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Geo- and ethnoarchaeological investigations of a cave in the Northern Zagros Mountains (Ashkawta Rash, Iraqi Kurdistan)

Tim Kerig [a,*], Jutta Lechterbeck [b], Benny Waszk [c], Philipp Serba [d], Tobias Helms [c], Abdulwahab Soleman [e], Goran Fakhir Hasan [f], Kamal Kolo [f]

[a] Cluster of Excellence ROOTS, Subcluster Social Inequality, University of Kiel, Leibnizstr. 3, D-24118, Kiel, Germany
[b] Arkeologisk Museum Universitetet I Stavanger, Peder Klows Gate 31A PB 8600, Forus. NO11 4036, Stavanger, Norway
[c] Institut für Altertumswissenschaften, Arbeitsbereich Vorderasiatische Archäologie, Johannes Gutenberg-Universität Mainz, Hegelstr. 59, D-55122, Mainz, Germany
[d] PAS Digital Media, Alte Leipziger Str. 58, D-63571, Gelnhausen, Germany
[e] Directorate of Antiquities of Soran, Soran, Iraqi Kurdistan, Iraq
[f] Scientific Centre of the University of Soran, Soran, Iraqi Kurdistan, Iraq

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ABSTRACT

Ashkawta Rash Cave was investigated in two short excavation campaigns in 2018 and 2021. Hundreds of anthropogenic layers testify to the use of the cave over the last three millennia. In this article, we combine ethnoarchaeological and measurement technology related issues with the excavation results. After reviewing the archaeological and ethnographical literature we describe various economic practices, such as the stockpiling of dairy products, which can be demonstrated or at least made probable in the cave and its immediate surroundings. We catalogue different uses of the cave and date them wherever possible. Furthermore we describe general modes of cave use within the pastoral economy of northern Zagros, namely the phases of site formation with deposition and accumulation, followed by systematical removal of cave sediments and cultural layers. Grazing initially brings considerable amounts of material into the cave, then these layers, several metres thick, are removed again and again. As a result, future investigations can identify from remote wheter caves in the area yield potential undisturbed strata sequences or not. At the same time, this recognises an important process in the formation of the specific cultural landscape.

1. Introduction

Mountain archaeology, as demonstrated in the various papers of this issue, can be defined by environmental archives and archaeological sources that are either 1) exposed to or 2) resist the forces of the energy effecting the different landscape elements which may generally be characterised by extraordinary potential energy (cf. Penk, 1894; Gregory and Lewin, 2017). Both aspects can be realised in caves: shaft caves, e.g., can be sediment traps, which collect and preserve eroded material from a larger surface, while in horizontally accessible and dry cave interiors, archaeological layers are protected from processes outside the cave (Springer, 2012). Inside such caves and in addition to natural factors such as running or freezing water or the movements of burrowing or hibernating animals, human agency causes the formation of layers and their erosion. Here, human agency is, to a certain extent, a geological factor. The factors of site formation (Mandel et al., 2016, 807–812) can now be linked archaeologically to other factors that shape the landscape (Denham, 2016). The use of the mountain zone separately from permanent lowland settlements can be expected to be directly documented in caves, however a specific bias has to be assumed.

The archaeology of the Soran district (Gómez-Bach et al., 2019; Kerig et al., 2019; Beuger et al., 2021) can be characterised as site-oriented. Quaternary palaeoenvironmental research (Reynolds et al., 2015a,b) is still scarce and data for settlement archaeology is not available yet. Here we start from a single site and integrate it into an economic landscape of practices (Helms and Kerig, 2021). In this investigation, starting from a compilation of the disperse references (s. Chapter 2), we use a scale perspective (Schlummer et al., 2014) on a particular cave in a mountain landscape (Kerig et al., 2019) where factors on different scales are identified within the site. For example, only the neo-tectonic activity caused by the large-scale plate tectonic structure explains why the deepest cave sediments – still-water sediments – are tilted. Moreover,

* Corresponding author.
E-mail address: tkerig@roots.uni-kiel.de (T. Kerig).

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only the assesment of regional archaeology will allow us to adequately evaluate the importance of the site in the settlement landscape. Practices that shaped the immediate cave environment prove key to interpretation. Using an example from the Northern Zagros, we will illustrate some uses of the cave and place it in its specific landscape. We focus on aspects of cave use based on surveying, excavation and ethnographic information from 2017, 2018 and 2021. In the following, we discuss the archaeological features. Finds, generally poor in numbers and not yet sequenced, will be published elsewhere. On first sight, no very pronounced differences between the material from the cave and that from the recent layers of the tell site Girda Dasht (Danti, 2014a; and b; Kerig et al., 2019) or from Jafrakani Kon (Helms and Kerig, 2018a) were obvious but a chronological and sociological classification of the regional ceramic finds is not yet possible. The study contributes to an understanding of the regional cave use in the Soran region from the Iron Age to most recent times. At the same time, it is a contribution to the development of measurement routines for remote sites.

2. Regional setting

2.1. Situation

The cave Ashkawta Rash (in Sorani literally: *The Black Cave*) belongs to the self-governed district of Soran in the Kurdistan region of Iraq. The site (Fig. 1) is situated ca. 4 km west of the town centre of Soran, at 36.645536° N 44.494400° E. The portal opens on the northern slope of the *Gali-Ali-Beg* gorge of the Balakian River, 575 m above sea level and 92 m above the river bed.

The Balakian runs from the North, parallel to the Baradost mountains, deviding them from the Delzian Plain. The fertile Delizian plain (sometimes also called Diyana plain) is the main agricultural area of the district, surrounded by badlands. Apart from the plain, the potential economic areas for horticulture and arable farming, livestock breeding and timber use can be sufficiently determined by the slope gradients. In addition, hunting and gathering resource use is common, though locally extremely over-exploited. In the 19th and 20th centuries, tobacco, wild oak acorns and gall apples were important agricultural products of the region (Taylor, 1868; Leach, 1940; Galloway, 1958). The Balakian River then cuts the *Ali-Gali-Beg* gorge through the Baradost and runs to the west, finally draining to Mesopotamia via the Harir Plain.

The archaeology and history of the landscape is shaped by its geographical relationships between the core areas of Western Asian archaeology. The Northern Zagros Mountains are about equidistant from the Black Sea, the Caspian Sea, the Mediterranean Sea and the Persian Gulf. They lie in the triangle of Mesopotamia, Anatolia and the Iranian highlands where important roads converge. It is here where the contrasts between highlands, lowlands and mountains have always been emphasised. From early historical times until today, the mountainous territories play a significant role in the self-image of its inhabitants as well as in the perception of their neighbours.

