Athar آثار

Bulletin of Archaeological Research in the Sultanate of Oman

Issue 2 Field Season 2023-2024

وزارة التراث والسياحة
Ministry of Heritage and Tourism

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Athar: Bulletin of Archaeological Research in the Sultanate of Oman, Issue 2. Field Season 2023-2024

1. Arabia. 2. Oman 3. Heritage. 4. Archaeology 5. Antiquities.

This edition is published by the Ministry of Heritage and Tourism, Sultanate of Oman

Ministry of Heritage and Tourism
Sultanate of Oman, Muscat
P.O. Box 200, Postal Code 115
Thaqafah Street
Muscat, Sultanate of Oman

Printed in the Sultanate of Oman, 2026

ISBN: 978-99992-1-402-5

بعض الخرائط الواردة في هذا الكتاب تاريخية ولا يمكن تعديلها، إذ جرى إعدادها خصيصاً لتلك الفترات الزمنية فقط، ولا تعكس بالضرورة الحدود السياسية أو الجغرافية أو الإدارية. كما أن الحدود الإدارية الواردة في هذه الخرائط رُسمت لأغراض هذا المشروع فقط، ولا تُعد حدوداً حقيقية أو معتمدة من قبل الجهات المختصة. ولم تُكتب أسماء المواقع الجغرافية في هذه الخرائط وفق نظام التعريب والكتابة بالحروف اللاتينية الموحّد المعتمد لدى الهيئة الوطنية للمساحة والمعلومات الجيومكانية (NSGIA) في سلطنة عُمان. (NSGIA) غير مسؤولة عن الأسماء الجغرافية التي ليس لها مصدر ويتحملها المؤلف.

Some maps in this book are historical and cannot be modified as they are specifically drawn for that period only and they do not reflect political, geographical and administrative boundaries. The administrative boundaries in these maps are drawn for the purpose of this project only and not real or approved by the concerned authorities. The Geographical Place Names in these maps are not written by the Arabic Standardized Romanization System applied in the National Survey and Geospatial Information Authority (NSGIA) of the Sultanate of Oman. The NSGIA is not responsible for any geographical names lacking a documented source, and responsibility for their usage rests with the author(s).

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Issue 2 Field Season 2023-2024

وزارة التراث والسياحة
Ministry of Heritage and Tourism
Sultanate of Oman سلطنة عمان


Atha

1. Bukha
2. Qumayra
3. Aqir Al Shamoos
   Waby Al Zady
   Tawi Zaba
4. Hayy Ukur
   Shwaghy
5. Ash Shukur
6. Al Arid
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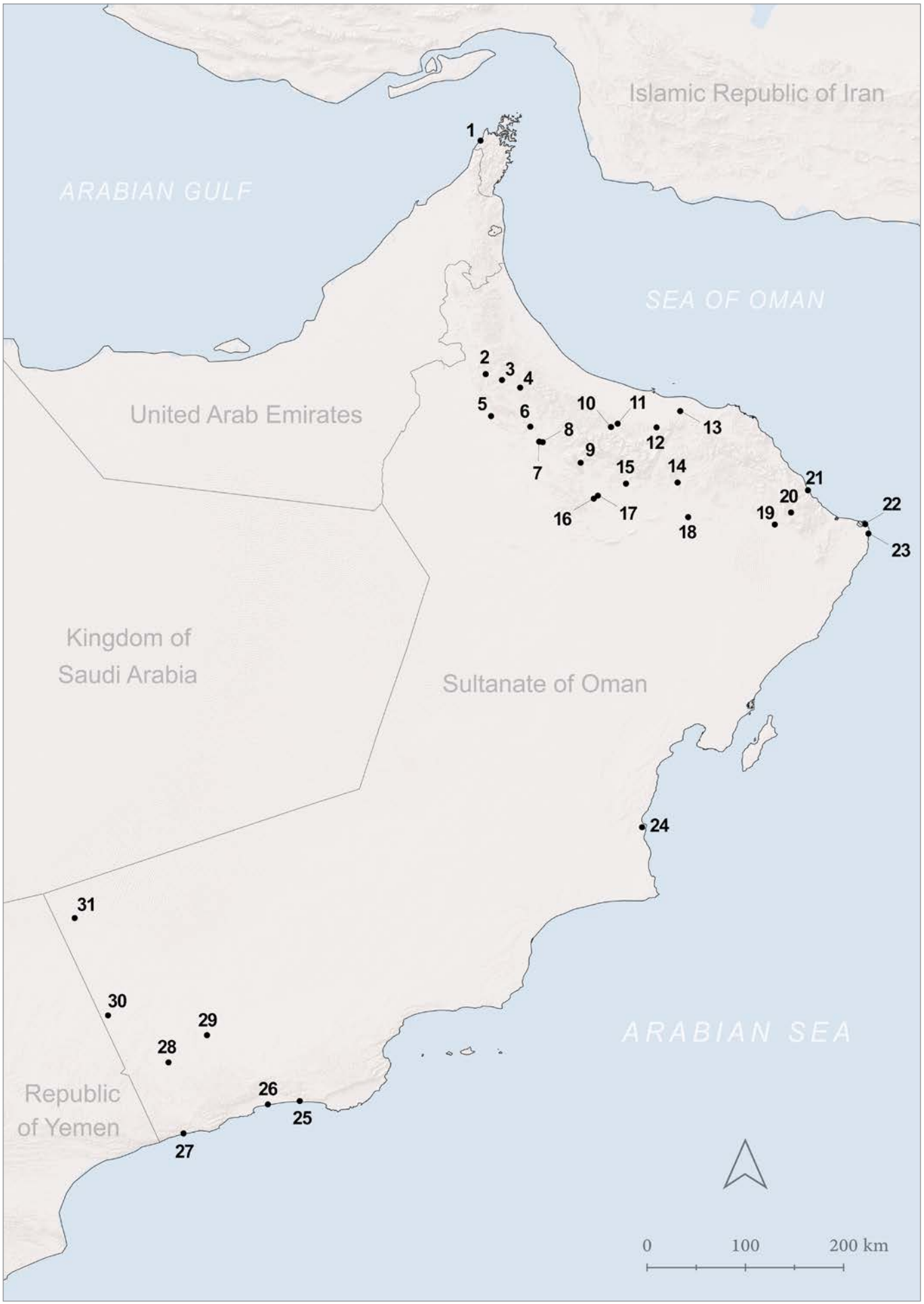
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Introduction

Muscat, January 2026

It is with great pleasure and profound pride that I present the second issue of *Athar*, the *Bulletin of Archaeological Research in the Sultanate of Oman*, which, season after season, will continue to showcase the diverse and multifaceted archaeological projects undertaken under the auspices of the Ministry of Heritage and Tourism.

Within these pages, we embark on a continuing intellectual journey across Oman's archaeological landscape, guided by the expertise of eminent scholars and leading research institutions from around the world. This volume represents the culmination of scholarly endeavour manifested in twenty-five projects conducted during the 2023–2024 field season by institutions and researchers from several countries, including Italy, France, Germany, the Czech Republic, Greece, Spain, Portugal, the Netherlands, Poland, the United Kingdom, the United States of America, Japan, Australia, and, of course, the Sultanate of Oman.

The Ministry of Heritage and Tourism extends its profound appreciation to all researchers, institutions, and technical partners whose scholarly dedication and methodological rigour have driven these projects forward. Through their unwavering commitment, we are afforded the privilege of delving ever deeper into Oman's archaeological heritage, unravelling the hidden narratives of our ancient civilisation, and enriching our collective understanding of humanity's shared past.

As custodian of Oman's heritage, the Ministry pursues its mission with intellectual curiosity and scientific integrity, recognising the indispensable value of interdisciplinary and international collaboration in preserving and perpetuating this legacy for future generations, ensuring that the echoes of Oman's past continue to inspire and enlighten us all.

Sayyid Ibrahim bin Said Al-Busaidi
Minister of Heritage and Tourism

مقدمة

مسقط، يناير 2026

يسعدني ويشرفني أن أقدم لكم العدد الثاني من " آثار"، نشرة البحوث الأثرية في سلطنة عُمان، التي ستواصل تسليط الضوء على المشاريع الأثرية المتنوعة والمتعددة الجوانب التي تُنفَّذ تحت رعاية وزارة التراث والسياحة.

ننطلق في هذه الصفحات في رحلة فكرية متواصلة عبر المشهد الأثري في عُمان، مسترشدين بخبرات نخبة من العلماء البارزين، وبمؤسسات بحثية رائدة من جميع أنحاء العالم. يُمثل هذا العدد تتويجًا للجهود البحثية التي تجلّت في خمسة وعشرين مشروعًا نُفِّذت خلال الموسم الميداني 2023–2024 من قِبَل مؤسسات وباحثين من دولٍ مختلفة، منها إيطاليا، وفرنسا، وألمانيا، والتشيك، واليونان، وإسبانيا، والبرتغال، وهولندا، وبولندا، والمملكة المتحدة، والولايات المتحدة الأمريكية، واليابان، وأستراليا، وبالطبع سلطنة عُمان

تتقدم وزارة التراث والسياحة بجزيل الشكر والتقدير لجميع الباحثين والمؤسسات والشركاء التقنيين الذين ساهم تفانيهم العلمي ودقتهم المنهجية في دفع هذه المشاريع قدمًا. ومن خلال التزامهم الراسخ، نحظى بشرف التعمق أكثر فأكثر في التراث الأثري العُماني، وكشف خبايا حضارتنا العريقة، وإثراء فهمنا الجماعي للماضي المشترك للبشرية.

تواصل الوزارة من واقع اختصاصاتها المعنية بالتراث العُماني، رسالتها بفضول فكري ونزاهة علمية، مُدركةً القيمة الأساسية للتعاون الدولي متعدد التخصصات في الحفاظ على هذا الإرث وإستدامته للأجيال القادمة، وضمان استمرار أصداء ماضي عُمان في إلهامنا وتنويرنا جميعًا.

السيد/ إبراهيم بن سعيد البوسعيدي
وزير التراث والسياحة

Aerial view of building B24 after excavation (@DHOMIAP Project)

Omani–Polish Archaeological Mission 2023: Investigations in the Qumayra Micro-Region and its Surroundings

Bieliński P.,[1] A. Pieńkowska,[1] A. Szymczak,[1] M. Iskra[1] & M. Sobczak[1]

This report presents the results of the 2023 field season of the Omani–Polish Archaeological Mission (OPAM) researching the organization of settlement in the Qumayra micro-region (Adh-Dhahirah province) in the Hajar Mountains of Northern Oman and its hinterland during the Early Bronze Age and the Iron Age, with particular focus on settlement dynamics and functional changes in a long-term chronological perspective.

يستعرض هذا المقال نتائج موسم الحفريات الميداني لعام 2023 للبعثة الأثرية العُمانية-البولندية (OPAM) التي تبحث في تنظيم الاستيطان في المنطقة المصغرة لموقع قُميرا بمحافظة الظاهرة - ضمن سلسلة جبال الحجر الغربي في الجزء الشمالي من عُمان - خلال فترتي العصر البرونزي المبكر والعصر الحديدي مع تركيز خاص على ديناميكية أنماط الاستيطان والتغيّرات الوظيفية في منظور زمني طويل المدى.

The 2023 fieldwork of the Omani–Polish Archaeological Mission (OPAM) continued systematic investigations of key sites within the Qumayra micro-region (Fig. 1). The research concentrated on documenting architectural remains, testing functional interpretations, and refining the chronological framework of settlement and resource exploitation.

Bilt: Bronze Age tower QB 6

Explorations near the village of Bilt, c. 4 km east of Qumayra village, have revealed numerous Umm an-Nar remains documented since 2015. These include a settlement of at least five building units (QB 2) and a tomb (QB 1) from the same period (Bieliński *et al.* 2024a: 7–8; 2024b). In 2021 a Bronze Age tower (QB 6) was recorded c. 800 m NW of QB 2 (Fig. 2); earlier surveys had noted it as Site 4/1 in Mirbat Al-Khay (Costa 2006: 147).

In 2023 wall outlines were documented and a test trench excavated inside the tower. The building proved to be a massive circular structure with an outer wall ring c. 15.5 m in diameter. Its interior was divided by a N–S corridor c. 2 m wide, with small rooms on either side. In the better-preserved eastern part, five chambers could be distinguished; in the west, only two wall fragments survived, but they suggest a similar symmetrical layout. Founded directly on bedrock, the outer wall outline and a rectangular structure near the tower show deliberate adaptation to the rocky substrate.

North of the tower lies a natural basin (c. 100 × 100 m) with at least five parallel stone-lined channels oriented NW–SE, spaced a few meters apart and preserved mostly in fragments. The entire system is bordered by a retaining wall, probably to protect against run-off or erosion. In the basin's centre a small rectangular, single-room structure was recorded between two channels.

Ceramic material collected around the tower belongs to the Umm an-Nar period (Fig. 3: 4-7). Importantly, such potsherds were found directly in the channels, suggesting the irrigation system may have been contemporary with the tower and functionally connected to it. While further study is needed, this raises the possibility of the tower's integration into a broader water management system.

Al-Muraybi: Umm an-Nar settlement (MRB 3) and Wadi Suq graves

The archaeological site of Al-Muraybi (MRB) lies about 7 km west of Bilt, on the southern bank of Wadi Suwar. The site extends c. 1 km E–W and 300–400 m N–S. A considerable part has probably been destroyed by modern construction and by wadi erosion, which also damaged northern parts of some structures.

Remains from various periods at Al-Muraybi were first recorded in the spring of 2022 (Bieliński *et al.* 2024b). Of particular interest were buildings with characteristic features of the Umm an-Nar culture (Fig. 4A).

The largest and best-preserved structure is MRB 3-1, situated near the wadi's edge. Surface finds included Umm an-Nar pottery. Measuring c. 16.5 × 13 m, it shows a tripartite layout with at least nine rooms: four narrow western rooms, a central cham-

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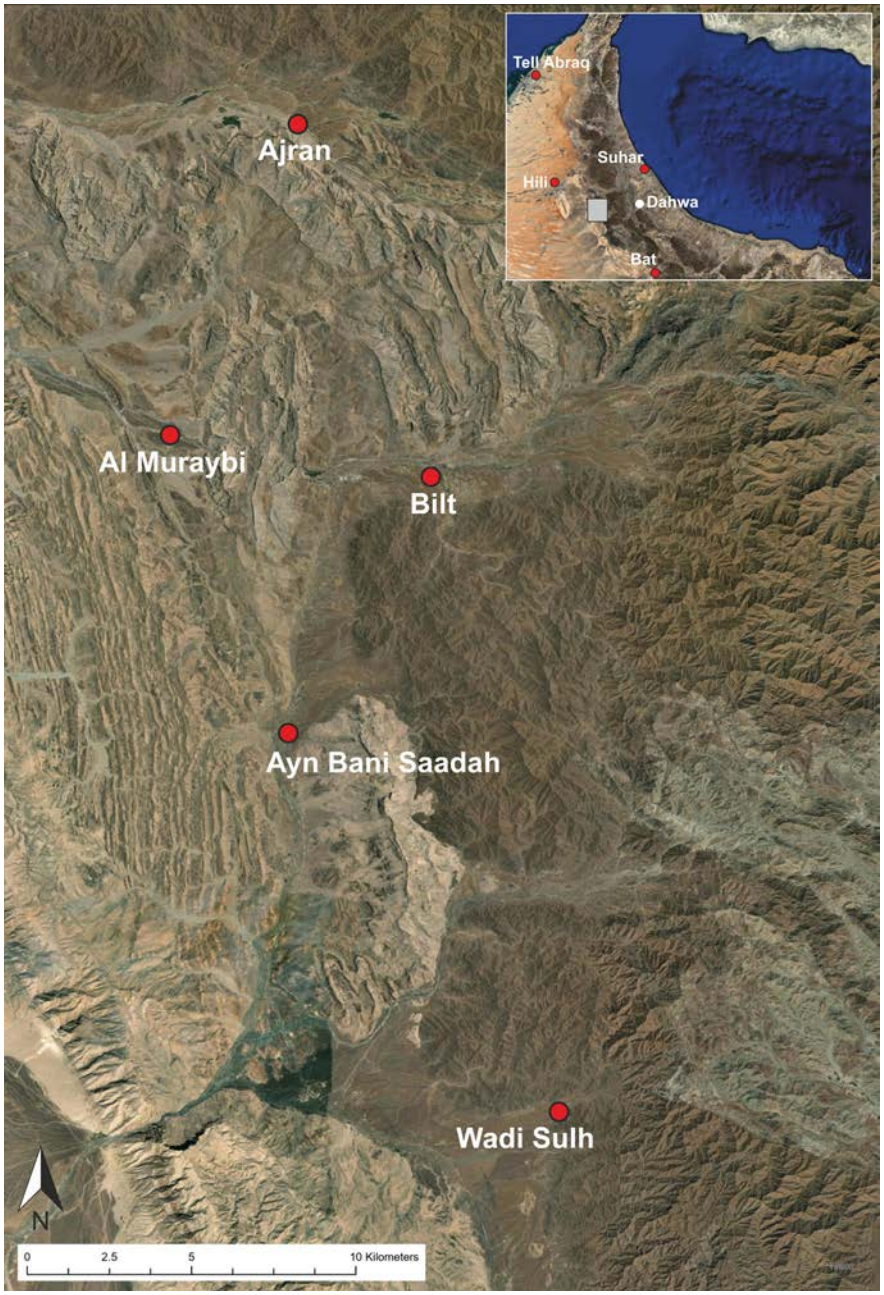

Figure 1. Location of the study area (Map: Google Maps; edited by Paweł Czernic, Marta Momot).

ber, and traces of a larger eastern room, the full plan of which awaits excavation. Extensions on the southern, western, and eastern sides indicate enlargement during use. The 40–50 cm thick walls were built of large, horizontally laid stone slabs. Four test trenches reaching foundation level revealed careful construction with precisely fitted blocks. The walls survive up to c. 55 cm. Two further buildings, MRB 3-15 and MRB 3-21, were identified at the eastern edge of the site. MRB 3-15 survives only in part: its western part, about 22 m long, is divided into three rectangular rooms. MRB 3-21, on the wadi edge, lost its northern part to erosion, but at least five rooms can still be distinguished. Both buildings were likewise constructed of large, horizontally laid stone slabs. Within all three buildings oval graves were recorded, ranging in size from 2.6 × 2.4 m to 4 × 3.5 m. Their placement inside abandoned houses indicates secondary reuse of domestic space, typical of later phases of occupation. The typology of the tombs suggests they date to the Wadi Suq period (c. 2000–1600 BCE).

Ajran: Multi-period remains (AJR 1–4)

A 1.6 km-long area along the eastern bank of Wadi Ajran, c. 10 km NW of the Qumayra, was surveyed in 2023 and four sectors were defined, designated AJR 1–4 (Fig. 5).

Figure 2. Site QB 6: Bronze Age tower located on a rocky outcrop (Photo: Omani-Polish Archaeological Mission)

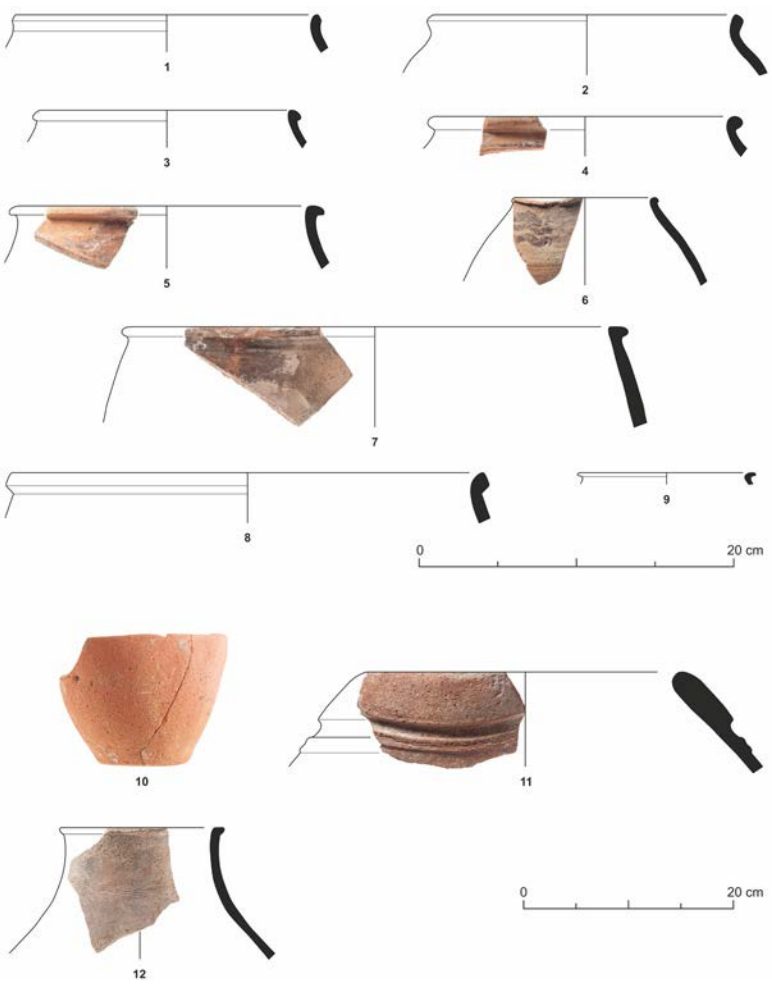

Figure 3. Selected pottery from Ajran (AJR 4: 1–3), Bilt (QB 6: 4–7), Salh 1 (8–9), and Ayn Bani Saadah (QA 21: 10–12) (Drawings: M. Momot, J. Pawlik; digitizing: M. Iskra, M. Sobczak; Photos: J. Śliwa)

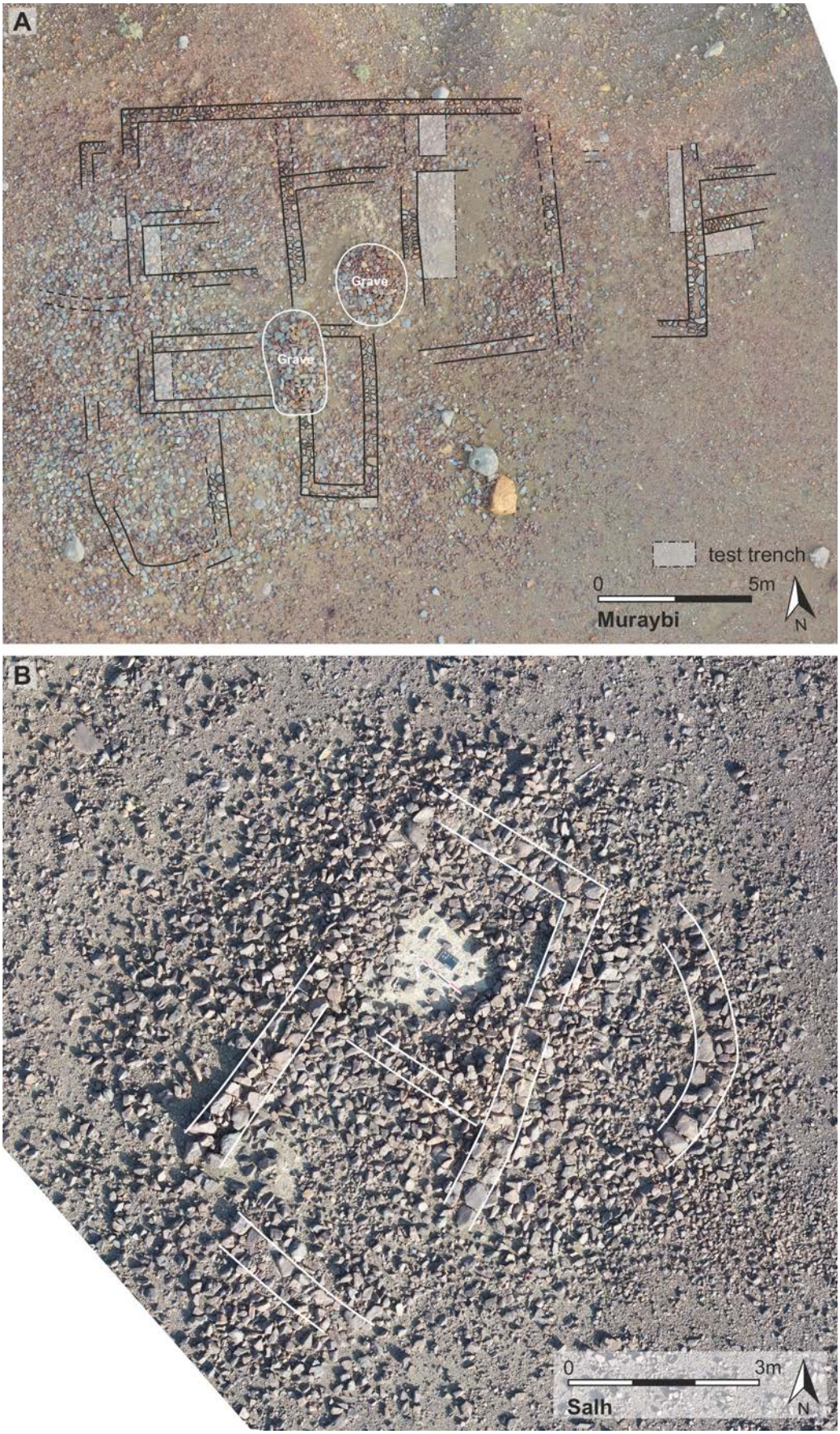

Figure 4. Plans of selected structures: (A) Al-Muraybi – MRB 3; (B) Salh 1 (Photos: Omani-Polish Archaeological Mission; drawings: Szymon Lenarczyk, Marta Momot).

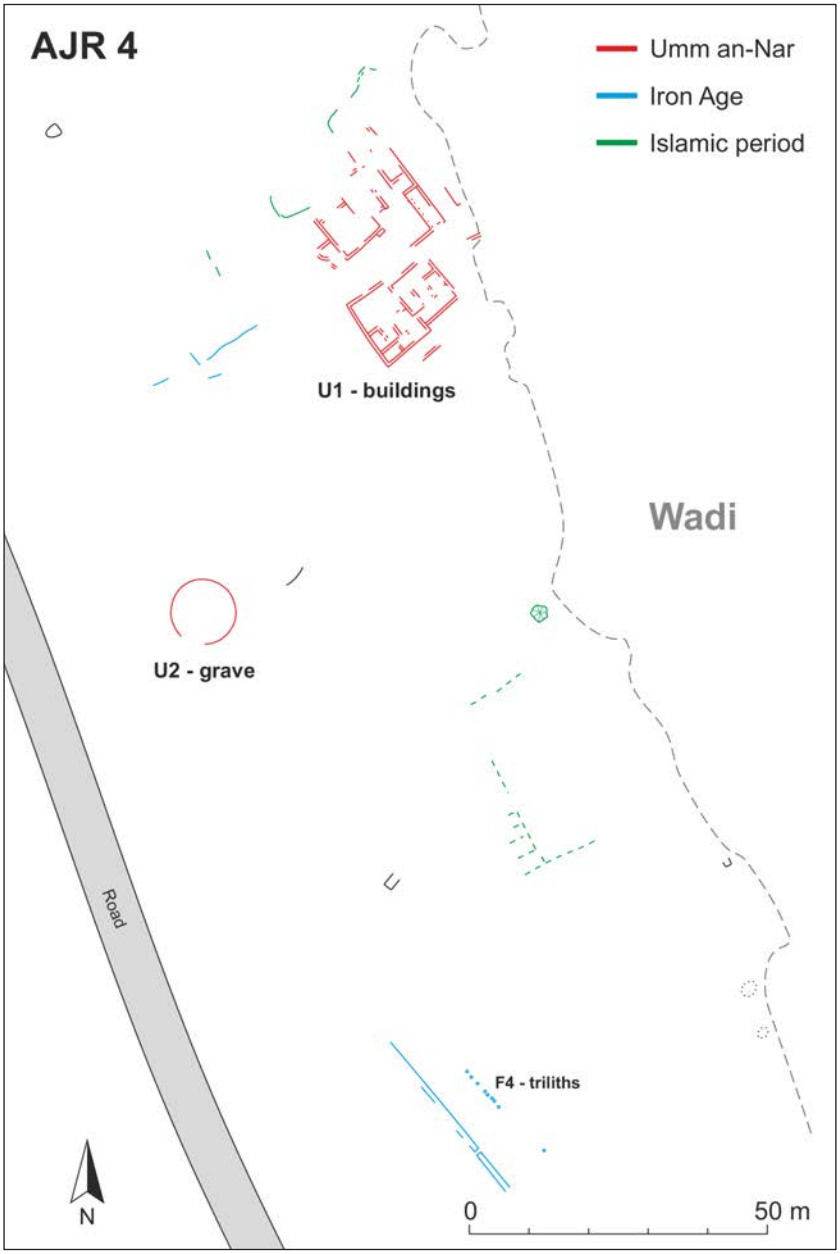

Figure 5. Ajran: plan of surveyed structures at site AJR 4 (Mapping: P. Czernic; drawing: M. Momot)

The first, at the western end of the area (AJR 1), comprised a Bronze Age tower and its immediate surroundings. This tower, standing about 100 m from the wadi bank, had already been noted in earlier surveys (Döpper 2024: 26–27). East of the tower (AJR 2), 29 stone structures were documented, most likely tombs. At least two had recently been destroyed, probably during road construction. Their date cannot be confirmed by surface remains, but building techniques suggest that most belong to the Wadi Suq period. In addition, the remains of a building were recorded here, tentatively assigned to the Umm an-Nar period based on wall construction and surface pottery.

North of AJR 2, on a rocky ridge (AJR 3), a cemetery of 21 graves spreads over c. 160 m. These include large constructions, up to 10 m long, with clearly defined burial chambers, as well as smaller, simpler forms.

The most extensive architectural remains were observed in the most southerly part of the survey zone (AJR 4). This 400 m-long area preserves remains from several periods, from the Bronze (Fig. 3: 1–3) and Iron Ages to the Islamic period. Particularly notable are an Umm an-Nar tomb and two building complexes (Unit 1). The southern complex consists of two houses: the larger (12 × 9 m), with at least five rooms and a spacious courtyard, the smaller (9 × 7

m) probably with four rooms and a courtyard, corresponds to the standard layout of Umm an-Nar houses. The northern complex, harder to define, formed a cluster at least 22 × 24 m, comprising four or five buildings. Large quantities of Umm an-Nar pottery were collected from the surface in this sector. In the northern part of AJR 4, later buildings and 'triliths' were also recorded, most likely dating to the Iron Age (IA) and subsequent periods.

Salh: Copper smelting sites

The area of Salh, located about 15 km southeast of the village of Ayn Bani Sa'dah, comprises two sites, Salh 1 and Salh 2, situated only c. 200 m apart.

Salh 1 measures c. 300 × 60–70 m. Surface survey revealed slag deposits covering c. 80% of the site, with stone tools for ore processing and numerous furnace fragments. Fieldwork aimed to evaluate production scale and the role of both sites in the microregional economy. Four test trenches in zones of varying slag density indicate a total mass of c. 288 tonnes.

Twenty-seven stone structures of different size and preservation were also identified. The most important is SLH 1-1 (S1F1), the best-preserved and largest building at the site (Fig. 4B). Located on the eastern terrace edge near main slag zones, it measures 10 m and consists of two rectangular rooms (c. 5 × 2.5 m each) with a semicircular annex on the east. The 70 cm thick walls were faced with large stones, with a core packed with smaller pebbles and gravel. Although the test trenches did not expose clear occupation surfaces, the building's layout and location suggest a workshop function—most likely a metallurgical facility directly connected with smelting. This interpretation is supported by analogies from Wadi Hilo (HLO1) in the United Arab Emirates, where similar buildings served as production workshops.

Salh 2 is located on a higher terrace c. 200 m SW of Salh 1. Covering c. 100 × 100 m, it contains six semicircular stone structures, the best preserved (S2F3) built of carefully laid medium-sized stones. Unlike at Salh 1, no clear evidence of metallurgical activity was found here.

The chronology of site use was determined through radiocarbon (C14) and optically stimulated luminescence (OSL) analyses. Results indicate two phases of activity at Salh 1—during the Early Bronze Age and the Early Islamic period. Salh 2, by contrast, appears to have been used only in the Late Islamic period (Bukowski *et al.* 2025).

Ayn Bani Saadah: Iron Age village at site QA 21

QA 21 south of Ayn Bani Sa'da, on the left bank of Wadi Al-Fath was revisited to refine the 2018–19 mapping of surface remains, after excavations in 2021 had shown that, despite poor preservation, with most walls reduced to a single course of stones, stratified deposits could still be reached there (Szymczak and Iskra 2024). The number of recorded features scattered across an area of c. 250 × 50–100 m increased from c. 100 to over 120, with many reattributed to specific building units. They represent two main phases of occupation: IA II and a later reoccupation, either Islamic (though no pottery of this date) or IA III (scant pottery; see Szymczak and Iskra 2024; Pieńkowska *et al.* 2025) (Fig. 3: 10–12).

The IA II phase includes at least 20 buildings from at least two construction stages (and possible earlier IA occupation). The buildings are generally orthogonal, though complete plans are rare. The most extensive remains, Units 44–45, measure c. 10 × 17 m and comprise at least seven rooms. Walls were typically constructed of double rows of vertical slabs 30–55 cm wide, with occasional reuse of white facing stones from Umm an-Nar graves as thresholds.

Thirteen buildings or enclosures belong to the later phase. Their often curvilinear walls consist of two faces of medium-sized stones with an infill of pebbles and gravel. Several other structures, including possible graves, remain undated.

Acknowledgements

This research was funded by the National Science Centre, Poland, under the HARMONIA 10 programme, grant no. 2018/30/M/HS3/00635.

