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Investigating the Neolithic Presence in South-Central Oman The DUQ-25A Rock Shelter

Maria Pia Maiorano, Dominik Chlachula, Alžběta Danielisová, Roman Garba

Abstract: Over the past decade, extensive surveys have been carried out in the wider area surrounding the city of Duqm (south-central Oman). During fieldwork in 2023, research on the Neolithic encampment in the Wādī Ṣayy area was conducted. Numerous locations surrounding this large wadi have yielded evidence of Neolithic occupation. The proximity to chert outcrops and the presence of elevated fluvial terrace systems overlooking the wadi floodplains likely played a pivotal role in attracting human habitation during that period. Among these sites, DUQ-25A stands out for its exceptional preservation and the abundance of flint scatters. The excavation at the site aimed to achieve multiple objectives: validating the site's chronology, expanding our understanding of its spatial extent and occupational sequence and filling the gaps in our knowledge about Neolithic societies in south-central Oman. Our research aims to provide new perspectives for the study of the Early and Middle Holocene in Al-Wusṭā.

Keywords: rock shelter, projectile points, Neolithic, Oman, Duqm

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The region of Al-Duqm (**Fig. 1**) in the Sultanate of Oman is located in the south-central part of the country and features a small gulf to the north and steep hills to the south that gradually flatten out. The region predominantly consists of sedimentary rock formations and has been affected by fluvial and coastal dynamics, along with other geomorphological

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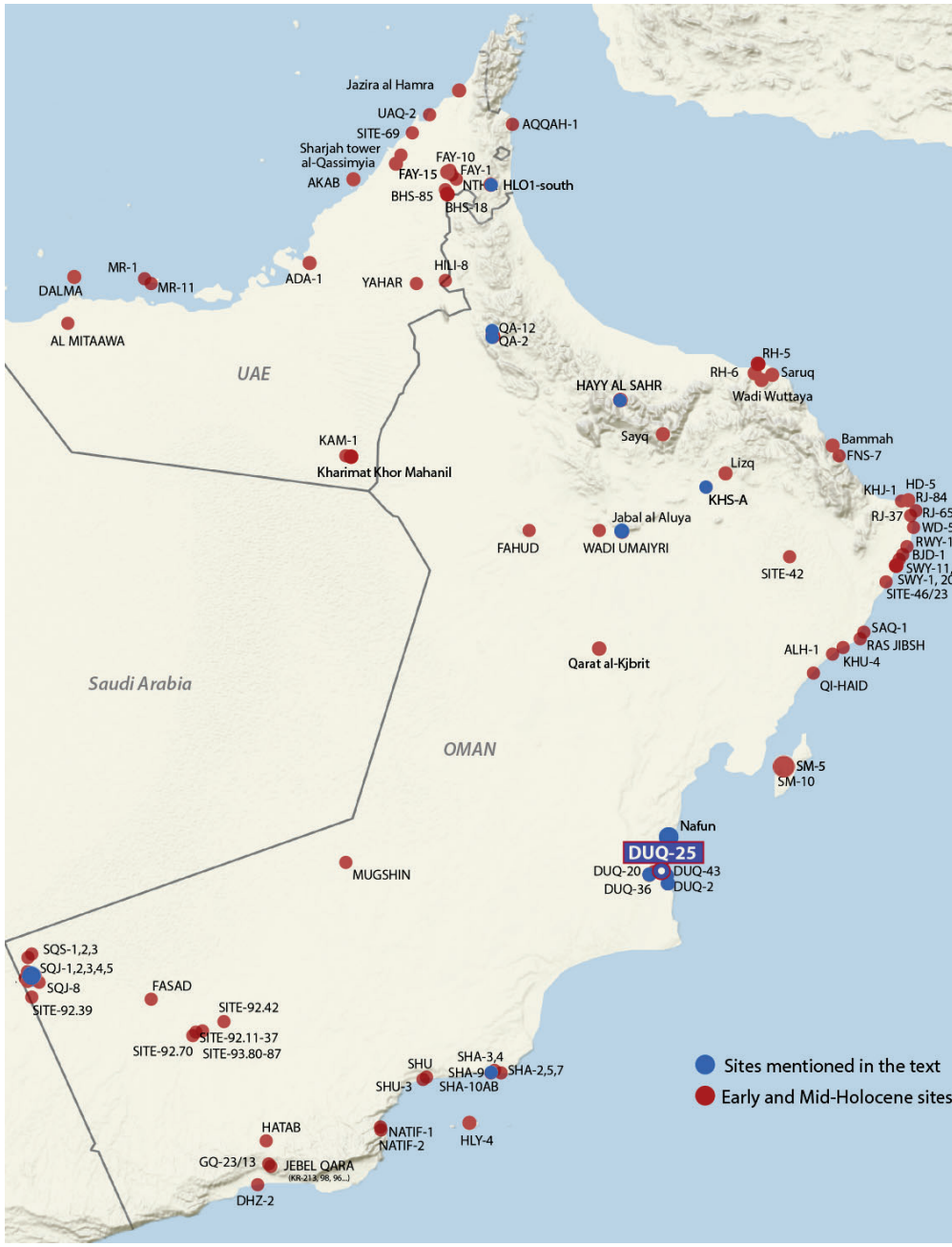