2.2. Geology and environmental history

The cave is located within the Zagros high folded zone of Kurdistan. The Zagros belongs to the intercontinental mountain belt caused by the Alpine orogeny (Jassim and Goff, 2006), extending from the Pyrenees to Malaysia. The Zagros was formed by the collision of the Eurasian and Arabian continental plates (Numan, 1997; Al-Qayim et al., 2012). This collision, which resulted in a series of parallel NW-SE directed anticlines and synclines, still shapes the landscape and determines the energetic level of the individual parts of the landscape, which are characterised by badlands, deep gorges, steep slopes, high erosion rates and coarse sediments.

Because of still active tectonic uplift, rivers cut deep gorges into the Mesozoic and Cenozoic layers, predominantly limestones. The cave is located on the northern slope near the entrance of the *Gali-Ali-Beg* Gorge of the Balakian River that cuts through the Bradost Upper Cretaceous limestones coming from the Delzian Plain. This is an intramontane basin filled with Plio- and Pleistocene sediments. Pre-Pleistocene layers in the cave slope largely in line with the surrounding limestone layers of the formation, indicating that the cave was open at least in the Pliocene and that the river flooded it frequently. The layers were then tilted during the further Zagros uplift, while the river cut deeper into the limestone (Kerig et al., 2019).

In the 1960s, when the region was in the focus of archaeological interest, the Quaternary environmental history was also investigated (e. g. Wright, 1962). In addition, there has been more recent work on engineering geology, especially hydrography (Sissakian, 2013; cf. Jassim and Goff, 2006; Helms and Kerig, 2018a, 2018b). First pollen analyses of the region prove the presence of palynomorph-bearing sediments (Al-Ameri et al., 2010) and show the great potential for further vegetation history studies in the region. Also from a geomorphological perspective, the wider area has recently received increased interest: Larger-scale investigations in neighbouring areas show how necessary further research is (Forti et al., 2021). The current interdisciplinary palaeoanthropological, archaeological and palaeoenvironmental

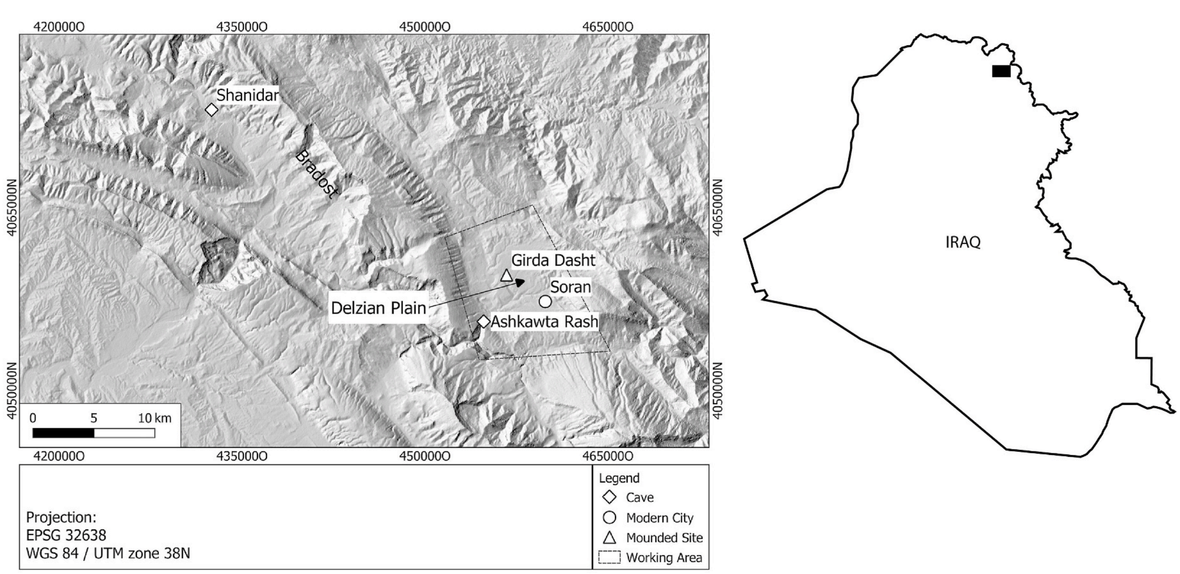

Fig. 1. Ashkawta rash. Situation (CAD Backhaus, Lechterbeck).

research in Shanidar addresses issues of the Pleistocene and the early Holocene (e.g. Reynolds et al., 2015a,b).

2.3. Archaeology

Archaeological fieldwork around Soran has concentrated on a few promising and longer known localities, not at least for logistical reasons (Bradosty, 2018): Shanidar (cf. Solecki, 1971) and other caves in the Bradost Massif (Safar, 1950; Batten, 1951; Field, 1951a, 1951b; Al-Haik, 1968), Zawi Chemi Shanidar (Solecki and Rubin, 1958; Solecki et al., 2004; Solecki, 2005, 1981), and the Halafian Banahilik settlement (Braidwood, 1954; Braidwood and Howe, 1954; Watson, 1983). A major topic of the region's historical archaeology is the potential location of Iron Age Muṣaṣir (Boehmer, 1973a, 1973b, 1997). After archaeological research came to a virtual standstill due to the conflicts of the past four decades (Marf, 2016), the above mentioned sites have again recently received renewed attention. At the same time, the middle and immediate neighbouring regions are being opened up for rescue excavations and survey projects (Beuger et al., 2016, 2018; Beuger, 2018; Helms et al., 2016; Helms and Kerig, 2018a, 2018b; Koliński, 2018; further contexts: Wilkinson and Tucker, 1995; Altaweel et al., 2012; Ur et al., 2013; Pfälzner and Sconzo, 2016; Ur, 2017; Koliński, 2019 and following).

The important sites of the region gave rise to important general anthropological questions: the 'Neanderthal cemetery' in Shanidar Cave fuelled the ongoing discussion on Middle Palaeolithic social behaviour like only very few other sites world-wide (Solecki, 1971; Leroi-Gourhan, 1998), and the following Baradostian culture has yet to be assessed in its relations to the archaeological techno-complexes of the Early Upper Palaeolithic of Europe, West and Inner Asia (Olszewski, 1999, 2009; Reynolds et al., 2018). The Epipalaeolithic/Protoneolithic ensemble from the Shanidar Cave burial ground and the nearby contemporaneous Zawi Chemi settlement shed light on lifestyles and economies immediately before and during the process of neolithisation (Solecki, 1981; Aurenche and Kozlowski, 1999, 46–53, 186; Solecki et al., 2004; Olszewski, 2012 cf. Asouti et al., 2020).

