Two Mesolithic burials from Khor Shambat, Sudan

Abstract: The site of Khor Shambat 1 (KSH1) is located on the west bank of the Nile, in Omdurman, approximately 5 km north of Tuti Island. The first surveys there started in 2012, to be followed by an expedition of the Institute of Archaeology and Ethnology, Polish Academy of Sciences, which began four years later. A series of radiocarbon dates show that Mesolithic hunter-fisher-gatherers inhabited the site between 7000 and 5200 calBC, while Neolithic pastoralists settled there between 5000 and 3800 calBC. The research, carried out in nine trenches with a total area of nearly 180 m², yielded 66 human burials. While most of them were Neolithic and post-Meroitic, two graves found in the central part of the site contained remains of hunter-fisher-gatherers. The paper presents the results of archaeological, anthropological, and bioarchaeological research on the skeletons of the two Mesolithic men. The analyses are presented against a broader background of Early Holocene settlement in Central Sudan.

Keywords: Central Sudan, Early Holocene, Mesolithic, hunter-fisher-gatherers, burials, anthropology, bioarchaeology

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INTRODUCTION

In the Early Holocene, Central Sudan was inhabited by hunter-gatherer communities. Until recently, the cultural landscape of this period was very unclear, even though nearly eight decades have passed since the discovery of the first Mesolithic sites in the area of Khartoum (Arkell 1947;

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1949). Archaeological research conducted in the last 40 years has provided new data that help to unravel some of the obscurities. Sites [*Fig. 1*] such as Saggai (Caneva 1983), el-Damer, Aneibis and Abu Darbein (Haaland and Magid 1995), Shaqadud (Marks and Mohammed-Ali 1991), several sites on the Blue Nile (Fernández, Jimeno, and Menéndez 2003) and the White Nile, including Shabona (Clark 1989), el-Salha, and el-Khiday (Usai et al. 2010; Salvatori 2012; Salvatori et al. 2014; Usai and Salvatori 2019) have been explored. The most recent data comes from Sabaloka West (Varadzinová, Varadzin, Crevecoeur et al. 2022), Khor Shambat 1 (Jórdeczka, Chłodnicki et al. 2020; Jórdeczka, Stanaszek et al. 2020; Dunne et al. 2021), and excavations resumed at Shaqadud (Varadzin et al. 2023). New research in the 6th Nile Cataract area has shown that traces of the first Early Holocene settlers in Central Sudan are likely to be found at higher altitudes or farther from the river, in places beyond the reach of the Nile floods. An almost continuous sequence of radiocarbon dates obtained at the Sphinx site begins around 8750 calBC and shows fairly stable settle-

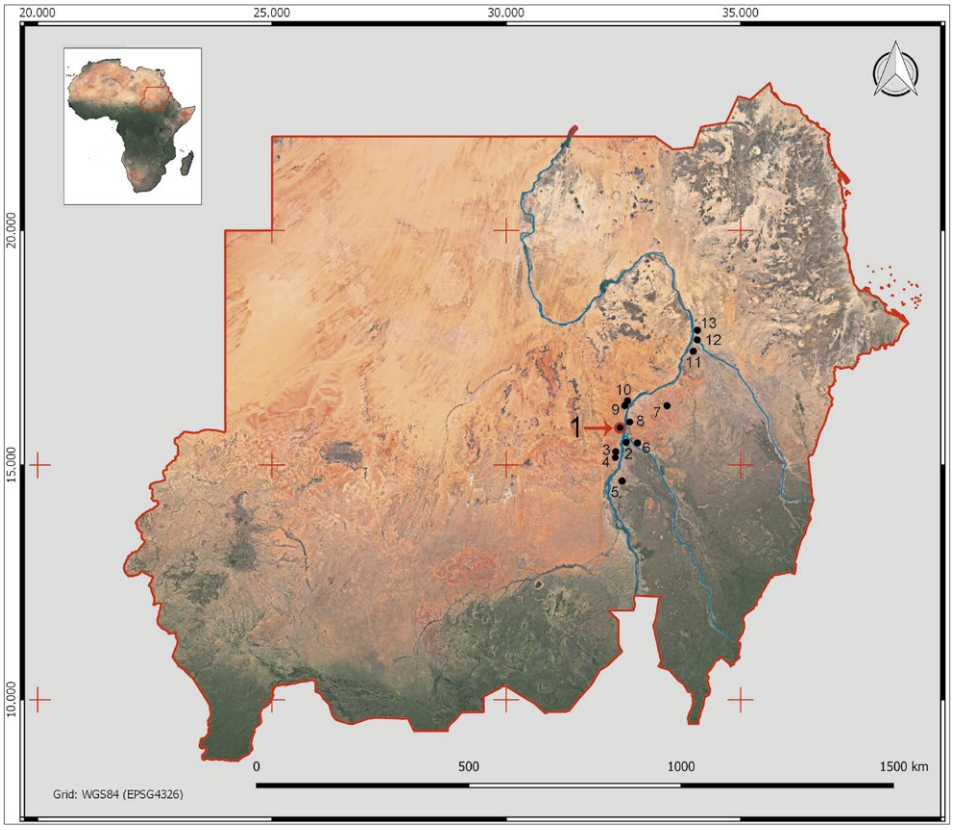

Fig. 1. Map of Sudan showing the Khor Shambat site and the other locations discussed in the paper: 1 – Khor Shambat; 2 – Khartoum Hospital; 3 – el-Salha; 4 – el-Khiday; 5 – Shabona; 6 – Blue Nile region; 7 – Shaqadud; 8 – Saggai; 9 – Sabaloka Fox Hill; 10 – Sabaloka Sphinx; 11 – el-Damer; 12 – Abu Darbein; 13 – Aneibis (Processing M. Jórdeczka and P. Wiktorowicz)