1. Map of the Sultanate of Oman and UAE with the Final Palaeolithic and Neolithic sites (Drawing: M.P. Maiorano).

processes.[1] Until recently, the area remained relatively unexplored, with the initial survey conducted by a Swiss team (COPS – Central Oman Palaeolithic Survey) in 2007 and 2008,[2] followed by subsequent investigations led by an Italian team in 2015.[3] As part of a survey project funded by the Ministry of Heritage and Tourism (formerly Heritage and Culture) and coordinated by the late Professor Maurizio Tosi, the Italian mission undertook an assessment of the SEZAD (Special Economic Zone Al Duqm) area. The primary objective was to obtain a comprehensive understanding of the prehistoric and early historical human activities within the boundaries of the SEZAD region. The assessment aimed to evaluate the archaeological potential of the area and draw attention to the potential risks and threats facing its archaeological heritage.

The investigation of Duqm area was suspended for several years as the new team working in the area (TSMO – Trilith Stone Monuments of Oman) focused on documentation of the triliths.[4] In January 2022, the newly established project ARDUQ (Archaeological Landscape and Environmental Dynamics of Duqm and Nejd) revamped its research objectives and embarked on an extensive geo-archaeological investigation in Duqm and Dhofar.[5] This project embraces a multifaceted and multidisciplinary approach aiming to explore various aspects of the region's archaeology and its environmental dynamics. The 2022–2023 season of the ARDUQ expedition consisted of three field campaigns: ARDUQ_2A in Duqm (December 2022), ARDUQ_2B in Dhofar (January-February 2023) and ARDUQ_2C in Duqm (February-March 2023). The Dhofar team focused primarily on the study of Middle and Lower Paleolithic lithic technologies, while the Duqm team investigated the Neolithic rock shelter in DUQ-25A and the archaeological evidence at Nafūn, covering periods from the Neolithic to the Late Iron Age.[6] In Nafūn, since 2020, part of the team has dedicated their efforts to studying the first monumental tomb dated to the Neolithic period in whole of south-central Oman.[7]

A multidisciplinary team of experts specialising in lithics, geology, geo- and biochemistry, bioarchaeology, triliths, flint raw material and rock art was assembled and split between the regions of Dhofar and Duqm. Their collaboration was centred around conducting a comparative study of the two areas and synthesising the collected data on a regional scale. This approach aimed to gain deeper insights into the archaeological landscapes of Dhofar and Duqm while facilitating a comprehensive understanding of the broader regional context. The project plans to use extensive archaeometric methods to obtain secure scientific data

[1] Deif *et al.* 2021.

[2] Jagher 2009; Jagher *et al.* 2008.

[3] Genchi *et al.* 2017.

[4] Garba 2021.

[5] Garba *et al.* 2022.

[6] Genchi *et al.* 2017; see also: Garba, R., Danielisova, A., Maiorano, M.P., Fossati, A., Danecek, D., Chlachula, D. 'Back to Duqm: Archaeological landscape of Nafūn, south-central Oman', poster presented at the 55th Seminar for Arabian Studies, Aug 5–7, 2022, Berlin; Nafūn was also discussed during a lecture 'Unique megalithic grave in Nafūn (al-Wusṭā Governorate, south-central Oman) as a reflection of the collective identities in the Neolithic period', presented during the 56th Seminar for Arabian Studies, Aarhus, Denmark, 4–6 August 2023.

[7] See previous foonote.

by collecting environmental samples to reconstruct the landform and hydrosphere evolution of the territory. Moreover, the project aims at testing the hypothesis of climatic changes and cultural evolution across the millennia, from the Lower Paleolithic occupation at the fringes of the Rub' al Khali to the Iron Age sites in Nafūn.

One of the most interesting sites is the rock shelter in the DUQ-25 archaeological complex in Wādī Ṣayy.[8] Based on the lithics, this site is dated to the Neolithic period. Even if the site had previously been surveyed, no systematic study was conducted at DUQ-25A. Given the discovery of a projectile point in the test trench made in 2015 by an Italian team,[9] we decided to extend and deepen this sounding. The main objectives were: 1. to establish a preliminary chronology of the Neolithic occupation in Duqm with ^{14}C dating; 2. to reconstruct the operational chain of arrowhead production and the techno-cultural connection with other sites in Dhofar and Sharqiyah (Aš Šarqīyah); 3. to explore the subsistence strategies of the Neolithic societies in the Duqm area. Over the past decade, the entire Duqm area has experienced substantial landscape modifications attributed to the presence of heavy industry and quarries. This marked transformation serves as a compelling rationale to excavate and meticulously document a site located in close proximity to the areas of extensive modern human intervention.

