLLMANN-SCHULZ 2003.

¹²⁷ HENDERSON 2013: 94.

¹²⁸ TAL, JACKSON-TAL, FREESTONE 2008: 91; HENDERSON 2000: 28–29.

¹²⁹ HENDERSON 1985: 283.

¹³⁰ REHREN, CHOLAKOVA, JOVANOVIĆ 2018.

¹³¹ HENDERSON 1985: 276, 285.

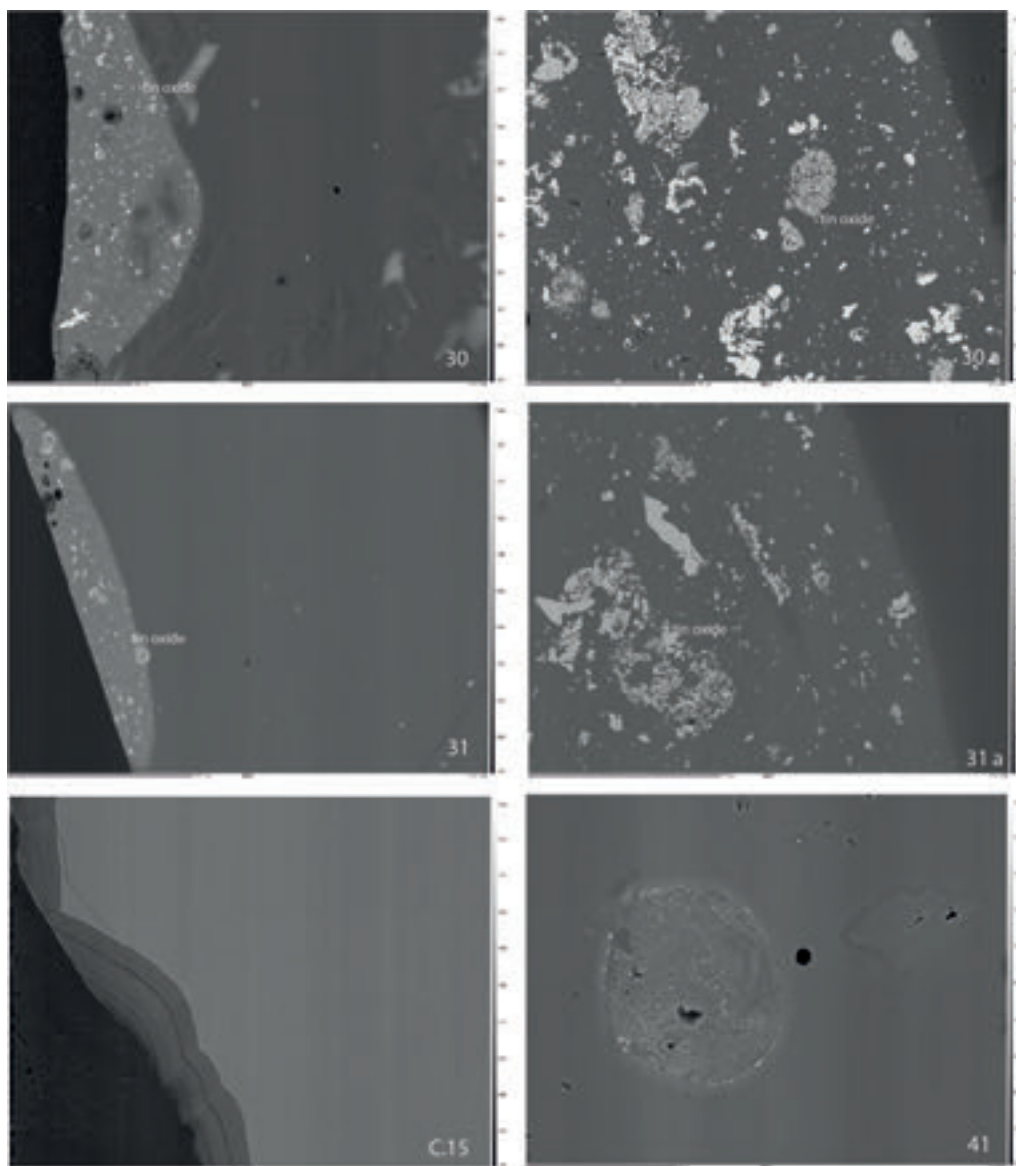


Fig. 7
BSE images of tested
glasses

to around the fourteenth century. Two groups (**Fig. 6**) are distinguished based on hierarchical cluster analysis (HCA). Oxides representing the composition of the ashes and sands used to melt the glass mass (K_2O , P_2O_5 , MgO , CaO , Fe_2O_3 , Al_2O_3 , TiO_2) were selected to form the HCA tree.¹³²

Group B2a

Glass Group B2a is characterised by relatively high concentrations of alumina (2.3–6%), calcium oxide (about 5–8%), and iron oxide (above 0.7%). Vessel fragments classified in this group are of slightly greenish-blue, highly translucent glass, resulting in an increased Fe_2O_3 content (**Figs. 1:19, 20; 2:11**). It is difficult to determine whether the component entered the glass set naturally. Certainly, iron compounds were intentionally added to the glass mass of the

¹³² BARKOUDAH, HENDERSON 2006.

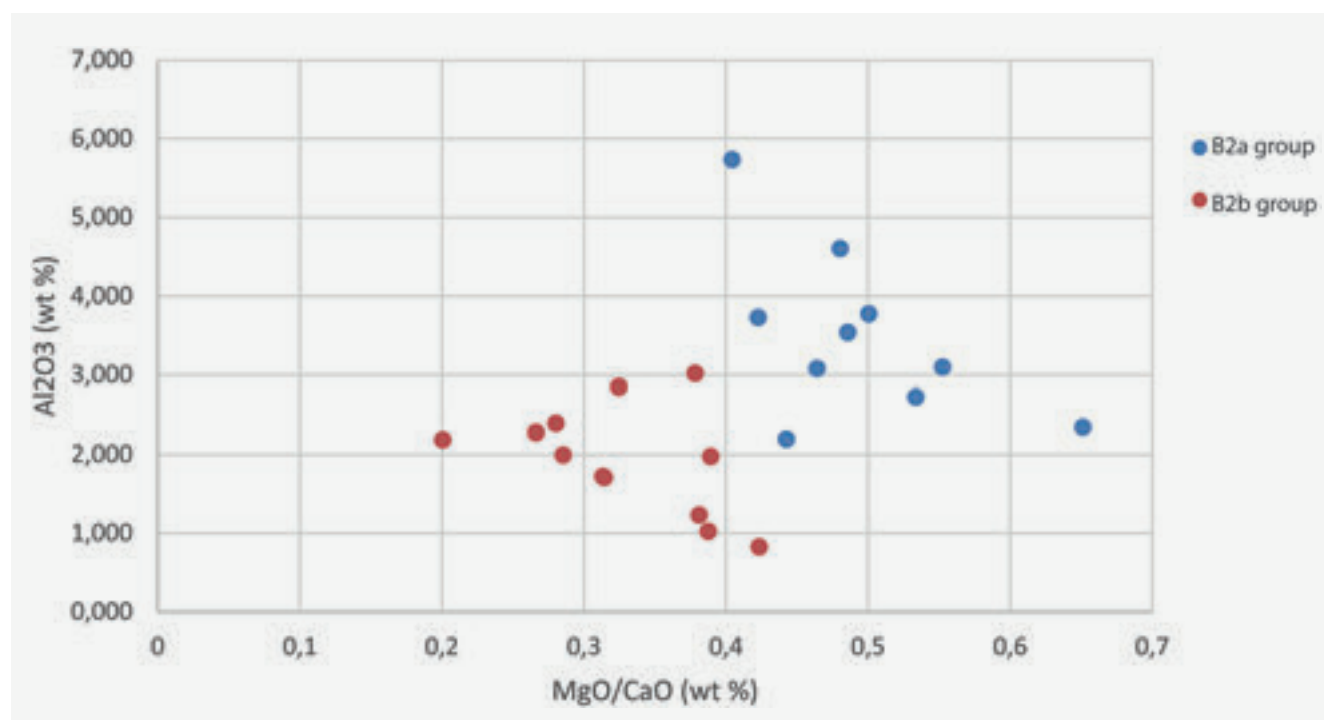


Fig. 8
MgO/CaO against
Al₂O₃ for the identified
groups in plan ash
glasses

two samples with stronger green (sample C.11) and brown colouration (sample C.15; **Fig. 1:8**) (1.277% and 1.648%). Sample C.11 has a very high MnO₂ content (2.047%), a discolouring and clarifying glass component.¹³³ The remaining samples are coloured blue-greenish (sample C.1), colourless (sample 38), and white opaque (samples 30a, 31a). White glasses are coloured with lead (6.586%, 7.408%) and tin (3.444%, 3.591%) compounds in the form of lead–tin oxides Pb₂Sn₂O₇ or Pb₂SnO₄.¹³⁴ White grains of the component with a higher amount of SnO₂ and PbO are visible on the BSE images (**Fig. 7:30, 30a, 31, 31a**), including on two fragments with mould-blown decoration.

Group B2b

Glasses of the second group melted with ash soda are mainly greenish (**Figs. 1:5, 21; 2:9, 12**), as well as blue (sample 41; **Fig. 2:2**) and slightly yellowish (sample 49b). All are characterised by a higher content of calcium oxide (about 8–10%), iron oxide (0.4–1%), manganese oxide (0.5–1%) and a lower concentration of aluminum oxide (about 1–2.5%) than Group B2a samples. In one sample (49a), an increased amount of copper oxide (1.690%) can be seen, which gave the glass a slightly blue-greenish colour.

It appears all glasses analysed can be classified as Eastern Mediterranean glass melts based on the low ratio of MgO/CaO against Al₂O₃ (below 0.5; **Fig. 8**).¹³⁵ Glasses in both groups described above, like Fatimid-period Types E1 and E2 of Egyptian provenance, contain many colouring, clarifying or opacifying elements in the glass (Cu, Pb, Mn, Sb, Sn, Zn), probably indicating they were

¹³³ HENDERSON 1985.

¹³⁴ HENDERSON 1985: 285.

¹³⁵ KATO, NAKAI, SHINDO 2010.

recycled.¹³⁶ Glasses from both groups are similar to the tenth–twelfth-century glass found at the Monastery of Wadi el-Tur, Sinai Peninsula (Group PA-1b). Some Banganarti samples classified as having Group B2a or B2b glassmelting technology are vessels with mould-blown decoration (**Fig. 1:5, 19, 20**), as well as two windowpane fragments (**Fig. 2:2, 12**) dated to the eleventh–fourteenth centuries. BSE images (**Fig. 7, C:15, 41**) of two vessels, a bottle with a square-sectioned body and a blue panel, show the glass mass is well-distributed, with few sand grains.

CONCLUSIONS

The Banganarti glassware is a collection of typical Early Islamic glass vessels ubiquitous over North Africa and the Middle East. The material studied is dominated by small and medium bottles that probably contained various kinds of precious oils or perfumes. This is the most common vessel type in the Early Islamic period.¹³⁷ Considering Banganarti's specific function as a pilgrimage centre, it can be assumed they are mainly church equipment and/or belonged to visiting pilgrims. Compared to other archaeological sites in Sudan where glass vessels have been discovered (e.g. Soba), the amount of glass found at Banganarti is small and there is little diversity in terms of use. All the samples examined for the elemental composition of the glasses were made of soda glass. The results indicate that the glass that reached Banganarti between the eighth and ninth centuries was mainly produced using natron. Fragments of glass vessels from the later period (tenth to fourteenth centuries) belong to glasses smelted from the ash of halophytic plants, possibly using a cullet. Chemical composition analyses reveal that the glass itself was primarily melted in both Egyptian and Syro-Palestinian glassmaking workshops. Archaeological investigations conducted there¹³⁸ have led to the discovery of primary glass-production sites where large quantities of glass were produced, then broken into lumps and distributed to glass workshops where various artefacts were produced.¹³⁹ Primary glass production was usually located in places where the raw material was easily accessible (e.g. the mouth of Belus River, Syria, where sand was collected, and Wadi Natrun in Egypt, a source of mineral soda). Many researchers emphasise the relatively high technological homogeneity of glass from this region.¹⁴⁰ Undoubtedly, the production of glass vessels took place in glassworking workshops other than those where the glass mass was melted from primary raw materials. Shipwreck finds at Serçe Limani and Java show the scale of this production and attest to the long-distance trade in these goods. And, although Islamic-period glassware is known elsewhere in Sudan (e.g. Soba, Sennar, Aidhab¹⁴¹ and Old Dongola),¹⁴² important questions concerning the exact location of Sudanese

136 SCHIBILLE *et al.* 2019: 12.

137 MAYER 1992.

138 HENDERSON 2013; NENNA *et al.* 2005; NENNA 2014; 2015.

139 FREESTONE, GORIN-ROSEN, HUGHES 2000: 66.

140 SCHIBILLE 2011; FREESTONE, GORIN-ROSEN, HUGHES 2000.

141 MORRISON 1991: 246–259; HARDEN 1955: 60–76.

142 DZIERZBICKA, DEPTUŁA 2018: 96; GODLEWSKI 2013: 133.

production sites, the chronology and extent of technological types, and the characteristics of regional compositional groups remain unresolved. Undoubtedly, study of the glass finds at Old Dongola, where Włodzimierz Godlewski¹⁴³ believes a glass workshop functioned, is crucial.

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¹⁴³ GODLEWSKI 2013: 121, 133.

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Shapes of Light: Window Grilles from Banganarti

Agata Momot

Abstract:

In the demanding desert conditions, windows need some kind of shading. A window grille is an ideal solution because it keeps out excess light and lets in a lively breeze. During research at Banganarti, various window grilles were collected in the Raphaelion and its vicinity. The present paper is an attempt to characterise and systematise this numerous and diverse material. The collection is divided into three groups, the primary criterion being the material from which the grilles are made. The most numerous group is stucco. The second group is terracotta, and the third is sandstone. Finally, types and subtypes are distinguished within each group, based on the design. This collection broadens our knowledge of the site and the architectural appearance of its churches and some elite houses, and constitutes valuable comparative material for studying Christian Nubia. It is essential in the context of stucco grilles, an extremely rare phenomenon in Nubian architecture.

Keywords: Sudan, Banganarti, window grilles, stucco, terracotta.

During excavations at Banganarti, in total, 443 fragments of various window grilles were collected. The assemblage is abundant, outnumbering the group of window grilles from Faras, where about 300 grille fragments were found.¹

The various openwork window apertures have several functions. In the demanding desert conditions of the region, windows need some kind of shuttering. A window grille is then both a barrier and a skylight. A stationary barrier weakens the wind and reduces sand entry while also letting light inside the building. It is especially important in ecclesiastical buildings, where sunlight symbolises the divine.² Light penetration through the different aperture shapes and patterns gives the interior a unique atmosphere. Furthermore, the grilles' exterior decorations have an additional artistic value, significantly influencing the appearance of the façades.

Different kinds of window grilles have been used throughout history. Terracotta grilles are known from 3rd-millennium B.C. Mesopotamia.³ Grilles cast in bronze and iron were popular in Greek and Roman architecture and very common in subsequent periods.⁴ However, numerous archaeological sources confirm using stone and terracotta window grilles in Roman architecture, e.g. grilles preserved *in situ* in an amphitheatre in Pula.⁵ Their apertures either could have had glass panes or been covered with *lapis specularis*.⁶ Terracotta or stone blocks with openings of that period were also found in North Africa, e.g. Algeria and Numidia.⁷ Openwork window fillings were commonly used in subsequent periods, as the *transenna* known from Ravenna and Rome.

In Islamic northern Africa and western and southern Asia, windows are closed using elaborate networks of geometric or vegetal motifs carved in stone or wood. Such construction reduces heat by filtering the intense light while admitting cooling breezes.⁸ To this day, *mashrabiya*s adorn buildings in this part of the world.

Window grilles are known in Nubia from the Meroitic period. Sandstone grilles, richly decorated with figural and floral ornamentation, were found at Faras.⁹ Sandstone was rarely used in later periods, but window grilles of terracotta are abundant at medieval sites. Stucco grilles also occur, but much less frequently. Window openings at many sites were protected using grilles of either stone or terracotta in ecclesiastical and domestic structures, with decorated window grilles a standard feature of ecclesiastical architecture.¹⁰

Nubian window grilles rarely are subject to a separate study. The material is the most often mentioned in reports on individual sites but rarely given more attention. The grilles at Faras were elaborated by Mieczysław Rodziewicz.¹¹ The collection of grilles at Old Dongola was described quite extensively by Przemysław Gartkiewicz in his study of the Cathedral.¹² In 2019, Szymon Maślak published a detailed study of

1 RODZIEWICZ 1967: 143.

2 SMITH 1996: 245.

3 RODZIEWICZ 1967: 144.

4 MACZEŃSKI 1956: 475.

5 RODZIEWICZ 1967: 145.

6 PANNUZI, LUGLI 2019: 238.

7 WEBSTER 1959: 10–11.

8 SMITH 1996: 245–246.

9 RODZIEWICZ 1967: 144.

10 WELSBY 1992: 177.

11 RODZIEWICZ 1967.

12 GARTKIEWICZ 1990: 203–211.

the gypsum window grilles from the monastery at Naqlun.¹³ However, in most cases, these finds are only mentioned or appear in broader studies of architectural detail.

The window grilles at Banganarti also have not yet been studied. A set of stucco grilles was inventoried and divided into categories in 2005 by Dobrochna Zielińska, who also attempted to reconstruct several of their decorative motifs. Ewa Skowrońska made many valuable comments in her short 2011 report on stucco window grilles. However, both studies remain unpublished. Bogdan Żurawski mentioned and described the grilles in both volumes of the Banganarti series.¹⁴

The present paper primarily attempts to characterise and systematise this numerous and diverse material, which turned out to be challenging, as no uniform, systematic typology exists for this type of architectural detail. An attempt has also been made to reconstruct some ornamental types that the author hopes will serve as a valuable comparative contribution towards a more comprehensive study of this type.

The collection is divided into three groups. The primary criterion is the material from which the grilles are made. The most numerous group is stucco (356 fragments). The second group is of terracotta (85 fragments), and the third of sandstone, of which only 2 pieces were found. The material is fragmentary. Unfortunately, no grilles have been preserved *in situ* or found complete. Finally, types and subtypes are distinguished within each group based on the design. However, the small size or lack of characteristic features make many fragments in the first two groups impossible to classify. Nevertheless, typological divisions allow for the material to be organised and described, and systematisation is proposed for two groups.

This group of material broadens our knowledge of the site and the architectural appearance of its churches and some houses, and constitutes valuable comparative material for the study of Christian Nubia. It is essential especially in the context of stucco grilles, a sporadic phenomenon in Nubian architecture.

TERRACOTTA WINDOW GRILLES

Terracotta grilles are the most interesting group of artefacts at Banganarti. They comprise fragments of window grilles derived from different parts of the site. Specimens were found both in layers associated with the Lower Church and within the Banganarti enclosure.

The technology of producing terracotta grilles is straightforward. A flat slice of clay is first prepared, then a pattern is applied to its surface with a stick or sharp tool, as evidenced by the remains of a pattern made by a knife or thin stick (**Fig. 1**), before apertures are cut out of the wet clay. Then the openwork is customised, as knife-use traces are preserved on almost every specimen (**Fig. 2**). The outer surface is usually also smoothed using water and the craftsman's fingers. The grilles were probably manufactured in local workshops, and intended for individual window openings.¹⁵

The group of terracotta window grilles at Banganarti represents an interesting and typologically diverse group. Fragments differ primarily in terms of morphological form, including filling motif shape, and polychromy and plastic ornamentation,

¹³ MAŚLAK 2019: 369–377.

¹⁴ ŻURAWSKI 2012: 173; 2014: 115–118.

¹⁵ GODLEWSKI 2013: 127.



Fig. 1 (left)
Teracotta window grille
with traces of applying
the ornament before
cutting out openings.
Photo by Agata Momot

Fig. 2 (top)
Traces of the process of
cutting out apertures.
Photo by Agata Momot

which are present on almost every form. The material from which the grilles are made cannot constitute a basis for a typological division. With few exceptions, it is a porous brick-red clay, grey or black at the fracture, suggesting both material and firing technology were generally similar. As at Faras, the clay differs from that used to produce pottery, and is more porous after firing.¹⁶ Four main terracotta window-grille types are distinguished, based on the appearance of the frames and the design of the filling ornament.

Type 1

Slab with circular openings

A prevalent grille type at Banganarti, with 29 fragments. It is a single flat slab of clay, varying in thickness between 1.5 and 4.3 cm. Circular openings were cut into unfired wet clay, ranging in diameter from 6 to 15 cm. Distances between the apertures also differ, from almost touching edges to loosely deployed circles. Interestingly, the openings probably constitute no regular arrangement but were just loosely placed over the entire slab surface (**Fig. 3**). Circumferential notches surrounding the circular openings on the reverse of the grille are additional characteristic features. They are never polychromed, whereas the decorative elements very often are.¹⁷ Notably, two notch types are distinguished (**Fig. 4a–b**), one square-cut (10 fragments) and the other rounded (11 fragments) in cross-section. Very few registered finds either lack or have undefined notching. Notch thickness also differs – some being very deep, and others barely marked. Grilles of this type are mostly polychrome on the obverse, while an entire object is seldom slip-covered. Some specimens are also decorated with a single-fold groove around the frame edge.

The earliest comparable window filling with round apertures is known from Mesopotamia as early as the 3rd millennium B.C.¹⁸ Amongst medieval Nubian examples, slabs at Selib I should be mentioned first. In technical aspects identical to those known from Banganarti, they are also similar in size. Moreover, the arrangement of two successfully reconstructed large fragments (**Fig. 5**) confirms that apertures were placed without a specific layout, and their diameters could differ within individual examples. This grille type predominates in the Selib I collection, where they mostly

¹⁶ RODZIEWICZ 1967: 147.

¹⁷ It is possible grilles of this type were placed on the side of the edifice most exposed to wind, and occasionally the apertures might have been blocked.

¹⁸ RODZIEWICZ 1967: 145.