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Italian Anthropological Mission for the Heritage of the Arabian Peninsula (IAMHAL) at Halban (Al-Batinah South Governorate) and Romail Shelter (Ash-Sharqiyyah North Governorate): Preliminary Results of the Second Season (January 2024)

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The Italian Anthropological Mission for the Heritage of the Arabian Peninsula (IAMHAL) Project is currently investigating the Halban monumental Bronze Age tombs in northern Oman dated to the Hafit and Umm an-Nar periods (3100–2100 BCE). Excavations of tombs HAL021 and HAL025 integrate stratigraphy, 3D modelling, and osteological, isotopic and proteomic analyses, highlighting long-distance trade connections and individual mobility, including possible links to other regions of western Asia. Meanwhile, Romail Shelter presents stratified evidence of Late Palaeolithic evidence, including lithic tools, hearths, and rock art. Combined, these sites provide key insights into the Prehistory of Oman and its intercultural dynamics, supporting heritage preservation and public engagement through digital reconstruction and future musealisation.

يبحث مشروع البعثة الأنثروبولوجية الإيطالية لتراث شبه الجزيرة العربية (IAMHAL) في قبور حلبان الضخمة بالعصر البرونزي في شمال عُمان، المؤرخة لفترتي حفيت وأم النار (3100–2100 ق.م)، باستخدام منهجيات طبقية ونمذجة ثلاثية الأبعاد وتحليلات عظمية ونظيرية وبروتيومية، للكشف عن شبكات تجارة بعيدة المدى وأنماط تنقل فردي تربط عُمان بمناطق أخرى في غرب آسيا. كما يوثق مأوى الرميل أدلة طبقية من العصر الحجري القديم المتأخر، تشمل أدوات حجرية ومواقد وفنًا صخريًا. تُسهم هذه المعطيات مجتمعة في إثراء فهم ما قبل التاريخ العُماني وديناميات الثقافية، ودعم صون التراث وتعزيز الوعي العام عبر إعادة البناء الرقمي والمتحفة المستقبلية.

Halban

The funerary site of Halban, first documented in 1993 (Yule and Weisgerber 1998), comprises monumental tombs located on a limestone terrace connecting the Batinah coastal plain with the Hajar Al Gharbi Mountains. Thirty-four funerary structures have been identified, some of which exceed four meters in height (Fig. 1). Architectural features suggest a dating attributable to the Hafit period (3100–2600 BCE), while others appear to belong to the transitional phase leading to the more complex funerary characteristic of the Umm an-Nar period (2600–2100 BCE). The monumentality of these tombs attests to the significance of the site as a link between agricultural communities, coastal populations, and long-distance trade routes.

Figure 1. Location of the site of Halban in Al-Batinah South Governorate (left) and its relationship with the local landscape (right).

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Figure 2. Final appearance of tomb HAL021 from east, with a view of its entrance and monumental lintel.

During the second excavation season in January 2024, two tombs, designated HAL021 and HAL025, were investigated employing multiple complementary approaches to capture their socio-cultural and architectural variability. The systematic use of digital site reconstructions aims to proposing the musealisation of the tombs and the creation of augmented reality contents to enhance public accessibility in the near future.

Tomb HAL021

Tomb HAL021 was selected for excavation due to internal collapse, which may have preserved original contents, and because its still legible structure offered valuable insights for analysing construction techniques and establishing chronology. The tomb covers an area of approximately 4x4 m, with an internal chamber measuring 2 x 2 m and a preserved height of about 1.5 m. The most prominent structural element is a large, monumental lintel positioned over the east-oriented entrance (Fig. 2). Four Stratigraphic Units (SUs) were identified: SU1 and SU2 correspond to collapse of the structure; SU3, a compact brownish matrix, yielded numerous fragments of long human bones and teeth mixed with animal remains and some small beads; SU4, a compact red foundation layer, contained osteological fragments as well as grave goods.

Analysis of Funerary Goods

The considerable amount of beads and small beads recovered exhibits great variability in form and material. Shapes range from flattened circular, spherical, and segmented beads, with some specimens showing a distinctive form of stacked spheres. Diameters vary from 0.2 to 1 cm. Materials include carnelian, rock crystal, copper, soft stone, and coloured faience. Some beads indicate long-distance exchange networks (Fig. 3): segmented faience beads show analogies with artifacts from the Indus Valley (Harappa phase 3B-C, ca. 2450–1900 BCE; Kenoyer 2021) and with beads found in potential Wadi Suq funerary contexts in northern Oman (Hilton 2016). Similarly, carnelian beads analysed via scanning electron microscopy (SEM) confirmed percussion drilling (pecking) useful for identifying likely local productions (Kenoyer and Frenez 2018).

Anthropological Analysis

Anthropological analysis was hindered by the high degree of fragmentation of the identified remains. Dental enamel fragments were therefore subjected to proteomic analysis (amelogenin extraction) for sex determination, and strontium isotope ($^{87}Sr/^{86}Sr$) analysis to investigate mobility. The Minimum Number of Individuals (MNI) was estimated as three, based on the presence of permanent dental fragments exhibiting different wear patterns and a deciduous tooth. Proteomic analysis confirmed the presence of three individuals: an adult male, an adult female, and a non-adult female. Strontium values from human dental fragments, compared with a local baseline constructed from vegetation and carnivores (e.g., foxes), indicate that the remains

Figure 3. Barrel and segmented faience beads of potential Harappa 3 manufacture documented in tomb HAL021, SU4, q.B-C.

attributed to the adult male and non-adult female are consistent with the local Halban environment. In contrast, the adult female's isotopic values diverge significantly from the local baseline.

Radiocarbon dating

Radiocarbon dating of animal tooth samples from tomb HAL021, conducted at CEDAD (University of Salento, Italy), reveal a complex sequence of use. Obtained values from the lowest layer (SU4) – the one bearing the majority of human fragments - date to the late 3rd millennium BCE, aligning with most associated grave goods. A third sample, found higher in the sequence (US3), yielded an earlier date, supporting that the tomb underwent complex taphonomic processes and suggesting that the tomb's construction may belong to the first half of the 3rd millennium BCE (Williams 2023).

Tomb HAL025

HAL025 presented with a complete collapse of its southern side, which exposed a complete cross-section of the ring walls, providing valuable insight into construction techniques. The tomb entrance is surmounted by a large lintel and is completely sealed by three overlapping rows of stone blocks arranged orthogonally. The tomb's dimensions (diameter and height) are comparable to those of HAL021. Following the removal of superficial collapse layers (SU5-7), a more compact layer with a horizontal floor composed of flat stones (SU8) was identified, possibly recovered from the original structure. Beneath this was a compact red deposit yielding numerous fragmented human and animal remains (SU9). Adjacent to the southeastern wall, a modification containing ashes and hearth remains was found and sampled for radiocarbon dating. Excavation is not concluded and will continue during the 2025 field season.

Analysis of Funerary Goods

The funerary assemblages recovered thus far from HAL025 differ from those of HAL021 and appear to indicate a slightly earlier or equally long use of the structure. Significant finds include a copper pin, flat circular beads made of carnelian and steatite, a heat-treated tubular steatite bead, and several *Conus* shell beads. These objects reflect a local assemblage and find parallels in other funerary structures from the second half of the 3rd millennium BCE. Additionally, SU6 yielded fragments of blue-decorated Islamic pottery dated between the 14th and 17th centuries CE and three copper rings, indicating a later reuse.

Anthropological Analysis

Osteological analysis allowed for a preliminary estimation of a MNI of two individuals, based on dental wear patterns. Four fragments of human dental enamel were selected for proteomic strontium isotopes analysis. One enamel fragment exhibits linear enamel hypoplasia, indicating metabolic stress

Figure 4. Details of the main calcareous massif forming Romail Shelter: a) the site seeing from west while approaching; b) the site seen from north; c) the top of the massif seen from above; d) Shelter 1 with its two, almost symmetric openings.

during growth, as previously observed in tomb HAL021. Long bones with potential anatomical connections and cranial fragments were also found, and consolidated with Paraloid to be carefully retrieved in the following field season.

Models

High-resolution 3D models of the excavated tombs were created using photogrammetry and Structure from Motion (*SfM*) to start building the final virtual/dynamic tour of the site. To better assess structural variabilty of the Halban tombs, a study on the building materials was initiated. Specifically, 30 stone blocks were randomly sampled from the collapse of tomb HAL025. Each block was digitally documented with a high-resolution 3D model, and their weights (in kilograms) were recorded. This work will be extended to future structures subject to excavation.

Romail Shelter

Romail Shelter, located between the Wahiba Sands and the Eastern Hajar Mountains, is characterized by a massive limestone formation featuring multiple rooms (Fig. 4). The site's strategic location, close to water sources and lithic materials, makes it ideal for studying prehistoric human activities.

The 2024 field season included the systematic collection of lithic materials and the excavation of a small test pit in the northern part of the main shelter (Shelter 1). This excavation revealed seven stratigraphic units, with evidence of lithic tools, a hearth, and remains of partially burnt animal bones and plant material. Among the most significant finds are perforated shell fragments, yellow ochre, and a yet unidentified fruit. The lithic assemblage primarily consists of production debris (cores, flakes), likely attributable to the Late Palaeolithic, indicating the site was actively used for lithic manufacture. Some of these finds have been sent for radiocarbon dating.

Figure 5. One of the painted rock art panels discovered at Romail Shelter 1. The vast majority represent standing human figures in lines, some of which seem to be armed with spears or shields, and potential other animals.

Romail Shelter also hosts a palimpsest of rock art, featuring motifs spanning from prehistory to the Islamic period. The paintings include human figures, some armed with spears or shields, which require further study. The paintings are executed with red ochre and darker pigments, likely mixtures of ochre, charcoal, or manganese (Fig. 5).

Conclusions

The sites of Halban and Romail Shelter are of critical importance for the reconstruction of Oman's ancient history and archaeology. Halban illustrates Bronze Age mortuary practices and intercultural interactions. Romail Shelter offers a unique stratified sequence for the study of prehistoric human occupation, covering significant transitional phases between the Paleolithic and Neolithic. Both sites hold exceptional potential for future research, and will play role in the preservation and promotion of Oman's cultural heritage.

Acknowledgements

We express our sincere gratitude to the Ministry of Heritage and Tourism of the Sultanate of Oman for granting permission to conduct research at the aforementioned sites. We are especially indebted to Mr. Sultan bin Saif Al-Bakri, Advisor to the Minister for Heritage; Ms. Amina Abdullah Al-Balushi, Advisor to the Minister for Research; Eng. Yousra Khalaf Al-Subhi, Director General of Antiquities; Mr. Ali Hamood Al-Mahrooqi, Director of Department of Exploration and Archaeological Studies; Mr. Sultan Jamil Al-Makhmari, Head of the Archaeological Missions Section; Ms. Sheikha Khalifa Al-Rasbi; Ms. Buthaina Rashid Al-Ghefeili; Mr. Khalil Masoud Al-Nadabi; Mr. Othman Mohammed Al-Wardi; Mr. Mufleh Ahmed Salem Al-Zawaidi; and Dr. Dennys Frenez for their invaluable support and collaboration. The activities of the IAMHAL Project were made possible through the generous support of the University of Bologna under the AlmaScavi 2024 funding scheme, as well as the Italian Ministry of Foreign Affairs and International Cooperation through the Foreign Excavations funding programme (grant no. Arc2816/2024).

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Archaeological Mission at Bāt/Al-Arid (MBA), Oman: 2024 Season

Castel C.[1,2] (with the collaboration of J.-L. Bertrand Krajewski[3], N. Blond[4], J.É Brochier[2], B. Chamel[5], J. Floquet[6], W. Al-Ghafri[7], I. Keuter[8], T. Kuronoma[9], C. Le Carlier de Veslud[2,10], G. Mastelli[11], S. Misery[6], S. Sanz[2] & S. Sorin[2])

The CNRS and the University Lyon 2 with the support of the MHT of Oman and different French institutions has conducted the 5th season of intensive excavations at the Early Bronze age site of Al-Arid, 15 km to the north-west of the UNESCO site of Bat, in January-February 2024. This article aims at presenting the results of these excavations helded on five sectors: Tower 3 (Sector 6), Tomb 2 in the small cemetery in the north-eastern part of the site (Sector 4), the 'Ancient canal' which is highly probably dated to the end of the fourth millennium, Sector 7 which is confirmed to be a Hafit metallurgical workshop, and a new sector (Sector 8) close to Tower 3.

واصل المركز الوطني الفرنسي للبحث العلمي وجامعة ليون 2 - بدعم من وزارة التراث والسياحة في سلطنة عُمان وعدد من المعاهد الفرنسية المتخصصة - أعمال الموسم الخامس من الحفريات المكثفة في موقع العصر البرونزي المبكر في موقع العارض على بعد 15 كم إلى الشمال الغربي من موقع بات المدرج في قائمة اليونسكو للتراث العالمي حيث أقيمت هذه الحفريات على مدى شهري يناير وفبراير 2024. تهدف هذه المقالة إلى عرض نتائج هذه الحفريات التي أجريت في خمس قطاعات: البرج 3 (القطاع 6)، القبر 2 في المقبرة الصغيرة في الجزء الشمالي الشرقي من الموقع (القطاع 4)، "القناة القديمة" التي يعود تاريخها على الأرجح إلى نهاية الألفية الرابعة، والقطاع 7 الذي تم تأكيد أنه عبارة عن ورشة تعدين تعود إلى فترة حفيت، وقطاع جديد (القطاع 8) بالقرب من البرج 3.

The archaeological settlement site of Al-Arid is located in an open valley, a crucial corridor between the Al-Batinah Governorate which stretches along the coast of Oman and the inland region of piedmont, south of the foothills of the Hajar Mountains. The archaeological remains are distributed along the left bank of the Wadi Khuwaybah, on the lowermost alluvial terrace, about 2 m above the current wadi bed. After five seasons of excavations, two main phases of occupation, dated to the Early Bronze Age (Hafit and Umm an-Nar periods) and the Late Islamic period, are now well documented.

Sector 6: Tower 3

With seven 'towers' or high platforms spread over an area of approximately 130 hectares, the Al-Arid site has the largest concentration of monuments of this type known to date on the Arabian peninsula. All are distributed along the southern foothills of Al-Hajar Mountains.

In 2024, the excavation was pursued at the base of what we call 'Tower 3' to the substratum. It has not been possible to evidence any *in situ* Early Bronze Age layer there during the excavations. A test trench was also dug at the summit of the tower's mound to test the presence of a well in the center, in vain.

Finally, after excavations during four consecutive seasons in this sector, the pottery and the C14 dates we obtained from samples collected from the five different levels of the tower's mound indicate that it was occupied between a period comprised between the end of the 17th and the beginning of 20th century. Nonetheless, different clues indicate that an Umm An-Nar tower existed in the heart of the mound. A sounding dug through the floor of a room dating to the latest phase of occupation at the summit of the tower's mound revealed a kind of platform made of very large blocks held together by a very hard, earthen mortar. Between the blocks, only Umm an-Nar sherds and a charcoal dating from this period were discovered in this sealed context beneath the Late Islamic floor. Furthermore, a new cleaning of the mound and a close study of the architecture with the creation of a 3D model revealed the existence of large blocks, larger than the small stones of the basements of the late Islamic period walls (Fig. 1), over half the circumference of the mound. So, more than 4000 years after the construction of an early Bronze age tower, Late Islamic period rooms were built against the tower and at its summit as successive additions.

Sector 4: North-East Cemetery

The north-west quarter of Tomb 2 has been excavated and this grave has now been completely cleared (Fig. 2). Tomb 2 is a Hafit-type cairn very similar to

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Figure 1. North face of the Tower's mound (sector 6) and excavation at the base. The biggest blocks belong to the Early Bronze 'Tower'. © Mission archéologique Bāt/Al-Arid. Photograph: C. Castel

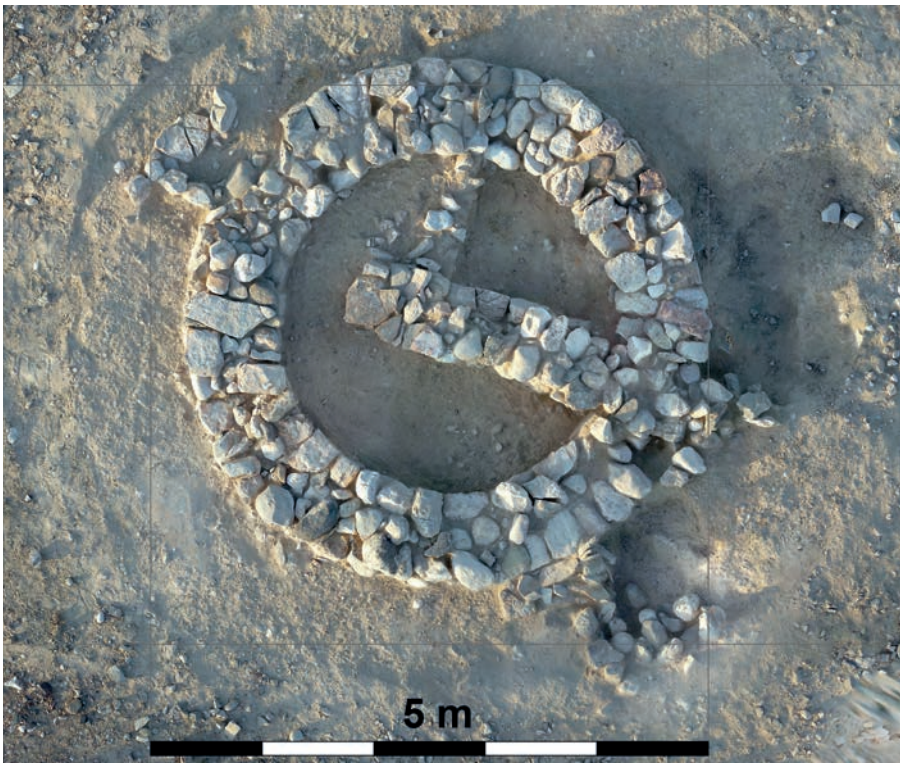

Figure 2. Orthophotograph of Hafit-type Tomb 2 (Sector 4) taken at the end of the 2024 excavation season. © Mission archéologique Bāt/Al-Arid. B. Chamel

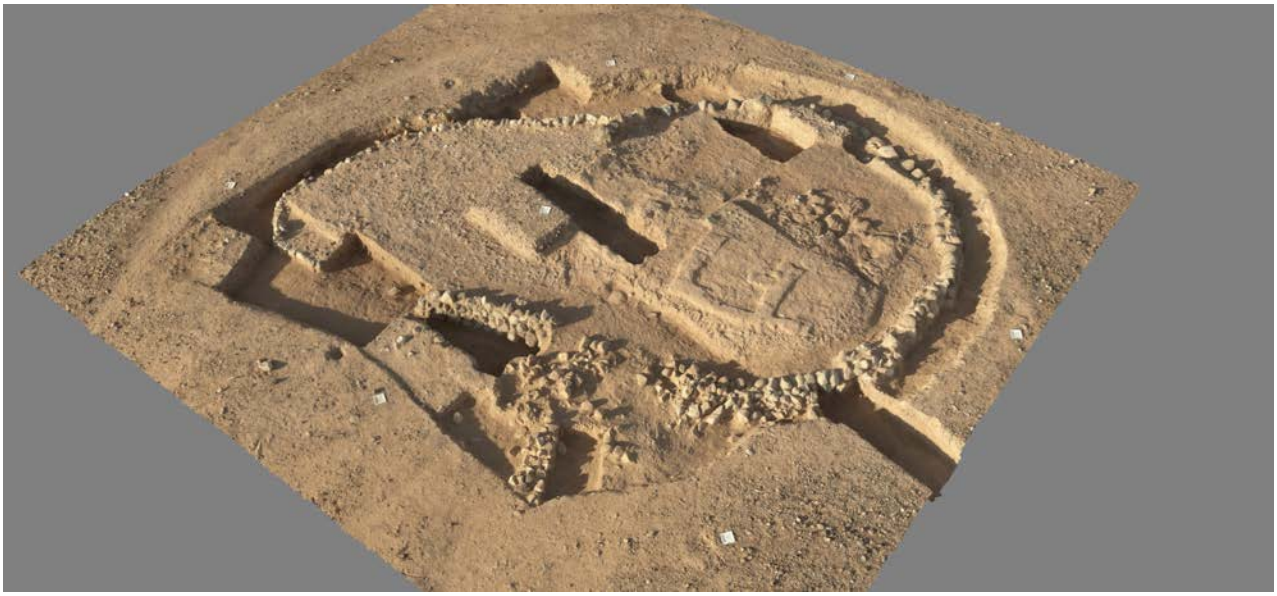

Figure 3. 3D model of the copper workshop (around 3000 BCE) to the South-East © Mission archéologique Bāt/ Al-Arid. S. Sanz

Tomb 1 whose dating is confirmed by the bioapatite from the bones. However, tomb 2 may have been built a little later than tomb 1, as attested by its internal partition wall. Tomb 1 was also used during the Umm an-Nar phase, whereas there is no trace of use of Tomb 2 during this period. We found a Mesopotamian Jemdet Nasr-type vessel in Tomb 1, and a globular vessel of a similar formal type in Tomb 2, but the very poor quality of the ceramic from Tomb 2 shows that it may have been produced locally. If this is confirmed by the petrographic analysis, this will be a very important aspect as it may be indicative of the introduction of a local pottery production in the region. The study of the human bones from the two tombs is still underway, but in total, the excavation of Tomb 2 yielded a Minimal Number of Individuals of ten of different ages, eight inside the crown, two outside.

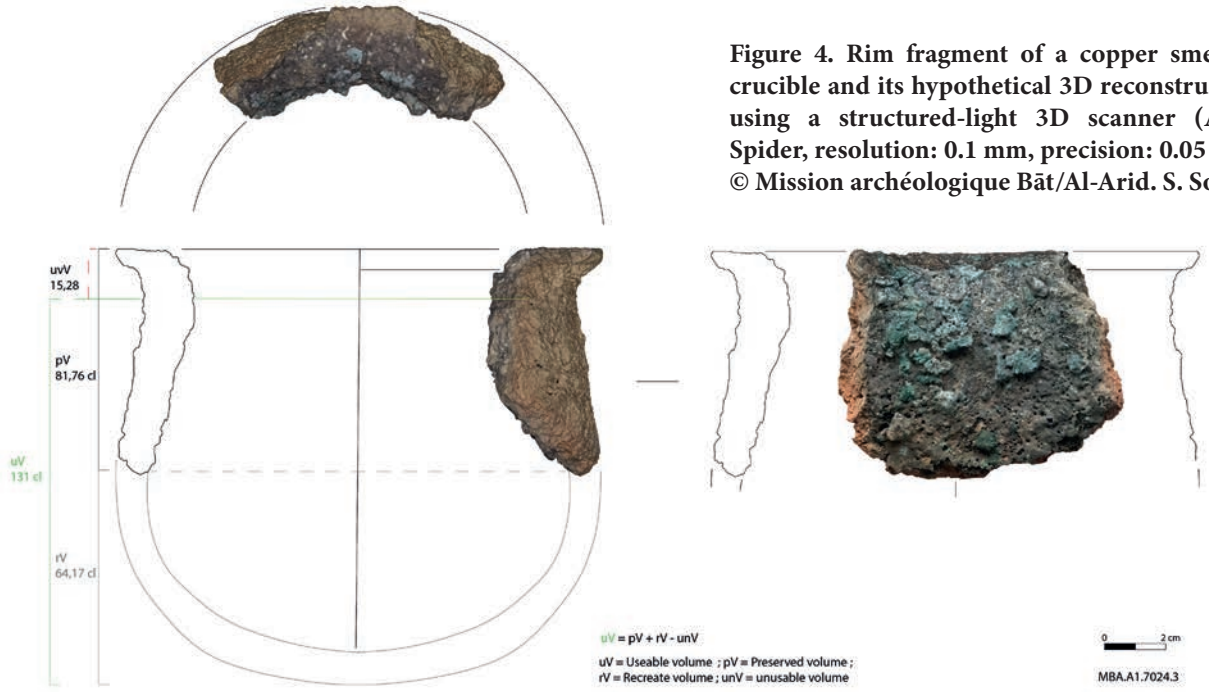

Figure 4. Rim fragment of a copper smelting crucible and its hypothetical 3D reconstruction using a structured-light 3D scanner (Artec Spider, resolution: 0.1 mm, precision: 0.05 mm) © Mission archéologique Bāt/Al-Arid. S. Sorin

Figure 5. Analysis of a section of one of the trenches cutting the Hafit canal (around 3100 BCE) © Mission archéologique Bāt/Al-Arid. Photograph: C. Castel

Sector 7: Hafit copper processing area

We found in sector 7 a circular built platform, 8.80 m in diameter, bounded by a stone terrace wall enlarged to the southeast in a second step. The material discovered *in situ* together with copper artefacts indicate that the platform is a workshop dedicated to the processing of copper. Radiocarbon dating of charcoals found in fireplaces and in a charcoal sample taken directly from the wall of one of the crucibles prove that the workshop in Sector 7 was in use at the beginning of the 3rd millennium BCE and only during this period. The excavation this year revealed the presence of three successive levels of installation (Fig. 3). Crucibles (Fig. 4), fragments of ore, several fragments of copper mass stemming from the smelting process, lumps and melting droplets as well as production waste document the entire operational sequence of the transformation of copper ore into metal. Archaeometallurgical study will continue in France in order to determine the elemental composition of the artefacts, to find out how they were made, by analysing the content of alloying elements, and to determine if the artefacts have a common origin or not, by analysing the content of trace elements. These analysis should also help us to know if the remarkable copper axe head discovered in 2024 was produced in this copper workshop or comes from elsewhere.

Sector 8: Another copper workshop?

Sector 8 was opened up in one of the dozens of burial mounds discovered at Al-Arid because of a wall of large stone modules flush with the surface. The investigations carried out on this mound were a particularly complex task, both in terms of excavation and understanding. However, several possible parallels with sector 7 should be highlighted. Firstly, the wall flush with the surface is very prob-

ably a retaining terrace wall, possibly supporting a platform. There is also the presence of a fragment of a crucible, probably like those found in sector 7. Finally, we can note the presence of what is known as a matte composed of copper, sulphur and iron, which could be an indication of ore processing activity, since a copper matte is not a metal, but an intermediate product of the *chaîne opératoire* in the ore extraction process. These three elements and the absence of sherd clearly *in situ* could suggest a function and a dating similar to that of sector 7. But the exposed levels are so damaged that it is impossible to go any further at this stage.

***The 'Ancient canal' and the 'Islamic* falaj'**

The two ancient irrigation canals that we discovered in the plain after a flooding of the Wadi Khuwaybah in 2019 were explored again this year by a geoarchaeogeologist, a hydrologist and a geographer. Five new trenches were dug with a mechanical shovel in order to follow the evolution of the ancient canal route. This canal, now filled in by the sediments we are studying, was possibly fed by the water table that flows beneath Wadi Khuwaybah but a confirmation is needed. To the south, it crosses the terrace on which the settlement site was established in the 3rd millennium BCE. The bottom of the canal was reached at a depth of 1.80 m below the current surface. It runs alongside an ancient *falaj* dating from the Islamic period. Our work provided evidence for the continuity of the Ancient canal. It was an open-air irrigation canal, 40 to 50 cm wide at the bottom and widening sharply into a V at the top (Fig. 5). At 322 m from Wadi Khuwaibah, at its southern end, we lost its track. This is probably due to the fact that it was cut through and destroyed by the construction of the Islamic *falaj* whose cover slabs we found at the bottom of a sondage during this season of excavation.

Three charcoal samples collected at three different points along the canal, in the lowest part of its fill and above in sealed levels, provided radiocarbon determinations surprisingly all indicating the Hafit period.

Acknowledgments

The Ministry of Heritage and Tourism in Oman, the French Ministry for Europe and Foreign Affairs, the CNRS (French National Center for Scientific Research), the French Embassy in Oman, the Universities Lyon 2 and Strasbourg (France), the Archéorient Laboratory (UMR 5133, CNRS, Maison de l'Orient et de la Méditerranée-Jean Pouilloux, Lyon), the INSA Lyon (National Institute of Applied Sciences), the CEFREPA (French Research Centre of the Arabian Peninsula), the EPHE (École Pratique des Hautes Études, Paris), the French National Museum of Natural History (Paris), the École Normale Supérieure at Lyon, The Research Institute for Languages and Cultures of Asia and Africa, Tokyo University of Foreign Studies (Japan), the UNESCO chair on *Aflaj* studies and archaeohydrology (UCASA team headed by Prof. A. Al-Ghafri). A memorandum of understanding was signed in 2024 between Nizwa University and INSA Lyon through the MBA mission.

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Archaeological Investigations at Al-Khutm and Ras Al-Hadd (HD-7): The 2023–2024 Seasons of the University of Bologna Mission

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During the 2023–2024 field seasons, the University of Bologna Archaeological Mission in Oman conducted coordinated excavations at the Bronze Age sites of Al-Khutm (Bat) and Ras Al-Hadd (HD-7) under the authority of the Ministry of Heritage and Tourism. At Al-Khutm, investigations exposed new external structures around the monumental tower, refining its architectural and chronological sequence. At Ras Al-Hadd, two newly discovered cairns confirmed local variants of Hafit and Umm an-Nar funerary traditions. Together, these results enhance understanding of 3rd- and early 2nd-millennium BCE settlement and mortuary practices across Oman's interior and coastal regions.

خلال موسمي التنقيب الميدانيين 2023-2024، أجرت البعثة الأثرية لجامعة بولونيا حفريات منسقة في موقعي الخطم (بات) ورأس الحد (HD-7) اللذين يعودان إلى العصر البرونزي، وذلك تحت إشراف وزارة التراث والسياحة. في الخطم، كشفت الحفريات عن هياكل خارجية جديدة حول البرج الضخم، مما حسّن من فهمنا لتسلسله المعماري والزمني. أما في رأس الحد، أكد اكتشافان حديثان وجود متغيرات محلية لتقاليد حفيت وأم النار الجنائزية. تُعزز هذه النتائج فهم ممارسات الاستيطان والدفن في المناطق الداخلية والساحلية في عُمان خلال الألفية الثالثة وأوائل الألفية الثانية قبل الميلاد.

The 2023–2024 fieldwork seasons of the University of Bologna Archaeological Mission in Oman continued a long-standing collaboration with the Ministry of Heritage and Tourism aimed at documenting and interpreting the cultural development of Bronze Age communities in the Sultanate. The mission's dual campaigns focused respectively in Adh-Dhahirah Governorate on the tower site of Al-Khutm, a UNESCO World Heritage site together with Bat and Al-Ain, and in Ash-Sharqiyyah Governorate on the funerary complex of Ras Al-Hadd (HD-7). Both projects applied advanced recording technologies, integrated GIS analysis, and systematic sampling to refine architectural, chronological, and functional interpretations of key 3rd- and early 2nd-millennium BCE contexts.

Al-Khutm Bronze Age Tower

The UNESCO site of Al-Khutm (Bat) represents an archaeological complex of exceptional importance dating back to the end of the 3rd millennium BCE. Beginning in 2017, extensive archaeological investigations have revealed the characters of a monumental structure whose state of preservation and monumentality is unique among the towers investigated thus far in Oman.

Following an agreement between the Ministry of Heritage and Tourism of the Sultanate of Oman and the University of Bologna, consecutive excavation campaigns from 2018 to 2022 (Cattani *et al.* 2024) have been conducted with the primary objective of exposing the entire perimeter outer wall located on the western side of the tower, to better understand the construction phases and life of the tower itself, starting from its earliest occupation phases. It is important to emphasize that the tower remained essentially invisible until 2015, covered by meters of stone collapse.

The excavation work revealed the exceptional monumentality of the complex and documented a stratigraphic sequence that bears witness to different phases of occupation, from the end of the 3rd millennium to most of the 2nd millennium BCE.

Fieldwork and Methodology

The excavation methods employed 3D photogrammetry and open source GIS-based platforms for spatial and stratigraphic recording. Each stratigraphic unit was digitally recorded with detailed forms describing the context, relationships, and associated finds. Over 1,000 diagnostic fragments were photographed and 400 were drawn, forming the basis for a preliminary typology. Additional materials included fragments of steatite vessels, lithic artefacts, metal granules, and bioarchaeological remains, particularly seeds collected for palaeobotanical analysis. All documentation was digitised and submitted to the Ministry of Heritage and Tourism.

The 2023 campaign (3–26 December 2023) targeted the western side of the tower (Sectors 6 and

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Figure 1. Al-Khutm. Zenithal view with 2023 excavation area.

7) across a 20 × 5 m area to a depth of 1.5 m. The principal goal was to uncover the full height of the outer wall, assess stratigraphic relationships, and document associated external structures.

The wall structure, presumably the boundary of a buffer zone that served as a path or possibly a drainage channel, follows the circular profile of the tower wall (SU 463). Excavations began at the southeast corner of the perimeter wall and continued north-westwards. The identified wall structure, visible a few centimetres below the modern floor surface, consists of a maximum of five rows of medium and small stones (20 to 40 cm wide), often regular in shape, almost rectangular. In some cases, the base stones are larger and heavier (Fig. 2-3).

These new structures, which could be identified as ditches or terracing elements, are fairly well preserved and, compared to the types of ditches found so far in Oman near the towers, are made of stone rather than rough material.

As a second important result, the perimeter wall of the tower is now fully exposed and designed with 3D documentation (Fig. 4). The extraordinary state of preservation and the imposing monumentality of the tower, enhanced by the presence of the perimeter wall, make this complex unique among the towers excavated in the Bat area to date.

The exposure of these new structures and the initial plans for their use, which could be related to those of the tower, have revealed a well-preserved sequence of anthropic deposits that may include the initial phases of the tower's construction. At the same time, it cannot be ruled out that the anthropised area may extend much further east.