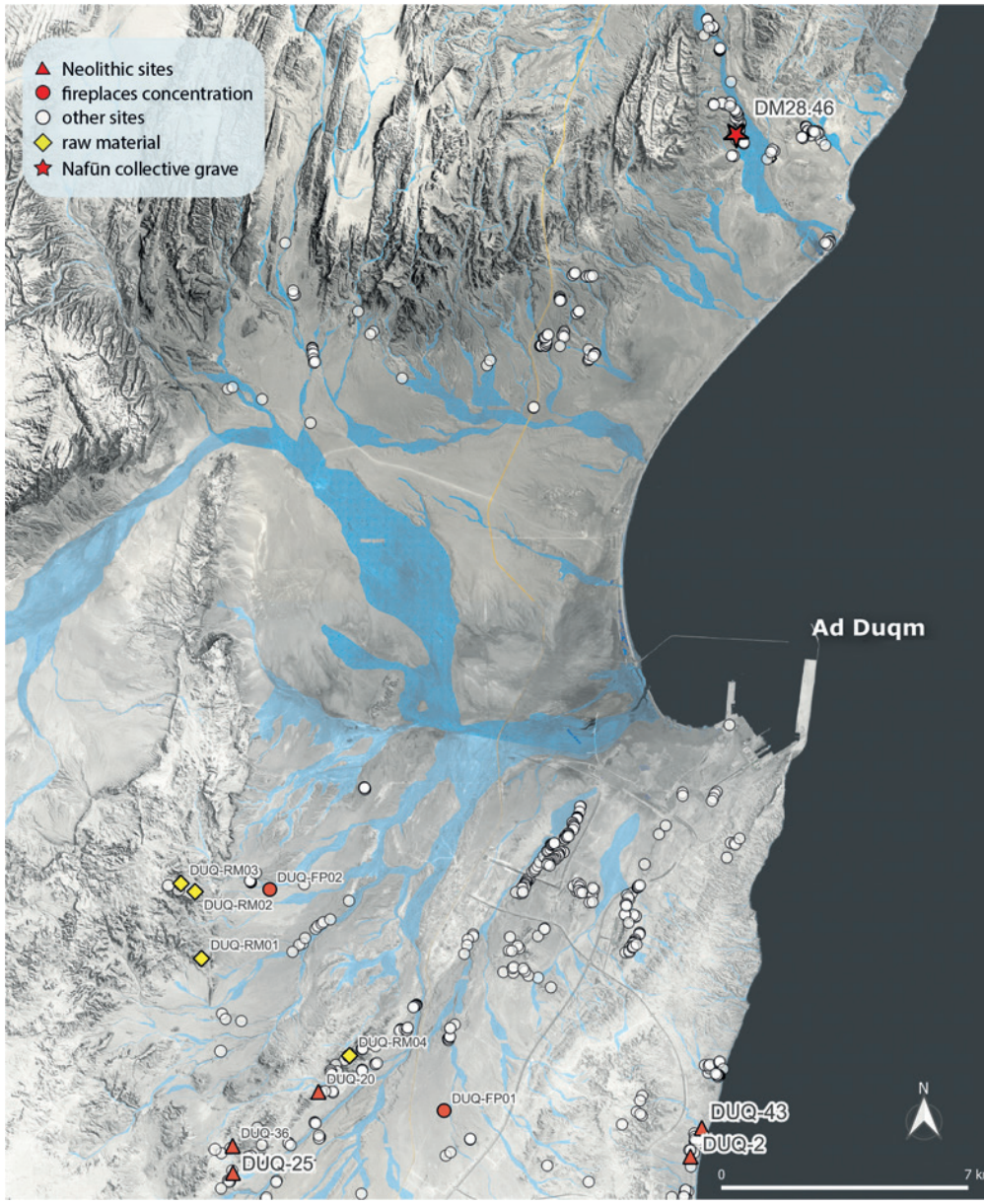
EXCAVATION AT THE DUQ-25A ROCK SHELTER

DUQ-25A is located nearly 250m from a tributary branch of Wādī Ṣayy (**Fig. 2**). Nestled beneath a small shelter, the site is positioned strategically on a slope within an ancient gully that stretches approximately 10m in length and 5m in width, running from east to west. Today, the overhang of the upper part of the shelter is no more than a meter deep. The rock shelter owes its existence to the incised interbedded bioclastic limestone terrace originating from the Dammam formation. This terrace displays embedded echinoids, molluscs and quartz fragments.

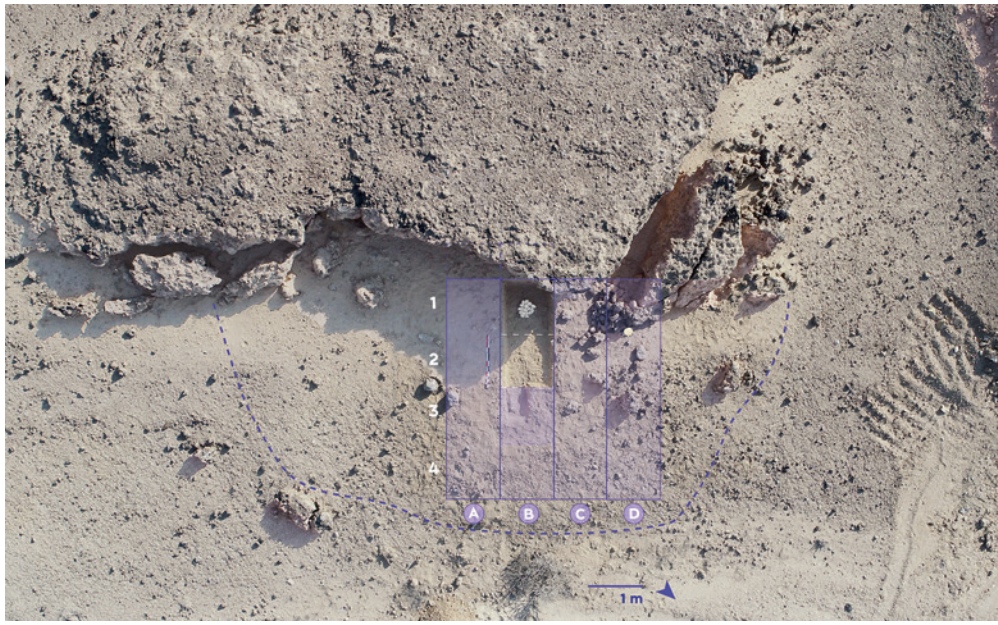
To understand the technological complex present at the site, we decided to systematically collect the surface material, dividing the area into parallel transects from A to D (**Fig. 3**). Compared to other Neolithic sites in the area where co-occurrence of chronologically different materials is very common, DUQ-25A showed a consistent assemblage scattered in a limited area. The lithic industry appeared to be different from those known from Dhofar and Sharqiyah, and the operational chain recorded at the site needed extensive documentation.