The new excavations (since 2018 by Anna Gómez Bach, Univ. Barcelona) at Banahilik promise to shed light on social and economic aspects of the Halaf complex in the north-eastern periphery of its range (Matthews, 2000, 105; Gómez-Bach et al., 2019).

Bronze and Iron Age research has so far remained largely unsatisfactory from an archaeological perspective: according to Mesopotamian textual evidence, regional power blocs were formed in the north-western Zagros region where states were eventually established (Fuchs, 2016). Between the 9th and 8th centuries BC, the region formed the border area between the kingdom of Urartu (urart. Biainilli) and the Neo-Assyrian Empire. The city of Muṣaṣir – a cult place of the supreme Urartian deity Ḫaldi – and the eponymous buffer state have been localised in the area of the Soran district, in particular on the basis of the interpretation of the inscriptions of the well-known stelae of Kelišin and Tōpzāwa (Salvini, 1980, 1997, 2014; e.g. Parpola and Porter, 2001; Radberm, 2012; Marf, 2014, 2016). An Iron Age fortification in the vicinity of present-day Mudjesir has repeatedly been identified with Muṣaṣir (Boehmer, 1973a, 1973b, 1997; Danti, 2014a, 2014b). A direct link to Sargons 8th campaign against this city may become visible at the newly discovered Assyrian site of Pir Wali (Beuger et al., 2021).

Archaeological research into the Islamic and post-Ottoman periods has only just begun in the study area (cf. Vorderstrasse, 2014). A first step in this direction is the investigation of the Ottoman to post-Ottoman village of Jafrakani Kon (Helms and Kerig, 2018a, 2018b): for the first time, stratified finds of the otherwise hardly known village material culture of this part of the Ottoman Empire become available. In addition, it is possible to record recent conflict events in connection with fire horizons and oral tradition ("oral history"), which are probably not recorded elsewhere.

Apart from older accounts of travel and activity (e.g. Ainsworth, 1842; Perkins, 1851; Thielmann, 1875; Lehmann-Haupt, 1910, 1926; Hay, 1921; Hamilton, 1937; Field, 1951b; Edmonds, 1966; Boehmer, 1973a; cf. Hameed and Zamua, 2018) and the important comprehensive ethnographic and ethnoarchaeological works on Kurdistan (e.g. Kramer, 1982; van Bruinessen, 1992), the specific ethnology of the Soran area is limited to two accounts of economic conditions (Leach, 1940; Galloway, 1958) as well as one shorter article on coppicing (Kerig and Helms, 2017).

There is also an important contribution to the regional ethnoarchaeology of caves, building on former fieldwork around Shanidar (Solecki, 1979; Solecki, 1998). Extensive cave-related information from south of the area has recently been published (Stefanski, 2021). Without knowledge of both publications, it is not possible to work in caves of the region.

3. Material and methods

Ashkawta Rash was registered by the Soran Directorate of Antiquities as a possible archaeological site. Prior to excavation, there were no known archaeological finds from the surface. The site was first visited as part of the 'From Mound to Cave' project by Kerig and Helms in February 2017 (Mann et al., 2017). The cave's surface was mapped and described in May 2017. First excavation work took place in October 2018 when a single trench was excavated (Kerig et al., 2019). Drone flights enabled topographic modelling of the gorge in the immediate surrounding of the cave. In October 2021, the cave's interior was photogrammetrically documented. Three trenches were opened and wall remains were investigated in all three trenches. The excavated archaeological material is stored at the Directorate of Antiquities of Soran, Iraqi Kurdistan.

3.1. Measurements

The first measurement and documentation of the cave interior and the surface structures took place in February 2017 with the help of a compass, a measuring tape and a measuring line as the baseline. Later work proved these measurements to be sufficiently accurate to 20 cm. During the 2018 campaign, measurement was carried out using classical geodetic surveying techniques with the aid of a total station theodolite. A ground plan of the cave (Fig. 2) was drawn up, which included not only the cave chamber itself, but also the rock shelter and the eaves zone of the entrance area (Kerig et al., 2019). This survey data was augmented in 2021 by an overall photogrammetric model of the cave chamber using SfM. A light-sensitive system camera (Nikon Z6 II) with a full-frame sensor and a remote camera gimbal (Ronin RSC 2 from DJI) were used for this purpose. This made it possible to set the desired photo overlap and automate the photography process, while the camera was held steady to reduce the number of blurred shots. In addition, the remote-controlled gimbal takes over the focusing of the camera. This process was repeated at various strategically selected positions in the interior. The data set of approximately 780 high-resolution images generated in this way was subsequently processed using SfM techniques. The model generated in this way is self-contained, scalable and can be inserted into the existing survey data. This procedure and the equipment used for it represented the ideal ratio of effort and benefit and reduced the logistical and administrative effort not inconsiderably when compared to the work with industrial laser scanners. Depending on available computing power, the generated raw data can also be subsequently reprocessed and converted into a higher-resolution point cloud. The textured model is the adequate basis to render image material for scientific evaluation, perform simulations or volume calculations. The overall cave model in medium resolution allows us – both in the form of the point cloud and as a textured mesh – to capture the natural shafts and display them in the form of a rendered profile image of the cave wall. Using prominent points on the cave wall, the existing model can also be subsequently processed in CAD programs and inserted into overall plans