A final feature of significant value is represented by the ceramic elements, which provide a more certain chronology for the phases of use.

Another significant result of this campaign is the identification of the various main phases of construction of the tower and its external masonry structures (Fig. 5).

The chronological data collected so far through the typological study of the finds (in particular the large quantity of ceramic fragments) indicate a period of occupation from the end of the 3rd to the early centuries of the 2nd millennium BCE. More

Figure 2. Al-Khutm. View of respect area or drainage feature next to the perimeter wall.

specifically, preliminary analysis of the ceramic assemblages suggests that the tower was probably built in the late Umm-an-Nar period and continued to be inhabited in the subsequent Wadi Suq period.
C14 dating of a large number of collected charcoal fragments will provide further data to refine the chronology of this complex.

Interpretation and Chronology
The campaign revealed a remarkably well-preserved perimeter wall, standing to 2.20 m with eight courses of squared limestone blocks, and newly identified external stone structures forming a concentric boundary. The latter, constructed of five rows of regularly shaped stones with larger basal

Figure 3. Al-Khutm. View of the entrance from the outer terraced area to the respect area surrounding the external wall.

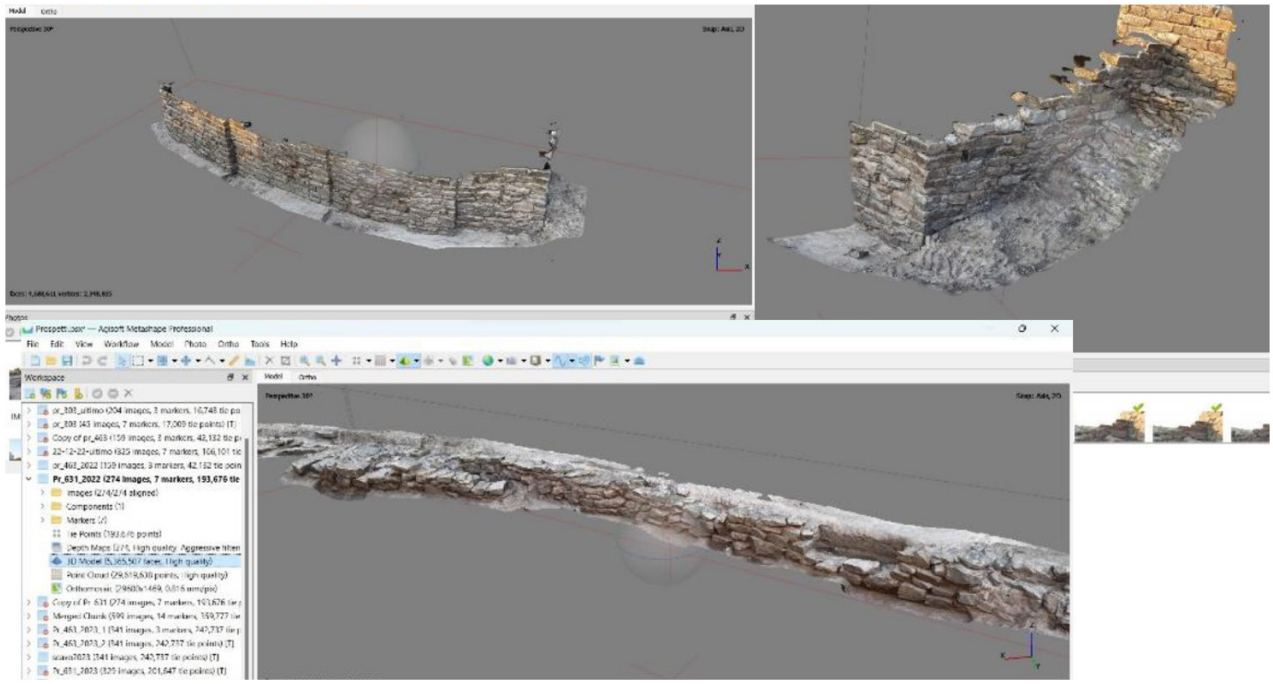
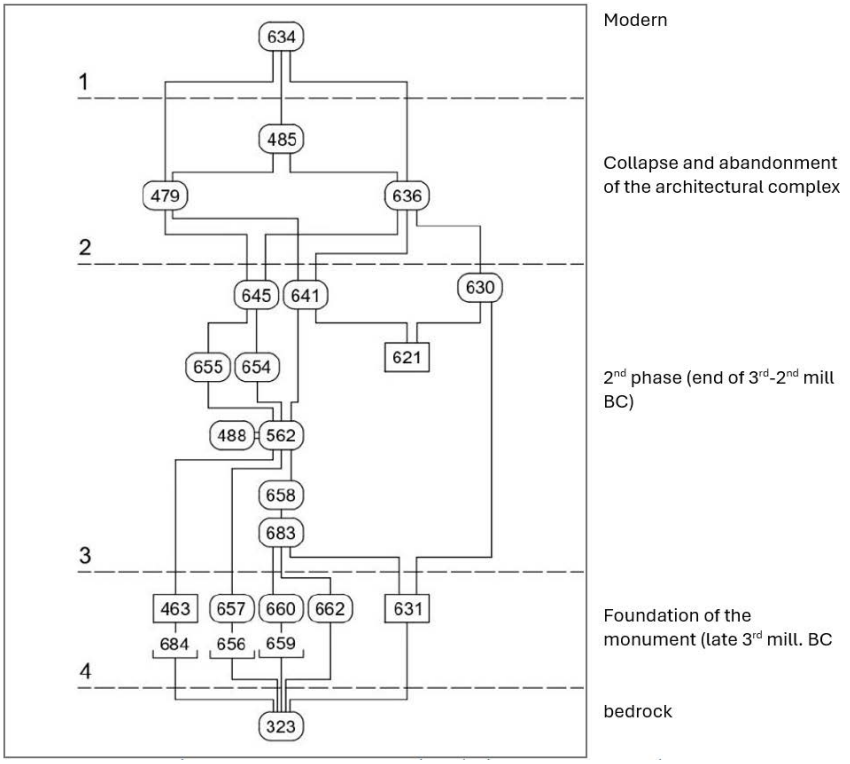


Figure 4. Al-Khutm. 3d model of the perimetral walls.

elements, likely delimited a respect area or drainage feature following the circular tower profile. These discoveries demonstrate that the tower's functional zone extended beyond its perimeter, indicating a more complex architectural arrangement than previously recognised.

The combined evidence defines a prolonged sequence of occupation spanning the late Umm an-Nar and early Wadi Suq periods. Ceramic typology supports a date between the late 3rd and early 2nd millennium BCE, while forthcoming radiocarbon analyses of charcoal samples will refine this range.

Figure 5. Al-Khutm. Stratigraphic diagram and proposed dating.



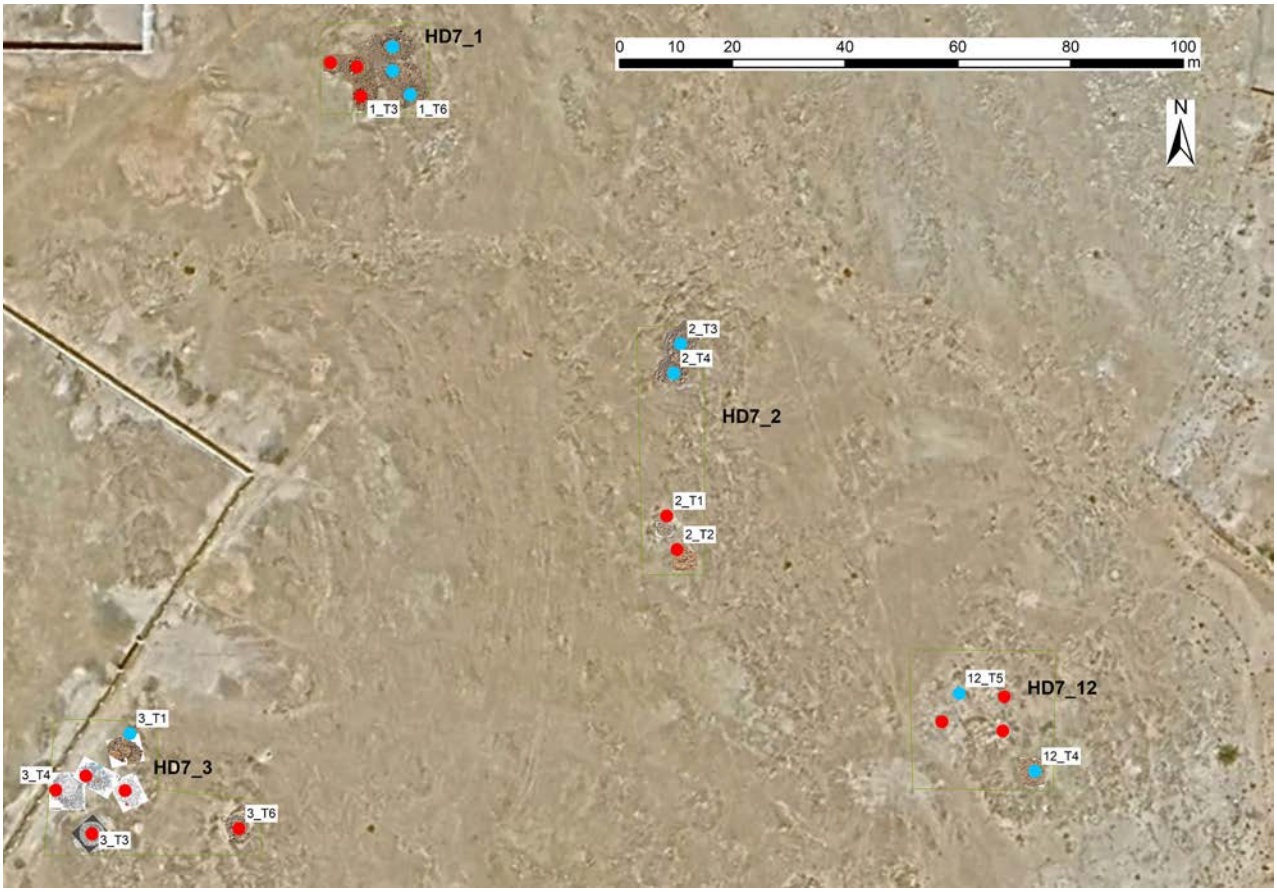


Figure 6. Ras Al-Hadd HD-7. Detailed map of tombs clusters.

The stratigraphic relationships suggest multiple construction and reuse phases, possibly including the initial building stage of the tower.

The exposure and 3D documentation of the entire structure, together with the newly detected external features, enhance both scholarly understanding and heritage presentation. Since the tower's clearance in 2015, its restoration and illumination have made it a major component of the local cultural landscape.

Ras Al-Hadd (HD-7)

The Ras Al-Hadd area has been a focal area for University of Bologna research over three decades, encompassing settlement and cemetery sites dated to the 4th and 3rd millennia BCE. The 2023–2024 investigations continued work at HD-7, a funerary complex associated with the Hafit settlement of HD-6. The site lies on a rocky terrace overlooking the sea and comprises small clusters of cairn tombs forming a coherent funerary landscape. Earlier excavations and surveys had defined its use during the first half of the 3rd millennium BCE, with later activity reflected at nearby HD-5 (Fig. 6).

Over the past three decades, numerous research projects have been carried out in Ras Al-Hadd by the University of Bologna, notably the excavation at settlements of HD-6, HD-5 and HD-1 or the cemetery of HD-10. The recent attention to the nearby Bronze Age cemetery of HD-7 was due to investigate numerous tombs located inside the urbanistic development (Munoz 2007).

Previous and Current Fieldwork

A comprehensive GIS survey conducted in 2022 mapped all ancient structures and documented the poor state of preservation. In 2023, excavations of two cairns (group HD-7.12) identified a distinctive architectural typology: two or three concentric circular walls with an outer ring of white beach-rock and inner walls of local limestone (Fig. 7). The January 2024 campaign extended work to group 2 , leading to the discovery of two additional cairns replicating this design (Fig. 8). Tomb 1 was well preserved, with intact human remains in the central chamber currently undergoing anthropological analysis. Tomb 2 displayed a comparable plan but

Figure 7. Ras Al-Hadd HD-7. View of tomb 2 of cluster 12.

contained fewer artefacts, limited to a few beads and bone fragments. Unlike the earlier graves of group 12, neither exhibited traces of cremation.

Artefacts and Chronological Implications
Grave goods and associated materials from the HD-7.2 and HD-7.12 tombs correspond to assemblages dating to the early 3rd millennium BCE. One tomb in group 12 contained typical Umm an-Nar pottery, marking a later phase, and bridging stylistic traits between Hafit-type cairns and more structured Umm an-Nar-style tombs. Artefacts recovered from surrounding layers, including *Conus* shell rings, steatite beads, and flint borers, indicate local craft activity and suggest ritual object preparation associated with burial ceremonies. These data contribute to broader interpretations of funerary behaviour, material symbolism, and bone manipulation in early Bronze Age Arabia.

Interpretation and Regional Significance
The Ras Al-Hadd evidence reinforces the existence of a regional variant of the Hafit funerary model, defined by the use of white beach-rock in the external rings. The model is also present at Ras Al-Jinz RJ-6 and Shiya cemeteries. This distinctive coastal adaptation underlines the symbolic interplay between terrestrial and marine materials and reflects a community deeply engaged with its shoreline environment. By integrating stratigraphic data, artefactual analysis, and radiocarbon dating, the mission aims to refine the chronological framework of these burials and clarify their relationship with broader socio-economic transformations along Oman's eastern coast during the 3rd millennium BCE.

Conclusion
The 2023–2024 field operations at Al-Khutm and Ras Al-Hadd exemplify an integrated research approach combining excavation, digital documentation, and heritage management. Together, the two projects illuminate complementary aspects of Oman's Bronze Age: monumental settlement architecture in the interior and regional funerary traditions along the coast. Their combined results refine the cultural and chronological framework of the 3rd and early 2nd

Figure 8. Ras Al-Hadd HD-7. View of tombs 1 and 2 of cluster 2.

millennia BCE and underscore the enduring value of collaborative research between the Ministry of Heritage and Tourism and the University of Bologna in advancing the study and preservation of Oman's archaeological heritage.

Acknowledgements
The mission gratefully acknowledges the continuous support of the Ministry of Heritage and Tourism of the Sultanate of Oman, with special thanks to site supervisor Mr Sulaiman Hamood Al-Jabri at Al-Khutm and Mr Khamis b. Nasser Al-Amri at Ras Al-Hadd for their invaluable collaboration. The fieldwork was conducted under the institutional patronage of the Italian Ministry of Foreign Affairs and International Cooperation and support from ISMEO - International Association for Mediterranean and Oriental Studies.

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Archaeological Expedition to the Wilaya of Al-Mudhaybi: Season 2024

Döpper S.,[1] C. Schmidt[2] & F. Mauro[1]

The 2024 field season focused on a rescue excavation of an Early Bronze Age, two-storey tomb at Al-Musalla. The tomb contained a number of grave goods typical of the Umm an-Nar period, including soft-stone and calcite vessels, as well as more than 100 beads. The second focus was on the preliminary results of the 2024 field season of the Jebel Madar Survey, which is part of a PhD project studying occupation patterns during the Samad Late Iron Age.

ركز الموسم الميداني لعام 2024 على حفرية إنقاذية لمقبرة من طابقين تعود للعصر البرونزي المبكر في المصلى. احتوت المقبرة على عدد من المقتنيات التي تعود إلى فترة أم النار، بما في ذلك أوانٍ من الحجر الأملس والكالسيت، بالإضافة إلى أكثر من 100 خرزة. أما التركيز الثاني فكان على النتائج الأولية للموسم الميداني لعام 2024 لأعمال المسح الأثري في جبل مدر، وهو جزء من مشروع دكتوراه يدرس أنماط الاستيطان خلال العصر الحديدي المتأخر في فترة سمد.

Al-Musalla

The Umm an-Nar period (Early Bronze Age, 2700–2000 BCE) in Oman is considered a period of fundamental changes in subsistence strategies, resource exploitation and the social complexity of society. It is the time of the first evidence of agriculture and sedentarisation in southeast Arabia, intensive copper processing, local ceramic production, monumental architecture and extensive long-distance trade with neighbouring regions along the Arabian-Persian Gulf (e.g., Magee 2014; Cleuziou and Tosi 2018). This period is characterised by monumental com-

Figure 1. Umm an-Nar period tomb in Al-Musalla: a-b: construction of water pipe in Al-Musalla 2022, which accidentally hit an Umm an-Nar period tomb (photos: Abdallah Al-Amri); c: tomb before excavation, and d: tomb after excavation in 2024.

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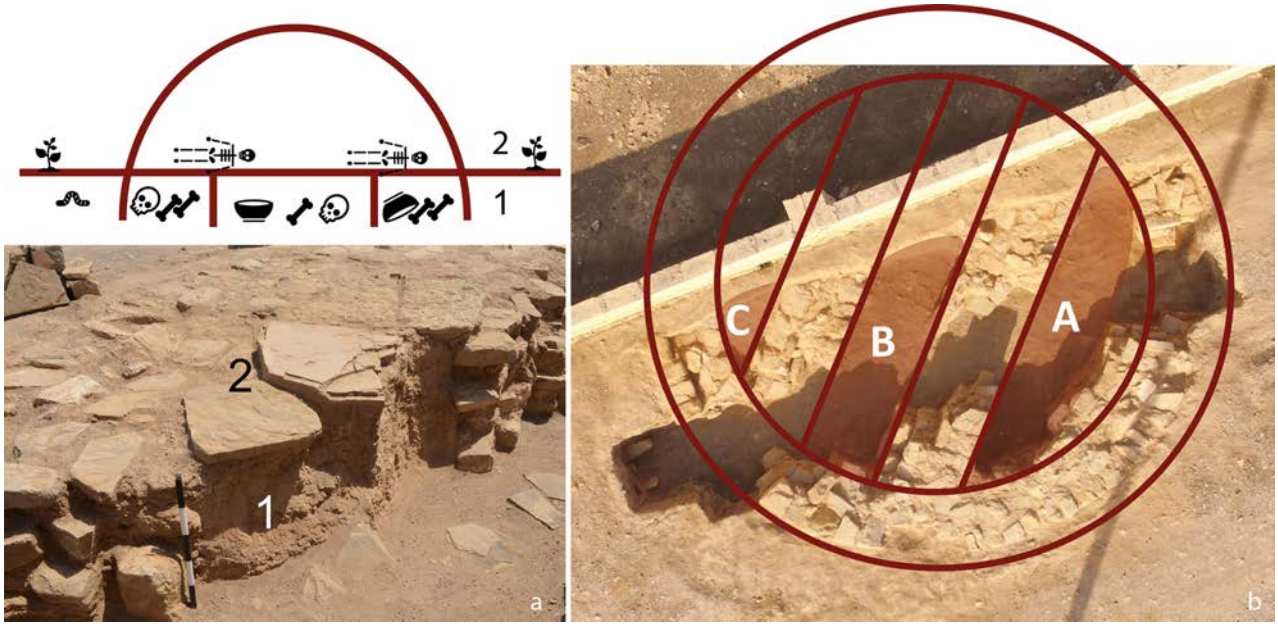

Figure 2. Umm an-Nar period tomb in Al-Musalla: a. upper and lower floor of the tomb, separated by large stone slabs, b: internal walls divide the tomb into three chambers, A, B and C.

munal tombs made of stone (e.g., Williams 2024). These predominantly above-ground, round constructions with diameters of up to 14 metres are divided into several interior burial chambers. The façade of the tombs is made of carefully cut stones, sometimes using so-called 'sugar lumps' of white limestone. The tombs contain collective burials of between a dozen and 400 people of both sexes and all ages. It is assumed that each tomb was used for around one to three centuries, i.e. over several generations, probably by a social group such as a family.

In November 2022, during construction works along a dirt road in Al-Musalla, Wilaya Al-Mudhaybi, governorate Ash-Sharqiyyah North, in the Sultanate of Oman (UTM 40N 605450 E, 2478843 N), human remains and grave goods belonging to an Umm an-Nar tomb were found by the construction workers. Informed of the finds by residents of Al-Musalla, the Ministry of Heritage and Tourism of the Sultanate of Oman stopped the works and initiated a rescue excavation that was carried out in spring 2024 by a team from the universities of Heidelberg and Tübingen, Germany.

At the start of the rescue excavations in 2024, the material dug out by the excavator had been backfilled into the tomb so that stratified layers were only accessed in the smaller parts outside the excavator's trench. The majority of finds and human remains, however, came from the re-filled deposits, so that a reconstruction of their original distribution within the tomb is unknown. The construction work's excavators cut runs straight through for the whole depth of the tomb, affecting it severely (Fig. 1). Nevertheless, the general layout of the tomb could be reconstructed. It is a double storey tomb with the lower part reaching approx. 60 cm below ground (Fig. 2). Internal dividing walls separate this lower storey into three chambers (A, B, C). The tomb has an external diameter of 7 m. Large stone slabs, of which only some survived the 2022 construction works, cover the lower chambers and form the floor of the upper storey. Of this, only very little is preserved, and nothing of the above-ground walls remains. As parts of the tomb are below the perimeter wall of the modern cemetery, only those parts outside the cemetery, about two-thirds of the tomb, were excavated.

Finds from the tomb include pottery, soft-stone and calcite vessels, copper/bronze objects and pieces of personal adornment, mainly beads. The pottery from the tomb belongs to typical Umm an-Nar fine red and sandy wares, often featuring painted geometric decoration (Fig. 3a). The shapes are restricted to small necked pots, including suspension vessels, none of them found complete. The stone vessels comprise four small globular calcite cups (Fig. 3b) as well as several fragments of and some complete soft-stone vessels. Among the soft-stone vessels are open bowls with a flat and globular pro-

Figure 3. Finds from the Umm an-Nar tomb: a. pottery sherds, b. small calcite vessels, c. selection of soft-stone vessels, d. reconstructed necklaces and bracelets made from beads found in the tomb, and e. tiny discoid beads (diameter less than 1.5 mm).

file, rectangular boxes and beakers as well as circular and rectangular lids, forming a typical tomb inventory of the Umm an-Nar period (Fig. 3c). There is, as often is the case in Umm an-Nar tombs, a notable mismatch between lids and vessels. Only one of the lids had a fitting vessel and was found with it still attached. Decoration of the soft-stone vessels comprises mainly of the well-known dot-in-circle type. Additionally, more than 100 beads were found in the Al-Musalla tomb, many of them made of carnelian, indicating contact with areas in modern-day India. Other materials include shell, talcose steatite and other types of stone (Figure 3d-e). Five beads are made from copper/bronze, still featuring traces of the original string preserved. Other copper/bronze objects include pins and rings. Additionally, five rings made from shell were found in the tomb, indicating contact with the coast (Fig. 4).

The Al-Musalla tomb has provided new insights into the Umm an-Nar culture, particularly in the southernmost extent of its currently known distribution. It represents a valuable addition to the known set of double-storey, semi-subterranean Umm an-Nar tombs, offering important information that enhances our understanding of Umm an-Nar burial customs.

Jebel Madar

The PhD project "Resilience and Adaptability Strategies in the Samad Late Iron Age" aims to shed new

Figure 4. Collection of finds from the Al-Musalla tomb, including soft-stone vessels, reconstructed necklaces and bracelets and copper and shell rings.

Figure 4. Iron arrowhead from a Bronze Age cairn in the Al-Aflaj necropolis.

light on the archaeological landscape of the Jebel Madar region (Wilayat Al-Mudhaybi, Sharqiyyah North), with a focus on settlement dynamics during the Samad Late Iron Age (SLIA, ca. 300 BCE – 300 CE). The 2024 season primarily involved archaeological survey work in selected areas. The methodology included the targeted inspection of funerary sites, initially identified via satellite imagery, particularly Bronze Age cairns that may have been reused during the SLIA. Field data were also collected with the goal of developing an Archaeological Predictive Model for the 2025 field season.

The survey began with a systematic investigation within a 1.5 km radius of the well-known Sinaw G58 tomb (Mauro 2018), a grave discovered in 2014 which yielded typical findings dating to the last centuries BCE. Although no direct SLIA material was recovered, several nearby tomb structures shared architectural features with G58, possibly indicating SLIA use of the area or the remains of Bronze Age cairns. Additional investigations were carried out in the villages of Al-ʻUyun, Abu Eid, and Barzaman. These areas were dominated by Late Islamic

evidence and Early Iron Age artefacts and tombs. In contrast, the eastern side of Jebel Madar and the oasis of Al-Aflaj revealed a more diverse occupational sequence, ranging from the Bronze Age to the present, including the SLIA. Numerous structures were documented, particularly Bronze Age cairns and stone alignments. Notably, several iron artefacts, such as arrowheads (Fig. 5), spearhead fragments, and blade fragments, were recovered from Bronze Age tombs, suggesting SLIA reuse.

Overall, the 2024 survey provided valuable insights into the archaeological complexity of the Jebel Madar region and confirmed the potential presence of SLIA occupation. Future work, planned for 2025, will focus on further exploration and the implementation of the predictive model.

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Archaeological Landscape and Environmental Dynamics of Duqm and Nejd (ARDUQ): Season 3 (2023–2024)

Garba R.,[1,2] A.F. Danielisová[1] & J.I. Rose[3]

In early 2024, researchers from eight countries participated in fieldwork in Duqm and a study season at the Oman Across Ages Museum in Manah. The first team in Duqm continued in excavation of a Neolithic megalithic collective grave and documentation of rock art sites with discovery of a marine-themed rock art panel with leatherback turtles and other sea creatures. Excavations at the DUQ-25 rock shelter yielded Neolithic projectile points, including the first Fasad and Trihedral types to be found in central Oman. A second team studied lithic material stored in the MHT storeroom in Nizwa at the Museum Across Ages in Manah.

في مطلع العام 2024، شارك باحثون من ثماني دول في أعمال ميدانية في الدقم وفي موسم دراسي بمتحف عُمان عبر الزمان في ولاية منح. استمر الفريق الأول في الدقم في أعمال التنقيب في مقبرة جماعية من العصر الحجري الحديث وفي توثيق مواقع الفن الصخري مع اكتشاف لوحة فنية صخرية ذات طابع بحري تحمل السلاحف الجلدية الظهر وغيرها من الكائنات البحرية. وأسفرت الحفريات في ملجأ DUQ-25 الصخري عن اكتشاف رؤوس مقذوفات من العصر الحجري الحديث بينها أول أنواع الفسد ورؤوس السهام ثلاثية الأوجه التي تم العثور عليها في وسط عُمان. فيما قام الفريق الثاني بدراسة مواد حجرية محفوظة في مخزن متحف عُمان عبر الزمان في ولاية منح.

The 2023–2024 field season of the ARDUQ expedition comprised two campaigns: ARDUQ_3A in Duqm and ARDUQ_3B in Manah (Garba *et al.* 2024).

The primary aims of the Duqm fieldwork were: 1) continuation of the excavation of the Neolithic megalithic collective burial mound DM28.46/NAF.644; 2) Expansion of rock art documentation in Wadi Nafūn, with a focus on petroglyphs. 3) Further excavations of the Neolithic rock shelter DUQ-25 in Wadi Ṣayy (Duqm). 4) Geoarchaeological investigations of selected areas and stratigraphic profiles in Duqm and Nafūn.

The main goal of the second team in Manah was to study Palaeolithic material from Dhofar stored in Nizwa, carrying out attribute and patination/surface weathering analyses, as well as 3D scanning.

Archaeological landscape of Nafūn

The Wadi Nafūn north of Duqm is one of the most impressive and important cultural landscape areas in southeastern Arabia (Fig. 1). Nafūn was an important place of social gathering and mobility. A total of 214 archaeological sites in Nafūn provide a unique insight into the communities and trade of central Oman from the Neolithic to the Late Iron Age. The archaeological landscape of Nafūn encompasses a diverse array of elements:

- *Shell midden complex*: The Nafūn shell midden complex is a unique coastal settlement located on eight shell mounds with evidence of seasonal occupation and limited metallurgical activities (Danielisova *et al.* 2024). Excavations in year 2020 yielded marine shells, fish remains, carnelian beads, and charcoal samples for radiocarbon dating placing shell midden to Early Iron Age 1012–536 BCE.
- *Rock art sites*: The pegged figures (500+) and important ancient scripts (200+) are located on 56 horizontal rocks and are the first known in south-central Oman (Al-Wusṭā Governorate). This visual record spans circa 6000 years and is unique for southeastern Arabia (Fossati and Garba 2025).
- *Megalithic collective grave DM28.46/NAF.644*: An exceptional structure in the context of Arabia, combining monumental architecture and collective deposition of human remains of more than 50 individuals, dated to the Neolithic period 4946–4673 BCE.
- *Triliths*: Are enigmatic 2000-year-old ritual stone monuments located on the terraces of the banks of Wadi Nafūn. The area contains 22 trilith sites, the highest concentration in south-central Oman, and exceptional configurations such as the longest trilith platform in Oman or "sacred hill" site where hearths are placed on the foot of the hill. The radiocarbon dating from Nafūn trilith hearths indicates period of use 96 BCE–78 CE.

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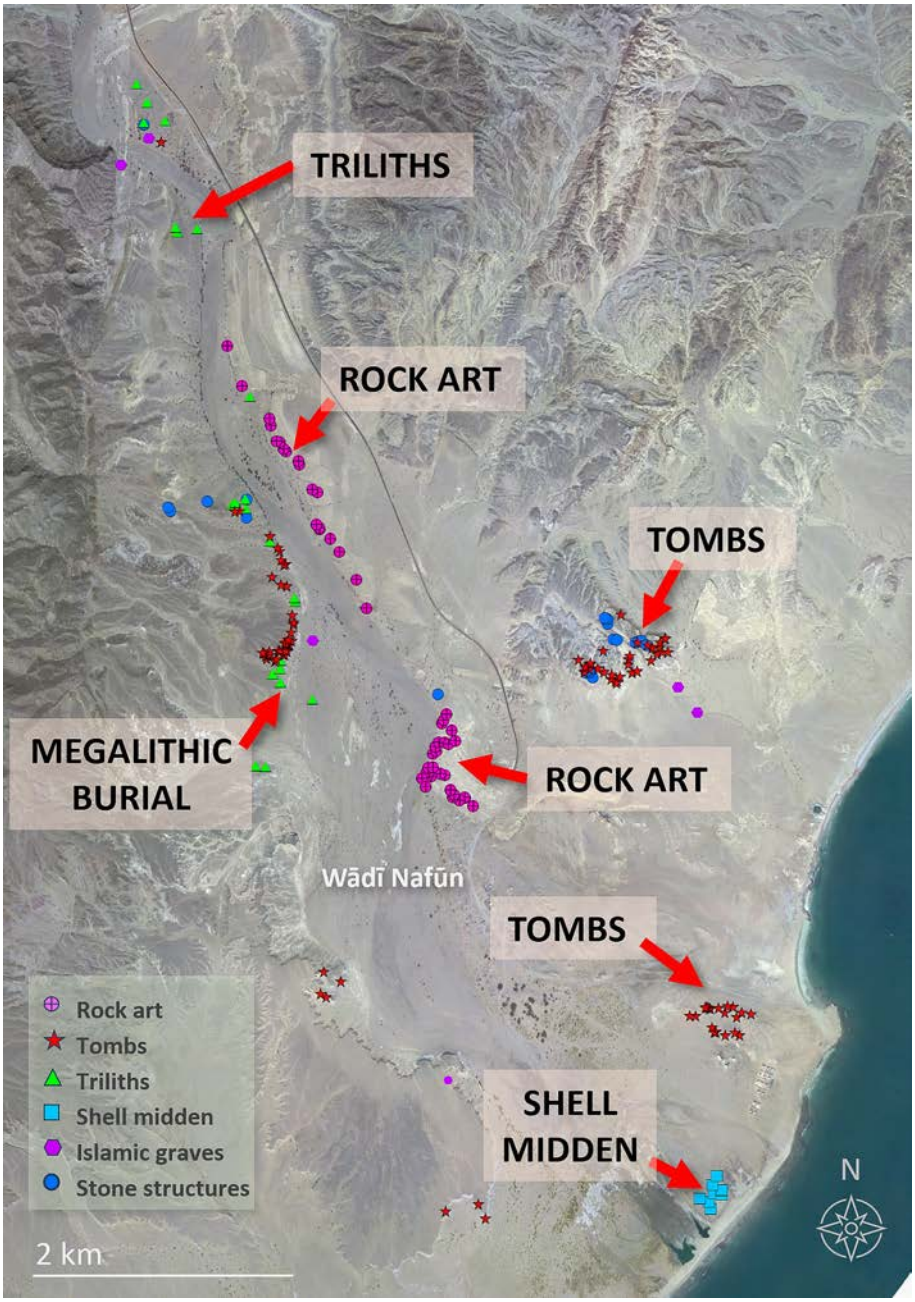

Figure 1. Nafūn landscape with archaeological sites. Source: ARDUQ/R. Garba

- *Cairn tombs and stone circles*: The area survey mapped 22 stone structures suggesting settlement huts and 106 cairn tombs, most likely of Iron Age origin and possibly earlier periods.

Rock Art and Inscriptions

The ARDUQ 3A campaign revealed ten more engraved rocks, all of which are located at the current north-eastern edge of the Aṣ Ṣufayyah limestone outcrops. This brings the total number of engraved surfaces to 59. The engravings are on flat limestone rocks that are slightly inclined towards the west, i.e. towards the riverbed. The surfaces are made up of whitish grey, cream or orange limestone, which is often very smooth where the petroglyphs have been drawn. These solid outcrops rise above the surrounding lower areas by a few centimetres to several metres, and are separated from each other by silt and sand, where shrubs often grow.