Given the nature of the site, we decided to place the trench in an extension to the previous one. Placed in the centre of the site, it consists of four squares numbered B1 to B4. It comprises a trench (T1) measuring 4 x 1m, oriented from north-east to south-west and perpendicular to the edge of the rock shelter. In T1, the excavation revealed nine stratigraphic units (SU), which constitute the reference stratigraphy for the entire deposit. The excavation in squares B1 and B2 has been finished. The residual sediment in B3 and

[8] Genchi *et al.* 2017: 96–98.
[9] Genchi *et al.* 2017: 96–98.



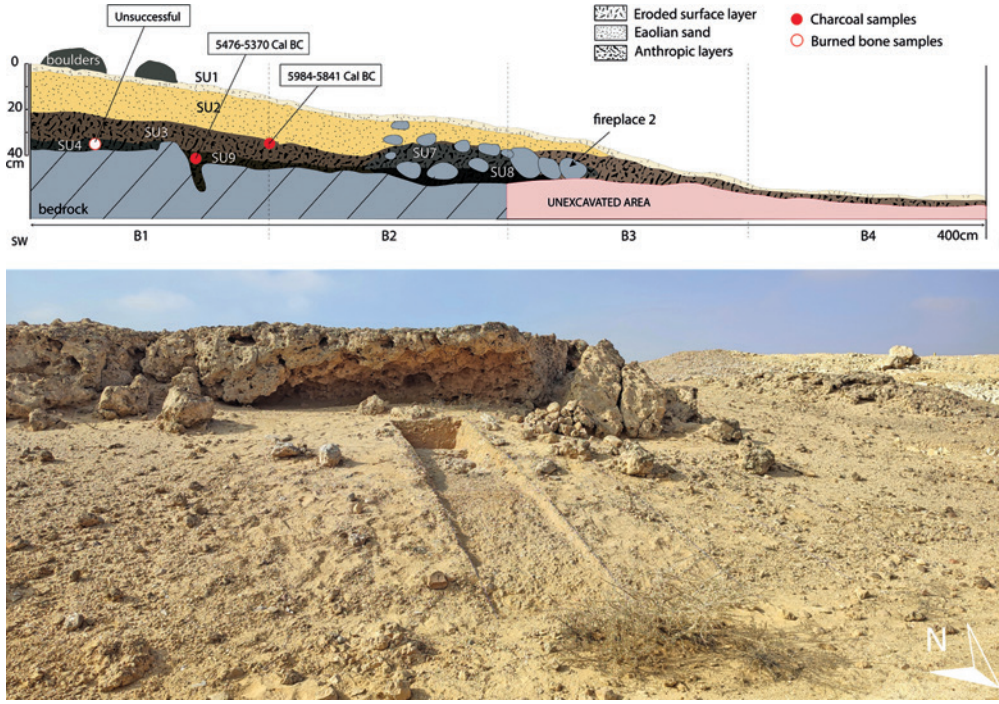
2. Archaeological sites discovered during Duqm Survey 2015 and TSMO (2018–2020) campaigns in Duqm and Nafūn (Processing: R. Garba).



3. DUQ-25A, general plan of the investigated area (Phot. Waleed al-Ghafri; processing: M.P. Maiorano).

B4 was highly eroded but rich in ashes; it will be micro-stratigrafically excavated in the coming season. The stratigraphic levels of DUQ-25A were excavated and entirely sieved, and the few collected charcoal remains were acquired in SU 3, 4 and 9 and submitted for radiocarbon dating, while animal bones and lithics are currently under study. Lithic material was present in all levels. The oldest level is deposited directly on the bedrock. The sediments of all stratigraphic units were sampled and analysed through flotation. Several bifacial pieces at different stages of reduction, together with a massive amount of debitage products and waste, were collected.