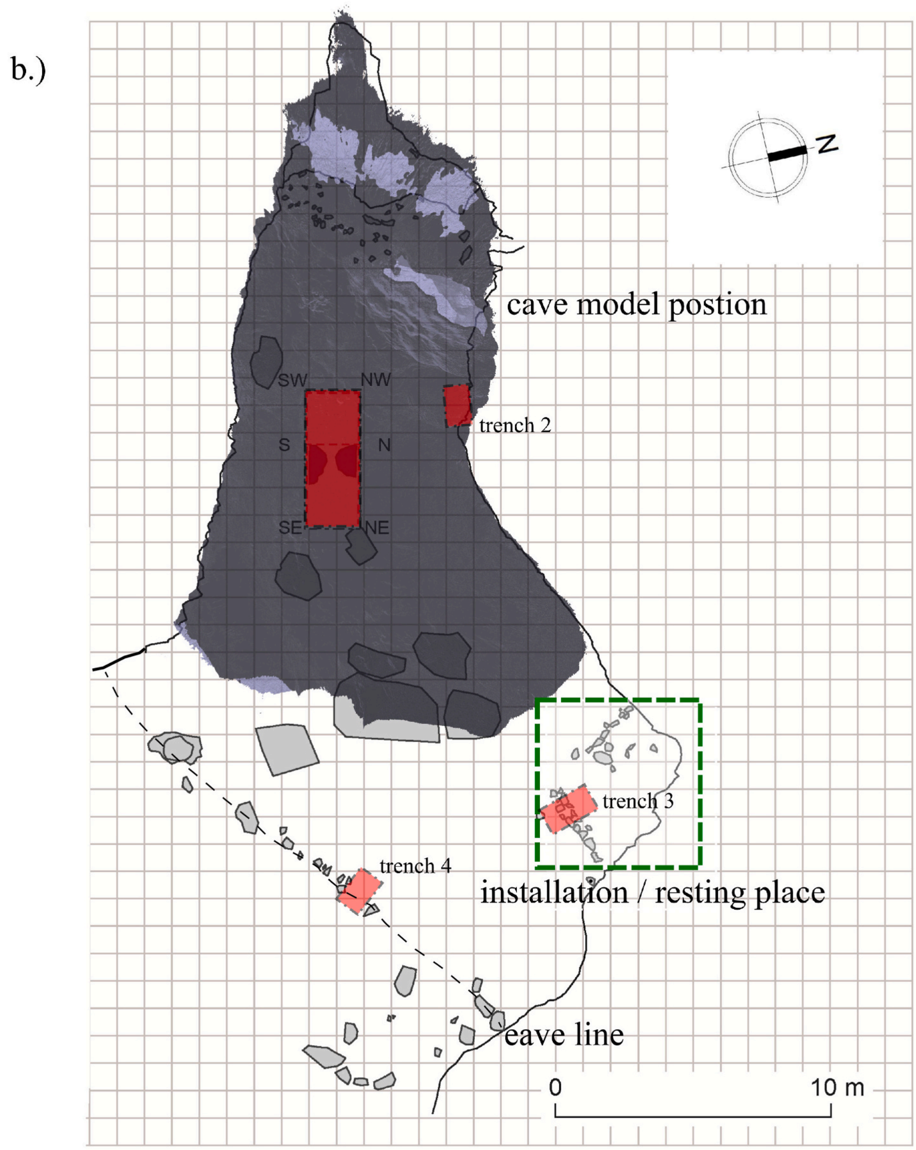

Fig. 2. Ashkawta Rash. Ground plan of the cave. Trenches in red. Trench 1 with the two pits marked. For area marked green see Fig. 5 (CAD Waszk, Pohl, Rünger).

Fig. 3. Ashkawta Rash. Southern cave wall. Rendered SfM orthographic view, for area marked red see Fig. 4 (CAD Waszk).

or georeferenced and integrated into GIS applications – provided that measurement data is available. In addition, archaeological and ethnographic features were documented separately in the form of drawings, photographs, and high-resolution photogrammetric models. This applies both to presumed anthropogenic interventions in the cave structure, such as the assumed breaking through of the sinter ceiling (Figs. 3 and 4), and to human installations, such as the resting camp below the rock shelter (Figs. 4 and 5). Furthermore, excavation trenches 2 to 4 were also photogrammetrically documented. A total of seven plana were recorded for excavation section number 2, five plana, 2 features and 2 profiles for excavation section 3, and two plana and one profile for excavation section 4. In the case of trench 3, orthomosaics were created from the 3D models of the profiles, which usefully complement the following investigations and descriptions of the stratigraphy.

The site's immediate surrounding (Fig. 6) has been documented via drone-photography as a basis for a terrain model via Structure from Motion (SfM). This method's value as a low-cost alternative to conventional measurement techniques has been discussed and researched for some time in geosciences (Carrivick et al., 2016) and mining engineering (Berger et al., 2017). Accordingly, it made sense to record the cave and its surroundings in this way on a trial basis. Outside the cave, ca. 200 GPS-based images were acquired and a dense cloud with 66 million points was generated. A digital elevation model and an orthomosaic with 3.78 cm/pixel were calculated. Both were embedded into a WGS84 coordinate system in order to deliver a height map with contour lines.

3.2. Archaeological excavation

In the first campaign of 2018, a large trench ("trench 1") was opened in the centre of the cave to get a general idea of the stratigraphy (Kerig et al., 2019). In 2021, three more trenches were opened. In a trench ("trench 3") at the northern wall/ceiling a walled-up niche was discovered below the walking horizon. Another trench ("trench 3") was made through the dry wall visible on the surface in the NE part of the cave. A trench ("trench 4") cut the stone row directly under the eave line (Fig. 2). In trench 1 the N, the S and the SW-NW profiles as well as several plana were documented. In trench 2, trench 3 and in trench 4 the N and the E profiles were documented, in trench 3 also plana. The documentation follows the German national standards (VLA, 2011) in description, drawings in the scale 1:20, photography and photogrammetry.

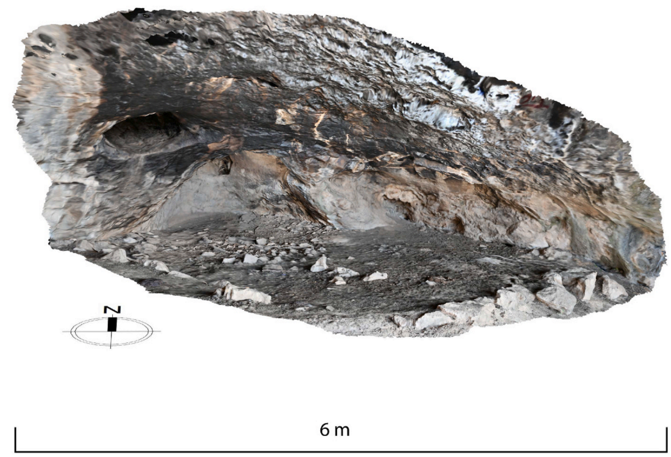

Fig. 5. Ashkawta Rash. Detail of northern part with resting place. Rendered SfM orthographic view, for situation and scale see Fig. 2 (CAD Waszk).