In this 2024 campaign, the survey and analysis focused mainly on four rocks (ASF 46, 47, 48 and 49) featuring interesting themes, such as marine figures (ASF 49), hunting scenes (ASF 47, 48 and 49), and unusual inscriptions (ASF 46). Of particular interest is 'Marine Life' Rock 49 (Fig. 2), which features leatherback turtles (Dermochelys coriacea), a

Figure 2. Rock art panel No.46 with marine life petroglyphs, Nafūn, al Wusṭā. Source: ARDUQ/A. E. Fossati.

sperm whale, squid, jellyfish, a mola mola and a ray or flying fish. This panel is unprecedented in Arabian rock art and rare worldwide. Rock 49 was traced in its entirety and divided into seven sectors (A to G), containing more than 150 figures, of which half are significant. Sector A contains around 100 figures, sector B contains 13 figures, sector C contains four figures, sector D contains 15 figures, sector E contains 11 figures, sector F contains five figures and sector G contains four figures. Sector A features a variety of marine animals, including an exceptional group of 12 turtle figures, nine of which are leatherback turtles (Dermochelys coriacea), while the remaining three are unidentifiable. There are also some possible turtle egg figures, including two in which the young turtle is depicted emerging from the egg, showing its head or head and paws. In two other cases, only the eggs are visible. Leatherback turtles are identifiable by their distinctive longitudinal crests, of which there are seven in nature, but in rock art they are depicted with an irregular and smaller number of crests, ranging from one to four. Additional panels depict ostriches, lions and horsemen, some of which are dated to circa 1st millennium BCE. During this tracing campaign, the focus was primarily on figurative art rather than the inscriptions in the South Arabian alphabet, which had constituted the majority of the previous 2023 campaign's work. Nevertheless, over 200 South Arabian inscriptions were recorded. The rock art research is led by Angelo E. Fossati (University of Cattolica del Sacro Cuore, Milan, Italy) and supported by linguist Mounir Arbach (CNRS, France).

Neolithic megalithic tomb DM28.46/NAF.644

The NAF.644 (later marked as DM28.46) burial mound is located on the western edge of the wadi on the first flat sand and gravel terrace above. This mound is part of a larger monument complex around the path that could run through the wadi to the coast and visually align with the Al-Hamr Island, a marker for the Nafūn-Duqm coastal landscape. In the previous seasons, the burial structure was established to belong to the Neolithic period. Twenty-two radiocarbon dates place the mound in the first half of the 5th millennium BCE. Bayesian modelling in

Figure 3. Megalithic collective burial DM28.46/NAF.644 showing burial clusters and standing stone stelae, Nafūn, al Wusṭā. Source: ARDUQ/R.Garba.

OxCal v. 4.4.4 established the use of the structure between 4946 and 4673 BCE, i.e. more than 200 years. The tomb (Fig. 3) was constructed with local limestone slabs and has an oval chamber of 6.09 x 5.52 meters. Rubble and aeolian sands was used as filling material between walls. Five standing stone stelae marking the original entrance or ritual area. Twenty burial clusters were identified. Human remains included disarticulated bones and articulated skeletons in fetal positions. A crescent-like arrangement of remains along the chamber walls was observed. The stratigraphic sequence reveals a complex history of reuse and secondary manipulation of remains.

This season brought forward a unique opportunity to excavate undisturbed contexts as, unlike the northern part, the southern half of the burial mound was not disturbed by the later burial activities (of the Iron Age) and also by the collapse of the inner wall perimeter as was observed in the case of the southern half. The excavations provided invaluable information about the original organisation of the burial chamber in Mound 1. This unique structure

contained more than 60 individuals, but the number of deposited individuals was probably much higher. The structure was built with the intention of a particular area designed for the placement of the burials and a paved area of an "entrance" (from the western side). Two articulated skeletons ("Jacoby" and "Valentine") were found in prominent positions near the original entrance, suggesting special social or ritual status. One of the individuals held a grinding stone-like object, possibly symbolizing craft or ritual function. Dental and osteological analyses indicate advanced age and suggest dietary adaptations consistent with mixed coastal and terrestrial resources. Bioapatite radiocarbon dating should prove whether this was the first generation of burials and a ritual beginning of the burial structure. During time the volume of sediments increased, and the original concept was abandoned in favour of a more haphazard placement of burial clusters. However, the intention still was to use the eastern side more intensively for burial purposes. Only in the latest period, and perhaps due to the collapse of the chamber walls in the north-western area, this space was also used for placing the bones. It is expected that the latest clusters were younger, but the ^{14}C analysis conducted on charcoals so far has not been able to detect any chronological trends apart from the fact that the structure has been used for more than 200 years. Isotopic and geochemical analyses are underway to investigate diet, mobility, and material provenance. Preliminary strontium isotope data suggest some individuals may have originated from coastal environments, while others had inland signatures. Material culture (Fig. 4) includes Perforated marine shells (Volverina sp., Dentalium, gastropods); shark teeth ornaments, both perforated and unperforated; chlorite beads and a trapezoid shell pendant; worked limestone hammers and a pebble with use-wear traces; and turtle breastplate bone, possibly symbolic. In the next season, the main attention will be then dedicated to the conjunction of Mound 1 to Mound 2 and an accurate chronological assessment of the building and burial activities onsite. A trench – aiming for at least half of the structure will

Figure 4. Material culture from DM28.46/NAF.644: a) shark teeth; b-g) Beads and shell ornaments (chlorite, softstone, Dentalia, Volverina). Source: ARDUQ/A. Danielisova/M.P.Maiorano.

be excavated in Mound 2 to assess the concept of the structure and burial rites there. Also, an exact chronological assessment will be part of the planned activities for the next season. Isotopic collection of baseline samples is planned to continue in the next season as well, this time more focused on water and plant samples. A prospection aimed at the location of the neolithic settlements based on the terrain assessment and the isotopic analysis is the final plan for the next season. The excavation is led by Alžběta Frank Danielisová (Institute of Archaeology Prague, Czechia).

Neolithic rock shelter DUQ-25

During the 2023–2024 season, the ARDUQ expedition continued to excavate the rock shelter at DUQ-25A (Fig. 5). DUQ-25A is situated almost 250 metres from a tributary of Wādī Ṣayy (Maiorano *et al.* 2023). Strategically positioned beneath a small shelter and on a slope within an ancient gully, the site runs from east to west and measures approximately 10m in length and 5m in width. Currently, the overhang of the upper part of the shelter extends no more than one metre. The rock shelter owes its existence to the incised, interbedded, bioclastic limestone terrace originating from the Dammam Formation. This terrace contains embedded echinoids, molluscs, and quartz fragments.

The team extended a test trench across the archaeological deposit to investigate the following: 1) to verify whether the population inhabiting the shelter was contemporary with, and related to, the population buried at Nafūn, thereby confirming the chronology through ^{14}C dating; 2) to reconstruct the production process of arrowheads and the cultural connections with other sites in Dhofar and Ash-Sharqiyyah; 3) to explore the dietary habits of the Final Palaeolithic and Neolithic people of Duqm. New excavations recovered a number of projectile points and other diagnostic lithic artefacts (Fig. 6), mainly in a stratified context with charcoal for ^{14}C dating. Fasad and Trihedral points were found in central Oman for the first time. Lithic assemblage analysis focused on the morphological and technological analysis of the artefacts, and use-wear analysis to identify their functions. DUQ-25A rock shelter, Duqm has proven to be a site of considerable archaeological importance, offering profound insights into the Early and Middle Holocene period in Oman. Our recent excavations revealed the first site to show the transition from the final Palaeolithic period (8th millennium BCE) to the Middle Neolithic period (6th millennium BCE), passing through the 7th millennium, a period that is still unknown in Oman. The extensive assemblage of over 6,300 lithic artefacts includes a remarkable abundance of façonnage elements. This diverse collection highlights innovation in stone tool technology from the Late Palaeolithic to the Neolithic and provides a comprehensive view of occupational and subsistence strategies. Radiocarbon dating has played a crucial role in establishing a precise chronological framework for the site. With four radiocarbon dates already obtained and a further 20 charcoal samples submitted for analysis, we are on the verge of accurately dating the stratigraphic sequence. This will enable us to identify the periods of occupation more precisely and gain a clearer understanding of the temporal dynamics of the site. The discovery of 32 diagnostic projectile points, 20 of which were found within the excavation layers, establishes DUQ-25A as the first site in Oman where the transition from the Late Palaeolithic to the Neolithic has been documented. This significant find provides valuable insights into the cultural and technological changes that occurred during this period. The excavation is being led by Maria Pia Maiorano (Institute of Archaeology, Prague, Czechia).

Landscape evolution and environmental dynamics

The first team conducted landscape and environmental reconstruction by carrying out test pits and sediment sampling around Nafūn and Duqm South, providing a lithostratigraphic description of selected profiles in Duqm and investigating the 'stromatolite' geosite in Wadi Saay. Geomorphological mapping included three test pits for desert pavement and surface soil characterisation because the surface of fine sediment is most often made up of vesicular crust (Av horizon), which conserves the fine sediments and soils below. A focused study was performed on the weather classification of the rock surfaces in Nafūn to enable the rock art sites to be relatively dated. In Duqm South, the ASK-4, WAQ-1 and WAQ-2 profiles, for which samples were collected for OSL dating, were described in detail, including sediment layer descriptions and profile drawings. These samples will be used for a geomorphological

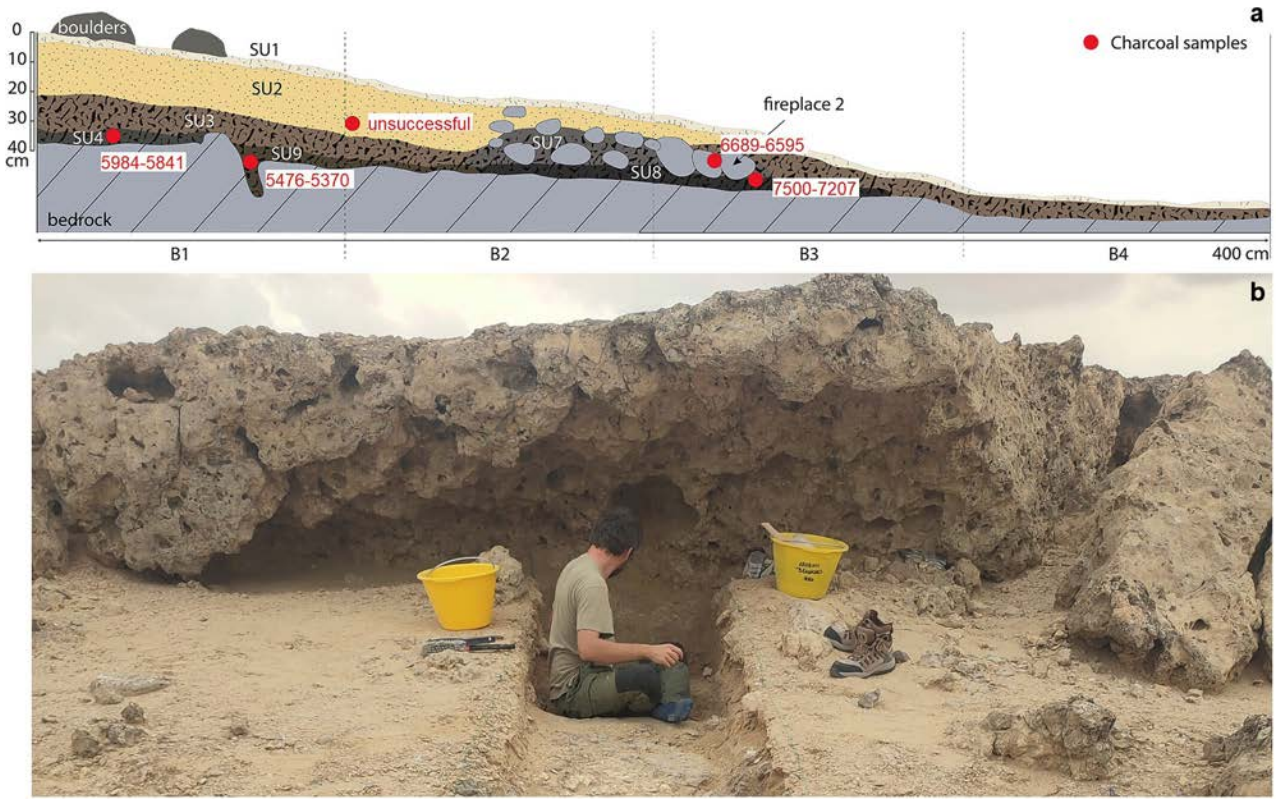

Figure 5. DUQ-25 Neolithic rock shelter: a., excavated profile with radiocarbon dates; b., General view of rock shelter with excavated trench. Source: ARDUQ/M.P. Maiorano.

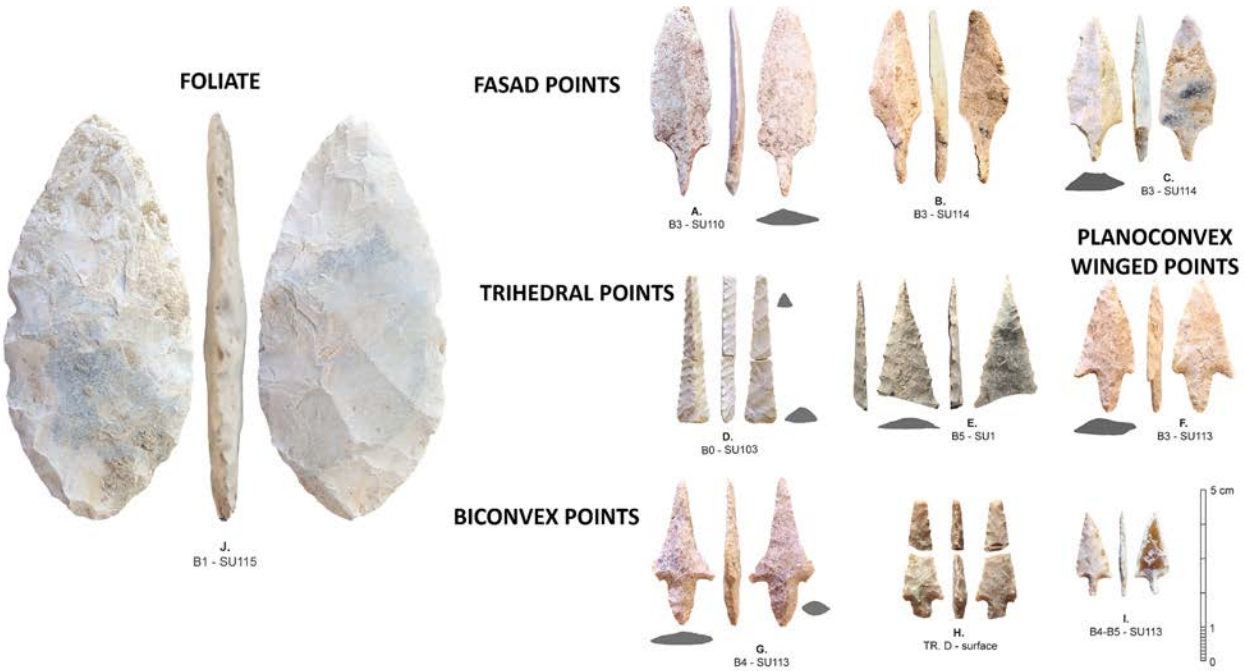

Figure 6. DUQ-25 Sample of lithic assemblage at DUQ-25 Neolithic rock shelter, Duqm, al Wusṭā. Source: ARDUQ/M.P. Maiorano.

study of the landscape evolution of Duqm once the OSL dates are available. The ASK-4 profile is an archaeological site with a cultural layer consisting of blade lithic industry. Isotopic background mapping of local hydrology and sedimentation was conducted to provide detailed information on the rock lithologies and their strontium (Sr) isotopic composition within the wider Nafūn area. Twenty-two rock samples were collected from the wider Nafūn area to investigate variations in $^{87}Sr/^{86}Sr$, and an additional two samples were collected directly from the Nafūn archaeological site, representing the burial chamber walls (limestone and dolomite) with a supposed Cretaceous and Neoproterozoic-Cambrian age, respectively. Finally, a water sample was collected directly from Nafūn Wadi to complete the dataset. The obtained Sr isotopic data outline the variation in bedrock and environmental $^{87}Sr/^{86}Sr$ values needed to interpret enamel data. The geoarchaeological fieldwork was led by Tara Beuzen-Waller (University of Perpignan Via Domitia, France). The isotopic background mapping was conducted by Lukas Ackerman (Institute of Geology, Czech Geological Survey, Czechia).

Middle Stone Age/Middle Palaeolithic of Dhofar

The ARDUQ 3B study focused on the lithic material stored in the MHT storage room in Nizwa. The Oman Across Ages Museum in Manah provided the study room and supporting facilities. A total of 35 boxes containing lithic artefacts from the Dhofar Archaeological Project (DAP) were studied. The taphonomy of the lithic material from selected sites was examined in order to address the research question of whether we can utilise lithic taphonomy to develop relative chronologies at surface sites, given that the chemical composition of Omani cherts provides an opportunity to explore lithic taphonomy as a temporal and palaeoenvironmental archive. A publication on lateral stratigraphy incorporating analyses of lithic taphonomy scores from this study season has recently been published in the Journal of Archaeological Science (Rose *et al.* 2025). Additionally, two further analyses were conducted: 3D scanning of Nubian Middle Palaeolithic cores and Lower Palaeolithic bifaces by Emily Hallinan (Universidade do Algarve), and a study of Nubian points by Metin Eren and Michele Barber (University of Kent). These studies support models of human dispersal along southern Arabia and contribute to debates on 'Out of Africa' migrations. The study season was led by Jeffrey I. Rose (Universidade do Algarve, Faro, Portugal).

Conclusion and future perspectives

The third season of the ARDUQ expedition continued to lay the groundwork for archaeological research in south-central and southern Oman. The first study area, Duqm, is rich in heritage sites and represents a fusion of northern and southern cultural circles in southeastern Arabia. The Nafūn area in particular, with its shell middens, trilith monuments, extensive rock art clusters, cairns and unique Neolithic collective burial site, has the potential to become a major cultural attraction in central Oman, supporting tourism. The second study area, the Nejd plateau in Dhofar, provides an extraordinary wealth of Palaeolithic sites and is of global importance, placing Oman at the heart of discussions about human dispersal and evolution out of Africa. The fourth season of the ARDUQ expedition in Duqm will focus on excavating Mound 2 at DM28.46 in Nafūn, conducting further lithic analyses and isotopic studies, and carrying out surveys of Neolithic settlements and expanded palaeoenvironmental investigations. The second team investigating the Palaeolithic sites in Dhofar will not perform fieldwork for ARDUQ season 4, instead focusing resources on processing the collected material and writing publications.

Acknowledgements

The 3rd ARDUQ season was funded by the Czech Academy of Sciences (Praemium Academie of Viktor Černý). The radiocarbon dating was supported by OP RDE, MEYS No. CZ.02.1.01/0.0/0.0/16_019/0000728. Additional funding for participating experts was provided by Kent State University, and the University of Perpignan Via Domitia. We extend our gratitude to the Ministry of Heritage and Tourism, Sultanate of Oman, for granting permission for fieldwork and access to Nizwa storage, and to the Special Economic Zone Al-Duqm (SEZAD) for providing local support in Nafūn. Team members and guest researchers: ARDUQ 3A/

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Italian Archaeological Project at Ash-Shukur (Sapienza University of Rome) (2023-24): A Multi-Period Fortified Settlement

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The Ash-Shukur settlement in Oman's Dhank region is a multi-tiered fortified site occupied from the Bronze to Early Iron Age. Excavations revealed a central tower, terraced walls, domestic and production areas, and multiple construction phases. Artefacts include Umm an-Nar, Wadi Suq, and Early Iron Age ceramics, stone tools, metal fragments, shells, and ritual objects, indicating domestic, craft, and cultic activities. The site's strategic location along inland trade routes, near copper and soft-stone sources, suggests its socio-economic importance. Findings highlight continuity of occupation, phased expansion, and the central role of Ash-Shukur in regional settlement and trade networks.

موقع الشكور في ولاية ضنك بسلطنة عُمان هو موقع محصن متعدد الطبقات تم استيطانه من العصر البرونزي إلى أوائل العصر الحديدي. كشفت الحفريات عن برج مركزي وجدران متدرجة ومناطق سكنية وإنتاجية ومراحل بناء متعددة. تعود القطع الأثرية التي عثر عليها إلى فترات أم النار ووادي سوق، وهنالك أوان خزفية تعود إلى أوائل العصر الحديدي، وأدوات حجرية وشظايا معدنية وأصداف وأدوات طقسية، مما يشير إلى أنشطة منزلية وحرفية وعبادية. يشير الموقع الاستراتيجي لِموقع الشكور على طول طرق التجارة الداخلية بالقرب من مصادر النحاس والحجر الناعم، إلى أهميته الاجتماعية والاقتصادية. تسلط الاكتشافات الضوء على استمرارية الاستيطان، والتوسع التدريجي، والدور المركزي لموقع الشكور في شبكات الاستيطان والتجارة الإقليمية.

The Dhank region has long been a focus of archaeological research (Costa 2006). Ash-Shukur was first reported to the Department of Excavations by G. Weisgerber in 2004. Since 2010, Temple University has investigated the site under the *SoBO* project, studying Bronze Age burial landscapes. Fieldwork and surface collections indicate that Ash-Shukur is part of a larger archaeological landscape including Umm an-Nar cemeteries, now separated by a modern farm (Williams & Gregoricka 2013).

Ash-Shukur is located on the western slopes of Jebel Al Abyad, in the Wadi Dhank plain south of Dhank town (23°31′54″ N, 56°15′34″ E). The floodplain features braided channels, sediment bars, ephemeral streams, and low terraces. The settlement core occupies one of the lower elevations (Fig. 1).

Settlement Configuration

The main mound rises about 5 m and spans ~83 m, forming three tiers (Fig. 2).

- T.1: The lowest tier, 83–85 m in diameter, consists of irregular boulders curving clockwise ~280°, with traces of internal partitions and ~40 cm of silty sediment, likely from eroded mudbrick.
- T.2: Central terrace (~50 m diameter), slightly northwest, rises >1 m above T.1, with small boulders forming a partially visible outer wall.
- T.3: Upper terrace, slightly southwest and higher, likely the original Bronze Age tower. Medium limestone blocks form a curved enclosure (~21 m), with mudbrick remnants indicating defensive features.

The site, covering ~1.36 ha, is enclosed by at least three walls. The central citadel likely represents the earliest occupation. Artefacts from Umm an-Nar, Wadi Suq, and Early Iron Age periods suggest phased expansion, including new enclosures and ancillary structures.

Excavated Sectors

The excavation aimed to expose the archaeological remains across the three settlement tiers. After removing the surface layer of loose yellow-grey sandy sediments mixed with ceramics and lithic tools, stratigraphic excavations were conducted in Sectors I–III.

Sector I

This sector revealed the core of the settlement: a circular Bronze Age tower wall, partially exposed to a height of 50–80 cm and enclosing an area about 22 m across. Limited excavation focused on clearing surface deposits and sediments to reveal the upper wall layout. Abundant, black-painted Wadi Suq pottery and large stone blocks in Umm an-Nar style confirm the tower's antiquity, while charred seeds

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Figure 1. Overview of the Ash-Shukur settlement from the north/west with an indication of the terraces.

provided radiocarbon evidence for occupation around the transition to the 2nd millennium BCE. A compact clay surface against the tower indicates a trodden floor, marking the sector's excavation limit.

Sector II

Downslope from the tower, Sector II spans 14 × 10 m and contains three terraced levels delineated by stone walls. Excavation revealed two main phases:

- Phase 1 corresponds to abandonment, marked by collapsed walls, eroded mudbricks, and layers of ceramic and lithic debris, dominated by Wadi Suq pottery.
- Phase 2 reflects occupation, including terracing walls-oriented east-west, mudbrick floors, and structural additions. A large south-west wall, up to 1 m high, was dated to the Early Iron Age, while additional parallel north-south walls, combining stone and mudbrick, likely represent internal subdivisions. Overall, the sector demonstrates repeated construction, collapse, and reorganization over time.

Sector III

Located at the mound's southwestern base beyond the fortified enclosure, Sector III covers approximately 400 m², divided into northern (16 × 10 m) and southern (20 × 12 m) areas. Excavation focused on a 20 m-long enclosure wall with over two metres height difference between north and south sections, revealing a double defensive structure and three partially preserved rooms, two with hearths dated to the Early Iron Age. Artefacts included 2294 pottery sherds, 69 stone tools, and sporadic metal and soft-stone fragments. The wall shows at least two construction phases, with rubble-core masonry and larger outer stones reinforcing the façade. Future excavations will clarify construction sequences and room boundaries.

Finds Review

Ceramics dominated (92–98%), primarily coarse buff/orange ware, with fine wares often slip-decorated or painted. Wadi Suq painted pottery was most frequent in Sector II. Stone tools, mostly fragmented, included grinding stones, anvils, ham-

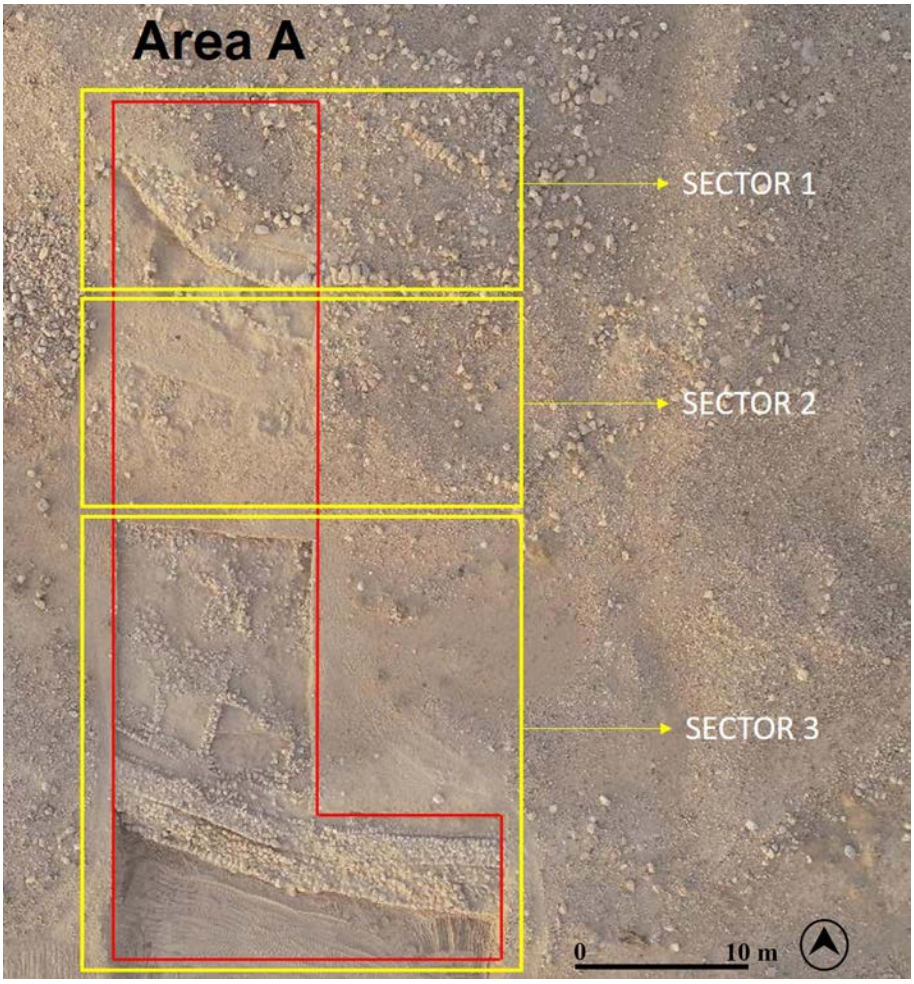

Figure 2. Area A of the excavation divided into three sectors.

Figure 3. Detail of the exposed portion of the tower at the head of the mound.

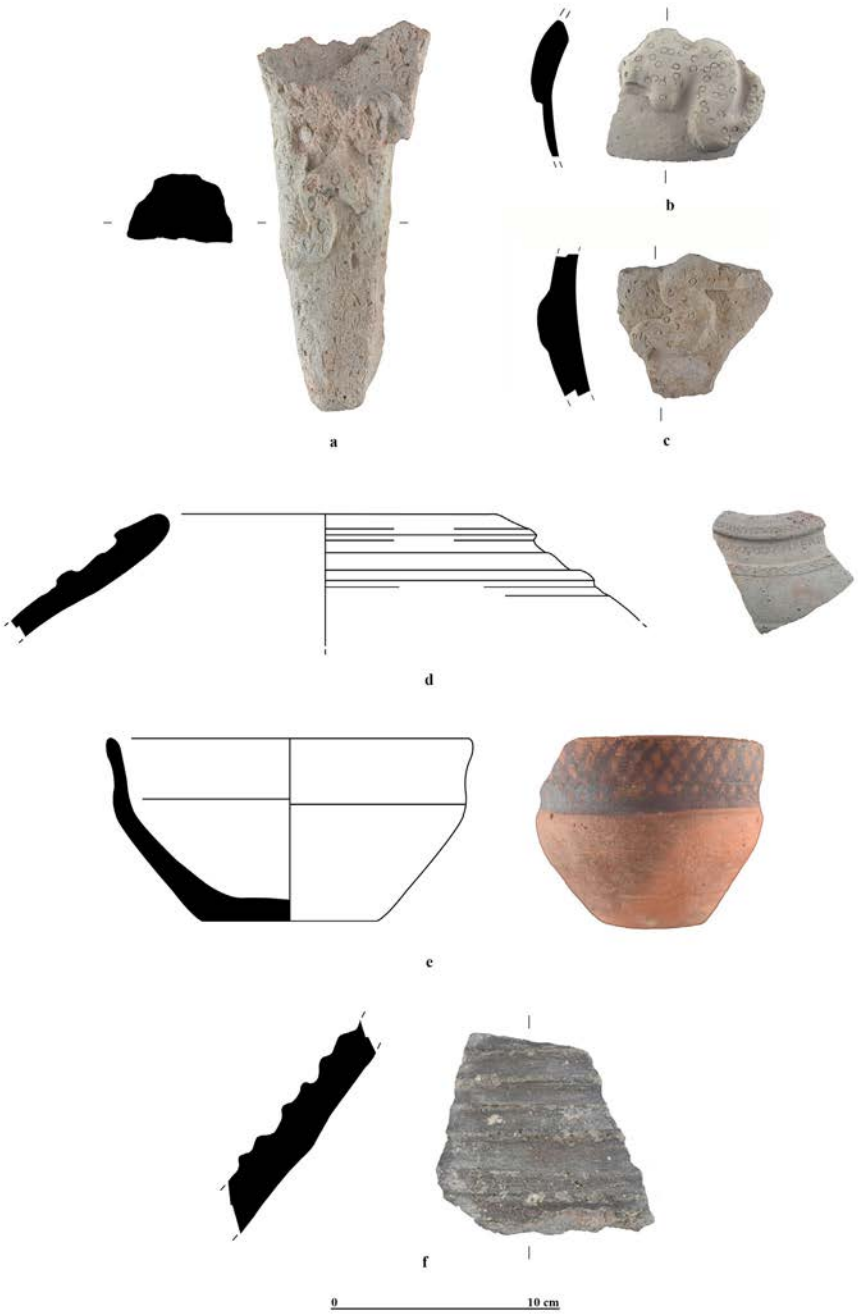

Figure 4. Selection of Iron Age pottery finds.

mers, mortars, pestles, whetstones, and a spindle; some were reused in wall construction. Shells (22 specimens) occurred mainly in Sector III, including marine gastropods and bivalves, some used as containers. Fragmentary clay figurines, pottery lids, and stone vessel fragments indicate domestic and ritual use. Metal finds were limited, mostly copper/bronze fragments, concentrated in Sector III, alongside beads of various sizes. The ceramic assemblage is primarily Early Iron Age II, with large storage jars in coarse buff or orange ware, decorated with incised or plastic motifs, including the snake motif. Wadi Suq pottery occurs in Sector II/I, and a single black-on-red sherd hints at Umm an-Nar origins. The presence of numerous stone tools suggests workshop areas, with some reused as building material. Overall, the artefacts reflect continuous occupation from the Umm an-Nar through Early Iron Age, documenting domestic, craft, and ritual activities.

Final Observations

Ash-Shukur was a fortified settlement occupied between the 2nd and the 1st millennium BCE, characterised by extensive walls and likely bastions. A major expansion occurred in the later 2nd millennium BCE, with the construction of domestic and production areas within the external fortifications, evidenced by numerous storage jars and stone tools. Like other Iron Age sites such as Bithnah and Muweilah, Ash-Shukur may have included a ritual area, suggested by pottery decorated with serpent motifs. The central mound preserves traces of Early and Middle Bronze Age occupation, with Wadi Suq ceramics and large squared stones typical of Umm an-Nar architecture.

Future studies aim to confirm continuity from the Early Bronze Age through the Early Iron Age, as indicated by similar stratigraphy and artefact sequences at sites such as Al-Khutm (Cocca *et al.* 2019), Salut, Hili, and Tell Abraq. These comparisons support the view that Ash-Shukur began in the Early Bronze Age and was expanded over time, retaining strategic and cultural significance. Its prominent location suggests the tower symbolised the community's control over a key route between desert and mountains, likely tied to the development of nearby oases.

The site's size and position also point to its role as a trading hub along inland routes connecting the coast, mountains, and desert. Proximity to Hajar copper mines, local soft stone deposits (chlorite and steatite) (Harrower *et al.* 2016), and caravan routes (Potts 1988) would have made Ash-Shukur a pivotal centre for socio-economic activity during the 2nd and 1st millennia BCE.