Where the deposit reaches the maximum thickness, it extends to a depth of *c*. 40cm before reaching the bedrock. Below the surface crustal layer (SU1), at a depth of approximately 3cm, lies the second stratigraphic unit (SU2, **Fig. 4**). This unit is comprised of a loose yellow aeolian sand layer which was almost sterile, with a few sporadic lithics finds. Under the shelter, in squares B1 and B2, SU1 and SU2 consist of almost fully sterile sand and scarce lithic debris, while on the slope (in squares B3 and B4), there is a pronounced and substantial change in SU1's character, together with a completely eroded SU2. The eroded soil is manifest in the high concentration of archaeological material continuing from the surface level. All along the trench, below SU2, a loose, dark ashy/sandy layer (SU3) represents the actual anthropogenic level. It includes several bones, shell remains, lithics, and, in square B1, a well-preserved fireplace (**Fig. 5A**). Observations in square B3 made clear that the erosion processes, to 20cm in depth, removed part of the stratigraphy. This square revealed a second fireplace *c*. 12cm below the surface



4. DUQ-25A: west section of trench T1 (above); general view of the site (below) (Phot. and drawing: M.P. Maiorano).

(Fireplace 2, SU7; **Fig. 4**). The fireplace was partly eroded, but its excavation is only at the initial stage. In the opposite corner of the square, another ashy layer was recognised (SU6). The bottom layers in squares B1 and B2 (SU4 and SU9; **Fig. 5B**) consisted mostly of gravel below the first fireplace and contained a few lithic remains and shell fragments. Below SU4 and SU9, the flat limestone bedrock was identified (**Fig. 4**), while the excavation of B3 and B4 will be completed in the next field seasons.

In total, two fireplaces were uncovered throughout the trench and three charcoal samples yielded two results, marking the chronological reference for at least one phase of occupation (**Table 1**). SU3 has been dated to the first half of the sixth millennium BCE (5984–5841 cal. BCE), while SU9 falls within the second half of that period (5476–5370 cal. BCE). The lowest SU exhibits the most recent date due to charcoal chunks percolating into a deep crack in the bedrock, as clearly depicted in **Fig. 4** (square B1). However, it corresponds to the same period of occupation as SU3, which is the lowest anthropogenic layer in B1 and B2. Furthermore, the older date, ARDUQ-2C_746, can be attributed to a sample of old dry wood. Unfortunately, the micro-chunks of charcoal from SU3 and SU9 were too small and fragmented for anthracological identification. Despite being partial and preliminary, the radiocarbon dating results serve as a crucial initial reference point for understanding the Neolithic era in this extensive semi-desertic region.

5. DUQ-25A: A. well-preserved fireplace in B1; B. ashy layers below it; C. southern section at the end ot B1 excavation (Phot. M.P. Maiorano).

Table 1. Radiocarbon dating results from DUQ-25A trench T1 calibrated using the IntCal20 (Reimer *et al.* 2020) calibration curve and OxCal v4.4.4 software (Bronk Ramsey 2021)

Sample	Lab code	Material	Context ID	^{14}C age (yr BP, ± 1σ)	Calibrated Age (cal BCE, 2σ)
ARDUQ-2C_746	CRL231071	charcoal	B2 | SU3	7021 ± 23	5984–5841
ARDUQ-2C_747	CRL231072	burned bone	B1 | SU4	unsuccessful	–
ARDUQ-2C_749	CRL231074	charcoal	B1 | SU9	6448 ± 22	5476–5370

Surface finds and excavated lithics are both typologically and technologically similar and fabricated exploiting the same raw material. As already mentioned, further away from the area still covered by the rock shelter, the erosion is deeper and the amount of surface

material increases. This shows that the most exposed section has experienced significant erosion and preserved very little strata. Moreover, the upper part of the rock shelter was originally thicker and more protruding, as indicated by the collapsed boulders found at the southern part of the trench (**Fig. 4**).

MATERIAL CULTURE: PRELIMINARY RESULTS

Beads and ornaments were discovered inside the excavated area, including two perforated shells of marine gastropods of the family Marginellidae (Genus: *Prunum*, **Fig. 6G**). The irregularity observed along the entire perimeter of perforation provides evidence that it was achieved by crushing the dorsal part of the gastropod. Several pieces of animal bone were discovered near the fireplaces and were determined to be medium/large ungulates; however, detailed analysis at the site was impossible due to fragmentation and poor preservation of the bones. They will be studied by a specialist and sampled for ZooMS and DNA during the next field season.

Lithics and stone artefacts

The region is rich in raw material, with banks of flint plates and boulders (**Fig. 7**) of varying thicknesses and textures that likely attracted prehistoric populations in the area. The raw material – the brownish chert and the blue-grey chert rich in fossils from the Rus Formation – can be found about 6km north of the site. It has a patina that is similar to all the Neolithic industries found in the Duqm area: a brown, lustrous patina for the brownish chert and a thin opaque white patina for the blue-grey chert (**Figs 6**–**7**). The majority of the material is waste from bifacial manufacture, and a few common tools such as scrapers and borers that suggest activities other than flintknapping.