Fig. 3

Compilation of sizes of terracotta window grille apertures, Type 1. Elaborated by Agata Momot

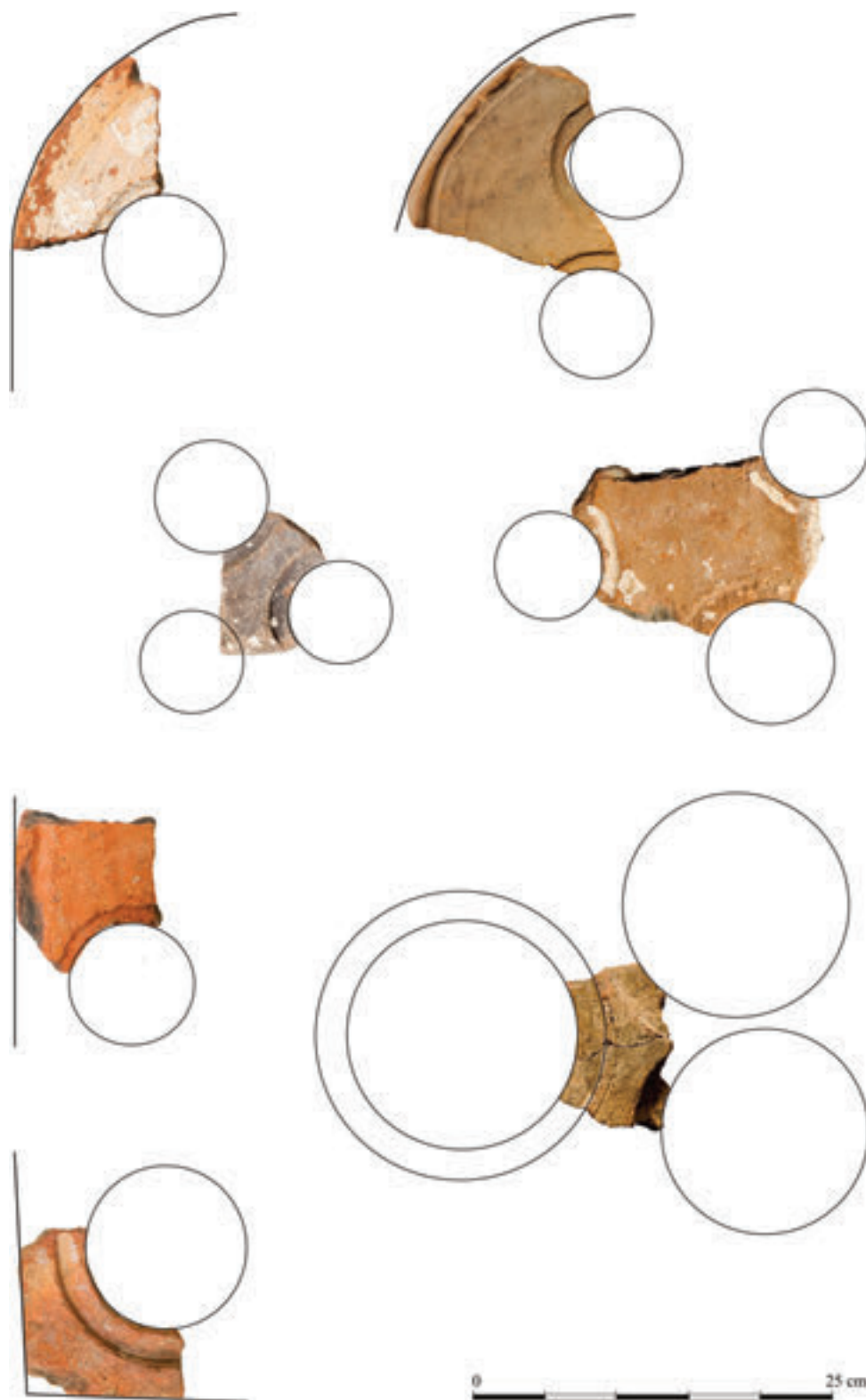


Fig. 4

Sections of two types of notches. Elaborated by Agata Momot

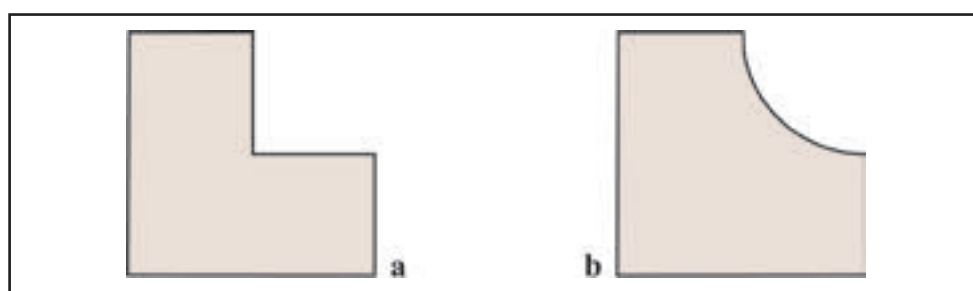




Fig. 5
Terracotta window
grilles with circular
openings from
Selib I. Photo by Agata
Momot

date to the Early Christian period¹⁹ and some to the Classic Christian period.²⁰ The corner of a slab found in a context from A.D. 750–850 at Meinarti also is Type 1. The edges of its circular apertures suggest it originally was a window grille, painted yellowish on one side.²¹ Identical specimens were found in Building D at Soba East, but the round apertures are covered with glass panes that were also recovered nearby. This grille type might have been used in storage rooms, as they transmit less light.²²

Type 1 grilles at Banganarti are mostly from layers associated with the Lower Church or nearby (ca. 30 fragments), less often from other parts of the site, and were also found on the surface. Thus it can be proposed that slabs with round openings decorated the windows of this edifice.

Type 2 **Interlace**

The typical interlaced grille consists of stripes of equal width interwoven at equal intervals to form approximately rhomboidal apertures. Plaitwork decoration

¹⁹ ŻURAWSKI, Cedro, Bury 2016: 359.

²⁰ CEDRO 2015: 406.

²¹ ADAMS 2001: 15, 39.

²² WELSBY 1992: 177–178.



Fig. 6 (top)
Terracotta window
grilles, Type 2,
Subtype 1. Photo and
reconstruction by
Agata Momot



Fig. 7 (on the right)
Terracotta window
grille, Type 2, Subtype 2.
Photo by Agata Momot

was popular in Nubian architecture and other fields of art, e.g. ornamentation at Faras mostly imitates a more or less geometric braid.²³ Interlace motifs are found painted on one wall in the south wing of the Faras cathedral. Painted schemes probably are patterns for garment ornamentation.²⁴ Plaitwork also is a stone architectural detail at Faras,²⁵ and geometric interlace is the leading ornamental motif among terracotta grilles there.²⁶ Interlace motifs are also frequently used at Old Dongola, combined with circles.²⁷ Plaitwork on the stone slab in the Kom E church²⁸ also resembles interlace, where intertwining bands go from its corner to its centre.²⁹ Interlace also occurs on a ceramic window grille found in Room CB.1, inside the Central Building. The braid in its centre is divided into three parts, highlighted by a groove through the middle of each element.³⁰

Two subtypes are distinguished at Banganarti, mainly by the degree of artistic development in the design.

²³ RODZIEWICZ 1967: 150.

²⁴ MICHAŁOWSKI 1974: 277.

²⁵ RYL-PREIBISZ 2001b: 290.

²⁶ RODZIEWICZ 1968: 58.

²⁷ GARTKIEWICZ 1990: 205, fig. 117A4.

²⁸ JAKOBIELSKI 1994: 127.

²⁹ RYL-PREIBISZ 2001a: 376.

³⁰ JAKOBIELSKI, MARTENS-CZARNECKA 2008: 337–339.

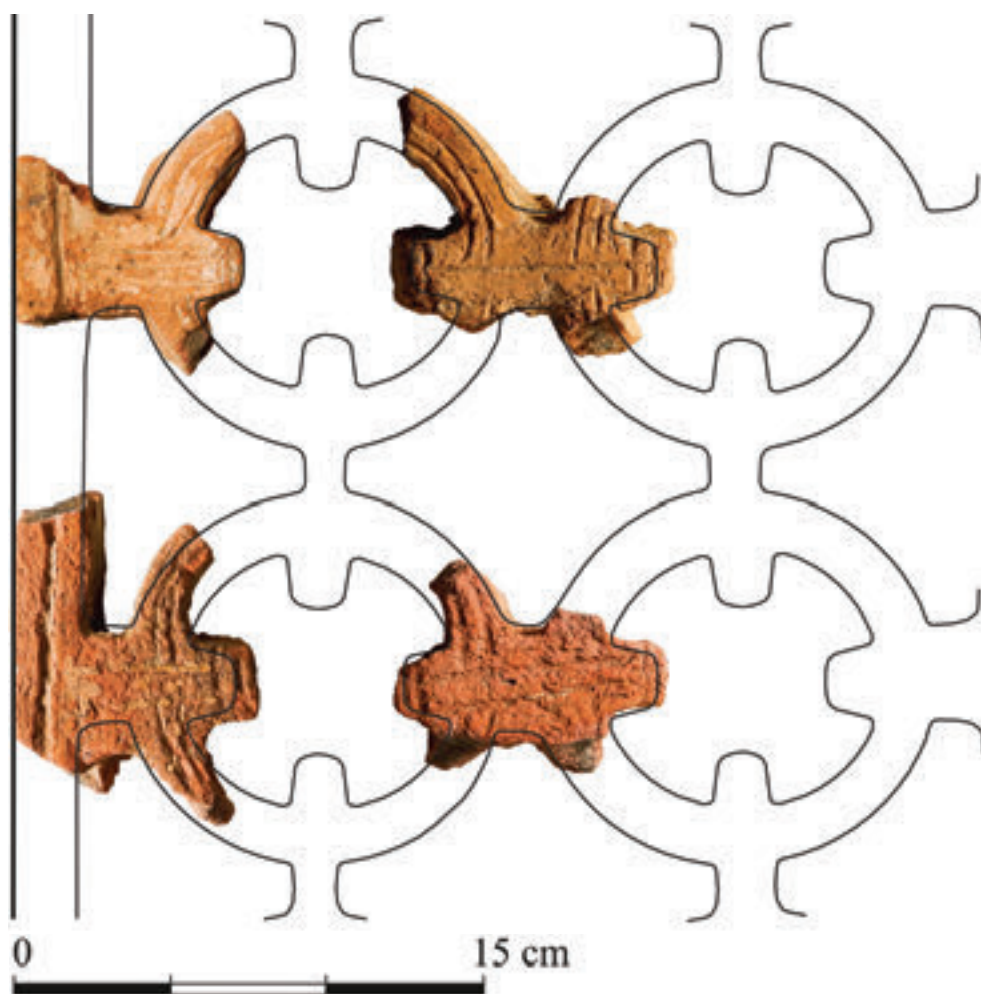


Fig. 8
Teracotta window
grille, Type 3. Photo
and reconstruction by
Agata Momot

Subtype 1.

A separately extracted frame does not occur in this type. The area between the grille edge and its interior design is blind but partially depressed (**Fig. 6**), the ornamentation being emphasised by a groove incised with a stick in the fresh clay on both the framing course and the arm of the plaiting ornamentation. The elements of the plait are often covered with polychrome. Perhaps this production method strengthened the grille edge, as the clay is also thickest here.

Subtype 2.

Here, the area between the grille edge and the plaiting elements are not depressed. The design also is outlined with grooving and emphasised with polychrome (**Fig. 7**). This type also is characterised by using the thickest slabs of clay, some 4–4.5 cm in section.

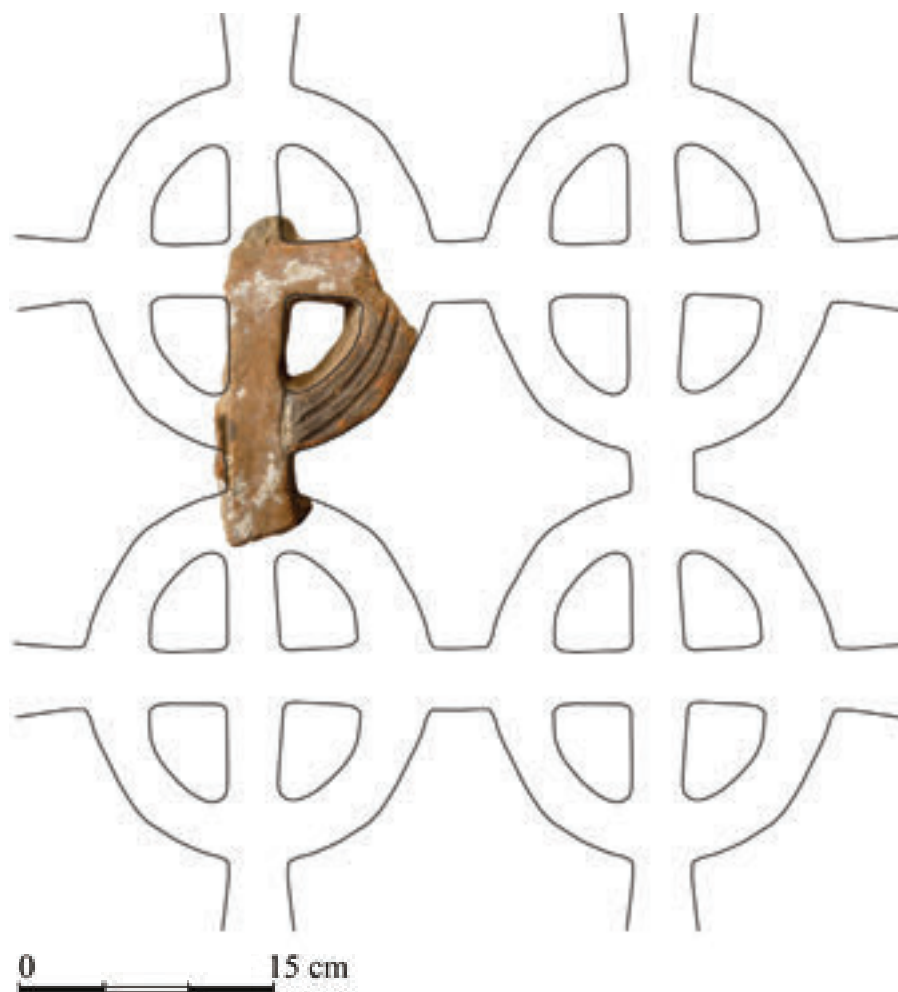
Type 3

Openwork circles.

Four fragments of this characteristic openwork ornamentation belonged to at least two different grilles. The pattern consists of a thin frame and ornament composed of circles connected by short segments (**Fig. 8**). Parallel grooving accentuates the

Fig. 9

Terracotta window grille, Type 4. Photo and reconstruction by Agata Momot



composition, which is identical to that on the sandstone grille described below. The exclusive formula simplifies the stone grille design, and thus might be copied in terracotta. Such terracotta examples also are known from Old Dongola, where patterns were simply imitated or were taken from stone decoration.³¹

Type 4 **Celtic cross.**

Crossed arms inscribed within a circle are the basis of this composition, probably developed from multiplied Celtic cross motifs (**Fig. 9**) and rhomboidal spaces between the individual circles. Some elements are decorated with grooves or sets of parallel grooves, as well as with paint. For the observer, the crosses and rhomboidal spaces are best seen from a dark chamber. A sizeable ornamental group of grilles at Faras employs the cross within a circle motif.³²

The remaining 36 fragments are openwork patterns that cannot be classified as any of the above types. Their decorative motifs are impossible to reconstruct because the material is either too fragmentary or individual. However,

³¹ RYL-PREIBISZ 2001a: 380.

³² RODZIEWICZ 1967: 151.



Fig. 10
Examples of other
decorative motifs of
terracotta window
grilles. Photo by Agata
Momot

distinctive groups of material can also be distinguished in this category. The largest group includes fragments having a characteristic round or semicircular stamped ornamentation, most often (14 fragments) accompanied by grooves made by cutting. Fragments of frames and arms with this type of decorative motif also are registered at Banganarti, but it seems that it adorns different grille types and thus cannot be a distinctive element in itself. Other openwork pattern fragments are both elements of frames (12 fragments) and filling ornaments (10 fragments). In addition to three corners and two sides, seven upper curved frame fragments were found, proving windows were closed with a segmental arch at the top.

The remaining fragments are primarily parts of filling ornamentation. Small fragments of undefined shape and larger fragments with round, triangular or ellipsoidal openings are also registered (**Fig. 10**). Unfortunately, they also do not allow reconstruction of the decorative leitmotifs because they are unique, fragmented, and often irregular.

Polychromy and other decoration were applied to the grilles' outer surface and are associated with the visual appearance of the building's overall façade. Polychromy is visible from farther away than grooving, so its role was more important.³³ The colours and ornamentation were not visible from the interior, as the viewer had the sun in their eyes and saw only the black outline of the window design. Type 1 grilles are coated with one layer of paint or, occasionally, with slip. Usually, only one colour is used on unique grilles within this type. Polychromy is always used to underline the plastic forms of the other types. The interlace stripes

³³ RODZIEWICZ 1967: 152.

most often are painted in different colours. Paint is used to highlight the Faras grilles' design, applying two colours for one grille at most.³⁴ In the discussed collection, the most popular colours are different shades of orange and cream, also brick-red and purple. In comparison, stripes on the Faras grilles are painted using light and dark yellow and brown, red and white, and frames remain unpainted.³⁵ Yellow polychrome occurs with red-brick slip on the grille found in the church at Ghazali,³⁶ and yellowish slip is recorded at Meinarti.³⁷

Paint application only emphasises plastic motifs; no individual decorative elements are painted. Such cases are well known at Old Dongola, where terracotta grille fragments recovered in the Monastery on Kom H are painted on both sides but shaped in high relief only on the obverse. However, considering their probable dimensions and shapes, these are not interpreted as window grilles but as decorative partitions.³⁸ One interesting grille, dated to the mid-eleventh century, depicts two cocks flanking a column, below an arched frame with a painted dedicatory inscription.³⁹ However, no other such richly decorated examples are known.

Other types of decoration include incisions, grooves and circular stamps. Incisions are usually cut with a knife or another sharp tool to emphasise existing ornamentation or separate ornamental spaces. Grooves range from shallow and messily made using sticks to quite deep, neatly formed regular parallel grooves. This decoration type is characteristic of this kind of architectural detail, as at Ghazali,⁴⁰ and is also popular on grilles at Old Dongola, as in the Church of Granite Columns⁴¹ and the Monastery Church on Kom H.⁴² It is the easiest to design and create, and it occurs on all grilles of all categories and types at Banganarti.

Stamps usually are undifferentiated. Small, circular traces of round stamps are aligned in individual rows, garnishing particular ornamental elements. They very frequently occur in conjunction with incisions or grooves (**Fig. 11**). Some stamps are incompletely impressed and remain semicircles. The stamps on two fragments (probably from the same grille) were made using a blunt end of a tool, leaving short-staple marks (**Fig. 12**). Twenty fragments bearing traces of whitewashing prove that building façades and internal walls were repainted.

It can be assumed that such a varied collection of specimens certainly would not have come from one building. As mentioned above, the Lower Church was adorned with slabs having round openings. However, a significant number of the other different forms probably adorned the houses surrounding the main edifice. The Old Dongola collection, for comparison, is also numerous and fragmentary. Both primitive, roughly made and precisely executed specimens have been recovered. Very often fragments are too small to reconstruct the whole design.⁴³ No object was preserved *in situ*, but grille use outside religious buildings is

34 RODZIEWICZ 1967: 152.

35 RODZIEWICZ 1967: 149.

36 SHINNIE, CHITTICK 1961: 28.

37 ADAMS 2001: 39.

38 JAKOBIELSKI 1993: 106; 1994: 124; 1995: 92; RYL-PREIBISZ 2001a: 381–382.

39 JAKOBIELSKI 2003: 213.

40 SHINNIE, CHITTICK 1961: 28.

41 GARTKIEWICZ 1990: 203.

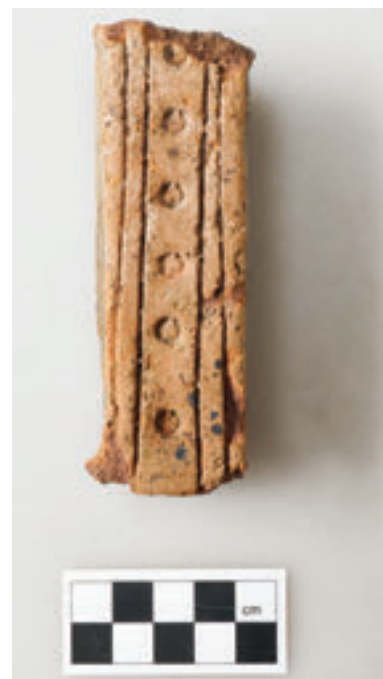
42 Gazda 2008: 354.

43 RYL-PREIBISZ 2001a: 379.

known from other sites. The upper floor of House A.106 on the Citadel hill at Old Dongola was lit by large windows screened with ceramic grilles. Several dozen fragments were found in the room fill. The finds dated to the first half of the seventh century.⁴⁴

Grilles were found in seventh-century dwelling houses, as in the southwest sector at Banganarti,⁴⁵ and in later phases. Purple paint observed among the colours used at Banganarti may be a clue for dating. It was not registered among the grilles of Type 1 but was used to decorate almost 50% of other types. Identical paint occurs on pottery dated to the eleventh century here.⁴⁶ The fact that it was not used to adorn slabs with openings may confirm their previous provenance.

Motifs connected with liturgical functions, such as the Maltese cross, which may be found almost everywhere in Egypt and other regions in Africa, and along the northern and eastern shores of the Mediterranean,⁴⁷ are not registered at Banganarti on terracotta grilles. Also, popular Christian motifs, such as fish, common at other sites,⁴⁸ were not recorded among the finds. The lack of such typical motifs at Banganarti might also suggest that the grilles originated in domestic architecture.