Acknowledgements

The authors would firstly like to thank the Ministry of Heritage and Tourism of the Sultanate of Oman for their continued support in their research. We would like to thank the Minister His Highness Salim bin Mohammed Al-Mahruqi, Mr. Sultan Al-Bakri, Special advisor for Heritage to H.E. the Minister of Heritage and Tourism and Ali Al-Mahruqi, General Director of Archaeology. Moreover, the main thanks go to La Sapienza University of Rome, which supports our research in Oman, as well as ISMEO (International Association for Mediterranean and Oriental Studies) and MAECI (Italian Ministry of Foreign Affairs and International Cooperation).

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A Rasulid Mosque at Al-Balid: New Excavations and Interpretative Perspectives

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During the 2023–2024 field seasons, the Italian Archaeological Mission at Al-Balid (IAMOB) resumed investigations at mosque BA074, located in the centre of the ancient settlement. The mosque was part of a larger religious complex that the excavations have now brought to light, including a rectangular-plan minaret, a spacious area for ablutions, and a small funerary enclosure containing six burials. Full exposure of the structure confirmed a construction date in the 13th century, corresponding to the period of Rasulid domination in the Dhofar region. However, a trench excavated in the south-west corner of the prayer hall revealed that the mosque had been built over an earlier structure. The recovered assemblage includes locally produced and imported ceramics, glassware, coins, and fragments of gypsum plaster decorated with geometric and epigraphic motifs. Aerial photogrammetry and 3D modeling were employed to support documentation and to inform a virtual reconstruction of the complex.

خلال موسمَي الحفريات 2023–2024، استأنفت البعثة الأثرية الإيطالية في البليد (IAMOB) الحفريات في المسجد الواقع (BA074) في وسط المستوطنة القديمة. كان المسجد جزءًا من مجمع ديني أكبر. أظهرت الحفريات مكوناته الآن، بما في ذلك مئذنة ذات مخطط مستطيل، ومنطقة واسعة للوضوء، وسور جنازي صغير يحتوي على ست قبور. أكد الكشف الكامل عن البناء تاريخ إنشائه في القرن الثالث عشر، وهو ما يتوافق مع فترة سيطرة الرسولية على منطقة ظفار. ومع ذلك، كشف خندق حفري في الركن الجنوب غربي من قاعة الصلاة أن المسجد بُني فوق بناء أقدم. تشمل المجموعة المستردة فخارًا محلي الصنع ومستوردًا، وزجاجيات، وعملات معدنية، وقطعًا من الجص مزينة بزخارف هندسية ونقوش كتابية. تم استخدام التصوير الجوي الفوتوغرافي والنمذجة ثلاثية الأبعاد لدعم التوثيق والمساهمة في إعادة بناء افتراضية للمجمع.

The field activities carried out by the Italian Mission of the University of Naples L'Orientale at Al-Balid (hereafter IAMOB) during the 2023–2024 field seasons focused on continuing the archaeological investigations initiated in 2021. The team, comprising R. Giunta, A. D'Andrea, A. Pavan, R. Valentini, C. Passaro, and A. Antonelli, with the support of three local workers, fully exposed the remains of a mosque that had been almost entirely concealed beneath mound BA074. The mound is located at the centre of the ancient settlement (Fig. 1), near both the intersection of the town's two main axes, aligned north–south and east–west, and the so-called "Area B," where a complex of structures of unknown function was uncovered during excavations conducted by P.M. Costa in the late 1970s.

Based on the analysis of its structural features and a preliminary assessment of the associated material assemblage, the building can be confidently dated to the 13th century, specifically to the period of Rasulid control over the Dhofar region (Giunta 2024).

During the 2021–2022 and 2022–2023 field seasons, excavations uncovered the mosque's prayer hall (14.5 × 14.5 m), a hypostyle structure with nine

Figure 1. Aerial photograph of the site, with the location of Mosque BA074 marked in red (© IAMOB 2024).

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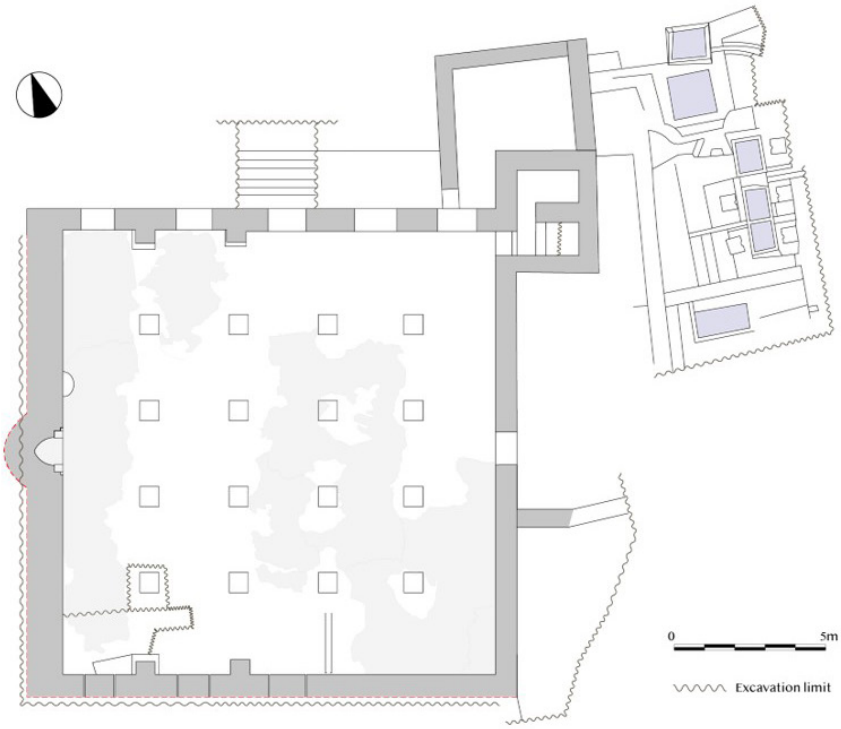

Figure 2. Plan of the religious complex BA074 (Drawing by C. Passaro; © IAMOB 2024).

Figure 3. Deep Sounding 1, showing the foundations of a wall oriented differently from the southern wall of the mosque (© IAMOB 2024).

doorways: one in the wall opposite the *qiblī*, three in the south wall, and five in the north wall. Sixteen monolithic columns, arranged in four rows, were originally set into square sockets measuring 65 × 65 cm. The structure notably lacks a courtyard. All columns have disappeared, leaving only the roughly square foundations in place.

The primary evidence for the original appearance of these elements consists of four fragmentary examples, now on display at the Museum of the Frankincense Land in Salalah, and the tentative reconstruction published by Costa in 1982 (120, fig. 7). The *miḥrāb* (1 m wide) was located at the centre of the western wall and was flanked by two granite semi-columns, of which only a few fragments survive. The roof of the prayer hall was supported by wooden beams. The minaret, built against the northern end of the eastern wall, was accessed through a doorway in the prayer hall's eastern wall. Of the minaret tower, which has a rectangular plan (4.10 × 3.30 m), only the sill remains, from which a few steps ascend to a height of about 1 m.

Both the prayer hall and the minaret were built of local stone bonded with mortar, with the interstices packed with small stone fragments and chips. The structures stand on a raised platform about 1 m above street level and 4 m above sea level, reflecting a tradition typical of mosque architecture in Dhofar and parts of Oman (Costa 2001; Giunta 2024).

Excavation activities conducted during the most recent campaign brought to light the external face of the eastern wall of the prayer hall (to the left of the main entrance), the entire lower section of the minaret—flanked to the east by a staircase—and, further east, a large area used for ritual ablutions (Fig. 2).

The ablution area comprises five stone basins coated with a thick layer of hydraulic plaster, a well, and part of a basin that was likely used for watering animals. The five central basins were interconnected through multiple openings at various heights, allowing for the inflow and outflow of water via a complex system of channels. A funerary enclosure was also discovered to the north of the minaret, containing six stone-built graves, perfectly aligned and correctly oriented towards Mecca.

Two deep soundings were also carried out in the south-western part of the prayer hall. The first trench DS1 (2.60 m E–W × 1.90 m N–S) made it possible to assess the depth of the foundations of the southern wall of the prayer hall and of one of the column bases of the first row (SU4). The second trench DS2 (1 m E–W × 2.50 m N–S) aimed to investigate the consistency and nature of a short N–S alignment (W9) found in front of one of the three southern doorways of the hall. Trench DS1 also led to the discovery (at a depth of 2.50 m) of a small portion of the foundations of a wall upon which part of the southern wall of the prayer hall is built (Fig. 3). This earlier wall, also running E–W but with a slightly different orientation compared to the southern foundation wall of the mosque, is associated with a compacted earthen floor.

The presence of structures beneath a couple of the site's mosques had already been noted during the investigations conducted by Paolo Costa and Juris Zarins. Contrary to Zarins' interpretation (2007), and in agreement with the hypothesis put forward by Costa (1982), the wall structure to which the earlier building belonged appears to be chronologically very close to that of the mosque.

Trench DS2 revealed that the alignment rests directly on the floor of the hall, indicating that it was added at a later stage—possibly intended to mark a separation within the space, possibly a prayer area for women.

The excavation activities yielded numerous ceramic fragments—mainly locally produced, as well as Yemen Yellow ware, diagnostic of the Rasulid period, and some sherds from East Asia. A number of small glass fragments were recovered, including a few pieces of enameled and gilded glassware, as well as fragments of glass bangles. Several stone slabs with central cavities—likely functioning as sockets for door pivots—were also found, along with perforated stone objects of uncertain purpose, fragments of stone basins, and a single bead.

Additional finds include five coins, a bone bead, small metal fragments probably related to nails or pins, and a piece of worked wood, possibly part of a piece of furniture. A substantial quantity of animal bone fragments was also recovered, likely associated with a later phase of occupation within the building.

Fragments of architectural decoration carved in gypsum plaster were found within the collapse layer of the minaret. Some bear incised geometric patterns, while others preserve short inscriptions that can be dated to a phase of use of the mosque following the Rasulid period.

Figure 4. Virtual reconstruction of the exterior (a) and the interior (b) of the mosque (Drawing by C. Passaro; ©IAMOB 2024).

During and after the excavation activities, both graphic and photographic documentation of the area was collected. The photographic record also includes drone imagery—kindly provided by Said Al Amri, Supervisor of the Archaeological Park—which enabled the production of detailed and overall photogrammetric models of the entire excavated area. The drone was also employed to document the south-western sector of the site, where the Mission plans to continue archaeological investigations in the forthcoming campaigns.

In order to support the interpretation and communication of the site's original appearance, mission architect Carlotta Passaro developed a virtual re-

construction of the entire complex (Figs. 4*a*,*b*). The 3D model integrates archaeological data with comparative analysis of similar structures and elements of traditional architecture from the Dhofar region. It includes both external and internal reconstructions, providing a spatially accurate and visually informed representation of the building.

Acknowledgements
The Mission was carried out in close collaboration with the Ministry of Heritage and Tourism of the Sultanate of Oman. Its activities were made possible through funding from the Italian Ministry of Foreign Affairs and International Cooperation (MAECI), the University of Naples L'Orientale (UniOr), and the International Association for Mediterranean and Oriental Studies of Rome (ISMEO). The team would like to extend special thanks to Ali Al Kathiri, Director of the Land of Frankincense Sites Department, and Said Al Amri, Director of the Al-Balid Archaeological Park, for their invaluable logistical support and assistance during the fieldwork in Salalah.

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ARI Archaeological Project in Oman (2023–2024): Stepped Pyramid at Khawr Kharfut, Dhufar

Hauck F.R.[1]

This study reports the discovery of a stepped pyramid at the Khawr Kharfut site on the southern coast of Dhufar, Oman. The platform exhibits architectural features reminiscent of southern Mesopotamian stepped structures and suggests connections to broader Neolithic cultures of the Arabian Peninsula. Stratigraphic data, ceramic typologies, and stone ware indicate a well-organized Neolithic settlement that existed at Khawr Kharfut with evidence of long-distance exchange, including possible links with Mesopotamia. The findings provide new insight into the architectural and cultural dynamics of early coastal populations in South Arabia and raise questions about ritual or administrative functions tied to Neolithic maritime networks.

تتناول هذه الدراسة اكتشاف وتحليل هيكل منصة متدرجة في موقع خور خرفوت على الساحل الجنوبي لمحافظة ظفار في سلطنة عُمان. تُظهر المنصة ملامح معمارية تشبه البنى المتدرجة في بلاد ما بين النهرين، مما يشير إلى وجود روابط رمزية أو وظيفية مع ثقافات العصر الحجري الحديث الأوسع في شبه الجزيرة العربية. تشير البيانات الطبقية وأنماط الفخار ومجموعات الأدوات الحجرية إلى وجود مستوطنة من العصر الحجري الحديث منظمة جيدًا، مع أدلة على تبادل طويل المدى، بما في ذلك روابط محتملة مع مناطق شمالية مثل بلاد ما بين النهرين. تقدم هذه النتائج رؤى جديدة حول الديناميكيات المعمارية والثقافية للسكان الساحليين الأوائل في جنوب شبه الجزيرة العربية، وتثير تساؤلات حول الوظائف الطقسية أو الإدارية المرتبطة بالشبكات البحرية.

The Khawr Kharfut Archaeological (ARI) and Ecological Reserve located on the Arabian Sea coast in the Dhufar region of Oman has been under investigation by the Archeological Research Institute since 2014 and is funded by various donors including the Khor Kharfot Foundation, Scott and Mark Gubler, and Brent and Marty Heaton.

Khawr Kharfut is situated at the convergence of the Wadi Sayq canyon and the Arabian Sea at 16°43’51”N by 53°20’E (Fig. 1). Its numerous cultural sites situated within five sectors (I-V) range from Paleolithic through the Islamic period and yield plentiful evidence of a significant Neolithic coastal population utilizing masonry architecture and long-distance trade connections. Situated on the coast, buffered by high cliffs, and perennial freshwater, it is one of the few naturally fortified and sustainable environments in the region. Nestled between the Qamar Mountain escarpments and the Arabian Sea, Khawr Kharfut forms an almost inaccessible but ecologically rich environment featuring an estuary system fed by springs in the canyon walls. Khawr Kharfut’s lagoons coincide with the destruction of the ancient coastal bay ca. CE 1000 due to dense monsoonal slurries coming down the canyon that clogged the bay and raised the adjacent sea floor. The subjection of accumulating mud and rock deposits to tidal and wave energies resulted in the locale’s barrier beach and lagoon. Kharfot’s abundant woodlands, water, maritime resources, and incense in the adjacent highlands would have been particularly attractive to Paleolithic populations expanding northward onto the Arabian Peninsula from Africa. Thus, Khawr Kharfut is a key to better understanding of interregional interaction, trade, and symbolic exchange in South Arabia.

Site IV-1 Stepped Pyramid

This brief article of Khawr Kharfut Site IV-1 provides preliminary stratigraphic, ceramic, radiocarbon, and contextual analyses of a Neolithic Age stepped pyramid and evidence of its architectural and ideological interaction with early Mesopotamia as revealed through careful surface mapping and the 2023-2024 excavations. Although partially eroded, the stepped mound is still prominent in the landscape (Fig. 2). Its placement on the terrace overlooking the sea suggests centralization of ritual and administrative functions.

The stepped pyramid’s construction date has yet to be determined by radiometric analysis; however, stratigraphic, ceramic and stone vessel recoveries suggest its main occupation may have occurred during the 4th millennium BCE. This date seems appropriate because 2016-24 excavations in the nearby Neolithic Site II-4 have produced a variety of radiocarbon dates that mark the initiation of the Neolithic occupation of Khawr Kharfut at ca. 5900 BCE.

The Neolithic construction of the stepped mound was initiated by the excavation of a two-to three-me-

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Figure 1. Map of Coastal Archaeological Sites in Southern Dhufar (Wendell Phillip's historic map redrawn by the author).

ter-deep trench into the sloping terrace situated on the northern or up-slope side of the mound. That Neolithic period trench was created to establish the structure's foundational platform. Thus, during the 2022-2023 season, excavations were initiated to identify the perimeters of that ancient trench. This was done by placing a series of sequential 1 x 1- meter excavations proceeding on a southern heading for the purpose of eventually exposing the mound's buried north wall (Figs. 3 and 4).

The intensive 2023-2024 excavations ultimately exposed a portion of the vertical and stepped masonry associated with the mound's north wall (Fig. 5). That portion of the exposed north wall appears to be partially dressed limestone blocks set in a vertical, coursed fashion. Mud mortar and smaller stones were used to fill the gaps between the stones.

During excavations, burned organic matter, ceramics, metal and glass fragments of the Abbasid occupations (see contexts 3-8 in Fig. 4) were found superimposed over culturally rich, secondary soils (see contexts 9-11 in Fig. 4) containing mixed Paleolithic, Neolithic, Iron Age, and Abbasid artifacts. These secondary soil strata were obtained elsewhere at Kharfot during the Abbasid period to partially refill the Neolithic trench dug into the sloping terrace to construct the foundation platform for the mound. Radiocarbon samples derived from the upper Abbasid occupations corresponded with the dates for carbon extracted from those lower secondary strata: all date between CE 1082 and CE 1110 and thus establish the Abbasid phase (CE 750-1258) as the time when the Neolithic foundation trench was partially filled with secondary soils and cultural matter and that refilled surface was occupied. All subsurface layers including contexts 3 through 11 are covered by rock rubble and cultural debris (contexts 2, 20) that have eroded from the structure's collapsed upper walls.

Figure 2. Mound Site (IV-1) & Rock-lined Walkway Corridor (Site IV-5) in Sector IV. View is looking northeast.

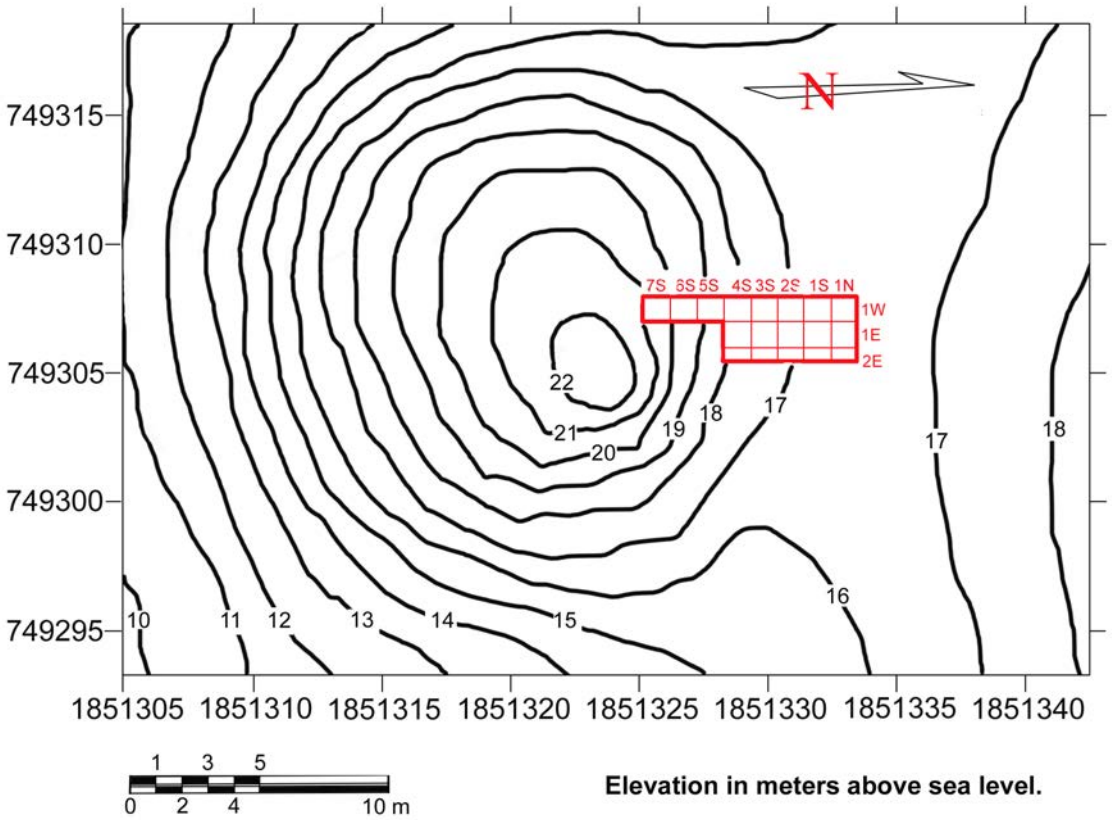

Figure 3. Planview of 2023-2024 Excavations in the North Trench Site IV-1.

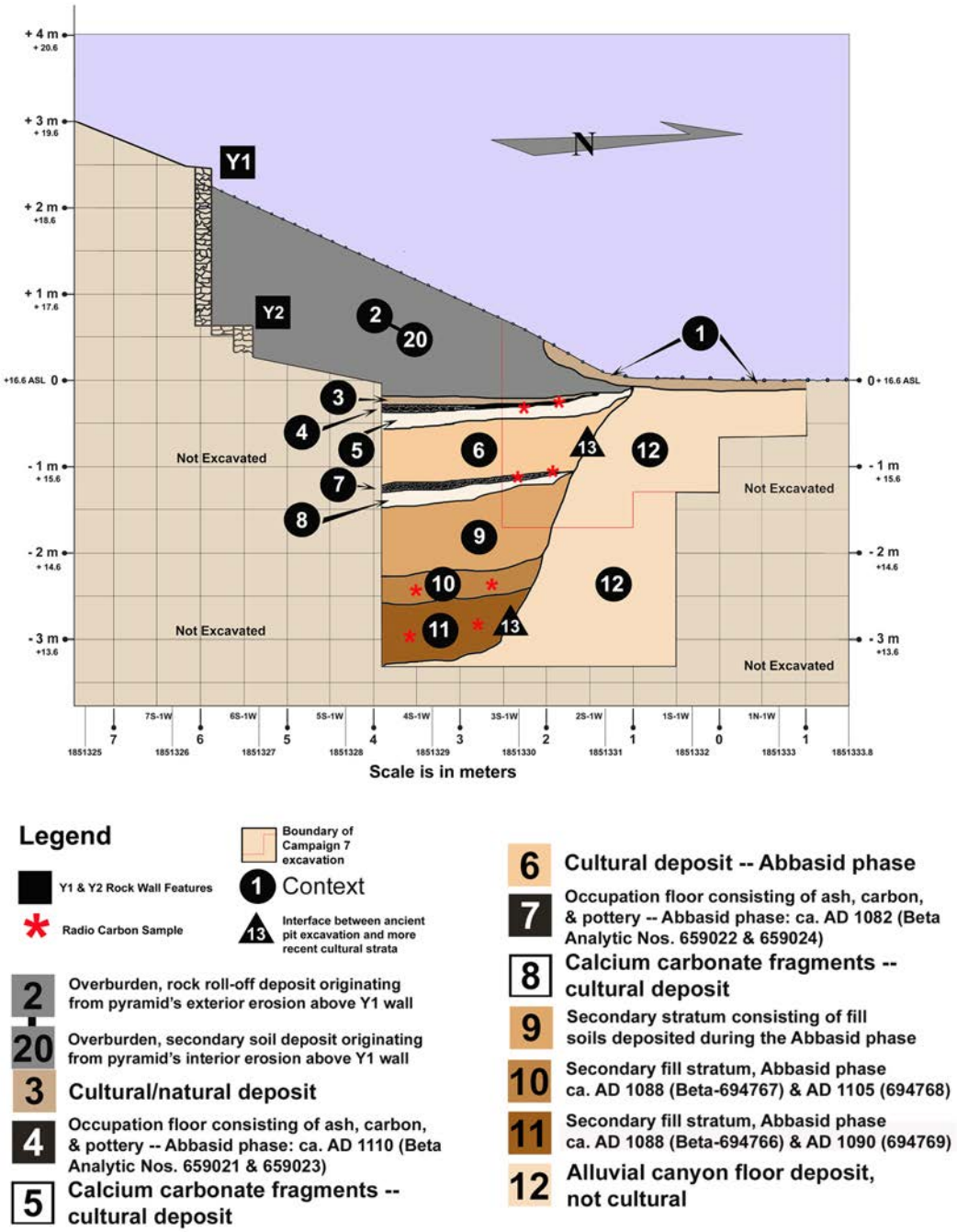

Figure 4. Profile Drawing of Site IV-1: Stratigraphic contexts exposed during the Campaign 7 and 8 excavations.

Ceramic and Lithic Evidence

Ceramic fragments recovered from this site's various stratified contexts include simple, undecorated red and brown wares — a minority exhibiting fingernail impressed designs — and an occasional sherd of imported glazed ware. A preliminary typological analysis of recovered ceramic fragments indicates both the presence of large storage jars and a predominance of jars, bowls, and shallow vessels used food preparation and consumption.

A basal fragment of a stone ware vessel was recovered from the aceramic soils eroded out of the structure's interior on the pyramid's north slope (context 20). A.L Perkins offers information on similar stone vessels uncovered at the Anu ziggurat in Mesopotamia during the Warka phase, which dates between 3400 and 3800 BCE. The recovery of this artifact from among the pyramid's fill soils, which have eroded out from the pyramid's interior, possibly correlates the construction of this structure to the late

Figure 5. Excavation Trench, Exposed Mound Walls Y1 and Y2, and Exposed Strata in Site IV-1 (View is to the south.)

Neolithic II phase (4000 to 3800 BCE) or the early years of Neolithic III (3800 to 3300 BCE).

Occasionally lithic flakes exhibiting a technology centered on opportunistic reduction of local chert/flint nodules were recovered from the secondary soils extracted from the trench flanking the stepped pyramid's northern wall. Evidently, these flakes — Neolithic or possibly Paleolithic — originated elsewhere at Khawr Kharfut, but were inadvertently included within the earth that Abbasid phase laborers dumped as fill into the ancient construction trench.

Cultural Context and Interpretation

The architectural complexity and symbolic placement of the stepped pyramid at Khawr Kharfut invite comparisons with other monumental constructions across the ancient Near East. The form of the platform, though smaller in scale, evokes stepped temples or administrative structures found in early Mesopotamian contexts. While direct cultural transmission remains difficult to prove, the parallels suggest either ideological diffusion or a symbolic system shared across distant regions.

The ceramic and lithic materials recovered from the site further support this interpretation. Decorative motifs observed on stone/pottery vessel surfaces echo traditions known from inland South Arabia and southern Mesopotamia suggesting Khawr Kharfut functioned as a node in a broader cultural and economic network linking coastal and interior populations. In their writings S. Cleuziou, J. McCorriston, and M. Tosi discuss the applicability of the nodal paradigm for explaining Neolithic settlement patterns in Arabia and north Africa—settlement patterns evidently intended to coordinate resource acquisition among diverse ecological and topographical regions. Khawr Kharfut, with its strategic geographical placement at the mouth of Wadi Sayq,

strongly supports a conclusion that it functioned as one of these important Neolithic nodal settlements. It appears to have mediated seasonal exchange and interaction between the Dhufar highlands — with their important incense resources — and the coastal zone — with its rich coastal marine resources — by providing a sheltered bay to facilitate long-distance maritime opportunities.

Moreover, the paucity of domestic habitations and refuse immediately adjacent to the north face of the stepped pyramid implies an exclusive zone once existed about that structure possibly reserved for special, administrative and possibly ritualized, activity. And, as far as can be determined with current information, that zone was avoided, not utilized, for perhaps three millennia. It was not until late in the 11th century CE, during the Abbasid phase, when the structures' north trench was partially filled by individuals — probably not the local inhabitants — who invaded that exclusion zone for economic reasons. Apparently, the trench was refilled at that time to provide a level workplace where calcium carbonate boulders, quarried the highlands, were deposited, subsequently reduced into small, white chips and evidently bagged for export (see contexts 5 and 8 in Fig. 4). This tentative assessment implies that that the Kharfot bay was still open to the Arabian Sea at that time, furnishing a maritime transport of the reduced calcium carbonate to other coastal localities — possibly Dalqut or Rakhut — for use in Abbasid structural construction.

Such exclusive spaces are well-documented in other Neolithic contexts where trade, ceremony, and governance all intersect at coastal hubs. Khawr Kharfut, therefore, evidently played an important role not only in subsistence and settlement but also in symbolic and social coordination across the region.

Conclusion

The findings from Khawr Kharfut contribute significantly to our understanding of early coastal settlements in Dhufar and their role in broader Neolithic dynamics. The discovery of a Neolithic era stepped platform structure — whose original foundation trench was partially filled during its Abbasid phase with distinctive Neolithic stone ware and Iron Age ceramic vessel fragments plus Paleolithic/Neolithic lithic artifacts — points to a long-term, organized, symbolically charged settlement utilizing far-reaching trade networks into Mesopotamia and probably elsewhere.

Although absolute dating this structure remains a future goal, the stratigraphic and typological evidence places this occupation within a timeframe that coincides with increasing complexity in South Arabian and Near Eastern cultural developments. Khawr Kharfut apparently was a localized expression of these wider processes, acting as a ceremonial and strategic contact point on the Arabian Sea.

Future work should prioritize radiocarbon sampling, both regional and distant ceramic comparisons, and geomorphological studies to refine the site's chronology and contextual significance. As new data emerge, the site will undoubtedly offer further insights into the movements, interactions, and ideological expressions of prehistoric populations in southern Arabia.

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French Archaeological Mission in Central Oman (2024): Explorations in Bisya

Jean M.[1] & M. Sauvage[2] (in collaboration with V. de Castéja, T. Beuzen-Waller, E. Casanova, Z. Hashemi, G. Antinori, L. Audebert, T. Mespoulet, S. Sepeau, M. Brummelhuis, S. Courtois, M. Danckaert, A. Al-Oufi & A. Al-Tamimi)

The French Archaeological Mission in Central Oman (FAMCO) studies the diachronic settlement of Bisya (Ad-Dakhliyyah), one of Central Oman's main archaeological zones, in the Hajar foothills. The mission focuses on the Early Bronze Age to investigate the emergence of the oasis system, including the exploitation of the date palm, the earliest groundwater-based irrigation systems, the rise of monumental, domestic and funerary architecture, and the development of crafts such as pottery and copper metallurgy. Our research also aims at providing evidence on the role of the Oman Peninsula within trade networks in the Bronze Age, particularly with Iran and the Indus Valley.

تدرس البعثة الأثرية الفرنسية في وسط عُمان (FAMCO) أنماط الاستيطان التاريخي لمنطقة بسياء بمحافظة الداخلية، إحدى المناطق الأثرية الرئيسية في وسط عُمان، الواقعة في سفوح جبال الحجر. تركز البعثة على العصر البرونزي المبكر لدراسة نشأة نظام الواحات، بما في ذلك استغلال أشجار النخيل، واكتشاف أقدم أنظمة الري المعتمدة على المياه الجوفية، وظهور العمارة الأثرية والمنزلية والجنائزية، وتطور الحرف اليدوية مثل الفخار وصناعة النحاس. كما يهدف هذا البحث إلى تقديم أدلة على دور شبه الجزيرة العُمانية ضمن شبكات التجارة في العصر البرونزي، وخاصةً مع إيران ووادي السند.

The French archaeological mission in Central Oman (FAMCO) is supported by the French Ministry for Europe and Foreign Affairs and the French National Center for Scientific Research (CNRS). This mission received the approval of the Sultanate of Oman's Ministry of Heritage and Tourism and the support of the French national research agency (ANR, Arabiancairns Project #ANR-22-CE27-0001), the National Geographic Society (National Geographic Grant EC-95836R-22, project "First oases of Arabia"), the French Embassy in Muscat, the French Research Center for the Arabian Peninsula (CEFREPA, Koweit-City), the University of Paris 1 – Panthéon-Sorbonne, and the joint research units (UMR) no. 7041 "Archaeology and Sciences of Antiquity (ArScAn)" (Nanterre, France), no. 8215 "Trajectoires" (Paris, France) and no. 7194 "HNHP – PAST" (Paris, France). Many thanks are addressed to the MHT in Muscat and to the Bisya and Salut Visitor Centre staff (A. Al-Tamimi, A. Al-Oufi, S. Al-Abri, A. Al-Hinai, A. Al-Daraai). The mission was held from January 3 to February 9, 2024.

Regional study of the oasis of Bisya

Survey of the Bisya Early Bronze Age towers

(G. Antinori, M. Sauvage, A. Al-Oufi and A. Al-Tamimi)

Thirteen monuments, so-called "towers", have been identified within a 20 km radius (Fig. 1). Our multidisciplinary approach includes remote sensing from satellite images, pedestrian surveys, sampling and photogrammetry. Some monuments are entirely new and unpublished, such as Al Adhar Tower and Fal Tower 2; others were little documented previously, like Fal Tower 1 and Waddhah.

Geoarchaeology

(T. Beuzen-Waller)

The objectives of the geomorphological mission in Bisya were to excavate and describe a sounding in Al Dhabi South (areas of AD1 and AD4); to specify and complete the description of Sounding 1 in Al Dhabi North (areas of AD2 and AD3) and to collect fluvial and terrestrial snails (*Melanoides tuberculata* and *Zootecus insularis*) for paleoclimatology (Schmitt *et al.* 2025).