The DUQ-25A lithic assemblage is homogeneous throughout the stratigraphy and the surface. Most lithics are surface finds, likely originating from the exposed part of SU3. Small blocks of quartz from the shelter formation are ubiquitous, but none of them was used to produce artefacts. Several bifacial pieces at different stages of reduction were collected. While the smaller pieces are clearly projectile points, the larger ones are asymmetrical and non-refined and might be early stage preforms rather than tools or objects, with the exception of the biface E, in **Fig. 6.** This medial fragment's margins were refined with pressure retouch, and the cross-section symmetry is well balanced. However, it is too fragmented to infer the original shape and, consequently, its function. The first shaping of the bifaces is performed using a hard hammer (a broken limestone hammer has been found in SU4). After this preliminary phase, the *façonnage* is done using of a soft organic hammer (fine and convex flakes with a very tangential percussion). On smaller pieces, the pressure is clearly attested for the definition of the edges. Most of the bifacial pieces are fragmented or abandoned during manufacture due to structural problems. Three points were found in SU3, one of which was complete (46 x 14 x 6.5mm; **Fig. 8A, C, D**). Four others were discovered in SU1 (**Fig. 8B, E-G**). Another five points come from the surface of

6. Bifaces preforms at different stage of reduction (A, B, C, E), scraper (D), plunging flake (F), shell beads (G) from DUQ-25 (Phot. M.P. Maiorano).

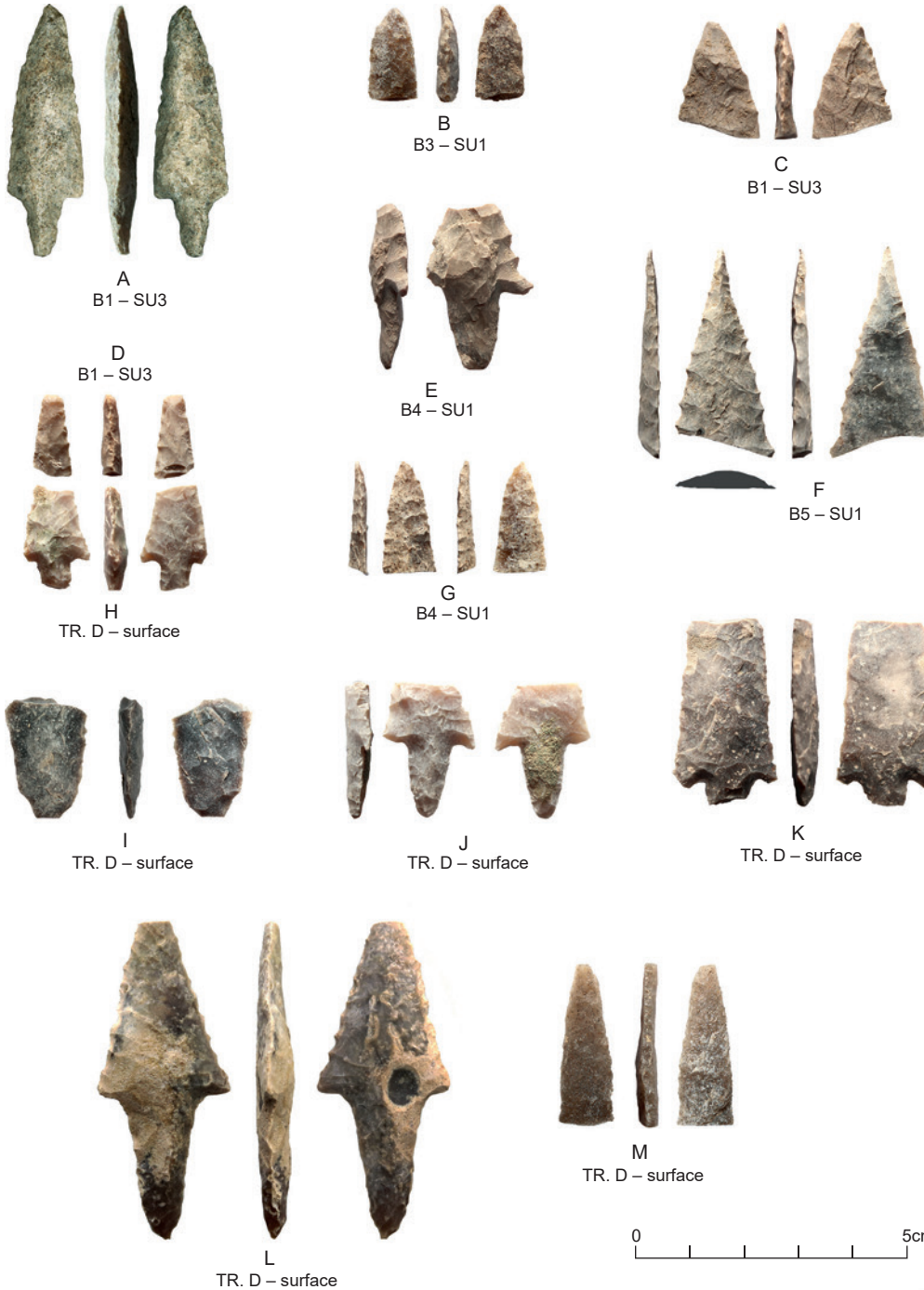
transects C and D, respectively. Moreover, two parts of the same broken point (**Fig. 8D, H**) were found in two different parts of the site.

The assemblage shows highly refined arrowhead technology that draws from a range of forms, from the typical South Arabian Concorde point[10] to the more ubiquitous bifacial shouldered and tanged arrowheads with symmetric biconvex or planoconvex flat sections.[11]

[10] Crassard *et al*. 2006: Fig. 10; Maiorano *et al.* 2018: Fig. 6; 2020a: Fig. 4.
[11] Charpentier 2008; Crassard, Bodu 2004; Genchi *et al.* 2017: Fig. 5; Maiorano *et al.* 2018.