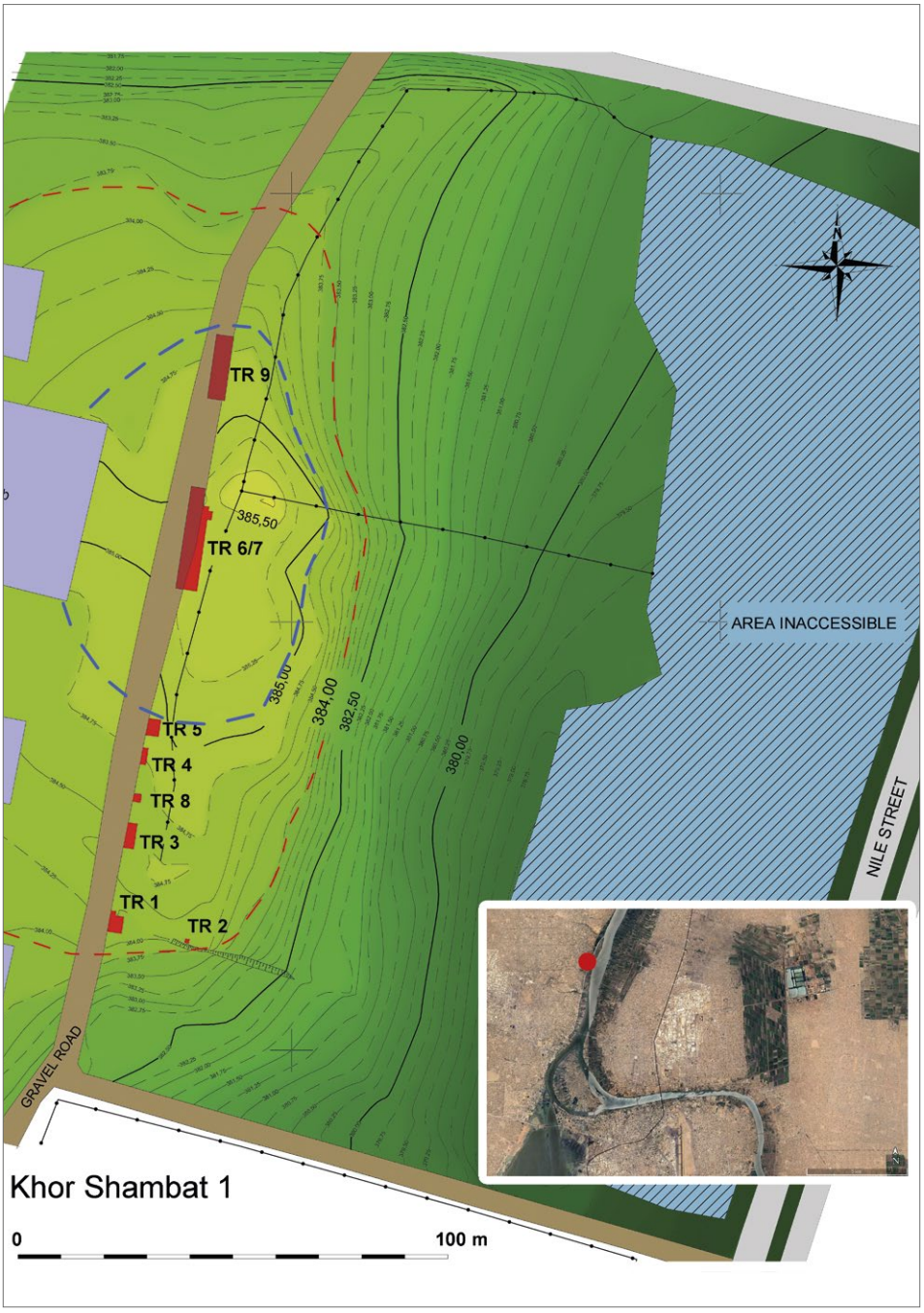

Fig. 2. Contour map of the KSH1 site with the location of test trenches marked (Drawing M. Jórdeczka and P. Wiktorowicz). The maximum extent of the Neolithic site is marked with a red dashed line, and the hypothetical extent of the Mesolithic settlement is marked with a blue dashed line. Inset: satellite image with the location of the site marked (Google Earth)

ment lasting about 4000 years (Varadzinová, Varadzin, and Ambrose 2023). This indicates that local hunting, fishing and gathering communities were able to adapt to environmental changes and climate fluctuations.

Unfortunately, many Early Holocene sites in Central Sudan were poorly preserved due to various post-depositional factors and processes, mainly the repeated use of the same locations by successive settlers as well as severe erosion and bioturbations.

Funerary practices are among the lesser-known aspects of the Mesolithic communities from the region. Studies focusing on age, sex, and health of the deceased have the potential to offer valuable insights into the living conditions and ways of life of ancient populations. Burials can also contribute abundant and useful information about social structure, health status, diet, origin, beliefs, and rites. However, for the Early Holocene in Central Sudan, such information is generally unavailable due to the paucity of sites with hunter-gatherer burials and the poor state of preservation of bone remains. The exceptions are the sites located in the area of el-Khiday (Usai et al. 2010; Jakob 2014) and Sabaloka West (Varadzinová, Varadzin, Crevecoeur et al. 2022; Varadzinová, Varadzin, Brukner Havelková et al. 2022; Varadzinová, Varadzin, and Ambrose 2023).

This paper presents the findings of a project of the Institute of Archaeology and Ethnology, Polish Academy of Sciences, which involved the exploration of the site of Khor Shambat 1 (KSH1) in Sudan from 2016 to 2019 (Jórdeczka, Chłodnicki et al. 2020; Jórdeczka, Stanaszek et al. 2020; Dunne et al. 2021).

The site is located on the west bank of the Nile [*Fig. 2*], at 384.0–385.5 m a.s.l., on a small hill the top of which rises approximately 5 m above the current maximum flooding level. Covering an area of approximately 1.5 ha (maximum extent of the Neolithic settlements), it occupies a small limestone hill and overlies an archaeologically sterile layer of eroded iron mudstone. The archaeological deposits at KSH1, over 1.5 m thick in the central part of the site, are mostly characterized by a silty-sand loam matrix with sandstone clasts and numerous fragments of pottery, flaked and ground stone tools, faunal remains, and shells of Nile mollusks and land snails. The sequence of Neolithic layers reaches a depth of about 0.9 m. Around 1.1–1.5 m below the level of the modern surface and at approximately 384.0–384.4 m a.s.l. are darker Mesolithic layers containing more eroded ferruginous sandstones and fewer silts [*Fig. 3*]. The Mesolithic layers (with vertical stratigraphy and utility pits) were generally better preserved than the Neolithic ones, although they were often interrupted by bioturbations and younger graves (Neolithic and post-Meroitic).

The oldest radiocarbon date associated with hunter-fisher-gatherer settlements comes from the bottom of the deep Pit 14 and falls in the range of 7036–6696 calBC with a probability of 95.4% (Poz-103040, 7950±40 BP). The next three dates generally fall in the second half of the 7th millennium calBC, and the youngest one comes from the end of the 6th millennium calBC (5306–5014 calBC at 95.4%; Poz-91019, 6210±50 BP) (Dunne et al. 2021). The Neolithic activity began in the first half of the 5th millennium BC, reached its peak in the second half,

and faded away in the 4th millennium BC. In the post-Meroitic period (AD 350–543), the site was used as a burial ground, which unfortunately caused serious damage to the older, especially Neolithic layers (Bobrowski et al. 2020).