STUCCO WINDOW GRILLES

Fragments of window grilles in stucco constitute the largest group in the Banganarti collection, with 356 inventoried fragments, both as large characteristic specimens and highly fragmented material. Stucco window grille fragments come primarily from the layers associated with the Upper Church, mainly from excavations within the building. Fragments were found near window openings, mostly in debris fill layers,⁴⁹ but it should be considered that find locations do not necessarily reflect the location within a structure when recovered in demolition layers. The layers, unfortunately, were disturbed, with no particular concentrations of this material. Thus, it remains debatable why most fragments were found inside the church; perhaps the building was demolished from outside.⁵⁰

The use of stucco as the material for these grilles is unique in Nubia. *The Dictionary of Art* defines stucco as a hard, slow-setting substance based on lime that can be shaped and used for repairs or covering architectural surfaces; it refers mainly to finished modelled, drawn or cast decorative plasterwork.⁵¹ The material is known in Old Kingdom Egypt. It was a popular inexpensive substitute for marble in Italy, Greece, Asia Minor, Syria, Egypt and France, as well as Ethiopia in the Early Christian and Byzantine periods, and also was essential in Islamic architectural decoration.⁵² Stucco barriers seem to be the best way to close large spaces, such as

44 GODLEWSKI 1998: 174–175.

45 ŻURAWSKI 2014: 64.

46 Aneta Cedro, personal communication.

47 GARTKIEWICZ 1990: 209.

48 RYL-PREIBISZ 2001a: 379.

49 ŻURAWSKI 2014: 115.

50 Ewa Skowrońska in an unpublished report from the 2011 season suggests the demolition was performed from outside the edifice, also proving it was intentional.

51 PROUDFOOT 1996: 812.

52 RAUTMANN 1996: 816.

Fig. 11 (on the left)
Fragment of the
terracotta window grille
decorated with grooves
and round stamps.
Photo by A.Agata
Momot



Fig. 12
Fragments of
terracotta window
grilles decorated
with polychromy and
grooves combined
with stamps. Photo by
A.Agata Momot

church windows.⁵³ The material from which the Banganarti grilles are made also consists of lime paste, sand and (in two fragments only) additives in the form of red-brick rubble. The paste very often contains small lumps of lime. For comparison, stucco window grilles found at Naqlun, the closest analogies, are pure gypsum, with a slight organic material additive,⁵⁴ constituting finely chopped straw.⁵⁵ The slaked lime necessary for preparing the lime paste undoubtedly was produced on site. Two lime kilns discovered at Banganarti date to the eleventh–twelfth centuries, proving they were constructed to provide slaked lime for plastering the Upper Church. Moreover, two sizes of sand grains are observed in the paste composition. Thus, in terms of stucco typology, two groups are distinguished:

- Fine-grained sand paste;
- Coarse-grained sand paste.⁵⁶

The first category was used in most cases, where the sand is very fine and homogeneous. Sand grain sizes can be as small as ca. 1 mm. The coarse-grained sand paste is identified in 27 cases. Ewa Skowrońska suggests that the fine-grained paste might have been typical of the original, initial Raphaelion window grilles, and coarse-grained sand paste used for later grilles.⁵⁷ As the first category of sand paste was used for most grilles, the 27 coarse-grained grilles may represent later ongoing replacements for specific windows.

Stucco window grilles were formed in wooden moulds. There were two methods of moulding, as already observed earlier:⁵⁸

- Moulding the whole grille in one run;
- Moulding the grille in several layers.

⁵³ PANNUZI, LUGLI 2019: 239.

⁵⁴ GODLEWSKI, DANYS, MAŚLAK 2016: 275.

⁵⁵ MAŚLAK 2019: 370.

⁵⁶ Skowrońska cites this same division.

⁵⁷ Skowrońska's unpublished report from the 2011 season.

⁵⁸ Skowrońska's unpublished report from the 2011 season.

**Fig. 13**

Fragment of a grille
moulded in three steps.
Photo by Agata Momot

In the first case, the lime paste was poured into the mould to create the entire grille. The gypsum grilles at Naqlun are similarly cast,⁵⁹ additionally, with using a litter to separate the gypsum from the base surface.⁶⁰

The second technique, multi-phase casting, is less common. Two, or, more frequently, three layers of lime paste can be observed. The first layer is always thin (ca. 0.5 cm), and the second thick, comprising the majority of the mould filling. The final layer also is 0.5 cm thick (**Fig. 13**). It can be assumed that such a process accelerated drying the grille. It was easier to mould and dry the layers gradually. Two- or three-layered grilles also differ in structure from grilles moulded in one run. It can be assumed that objects made using the three-layer technique were less brittle.

The collection of stucco window grille fragments includes both those enabling classification into types and unclassifiable fragmentary material. Unfortunately, no concentration of fragments that could correspond to an individual grille was found.⁶¹ This made the reconstruction process difficult, arduous and hesitant in a few details. Nevertheless, Dobrochna Zielińska elaborated several decorative motifs in the 2005 season⁶² and Ewa Skowrońska described and elaborated six central motifs, quoted by Bogdan Żurawski.⁶³ The above-mentioned decorative motif types have been developed, completed and adjusted according to the latest findings, and new types have also been extracted. Excepting individual fragments combined into more prominent decorative motifs, the repeatability of the decorative pattern is taken into account. All motifs except Type 6 are symmetrical. Frame fragments also prove Upper Church windows typically are closed at the top with a segmental arch, and their dimensional range is ca. 50/60 × 70/80 cm.⁶⁴ Consequently, considering the above findings, eight central decorative motifs have been reconstructed, distinguishing the following types.

59 GODLEWSKI, DANYS, MAŚLAK 2016: 275.

60 MAŚLAK 2019: 372.

61 ŻURAWSKI 2014: 116.

62 Unpublished reconstructions of decorative motifs from the 2005 season.

63 ŻURAWSKI 2014: 116.

64 ŻURAWSKI 2014: 116.



Fig. 14
Stucco window grilles,
Type 1. Photo by Agata
Momot, reconstruction
by Dobrochna Zielińska,
elaborated
by Agata Momot



Type 1

Quatrefoil 1

Repetitive quatrefoil motif composed of overlapping arcs. Individual decorative patterns are joined together using short segments, creating square spaces where their corners meet, with rectangular fields between the motifs (**Fig. 14**). All elements of the pattern are the same width. Approximately 20 fragments in this category are preserved. The following reconstruction is based on a 2005 study by Dobrochna Zielińska.⁶⁵

Type 2

Quatrefoil 2

The repetitive quatrefoil motif is composed of overlapping arcs similar to Type 1, but without gaps and additional connections between individual motifs (**Fig. 15**), resulting in a simpler and more compact pattern. All elements except the frame are the same width, as also in Type 1. The largest fragment of this grille type also preserves part of its frame. A single groove runs around the frame, surrounding and separating it from the filling ornament. A sizeable ornamental group amongst the terracotta grilles at Faras includes overlapping, geometric circles and semicircles.⁶⁶

Type 3

Oblique mesh

This motif is composed of small, rhomboidal apertures, forming a design similar to a dense mesh or a reticulated pattern (**Fig. 16**). The rhomboidal openings are not identical but similar in size. Other than a single-fold shallow groove engraved on the frame around the whole pattern, no additional decoration is noted. A grille fragment having a similar pattern, but of terracotta, was found in Room L of the Ghazali monastery.⁶⁷ The lattice pattern is also popular among grilles at Faras.⁶⁸

Type 4

Rosette

The pattern is based on a rosette consisting of a quatrefoil within two interlaced squares. Its connection to the frame is unknown.⁶⁹ However, the rosette as a singular motif is large compared with other types, possibly suggesting it is the central motif within the grille and surrounded by other, different motifs. Such decorative solutions are found on terracotta window grilles in the Church of Granite Columns

⁶⁵ The author would like to thank Dobrochna Zielińska for sharing the results of her work, which were extremely helpful for this part of the study.

⁶⁶ RODZIEWICZ 1967: 150.

⁶⁷ SHINNIE, CHITTICK 1961: 28.

⁶⁸ RODZIEWICZ 1967: 151.

⁶⁹ ŻURAWSKI 2014: 117.

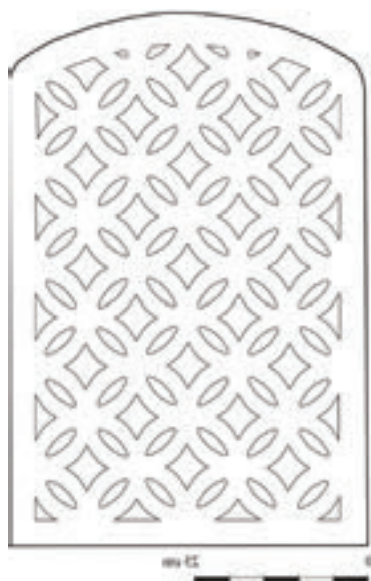


Fig. 15

Stucco window grilles, Type 2. Photo by Ewa Skowrońska, reconstruction by Agata Momot



at Old Dongola.⁷⁰ The particular fragment illustrated (**Fig. 17**) was found almost complete but required conservation work by Ewa Parandowska in 2020.

Type 5

Trefoil

This motif is composed of openings in the form of a trefoil (**Fig. 18**). The pattern is simple, without additional decoration. Connections between individual motifs are unknown, as only small fragments are preserved and the number and size of specimens do not allow for a more complete reconstruction. However, this pattern is not composed of sections but instead resembles trefoil apertures, making it visually heavier and less delicate than other stucco window grille motifs. Only seven fragments might fall into this category, making this a rare type compared to the entire set.⁷¹

⁷⁰ GARTKIEWICZ 1990: 204–205.

⁷¹ ŻURAWSKI 2014: 116.

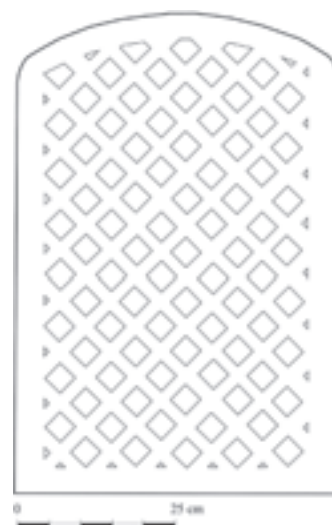


Fig. 16
Stucco window grilles,
Type 3. Photo and
reconstruction by
Agata Momot

Type 6 **Crosses**

This motif comprises simple sections joining at right angles, forming a kind of dense mesh with apertures that create Greek crosses arranged in diagonal rows (Fig. 19). Thus, the viewers would have seen the crosses from inside the church. As above, all elements are the same width and underlined with grooves in the centre of the element. One frame fragment allows the grille to be reconstructed with a segmental arch, including a groove engraved into a wet lime paste that emphasises the frame. Another set of fragments of this type are not grooved. Some terracotta grille fragments at Selib have similar geometric elements but are too small to reconstruct the motif.

Type 7 **Interlace**

Preserved fragments represent crossed arms arranged as a reticulated interlace (Fig. 20). One cross arm is always at the top of the pattern, which is visually underlined with grooves. No other decoration can be observed.



Fig. 17

Stucco window grille,
Type 4. Photo and
computer processing
by Agata Momot



Type 8 **Pointed cross openings**

Attempts to reconstruct this motif are very hesitant, with possibly questionable results, although Dobrochna Zielińska's reconstruction of the apertures as a pointed cross⁷² seems justified. The refracted arms of the motif undoubtedly create a pointed cross arrangement, but it is difficult to join the small fragments as a repeating pattern. The result described here seems the most probable arrangement (**Fig. 21**).

Stucco is a brittle material, so that over 50% of this collection is highly fragmented, making classification into specific types impossible. Fragments can occur as short, simple sections with no characteristic features, while others from the site surface can be eroded. This group includes 21 fragments of unidentifiable frames, and 20 fragments with remains of the round apertures whose motif could not be reconstructed.

Almost all stucco window grille fragments bear traces of smoothing, probably done after removing the mould before the stucco was fully hardened. It is worth emphasising that only the outer (front) side is smoothed; the inner surface remains unfinished. Smoothing the grille front has also been observed among

⁷² Unpublished reconstructions of decorative motifs from the 2005 season.

**Fig. 18**

Stucco window grille,
Type 5. Photo by Ewa
Skowrońska

gypsum objects at Naqlun,⁷³ probably just after the mould was inverted and the grille extracted. Subsequently, all grilles were whitewashed. More than one layer of whitewash is visible, presumably being later re-paintings of the church façade. Fifty fragments show marks of a greyish lime paint (**Fig. 22**). Preserved remains suggest grilles were re-painted from the church interior or on both faces – 42 fragments have greyish paint on the inner side, undoubtedly traces of the last re-painting as, in any case, this is the final coat.

Other than painting, the only decoration on these grilles is grooving, in almost all cases as one or two shallow parallel grooves running around the frame. The other form is also one or two parallel grooves underlining the course of decorative motifs by cutting the arms or sections in half (Types 6 and 8). This may also visually

⁷³ GODLEWSKI, DANYS, MAŚLAK 2016: 275.

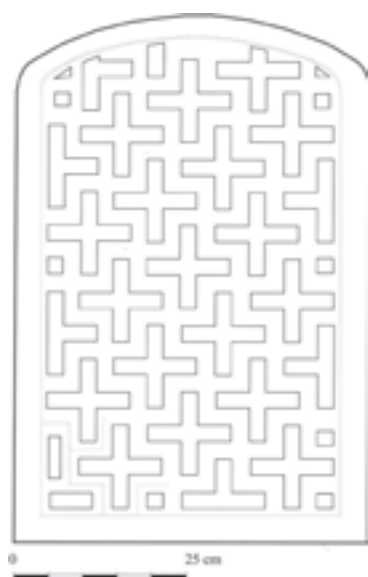


Fig. 19
Stucco window grille,
Type 6. Photo and
reconstruction by Agata
Momot



emphasise some parts of the motif, as in Type 7. Grooves are incised in still-viscous stucco, further evidence that moulds were removed after the stucco had thickened but before it was thoroughly dried. Traces of the flat tools used to form the grilles are also noted. For comparison, the decoration of the gypsum grilles from Naqlun was very simple. It was limited to circular and quatrefoil openings with coloured windowpanes and circular vents, arranged in specific patterns.⁷⁴

Only one glazed grille fragment was found (**Fig. 23**), a frame fragment⁷⁵ with remains of a decorative motif and aperture between its arms. It is obscured by a small glass fragment and covered with a thin layer of stucco, but its shape is not adapted to the aperture shape. The glass is turquoise/bluish, 2 mm thin, faintly

⁷⁴ MAŚLAK 2019: 375.

⁷⁵ PROBABLY Type 1.



Fig. 20
Stucco window grille,
Type 7. Photo and
reconstruction by
Agata Momot

transparent and with many small round air bubbles. The question is whether the stucco window grilles at Banganarti were glazed. Such examples are known from Naqlun, where fragments of stucco window grilles with glass panes were found in Rooms D.5–8 within the monastery⁷⁶ and in Room D.50. Among these objects, apertures both circular and in the form of a Greek cross were closed with usually round windowpanes placed in the middle of the object section. Several irregular fragments were also re-used, but almost all of the panes were made using the crown glass technique; however, a fragment that was cut-off from a larger pane was also found.⁷⁷ The glass used at Naqlun is predominately green or blue and, rarely, olive colour or colourless.⁷⁸ An interesting collection of windowpanes was found at Marea.⁷⁹ Among these finds some of the panes were still embedded in the plaster window openings, the remaining wear traces of the lime mortar. The windows were composed of round openings, probably arranged in a geometric pattern.⁸⁰ Glazed terracotta window grilles have been found in the Monastery of the Holy Trinity at Old Dongola⁸¹ and at Soba⁸² and Ghazali, where windowpane fragments were recovered.⁸³

⁷⁶ GODLEWSKI 1990: 33.

⁷⁷ MAŚLAK 2019: 371.

⁷⁸ GODLEWSKI, DANYS, MAŚLAK 2016: 275; Maślak 2019: 371.

⁷⁹ KUCHARCZYK 2002: 68.

⁸⁰ KUCHARCZYK 2002: 69.

⁸¹ Wojciech Chmiel, personal communication.

⁸² WELSBY 1992: 177.

⁸³ SHINNIE, CHITTICK 1961: 26.

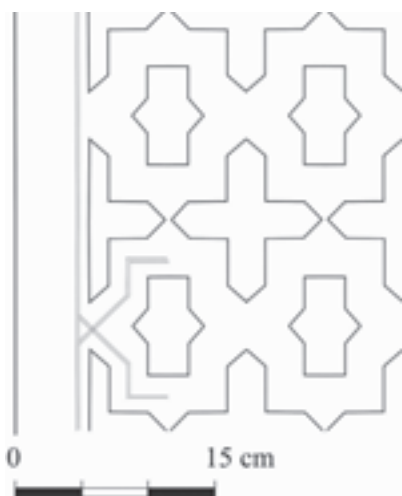


Fig. 21

Stucco window grille,
Type 8. Photo and
reconstruction by
Agata Momot



However, the Banganarti specimen is unique at the site; no other glazed grilles were found. Nor were traces of glazing or windowpane finds registered among the terracotta grilles. Therefore, faced with insufficient evidence, it would be risky to propose that the Raphaelion windows were glazed.

Five frame fragments, undoubtedly belonging to the same Type 6 grille, were found with characteristic apertures within the frames (**Fig. 24**). The section is irregular and identical in all cases, with macroscopic observation proving the gap to be the negative imprint of *jarid* (palm ribs split to ca. 1 cm thickness),⁸⁴ impressed into the stucco at the frame bottom and sides. Their initial interpretation as punctures left by fixing objects⁸⁵ cannot be upheld. The rib was placed inside the frame structure, not protruding beyond it, so the apertures are present only within the frame and could not have been used to fix the grilles into the window. It seems probable that the palm rib was placed in the frame to strengthen it from the inside. Stiffening the entire object in a brittle material such as stucco is reasonable, but why such a method was used only in a single case is unknown.

Considering fragment thicknesses (2.8–7.0 cm range), lime paste composition, and presence or absence of grooved decoration, at least 19 different objects were distinguished, but probably more existed due to the many unidentified fragments. The edifice may prove to have had a large number of windows – apertures beneath the central dome and perhaps also in the vaults⁸⁶ or the gallery on the first

⁸⁴ The palm rib, an unstable organic material, is not preserved.

⁸⁵ Unpublished excavation inventory from the 2005 season.

⁸⁶ ŻURAWSKI 2014: 116.

**Fig. 22**

Fragment of a window grille frame originally covered with grey paint. Photo by Agata Momot

Fig. 23 (on the right)
Fragment of a window grille with a glazed aperture. Photo by Agata Momot

floor. Not all window grilles may also prove to have originated during the construction of the Upper Church within the late eleventh century; some may be later additions. Openwork filling made in a pretty brittle material would have been damaged over time and under the influence of weather conditions, and could have required replacement. The large quantity of individual objects suggests another conclusion: the mould was used only once and was damaged when being separated from the grille. This means mass production was unlikely. The manufacturing process of stucco grilles required more precision and work than terracotta, and more attention was paid to the artistry. This means that skilled artisans were required, another factor proving the uniqueness of the St Raphael Church II at Banganarti.

Stucco window grilles are a rare architectural feature in medieval Nubia. Their closest analogies are at the Naqlun monastery, located in Northern Egypt, in the Faiyum Oasis, where they were registered in the Church of the Archangel Gabriel and have been found over the years in different parts of Complex D,⁸⁷ dated to the ninth and tenth centuries.⁸⁸ However, some critical differences distinguish these two groups. As mentioned above, the Naqlun grilles are of pure gypsum, apparently having much more modest decorative motifs and distinguishing aper-

⁸⁷ MAŚLAK 2019: 369.

⁸⁸ MAŚLAK 2019: 376.



tures in circles and Greek crosses that do not follow an established pattern. However, they are distinguished by their glazing⁸⁹ and the presence of round openings with relatively small diameters (1.6–6 cm)⁹⁰ that have been interpreted as vents since they are placed near the object edge and smoothed inside.⁹¹ No similar holes are recorded at Banganarti. The bottom corners are slightly rounded, and curved edges indicate segmental-arched tops, but no complete grille was found again. Window widths are similar at ca. 55 cm.⁹² However, the general form of the Raphaelion stucco grilles differs slightly and their aperture compositions remain closer to those on the terracotta slabs than to openwork decorative motifs.

SANDSTONE WINDOW GRILLES

Only two fragments of sandstone window grilles were found at Banganarti. The first is a frame fragment of light-beige sandstone, trapezoidal in profile with an undecorated surface. It also seems slightly eroded, making it difficult to distinguish its inner and outer faces. The second fragment (Fig. 25) is

89 GODLEWSKI, DANYŚ, MAŚLAK 2016: 275.

90 MAŚLAK 2019: 371.

91 GODLEWSKI, DANYŚ, MAŚLAK 2016: 275–276; MAŚLAK 2016: 154.

92 GODLEWSKI, DANYŚ, MAŚLAK 2016: 276.



Fig. 24
Fragments of a window grille frame with the negative imprint of jarid. Photo by Agata Momot



Fig. 25 (on the right)
Fragment of a sandstone window grille. Photo by Agata Momot

another frame, with part of the filling motif attached. Its uniqueness and state of preservation make it extremely interesting. The grille is of brittle sandstone, brown on the surface and pinkish at the fracture and damaged areas. It most likely is a raw material of local origin. Pink sandstone was used also, e.g. at Faras for capitals in the First Cathedral.⁹³ This large (30 × 19.7 × 7.5 cm) fragment preserves a smooth undecorated rectangular frame with a lower part of a semicircle, a fragment of the side circle and three segments of the filling ornament, sufficient to reconstruct the entire motif. Short vertical and horizontal segments connect its constituent circles, a configuration reminiscent of the cross. An identical decorative motif was found on a stone slab (Fig. 26), which was formerly displayed in the Sudan National Museum in Khartoum among Christian objects.⁹⁴ Unfortunately without provenance, it allows an almost

⁹³ RYL-PREIBISZ 2001b: 288.

⁹⁴ Museum number undetermined; the object has been unavailable for some time due to the modernization of the exhibition.