Archaeomining survey

(Z. Hashemi)

The survey aimed at locating and characterizing possible ancient mines of copper ore. Thanks to the expertise of Tara Beuzen-Waller, and collaborations with N. Nezafati and P. Thomas (Bergbau Museum, Bochum, Germany), we were able to identify four sites exhibiting evidence of ancient excavation, possibly mining (and maybe a fifth one at Izki), one

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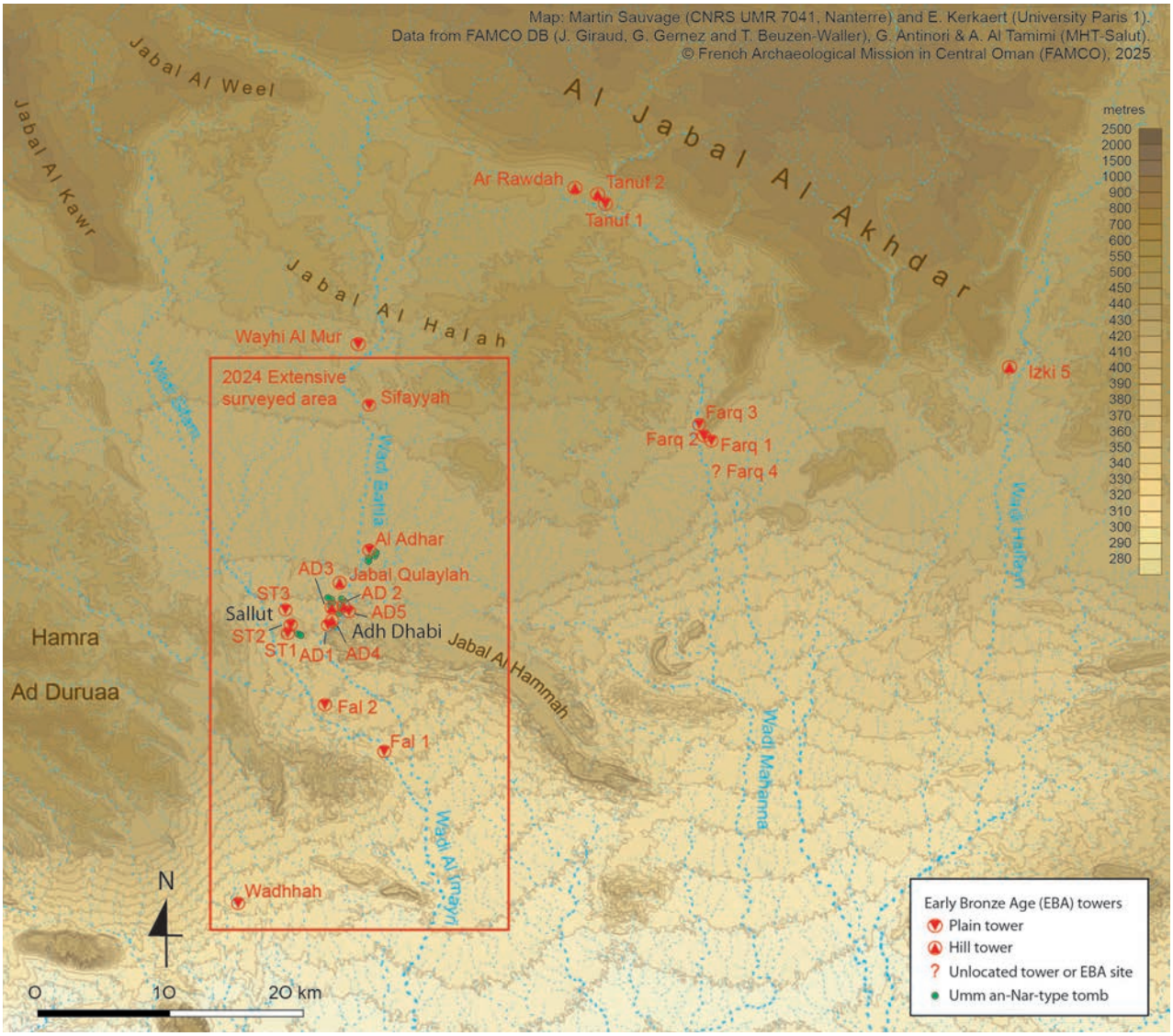

Figure 1. FAMCO 2024 EBA circular monuments ("towers") survey (© FAMCO 2024).

copper ore deposit, and two sites with copper or iron slags. This preliminary research will open up on an extended archaeometallurgy program.

Bisya necropolis survey
(M. Sauvage, G. Antinori and A. Al-Oufi)
The Bisya necropolis has long been known; J. & J. Orchard excavated one of the monumental tombs (named Building 2). Three tombs were excavated by G. Gernez's team. Our topographic work aimed at establishing a precise map of all the structures. We delimited five main areas (Fig. 2), all located on the terraces on the banks of Wadi Bahla and counted 181 visible tombs.

2024 excavations at Al Dhabi 2
(M. Jean, T. Mespoulet & L. Audebert)
In 2024, the FAMCO team conducted the third season of excavations at Al Dhabi 2. Three trenches were explored (Fig. 3): operations D and E, started in 2023, and operation F.

The first oases' economy: evidence for agriculture and coast-inland trade (M. Jean, M. Brummelhuis)
The topic of the 3rd millennium oasis economy was addressed in Operation E. This area has been very well preserved, as a layer of burnt and collapsed earthen architecture sealed the occupational floors. The first date stones and a whole charred date fruit were found in this place in 2023, as well as a shark

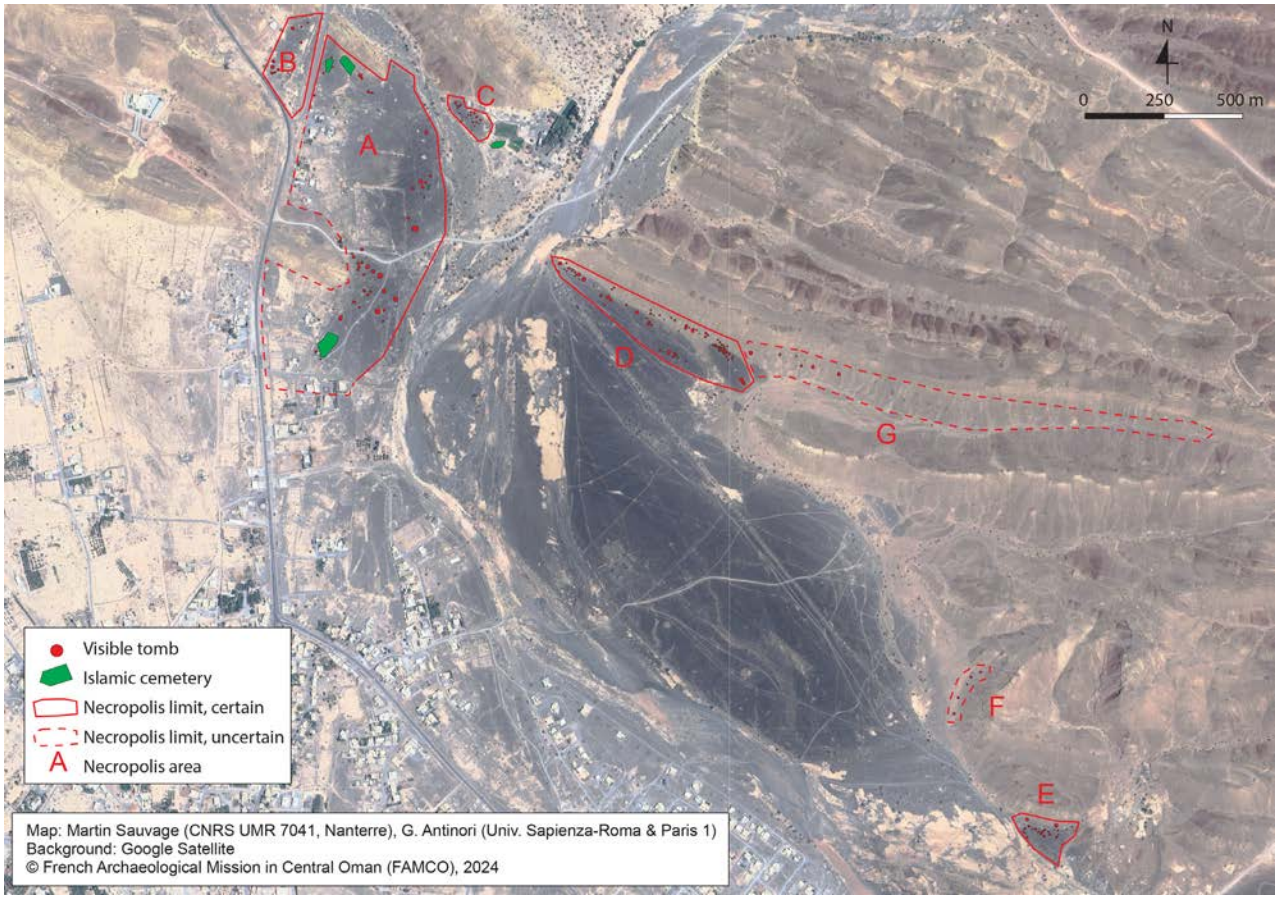

Figure 2. Zones of the Bisya necropolis (© FAMCO 2024).

vertebra. In 2024, we implemented a slow and precise excavation protocol, including systematic sieving. This was proved successful: the excavation yielded 221 date stones and fruits and about 600 fish bones, testifying of the consumption of dates and trade of fish in the first oasis sites (see Fig. 4 and below).

Understanding the tower's function: anthropogenic and natural structures
(T. Mespoulet)
Operation F is located at the centre of Al Dhabi 2 'tower'. This monumental building measures 45 m in diameter; its foundation trench was dated by radiocarbon ca. 3000 BCE (Hafit period). The primary objective was to understand the internal layout of the monument. The excavations revealed structures inside the building, mainly hearths and a stone-lined firepit. It demonstrates that several activities were conducted inside the tower, possibly related to cooking purposes. Several enigmatic stone structures, likely natural, were also uncovered that require further geomorphological and archaeological investigation.

Connection between the tower and the settlement
(L. Audebert & M. Jean)
Operation D is situated south of the tower (Fig. 5). This area gives a unique insight into the connection between the hill tower and the domestic quarters. The 2024 campaign focused on excavating the continuation of the tower's walls and surrounding buildings. The tower's architecture revealed a possible access gate on the southern side, leading to the settlement area. Buildings are settled on the tower's flank, of undetermined purpose. The filling revealed abundant Umm an-Nar pottery.

Materials studies at Al Dhabi 2
Pottery studies
(M. Jean)
Observation of the domestic assemblage indicates a very homogeneous production in terms of fabrics, techniques, shapes and decoration. Domestic jars

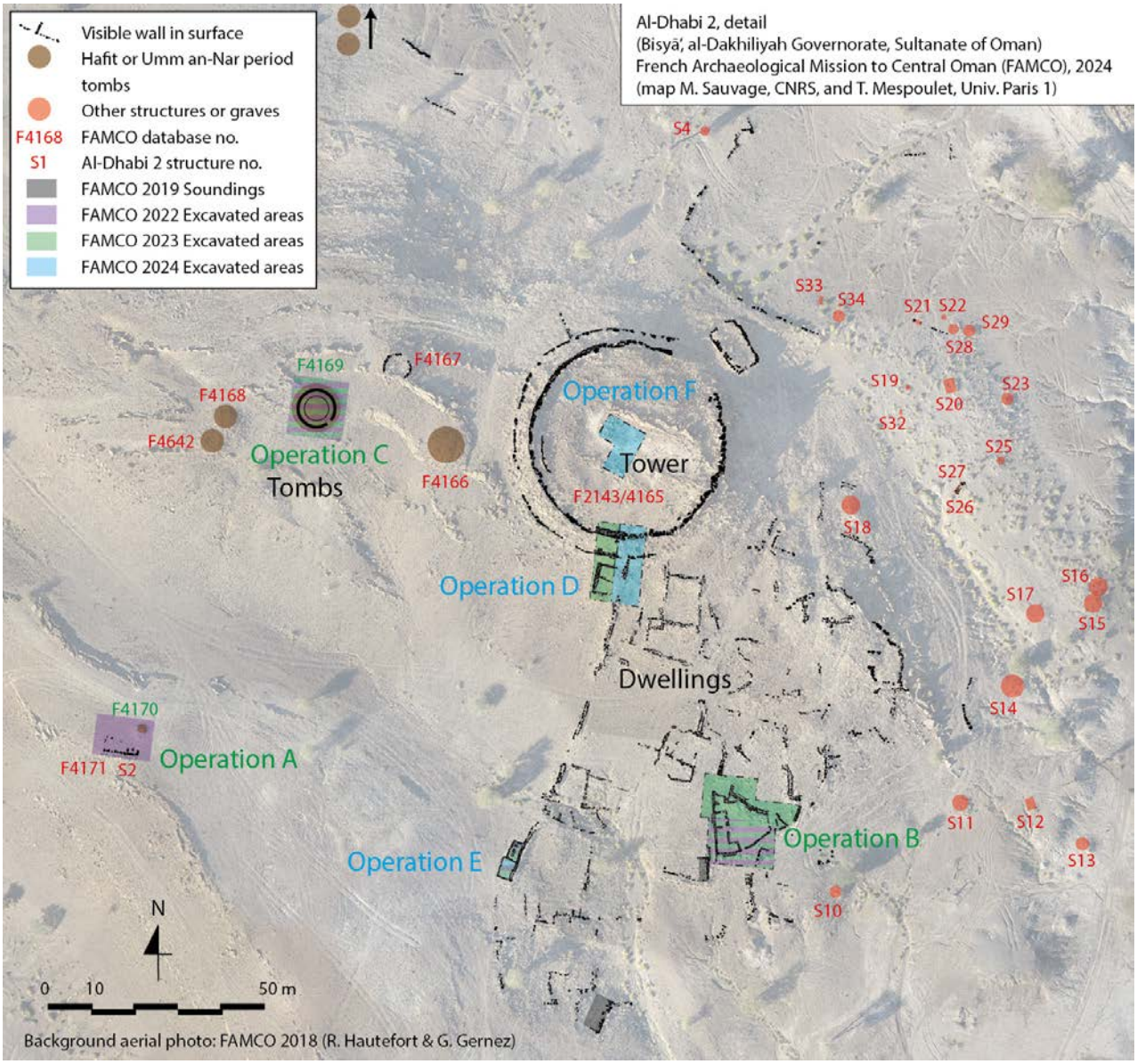

Figure 3. Plan of Al Dhabi 2 indicating 2024 excavations: Operations D, E and F (© FAMCO 2024).

with painted lines are the main vessel type in the settlement and tower. Few imported sherds, such as black-slipped Indus-type jars, are also identified. The diversity is much higher among the funerary assemblage from Tomb 4169 (see Jean *et al.* 2023: 199-200). About fifty vessels were identified in this assemblage. Some were clearly imported from Eastern Iran (painted grey ware, incised grey ware), and one small jar might have come from Mesopotamia. Archaeometric analysis of the pottery fabrics, slips and paints is being implemented, in part in cooperation with Sorbonne Abu Dhabi.

Organic residue analysis
(E. Casanova)
Twenty-two vessels were sampled to conduct preliminary analyses to evaluate the preservation of lipids in ceramics. Modern reference fats from camels and goat products (milk and carcass) raised in Oman with local food sources were sampled to establish a local reference database. Samples from a hearth in Operation F were taken to investigate whether organic residues are preserved in such contexts and could offer information on the organic products that were burned in situ (wood, food, etc.).

Figure 4. Date stones and fish bones collected in Operation E (S. Sepeau, © FAMCO 2024).

Bioanthropological study of human remains from Tomb 4169
(O. Munoz)
The study of the dental remains from Tomb 4169 aims at measuring the impact of diet on ancient populations' health. Despite the fragmentation of the remains, which limits the observations, the pathologies observed on the teeth indicate that the population deposited in the tomb consumed agricultural products. The high incidence of caries, tooth loss before death, and abscesses associated with low tooth wear indicate a diet rich in carbohydrates.

Archaeozoological study of animal remains
(M. Brummelhuis)
954 faunal remains were uncovered in 2024, long with 59 remains from the 2022 and 2023 seasons (total: 1013 remains). The faunal assemblage comprises mammals, reptiles and fish; no bird remains were identified. Operation E proved to be the richest area regarding faunal remains: 597 fish remains, along with reptile, small carnivore and other unidentified microfauna. Within the fish remains, preliminary identifications have highlighted the presence of sardine, anchovy and shark, indicating strong connections with the coast for subsistence.

Training, dissemination and preservation
This year, the photography project by S. Sepeau aimed at diversifying the subjects to bring out new visual archaeological-photographic themes. It highlights the scientific work, the archaeological sites, and Oman's archaeological, cultural, and natural heritage. Regarding training, the team hosted on the field Omani colleagues from the MHT and two students from Sultan Qaboos University. A special training session was delivered on the methods of archaeological excavations and reporting (22 January 2024, Bisya and Salut Visitor Centre). S. Courtoy and M. Danckaert prepared four exhibition panels (text and illustrations, 200 × 230 cm) for the Bisya and Salut Visitor Center. M. Jean prepared materials and captions for an exhibition of the project's latest discoveries.

Conclusions
The 2024 excavations at Al Dhabi 2 highlight the primary role of the site in the archaeology of EBA Oman. The site is now attested as one of the oldest oases in Oman, dated between 3000 and 2000 BCE (Hafit and Umm an-Nar periods) with no later reoccupation. Excavations revealed a unique assemblage of vegetal remains from oasis agriculture, including date palm, date stones, whole date fruits, cereals (wheat and barley), and other fruits (ziziphus). The consumption of carbohydrates from dates and other agricultural products is also supported by the anthropological study of the human remains from tomb 4169, where the deceased present frequent dental pathologies. The assemblage of 600 fish

bones, mainly from small species and also shark, is a unique testimony of the regional trade networks between inner Oman and the coast since the Early Bronze Age. The excavations revealed structures inside the monumental building, the so-called tower, mainly hearths and a stone-lined firepit. It demonstrates that several activities were conducted inside the tower, possibly related to cooking purposes. The tower's architecture possibly includes several building phases, which could indicate an Umm an-Nar use of the tower after the foundation in the Hafit period. Future excavation will focus on water management systems, on a large square building close to the tower (storeroom?), and on the extension of the excavation in the tower.

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ISTIDAMA: The Long-Term Cultural Sustainability Project (2023–24): Surveys and Excavations in Tanūf, Ad-Dākhilīyah Governorate, and Bukha, Musandam Governorate

Kondo Y.,[1] T. Kuronuma,[2] T. Miki[3] & K. Tanabe[4]

The Long-Term Cultural Sustainability (ISTIDAMA) Project aims to identify the eco-cultural factors of historical landscapes in the canyons and foothills of the Hajar Mountains. The team has been working in the Tanūf district of Ad-Dākhilīyah Governorate since 2016. This season, the team documented (1) 13 archaeological sites in Wādī Tanūf, including two Wādī Sūq tombs excavated, (2) two sites near the modern town of Tanūf, and (3) 15 sites in As-Suwayhiriyyah, 4 km east of Tanūf. Additionally, the team started surveys in the Bukha district of the Musandam Governorate and documented ten sites, including an abandoned settlement at Harāt Al-Jaddah.

يهدف مشروع الاستدامة الثقافية طويلة الأمد (ISTIDAMA) إلى تحديد العوامل البيئية والثقافية للمناظر الطبيعية التاريخية في وديان وسفوح جبال الحجر. يعمل فريق هذا المشروع في منطقة تنوف بمحافظة الداخلية منذ العام 2016. في هذا الموسم، وثّق الفريق (أولا) 12 موقعًا أثريًا في وادي تنوف، بما في ذلك قبرين تم التنقيب عنهما ويرجعان إلى فترة وادي سوق، و(ثانيا) 2 موقعين بالقرب من بلدة تنوف الحديثة، و(ثالثا) 15 موقعًا في السويحرية على بعد 4 كيلومترات شرق تنوف. بالإضافة إلى ذلك، بدأ الفريق مسوحات في ولاية بخاء بمحافظة مسندم ووثق 10 مواقع، بما في ذلك مستوطنة مهجورة في حارة الجدة.

The land of Oman has been experiencing millennial-scale climate changes. The Indian Monsoon and the Hajar Mountains have played a pivotal role in feeding water resources for life. However, the past lifeways in the mountain range in response to environmental change remain to be investigated. Therefore, this project documents the landscape history and identifies the eco-cultural factors for sustainable lifeways in the canyons and foothills of the Hajar Mountains in the past.

Field activities during the past seasons

The project team commenced general surveys in the Nizwā region, Ad-Dākhilīyah, in 2016 and discovered a cave site, locally known as Mugharāt Al-Kahf, in the canyon of Wādī Tanūf, along with some surface collections of pottery sherds and softstone vessel fragments (Miki *et al.* 2020). The excavations at the cave entrance revealed an occupational sequence during the Hafīt (ca. 3300–2700 BCE), Umm an-Nār (ca. 2700–2000 BCE), and Wādī Sūq periods (ca. 2000–1600 BCE; see Miki *et al.* 2022). The team also discovered cemeteries on the slope beneath the cave (WTN02, 07, 13, 14, and 16), in the canyon (WTN11), and at As-Suwayhriyyah (SWH11, 12, 13, and 14), 4 km east of the modern town of Tanūf (Kuronuma *et al.* 2021; 2022a; 2022b). WTN02, 07, and As-Suwayhriyyah sites have a high risk of destruction due to modern construction activities.

Tanūf district, Ad-Dākhilīyah Governorate

In December 2023 and January 2024, the project team conducted (1) general surface surveys in the Tanūf district, (2) detailed documentation of the cemeteries in the survey area, and (3) excavations at two prehistoric tombs in Wādī Tanūf (Fig. 1).

General surveys in the canyons of Wādī Tanūf and the floodplain of Wādī Al-Abyad detected archaeological features by a combination of high-resolution satellite image observation and subsequent ground-truthing. All the identified built features were documented using a worksheet and recorded in a digital heritage inventory. The team has documented 13 archaeological sites (WTN02, 07, 08, 15 to 24) in Wādī Tanūf, two sites (TNF05 and 06) near the modern town of Tanūf, and 15 sites (SWH04, 08, 11, 12, 15 to 25) in As-Suwayhiriyyah 4 km east of Tanūf, respectively. Well-preserved Hafīt cairns were discovered at TNF05 and SWH18. Among these, the Ḥafīt cairn TNF05-03 was unique in its built structure, featuring a platform, supporting walls, and niches (Fig. 2). Additional aerial photogrammetry sessions were conducted at the Iron Age hillforts of SWH06 and SWH13, using a drone.

The excavation of Tomb 34 in WTN13 confirmed a circular tomb measuring 5 metres in diameter. It had a partial double ring wall and a slightly oval, chamber measuring 1.5 by 1.7 metres. There were no artefacts except for two tiny fragments of pottery.

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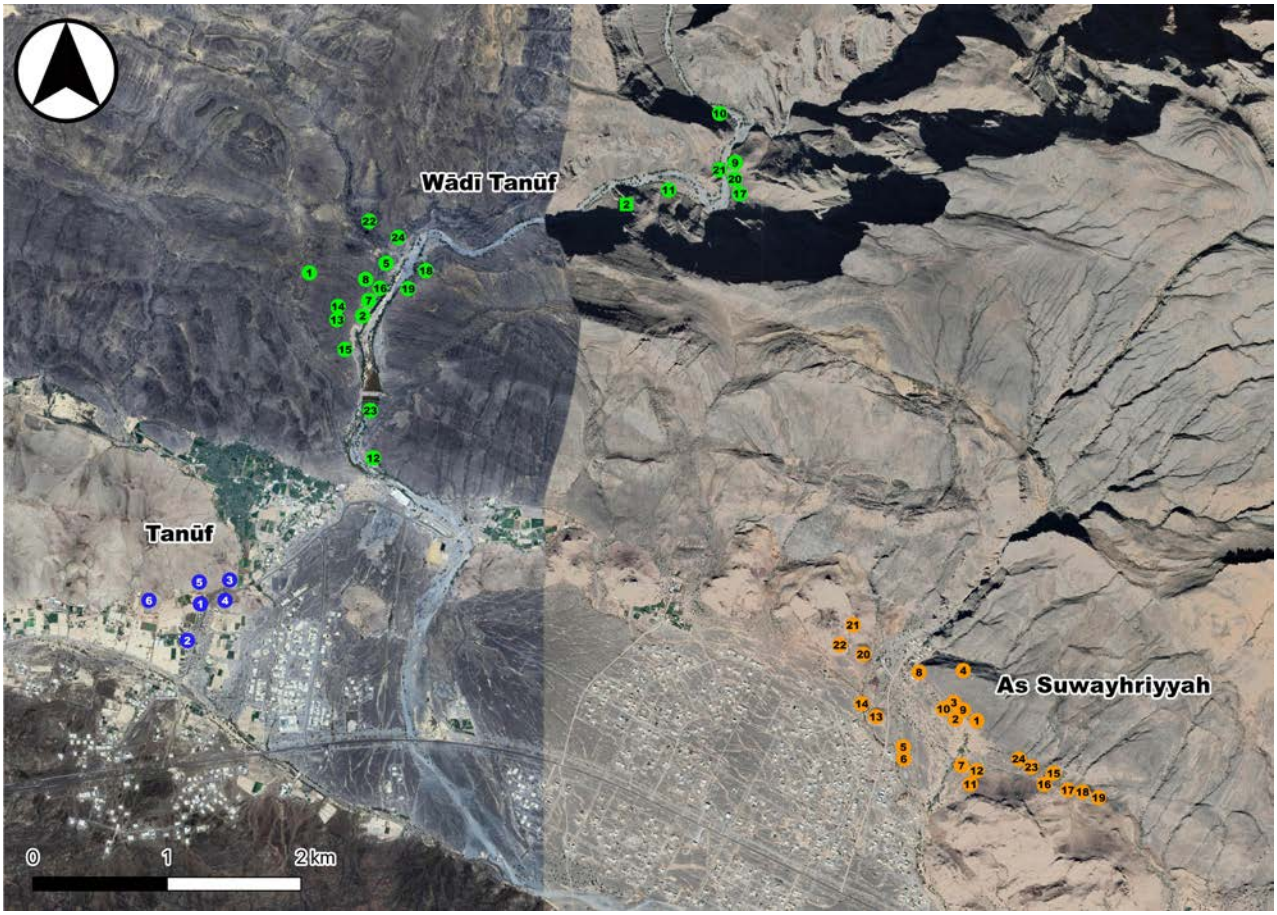

Figure 1. Map of the study area in the Tanūf district, where the location of the sites registered until the 2023–24 season is indicated (Background image: AW3D Ortho Imagery © DigitalGlobe, Inc., NTT Data Corporation, applied with QGIS).

Figure 2. Tomb TNF05-03 seen from the east.

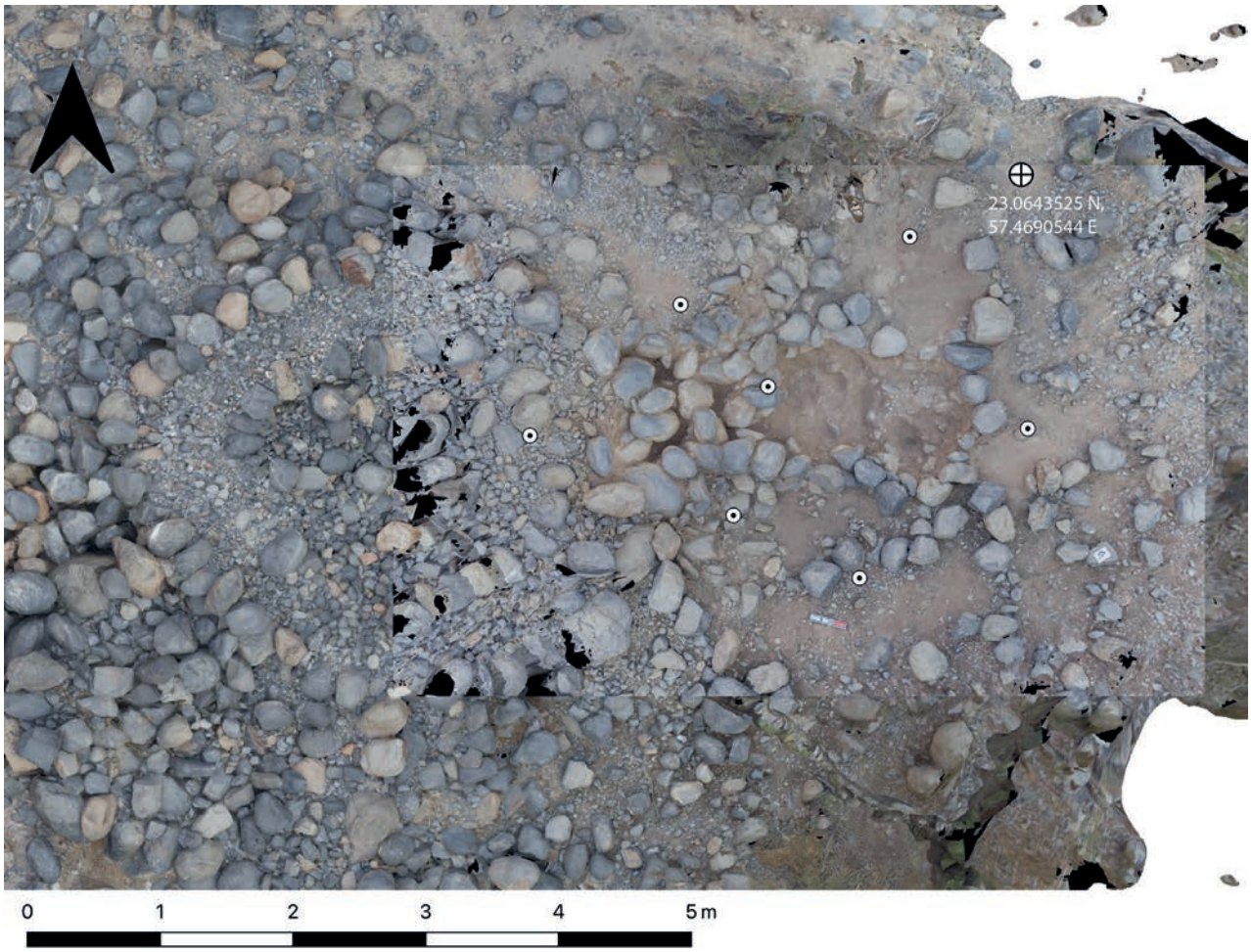

Figure 3. Plan of WTN07-122 after excavation (upper) and elevation lines 1-2, 5-3, and 3-4.

The tomb could be morphologically dated to the Wādī Sūq period.

Tomb 122 in WTN07 was a tomb complex with several annexes and attached features. The core structure was approximately 4 metres in diameter. The top of the tomb was covered with small cobbles. The tomb walls were constructed with rounded stones, likely sourced from the *wādī* bed. A rectangular protrusion to the northwest was excavated with the expectation of an entrance, but it was revealed to be a possible annexe tomb (Fig. 3). This tomb can be dated to the Wādī Sūq period based on its morphology, yet possible Early Iron Age pottery fragments were also found from the excavations.

Bukha district, Musandam Governorate

In addition, the project team conducted surface surveys in the Bukha district of the Musandam Governorate for three days in March 2024 to assess the yet-to-be-recognised archaeological potential. In total, ten sites have been documented in Bukha, Ghumdah, and Tibāt on the west coast (Fig. 4). A cluster of cairn tombs (BUK05) was confirmed on the terrace in the southern periphery of the Bukha urban area. The tombs had an oblong burial chamber and morphologically resembled those of the Early Iron Age.

There was also an abandoned settlement called Harāt Al-Jaddah in Ghumdah. The settlement extended 700 metres or longer in a small valley, comprising numerous stone building complexes, and was divided into upper and lower towns, connected by a network of streets. Terraced agricultural plots (locally called *waʿab*, pl. *awab*) and graveyards were identified on the slope near the junction of two *wādī* valleys in the upstream (Fig. 5). The settlement was located more than 1.5 km inland of the current coastline. Therefore, it was unlikely to be a coastal town.

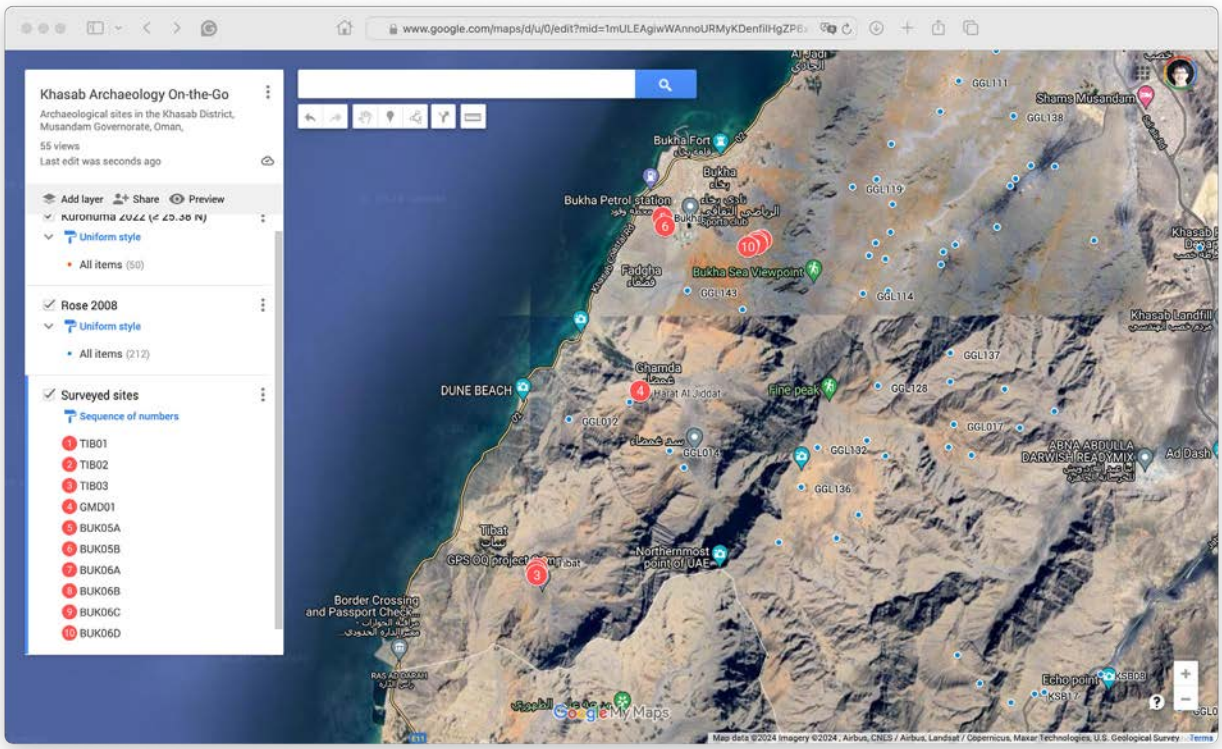

Figure 4. Map of the sites surveyed in the Bukha district during the 2023–2024 season. Blue dots stand for the sites identified by Jeffrey Rose in 2008.