7. Raw material sites: A-B. brown chert outcrop and first reduction place; C. blue-grey chert (Phot. M.P. Maiorano).

These projectile points exhibit variations in both shape and size suggesting the likelihood of differences in the applied technology used during their production. Some have been produced by gradual reduction from a bifacial preform. Specifically, points C and D seem to be fragments of preforms rather than finished implements. However, a different



8. Projectile points from DUQ-25A (Phot. M.P. Maiorano).

reduction technique starting from laminar blanks can be identified in the cases of points F and K (**Fig. 8**), where the ventral side is not entirely covered by covering pressure retouch. This technology has never been documented in Oman and might represent another variation in the production of these artefacts. However, blade cores or unretouched blades of the size suitable for projectile production are generally missing at the site. On the other hand, three bladelet cores were collected together with several bladelets ranging in dimension. The study of this interesting operational chain will be the subject of subsequent fieldwork. Apart from the bifacial pieces, scarce common tools have been found in the test pits (one borer, a few retouched flakes and one scraper; **Fig. 6D**).

DISCUSSION

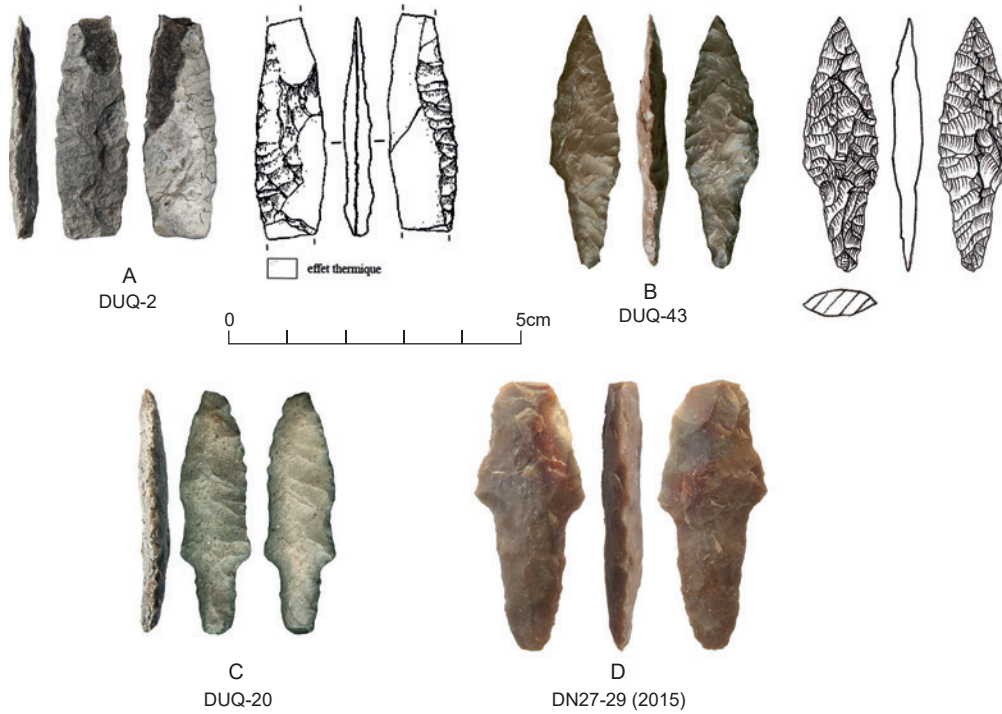
The 2023 field campaign yielded results that confirmed the presence of stratified archaeological material in the DUQ-25A rock shelter. Despite its exploratory nature, the field season has produced some substantial new data and the first radiocarbon results to date the Neolithic occupation in Al-Wusṭā region (**Table 1**). In conjunction with the collective tomb in Nafūn,[12] the only other Neolithic radiocarbon dated site in the region, it will play a pivotal role in understanding neolithisation processes and cultural transmission patterns across the entire peninsula. Based on recent findings, the site can be interpreted as a campsite and workshop dedicated to the production of bifacial pieces and projectile points. The site has excellent potential for contributing significant data to highly debated topics, such as the Neolithic settlements in inland regions and their interactions with the coastal areas approximately 7500 years ago.

DUQ-25A presents partially well-preserved strata containing lithic assemblages that are typologically and technologically consistent. These assemblages are closely associated with temporary structures, ornaments and animal bones. The presence of hearths, discarded material and evident traces of lithic knapping activities for projectile point production further accentuate the significance of the site. The site's strategic location near the abundant gullies and potential water sources of Wādī Ṣayy would have undoubtedly drawn the attention of mobile hunter-gatherers and herders, as evidenced by the presence of hunting tools and animal remains. It is possible that the site also served as a temporary hub for skilled stone knappers, who may have utilised the area for a specific period.

The nature of the deposit and the radiocarbon dating results do not allow one to draw overall conclusions, as only half of the trench is entirely documented. However, given the absence of permanent stone structures and the scarcity of tools other than projectile weapons and biface wastes, it is possible to speculate that it was only occupied for brief periods.

In the Duqm area, the Neolithic sites are characterised mainly by open-air surface scatters without any associated stone structures, with the exception of some eroded fireplaces, usually located close to the oceanic coast (DUQ-2, DUQ-43) or on wadi terraces (DUQ 20, DUQ-36). Only some of these sites manifest some stratigraphy, namely DUQ-25A and DUQ-2

[12] See footnote 6, above.