**Fig. 26**

Stone slab with a decorative ornament from the Sudan National Museum in Khartoum. Photo by Agata Momot

Fig. 27 (on the right)
Stone window grille. Photo and reconstruction by Agata Momot

certain reconstruction of the filling ornamentation of the unique Banganarti window grille (**Fig. 27**). A simple decoration in the form of two shallow, parallel grooves runs through the surface of each element of the motif except the frame, only on the outside. The outer face of the grille was prepared quite carefully, the inner surface remaining unsmoothed.

Its findspot in the western area of the site, in the vicinity of the western defensive wall, makes it difficult to associate it with any of the churches. But, on the other hand, it is worth remembering that stone objects are heavy, and unsuitable for opening large apertures.⁹⁵ Thus, it is hard to imagine the sandstone window grille found at Banganarti was used on a thin mudbrick wall of a dwelling house. The find should therefore be related to one of the churches.

Stone window grilles are rare;⁹⁶ this raw material was only sporadically used for window grille production. However, some are known at Faras, where sandstone Meroitic objects also were found.⁹⁷ One rare specimen is a re-used fragment, a limestone grille fragment found *in situ* in the window of the eastern wall of the Faras Late Cathedral but itself dated to the seventh–eighth centuries.⁹⁸ Another sandstone grille was found in the Monastery Church on Kom H at Old Dongola in 1990, closed within an arch at the top and decorated with a Maltese cross motif. Its lower part was embellished with barely visible intertwining lines, the whole within a thick border. An additional ornament, characteristically small beads added to the cross design, finds analogies in early decorative patterns at Old Dongola⁹⁹ and throughout Nubia.

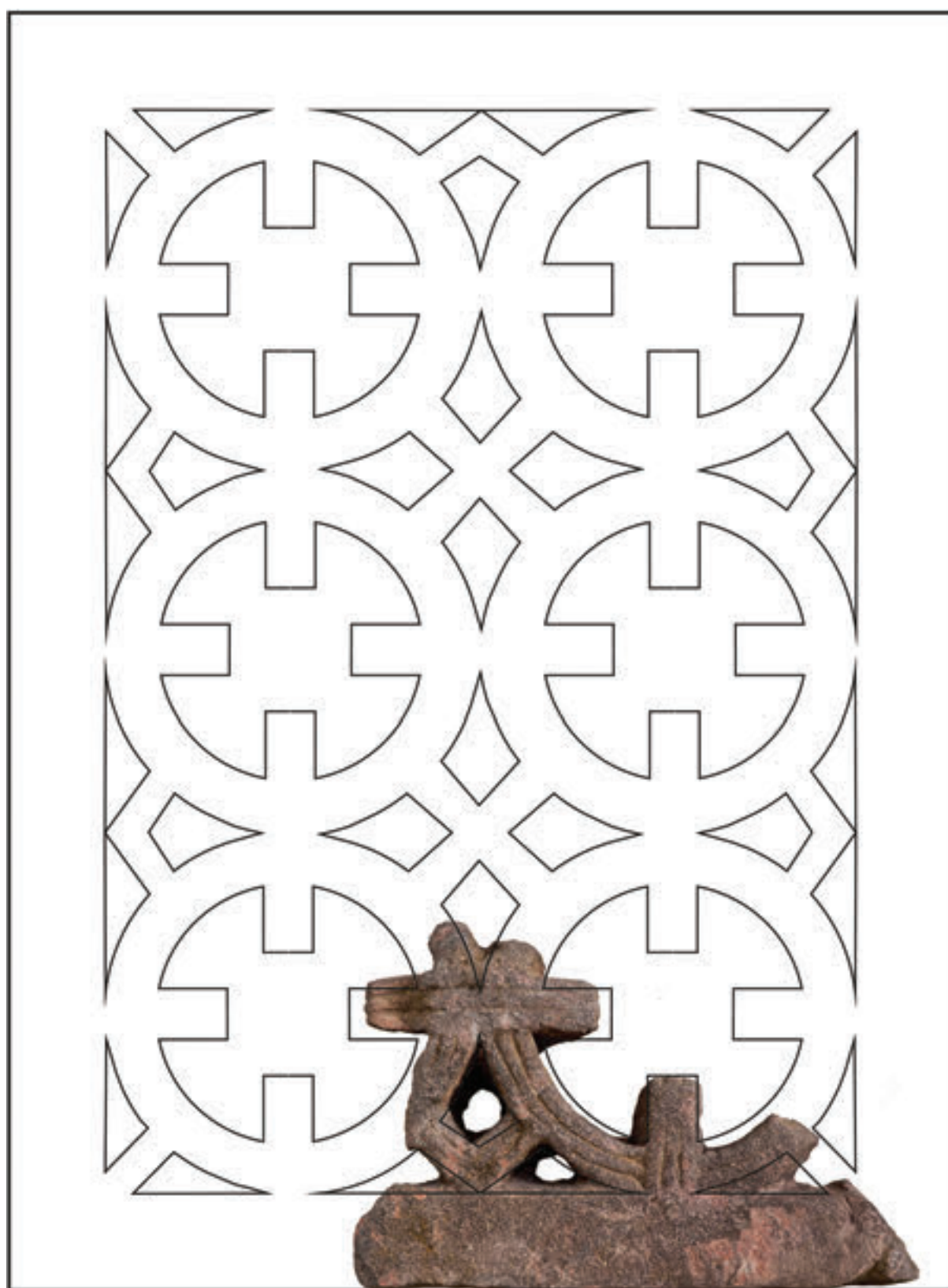
⁹⁵ PANNUZI, LUGLI 2019: 239.

⁹⁶ GODLEWSKI 2013: 127.

⁹⁷ RODZIEWICZ 1967: 144.

⁹⁸ GODLEWSKI 2006: 163.

⁹⁹ RYL-PREIBISZ 2001a: 378–379.



0 25 cm

CONCLUSIONS

This specific feature had a huge impact on the architectural form of the buildings of which it was part. The window is an extremely important element from both utilitarian and aesthetic perspectives, and its closure determines the look of the façades and the character of its interiors. Thus, window grilles provide a lot of relevant information on the appearance of medieval Banganarti.

The collection of window grilles at Banganarti appears to be unique. The wide range of terracotta window grilles is highly diversified in both forms and materials, except for a rare sandstone example. The unique collection of stucco grilles makes the Upper Church stand out amongst Nubian ecclesiastical buildings.

Despite the highly fragmented and disjointed material, several points can be made. Terracotta and stucco grille collections are highly diverse and multi-elemental, exhibiting characteristically distinct details that allow many decorative designs to be reconstructed. Based on these finds we can imagine what the Lower Church was like, appearing to be illuminated only by the light shining through the round apertures of simple slabs and, in this light, to be dark within. The appearance of the Upper Church seems to be different. The delicate patterns on its stucco grilles give buoyancy to the architecture and allow more light to shine through the apertures.

It is worth emphasising that terracotta grilles could be produced by brickmakers, as both material and technology were the same, but stucco grille production demanded qualified artisans. Their methodological knowledge and artistic sense both are evident in the high-quality execution of these grilles.

There are many indications that windows in domestic buildings were also equipped with grilles. Openings larger than slit windows had to be covered with partitionings. Both early-phase and later houses at Banganarti have terracotta window grilles. Several small fragments of windowpanes were found in the domestic quarters, which may suggest that window grilles from houses were also glazed, but it is not confirmed in the finds of the grilles.

Generally speaking, the window grille collection at Banganarti corresponds to the standard repertoire of motifs and stylistic features of medieval Nubia, as proven by numerous analogies at other medieval sites. However, it should be emphasised that a stucco window grille is a rare form of architectural detail. Undoubtedly, the fact of such use and its excellent quality underlines the uniqueness of this special site.

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Orthophotography of the Sacred and Profane: The Geodetic Basis of Archaeological Research at Banganarti

Roman Łopaciuk

Abstract:

The chapter presents issues relating to the creation of fully metric archaeological documentation using geodetic and photogrammetric techniques. The theoretical basis of photogrammetry is presented, the knowledge of which allows archaeologists to use tools such as cameras, unmanned aerial vehicles (UAVs) and photogrammetric software to build 3D models of buildings, architectural remains and monuments. Based on experience gained during work at the archaeological site of Banganarti, ways of using non-metric cameras to create precise archaeological documentation in the form of vector maps, orthophoto maps and photorealistic 3D models are described. The steps involved in the automatic generation of point clouds from sets of photographs are briefly presented with the theoretical background. Next, aspects of geodesy, spatial-mapping systems and basic measurement techniques using a total station and Global Navigation Satellite Systems receivers are discussed. Finally, the problems that occur during measurement and photogrammetric works in desert conditions using low-budget sensors and UAVs are described.

Keywords: photogrammetry, geodesy, UAV, land surveying, 3D modelling, aerial photography, multi-image matching.

Introduction

According to a widely accepted definition, 'geodesy is the discipline that deals with the measurement and representation of the Earth, including the gravity field, in a three-dimensional time-varying space', encompassing all possible measurements using a variety of both direct and indirect measurement techniques.¹ Today, the aim is to have all spatial data represented, integrated and harmonised in a global spatial reference system. Furthermore, due to the development of geodetic techniques, more accurate geoid models for the whole globe and mathematically uniquely defined global reference systems are being created.

Surveying techniques have been used in archaeological research in the Nile Valley since Egyptology ceased to be a pastime of wealthy enthusiasts in cork helmets and tall riding boots and became an auxiliary science of history. It was instrumental when it came to measuring large objects and terrain features. In the modern landscape, there are physical traces of previous land use. However, they are not always visible and measurable from the ground. Applying geodetic and photogrammetric techniques, analysis of maps, creation of orthophoto maps, numerical terrain models, and images generated using photogrammetric methods allows archaeologists to detect and then document these traces.

In scientific studies, we can find many definitions of photogrammetry. Sometimes it is said to be part of remote sensing. However, as a rule, photogrammetry is focused on measuring the shape and position of an object. On the other hand, remote sensing itself is a science and technique of detecting and analysing objects based on remote (non-contact) measurement of the energy of electromagnetic radiation that is reflected or emitted by an object.² In brief, remote sensing is used to detect an object and photogrammetry to measure it remotely. However, it should be emphasised that we are dealing with remote (non-contact) detection and measurement in both cases. To be more precise, we are dealing with two fields: remote sensing from a global perspective and photogrammetry from a local perspective. As one can see, land surveying and photogrammetry are used to describe objects, registering their shape and location in space. Using geodetic and photogrammetric techniques, it is possible to map objects efficiently, and what is very important, it is done in a non-contact, remote way. The advantage of photogrammetry over traditional geodetic measurements is undoubtedly preserving the continuity of shape and structure of the registered object. Using photogrammetric techniques, it is possible to quickly measure very complicated structures, which cannot be achieved with traditional techniques applied in classical geodesy. Despite the superiority in some aspects of photogrammetry over traditional geodetic measurements, photogrammetry needs data from total station or Global Navigation Satellite Systems (GNSS) measurements obtained through the tools of geodesy. Without precise measurement data, photogrammetric products would not meet adequate geometric and accuracy standards.

1 VANÍČEK, KRAKIVSKY 1986: 45.

2 LILLESAND, KIEFER 2000: 112.

Surveying an Archaeological Site: The Basics

Irrespective of the applied technique of acquiring spatial data, an archaeological site should be inscribed in the Cartesian plane coordinate system. The foundation for measurements and the basis for placing measured objects in space is the geodetic network, a fixed reference point with time-invariant *XY* coordinates and *Z* coordinates for a predefined surface. If possible, a plane coordinate system in the coordinate reference system of the country in question should be adopted for the given archaeological site. In European and developed Middle Eastern countries, this is easy to do. In African countries, such as Sudan, it is very difficult or even impossible. This is where GNSS surveying techniques can help, of course, by measuring spatial coordinates and reporting them in the global reference system WGS 84. WGS 84 is a global coordinate system where coordinates can be determined in both the Cartesian *XYZ* and ellipsoidal *BLH* systems.³ Coordinates acquired in this way can be converted to any rectangular coordinate system valid in a given region. With a precision GNSS receiver, it is possible to measure points using static GNSS measuring techniques. In this case, a sufficient number of GNSS observations must be recorded. Next, observations from the GNSS receiver should be post-processed to obtain, e.g., *B*, *L*, *H* coordinates with the appropriate accuracy (precision). Leading manufacturers of GNSS receivers and other entities provide free services to perform post-processing of static observations from GNSS receivers.

Currently, in Sudan, there are several local datums; e.g. for Khartoum State, there is Adindan datum.⁴ Adindan datum is the local historical datum of Sudan that all triangulation and traverse network observations have subsequently been reduced to it. Adindan base terminal *ZY* was chosen as the origin of 22° 10' 7.1098" latitude (North) and 31° 29' 21.6079" longitude (East), with the azimuth of 58° 14' 28.45" from the north to *YY*. *ZY* is now about 10 m below the surface of Lake Nasser.⁵

In 2020, Sudan intended to use ITRF2008-WGS84 as a unified geocentric datum of reference system for national geomatics and geospatial activities and comply with the regional intention to unify the African reference system and geoid. With the proliferation of GNSS techniques in 2020, Sudan has also started to establish a geoid model for the whole country.⁶ To successfully use GNSS measurements, one must have an appropriate geoid model for the region; otherwise, the heights derived from GNSS observations will be ellipsoidal, and the desired height is the relative orthometric height to mean sea level. For efficient determination of spatial coordinates of measured objects using GNSS receivers, the most commonly used methods are RTK (Real-Time Kinematic) and RTN (Real-Time Networks). The problem with GNSS RTK or RTN measurements is the access to corrections from base stations, without which it is impossible to achieve centimetre

3 INTERNATIONAL CIVIL AVIATION ORGANIZATION 2002: 90–102.

4 Adindan is none other than Faras West lying on the border with Egypt. Two well-preserved churches at Adindan were surveyed there in the first decade of the last century by the English architect Geoffrey S. Mileham (1910: 37–39). Adindan is well documented on aerial photographs taken in the 1950s and 1960s for the archaeological rescue operation associated with the construction of the Aswan High Dam.

5 ELGIZOULI, ZOMRAWI 2013: 60.

6 SAMI, ABORIDA 2020: 2.

Zone	34North	35North	36North	37North
λ_0	21°east of Greenwich	27°east of Greenwich	33°east of Greenwich	39°east of Greenwich
Φ_0	0°	0°	0°	0°
k_0	0.9996	0.9996	0.9996	0.9996
E_0	500000	500000	500000	500000
N_0	0m	0m	0m	0m

Table 1.
General UTM
parameters in Sudan

accuracy. Moreover, without suitable correction data, it is not possible to determine the position accurately. It is now possible to perform RTK measurements using RTX corrections provided directly via the satellite protocol; this is extremely useful in locations without access to corrections from ground-based reference stations.⁷ Determination of global coordinates is complicated and sometimes impossible without adequate data from a network of ground-base stations eliminating ionospheric, tropospheric and orbit errors, and without knowledge of the transformation parameters to the current datum. However, there is rarely a GNSS receiver available which enables the acquisition of coordinates with sufficient precision. However, apart from the difficulties in obtaining coordinates based on the national detailed geodetic control network existing in practically every country or from GNSS observations, it is possible to adopt a local coordinate system for the archaeological site successfully.

It is best to orient the local coordinate system to the north of the orientation of the leading linear elements of the site, maintaining the natural orientation of elongated objects. The origin of the coordinate system should have coordinates greater than 0 to avoid negative XY and H coordinates. It should be noted here that coordinates, or the geodetic coordinate system, differ from the mathematical coordinate system. In geodetic systems, the x -axis is directed north, and the y -axis is directed east. In clockwise mathematical coordinate systems, the x -axis points east, and the y -axis points north. Most CAD programs work in mathematical systems by default, and this should be kept in mind when working with measurements from GNSS receivers and those acquired classically.

The basis for measuring and positioning an archaeological site is a properly designed and measured geodetic control network. The above-mentioned geodetic control network should be in place on the site before excavation to measure each time with the same uniform spatial coordinate system adopted. The geodetic control network should be established with due care and accuracy. It should be taken into account that measurements for archaeology are specific, and the accuracy requirements are high, especially when measuring complex architectural structures. The accuracy of the geodetic control network and measurement techniques adopted should allow determining the coordinates of the measured objects with sub-centimetre accuracy. A control network used to inventory archaeological objects is a specific network with geometrical parameters and construction, which often makes it different from typical geodetic surveying control networks. Field conditions, frequent changeability in

⁷ CHEN *et al.* 2011: 2216.

time of both the location and shape of objects to be measured, and the specificity of measurements often force archaeologists to depart from the correctness of the spatial layout of the control network in favour of its functionality and adaptation to specific needs. Often the interior of architectural objects such as temples, tombs, houses with complex structures and layout of rooms or inaccessible objects is measured. Therefore, the installed control network should allow for the measurement of elements outside and inside the building in a uniform coordinate system for the whole object. When setting up the control network inside a building, stabilisation should be avoided, which would cause interference or 'damage' in the monumental object. As far as possible, natural points that are unambiguously identifiable and located on fixed elements of the monumental structure should be selected as control network points.

Determination of coordinates of points of the basic surveying control network is done based on observation of angles and distances between stabilised points of the control network. Measurement of the geodetic control network points with GNSS receivers usually does not give satisfactory results. Currently, available GPS receivers allow for the determination of plane coordinates with an absolute accuracy of ± 2 cm, horizontal accuracy, and height of points with ± 3 cm. These accuracies, especially for height determination, are insufficient. GNSS measurements can be used to determine coordinates in the global reference system. The target control point network should be set up so that it can be used to measure the elements of the site with high precision. Therefore, it is not advisable to just use direct coordinates of the survey control points network from GNSS observations. Instead, it is necessary to perform classical total-station measurements and align the coordinates using a modified least-squares method, known as free adjustment.

At Banganarti, the basic control network in the local system was established in 2005 as a simple closed polygon. During the following years, the control network was condensed by second-order network points, as fixed points placed on top of the walls of buildings surrounding the Raphaelion and then on walls and fixed infrastructure elements. Over the years, the surveying control network at Banganarti has been transformed several times. The primary control network points (order 1) are still placed on the concrete poles marking the concession boundaries. The second-order control network (order 2) consists of prism discs made from reflective tape and markers placed on the walls of the Raphaelion and the museum buildings. The prismatic targets allow for a rapid determination of total stations by making linear-angular resections at any location with an accuracy of ± 3 mm using an electronic total station with an angle measurement accuracy of $5''$ and a distance measurement accuracy of $2 \text{ mm} + 2 \text{ mm ppm}$. The weather conditions experienced at Banganarti do not allow for the placement of control network points more than 100–150 m from the site. Because of the heated air, at high temperatures it is impossible to accurately aim at the geodetic marks constituting the control network. It should also be remembered that refraction occurs to a greater degree in desert areas, and the control network should be adequately sufficiently 'dense' so those heights from distant control network points are not transferred. Establishing a geodetic control network on an archaeological site is a complicated task and requires much creativity from a surveyor.

According to our experience during survey work at the Banganarti site, it is necessary to avoid placing control network points in visible places. Such points are the object of interest of the local population, especially children. My experience over the years has shown that this is more often done by girls than boys. However, the promise of *halaawa*, sweets, guarantees that the points will be in the same place the next day, and thus we avoid tedious reconstruction of the area grid or geodetic control network at the site; that involves the necessity of re-aligning it using the least-squares method, and the achievable accuracy becomes lower and lower. All measurements in subsequent excavation seasons must be made in the same unchanging coordinate system. The control network as the basis for determining spatial coordinates on the site is fundamental. It is essential that the surveying control network is not destroyed and that the geodetic survey marks allow for measuring terrain details and ground control points (GCPs) which are the basis for photogrammetric studies with appropriate precision.

Photogrammetry at the Service of Archaeology

The view from the top has always allowed us to have a broader look of the surrounding world in order to know and understand it better. All objects, elements of nature, whether animate or not, are located in space. Creating plans, maps, photo sketches, orthophoto maps, and photo plans enables us to define relations between various objects, such as buildings, structures or natural elements of the landscape. The wider, global view makes it easier to understand and learn about interactions between objects and draw conclusions. For example, it makes it possible to analyse complex correlations between objects, understand the intentions of people and builders, or the reasons for placing a building in a given place; at first glance, this may be incomprehensible or considered accidental.

The results of archaeological excavations are presented in several reports that include both descriptive and graphical data. The graphical part contains many data, mainly geometrical, and shows the spatial relationships. More recently, the graphical part is transferred into virtual space and is an integral part of the databases. This provides excellent opportunities and imposes several obligations on the archaeologist to conform to strict rules during data acquisition and to demonstrate skilful use of measuring tools. All the information gathered from a given site is now placed in extensive databases to define appropriate relationships between data, etc. To facilitate the presentation of database content, more user-friendly interfaces have been created, often incorporating spatial data visualisation and photorealistic 3D models, with links to structured descriptive data or graphic documentation sets. For such forms of data presentation and archiving, it is helpful to use software previously used for the construction or design of computer games, enabling us to present various information concerning a site or its part.

Acquisition of Photogrammetric Data

The most essential part of an archaeologist's work is documentation. The more accurate, the better and the more valuable it is. When there is no other way to preserve objects, e.g. during rescue research, documentation in an appropriate form

becomes a form of object preservation. Creating reliable documentation is a moral duty of every researcher and, in the case of perishable objects, an indispensable necessity. Conscientiously made documentation and the abundance of data collected during excavations may bring unexpected results in the future. The documentation becomes a source for further research and is a foundation for future knowledge production, analysis and further excavations.