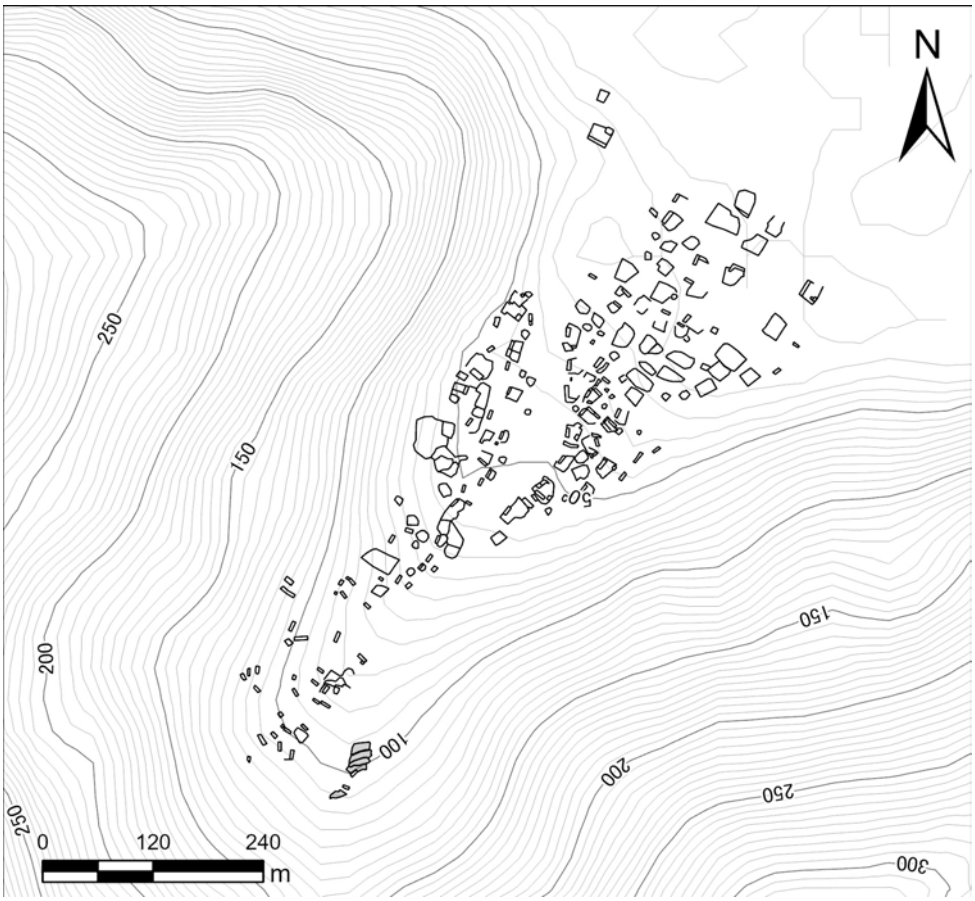

Figure 5. Plan of Harāt Al-Jaddah settlement.

Future plans

In the following season, we will continue surface surveys and open test trenches at selected tombs in the Tanūf district. The surveys also include exploring the trans-mountain trails connecting the northern and southern sides of the Hajar Mountains, with special attention to the mountain people and their livestock herding techniques. We will also continue surface surveys in the Bukha district with particular attention to *awab* and detailed documentation of the settlement of Harāt Al-Jaddah. We believe that these continuous studies deepen our understanding of the long-term cultural landscape history, which may provide hints for sustainable lifeways in the future.

Acknowledgements

This project was financially supported by the Japan Society for the Promotion of Science (JSPS) KAKENHI Grant Numbers JP16H06410, JP17K13572, JP20J0674, JP21H00605, JP24H00112, National Institutes for the Humanities (NIHU) Object-based Research on Nature-Human Interactions up to the Anthropocene (ORNHIA) project, and the Heiwa Nakajima Foundation. We thank His Excellency Undersecretary for Heritage Affairs Eng. Ibrahim Said Al-Kharusi, Advisor to the Minister of Heritage and Tourism Mr Sultan Saif Al-Bakri, Director General of Antiquities Eng. Yusra Khalaf Al-Subhi, Assistant Director General Mr. Salim Al-Hajri, Director of the Department of Excavations and Archaeological Survey Mr. Ali Al-Mahrouqi, Head Archaeological Missions Section Ms. Samiya Al-Shaqsi, Director of the Ad-Dakhliyyah Department of Heritage and Tourism Mr. Ali Al-Adawi, Director of the Musandam Department of Heritage and Tourism Mr. Saleh Al-Farsi, Assistant Director of the Musandam Department Mr. Noufal Al-Kumzari, Ministry's local representatives Mr. Hamud Al-Haji (in Ad-Dakhliyyah) and Mr. Ali Al-Shahhi (in Musandam), and other staff members for their amiable supports. Our special thanks also go to the local Omani crew members.

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The Bat Digital Heritage Inventory Project (February–March 2024): Surveys in Bat, Al-Khutm and Al-Ayn (Adh-Dhahirah Governorate)

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The 2024 fieldwork of the Bat Digital Heritage Inventory (BatDHI) Project aimed to update the 2013–2017 inventory and assess long-term landscape transformation at the UNESCO sites of Bat, Al-Khutm, and Al-Ayn. Documentation, including data collection and photography, was undertaken for previously recorded and newly identified features, as well as those reported by earlier expeditions but not yet included in the inventory. In total, 649 existing entries were revised, and 364 new features were added. This work updated the reconstruction of the archaeological landscape from prehistory to the Islamic period with a revised and expanded distribution map.

في عام 2024، استأنف مشروع جرد التراث الرقمي في بات أعماله الميدانية في مواقع اليونسكو في بات والخطم والعين، بهدف تحديث الجرد الذي أُجري بين عامي 2013 و2017 لتقييم التحولات الطويلة الأمد في المشهد الأثري. تم جمع البيانات والصور من المعالم الجنائزية وغير الجنائزية التي تم توثيقها مسبقًا والمكتشفة حديثًا. كما تم دمج المعالم التي أبلغت عنها بعثات سابقة. ونتيجة لذلك، تم مراجعة وتحديث 649 معلمًا موثقًا سابقًا، وإضافة 364 معلمًا جديدًا، مما وفر معلومات محدثة عن المشهد الأثري من عصور ما قبل التاريخ حتى الفترة الإسلامية في المواقع الثلاثة، إلى جانب خريطة توزيع منقحة.

Bat, Al-Khutm, and Al-Ayn (inscribed on the UNESCO World Heritage List in 1988) are representative Early Bronze Age (c. 3300–2000 BCE) sites in south-eastern Arabia. Previous archaeological expeditions have primarily focused on investigating the Hafit (c. 3300–2700 BCE) and Umm an-Nar (c. 2700–2000 BCE) remains; however, comprehensive documentation of archaeological heritage within the full extent of UNESCO protected area and its buffer zones remains incomplete. The Bat Digital Heritage Inventory (BatDHI) Project specifically aims to document and map the archaeological heritage

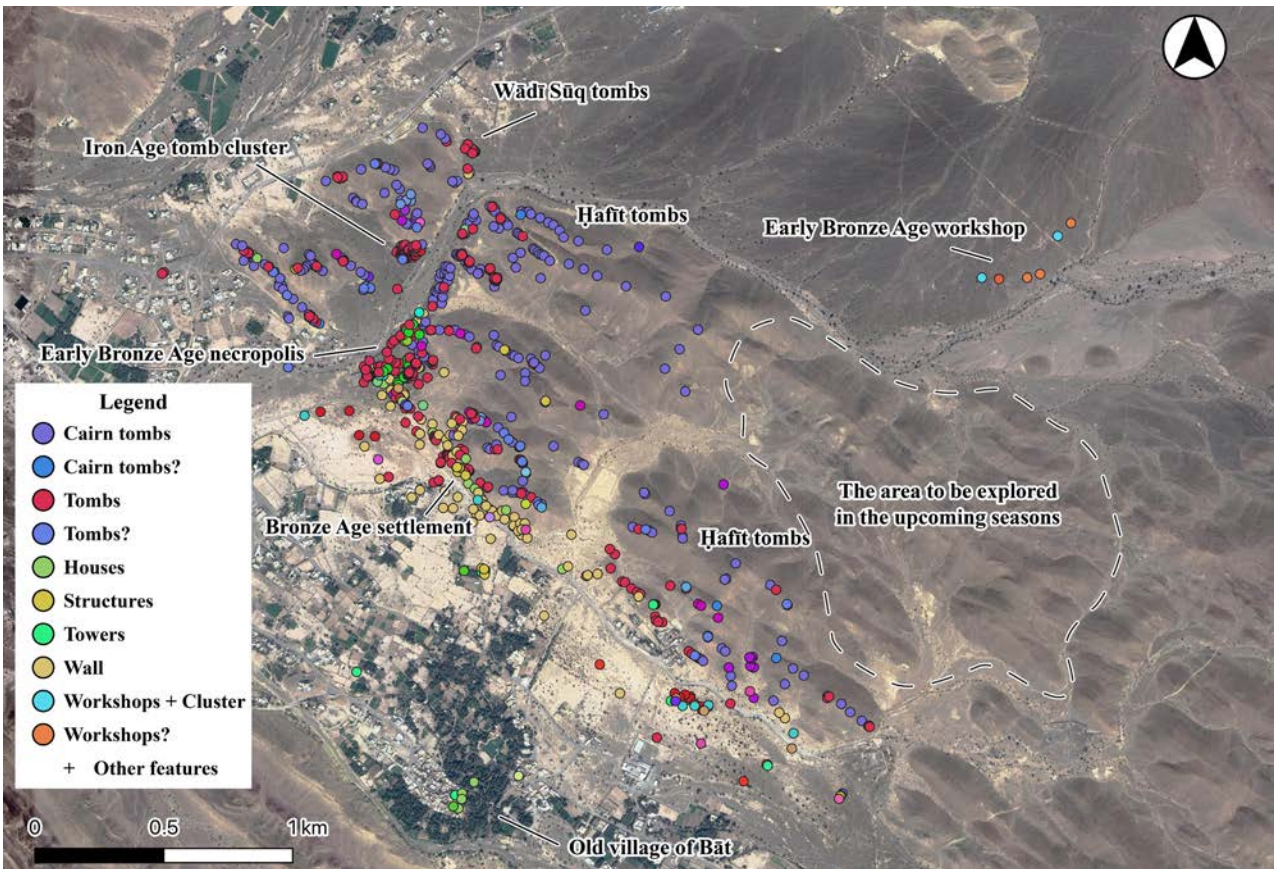

Figure 1. Distribution of archaeological features in Bat, based on the results of the 2024 season (Background image: Google Maps, applied with QGIS).

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Figure 2. DHI 81 complex (DHI 81, 910–912), separately re-registered in the 2024 season.

Figure 3. The possible aqueduct part of the canal DHI 739.

Figure 4. Distribution of archaeological features in Al-Khutm based on the results of the 2024 season (Background image: Google Maps, applied with QGIS).

within and around the UNESCO protected area to build a digital inventory, with the broader goal of reconstructing the long-term transformation of the archaeological landscape in these geographical areas.

Field activities during the past seasons

The team surveyed the sites of Bat, Al-Khutm, and Al-Ayn (Adh-Dhahirah Governorate), documenting 667 archaeological features—including artefact scatters—spanning a chronological range from the Palaeolithic to the pre-modern Islamic period between 2013 and 2017. Each entry was assigned a sequential DHI number. In addition, an Islamic wall (possibly a *falaj*) and a concentration of uncut limestones were excavated or cleaned alongside six soundings for geological investigation. These entries were integrated into the DHI and plotted in a mapping application as a distribution map, with data linked to a Geographic Information System (GIS). Based on the survey, papers on the archaeological landscape during the Umm an-Nar (Miki *et al.* 2019) and Wadi Suq (c. 2000–1600 BCE) (Kuronuma *et al.* 2023) periods have been published, along with a methodological discussion on the structuring of the DHI (Kondo *et al.* 2016). In preparation for the project's final monograph, field activities resumed in early 2024 to collect additional data and register further features reported or published by other expeditions.

Surveys in the 2024 season

We resumed fieldwork in February and March 2024. Following a thorough review of the previous inventory, the survey was carried out at Bat, Al-Khutm, and Al-Ayn. In total, 649 features were revisited to collect additional data, and 364 new features were documented and inventoried.

In Bat (Fig. 1), 603 features were revisited. Particularly significant was the identification of numerous additional prehistoric tombs that were attached to, mounted on, or installed in earlier tombs. The number of later additions varied from one to more than ten per host tomb. Notably, Hafit and Umm an-Nar tombs frequently hosted later tombs with partial

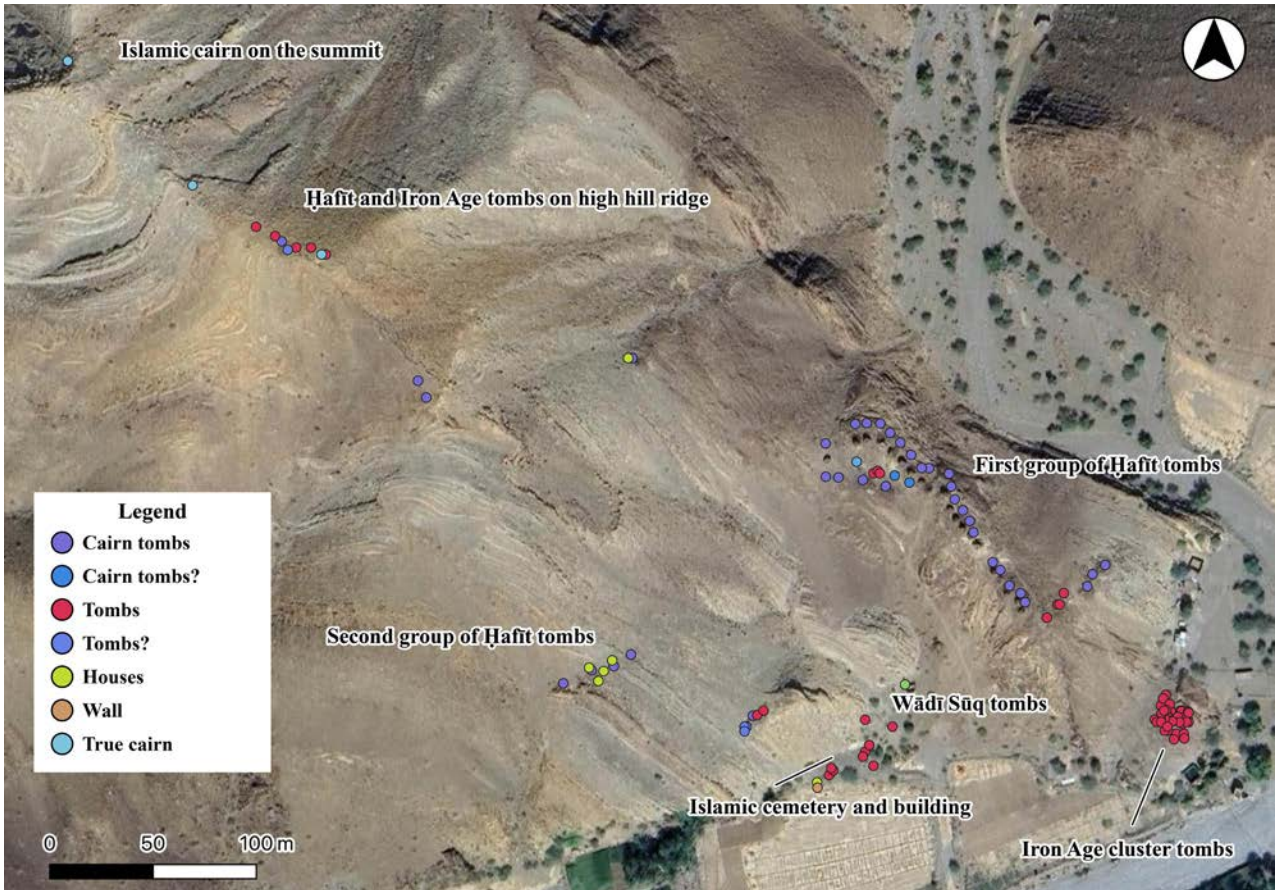

Figure 5. Distribution of archaeological features in Al-Ayn, based on the results of the 2024 season (Background image: Google Maps, applied with QGIS).

structural modifications, generally dated to the Iron Age, along with several examples from the Wadi Suq period.

Some of the previous entries, originally registered as batches of multiple archaeological features, have also been revised (Fig. 2). These revisions were related to the identification of additional tombs and instances of reuse.

New registrations include not only tombs of various periods but also non-funerary features, such as a possible canal with an aqueduct. For example, DHI 739 is a disused open-cut canal of considerable length on the plain, with a visible wall—possibly the remains of an aqueduct—at the section cut by a wadi (Fig. 3). The trace of the canal is clearly visible in commercial satellite imagery. Similar features have been identified at several locations in Bat.

In Al-Khutm, several errors in the previous documentation were corrected. The distribution map was also updated to include 15 newly added entries, including five additional tombs located on or beside the Hafit tombs (Fig. 4). The distribution of archaeological features on the hill at Al-Khutm, to the southeast of modern antenna facilities, was significantly revised. Compared with the previous record of nine Hafit tombs within this area, we documented three rectangular dwellings, nine Hafit tombs, and four later prehistoric tombs—most likely dating to the Early Iron Age (c. 1300–300 BCE) or the Late Iron Age (c. 300 BCE–630 CE).

In Al-Ayn, we identified the foundations of two probable Hafit tombs, one Hafit tomb, a probable Iron Age tomb complex (DHI 277 complex) comprising more than 40 subterranean tombs, a smaller similar complex with three subterranean tombs, two isolated subterranean tombs, one retaining wall, one house, five later structures attached to the Hafit tombs, and seven Islamic tombs (Fig. 5). The DHI 277 complex is particularly significant for understanding the transformation of the archaeological landscape after the Bronze Age. The foundations of the probable Hafit tombs were also evaluated as key features for examining the development and evolution of the Hafit cemetery.

Concluding remarks

The documentation of archaeological features within the UNESCO boundaries at Bat, Al-Khutm, and Al-Ayn was nearly complete, and most of the previous entries in the DHI were substantially updated with new discoveries from the 2024 season. The increased number of features dated to the probable Iron Age and Islamic period provides new insights into the transformation of the archaeological landscape across these three sites. The collected data are currently being processed and will be included in the final report monograph, which will discuss landscape transformation and present a comprehensive inventory catalogue for the UNESCO boundary and its buffer zone.

Tasks for upcoming seasons

Although the re-surveys in Bat are nearly complete, the north-eastern area where Charlotte Cable documented some archaeological features (Cable 2012) remains unexplored by the BatDHI project (Fig. 1). This area will be the focus of documentation in the next season. Completing this work will finalise the inventory of features on the right bank of Wadi Al-Hajar and enable a comprehensive discussion on the transformation of archaeological features within the UNESCO boundaries of the three sites.

Additionally, the left bank of Wadi Al-Hajar in Bat, which lies outside the UNESCO zones, has not been surveyed by this project. The features documented by Cable in this area (Cable 2012) should be revisited to support a potential future expansion of the UNESCO boundary. Therefore, the next objectives are to document the north-eastern area within the UNESCO boundary on the right bank and the area on the left bank of Wadi Al-Hajar.

Acknowledgements

We express our gratitude to His Excellency Undersecretary for Heritage Affairs Eng. Ibrahim Said Al-Kharusi, Advisor to the Minister of Heritage and Tourism Mr. Sultan Saif Al-Bakri, Director General of Antiquities Eng. Yusra Khalaf Al-Subhi, Assistant Director General Mr. Salim Al-Hajri, Director of Excavation and Archaeological Survey Mr. Ali Al-Mahrooqi, Head of the Archaeological Missions Section Ms. Samiya Al-Shaqsi, Director of the UNESCO World Heritage Department Ms. Ibtisam Al-Mamari, and all staff of the Ministry of Heritage and Tourism for their support to this project. We also thank Director of the Department of the Archaeological Sites of Bat, Al-Khutm and Al-Ayn Mr. Mohammed Al-Kalbani, Mr Sulayman Al-Jabri, Ms. Asma Al-Jassasi, Mr. Badr Ali Al-Moqbali, Mr. Sayf Al-Moqbali for their kind and warm cooperation, assistance and logistical supports during the fieldwork. This project was financially supported by the Core Project (History/Area Studies) 'Field Archiving of Memory: Dynamics of Cooperation in Muslim Society' of the Research Institute of Languages and Culture of Asia and Africa, Tokyo University of Foreign Studies, Japan, as well as by the Multidisciplinary Collaborative Projects 'The Object-based Research of Nature-Human Interactions up to the Anthropocene (ORNHIA)' of the National Institute for the Humanities, Japan.

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DHOMIAP Project (2023–2024): Archaeological Exploration in the Dhofar Governorate

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This year, the focus of the fieldwork in Khor Rori was investigating the function and chronology of the structures identified in Jabal Rori, which is located a few kilometres from the city of Sumhuram. Complementary archaeozoological, archaeobotanical and malacological studies examined how the Dhofar Coastal Culture exploited resources to refine its cultural identity and distinguish itself from South Arabian traditions. Furthermore, exploratory work in western Dhofar sought to shed light on this under-explored part of the governorate. The results emphasise the importance of the area along communication routes between the Kingdom of Hadramawt and the South Arabian centres in Dhofar.

ركزت أعمال التنقيب هذا العام في خور روري على دراسة وظيفة وتاريخ الهياكل التي تم تحديدها في جبل روري، والذي يقع على بُعد بضعة كيلومترات من مدينة سمهرم. وقد أجريت دراسات أثرية تكميلية في مجالات علم الحيوان القديم، وعلم النبات القديم، وعلم الرخويات القديمة لفهم كيفية استغلال ثقافة ساحل ظفار للموارد، بهدف توضيح هويتها الثقافية وتمييزها عن التقاليد الجنوبية العربية. كما شملت الأعمال الاستكشافية الجزء الغربي من محافظة ظفار، بهدف تسليط الضوء على هذه المنطقة التي لم تحظ بالاهتمام الكافي من قبل. وتؤكد النتائج على أهمية المنطقة الواقعة على طرق التواصل بين مملكة حضرموت والمراكز الجنوبية العربية في ظفار.

Khor Rori: Jabal Rori

Excavations at Building 24 (B24) on Jebel Rori have significantly advanced our understanding of land use and architectural practices among ancient South Arabian communities in the Khor Rori area. This investigation is part of the wider DHOMIAP project (2016–2024), which has identified around 4,000 undocumented archaeological features in the coastal area of Khor Rori. Following the promising results of the IQM22/23 survey campaign, exploratory excavations were focused on B24 due to its strategic location next to the Dhofar Coastal Culture necropolis (KR-N1), as well as its architectural complexity, making it a promising subject for further study.

This excavation is an important step forward in understanding how the ancient South Arabian inhabitants of Sumhuram interacted with the local Dhofar Coastal Culture, particularly concerning territorial organisation.

Initial investigations revealed that B24 was a carefully designed structure with a well-defined internal layout comprising rooms of varying sizes. In the southern part of the building, a central corridor oriented north-south was uncovered, accessible via an entrance at the southern end (Fig. 1). This space provided access to two side rooms of roughly similar dimensions. At the opposite end of the corridor, a staircase was found that likely provided access to an upper floor.

Three additional rooms were identified to the rear of the structure. While these appear interconnected, no direct connections exist to the previously mentioned elongated rooms. The rear section was accessible via a north-facing doorway, suggesting a separate access route or a different functional zone within the building.

On top of the collapsed remains of the structure, four small hearths were found that had been constructed using reused architectural elements from the building itself. These hearths appear to be considerably more recent, potentially indicating pastoral groups' temporary reuse of the site following the building's abandonment.

While the whole sequence of construction phases is still being investigated, preliminary analysis indicates that B24 underwent at least three significant construction phases. The earliest phase comprised the southern elongated rooms and the staircase. The second phase included the addition of the northern rooms and the creation of a new entrance, which appears to have changed the orientation of access to the building. The third phase is characterised by blocking the northern entrance, which may indicate a change in the building's function (Fig. 2).

To date, excavations at B24 have revealed a complex, multi-phased structure that reflects dynamic shifts in use and possibly in social organisation over time. The architectural evidence demonstrates an advanced level of planning and construction, as well as adaptive reuse and transformation.

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Figure 1. View from the south-west of Building B24 after excavation (@DHOMIAP Project/Silvia Lischi).

Future research will clarify the relationship between B24 and nearby architectural remains, refine our understanding of the construction techniques, and incorporate artefactual and environmental data. These avenues of investigation will contribute to a more comprehensive understanding of B24's role within the broader cultural and chronological framework of South Arabian occupation in Khor Rori.

Khor Rori: Outside Sumhuram

During the survey, a series of stone alignments were documented on a bedrock terrace just outside the city walls of Sumhuram. While the area initially appeared to lack significant stratigraphy, the presence of numerous interconnected wall foundations and scattered archaeological artefacts indicate prolonged and diversified activity. While it is premature to assign a definitive chronology or function to these structures, their construction techniques closely resemble those used in the monumental city centre of Sumhuram. This similarity raises the possibility that they are contemporaneous. The construction techniques typically use the South Arabian 'sandwich' wall style with dressed local limestone.

The proximity of these structures to the fortified city, combined with the absence of significant collapse layers, suggests that some may have been dismantled for stone reuse during later construction phases. If so, the area could contain stratigraphic deposits relating to the early South Arabian occupation of the area. Such evidence would be crucial for understanding the "pre-Sumhuram" phase, during which the South Arabians first engaged with the indigenous Dhofar Coastal Culture.

Conversely, if the structures are found to be contemporaneous with the city's peak occupation (c. 100 BCE–300 CE), their presence would suggest a more extensive and potentially differentiated use of the landscape beyond the city walls. This could significantly refine our understanding of the spatial organisation, resource use and social dynamics at

Figure 2. Aerial view of building B24 after excavation (@DHOMIAP Project).

Khor Rori during the early centuries CE. Planned exploratory excavations will clarify these chronological and functional questions.

Archaeozoological Investigation

To increase our understanding of the Dhofar Coastal Culture, its subsistence methods, and resource exploitation, we have initiated a preliminary study of the faunal remains uncovered during the excavation. This study will provide not only new and important information about the Dhofar Coastal Culture but also new insights into its technical capabilities, traditions, and methods of land use. It will also enable us to compare the data collected with that obtained from the study of the faunal remains found in the city of Sumhuram, providing a new perspective on the relationships between these two distinct cultural entities.

Figure 3. Detail of a worked cattle metatarsal (@DHOMIAP Project/Matteo Bormetti)

For this preliminary study, four stratigraphic units (US59, US61, US134, and US144) were selected from the three main contexts relevant to the Dhofar Coastal Culture: the settlement (HAS1), the trash dump/midden (M1), and the fishermen's settlement (KR-FS).

All the faunal material has been sorted by broad taxonomic groups (osseous fish, cartilaginous fish, turtles, molluscs, mammals, and birds) for further study by different specialists. The identification of mammal remains was carried out with the help of osteological atlases (e.g. Schmidt 1972, Barone 1976). The soil residue from the bags has been collected and labelled for further archaeobotanical study. In general, the difference in composition between the two assemblages, HAS1 and KR-FS2, is evident in the taxonomic distribution based on weight.

The assemblage from US59 presented a relatively restricted range of species. The mollusc component is dominant, primarily represented by few gastropod taxa (mainly in the genera of Ciprea, Oliva, and Conus) with very few bivalves, consistent with the materials from other buildings investigated in HAS1 (this shell assemblage is currently under investigation; for more detailed information on the species found in other stratigraphic units of the settlement, see Crippa *et al.* 2024; Crippa *et al.* 2023). Mammals are the second most represented taxonomic group (Fig. 3), while fish and turtle remains are sporadic and represented by small fragments.

In contrast, the taxonomic composition of the assemblages from US134 is generally more varied (here, we found remains of birds and a wider range of molluscan remains, including more bivalve species and cuttlefish) and includes larger animals (cattle, dolphins, and very large turtles and fish). The dominant group of faunal remains in this stratigraphic unit are turtles, followed by fish, with mammals and molluscan shells being less abundant.

Preliminary Survey of the Tosnat area

In February 2024, a short field survey was conducted in the Tosnat area, western Dhofar, near the Oman–Yemen border, under the auspices of the Ministry of Heritage and Tourism. The mission aimed to verify local reports concerning a rock of ideological significance and assess the area's archaeological potential.

Despite its brief duration, the survey yielded significant findings. Preliminary remote sensing and field observations identified 226 undocumented archaeological structures, including triliths and tower tombs, as well as three significant epigraphic sites: Simmer 1 (Fig. 4), Simmer 2, and Rock Arch (Fig. 5). These locations revealed a diverse collection of graffiti in various scripts, primarily Thamudic and Ancient South Arabian (ASA), with a few examples of Arabic and Dhofari scripts etched or pecked onto prominent rock outcrops. Notably, the graffiti at Simmer 1 was the most numerous and diverse, including inscriptions in Thamudic variants.

Figure 4. View of the mushroom stone named Simmer 1 (@DHOMIAP Project/Silvia Lischi).

Figure 5. View of the rock arch mentioned in the text (@DHOMIAP Project/Silvia Lischi).

This is the first time the Thamudic script has been found in Dhofar, expanding the known distribution of ASA inscriptions beyond the coastal site of Sumhuram and inland centres like Hanun and Andhur. The discovery of a Dhofari script that was painted rather than incised is also significant, as it suggests continuity with epigraphic traditions from the Nejd and highland regions. These findings support the hypothesis that Tosnat may have functioned as a nodal point along trans-desert communication routes during the Iron Age. The prominence and visibility of certain rock formations may have lent them symbolic or practical importance as waypoints or gathering places — functions that seem to be retained in local tradition today. Given the potential for further discoveries, a follow-up mission focused on systematic documentation and conservation will be planned.

Acknowledgements

The authors would like to express their sincere gratitude to the Wainwright Fund for generously providing a research grant to support the activities of the DHOMIAP mission in Oman. This funding has been instrumental in enabling us to continue and develop our work in the field. We are also deeply grateful to the Ministry of Heritage and Tourism of the Sultanate of Oman for their continuous support and collaboration. Their invaluable assistance and facilitation have been essential to the success of our research.

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Ichtyophagoi, *their Culture and Economy: Survey, Excavation and Mitigation Strategies in Wadi Bani Khalid (WBK1 and WBK49, Aqr Zaida Al Athri) and Tiwi*

Loreto R.[1]

This archaeological project focuses on the study of exploitation strategies between the inner Al-Hajar oases and coastal settlements during the Iron Age (Ash-Sharqiyyah North). In particular, current efforts are focusing on Wadi Bani Khalid, at the Iron Age settlements of WBK1 and newly discovered WBK49; and at Tiwi Late Iron Age coastal site. Moreover, in light of the increasing number of tourists coming to Wadi Bani Khalid and the state of preservation of Tiwi Late Iron Age contexts, main aims of the project are related not only to scientific studies but also to sites management for the protection, valorization and fruition purposes.

يركز هذا المشروع الأثري على دراسة استراتيجيات الاستغلال بين واحات الحجر الداخلية والمستوطنات الساحلية خلال العصر الحديدي (منطقة شمال الشرقية). بشكل خاص، تركز الجهود الحالية على وادي بني خالد، في مستوطنات العصر الحديدي WBK1 وWBK49 المكتشفة حديثًا؛ وفي موقع طيوي الساحلي من العصر الحديدي المتأخر. علاوة على ذلك، في ضوء الزيادة المتزايدة في عدد السياح الذين يزورون وادي بني خالد وحالة الحفاظ على سياقات طيوي من العصر الحديدي المتأخر، ترتبط الأهداف الرئيسية للمشروع ليس فقط بالدراسات العلمية ولكن أيضًا بإدارة المواقع لحمايتها وتعزيزها والاستفادة منها.

This archaeological project focuses on the study of exploitation strategies between the inner Al-Hajar oases and coastal settlements during the Iron Age (Ash-Sharqiyyah North). Analyses devoted to the Early Iron Age were initially addressed at Bamah seasonal coastal settlement (2014-2018, Loreto 2018) whilst since 2019 investigations are going on both within Wadi Bani Khalid alluvial area and Tiwi coastal territorial unit.

In particular, Wadi Bani Khalid revealed a sparse Early Iron Age and a dense Late Iron Age occupation characterised by a huge and powerful fortified settlement (WBK1, ca. 160 x 80m) and several others sites revolving around it (including tombs and a newly discovered fortress – WBK49). On the other hand, Tiwi still preserves, although severely damaged, a Late Iron Age complex made of a permanent fortified settlement and a necropolis. Thus, main aims of the project are related to scientific studies and sites management for the protection, consolidation, valorization and fruition of the them within their natural environment which is one of the main attractions for touristic economy.