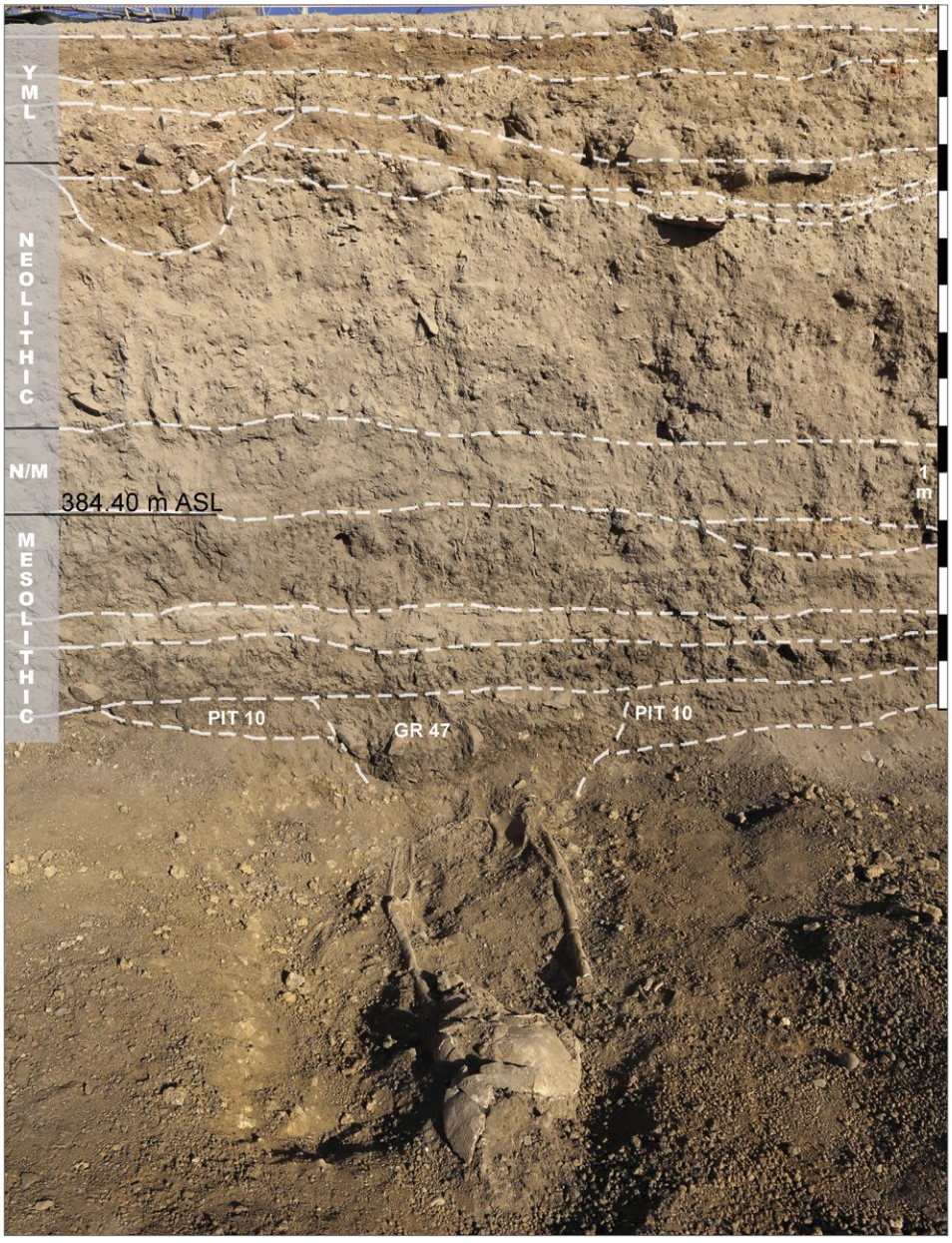

Fig. 3. KSH1 Trench 6/7, eastern profile, Meters 165–166. The Mesolithic burial is visible under the profile (Grave 47). Above the burial: Mesolithic layers, a mixed layer (Neolithic and Mesolithic, N/M), a Neolithic layer, and several younger mixed layers (YML) (Photo and processing M. Jórdeczka)

To date, 66 graves have been examined on the site, including about 30 Neolithic ones (Jórdeczka, Chłodnicki et al. 2020; Jórdeczka, Stanaszek et al. 2020). Below, the authors provide evidence that the two oldest burials contained remains of hunter-gatherers.

METHODS

EXCAVATIONS

The stratigraphic units were identified based on archaeological and archaeozoological data, as well as the color, texture, and compactness of deposits. The stratigraphic method was combined with the exploration of thin mechanical layers, and artifacts were recorded within a 1 m × 1 m square grid and assigned to the layers. The deposits were dry-screened, and numerous sediment samples were collected for further archaeobotanical analyses and a geoarchaeological study.

ANTHROPOLOGICAL ANALYSES

The skeletons were studied using commonly applied methods of analysis and anatomical description (cf. Ubelaker 1989; Bochenek and Reicher 1990; Buikstra and Ubelaker 1994; Bass 1995; Brickley and McKinley 2004; White and Folkens 2005; Rösing et al. 2007; Schaefer, Black, and Scheuer 2009), coupled with the authors' research observations (Stanaszek and Mańkowska-Pliszka 2016). The age at death was determined based on a comprehensive (multi-feature) analysis of changes in the formation of individual morphological features of bones and teeth. Particular attention was paid to the closure of the skull sutures and the condition of the occlusal surfaces of the tooth crowns, skeletal ossification, any degenerative changes in the skeletal system, the density of cancellous bone, as well as marrow cavity wall thickness in the proximal epiphysis of long bones (cf. Acsádi and Nemeskéri 1970; Ortner and Putschar 1981; Lovejoy 1985; Lovejoy et al. 1985; Brooks and Suchey 1990).

For sex determination, special attention was paid to the most pronounced metric and descriptive sexually dimorphic features (referring above all to the bearing features of the skull and the pelvis — cf. Phenice 1969; Malinowski and Wolański 1988; Buikstra and Ubelaker 1994; Rösing et al. 2007; Steckel et al. 2018), in combination with the so-called general morphological impression.

A few measurements of metric traits of the skeletons were taken using the Martin technique (Martin and Saller 1957), while stature was calculated as proposed by Raxter et al. (2008). The poor condition of the skeletons hampered the analysis of pathological changes, instigating instead a classification of individual diseases and injuries based on experiments and diagrams published by other researchers (cf. Ortner and Putschar 1981; Gładykowska-Rzeczycka 1989; Buikstra and Ubelaker 1994; Bass 1995; Ortner 2003; Steckel et al. 2018).

ISOTOPE, DNA, AND ^{14}C ANALYSES

Analyses of the $^{87}Sr/^{86}Sr$ isotope ratio in samples from KSH1 were carried out at the Isotope Laboratory of the Adam Mickiewicz University in Poznań. The

procedure involved a chemical separation of Sr and measurement of Sr isotope ratios. A total of 29 samples from various time horizons were examined, including three from Mesolithic contexts (two human enamel, one rodent), 19 from Neolithic contexts (15 human enamel, one rodent, one sheep, and two cattle) and seven from post-Meroitic graves (human enamel). Detailed analyses of data from all contexts are in progress and will be published in a separate article.