It is possible that what was created or executed years ago will allow an archaeologist to return to the object and to conduct new analyses and research in a 'virtual' way, without new direct contact with the object. The description of an object recorded in written words is unchangeable, but what was registered on analogue or digital photographs may allow us to extract further data with the use of new 'engineering achievements'. Very often, something interesting is discovered in old photographs, something that changes the view on a given problem or allows us to understand its essence. The developing field of computer vision (CV) combined with the achievements of modern photogrammetry has been changing the possibilities in engineering, entertainment and archaeology for years. The reconstruction of objects (archaeological, historical) is often done by analysing archival documents, images or photographs. Numerous collections of images gathered during excavations can have additional value. Machine vision and photogrammetry make it possible to transform what a person sees on a photograph into a virtual space and to build mentally. A flat photograph on which an object has been registered is seen by a person in 3D, even though the medium, such as paper or a computer screen, is flat. The shape of the object is seen by the learned mind. Having several photos, we can materialise the space virtually, using appropriate algorithms. It is possible to depict and visualise an object in 3D. To reproduce space in 3D, in the form of a photogrammetric model, it is necessary to have at least a couple of photos – a stereogram. Using stereoscopic images, it is possible to register, record and archive space in 3D. Dynamic development of digital photogrammetry currently offers several tools that almost automatically build spatial forms, photorealistic 3D models, from a set of images taken with non-metric cameras and often in a random manner. The created models correspond to the original shape of the object and maintain the proportions, colour and hue.

While creating documentation, the primary-source photographs of a given object must be sufficiently, fully and completely registered. When building a database of information about the site, large amounts of photographs are archived. Data for constructing 3D models or other products that can help in further work, spatial or quantitative analysis can be obtained in several ways:

- use of archival photographs held by various institutions;
- use of photographs taken in the past during excavations;
- use of images recorded for a given purpose with appropriate care and following basic photogrammetric rules.

In recent years, technologies and software have been developed which mean that oblique images are becoming a desirable product for building entirely realistic 3D models. Previously, in photogrammetry itself, efforts were made to take pictures from the top perfectly vertically while maintaining the appropriate geometry. Of course, this meant that most often the final product was to be an orthophoto map. Images of elevations of buildings were taken along the base





Fig. 1
Archive photo taken
from a kite – oblique
view of the Banganarti
site. Photo by Bogdan
Żurawski

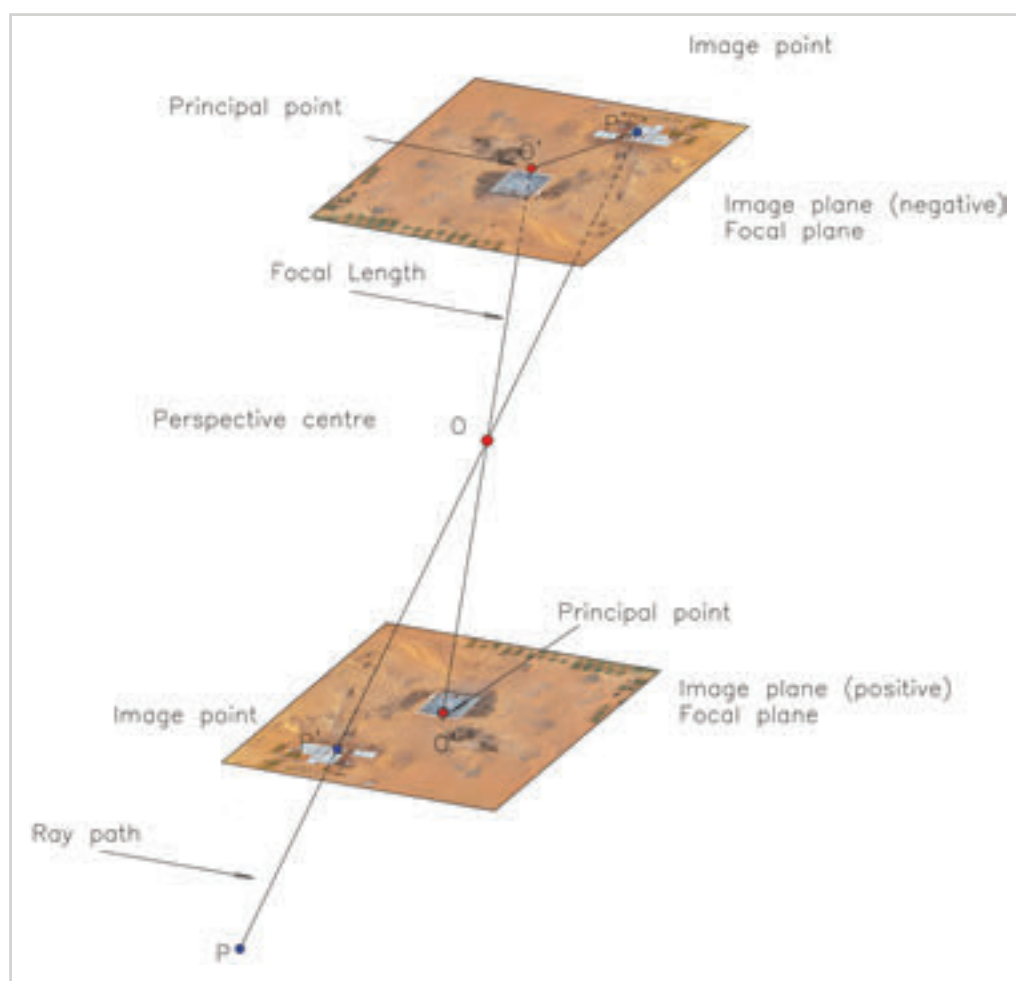


Fig. 2
Central projection –
positive and negative
positions

perpendicularly to it, i.e. parallel to the building wall. This was due to the limited possibilities of transforming the images. However, recently, when building 3D models, complete visualisations, giving the appropriate texture and rendering the complex shape of the object, photos taken perfectly vertically, orthogonally, parallel to the object are not enough. With such a set of images, there are gaps in the data needed to construct a complete model of the registered object. Efforts made in the past are not necessary. Currently known computational models successfully transform images obliquely and arbitrarily oriented in space. Software manufacturers clearly present in their product manuals how to take pictures of different objects, with simple explanations. Following the guidelines and rules results in a final product that has no shortcomings and is fully valuable.

To use photogrammetric tools consciously, one should understand essential concepts from the basics of photogrammetry. Thus, you first take photographs that may be used for photogrammetric studies and, secondly, evaluate existing data for suitability for photogrammetric tasks.

It seldom happens that an archaeologist has photos from metric cameras or photos on which ground control points are photographed in sufficient quantity; it is seldom possible to bring the photo to such geometrical form that allows us to measure distances between objects registered on it accurately. Geometrically,

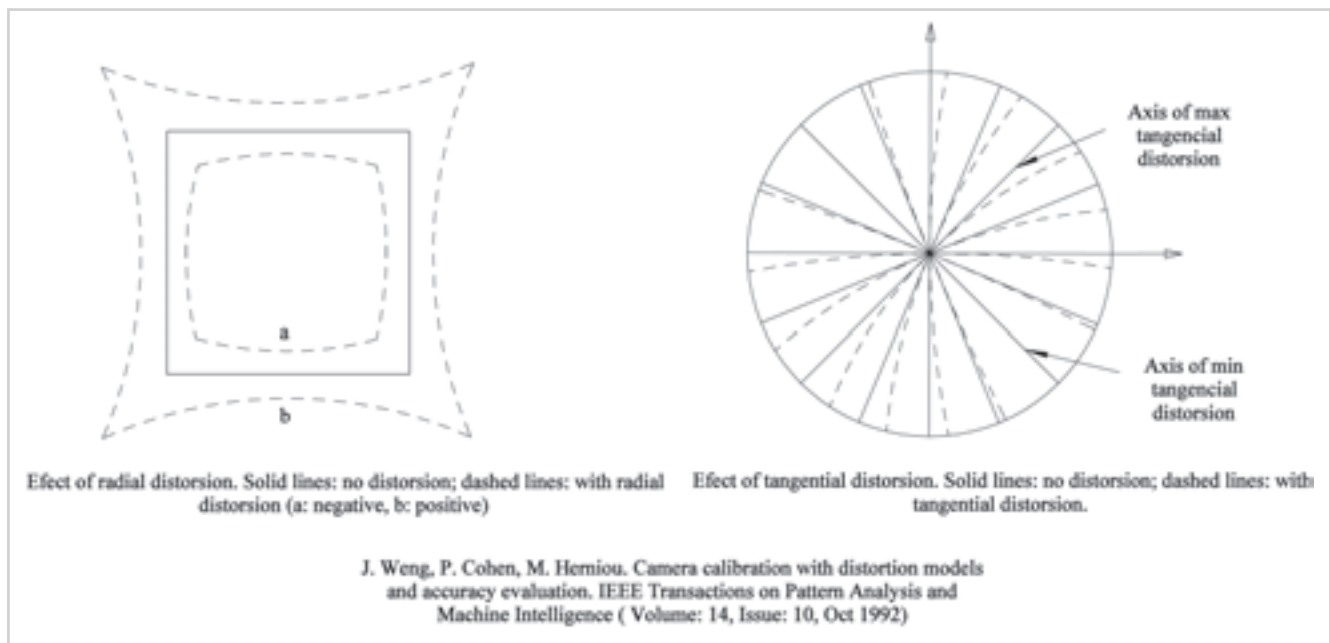


Fig. 3
Radial and tangential
distortions after WENG,
COHEN, HERNIOU 1992

a perfect photo in photogrammetric view is a centred, perspective projection. Central projection is a representation that assigns to each point of space (P) its image on the focal plane (P'), which is formed at the intersection of the focal plane by the ray path (straight line PO).

Geometric transformation of central projection to orthogonal projection is an essential operation in photogrammetric processing.⁸ The central projection is realised approximately in the camera. However, even in professional photogrammetric cameras, the realisation of the central projection is not perfect; there are several distortions. Distortions are of secondary importance in everyday photography, while the precise realisation of central projection in photogrammetry is essential. Geometric, radial and tangential, and chromatic distortions are the main problems that occur. These distortions are essentially related to the lens design. The occurrence of distortion degrades the recorded image, causing significant deviations from the theoretical model of central projection.⁹

Apart from radial and tangential distortion, there are several other errors and deformations. Structurally, in the cameras themselves, we have to deal with the non-orthogonality of the sensor axis, non-uniform scale, affine – non-uniform – pixel size along x and y , the flatness of the sensor surface and distortions caused by a rolling shutter. It should be mentioned here that the lack of a physical shutter in many digital cameras does not mean the lack of rolling shutter errors; the rolling shutter effect also depends on the kind of sensor used and the method of reading data from it. In non-metric digital cameras, especially those without interchangeable optics, geometric distortions are partially eliminated while recording the image itself. This process is not always desirable in further processing, mainly when an imperfect algorithm is used to correct this distortion.

⁸ KURCZYŃSKI 2014: 339–340.

⁹ WENG, COHEN, HERNIOU 1992: 965–969.

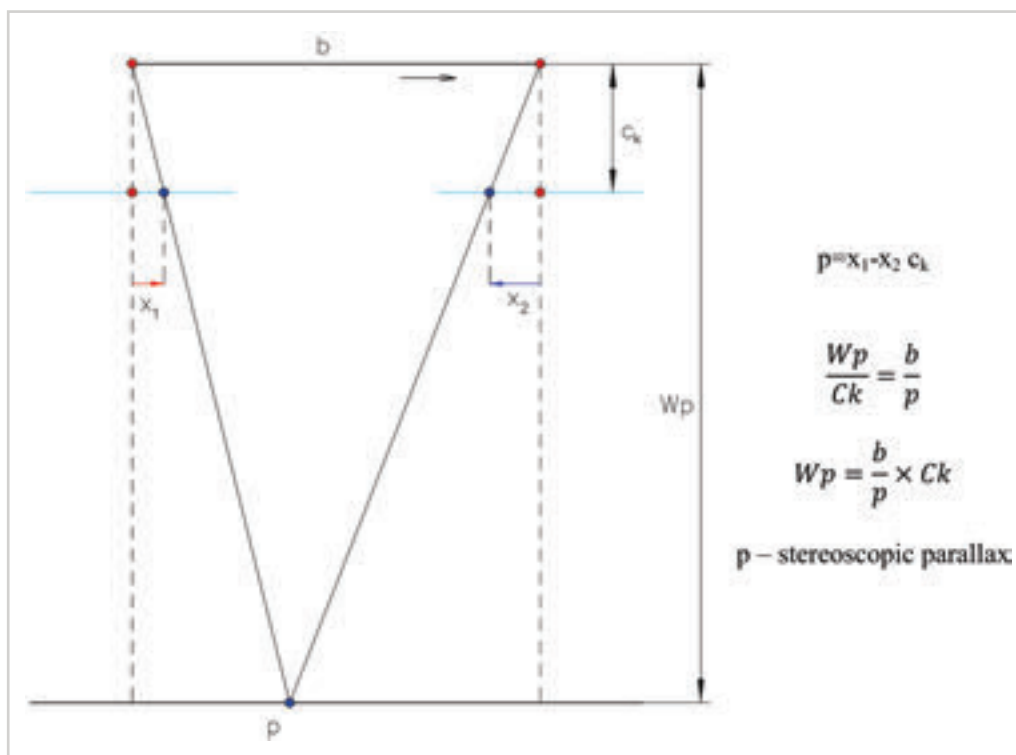


Fig. 4
Parallax on vertical
images

An ideally taken photo has gone through multiple reductions of the object and is metric. However, it is never possible to take a photo where the viewport is parallel to the object, and it is perfectly flat.

We obtain data such as pictures of objects or terrain that is not flat, and the object itself is photographed at an angle (non-orthogonal). A simple mathematical transformation applying only basic formulas is ineffective and does not eliminate errors that occur. The computational process is more complicated, but the currently used algorithms successfully eliminate most of the distortions, geometric errors that constitute a deviation from the theoretical central projection. Therefore, it can be assumed that an adequately transformed photograph is a precious, metric and accurate map of an object with the help of which we can determine with great precision the Cartesian coordinates of elements of interest preserved in the image.

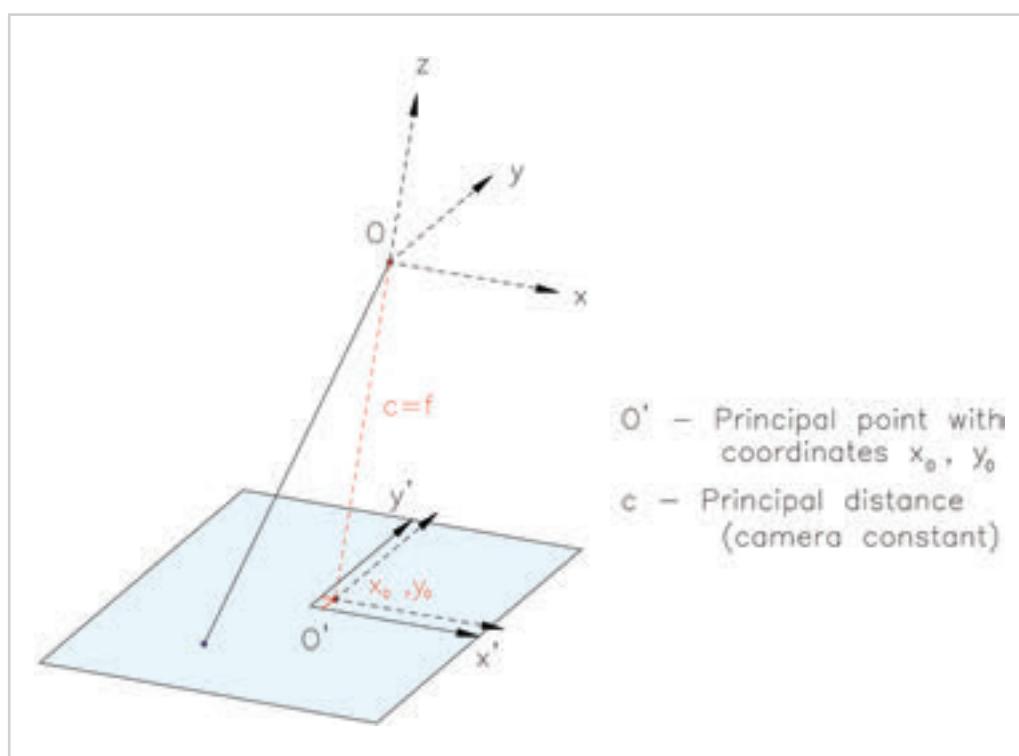
3D Photogrammetry – From Flat Images to 3D Models

While documenting an object, it is desirable to register its shape in 3D. Since its inception, photogrammetry has moved in 3D space: 3D photogrammetry mimics and models two-eyed vision or binocular vision.¹⁰ As already mentioned, to obtain 3D spatial data, you need at least two images in which the object is recorded. The basis for determining the third dimension is the measurement of longitudinal parallax, also referred to as disparity in CV.

Height difference or object height is a function of parallax difference and binocular disparity. So, in the most simplistic terms, having a pair of photos, it is possible to calculate the spatial coordinates of objects photographed on them by performing

¹⁰ WRIGHT 1954: 29–49.

Fig. 5
Interior orientation
of the camera



a simple space intersection. The measurement of coordinates on the pair of photos indirectly allows one to calculate horizontal and vertical angles and distances, as in classical geodesy. In reality, we usually have pictures taken diagonally, congruently, divergently, and arbitrarily, and the photographed object itself is not flat. In addition, the recorded image is distorted due to the occurrence of aberrations and other errors. Currently, there are known computational models which can be used to successfully obtain a point cloud from an appropriate set of photographs, which will be the basis for building a fully metric 3D model of the documented object.¹¹ However, with the calculations mentioned above, it is important to eliminate systematic errors during image registration. It is necessary to perform camera calibration. Such calibration can be performed on appropriate test fields in the case of metric cameras or cameras maintaining internal geometric parameters.¹² In practice, however, this method is not used due to the cameras' low geometric stability and the employment of non-metric cameras. The internal geometry of the camera changes each time the lens is removed from the body and sometimes also during the use of the camera itself. Such factors as vibrations, temperature and humidity differences, and focus influence camera calibration. Parameters of internal orientation in non-metric cameras are not constant in time. During the calibration process, there are certain errors caused by distortions, but, what is more important, there are two essential elements. That is, the position of the principal point relative to the centre of the image and image distance c (principal distance) (for distant plans, principal distance is focal length, $c \approx f$). Determination of these fundamental quantities is a process of metering and camera calibration.

¹¹ BRAZETTI, SCAIONI 2009: 2.

¹² KURCZYŃSKI 2014: 139–141.

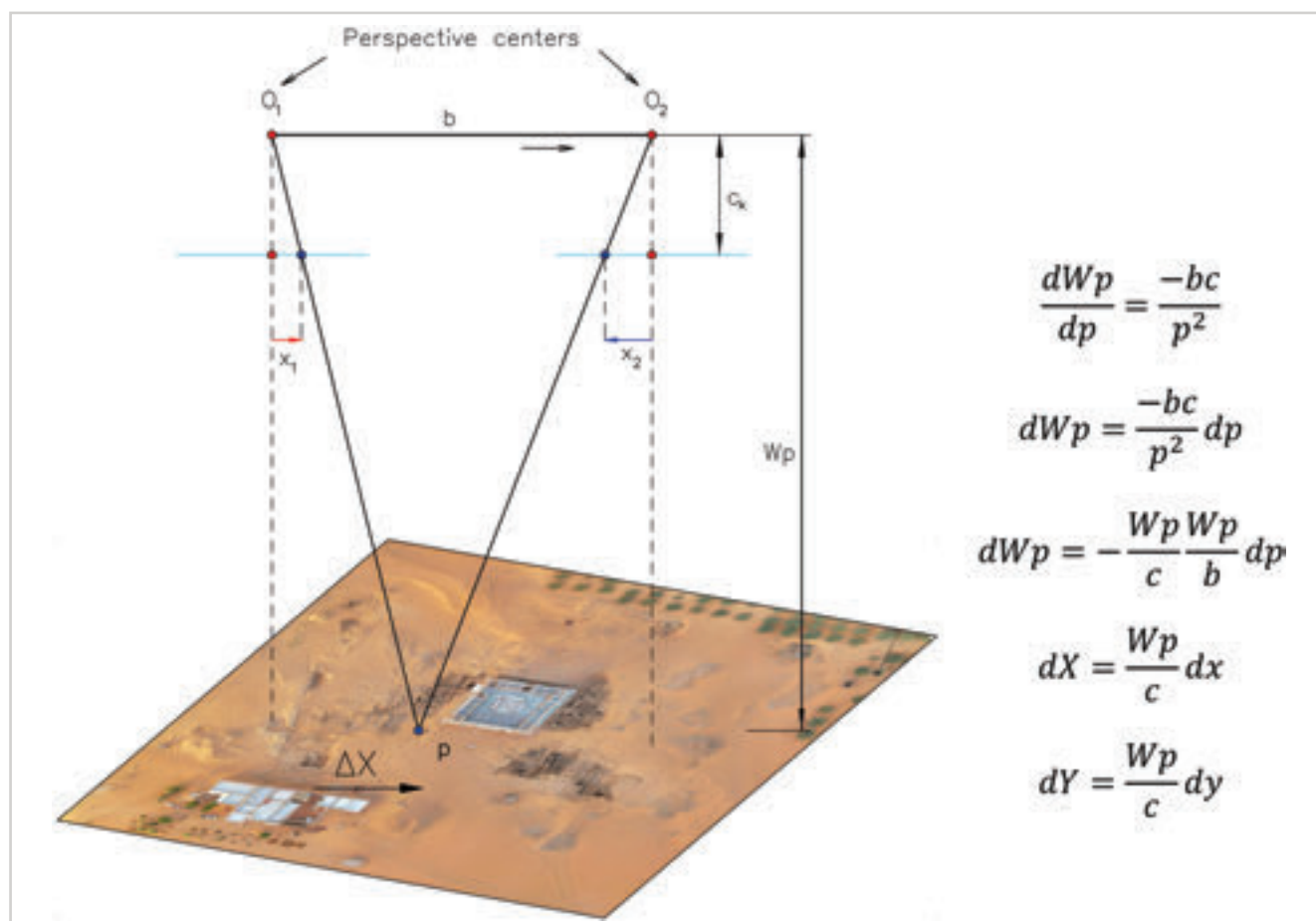


Fig. 6
Simplified analysis
of photogrammetric
measurement
accuracy

Thus, to arrive at the central projection conditions, the principal point's position, the principal distance, and the lens distortion parameters are determined. By calculating these parameters, the camera's interior orientation (IO) is established. When determining IO parameters, the imperfect realisation of central projection in a particular camera is corrected mathematically; the camera is calibrated. Camera calibration is usually performed using the on-the-job calibration method. On-the-job calibration is a pragmatic approach, and the calibration itself, such as the determination of the internal orientation of the camera, is added as additional unknowns to the alignment of the image block. Determining the calibration parameters or self-calibration during the image block alignment for non-metric cameras is the only reasonable way to establish the internal orientation parameters due to the instability of non-metric cameras.¹³ Performing the calibration of a non-metric camera on test areas before flight or acquisition of ground photos is impractical. The design of non-metric cameras does not guarantee the constancy of the internal orientation parameters. However, a properly calibrated camera is an excellent tool for acquiring geometric data with high accuracy.