9. Points from other sites in Duqm region (Phot. M.P. Maiorano; A. drawing: G. Devilder; based on: Charpentier *et al*. 2023; B. drawing: M.P. Maiorano; based on: Genchi *et al*. 2017: Fig. 5).

(see **Figs 1**–**2** above). Most of the surface-found lithic objects are highly worn and even occasionally broken by thermoclastic events (**Fig. 9**). At least for this specific chronological period, a general characterisation of the site typology becomes feasible due to the abundance of identified lithic clusters. The sites can be generally classified as flint scatters and workshops, shell middens or fishing encampments and sparse occupation spots. The first are often found on the plateaus or at the wadi banks, typically in the interior, near the raw material outcrops. The considerable quantity of lithic artefacts is often a result of the co-occurrence of different periods of occupation and sometimes even the superimposition of the Late Palaeolithic and Neolithic assemblages. Most common Neolithic production is the bifacial technology with broken laurel-leaf or ovate foliates and all of the by-products associated with this reduction sequence. Similarly to DUQ-25A, frequent occurrence at the recorded Neolithic sites of the broken and incomplete bifacial tools and the scarcity of cortical products indicate that the early stages of blank preparation and shaping were carried out right at the outcrop. Typically found beneath aeolianite terraces, the identification of shell middens and fisher campsites can be facilitated by the presence of flint scatters, occasional stone features and remnants of hearths (such as DUQ-2 and DUQ43, see **Figs 1** and **9**).[13]

[13] Genchi *et al*. 2017.

Through examining the stratigraphy, it becomes clear that these sites often represent multiple phases of occupation, suggesting repeated habitation over time. Lithic objects are especially prevalent and distinguished by bifacial industries (foliates and arrowheads) recalling the Middle and Late Neolithic (6500–3700 BCE) sites from the Sharqiyah region (Ras' Jibsh, Khuwaiymah and Suwayh)[14] and Dhofar (Sharbithat SHA-9).[15]

The location and character of DUQ-25A distinguish it from the known Neolithic sites in Oman. Situated approximately 13km away from the coast, it cannot be classified as a coastal site but rather appears to be associated with Neolithic inland settlements. The recent discovery of more inland Neolithic sites like Maitan (SQJ),[16] KHS-A,[17] Hayy al-Sarh,[18] Wadi Hilo,[19] Jebel Al-Aluya[20] and Qumayra (QA-12, QA-2),[21] is an encouraging development that offers new opportunities for enhancing our understanding of the Neolithic in south Arabia. The identification of exceptional paleoenvironmental sequences in close proximity to the archaeological sites indicates that additional investigations in these areas will greatly enhance our comprehension of the regional dynamics surrounding shifting climatic and landscape conditions in the ancient past, as well as their impacts on human populations during prehistoric times.

CONCLUSION AND FUTURE DEVELOPMENT

Further excavations at the site hold the promise of providing deeper insights into the Neolithic communities that inhabited it. Ongoing investigations of lithic, faunal and shell materials will contribute to a clearer understanding of their livelihood strategies. Furthermore, the results of radiocarbon dating play a crucial role in establishing a preliminary chronological framework of site occupation and its connection to other Neolithic sites in the region, providing a valuable reference point for comparative analysis and contextualising the timeline of the investigated site.

Moreover, the presence of at least three more Neolithic sites in Wādī Ṣayy shows that Neolithic societies were more widespread than previously thought in this arid location. To determine whether these sites represent contemporaneous communities, we plan to perform additional inspections at DUQ-25A and test another Neolithic site, namely DUQ-20 (**Fig. 2**). While south Arabia communities did not engage in agriculture, large-scale herding or the construction of large, structured settlements,[22] they did continue to hunt, fish and

[14] Charpentier *et al.* 2012; 2023.
[15] Maiorano *et al.* 2018.
[16] Maiorano *et al.* 2020b.
[17] The discovery of KHS-A was discussed during a lecture 'The Middle Holocene occupation of Al Khashbah (Sultanate of Oman): First results and chronological implications', presented at the 55th Seminar for Arabian Studies, Berlin, Germany, 5–7 August 2022.
[18] Bretzke *et al.* 2018; Bretzke, Parton 2020.
[19] Uerpmann *et al.* 2018.
[20] Lemée *et al.* 2013.
[21] Białowarczuk, Szymczak 2019.
[22] Charpentier *et al*. 2023.

perhaps manage small herds. It is also intriguing to consider how much the local population experimented with, modified and developed their own technological solutions in order to produce bifaces and projectile weapons. Most artefacts in Duqm were produced using resources that were found nearby or in the area. Social groups had strong ties to particular geographic locations, specifically the coast, as demonstrated by the presence of several shell elements. Preliminary studies on the transmission of projectile weapons technology have revealed that human communities during the Holocene Humid Period were highly interconnected, highlighting the significant level of interaction between them.[23] DUQ-25A stands as a significant archaeological discovery in Oman, holding the potential to increase considerably our understanding of the Neolithic era in south Arabia.

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[23] Maiorano *et al.* 2020a; Al Kindi *et al.* 2021.

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