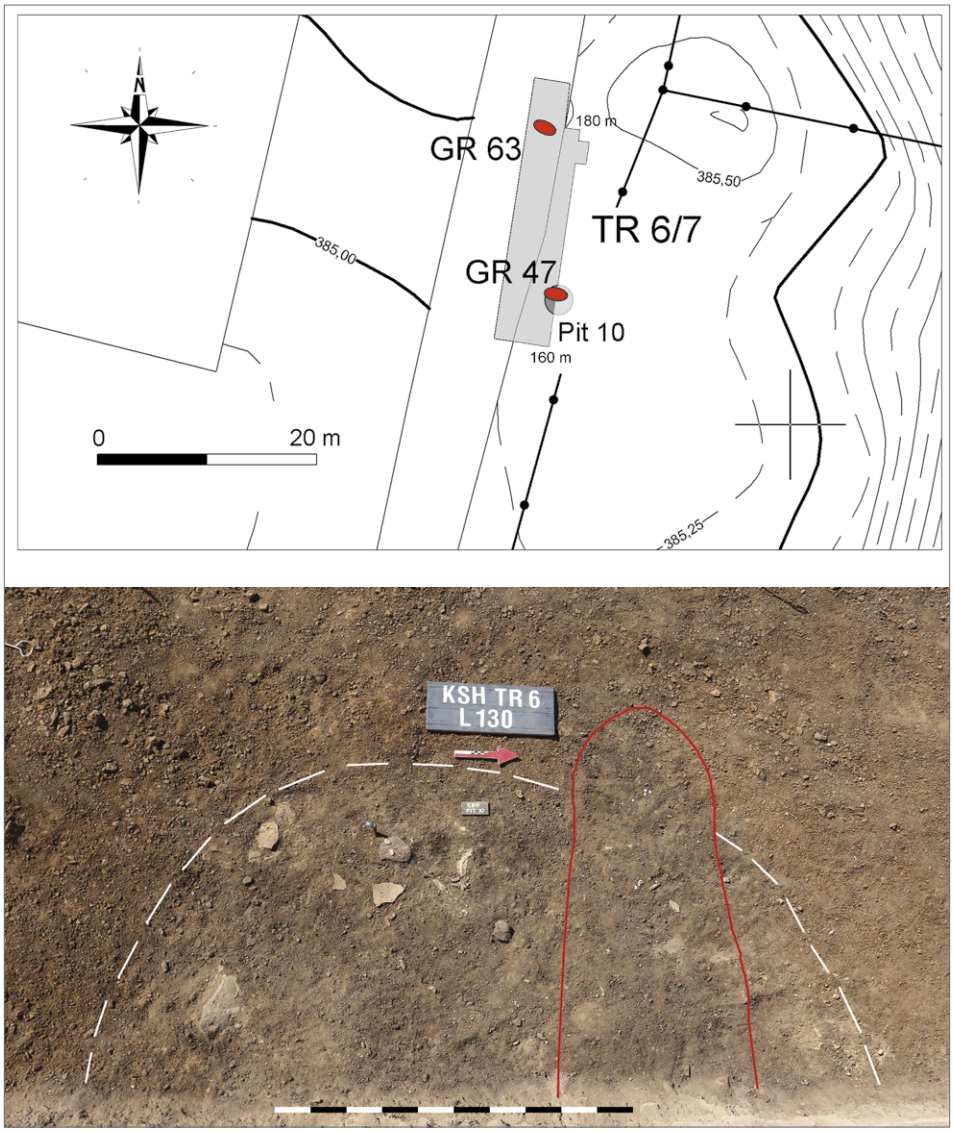

Fig. 4. KSH1 Trench 6/7. Location of Graves 47 and 63 and Pit 10 on the plan (Drawing M. Jórdeczka and P. Wiktorowicz). The photo shows a view of Pit 10 (at a level of 384.10–384.05 m), with a red line marking the outline of Grave 47 (Photo and processing M. Jórdeczka)

Two maxillary molars (M2 and M3) from the individual buried in Grave 47, as well as two petrous parts of the temporal bones, a fragment of a femur shaft, and permanent teeth (2 × M2, M3) from Grave 63 were collected for DNA testing. Attempts to extract DNA from human remains from KSH1 were made at the Institute of Human Biology and Evolution, Adam Mickiewicz University in Poznań.

Samples of charcoal were dated with the accelerator mass spectrometry (AMS) ^{14}C method at the Poznań Radiocarbon Laboratory (Goslar, Czernik, and Goslar 2004). All dates discussed in this paper have been calibrated with OxCal v4.4.4 Bronk Ramsey (2021), using the IntCal20 calibration curve (Reimer et al. 2020) and are reported with a 95.4% confidence interval.

Results of several other analyses, which were also performed at KSH1 and are referred to in the text, have already been published elsewhere (e.g. Dunne et al. 2021).

BURIALS

The first human burial from the Mesolithic context, Grave 47, was discovered in 2017, in Trench 6. The second one, Grave 63, was found in 2018, approximately 17 m to the northwest [*Fig. 4*], in an extension of Trench 7 (under a modern road).[1] Grave 47, in the form of a shallow, oblong pit (about 0.4–0.6 m in width, 2 m long, located at a depth of approximately 1.5–1.7 m below the modern surface), was partly dug into a Mesolithic structure (Pit 10) and layers of eroded ferruginous sandstones [see *Figs 3, 4*]. Although the burial was a secondary feature, separating the grave fill from the material filling the pit posed a challenge (the grave fill was, however, lighter and more uniform).

The grave belonged to an adult male, who died at the age of approximately 25–35. The bones were rather poorly preserved and incomplete, with a medium degree of fossilization and post-mortem fractures. The skeleton was laid in an extended supine position, arms along the torso, with the head to the west, facing north [*Figs 4, 5*]. The skull and the mandible were in fragments with slight bone displacements (damaged due to soil pressure), and marked alveolar prognathism was visible. The morphological features of the skull (i.e. supraorbital arch, upper edges of the orbits, mastoid processes of the temporal bones, presence of processus marginalis, angle of the mandible) indicate a male (Strzałko and Henneberg 1975; Buikstra and Ubelaker 1994). The teeth in the maxilla and mandible were preserved completely (up to M3) with visible dental calculus. Fully formed roots, slight dental abrasion (E–F, after Lovejoy 1985), as well as the

1 The combined surface area of Trenches 6 and 7 was roughly 120 m^2, with the longer side measuring 20 m along the north–south axis. Unfortunately, during the road construction, nearly 70 m^2 of this area was destroyed through removal of around 1.5 m of layers. Apart from the Mesolithic burials described in this report, these trenches also yielded seven Neolithic and six post-Meroitic graves.

lack of obliteration of the cranial sutures (Buikstra and Ubelaker 1994: 32–38) suggest a relatively young, although already adult, age of the deceased (young adult, 25–35 years old).

The postcranial skeleton was fully ossified and destroyed (eroded, incomplete). Of the torso bones, only fragments of the sternum, ribs, vertebrae and sacrum (severely curled) were extant. In a better state of preservation were the upper limbs (fragments of clavicles, two shoulder blades, two humeral bones, two ulna bones, two radius bones, two metacarpal bones, small fragments of wrist and phalangeal bones) and the lower limbs (fragments of two pelvic bones, two femurs, two tibias, two fibulas, and the right patella). The lack of the pubic symphysis and auricular surfaces reduced the diagnostic value of the pelvis for determining the age and sex of the deceased (Lovejoy et al. 1985; Brooks and Suchey 1990). Only a narrow and deep greater