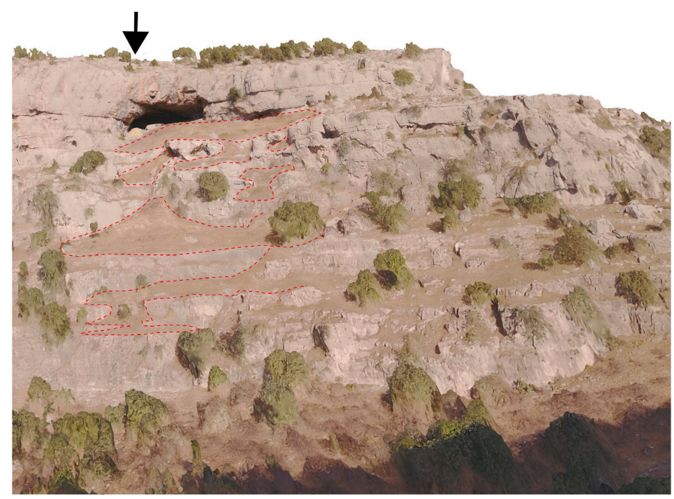

Fig. 6. Ashkawta Rash. Structure from Motion (SfM) drone model of the cave entrance and the surrounding slope. Arrow marks the lighter excavation heap. Below cave entrance, fans with cleared cave layers (CAD Serba).

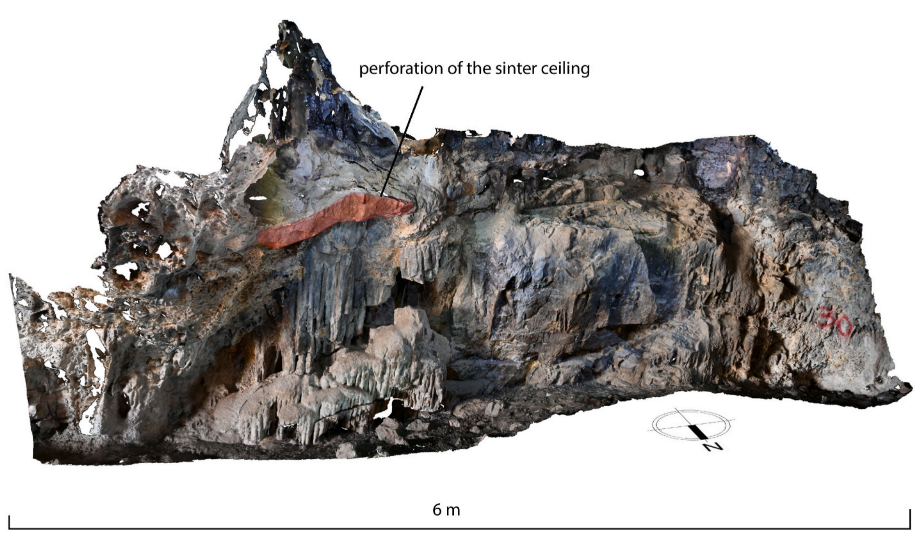

Fig. 4. Ashkawta Rash. Detail of southern cave wall. Area probably modificated by removing sinter ceiling. Rendered SfM orthographic view, for situation and scale see Fig. 3 (CAD Waszk).

3.3. Radiocarbon dating

In addition to the four radiocarbon samples already published (Kerig et al., 2019), four samples were taken from profile P3/E (Fig. 7). In order to obtain suitable material for dating, approx. 2–5 L of sediment were floated and sieved through a 1 mm sieve. The sieve residue was dried and examined for suitable material. Preference was given to seeds. If these were not available, charcoal pieces from short-lived woody plants were selected. The selected material was sent to the National Laboratory for Age Determination, NTNU Trondheim, Norway. For the results, see Table 1 and Fig. 8.

Table 1
Ashkawta Rash. Radiocarbon dates from campaign 2021.

Sample number	Lab number	Material (all charred)	14C age, uncal. BP	Cal. Age range (95.4 interval), cal. AD
27	TRa-1708	*Salix/Populus*	425 ± 20	1433–1482
28	TRa-1709	cf. Pistacia	285 ± 15	1523–1655
29	TRa-1710	cf. Prunus	370 ± 15	1457–1624
30	TRa-1711	Triticum sp.	1040 ± 15	992–1025

4. Results

4.1. Landscaping the cave

The cave opens 92 m above the river level of the Balakian River, which is located 135 m to the north and 163 m away as the crow flies. The plateau on top of the cave (about 6–8 m above the cave ceiling) lies on average about 104 m above the river. The ascent to the cave is difficult from the river side because of the banking of the limestone forming a multi-level terrace structure. A more natural access leads to the cave from downstream, following the slope of the main limestone layers along a path from the east.

The terrain model clearly revealed large heaps of relocated material in front of the cave. This material covers the slope wherever possible, lying on the mentioned natural terraces. Because of the uneven relief and the limited area, it must be assumed that larger quantities of material have been displaced into the gorge and were carried away by the river there. On top of these heaps, another lighter one is visible (Fig. 6): this is about half of the excavated material of trench 1, now backfilled. On the basis of our own work, we conservatively estimate 75 working hours for the excavation and shift of this relatively light material amounting to 15 m^3. In a cross-cultural sample, a higher value of 90 working hours seemed reasonable (Kerig, 2008, 131). The fans of relocated material beneath the cave's mouth contain at least more than twenty times that of the volume of the excavation spoil heap.

4.2. Observations concerning the ceiling

There are currently no unambigious traces of human modification of the cave ceiling. The ceiling consists of limestones/dolomites of the Upper Cretaceous (Maastrichtian-Campanian) Bekhme formation. This formation is a hydrocarbon reservoir, and in many locations, such as Bekhme Gorge, heavy bitumen seeps out of the rocks, filling the cracks and covering the rock surface. The same can be observed at Ashkawta Rash: large parts of the ceiling are covered with black bituminous matter – this is probably why the cave got its name. By common knowledge from other locations in Kurdistan, these types of rocks were used as a fuel source, as binding and waterproofing material and also for medicinal skin treatment of animals. This practice goes possibly back to the Mousterian of the Levant (Connan, 1999).

In the rear part of the cave, parts of the ceiling are covered with speleothemes, now dry. Remnants of a massive layer of sinter cover can be found at breast hight. We assume that this sinter cover was removed by human action during clearing activities of the cave. This, however, cannot be proven. The ceiling also shows "moonmilk" a whitish thin layer of secondary precipitated minerals (probably mixtures of calcites, gypsums and silicates as well as microorganisms) derived from dissolution of the carbonate rocks (*cf.* Spötl, 2018).