So with what accuracy are we able to determine terrain coordinates from a block of images? It depends on several factors. Considering the simplified

¹³ LUHMANN, FRASER, MAAS 2016: 37–46.

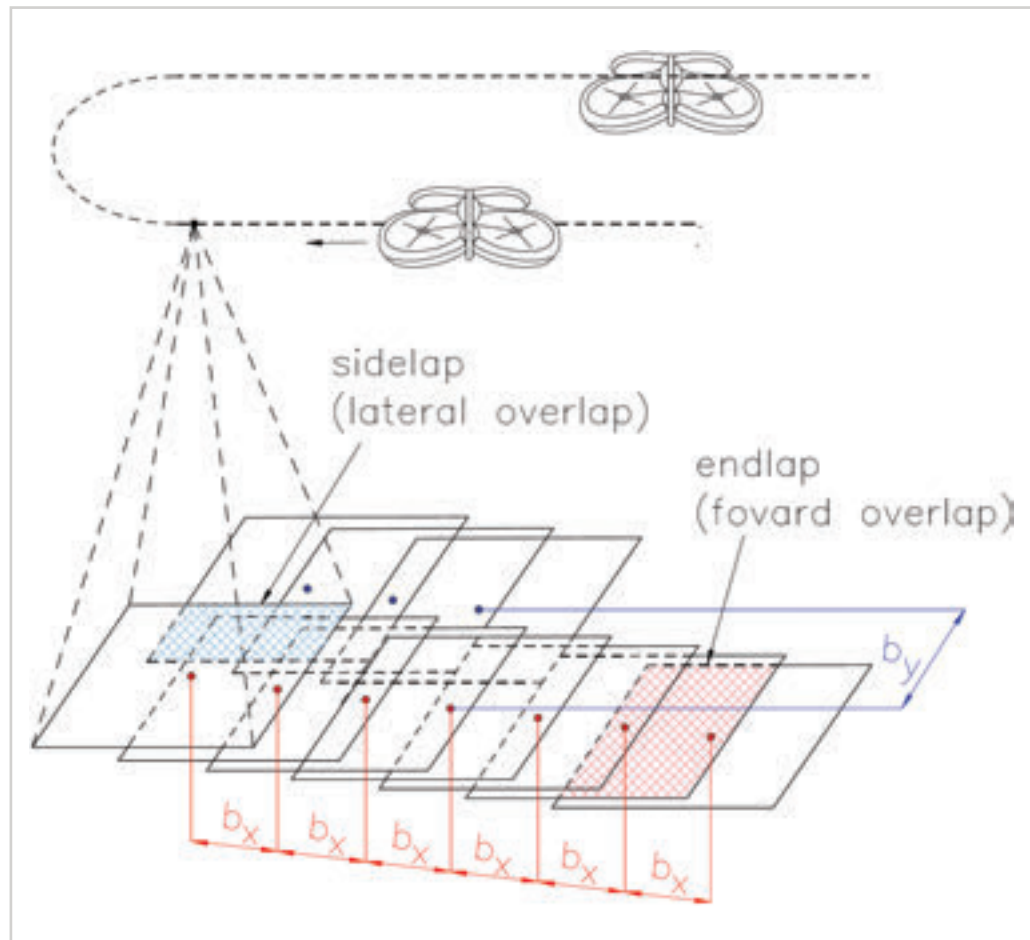
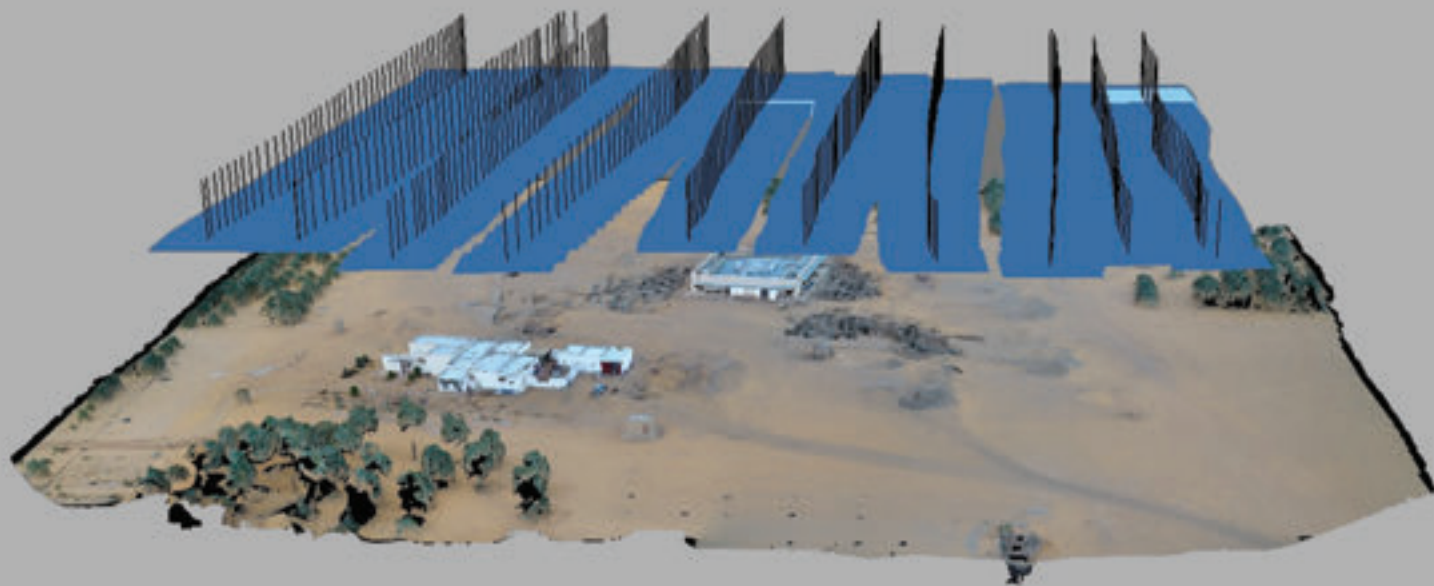


Fig. 7
Forward and side
overlap in a regular
image block

analysis of the accuracy of photogrammetric measurement, the error of field coordinates measurement depends on image scale number ratio of height, Wp , to camera constant, c_k , the ratio of height, Wp , to base length, b , indirectly from overlap ratio, and the accuracy of coordinates measurement on images, dp .

On images acquired from UAVs, i.e. from low altitude, the forward and side overlap should be much more significant than in classical aerial photogrammetry (high altitude) and is usually 80% of longitudinal coverage and minimum 60% of side coverage, with forward overlap of 80% and a sidelap of 60%. It follows that the base length (b) at such coverage is small, which theoretically negatively influences the accuracy of Z coordinate determination. On the other hand, significant overlap and amount of data allow us to perform multi-photo resection, i.e. resection from many pairs of photos both in the longitudinal and transverse direction.

Theoretically, the error in determining the plane X coordinate is at the ground sampling distance (GSD) level, field pixel size; the same is true for the Y component. On the other hand, the error of the third height coordinate is larger than that of the m_x , m_y errors, because it is multiplied by the base ratio, base to height ratio. In practice, however, due to such a large number of redundant observations, the precision of determining the Z coordinate is only slightly less than the precision of determining the X , Y coordinates. The assumption that $m_x = m_y = \text{GSD}$ flat coordinate errors are the same as GSD would be correct if each image's determination of perspective centres in space was error-free. However, errors in the determination

**Fig. 8**

Semiregular block of photographs taken over the Banganarti site

of perspective centres cause the accuracy of XYZ to decrease to 2–3 pixels for a correctly aligned block of photos.

A block of images is obtained by flying over the object with an adequately prepared UAV system or taking ground-based images for smaller objects, such as rooms. A regular block of images is a set of images in a series, in which the images overlap both longitudinally and transversely as they cover each other.¹⁴

In a regular block of images, images in a series are taken with a constant time interval ($b_x = \text{constant}$), assuming a constant UAV flight speed over the object while maintaining the parallelism of strips. The distance between the centres of the projections of successive images in a strip is the longitudinal base, b_x . The distance between the axes of strips is called the transverse base, b_y . Photographs are taken in such a way as to keep the predetermined forward and side overlap. In conditions like those at Banganarti, taking a block of photos in an automatic, programmed, planned manner is impossible due to the strong wind and the relatively low flight height. Additionally, photographs are often taken after the drone is stopped in flight and the camera is stabilised to preserve the appropriate quality of photography. Autonomous flight, in this case, is excluded.

Acquisition of images from low altitudes using UAVs allows recording the selected area with high resolution, GSD at the sub-centimetre level. However, vertical images taken from low altitudes have their disadvantages. The photograph, as already mentioned, is geometrically a centre projection. When photographing non-flat objects, such as buildings, vertical walls or deep excavations, blind spots and hidden areas occur, i.e. places that are not registered in the picture, occluded.¹⁵

To minimise the occurrence of blind spots, several techniques may be used: additional cross-flight (in the direction perpendicular to the original flight),

¹⁴ KRAUS 2007: 132.

¹⁵ KRAUS 2007: 382.

omnidirectional or oblique shooting, or complementing the aerial photos with ground-based photos. Of course, as can be easily seen from Fig. 10, the reduction of blind spots occurs with increasing flight altitude. However, the flight altitude affects the photo scale and the GSD size, which usually should be relatively small. To maintain the appropriate level of detail in photogrammetric processing, the GSD must be established in advance and correspond to the level of detail in the processing. The GSD parameter depends on several factors: flight altitude, camera sensor resolution, physical pixel size, indirect effect on camera sensor size, and focal length. For the same flight altitude, decreasing the focal length increases the GSD and the imaging area, while the field frame increases.

On the other hand, keeping the same frame size and flight altitude, using the same camera, the same body, and increasing the focal length by changing the lens, changes the scale of the image and, consequently, decreases the GSD and the field frame. Thus, selecting appropriate flight parameters impacts the number of photos needed to be taken in a given area while preserving the previously set average GSD and overlap. It should be emphasised here that many images do not always positively influence the quality of developed photogrammetric blocks.

When choosing a camera, a non-metric camera, the most critical parameter that should be taken into account is the resolution of the camera sensor. The sensor's resolution is indeed significant but, more critical for photogrammetric tasks is the physical size of the sensor itself. Images of the exact same resolution, but taken with cameras of different sensor sizes, are significantly different. A larger camera sensor size guarantees better quality of the photogrammetric product. The large sensor allows keeping better geometry for photogrammetric processing.

Everything in the photogrammetric process of acquiring spatial data is based on the already mentioned spatial forward intersection. Whether we want to extract a point cloud, a photorealistic 3D model, an orthophoto map or a Digital Elevation Model (DEM) from a set of images, the construction of these products will essentially be based on the forward intersection. To measure the field coordinates, the internal orientation values and the external orientation parameters of the images must be determined beforehand in the adopted coordinate system. Three coordinates, X , Y , Z (coordinates of the centre of projection), and three angles, ϕ , ω , κ , the angular position of the images in space, are the exterior orientation (EO) elements. The EO elements of the images are estimated and aligned. In practice, the EO elements cannot be measured accurately, especially the angles, ϕ , ω , κ ; in many software applications, these angles are represented as Pitch, Roll, Yaw. Measurement of EO parameters during the flight is not accurate enough to use it as the base EO of the image, but it is an excellent starting point for the estimation. EO elements are computed during aerotriangulation in the Bundle Block Adjustment process, often providing approximate EO values from direct measurements taken during the flight. The computational process concerns a spatial network of relatively huge size because, in reality, a block of images consists of hundreds of photographs. Each photo in the photogrammetric block is an independent bundle of spatial rays constituting a separate geometric element of the spatial network.¹⁶

16 KRAUS 2007: 269–271.

Within aerotriangulation, each image's EO elements are calculated so that a bundle of rays from different images intersect in tie points with the best possible accuracy. The tie points can be points that occur on at least two images. Bundle Block Adjustment is the default and currently optimal technique for block alignment. However, the Bundle Block Adjustment method initially needs to obtain the approximate X , Y , Z , ϕ , ω , κ values of each photo. The approximate values can be obtained from the measurement provided by the GPS (GNSS) and INS system, or calculated. Generally speaking, we start from a specific approximate spatial position of the photos, and, during the alignment, we obtain the best possible relative fit, block alignment. What is important here is the proper weighting of the observations, which will affect the final result. Bundle Block Adjustment is based on collinearity equations, which are mathematical representations of central projection with nine parameters.¹⁷

As shown in Fig. 12, points O , q , Q lie on the same straight line, i.e. they are collinear. Thus, x is a function of the coordinates of the centre projections (X_0 , Y_0 , Z_0) of the orientation angles (ω , ϕ , κ) and the coordinates of points in the field. Thus, when the collinearity equations are laid out for ground control points, the unknowns are X_0 , Y_0 , Z_0 and ω , ϕ , κ . On the other hand, the equations for the tie points have nine unknowns, i.e., additionally, X , Y , Z . Tie points are currently automatically found on images without human-operator involvement.

The SIFT¹⁸ algorithm and its modifications are used to automatically detect tie points. The SUSAN, Moravec, Harris, Trajkovic algorithms are no longer commonly used. The SIFT algorithm perfectly detects tie points independently of how the images were taken (obliquely, congruently, or divergently). As a result of using this algorithm, automatic mass measurement of tie points in images is possible. The SIFT algorithm 'sees' differently than a human and finds well visible elements, such as artificially signalled GCPs, in the image more difficult than seemingly insignificant and not very clear objects. Some of the detected points can be misconnected, misinterpreted, and there are gross errors, outliers; here, a tool created in 1981, called RANSAC, is used. RANSAC is an algorithm successfully applied in the computer vision and image-processing community. Using an appropriate elimination of errors that occur in the automatic detection of tie points makes a more precise relative matching of images possible.¹⁹ We aim to calculate the EO of each image using known CV tools, but before that, the coordinates of tie points must be determined.

In reality, during areotriangulation, there are no calculated coordinates of tie points and EO of images, but only corrections, increments, to approximated values of X , Y , Z and EO components. EO approximations, as already mentioned, are taken from measurements or calculated based on the old photogrammetric principle of relative orientation (RO). In the process of mass EO calculation, initially, a block is formed by successive RO of a set of images in an arbitrary local coordinate system based on previously automatically identified, found tie

17 KURCZYŃSKI 2014: 333.

18 'SIFT (Scale-Invariant Feature Transform) is a computer vision algorithm to detect, describe, and match local features in images, invented by David Lowe in 1999' – Wikipedia, https://en.wikipedia.org/wiki/Scale-invariant_feature_transform (accessed 7 January 2021).

19 ZAWIESKA 2013: 35.

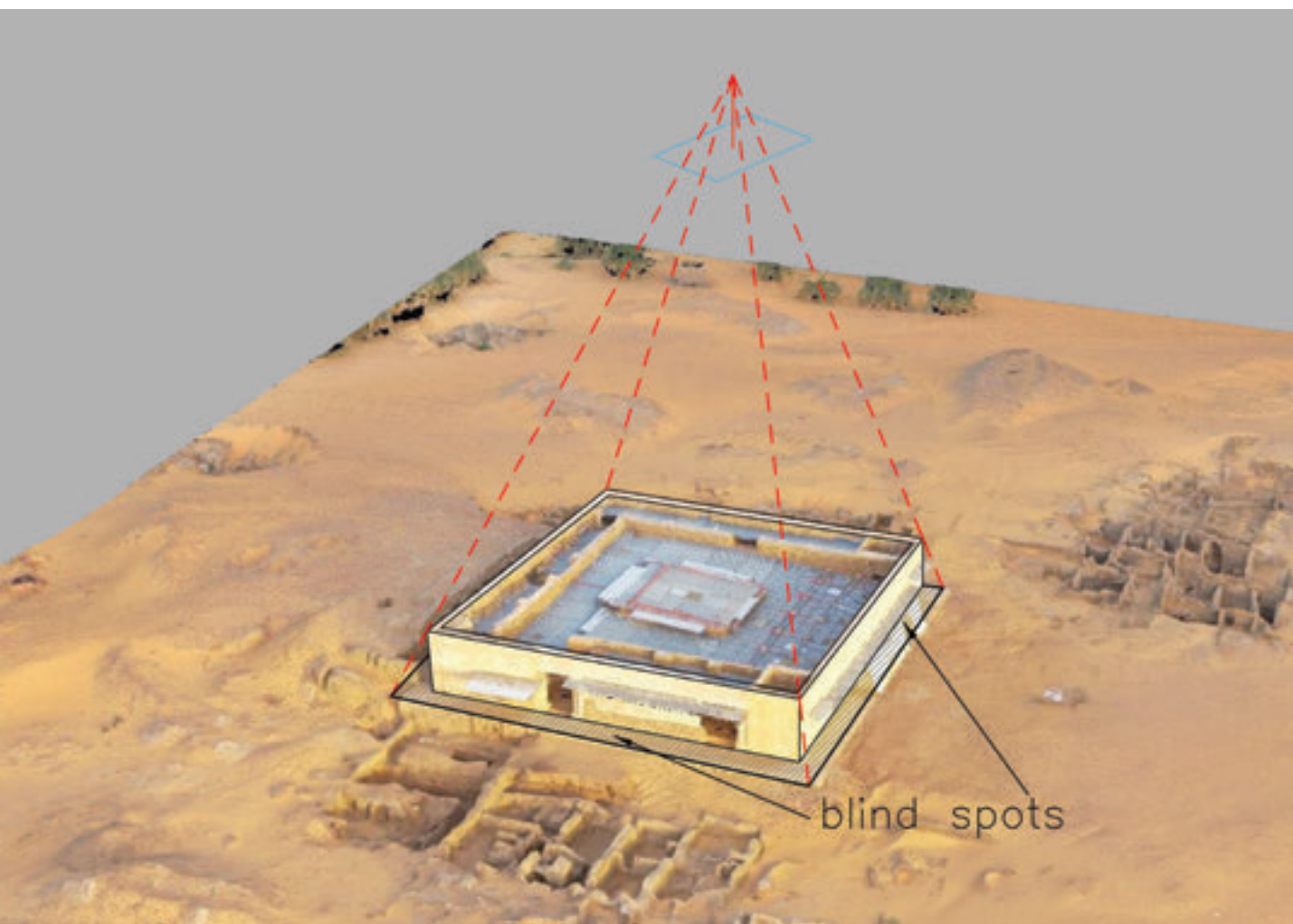


Fig. 9
Blind spots or hidden
(occluded) areas.

points. The matching starts with the pair formed by any two images from the block, usually the middle one and a neighbouring photo. The subsequent matching is done with the previously oriented photo. In this way, all the photos from the block are successively matched. Relatively oriented photos are in the local spatial coordinate system and do not have a proper scale. The scale, at this stage, is arbitrarily adopted. In virtual space, the scale does not matter much; it is only one of the determined coefficients. The result of RO is a local spatial model of terrain or object placed in the local coordinate system in the local frame. After performing RO, we proceed to absolute orientation (AO), which brings the model to the terrain or object frame. In this case, 3D transformation based on at least three control points is required. As a result, there are a lot of systematic errors in matching images to each other, and the image network is usually deformed. Based on the calculated RO and AO, approximate values for the EO of the images are initially calculated. At the same time, by performing a spatial forward intersection, the approximate coordinates of the binding points are calculated. The obtained approximations allow us to perform proper Bundle Block Adjustment and minimise projection errors.