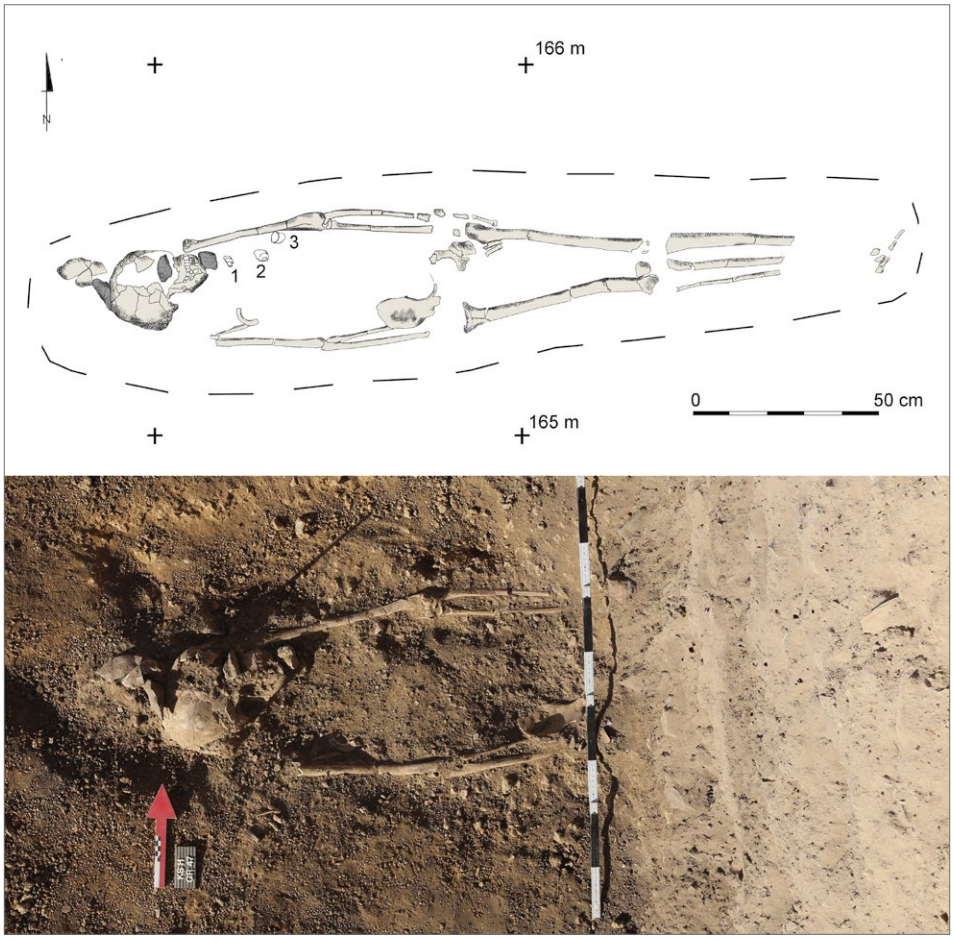

Fig. 5. KSH1 Trench 6/7, Grave 47. The photo was taken in 2017 and the exploration of the grave was completed in 2018 (Drawing and photo M. Jórdeczka)

sciatic notch (score of 5) was observed (Buikstra and Ubelaker 1994: 18), which, combined with the massiveness and the size of the skeleton, also suggests a male. Based on measurements of the long bones (femur, tibia, humerus, and radius), and sometimes only their fragments (Martin and Saller 1957), the deceased's height was estimated as 183–186 cm (Trotter and Gleser 1958; Strzałko, Piontek, and Malinowski 1972; Raxter et al. 2008).

The man was likely buried without any grave offerings. Fragments of a shell of a Nile bivalve and two Pila snails were found in the fill, but their deposition may have been accidental. Such remains are abundant in Mesolithic layers (they may have originally been deposited in Pit 10). The Nile bivalve is typically found in the Nile and south of the Sahara (Mienis 2004). Shells of this type have been discovered at many prehistoric and younger sites in Sudan (cf. Krzyżaniak 2011; Jórdeczka, Stanaszek et al. 2020), as well as in Mesolithic burial contexts (Caneva 1983; Honegger 2004: 28–29; Varadzinová and Varadzin 2017; Varadzinová et al. 2018).

Grave 63, the second Mesolithic burial discovered at KSH1, was found under the road. The body was placed in a 40–50 cm deep natural depression on the top of the hill (at the same absolute height as Grave 47, approximately 383.5–384.0 m). The individual was laid in an extended position on the right side, with the head to the northwest (facing south). The left arm was outstretched, and the right arm was bent towards the face [*Fig. 6:B*]. The skeleton was poorly preserved, damaged, and incomplete. The bones were eroded, with post-mortem fractures clearly visible, and with particularly heavy damage to the cranium (probably due to the pressure of the soil and the weight of a heavy boulder resting on the head, as well as unknown taphonomic factors). The skull and mandible were preserved in fragments, and a strong alveolar prognathism was visible. The morphological features of the skull (i.e. strong muscle attachments, mastoid processes of the temporal bones, presence of the processus marginalis, shape of the shaft, and angle of the mandible) indicate male sex (Strzałko and Henneberg 1975; Buikstra and Ubelaker 1994). The teeth in the maxilla and mandible are intact (up to M3). The formed roots, slight dental abrasion (D–E, after Lovejoy 1985), as well as the lack of obliteration of the cranial sutures (Buikstra and Ubelaker 1994: 32–38) suggest the young age of the deceased (young adult, 20–25 years).

The postcranial skeleton was ossified and damaged (eroded, incomplete). Of the torso bones, only a few fragments of ribs and vertebrae have been preserved. The upper limbs were represented by destroyed fragments of the shoulder blades, clavicles, humeri, ulnae, radii, wrists, metacarpals, and phalanges. Fragments of the pelvis, damaged femurs, tibias, and fibulas, as well as two cuneiform bones, a navicular bone, a fragment of the calcaneus, and a fragment of the talus have been preserved from the lower limbs. The lack of fragments from the area of the greater sciatic notch, the pubic symphysis and the facies auricularis prevented the use of the pelvis to identify the age and sex of the deceased (Lovejoy et al. 1985; Brooks and Suchey 1990). Still, the overall morphology of the postcranial skeleton and its size suggest a male. Based on measurements of long bones (humerus), and in some cases only their fragments (Martin

and Saller 1957), the estimated height of the deceased was 179–181 cm (Trotter and Gleser 1958; Strzałko, Piontek, and Malinowski 1972; Raxter et al. 2008).

Grave 63 was surrounded and covered with a stone enclosure composed of a dozen large sandstone slabs weighing from 10 kg to over 50 kg each, and several dozen smaller stones arranged in two rows along almost the entire length of the body [*Fig. 6:A*]. On the deceased's chest was a half of a sandstone ring [*Fig. 7*]. Within the pit, between the stone blocks, four fragments of Mesolithic pottery were found — three decorated with a rocker stamp motif and one decorated

Fig. 6. KSH1 Trench 6/7, Grave 63, Mesolithic burial. A – stone enclosure of the grave; reconstruction based on several photos. The numbers mark the places where the artifacts were found: 1 – stone ring, 2 – fragment of pottery decorated with an incised wavy line, 3 – two fragments of pottery decorated with a rocker stamp motif. B – skeleton after cleaning. Inset: two fragments of pottery in situ (Photos M. Jórdeczka)

with an incised wavy line. However, it is unclear whether these were indeed grave offerings, as the burial site was located in an area used for settlement purposes. No such doubts, however, arise in the case of the sandstone object placed directly on the body, under the stone slabs.

CHRONOLOGY AND ANALYSES

Charcoals found near the skull in Grave 47 have been dated to 6431–6244 calBC at 95.4% (Poz-91018, 7490±40 BP), and it is possible that they came from Pit 10, dated to 6408–6235 calBC at 95.4% (Poz-91017, 7450±40 BP) [*Fig. 8*]. These dates will constitute the *terminus post quem* for the burial, but it is worth emphasizing that its Middle Mesolithic chronology (6650–6000 calBC — see Dunne et al. 2022: 256) is rather certain. The dating is further supported by the stratigraphic relationships observed in the profile [see *Fig. 3*], which includes an intact layer of mud covering both the pit and the grave and separating these two contexts from the subsequent Mesolithic layer.