4.3. Excavation

Trench 1 (2 m × 5 m) was excavated in 2018 and is already published (Kerig et al., 2019). Packages of several hundred occupation layers were encountered. Two large storage pits with diameters of approximately 1 m were found cutting through most of the cultural layers and deepened into the natural layers, which were sealed by a sinter cover. The natural layers were numerous limnic/fluviatile stillwater sediments, some of

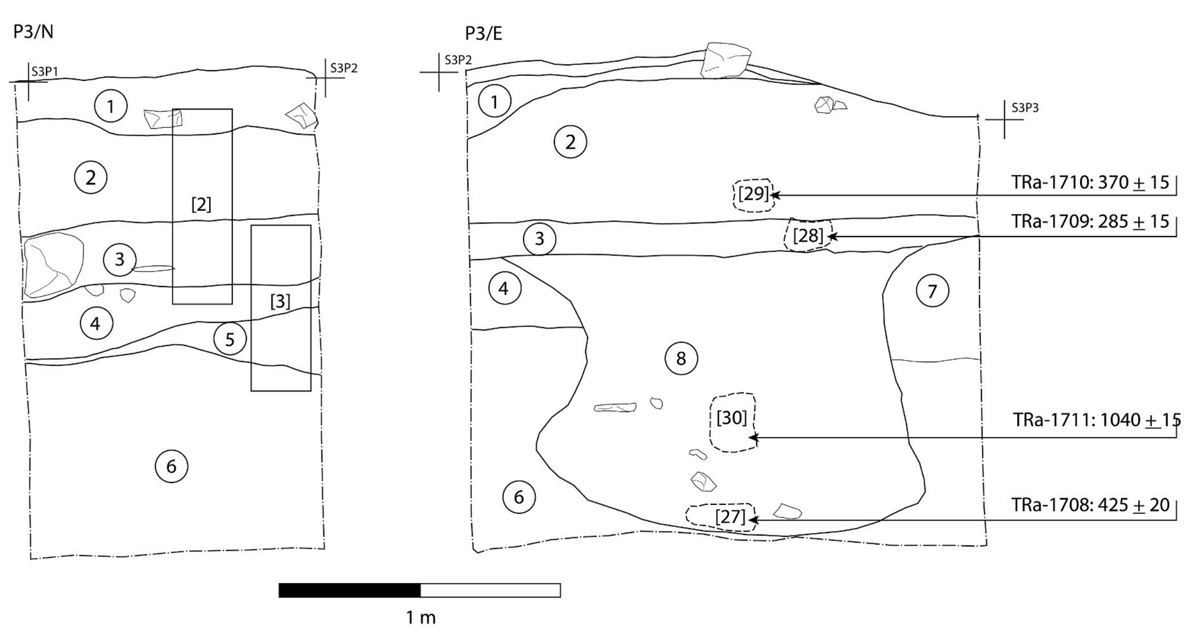

Fig. 7. Ashkawta Rash. Trench 3, profiles P3/N and P3/E (CAD Kerig, Lechterbeck).

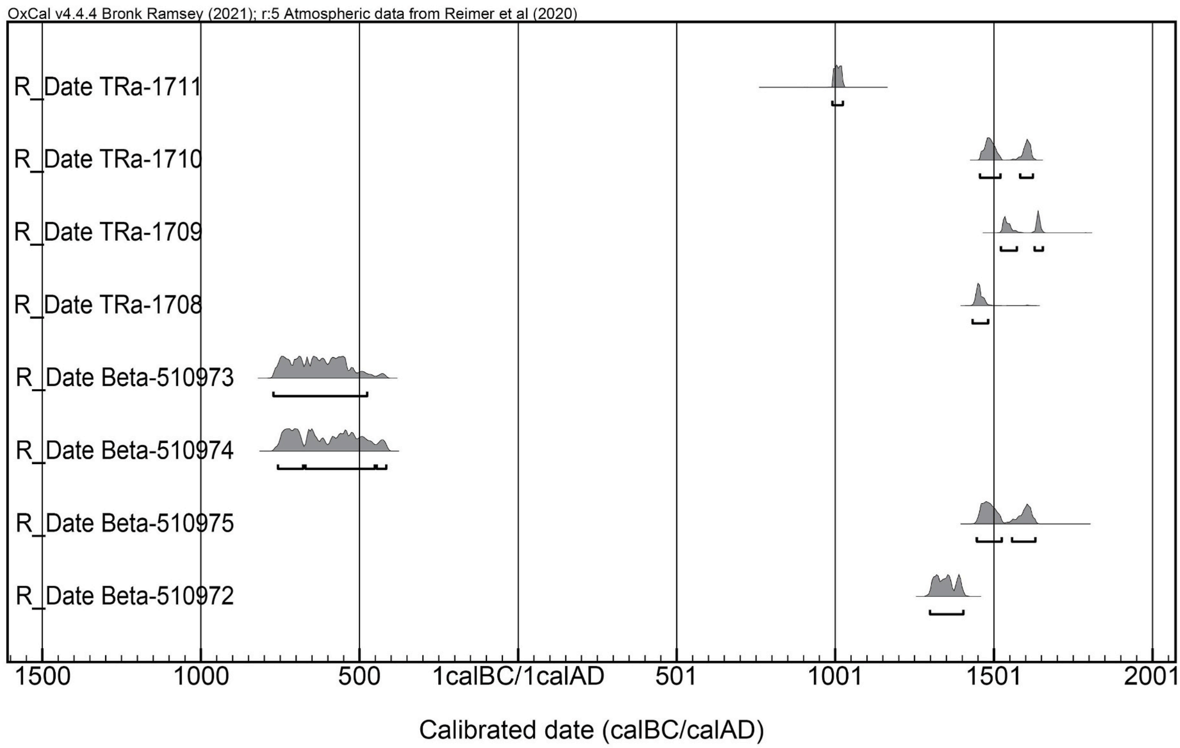

Fig. 8. Ashkawta Rash. Calibrated radiocarbon dates from campaign 2018 and 2021 (CAD Lechterbeck).

which were laminated and generally without visible discontinuities. These layers were tilted and essentially followed the strike and dip of the limestone.

Trench 2 (1.5 m × 2.5 m plus a side chamber ca. 2 m deep) was excavated in 2021. Finds include: 5 pottery fragments and 17 animal bones. A sequence of dung and ash layers as well as natural cave sediments similar to trench 1 were documented, with blocks up to 60 × 40 cm in size that have fallen from the ceiling. A natural niche opened up on the cave wall, which was walled up with loose dry masonry. This niche was empty and was neither filled with sediment nor with cultural layers.

Trench 3 (1 m × 2 m) was opened in the 2021 campaign to cut the loose dry masonry in the entrance area of the cave (Fig. 2). Finds include: 31 fragments of pottery, 1 piece of iron, 1 clay pipe, and bone fragments. Two profiles – P3/N and P3/E – were recorded from this trench.