As a result of the automatic processes of searching and matching tie points, we are dealing with thousands of observations. Such amount of data, acquired

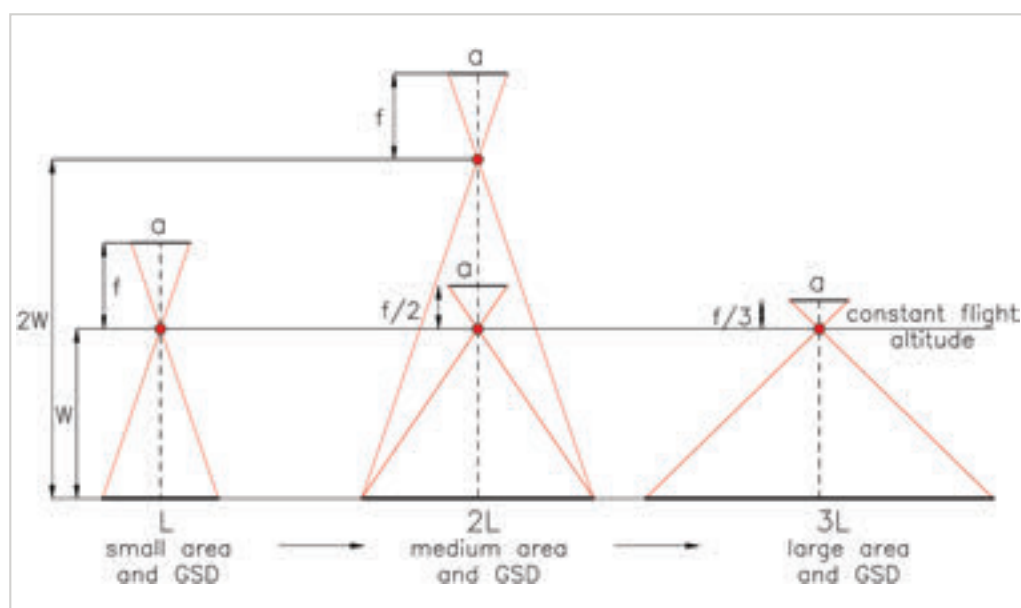


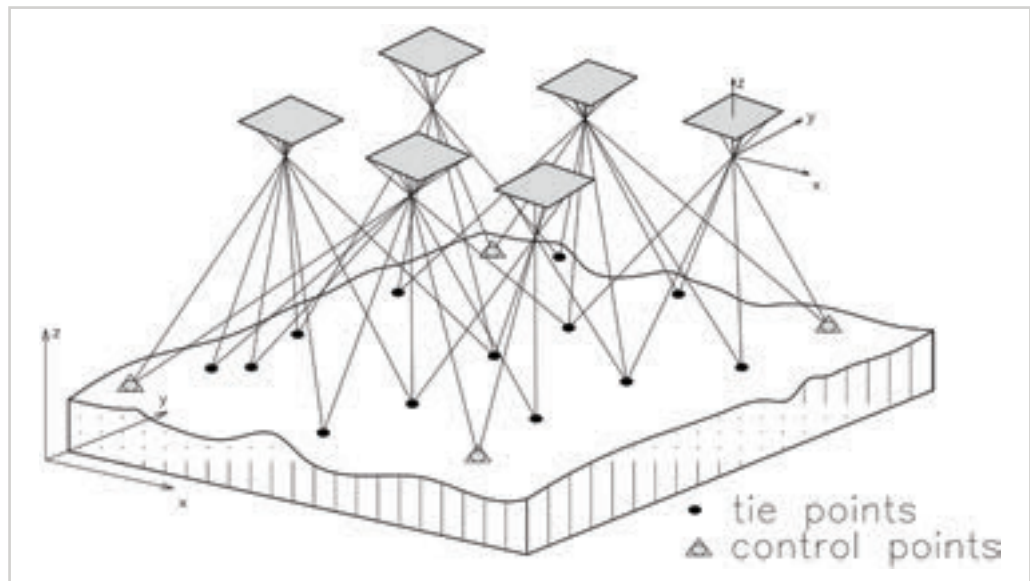
Fig. 10
Influence of focal
length and flight
altitude on the terrain
image size and GSD

at the stage of automatic identification and relative matching of tie points, allows for determining the elements of the internal orientation of the camera in the process of automatic camera calibration during bundle adjustment. Regardless of whether we have the parameters of the internal orientation of the camera, auto-calibration of the camera should always be a part of Bundle Block Adjustment; it does not introduce a potentially large number of unknowns into the calculation process. Currently available software to develop a photorealistic 3D model and its derivatives does not require any other data from the operator besides the images at the beginning of the computational process. Implemented algorithms perform automatic calculations that result in both internal orientation elements (based on auto-calibration) and external orientation elements. As a result of matching, a sparse cloud of points consisting of tie points is created in a fully automatic way. The Bundle Block Adjustment method used in photogrammetry has its equivalent in the CV environment. In a CV environment, the alignment of a block of photos is most often done with a method called SfM (Structure from Motion) where, as in Bundle Block Adjustment, the detection of tie points, the selection of pairs of photos, the relative orientation and the alignment of the beam method is made automatically.²⁰ In this process, additionally, camera auto-calibration is performed. The only thing required from the operator is a skilful indication of GCPs, sufficient for conducting AO and for the selection of proper parameters, such as GCP precision, Check Points (ChPs) and camera calibration components (depending on software development level). The implementation of algorithms from photogrammetric and CV environments has allowed us, in recent years, to build software that performs object reconstruction in a virtually automatic manner. The rapid development of software occurred after 2010, and the driving factor is, among others, the incredible popularity of autonomous vehicles and UAVs and the related possibilities of taking pictures from the air.

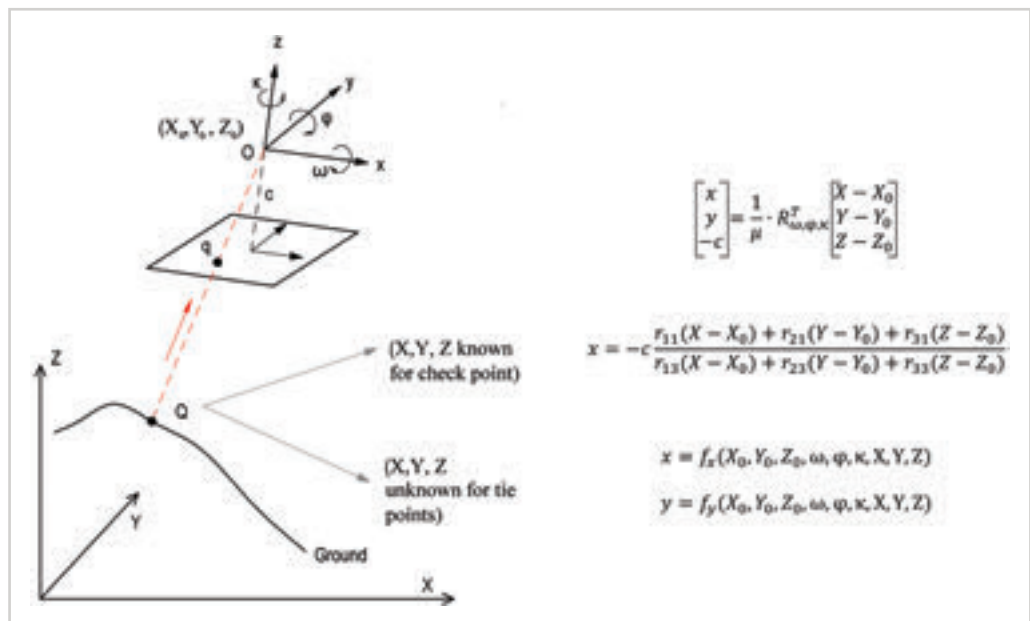
²⁰ ZAWIESKA 2013: 12.

Fig. 11

Bundle block
adjustment. After KRAUS
2007

**Fig. 12**

Collinearity equations



The general outline of mathematical dependencies shown above and the approximate size, the number of calculations that must be done by the computer, should oblige us to take pictures with caution and consciously so that the final study is not just an illustration but has a geometric, research, cognitive value. Complicated mathematical dependencies have been presented, and the amount of data and unknowns that a computer has to deal with has been shown. The purpose is simple and understandable. I hope that the pictures taken to create archaeological documentation will be done with due diligence and with observance of appropriate rules and principles. The theoretical basis presented above allows us to look at the non-metric photo from a different angle, namely as an excellent source of geometric information in 3D space. Properly taken photos allow us to reconstruct the space wholly and thoroughly and, significantly, maintain the precision often unachievable for other measurement techniques.

Images as a Basic Source of Information about the Geometry of Objects

Photographs can be taken from the ground using tripods or by carrying the camera on monopods, or simply by hand. Larger areas are photographed from multirotor drones, fixed-wing drones or, as was the case at Banganarti from the beginning, from kites. Each method of obtaining photographs has its advantages and disadvantages. Both ground and aerial photographs, taken from a drone or kite, can be used as a single set for building highly resolved, accurate models, or separately for a top-down project creating a specific study or depiction. It is important not to underestimate any of the steps of acquisition and processing of the photographs. In geodesy and photogrammetry, small things make a big difference, and available tools should be used carefully and consciously.

A properly made set of photographs is an excellent source of information about the shape, size, texture and colour of an object. Depending on the size of the site or object being documented, photographs are acquired in many different ways. For photographing larger areas, devices are used with the help of which the camera can be raised above the object, with the help of multirotors, kites, and complex UAV systems. However, the easiest and most common way to photograph the object is from the ground. Ground-based photos are used to record relatively small areas with high resolution. With ground-based photos, it is possible to document virtually any object down to its smallest detail. Photos taken from the ground allow us to quickly document complex, irregular shapes of architectural objects, buildings, monuments, and minor artefacts. The use of tripods, photographic poles and skilful use of the advantages of particular cameras allows us to record and document any object. The availability of tools and the relative ease of taking appropriate photographs make it possible to record the progress of excavations continuously. Nowadays, all mobile devices, such as cell phones and tablets, have a built-in camera. The quality of the built-in recording devices is high enough to take photographs as a basis for appropriate documentation. Therefore, the possibilities of cameras built into popular phones should not be underestimated. Recording objects with their help is trivial, and the degree of automation means that practically every picture, even if taken in a hurry or not in a skilful manner, is sharp and can be a valuable product. Our experience in Banganarti allows us to state that sometimes taking pictures with a built-in phone camera is the only way to create documentation, especially if we cannot bring a full-size camera into small, narrow spaces or we have to deal with non-standard objects, both in terms of shape and surface structure.

In many cases, architectural elements or other objects are so impermanent that documenting them on an ongoing basis is necessary. Using photogrammetric methods, we measure the object ultimately without contact, which makes them very useful. In some cases, measurement using photogrammetric methods is the only way to document an object. Taking adequate ground-based photos is the easiest, fastest, most effective and at the same time very accurate method of space registration. If we have appropriate equipment in the form of high-quality cameras, recording and documenting using photogrammetric techniques is a relatively easy and pleasant process.

The basis for taking pictures is the proper control of light. Lighting has a massive impact on the image acquisition process. Available peripheral devices, such as illuminators, blenders, poles, sliders, rotary tables, modules, to control the camera at a distance allow the implementation of any tasks related to the creation of documentation with adequate precision. Currently available cameras have sensors with very high resolutions. When selecting equipment, one should remember the camera itself and appropriate optics, image stabilisation, and efficient autofocus. When using cameras in desert conditions, as is the case at Banganarti, the critical parameter is also the waterproofness of the body and lens. Sealing is a guarantee of good durability of both the body and the lens. The quality of the lens is of fundamental importance; it is known that the optical system also has a resolution. The lens with its limited resolution is one of the most important factors limiting the quality of the photo.²¹

At the Banganarti site, non-metric mirrorless cameras are successfully used to take ground-based photos. Images taken with them are used to create fully metric 3D documentation. The construction of mirrorless cameras means that photographic sets can be configured with a very short focal length, which facilitates work, especially when documenting objects, narrow corridors and small rooms requiring wide-angle lenses. Acquisition of photographs from the ground surface is connected with taking pictures from close distances to the photographed object. In this case, practically every picture taken is separately focused, nailing focus, which causes internal geometric changes in the camera. Theoretically, the use of autofocus conflicts with photogrammetric rules in the processing of a block of images where in the process of self-calibration, the parameters of the internal orientation of the camera are calculated for a set of images. However, when capturing objects of relatively small size, focusing is essential. It is possible to use lenses like Voigtlander Super Wide Heliar 15 mm F.45, where, at the aperture set at 5.6, the depth of field reaches from less than a metre to infinity; this offers great flexibility in taking pictures. Depth of field is of fundamental importance. With a camera set where it is possible to set a large enough aperture, the inverse of the aperture size, we have the possibility of taking pictures from close distances without changing the parameters of the camera's internal orientation.

It should be remembered that photographs for photogrammetric applications are significantly different from artistic photographs. Every element photographed for photogrammetric applications should be clear and sharp; we reconstruct the object's shape based on the registered image. Blurred parts of the image degrade the final work to a large extent. Photogrammetric software often deals with discrepancies that occur in the camera's geometry due to changes in focal lengths that occur when taking pictures. In many cases, the geometric degradation of the model associated with varying internal orientation is negligible. However, it is suggested to take photographs without changing the focal length; that is not always possible. Furthermore, photographs taken with different focal lengths and parameters should be divided into groups and chunks so that the software does not assume the same orientation model for all the images.²² Dividing the set

21 KURCZYŃSKI 2014: 106.

22 Chunking allows for much better geometry of the block and at the same time does not introduce a bigger number of unknowns (compared to the total number) during the calculation process in which additionally self-calibration of the

of photos into subsets, in which there are photos taken from different distances and, as a consequence, with a different value of the camera constant, focal length, and position of the main point will allow for better relative matching of all the photos and the development of more precise models.

As mentioned before, light control is crucial during photo acquisition. In open spaces and outside buildings, it is more difficult; it depends on weather conditions. Inside the buildings, various artificial lighting sources can be used to illuminate each documented object element evenly. Particular attention should be paid to the illumination of room corners, all kinds of cavities in walls, etc. The possibility of controlling the light and exposure time means that fewer pictures can be enough to fully illustrate the documented object. When taking pictures outdoors or indoors, one should pay special attention to the camera itself and the accompanying equipment; the operator should not change the lighting conditions, create shadows or reflect light, and cause reflections. The set of images should be uniform in terms of white balance and brightness. The shape of the object is, in many cases, modelled by the colour itself. So it is essential to keep proper colour balance. If it is impossible to take enough pictures to give the entire shape of the object, we can use artificial lighting to shade some parts and artificially brighten others. This procedure can help interpret, but only visually, the shape of the documented element. Such procedures are successfully used when documenting ornamented artefacts where the shape of the ornament can be significantly clarified by the use of appropriate lighting.

Ground-based photos taken for architectural objects are often complementary when building 3D models or other metric products where the primary source are UAV images taken from a low altitude. With the widespread use of drones, it is possible to take low altitude images at high resolution with a GSD of less than 1 cm. Taking different sensors into the air gives excellent possibilities to register images in the visible light spectrum and in infrared and ultraviolet. Currently available are multispectral cameras and 3D scanners of compact size and low weight, which can be successfully deployed in UAV systems. The availability of affordable multicopter vehicles with high-quality built-in cameras has resulted in their widespread use in archaeology. Stabilisation and flight control systems make it easy to take photographs of the site. Flying a properly prepared drone can be done even by a not-so-skilled person. The possibility of autonomous programmed flights, successfully introduced in UAVs, is an additional simplification thanks to which relatively large areas can be documented.

All parameters regarding lateral and longitudinal coverage, forward and side overlap, flight altitude, and GCPs are established before the flight. Flight planning is a crucial factor, and all flight parameters should be entered consciously so that the acquired images meet the predetermined parameters. The conditions at Banganarti, as already mentioned, make autonomous flights impossible due to the permanently strong winds that occur during the excavation seasons. In autonomous flight, the drone, in windy conditions, changes its flight trajectory and does not maintain the initially assumed flight geometry. There are then problems

camera is performed.

with the proper overlap, especially in strips. The flight can be corrected manually as it happens, but it is demanding for the operator. In this case, the operator/pilot should know the photographed area very well and have appropriate skills to control the drone and estimate the distance and position of the drone in flight. Transverse and longitudinal coverage and forward and side overlap are controlled during manual flight based on continuous observation of the photographed terrain on the screen of the control device. When flying at low altitudes (7–20 m), autonomous flight is also excluded for safety reasons. With such a low flight, the probability of hitting an obstacle is very high, and controlling the flight is essential.²³ In autonomous flight, the acquisition of images is faster and does not require as much commitment; however, such flight is not always possible.

Economics is usually not considered when planning a flight on an archaeological site, but time is essential. A task may need to be done quickly, or a short flight may be limited due to low battery capacity or hardware limitations. However, the most fundamental problem is the changing lighting. With natural lighting, you cannot fully control the light. Shadows are a significant problem. To reduce the degrading effect of shadows, it is necessary to choose the right time of day to take the pictures. In desert areas, the sun gives apparent, sharp, and, most importantly, moving shadows. While maintaining the high resolution of the study, the influence of moving shadows, especially in trenches, is noticeable and degrades the documentation. Completely shaded areas cannot be modelled and are very difficult to interpret. We minimise the negative influence of shadows by taking photos around noon when the sun is at its zenith and, if lighting conditions are appropriate, we have to deal with diffused light before sunrise. When the field research is conducted at the Banganarti site, we cannot count on overcast skies. Hence, UAV flights and taking additional photographs from the ground are usually performed before sunrise or at noon. The experience gained at the Banganarti site allowed us to determine what conditions or time of day are optimal for taking pictures. We also learnt that time frame data could be collected in photographs so that the effect of moving shadow does not significantly affect the study. If the flight is conducted at noon, the length of the flight can be about 30–35 minutes; at other times of the day, the shadow is so long and visibly moving that photographs taken 20 minutes apart already record significant shadow changes. Photos taken before sunrise, so that they have no shaded areas, should be taken in a maximum of 15 minutes. The morning photos do not have shadows, but significant changes in light intensity are visible. There are problems with preserving the uniformity of the images with a changeable white balance. Photos taken in different lighting conditions should be tonally equalised and calibrated so that the texture applied to the model does not have visible mosaic lines, which are mainly caused by the tonal unevenness of individual photos in the block. Non-uniformity of photos in terms of colour leads to aesthetic imperfections in the whole model and hinders the interpretation of the model itself. In case of colour mismatch in the set of photos, plasticity of the built model is reduced, and the final result may be unsatisfactory.

²³ When using a drone, particular attention should be paid to flight safety and especially the safety of people in the area of work. UAV flights in individual countries are subject to legal regulations and require appropriate approvals and qualifications of the persons performing the UAV flights.

It is not always possible to take pictures with a multicopter, and, as has been mentioned in the introduction, capturing space is much more effective when the camera is elevated above the ground. In the past, kite photography was one of the best and cheapest ways to take low-altitude aerial photographs of archaeological sites. The Banganarti site is unique in this regard. Banganarti was documented by kite photography from the first days of excavation. The acquisition of images using a suitably constructed gimbal attached to a kite or placed on a suspension rope was relatively complicated. However, the results obtained were satisfactory. Photos were taken from relatively low altitudes and adjusted appropriately to the kite design's camera capabilities and lighting conditions.

The quality of the photo depended on the camera used, the lens, the accompanying equipment and the weather conditions. Stabilisation of the gimbal itself was done without active devices and was flawed. The effectiveness of stabilisation depended mainly on the inertia of the supporting elements and the strength and variability of the wind. Also of great importance was the sheer stability of the rope and thus the inability to move quickly with the entire photographing system. Using a kite to take pictures depends on weather conditions, and it is possible only on windy days. The control of the flight is highly dependent on the kite design, and the design and size influence the carrying capacity of the whole system. It was impossible to attach heavy cameras to kites with relatively efficient control. The only solution was to use stable, giant Power Sled-type kites. The shutter could be triggered cyclically at preset intervals or by servomotors controlled from a distance by radio equipment. From the beginning of the excavations at Banganarti, kites of various designs were used. Drawing on experience gained by Bogdan Żurawski during research work at sites such as Hambukol and Dongola allowed us to use the kite successfully at Banganarti until 2016.²⁴

A kite is still an excellent tool for taking aerial photographs of areas of several hectares. The handicap of the technique of obtaining images from kites is reduced by the gimbals that are now widely available to stabilise the camera. Active gimbals not only stabilise the devices but allow control of the camera. There are unlimited possibilities of constructing imaging devices on ropes stretched on kites or other flying objects, such as balloons. The only limitation is our creativity. There are no commonly available kite photography kits on the market, but most of the solutions used in UAVs are also perfect for kite photography. Even the high-resolution cameras are relatively lightweight, making them easy to use in dual-line framed kites where you can control the flight of the kite itself. An additional improvement when using the kite as a support device is now previewing live from the camera. Live view from the camera and the possibility to control it mean that we can now take properly framed pictures.

Legal regulations in individual countries sometimes make it impossible to use even the most straightforward UAV systems. Currently, importing and using a drone in Sudan and other African countries is prohibited or subject to challenging conditions. The alternative is systems based on kites or balloons.

²⁴ After 2016, the kite was replaced by a drone with a GoPro camera rigidly attached to the body of the drone. With the ability to fly at low altitude, it was possible to document the entire site with a GSD of 2 cm.

Unfortunately, pictures taken from kites have their disadvantages. When using a kite, it is necessary to involve at least two people to obtain the right pictures efficiently and not in a random way. When flying a kite, I suggest using cameras equipped with CCD sensors with a global shutter; the rolling shutter effect is eliminated due to the continuous inertial movement of the camera even when using an active stabilisation system. A set of photos taken with a camera attached to a kite is different from a regular block of photos. The collection consists of more or less random photographs from which it is more difficult to obtain an accurate model. Photos similar to orthogonal ones can be taken only when flying at high altitudes. It is not possible then to build 3D models based on them that accurately reflect the shape of the objects. Images from low altitudes are often blurry, unsteady and do not fully document the entire site area. When using a kite, it is difficult to take a sufficient number of photos that capture the object adequately. When using kite photos to build a consistent site model, it is also necessary to place more GCPs in the field. GCPs, in this case, should be signalled more clearly; they must be physically more significant and differentiated from the photographed terrain.

The theoretical part of this study mentioned that to calculate AO, we need control points unambiguously identifiable in the photo, evenly distributed over the area and measured in the field with sufficient accuracy. The final product of the RO of images is the so-called photogrammetric model. As it is already known, this model is oriented arbitrarily, more or less randomly, and does not have an appropriate scale. Such a model does not allow measurement coordinates and distances in given units. The minimum number of control points for a block of photos to calculate AO is only three. However, this number of GCPs does not control or guarantee that the entire area is consistent in accuracy and not subject to local deformations. Only a simple transformation between the image block system and the coordinate system adopted for the site or feature is possible with three control points. Please note that GCPs are used for transformation from the local coordinate system of the image block to the global coordinate system. These points are critical in the Bundle Block Adjustment process. Adding a sufficient number of GCPs into the computational process makes it possible to eliminate systematic errors occurring in the block structure. Hence, more control points appropriately distributed over the study area are adopted for the calculation process. The control points can be either artificial points, intentionally placed and properly stabilised on the object, or natural points, being an integral, inseparable part of the object. Both types of GCPs must be uniquely identifiable so that their measurement, indication and location on the photograph is possible with the best possible accuracy. The choice of shape, size and colour of artificial control points depends on the specifics of the object and the expected quality, accuracy, and detail of the final photogrammetric product. Artificial control points, premarked control points, are designated in the field with unique signs, placed on the object before taking the pictures, in the optimal places for later use. Their most significant advantage is unambiguous identification combined with high measurement accuracy in photographs and proper location within the area.