Determining a precise timeline of the second burial presents a challenge. The amount of collagen in the human bones and teeth has proved insufficient to use the AMS ^{14}C dating effectively (tests were conducted at the Poznań Radiocarbon Laboratory). The only charcoal fragment was found about 20 cm south of the buried man's head. It was dated to the interval 4330–4049 calBC at 2 sigma (Poz-103041, 5350±50). However, it is important to note that the charcoal was not obtained directly from the burial pit and may have originated from the unpreserved Neolithic layers destroyed during the construction of the road. Additionally, a Neolithic grave (GR 62) was discovered in the vicinity, south of

Fig. 7. Fragment of a sandstone ring from KSH1 Trench 6/7, Grave 63 (Photos M. Jórdeczka)

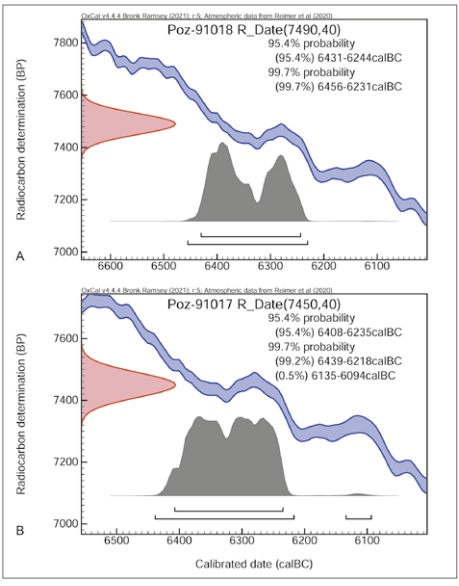

Fig. 8. Calibration of radiocarbon dates on charcoal from KSH1 using OxCal v.4.4.4 (Bronk Ramsey 2021): A – Grave 47; B – Pit 10; atmospheric data from Reimer et al. (2020)

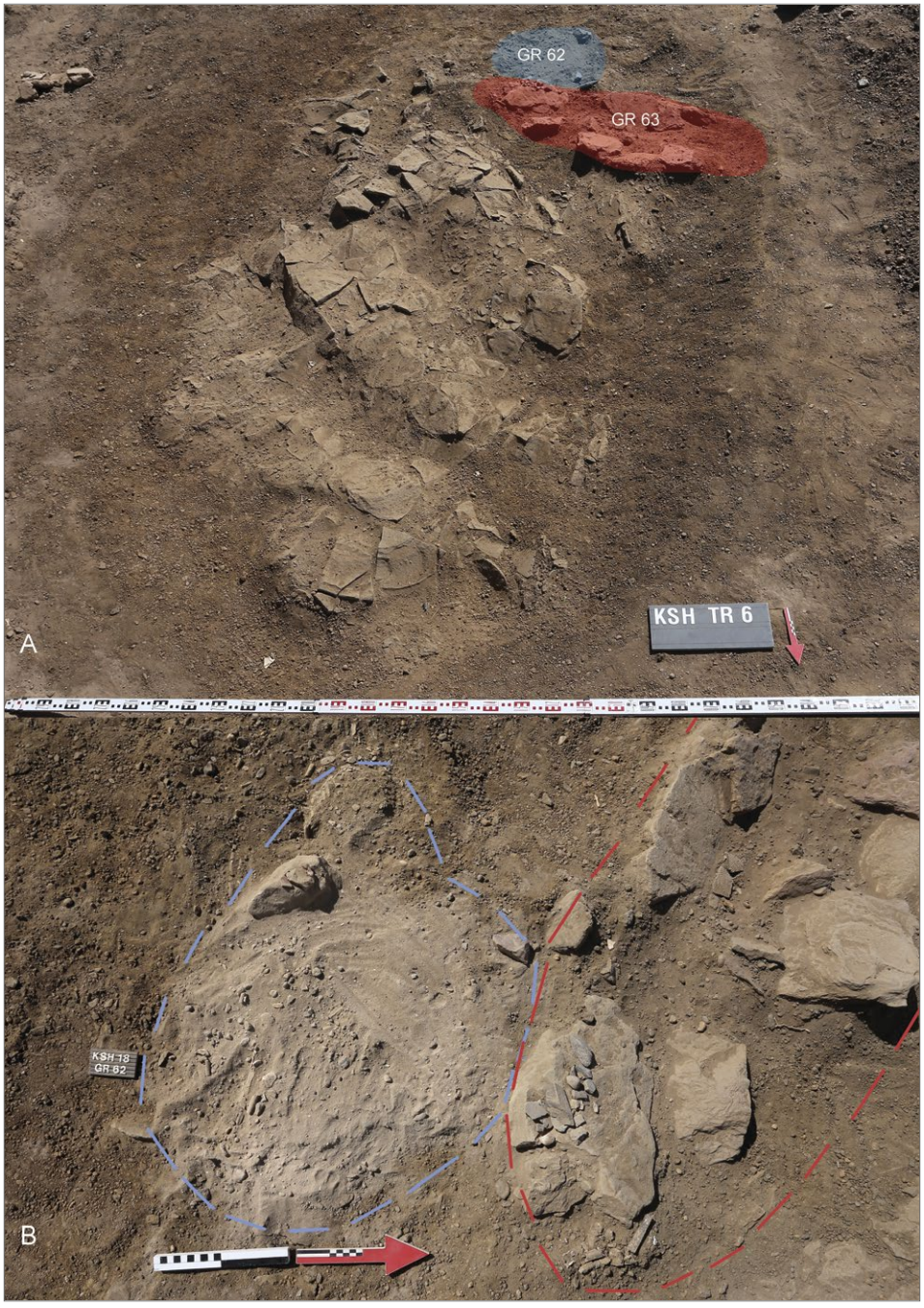

Fig. 9. KSH1 Trench 6/7. A – basement rocks forming the top of the hill. The location of Grave 63 is marked in red, and the extent of the Neolithic grave (Grave 62) is marked in blue. B – the blue dashed line marks the extent of the destroyed Neolithic Grave 62, the red dashed line marks the Mesolithic Grave 63 (Photos M. Jórdeczka)

Grave 63 (at the level of the legs [*Fig. 9:A*]), and it was radiocarbon dated to the interval 4678–4456 calBC at 2 sigma (5715±35) (Jórdeczka, Stanaszek et al. 2020: 141).

The Mesolithic chronology of Grave 63 is beyond doubt, although it is based mainly on archaeological data. This dating is indicated primarily by the color (brown) and texture (gravel-sandy, with a large amount of eroded ferruginous sandstones) of the filling, corresponding to the Mesolithic layers and very different from the younger Neolithic layers, characterized by a gray-brown color and a silty-sandy texture [*Fig. 9:B*]. What speaks for the Mesolithic dating is also the position of the body, extended rather than contracted, as was the case in the Neolithic layers. In addition, the structure of the grave and the archaeological materials found in the fill include Mesolithic ceramics and a sandstone ring.

Interesting data come from analyses of the $^{87}Sr/^{86}Sr$ isotope ratio, which is commonly used in the study of migration and mobility patterns of ancient populations (Montgomery 2010; Frei and Price 2011). The examined individuals from KSH1 show a wide spectrum of Sr isotopic signatures ranging from 0.70727 to 0.70905. The values obtained for the remains of the two Mesolithic men differed slightly from one another. The index calculated for the skeleton from Grave 47 was 0.708332, while for Grave 63 the result was 0.707921. Currently, the local range for KSH1 is between 0.708 and 0.709 (analyses are still ongoing and detailed data will be published in a separate article).