P3/N is the northern profile of the trench, in front of the cave wall. Six stratigraphical units were distinguished (Fig. 7) and two box samples for later examination ([2] and [3]) were taken.

Unit 1 The top sediment layer consisted of 5–10 cm of animal dung interspersed with pieces of wood, plastic and charcoal. Below this was a brown layer, probably subrecent, measuring about a hand's width (*c.* 8 cm), which was sandy to silty overall and also contained charcoal and plastic. In addition, this layer contained some larger stones.

Unit 2 This layered package contained some hearths, which show up in profile as crescent-shaped charcoal bands. The sediments are horizontally bedded and contain charcoal as well as burnt lime, which is partly fire reddened and partly burnt bone white. Within the package is an approximately hand-width (*c.* 8 cm), bone-white fill that contains neither red clay nor charcoal. All layers react with HCL.

Unit 3 In this unit, the strata dip slightly to west northwest. The package contains a large stone that rests on the surface of the stratigraphic unit below. The strata themselves are banded clay that has been variably affected by fire. One layer is bone white. All layers react with HCL.

Unit 4 This stratigraphic package shows significant fire exposure, containing burned rocks, charcoal, red clay, and unburned clay.

Unit 5 These strata represent the transition from the cultural strata to the natural strata. They consist of various clay bands that show clear fire exposure, sometimes with significant amounts of charcoal. The matrix is fine sandy and originally slightly grayish, as in the natural matrix.

Unit 6 The natural underground. The natural subsoil consists mainly of marls.

P3/E is the eastern profile of the trench. A large pit that cut into the lower layers could be distinguished (see Fig. 7).

Unit 1 This unit is comprised of a dark grey layer of animal dung on the surface, about two fingers thick (*c.* 4 cm) on the cave's interior side.

Unit 2 The layer package consisted of different brown-grey to bone-white layers influenced by fire. The layers contained charcoal, small branches and stones about the size of a thumb (*c.* 5 cm). Individual fireplaces were visible as charcoal bands or lenses. A sample for radiocarbon dating was taken from this layer ([29]).

Unit 3 The layered package consisted of banded clay layers, with varying degrees of fire exposure. The layers contained bone and reacted with HCL. Individual fireplaces were visible as charcoal bands or lenses. A sample for radiocarbon dating was taken from this layer ([28]).

Unit 4 Fine sandy to clayey layers with a fire pit are observed in unit 4. The layers showed varying fire exposure, and the colour shifts from dark brown to bone white. The layer lies on top of the natural layer and is cut by the pit. Connection to P3/N is unclear.

Unit 7 Intermixed layer with a fine sandy to clayey matrix, brown to dark brown. It contains stones about the size of a thumb. The layer adjoins the natural layer on the underside. Possibly same as unit 4.

Unit 8 The pit backfill is sharply demarcated laterally from units 4 and 7, and the boundary to the natural subsoil is mostly sharp, but blurred against the overlying cultural layer. The surface of the backfill layers is formed in the south by a black and white band that flows into the pit. At the time of the formation of this band, the pit must have been open. Sharp-edged stones up to the size of a child's head (*c.* 15 cm) are found in the pit backfill. The matrix of the backfill consists of loose, alternating light, medium and dark brown layers. The matrix contains charcoal and red clay, all layers react with HCL. Two samples were taken from the pit backfill for radiocarbon dates ([27] and [30]).

Unit 6 The natural underground as described above. The natural subsoil consists mainly of marls.

Trench 4 (1 m × 1.5 m) lies directly in the mouth of the cave. It cuts through a row of stones which follows the eave line. In the profiles, a small pit and a stake of a recent fence could be documented. No finds were made.

Unit 1 Dark grey layer of animal dung on the surface, about two fingers (*c.* 4 cm) thick.

Unit 2 Mixed middle brown layer with burnt clay and charcoal that reacts with HCl. On top of unit 2, a charcoal-rich concentration was observed. One stone (L 30 cm) lies on the surface of unit 3. A layer of charcoal lies on the surface of unit 3, indicating a fire place. The lower boundary of unit 2 adjacent to unit 3 shows a small pit with unclear boundaries inside unit 2.

Unit 3 Mixed yellowish-brown layer with charcoal that reacts with HCl. Leaning against the stone from unit 2, on the side of the cave's interior, there was a sharpened wooden stake (diameter up to 6 cm, depth in unit 3 approx. 20 cm). The pole was probably driven in from unit 2.

4.4. Ethnoarchaeology

The recent use of the cave could be documented archaeologically as well as in non-standardised interviews with neighbours and visitors of the excavation. Some accounts are of special interest: in conversations with local residents, they attributed the name Ashkawta Rash to the black colouring of the white limestone of the cave ceiling caused by numerous cooking fires. We have already identified these deposits as natural seepages from bitumen-saturated limestones, although cooking fires would also have contributed to the blackening of the cave. The usage of the highly bituminous limestones in fire buildup is possible.

Several informants described the cave as a popular place to visit in high summer because of its pleasant coolness. The cave was used on several occasions for overnight stays as part of herding and leisure activities, especially hunting. This is matched by the more frequent occurrence of shotgun shell casings in the cave environment, especially on the heap in front of the caves' entrance. A shepherd reported that he had repeatedly spent the night in the cave with his animals (sheep and perhaps goats) one or two decades ago. Additionally, a man reported that as a child in the 1980s, he and his grandparents had lived in the cave during the summer months. For this purpose, they had laid out parts of the cave interior with carpets and thus defined a used area: Cooking was done inside the cave next to the natural chimney. The sleeping place, on the other hand, was in the front area, where installations are visible today. Dairy products were kept cool in small pits and in niches in the cave wall. Another informant confirmed the practice of cooling dairy products in deeper pits for other nearby caves as well. Various small fireplaces testify to short-term cave use, possibly lasting for the duration as short as a tea break. These hearths – one with individual seat stones and a throwing zone with nutshells – were documented on the surface in the centre of the cave room. Other small fireplaces were found next to and in the area of the fixtures and are probably more related to overnight stays. In 2018, in the eaves area of the cave portal, playing children had built a "snake trap" out of sticks and nets. The cave is also considered to be a snake's nest by some of the locals. Some holes in the cave sediment are due to its use as potting soil. During the excavations, free-roaming cows kept coming into the cave, probably looking for shade. All of these uses were also observed in surrounding caves. In particular, use for recreational activities, such as smoking water pipes, is very popular.