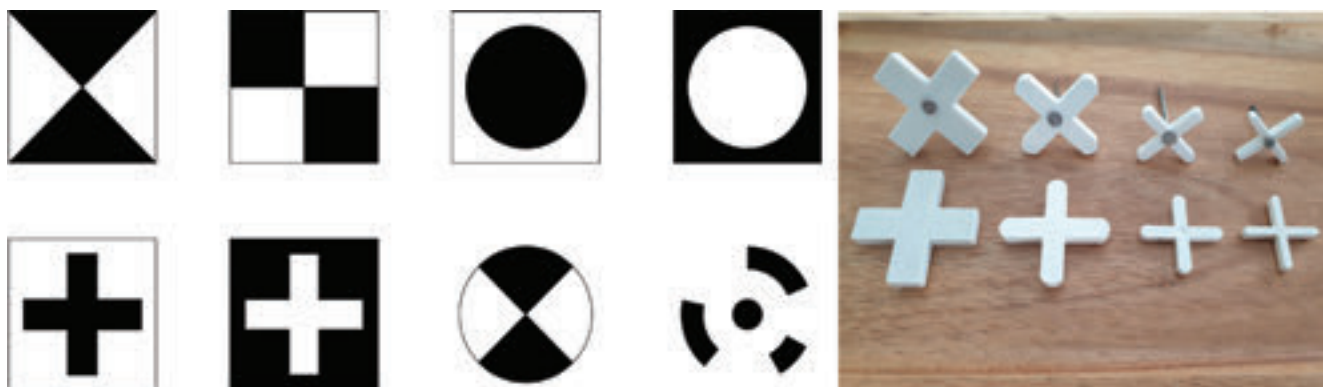


Fig. 13
Examples of premarked
GCPs for close-range
photogrammetry

Unfortunately, premarked control points are foreign elements that obscure parts of the documented object. When choosing the size of premarked control points placed on archaeological objects, one should consider their unambiguous identifiability and the fact that they obscure the object and are undesirable elements. When choosing the size of premarked control points, one should remember that they will be an integral part of the photograph. The size of the GCP for a given study depends on the estimated GSD value. In practice, a point on the image is unambiguously identifiable if it is not smaller than 4×4 pixels. Such a size may be assumed to be the minimum but only under the condition that the GCP can be distinguished from its surroundings to a considerable degree. For example, in a study where GSD is assumed to be 1 cm, photo points cannot be smaller than 4–5 cm. Large sizes of GCP should not be used. Such points should be discreet enough not to be the main content of the image at first glance. For photogrammetric studies for archaeology, artificial control points should be almost invisible in the final study.

It is essential to place artificial control points, premarked control points, on flat surfaces of the object to avoid both errors resulting from the identification of their central point and the possibility of partial obscuration by protruding elements surrounding the control point. Based on extensive experience gained during the work at Banganarti, we can state that white ceramic tile spacers are perfect as premarked control points for detailed studies of architectural objects. Placing them on walls built of mud bricks is simple and does not cause damage to the walls. The use of surface signs, squares, circles, and chessboards has some advantages; however, their placement on the object is more complicated. We need more flat space, and they are more visible in the final documentation. Such control points should be made, e.g., on PVC plates with a thickness of at least 1 mm to maintain proper rigidity. Using premarked GCPs printed on paper or cardboard is impractical in desert conditions. Paper under the influence of temperature and wind bends and deforms, which causes difficulties in the measurement itself and in indicating GCPs during the processing of images in photogrammetric software. Another essential element in the preparation of artificial GCPs is the proper selection of colour. The wrong colour selection causes the control point to blend with the environment; its unambiguous identification on the image is complicated. It is suggested not to use red- and orange-coloured points in desert conditions. Finding such marked points is very difficult,



Fig. 14
Premarked control points

especially in pictures taken from a kite or a multirotor before sunrise. Black and white points of regular shape are best.

Control points in the form of chessboards or circles were usually used for photogrammetric studies of the whole site, more extensive areas, during the works at Banganarti. Plastic crosses were more often used to document individual rooms or

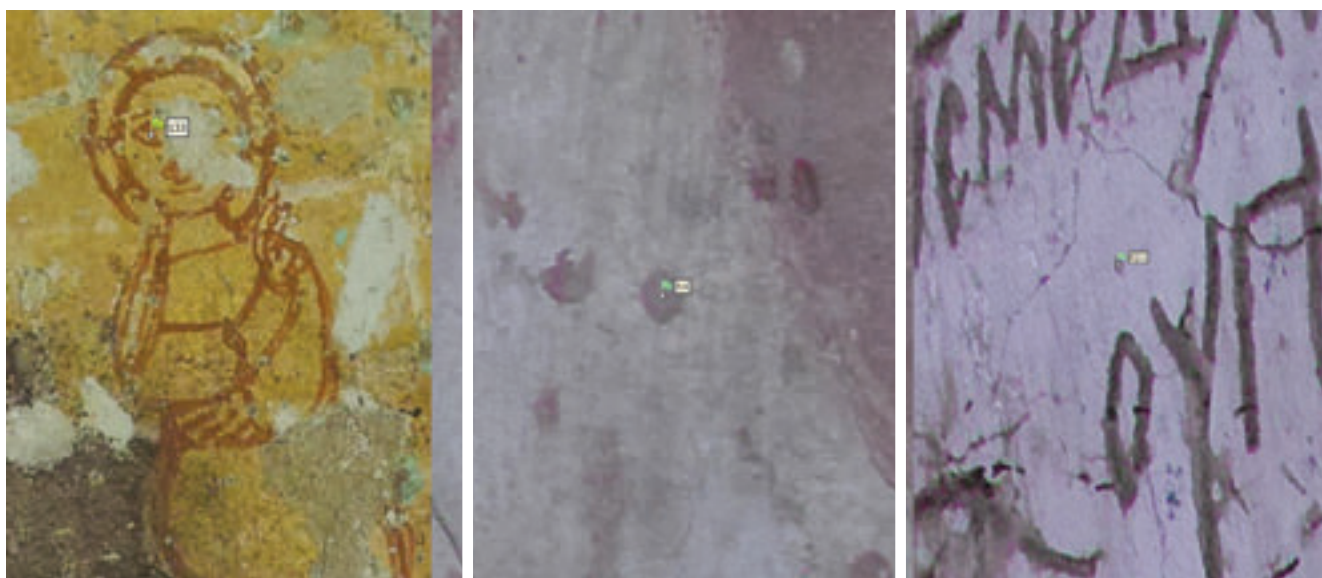


Fig. 15
Example of natural control points located on the walls of the Raphaeilion chapels

fragments of the site, and they fulfilled their role very well. As was the case with the geodetic control network placed on the ground surface, control points in the shape of crosses, circles, and chessboards arouse great interest among the local population. Unfortunately, before each drone flight or taking pictures on the ground, it is necessary to check the number of surviving control points to ensure we have a sufficient number of them. GCPs are an integral part of the calculation process and are indispensable. If there is a shortage of artificial control points, you can measure and use natural GCPs, which can be an excellent addition to the collection. Natural





Fig. 16
Example of control points
located on the site
(▲ control points)

control points are unambiguously identifiable terrain details, well visible on the image, the selection and measurement of which are usually carried out after taking the photos. It allows for control and assessment if a given element that is to be used as GCP is visible on the images.

It is not always possible to place premarked GCPs on an object due to its perishability and the risk of damage during GCP placement. The documented object or its fragment is difficult to access, and placing measurement points on it is practically impossible. Then the only solution is to select and measure natural GCPs. When documenting individual rooms and objects of small cubic capacity, natural control points may be local damages, gaps in plaster, scratches, discolourations or elements of inscriptions or paintings. In the case of larger areas, these may be identifiable elements, such as brick centres, local discolouration, joints in walls or floors, and elements of development around the archaeological site. The selection of natural GCPs should be guided by similar principles as for premarked GCPs. The natural GCP should be located on a flat surface, and its visible shape should not change under the influence of light or angle of observation. When using natural GCPs, it is essential to document the position of selected points and measure them correctly. Usually, for documenting the position of natural GCPs additional auxiliary photographs are taken. This allows us to find them on the images that are the source of photogrammetric elaborations. When using natural GCPs, it may be problematic to identify them correctly on the object. In such a case, it is suggested to place additional artificial GCPs outside the study area and take more photos. Control points are fundamental for photogrammetric consistency. GCPs should be distributed evenly throughout the site. Proper stabilisation, marking, and measurement of GCPs is a relatively lengthy and labour-intensive process. Distribution in space (on the object), the number of GCPs and the accuracy of determining their coordinates significantly impact the geometric quality of the developed model. Since the field measurement and stabilisation of control points is laborious, it should be calculated what is the optimal number of GCPs and how and where to place points on the object.

Most important for accuracy is the placement of control points at the boundaries of the site. If the subject of the study is a model archaeological site, an area object, control points are placed along the site's boundaries, preferably slightly outside the target area and evenly inside the block. The most considerable deformations in a block of images occur at the boundaries of the study area; so, it is reasonable to place control points around the site to minimise the deformations that occur. Additional points inside the area guarantee the geometric consistency of the generated model. From experience gained at the Banganarti site, it follows that no less than ten GCPs should be placed in the processing area. It is necessary to place them in the corners of the site and on the edges of the image block along the raid direction and inside the block. If the documented object is not a surface object, the control points should be placed evenly over the whole object. During the computation process, GCPs force the geometry to match, so the points must be evenly distributed. A properly acquired and aligned block of images does not require more photo points unless a large area is processed.



Fig. 17
Example of distribution
of natural control points
in Chapel 4, a small-size
object

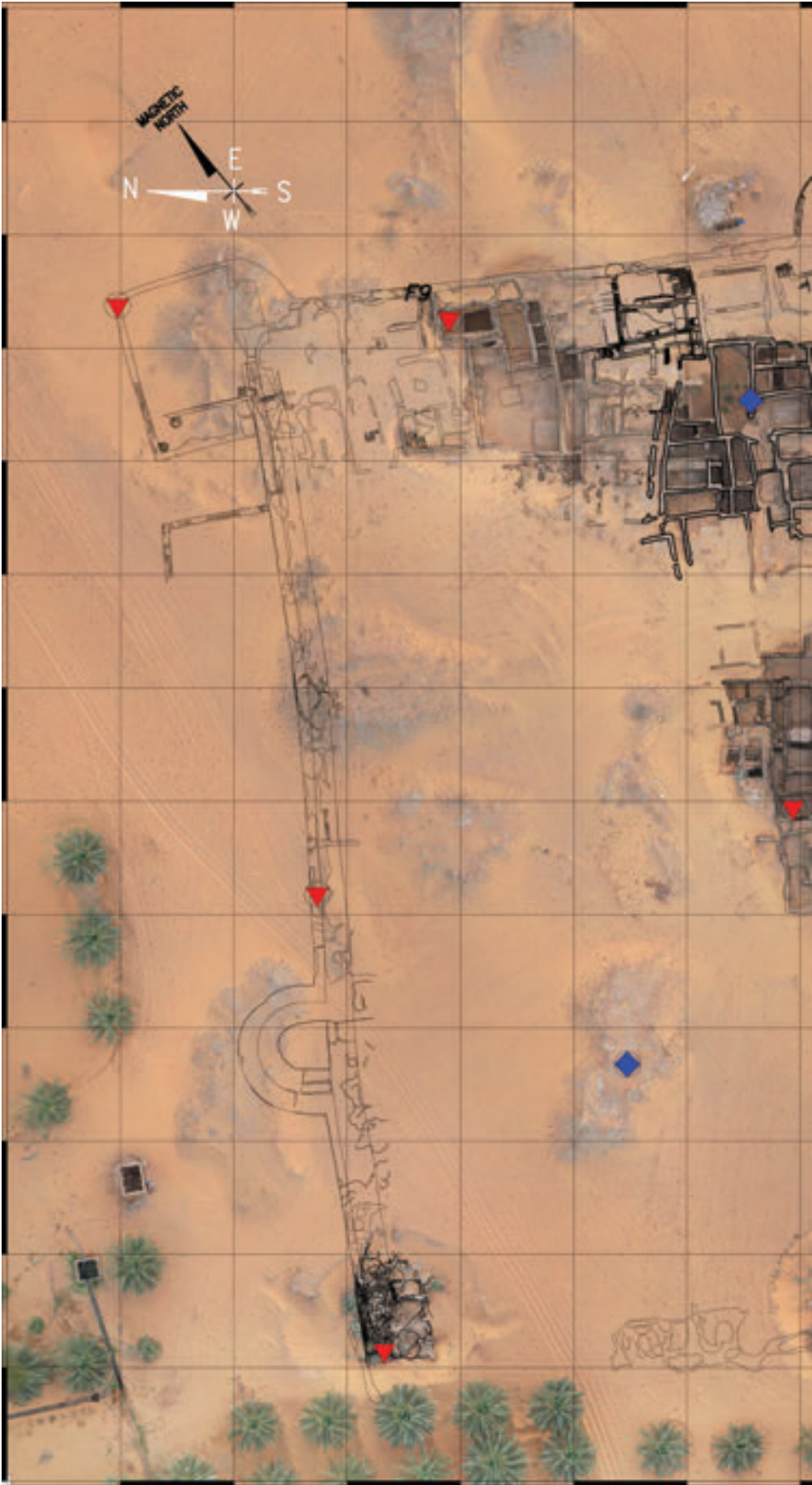
The larger and more complicated the area, the more GCPs are needed.²⁵ Then the number of GCPs is adjusted to the geometry and size of the object. Identification of control points and GCPs in images always requires an operator. It is a manual and relatively labour-intensive task. When developing small objects and small areas, the quality and accuracy of GCP coordinate determination are more important than their quantity.

When developing photogrammetric products or photorealistic fully metric models of historical objects, it is essential to control the geometric quality of the development. It compares the coordinates of points acquired from the generated model with coordinates of the same points derived from direct measurement on the object. Check Points (ChPs) are used to verify the survey. ChPs do not take part in the Bundle Block Adjustment calculation process and are intended only to check the geometric quality of the model. ChPs are placed inside the block at locations as far away as possible from the GCPs. For ChPs, spatial coordinates are defined as for GCPs. The differences in ChP coordinates extracted from

²⁵ WIACEK, PYKA 2019: 67.

Fig. 18

Layout of GCPs and ChPs
at the Banganarti site
(▲ control points
◆ check points)





photos and direct measurement provide an excellent measure of model accuracy. By controlling the block, we know the true precision with which we can measure coordinates and extract geometric data from photogrammetric studies.

Both GCPs and ChPs have to be measured; their *XYH* coordinates in the global or local frame coordinate system must be determined. The measurement technique and its accuracy should be adjusted to the detail and expected accuracy of the model that is to be created from the set of images. In the case of small areas and buildings, the coordinates of points are usually obtained using total-station measurements. However, for large areas, GNSS techniques are used. For GCP and ChP measurements indoors, inside buildings, it is best to use a total station with a reflectorless EDM.²⁶ A total station, detail pole and prism set are most commonly used for measuring points on more significant sites. Keep in mind that total-station measurements are subject to errors resulting from various factors. For example, the accuracy of distance measurement is affected by air temperature, atmospheric pressure and humidity. There are also errors resulting from refraction and inclination errors, collimation errors, tilt compensation and incorrect prism constants. Of great importance in the classical total station; measurement is affected by the quality of the tripod itself, the pole and the prisms. Most of these errors can be eliminated using the calibration procedures built into the total station's internal software. Before measurement, the total station and accompanying equipment should be checked and calibrated. An adequately prepared measurement set guarantees the precise acquisition of measurement data.

All measurements shall be made in a uniform coordinate system adopted for a given archaeological site. Determining the coordinates of the total station to the warp should not cause any problems, mainly when we determine the position and azimuth of the reference using resection or free station. However, the measurement of points may be less accurate than expected. Measuring coordinates of points using a pole, detail field, and a prism carries errors resulting from centring over the point. These errors are the consequence of the imprecise vertical alignment of the measuring pole itself. The position of the prism should be perfectly vertical over the measured point. Particular attention should be paid to the verticality of the measuring pole during precision measurements. It is best to minimise the height of the measuring pole and detail field for high accuracy. The vertical displacement of the prism over the point should be as small as possible to maintain accuracy. In the case of classic total-station measurements with the use of a prism, coordinate accuracy of less than 1 cm should not be expected. Accuracy of this level is entirely sufficient for elaborations such as orthophoto maps of the whole site or review models.

Usually, the size of GSD for the studies mentioned above is approximately 1 cm and more. When preparing models of particular rooms or their elements and especially when combining individual studies in the future, centimet-

26 EDM is an electromagnetic distance measuring technique. Distance measurement is based on the measurement of time over which the measuring signal emitted from the device returns reflected from the measuring point. Additionally, the phase shift of the signal is measured, which increases the precision of the measurement. For more information, see RÜEGGER 1990.

ric errors may be significant, primarily when documenting, e.g., successively uncovered rooms inside the building. In this case, it is necessary to take advantage of the equipment's measuring capabilities and carry out the measurements more accurately. To increase the accuracy of the measurement, precise reflective prisms, target plates, and reflective foils can be used. GCP and ChPs placed indoors or on particular fragments of buildings or objects are measured using reflectorless EDM. Any distance measurement in reflectorless mode is less accurate than using a prism; however, we measure without any additional tools, such as a pole and prism, when using this type of measurement. This gives us the ability to aim directly at the measurement point and measure the distance directly without attaching any additional tools. In addition, reflectorless measurement allows us to measure inaccessible points, which significantly facilitates the acquisition of coordinates, especially for natural GCPs placed in niches, depressions, or on unstable elements of historic buildings.

Unfortunately, every reflectorless technology measurement has its disadvantages. Distance measurement is based on the analysis of the laser beam or signal reflected from the surface; the time of the laser beam return and the phase shift are most often measured. The laser spot incident on a surface 'measures' the correct distance if the surface from which the beam is reflected is perpendicular to the line of sight of the total station. If you aim at an angle to the surface, which is most often the case, the distance measurement is erroneous.²⁷ In this case, the laser dot is larger and has a shape similar to an ellipse. The greater the angle of incidence, the greater the deviation from perpendicularity and the greater the distance measurement error. If the angle of incidence is large, it is impossible to determine exactly from which point the signal is reflected.

The accuracy of a distance metre depends on the colour and structure of the object being measured. Sometimes it is not possible to measure dark objects that are natural GCPs, and GCPs located in corners may be challenging to measure with a reflectorless total station. In such cases, making a spatial resection from two measuring stations is suggested, which allows precise measurement of the point without using an EDM. When using reflectorless total stations, make sure that the EDM is coaxial with the line of sight. Some total stations have offset EDM to the line of sight. Accurate reflectorless measurement is then complicated. Before choosing the right measuring equipment, one should pay special attention to the technical possibilities of the device in question and choose its parameters individually according to one's needs.

At the Banganarti site, all the natural control points and the surveying control network inside and partly outside the Raphaelion were established using a reflectorless total station. With the use of non-metric cameras and a standard reflectorless total station, it was possible to make photorealistic 3D models of individual rooms with an absolute accuracy of less than 4 mm and a GCP identification of 1 mm. The basis of the whole study was precise geodetic measurement as well as adequately taken photographs. The resulting documentation will be a valuable element of the spatial database for the Banganarti site.

27 LAMBROU, PANTAZIS 2010: 169.

CONCLUSIONS

The use of photogrammetric techniques with freely available, often open-source software enables automatic matching of non-metric images and minimises laborious tachymetric measurements that were previously the basis for creating archaeological metric documentation. Thanks to the available solutions, such as Bundle Block Adjustment, creating documentation 'on the fly' becomes easy and relatively fast. Additional software tools at our disposal allow us to replace expensive equipment, such as 3D scanners, with non-metric cameras. Commonly used image matching algorithms, such as SMG (Semi Global Matching), to generate dense point clouds and fully automatic tools to build mesh or tile models enable the creation of metric documentation. Automatic methods of applying textures to mesh models perfectly reflect the colour of the documented object. Complicated spatial forms and irregular remains of buildings discovered during excavations can be registered easily and quickly using essential tools, such as a camera and a total station. Accurate digital documentation in 3D models enables spatial analyses, and an insight into the object after the excavation is completed. Photogrammetric techniques are excellent for documenting both architectural objects and artefacts such as vessels and their fragments.

The experience gained during the implementation of photogrammetric techniques at the Banganarti site allows us to unequivocally state that measurement and recording using photogrammetric methods is currently the most effective and fastest. Photogrammetric software and space registration techniques, developed and improved on an ongoing basis, make it possible to measure objects in a completely non-invasive, non-contact manner. In the scientific process of exploring the world, the phenomena occurring in its measurement are one of the most critical activities.

Currently, archaeologists study the past and analyse written and unwritten sources, but it is possible that, in the future, they will move entirely to virtual space. There may be several reasons for this, and one of the most important is that it will be impossible to have direct contact with the object, as it will no longer physically exist, either because of natural erosion processes or because it was destroyed during military conflicts as was the case in the Middle East or during construction works. Virtual objects can then be analysed – what is stored on discs, memory dice, or physical media will be a source, a substitute for the actual object, a part of the real space.

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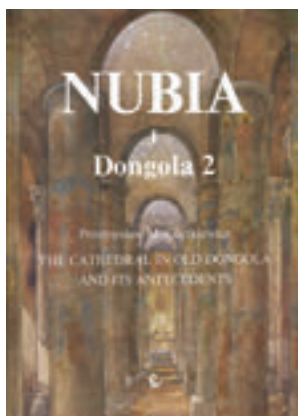
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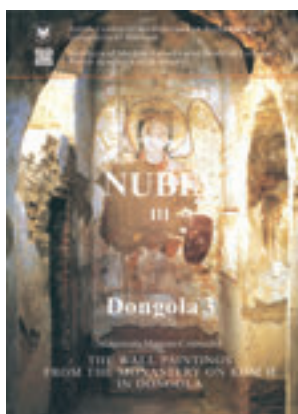
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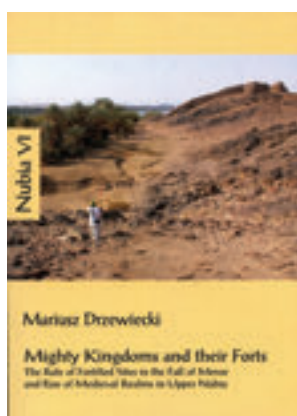
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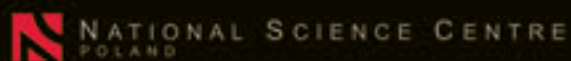
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