It was impossible to obtain usable nuclear DNA or mitochondrial genomes from any samples from KSH1, regardless of chronology (including the youngest, post-Meroitic samples).

EARLY HOLOCENE POPULATIONS IN CENTRAL SUDAN

Nine sites in Central Sudan are currently known to contain burials from the Early Holocene period. The earliest burials were found at site 16-D-4 in el-Khiday 2 on the White Nile, where 85 graves dated to the pre-Mesolithic period were explored (Usai et al. 2010; 2017; Salvatori, Usai, and Zerboni 2011; Salvatori et al. 2014). The bodies were laid in an extended prone position, with the head usually facing downwards, with no particular orientation.[2] Males and females were present in roughly equal numbers, although in many cases sex could not be assigned confidently to individuals. The majority of individuals buried were adults, while non-adults were underrepresented, with less than 10% under the age of 18. Only one was buried with a grave offering in the form of an ivory bracelet (Salvatori et al. 2014: 246). The communities were rather sedentary, with a diet based mainly on C_4 resources (Buckley et al. 2014; Iacumin et al. 2016). Their members were usually in good shape, and the population as a whole was mostly healthy (Jakob 2014), tall, with few injuries or diseases. An

2 Similar burials were found at Jebel Moya in the 1940s (Addison 1949).

exceptional finding was the discovery of three prostatic stones in one of the graves (Usai et al. 2017).

Burials from the White Nile site of Shabona (Clark 1989) may also be associated with Mesolithic settlement activity. Archaeological excavations conducted at this site have revealed five burials in shallow pits and a collection of long bones scattered on the surface. In the two best-preserved graves, the deceased were found in an extended position, one facing east and the other west. No grave goods were found in either of them. The other burials were severely eroded, with only one allowing determination of the presumed position of the body (flexed). The remains came from three adult males, one subadult male, and three adult females. The identified medical conditions included one case of caries and alveolar abscess, one healed rib fracture, and osteoarthritis of hands and feet. Furthermore, one of the females had her upper incisors removed (Clark 1989: 395). Despite its broad time span, a single date obtained (7470±240 BP, 7031–5849 calBC at 95.4%) confirmed the Mesolithic chronology of the graves.

A total of 17 burials were discovered at the Khartoum Hospital site (Arkell 1949). The graves were poorly preserved, the sex determination was possible in only two cases (one male and one female), and the age at death was not given. The local hunter-fisher-gatherers were described as belonging to the Negroid race, tall, with narrow and long skulls, and with pronounced facial and dental prognathism. Three (or four) bodies were accompanied by grave goods. The man from Grave 5 was found with 34 ostrich eggshell beads, while the skull of another individual (from Grave 6) of unknown sex was resting on a large fragment of pottery decorated with a wavy line motif. Remains of an individual of undetermined sex in Grave 8 were discovered with a single ostrich eggshell bead. Additionally, in Grave 12, next to the remains of an individual whose sex and age were unspecified, a Pila snail shell was found, but it is uncertain whether it was part of grave equipment.

On the Blue Nile, two damaged Mesolithic burials were found at the Sheikh Mustafa site. Both were located in an area interpreted as the beginning of the periphery of a camp settlement and both were heavily affected by post-depositional disturbances. They included parts of the skull and three teeth of an approximately eight-year-old child, as well as broken remains of the cranium, mandible and a few bones of the upper body (fragments of the scapula and the clavicle) of a probably adult male, placed presumably in a flexed position, with the head to the west, facing south (Fernández, Jimeno, and Menéndez 2003: 279). An analysis of stable isotopes and phytoliths collected from the child's teeth indicated that their diet was plant-based with a small addition of milk and a strong presence of fish (Trancho and Robledo 2003).

In Saggai, where Mesolithic settlement activity was dated to 6443–6073 and 6358–5905 calBC (Caneva 1983), burials of four females and one male were discovered. Some of the burials

contained grave offerings, including a mollusk shell found next to the body of a 30–40-year-old female, and three ovoid grinders placed next to the pelvis of an adult male. Additionally, two shells of a Nile oyster (*Etheria elliptica*) were found next to the skulls of two adult females buried together in a single grave (Caneva 1983).

Interesting data came from the region of the 6th Cataract. At the Sphinx site (SBK.W-60), where occupation began around 8764 calBC (median), the well-defined burial phase started some 2000 years after establishment of the settlement and ended about 5986 calBC (median) (Varadzinová, Varadzin, and Ambrose 2023). Remains of at least 45 individuals were discovered at this site (Brukner Havelková et al. 2022: 67), and 14 of them were successfully dated (on the basis of enamel bioapatite from human teeth) to the 7th and early 6th-millennium calBC (Varadzinová, Varadzin, and Ambrose 2023). The location of the cemetery remained the same over a long period of time, which resulted in the overlapping of the skeletons. The orientation and positioning of the bodies was not uniform. However, in each case the lower legs were bent (the degree of flexion between the spine and femur varied widely), the heels were against the pelvis, and the arms were extended in front of the face. The deceased were usually placed on their side or back, with their legs turned to the left or right — there was no clear preference for one side or the other. The graves were dug into functional layers. Some of the burials contained grave offerings such as shells of Nile bivalves, ground stone artifacts, and lithics found directly on some cadavers (Varadzinová and Varadzin 2017; Varadzinová, Varadzin, Crevecoeur et al. 2022). The local population was in good health, mostly suffering from dental diseases, especially periapical lesions and inflammatory changes, with a very low incidence of dental caries (0.43%). Healed traumatic lesions or fractures, probably of accidental origin, were identified in six cases (Brukner Havelková et al. 2022). The only trace of violence was a perimortem sharp force trauma caused by penetration of a heat-modified nonhuman bone between the right scapula and the rib cage (Brukner Havelková et al. 2023).

More burials from Sabaloka were found at the Fox Hill site (SBK.W-20), where a multi-phase cemetery was discovered alongside remains of Mesolithic and Neolithic settlements (Suková, Varadzin, and Pokorný 2014; Varadzinová and Varadzin 2020; Varadzinová, Varadzin, Crevecoeur et al. 2022; Varadzinová, Varadzin, Brukner Havelková et al. 2022). In addition to a large number of densely placed graves found on Terrace 3, several isolated grave clusters were identified as well, indicating spatial organization of the cemetery. Twenty-six burials examined were characterized by varying body orientations and positions, multiple superimpositions, as well as redeposition of skeletal fragments. Stones (and sometimes fragments of tools such as querns and grinders) were often placed over the body or the head. In some cases, they were ar-

ranged to form stone piles. In a few cases, grave offerings in the form of Nile bivalves, ostrich eggshell beads and parts of large mammals were found (Varadzinová and Varadzin 2020; Varadzinová, Varadzin, Crevecoeur et al. 2022; Varadzinová, Varadzin, Brukner Havelková et al. 2022).

DISCUSSION

The currently available sample from KSH1 is too small to determine the palaeogeography of the local Mesolithic community or the health status of its members. Nevertheless, the information obtained at the site may prove important for the reconstruction of Early Holocene human history in Central Sudan.