5. Discussion

Based on the archaeological results, especially the radiocarbon data, four phases of cave use can be distinguished. Layer packages document phases of occupation and use over longer periods of time – these may well have been of varying lengths – and also countless short-term stays. Discontinuities between the layer packages indicate individual removal of the layers. At chest height on the cave wall, there are remains of destroyed and removed heavy sinter layers. We consider the removal of this stone layer to be anthropogenic, even if this cannot be proven beyond doubt. Spatially limited diggings are numerous, including the three well-documented pits of roughly similar shape. The staircase-like access to the cave (not investigated here), the blocking of the cave portal with a fence, the partitioning of a sleeping area and the walled-off niche have been identified as upright structures.

Phase 0: Still-water sediments and undisturbed cave clays show no evidence of human agency.

Phase 1 According to the radiocarbon data, the oldest documented phase of use belongs to the Iron Age. The exact period cannot be narrowed down due to a plateau in the calibration curve (Jacobsson et al., 2018). This dating inaccuracy prohibits a connection to historical events. The samples come from an anthropogenic package of burnt and ash layers, not dated by other means and whose lower limit forms an unconformity against the pre-Holocene. An undisturbed natural stratification of cave clay would lead to a higher running horizon in the centre of the cave and a slope of the running horizon towards the cave wall. Here the running horizon is flat, proving the removal of clay, which could, for example, have been used as building material on site. It is possible that a single small piece of quartz pottery belongs to the Iron Age (Kerig et al., 2019, Fig. 3). The Iron Age phase is associated with stratified fire traces similar to those that are ethno-archaeologically observed from recent use. The absence of older Holocene sediments or anthropogenic material makes a clearing of older layers more than likely. This may have happened in the Iron Age or before. The heaps of redeposited cave sediments on the steep slope of the gorge could at least partially belong to this phase. An exclusive preservation of these layers of loose material in a highly exposed position over millenia seems rather unlikely, so that especially the remains of later clearings can be suspected to have contributed to the heaps. A comparison with the size of our excavation heap showed that a huge amount of labour was necessary to clear out those masses.

Phase 2 A single radiocarbon date from the pit's filling in trench 3 comes from a most likely relocated wheat grain.

Phase 3 A single radiocarbon date certifies an occupation in the first half of the second millennium CE. The date comes from the context of a stone structure unclear in scope and meaning which testifies not more than the existence of an ancient surface. Four radiocarbon dates belong to use episodes around or later than 1500 CE. While one date is from the pit fill of unit 8 in trench 1, two dates are stratigraphically younger than the pit fill in trench 3. Thus, construction and use as well as abandonment and backfilling of the deep pits in this phase are evidenced.

Phase 4 This phase includes all recent activity that was generally not selected for radiocarbon dating. Stratigraphically, the sleeping area separated by stone layers (examined in trench 3) belongs to this phase. The structures mentioned above – the fence in the eaves area, the walled niche (Fig. 9), and the stepped access – may belong to but cannot be clearly assigned to phase 4.

In total, the following activities can be verified: Short-term stays with/without livestock, seasonal stays, the processing of cereals/nuts, cooling of milk/dairy products, food preparation, use as a hunting stand and as a resting place/night's lodging, and finally children's playing. Despite the possibility for favourable control over the gorge, there is no archaeological evidence of military activity.

6. Conclusions

Different forms of cave use could be recognised and documented on different scales. While at least hundreds of short-term stays are clearly visible, the respective share of the main economic uses for livestock and for storage, especially of foodstuffs, varies between and within the phases without the two being mutually exclusive.

Human activity induced huge material flows from the immediate surroundings of the landscape into the cave. The majority of this material was ingested by lifestock as feed and deposited as dung. This material circulation should not be underestimated in scope. The storage of foodstuffs for human consumption is less significant in volume, even though it required a great deal of work to set up suitable installations (here pits and the partitioned chamber). Equipment for different purposes as well as fuel and water must also have been brought into the cave. An input of building material could not be proven. No traces of fortification were found.

The extent of the mass movements from the interior of the cave onto the slope could only be visualised by the terrain model. The cave filling was cleared and pushed away several times, now forming heaps on the gorge's slope. While the input of dung built layers inside, the clearings enlarged the available space and must have had hygienic effects. The relocations of natural sediments as well as anthropogenic layers must have required a total of at least more than one thousand working hours. This high labour input becomes somewhat datable, although it is not documented in form or extent by the hiatuses in the stratigraphy: it is spread over the centuries of more or less distinct phases of cave-use since the Iron Age. Little can be said about the Iron Age occupation. The pits belong to a period after 1500 CE, preceded by at least one phase of cattle husbandry. The discontinuous evidence is probably due to the repeated removal of the cultural layers.

The cave Ashkawta Rash is an example of a modified living space of human beings and their livestock that can only be understood from its overall geological, geographical, ethnographical and archaeological contexts, documented on different spatial and temporal scales. Especially the phases of clearing and relocation are of interest, but they are characterised inside the cave by nothing more than the absence of layers. In summary, the Ashkawta Rash cave represents a highly dynamic form of architecture common in mountain areas, formed and modified – thus built – over millenia by a wide range of practices that generations of people peformed.

Author contributions

The research was initiated and led by TK and strongly supported by AS in the field. TK designed the research. TK and JL coordinated and finalized the writing. TK, JL, BW, PS, TH, GFH, KK participated in the writing. All authors agree with the latest version of the text.

Data availability

The measurement data are photos which can be requested from the authors. The finds are archived at the Directorate of Antiquities in Soran.

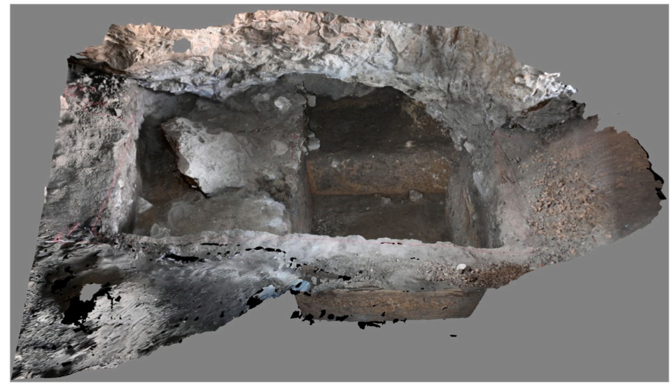

Fig. 9. Askawta Rash. Trench 2: View into the partially cleared side chamber, after removal of the dry-stone wall. View to North. Rendered SfM (CAD Waszk).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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