Dental calculus analyses of a sample from Grave 63 indicate the consumption of grasses, including panicoids (additionally confirmed by phytolith analysis from stone tools), as well as edible wild fruits (Dunne et al. 2021). However, the traces of phytoliths and plant fibers could just as well have been left by activities other than food consumption, such as raw material processing, oral hygiene (Radini et al. 2017) or ritual activities. No traces of starch granules, pollen grains, fungal spores or insect remains were observed. However, the presence of long fibers, presumably of plant origin, was confirmed alongside mineral aggregates.

More light is shed on the economy and diet of the KSH1 hunter-fisher-gatherers by archaeological investigations and bioarchaeological analyses carried out directly onsite (Dunne et al. 2021). Based on archaeozoological data, it can be inferred that there was immense pressure on securing animal meat, which was an important source of protein and fat. The Mesolithic diet mainly consisted of meat from large, medium, and small ruminants, wild pigs, and fish. The diversity of species and carcass parts found at KSH1 (Dunne et al. 2021: 1431) correlates with the sedentary or semi-sedentary lifestyle of the local communities, which is supported by data from other Early Holocene sites in the Nile's middle reaches (Chaix and Honegger 2015; Honegger and Williams 2015). The subsistence strategies observed at Mesolithic sites assumed intensive and comprehensive exploitation of the local environment, in keeping with the so-called "Broad Spectrum Revolution" concept (e.g. Clark and Kandel 2013).

The archaeobotanical remains from Mesolithic contexts at KSH1 include charred fruit stones of *Ziziphus spina-christi* (Christ's thorn jujube). The plum-like fruits would have been gathered for human consumption, while the charred and often crushed fruit stones suggest that the plums may have been processed (Dunne et al. 2021).

Analyses of lipids from ceramic vessels found in the Mesolithic contexts at KSH1 have shown that during the period in question pottery was mainly used in processing non-ruminant animal products. Some of these vessels were used for preparing plant- and meat-based dishes, and fish was probably cooked in them as well. One of the examined Mesolithic vessels yielded traces of processing of ruminant carcasses, probably game species, such as Salt's dik-dik, common bush duiker, and greater kudu (Dunne et al. 2021).

CONCLUSIONS

In recent years, there have been significant qualitative and quantitative advancements in our understanding of Early Holocene populations in Central Sudan. The most notable discoveries include organized cemeteries, such as those in the area of el-Khiday (Usai et al. 2010; 2017) and the 6th Cataract (Varadzinová and Varadzin 2017; Varadzinová, Varadzin, Crevecoeur et al. 2022; Varadzinová, Varadzin, Brukner Havelková et al. 2022). These burial sites were used for many generations and seem to indicate that the younger members of the population cared for the remains of their ancestors by protecting their graves against accidental destruction (Sabaloka). This observation implies that such hunter-gatherer communities were more complex and nuanced than previously assumed.

The cemeteries show no discernible divisions related to sex or age, and neither have clear rules been identified regarding body orientation. The body position itself also varies widely, from extended prone (pre-Mesolithic el-Khiday) to supine or on the side (e.g. KSH1), to positions with legs moderately or strongly drawn up toward the chest (e.g. Fox Hill). Grave goods are uncommon. The scarce finds mostly include mollusk shells, and occasionally Nile bivalve shells, stone tools, clay vessel fragments or bone ornaments and ostrich eggshell beads. In some cases, whether those items were deposited intentionally remains uncertain (Haaland 1993; Jesse and Keding 2002; Varadzinová and Varadzin 2017; 2020; Garcea 2020). Notable exceptions include graves with stone superstructures from Fox Hill, where granite blocks were placed as a two-sided enclosure or cover over the bodies. Sometimes they only weighed down the head or the body, but in other cases they formed larger mounds, providing additional protection of the burial against damage (Varadzinová and Varadzin 2017; 2020).

Mesolithic human bones from KSH1 —as from other Sudanese sites (cf. Jakob 2014: 271–272; Brukner Havelková et al. 2022: 69)— are fragile and susceptible to fragmentation. The young men buried in Graves 47 and 63 shared a number of features, both morphological and developmental. Their skulls were quite archimorphic, with pronounced alveolar prognathism, and their postcranial skeletons were quite massive with well-expressed sexual characteristics. Similar skeletal features were recognized, for example, among the dead buried at the Sphinx site located 80 km from Khartoum (Brukner Havelková et al. 2022: 72–73). In both cases from KSH1, a set of teeth with erupted molars up to M3 was preserved. The body heights of the deceased were also similar (Grave 47: 183–186 cm, Grave 63: 179–181 cm), which suggests, apart from good teeth and the lack of pathological and overload changes, quite good physical condition and perhaps social position, features observed at other Mesolithic sites as well (Brukner Havelková et al. 2022; 2023). Interestingly, considerable male height was also recorded at other Early Holocene sites, including el-Khiday and

Sphinx in Central Sudan (Jakob 2014: 273; Brukner Havelková et al. 2022: 73).

At present, due to the limited scope of research conducted at Khor Shambat, it is not possible to ascertain whether the site exclusively contains individual Mesolithic graves dug into settlement layers, or whether more organized burial practices are in evidence. However, the large scale of Early Holocene settlement observed at this site may imply the presence of further graves of local people from this period.

The two excavated graves differ primarily in their construction. The one with the stone enclosure was found directly under a trench made during the construction of the road (about 1.5 m of layers were removed), which unfortunately destroyed the younger cultural layers and hindered the interpretation of the context. However, it seems that the deceased was buried in a small, natural rock depression, at a time when the settlement layers were not very thick. This may have been one of the reasons behind the decision to additionally cover the grave with stone slabs to better protect the burial and perhaps also mark its place (similar observations were made at the Fox Hill site — Varadzinová and Varadzin 2017; 2020).

The Mesolithic chronology of Grave 63 was established based on archaeological data. It was indicated primarily by the color and structure of the filling, corresponding to the Mesolithic layers and very different from the younger Neolithic layers. The position of the body (extended vs. contracted) and the structure of the grave itself, including the presence of a stone enclosure, are also different than in the Neolithic. Finally, the presence of a stone ring on the chest of the deceased, as well as fragments of Mesolithic pottery (one of them decorated with an incised wavy line motif —ceramics of this type were found in the lower layers of Pit 14 dating to the beginning of the 7th millennium BC— cf. Dunne et al. 2021) in the grave filling confirm this conjecture (although in the latter case we only get a *terminus post quem*). The second grave from KSH1 differs from the first in terms of the body's position, the lack of equipment, and the structure itself — in this case, it was a shallow depression dug into the cultural layers and the Mesolithic pit. The charcoals from the grave and Pit 10 were used to obtain radiocarbon dates which give us the *terminus post quem* for the burial. Based on its stratigraphic position, it can be placed in the Middle Mesolithic period, most likely in the latter half of the 7th millennium BC.

Further research at KSH1 may be expected to resolve questions about the local population, its palaeodemography, sex distribution of the deceased, their health status, and social organization. The data obtained so far have contributed significantly to the knowledge about the conditions and ways of life of hunter-fisher-gatherers, their diet, origins, burial practices, and funerary rituals. The KSH1 site has exceptional scientific potential and, due to the stratigraphy preserved in some areas, it presents an uncommon opportunity in Sudan to investigate the chronology and evolution of Mesolithic and Neolithic settlements.

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