2023 Activities in Wadi Bani Khalid

Excavations at WBK1

Wadi Bani Khalid stands as one of the main territorial areas in the Al-Hajar range that have offered, in the past, the ideal morphological, hydrographic and ophiolitic conditions for the development of settled communities based on a proto-urban-type economy. In terms of morphology and hydrography, this is a synclinal valley in which a large catchment area and perennial natural springs ensure abundant water resources, as well as several terraced river bends resulting from the continuous inflow of sediments of a clayey nature suitable for the development of agriculture. Added to this is the surrounding ophiolitic landscape, which guaranteed additional metallurgical resources (a modern mining site is known along the southern course of the wadi) and chlorite, the latter widely attested in Iron Age settlements and burial contexts.

Research began here in 2018, when the major settlement, WBK1, was "rediscovered" through remote sensing analysis. Although known to local authorities, WBK1, like the entire course of the Wadi Bani Khalid, had been ignored by research up to that point, so much so that at the start of the analyses of "L'Orientale" project there was no mention in the bibliography of pre-Islamic evidence in the area (Loreto 2020). This confirmed, above all, how much archaeological research was still at an early stage for the study of Iron Age settlement contexts in the Omani mountainous regions.

From 2019 to 2023, the excavations involved both some housing units and some towers or wall sections, allowing not only to define a precise chronology of the major phases of the Late Iron Age (between the 4th-2nd centuries BCE and the 2nd century CE) (Loreto 2020), but also to intercept the earliest phases of occupation, datable to the Early Iron Age,

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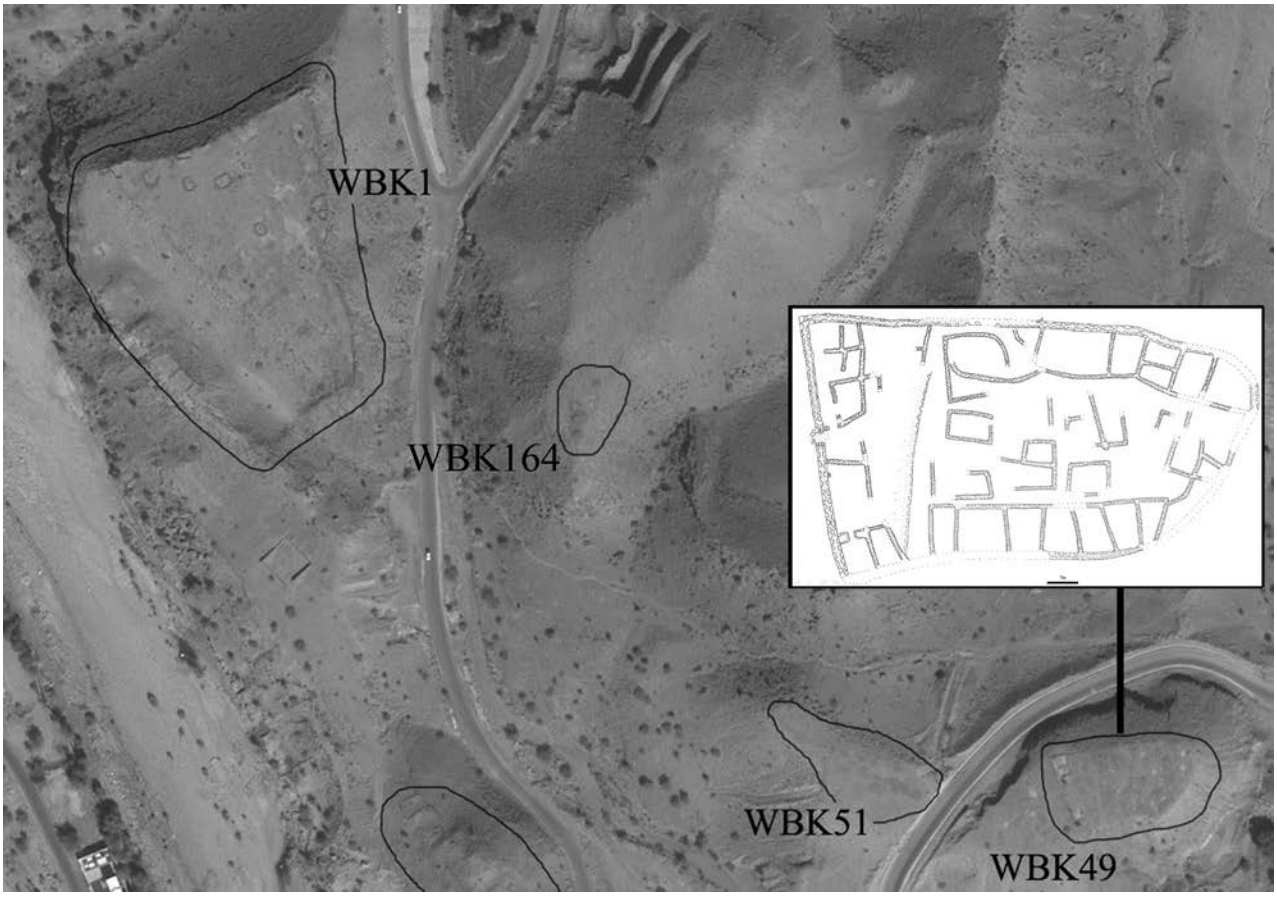

Figure 1. Location and plan of the newly discovered Late Iron Age fort (WBK49) at Wadi Bani Khalid (PNEO imagery, University of Naples Archaeological project at Wadi Bani Khalid).

with particular reference to the centuries between the 9th and 6th BCE (dating confirmed by ceramic comparisons with the sites of Lizq and Bamah).

In light of the large number of structures unearthed up to 2023 (4 towers and 7 residential buildings) and the state of preservation of the perimeter walls, the archaeological research has necessarily been accompanied by urgent preservation and enhancement works, about which we will discuss shortly.

Figure 2. The imposing fortified settlement WBK1. View from north-west of the northern and western fortification sectors. Visible, to the left, the access staircase for future fruition strategies (University of Naples Archaeological project at Wadi Bani Khalid).

Figure 3. An example of funerary good, a collection of beads that were assembled to have a glimpse of the local jewellery during the Late Iron Age (top: beads from mound tomb WBK50; bottom: plausible restitution of a Late Iron Age necklace) (University of Naples Archaeological project at Wadi Bani Khalid).

Discovery of WBK49

During 2023 campaign, and the aid of high-resolution satellite imagery (Pléiades at 30 cm ground resolution), mapping of the southern course of the wadi was initiated (Fig. 1). Prominent among the evidence found was the discovery of a second fortified settlement, WBK49, likely a fort, measuring 80 x 40 m, circumscribed by casemate walls and equipped with residential rooms.

Located about 500 m southeast of WBK1, WBK49 takes on the appearance of a secondary settlement functional to the larger habitation site. Although the site is mostly flattened, the foundation rows, made of stone, of its walls and rooms are well preserved; for example, the entrance portal, which opens in the middle of the west front of the walls, the casemates that circumscribe the site, and several dwellings along the central axis and parallel to the west front of the fortification wall stand out. Observation of surface materials, mainly large ceramic storage vessels and chlorite pottery fragments, suggests an occupation contemporary to the rich Late Iron Age phase of WBK1. This dating is confirmed by the site's architecture; in fact, the type of casemate fortifications is also attested at Samad in Fort M46, datable between the 2nd and 1st centuries BCE (Yule 2016: 65).

First fruition works at WBK1

Excavations in WBK1 follow the strategy to both carry on scientific study and prepare safe pathways for visitors to also appreciate the variability of structures in the *intra moenia* area. In accordance with the MHT, the first section of the site's fruition plan was prepared, namely to build a staircase to safely access the inner area of WBK1 (Fig. 2). The staircase, located immediately north of the main tower, i.e., the most monumental point of the enclosure, was designed and built in accordance with a philological criterion involving the use of dry-stone masonry techniques and the use of in situ materials in order not to alter the ancient landscape.

Figure 4. Part of the still preserved tombs in the heavily damaged necropolis of Tiwi. On the foreground is visible the settlement (University of Naples Archaeological project at Wadi Bani Khalid).

Excavation of tombs

The two remotely identified necropolises belong to two different types of burial ritual: WBK51, close to WBK49, is certainly a small Late Iron Age necropolis (a dozen cist depositions). WBK50, located ca. 300 m to the north-west of WBK1, is a necropolis of turret tombs or "mounds." The largest of these has been excavated and although it has been looted it has yet returned abundant material (Fig. 3).

Activities in Tiwi

The Late Iron Age settlement of Tiwi was surveyed and published by Korn *et al.* in 2004, but no excavations were conducted within the settlement (Korn *et al.* 2004). The data collected from this initial survey identified a settlement of particular importance, as the associated necropolis for the Late Iron Age alone consisted of more than 900 mound-type graves.

Currently, the activities of "L'Orientale" project involve surveys for mapping the evidence still in place, both in the settlement and in the necropolis (Fig. 4). Surveys at Tiwi took place at the beginning of December 2023 in both the Late Iron Age fortified settlement and its necropolis. The settlement, although damaged by invasive road works, looks highly promising for archaeological excavations and consolidation works. Several house units are preserved (ca. 25), with high walls and abundant surface materials. Observations of surface material from the settlement show, once again, the presence of shell jewelry, produced according to a well-established tradition, and ceramic material whose shapes and fabrics may be associated to materials from the inland sites of Wadi Bani Khalid, confirming the need to define the complex socio-economic framework that involved the mountain oases and coastal sites.

The necropolis appears far more damaged by the coastal highway, but sectors still remain to be investigated that may preserve burials (Fig. 5).

It is proposed, therefore, to continue, in agreement with the Ministry of Heritage and Tourism, the strategy of working on two fronts, mountainous and coastal.

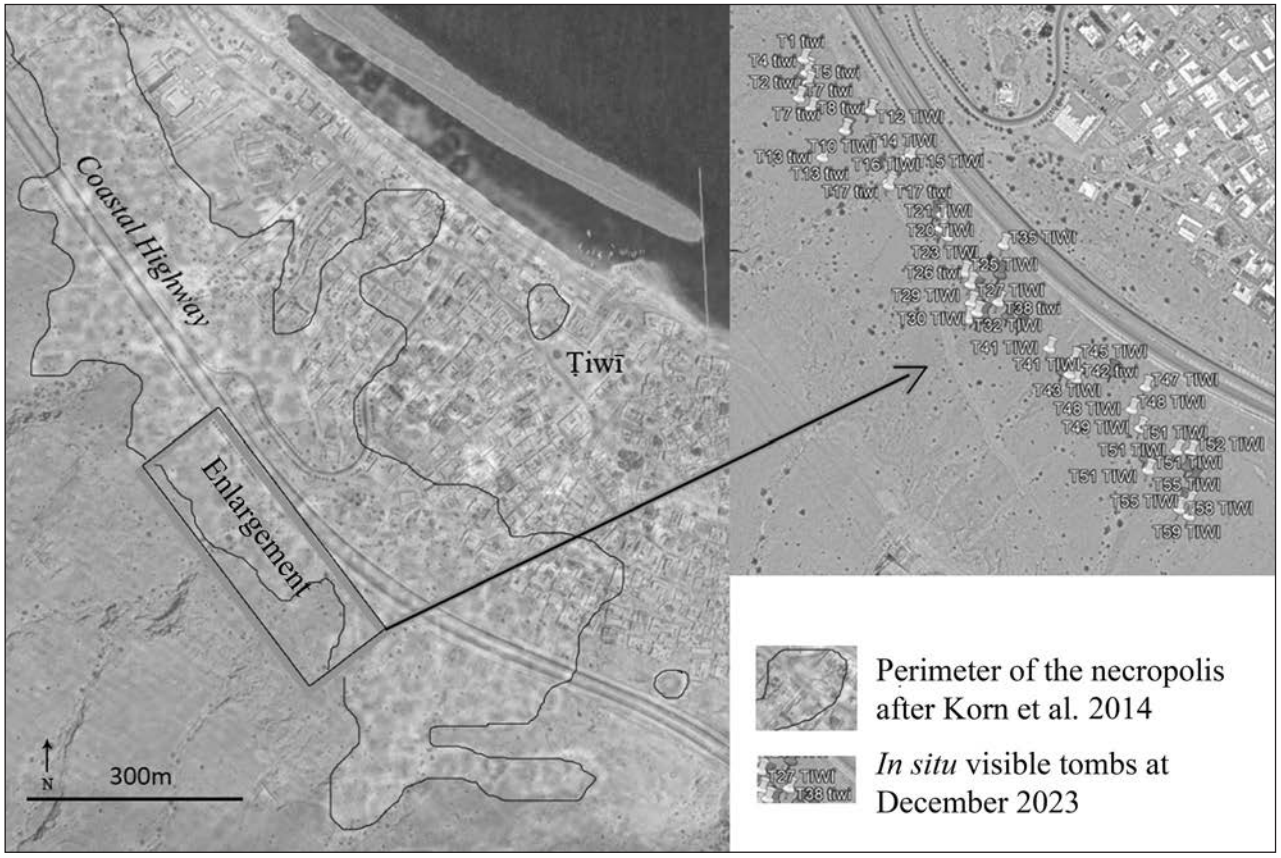

Figure 5. Mapping the preservation of the Tiwi necropolis following the construction of the Qurayyat-Sur coastal road and the development of modern settlement (University of Naples Archaeological project at Wadi Bani Khalid).

Conclusion and perspectives

From a settlement strategies point of view, the territorial area of Wadi Bani Khalid presents itself as an exceptional case for the definition of socio-economic contexts of historical times in Eastern Arabia. Numerous research topics are underway and will be developed within the framework of the project of "L'Orientale": the topographical and architectural study is accompanied by research on the abundant ceramic material that emerged from the excavations (more than 50,000 fragments); research in the necropolis, both from the historic period and from the 3rd and 2nd millennia BCE; definition of the contexts related to mining and production of chlorite artifacts, considering the orographic ophiolitic context in which it is operated.

Finally, from the perspective of the newly formed Oman Ministry of Heritage and Tourism (2020), the archaeological sites in Wadi Bani Khalid are part of a broader framework of tourism development and heritage preservation in a valley that, in addition to natural attractions, features monumental architecture in need of immediate protection and enhancement strategies.

Since 2022, therefore, the project of "L'Orientale" has been implementing first strategies for the preservation and fruition of the most monumental site, WBK1. Successful experimentation with systems for consolidating the earthen elements of ancient buildings based on the cyclical use of natural consolidants, such as arabic gum, has made it possible to keep the excavations exposed, without covering them. In this way, the complex "urbanization" of WBK1 can be made perceptible, in part through the design of special fruition routes that guide the visitor within the site, along pre-established itineraries that allow the visitor to reach both the main panoramic points of the settlement and the main excavated housing structures.

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Exploring the Omani Rub' Al-Khali (2023-2024): Archaeological and Geomorphological Investigations in Maitan and Wadi Stum

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The 2024 season of the "Exploring the Omani Rub' Al-Khali" project continued the archaeological and geomorphological work in the Maitan region (Shaqat and Urq Jadailah) and began investigations at Wadi Stum. Through a combination of archaeological surveys, excavations, and palaeoenvironmental analyses, the research identified significant Neolithic occupations and past hydrological activity. Newly collected radiocarbon and OSL samples will refine the environmental and cultural chronology of this scarcely explored area of southern Oman, emphasizing its importance as a corridor and hub for mobile prehistoric communities.

تواصلت خلال الموسم الميداني لعام 2024 الأعمال الأثرية والجيوموفولوجية لمشروع "استكشاف الربع الخالي العُماني" في منطقة ميتان (شقط وعرق جديلة)، وبدأت الاستكشافات في وادي ستوم من خلال الجمع بين المسوحات الأثرية، والتنقيبات، والتحليلات البيئية القديمة حيث كشفت الدراسة عن دلائل مهمة على استيطان إنساني خلال العصر الحجري الحديث إلى جانب نشاط هيدرولوجي سابق. ستُسهم دراسة أحدث العينات التي تم جمعها بواسطة التأريخ بالكربون المشع وتقنية التأريخ بالرنين الضوئي المحفز OSL في تحسين فهمنا للتسلسل البيئي والثقافي لهذه المنطقة البعيدة في جنوب عُمان، والتأكيد على أهميتها كممر حيوي للمجتمعات المتنقلة في عصور ما قبل التاريخ

Part of the broader Arabian Seashores program (Charpentier *et al.* 2023), this project focuses on the desert margins of southern Oman, particularly Urq Jadailah (UQJ), Shaqat Jadailah (SQJ), and Wadi Stum (WST) (Fig. 1). The first two areas, embedded within interdunal valleys and extensive playas, offered a unique opportunity to link archaeological evidence of Neolithic life with the palaeoenvironmental record of fluctuating hydrological conditions (Maiorano *et al.* 2020, 2024). The campaign employed a combination of geomorphological and topographic mapping, systematic surface collection, stratigraphic excavation, and palaeoclimatic sampling to explore long-term occupation and mobility strategies in the southern Rub' Al-Khali.

Palaeoenvironment and Geomorphology

In UQJ and SQJ the geomorphological study focused on understanding landscape evolution in link with the rainfall variability. At Urq Jadailah, OSL samples from palaeosebkha levels revealed two key humid phases: one during MIS 5 and another in the early Holocene. Shaqat Jadailah displayed concentric playa deposits suggesting a receding water body. These findings reinforce the interpretation of these interdunal basins as hydrologically reactive systems, fed by groundwater and episodic rainfall, likely connected to regional aquifers and influenced by both monsoonal and cyclonic events.

While the study of Maitan area is more advanced, Wadi Stum's fluvial deposits are currently under investigation with the aim of correlating riverine dynamics with the settlement history of the adjacent terrace.

Archaeological Investigations

The fieldwork focused on documenting extensive lithic scatters and associated features across UQJ, SQJ and make a preliminary assessment at WST. At UQJ, over three hectares were surveyed and subdivided into zones UQJ-1 through UQJ-5. Systematic collection and density transect revealed spatial clustering of activities, with high concentrations of debitage and diagnostic tools including projectile points, bifaces, ornaments and groundstone tools. Excavations in UQJ-2 uncovered three combustion structures, from which charcoal samples were retrieved for radiocarbon dating. Complementary mapping with high-resolution GNSS produced a digital elevation model (DEM) crucial for landforms and spatial analyses. The site's dense material culture—mortar and pestles, marine shell ornaments, flint hammers, and tethering stones—underscores the diversity of prehistoric activities and suggests repeated seasonal occupation (Fig. 2).

Shaqat Jadailah SQJ-1 to 5 appears partly different from UQJ and features one of the richest assemblages of ground stone tools in the region, with 168 grinding implements recorded, documented and sampled for use-wear and starch grains analysis. Two previous test soundings set over two fireplaces

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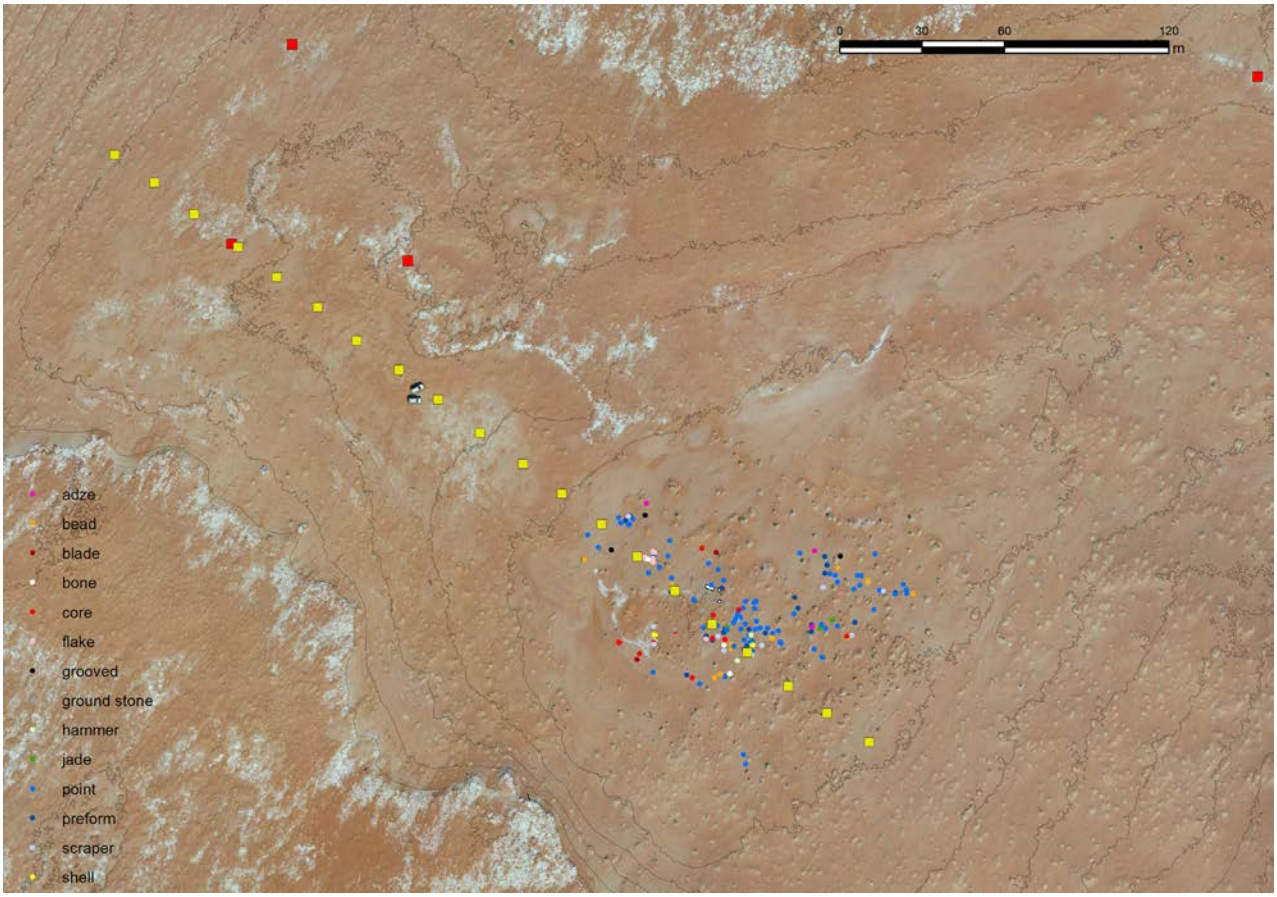

Figure 1. Map of UQJ survey area indicating the position of the collected artefacts, OSL sampling, density transect and test-trenches. Inset: general map of south and central Oman indicating the position of the mentioned sites (Source: NSA, Sultanate of Oman).

returned calibrated radiocarbon ages dating to the half of the 6th millennium BCE. This period aligns with the Holocene Humid Phase, reinforcing the hypothesis of increased mobility and attendance of these playa-lakes.

The fieldwork proceeded at Wadi Stum, where a previously undocumented site (WST-1) revealed fluted trihedral projectile point production workshops, comparable to the assemblages found at Ad-Dahariz (DHZ-2, Salalah) (Fig. 3). The presence of both preforms and finished points suggests on-site manufacture. Surface scatters of bifacial tools and stone structures indicate multiple occupation phases, potentially extending into later prehistoric or early historic periods.

Material Culture and Technological Insights

The lithic industries of Maitan are characterized by sophisticated bifacial techniques and the production of projectile points using high-quality chert. Diagnostic types include trihedral tanged and shouldered projectile points, bifacial adzes, scrapers, and various retouched pieces (Fig. 4; Maiorano *et al.* 2020, 2024; Al Kindi *et al.* 2021). A key focus was the collection of diagnostic pieces using D-GPS, alongside the systematic recovery of artefacts in three sample areas. This approach aims to reconstruct the operational chain of artefact production and to identify the primary objectives of flintknapping activities at the site. Grinding tools are largely made from Eocene bioclastic limestone and silicified sandstone. When grouped by typology and spatial distribution, these artefacts reveal standardized manufacturing practices and suggest coordinated processing activities—possibly involving wild cereals and grasses. The targeted sampling of the better-preserved grinding stones (and the surrounding sediment) supports ongoing use-wear and phytolith analyses (Fig. 5). Additionally, shell ornaments—beads and pendants crafted from marine mollusks—attest to symbolic expression and long-distance exchange.

Figure 2. General view of Urq Jadailah from the dune south of the basin (left). Inset: detail of a projectile point discovered on surface in UQJ-2.

Figure 3. General view of Wadi Stum from the top of the terrace with the Neolithic occupation (left). Section of the wadi with S. Al-Huraizi marking the position of freshwater shells (right).

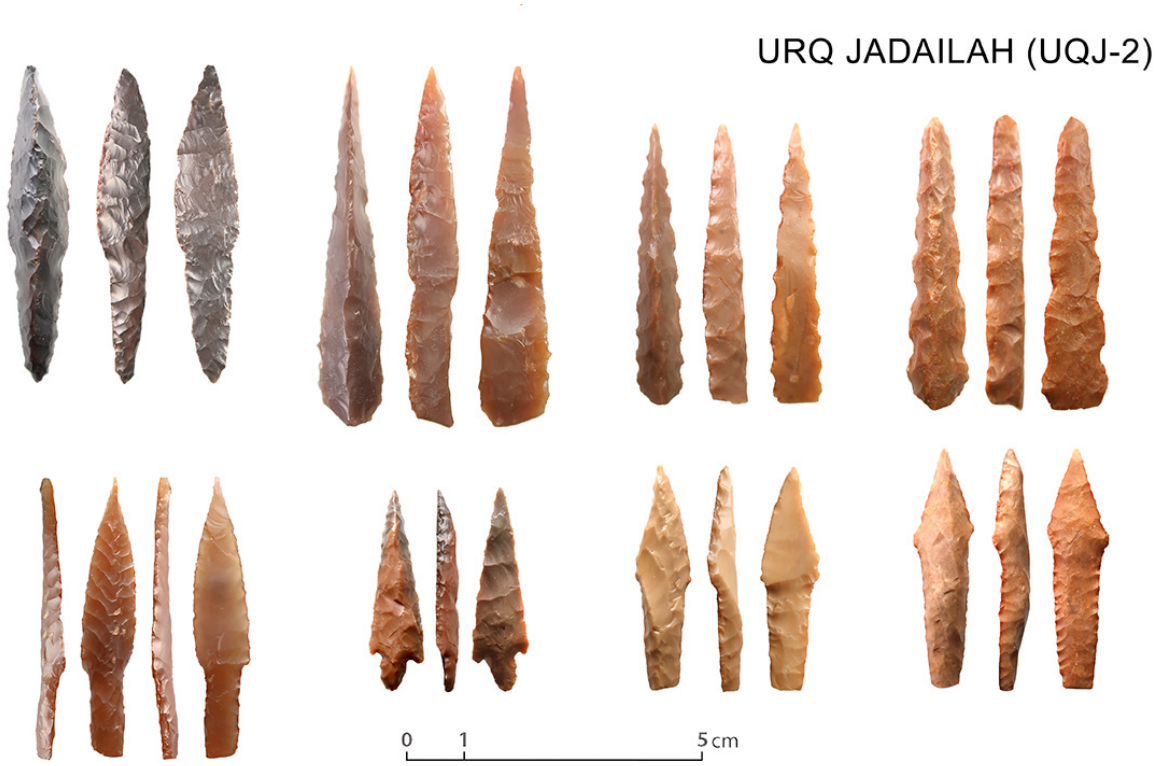

Figure 4. Selection of projectile points from Urq Jadailah.

Figure 5. Mapping and photographic documentation of the groundstone tools in Shaqat Jadailah SQJ-2, 3, 4, 5.

Lastly, in Wadi Stum WST-1, the presence of all-stages preforms and finished points suggests on-site manufacture for fluted trihedral points. Surface scatters of bifacial tools and stone structures indicate multiple occupation phases, potentially extending into later prehistoric or early historic periods.

Conclusion

The 2024 campaign fully integrates archaeology and geomorphology to approach the study of settlement dynamics of southern Oman's Neolithic populations. Initial radiocarbon and OSL dates align with known humid periods, supporting the hypothesis that this part of the Rub' Al-Khali might have represented a hub for nomadic and semi-nomadic communities. The density and richness of lithic material, combined with the systematic organization of grinding areas and ornaments, suggest a highly mobile yet structured society. Future field seasons will expand survey coverage, focus on dating early Holocene deposits at Shaq Shuayt, and complete the technological study of the collected assemblages.

Acknowledgements

This project was supported by the Society of Antiquaries of London (Beatrice de Cardi Award) and the Fokus A|B Grant from GRADE – Goethe University Frankfurt. We thank the Ministry of Heritage and Tourism of Oman for their continuous support, particularly the Directorate General of Antiquities and the Earth Science Consultancy Centre. Field assistance by Said Al-Huraizi, Ali Al-Mahri, and Adam Al-Ghafri was crucial to the mission's success.

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Maiorano M.P., M. Al-Kindi, V. Charpentier, J. Vosges, G. Marchand, F. Borgi, M. Pickford, D. Gommery, T. Beuzen-Waller, S. Al-Huraizi, and A. Al-Mahri (2024). Alle porte del deserto: gli insediamenti di Maitan nel quadro del Neolitico dell'Oman meridionale (Rub al-Khali, Sultanato dell'Oman). In M. Ramazzotti (ed.), *Costeggiando l'Eurasia: Archeologia del paesaggio e geografia storica tra l'Oceano Indiano e il Mar Mediterraneo* (Atlante del Vicino Oriente Antico, Opere Collettanee 3). Rome: Sapienza University Press, pp. 99–111.

Preliminary Results of the 4th Season of the SIPO Project at Hayl Ajah: Tackling the Depositional Palimpsest at Site HA 1

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Following geoarchaeological investigations during the spring seasons of 2022 and 2023, the autumn season 2023 at Hayl Ajah (1019 m a.s.l.) focused on developing excavation techniques for the site's HA1 depositional palimpsest. Although the archaeological loci were small (up to 5 per m^2), the sediment patches proved sufficiently differential in colour and texture to allow precise recording of the positions of lithic artefacts within the stratigraphic context. Achievements included: re-examination of a crucial OSL sampling spot from 2019 and new samples for luminescence dating; small-scale archaeological survey at HA1; continued mapping of the vegetation cover in Hayl Ajah.

بعد الاستكشافات الجيوأثرية خلال فصول الربيع لعامي 2022 و2023، ركز فصل الخريف 2023 في حيل العاجة (1019 متر فوق مستوى سطح البحر) على تطوير تقنيات الحفر للطبقات الترسيبية المتراكبة للموقع HA1. رغم أن المواقع الأثرية كانت صغيرة (تصل إلى 5 في المتر المربع الواحد)، إلا أن بقع الرواسب أثبتت تمايزاً كافياً في اللون والملمس للسماح بالتسجيل الدقيق لمواضع القطع الأثرية الحجرية ضمن السياق الطبقي. شملت الإنجازات: إعادة فحص موقع أخذ عينات OSL من العام 2019، وأخذ عينات جديدة للتأريخ بالإضاءة المتألقة، والمسح الأثري صغير النطاق في HA1، واستمرار رسم خرائط الغطاء النباتي في حيل العاجة.

In the mountains of Northern Oman, karst depressions have formed in fractured, horizontal limestone formations via solution. These large hollows at elevations between ca. 500 and 1500 m a.s.l. have been able to gather and preserve, in a unique manner, deep deposits of silty sediments higher up in the steep and eroded landscape (Fuchs & Buerkert 2008; Mateiciucová *et al.* 2023). According to microfossil analysis, the fertile silt accumulating in the karst depressions is former aeolian dust that has been blown from coastal shelves during low sea level stands into the "maze" of the Al-Hajar Mts. As natural sinks, these features (locally called *ḥuyu*l; sg. *ḥayl*) are predestined not only to receive sediments but also the concentrated run-off of their immediate surroundings. The mountain *ḥuyul* thus serve as "flowerpots" in their steep, rugged environment. As level spaces, the sediment-filled depressions were not only preferential places for plant growth at higher elevation (Luedeling & Buerkert 2008; Schlecht *et al.* 2009), but also meaningful locations for animals and prehistoric humans roaming the interior of the mountain range, as evidenced by the diversified lithic assemblages of Hayl Ajah (Mateiciucová *et al.* 2023). Additionally, places like Hayl Ajah (Fig. 1) represent rare intermountain sedimentary archives, supporting reconstructions of the past climate in Southeastern Arabia. When accompanied by archaeological artefacts, the relevance of these depressions at higher elevation for environmental archaeology becomes immediately clear.

The activities planned for the Autumn Season 2023 at Hayl Ajah (HA 1) have taken a decisive turn after receiving earlier in the year a surprisingly old date (Late Pleistocene) for an OSL sample taken in December 2019 (Fig. 2) and submitted for analysis in February 2020 (S57/Trench 1). If verified as indicating human activity, the dated deposit would evidence an occupation of the mountain site during a drier climatic phase, supporting the Al-Hajar Refugium Hypothesis (Mateiciucová *et al.* 2023). (The hypothesis suggests the presence of prehistoric groups at high elevations inside the Al-Hajar Mountains during times of aridisation). Accordingly, re-examining the exact location where the OSL sample had been taken four years earlier became the season's top priority. Through the meticulous separation of all sub-loci, systematic recording of individual artefacts, and sediment sampling in especially short intervals, we thoroughly examined the trench corner into which the OSL tube had been driven in 2019 (Q 08/25; Fig. 3). Fresh impact scars on rocks revealed the position and orientation of the steel tube in the ground unequivocally (Fig. 4B), allowing to attribute OSL sample S57 to a specific archaeological horizon with bladelets and bladelet cores (Mateiciucová *et al.* 2020). In addition to this re-examination quadrant, cross-sections were made down to the bedrock in two control quadrants (Q 99/14; Q 15/67) close to the scrutinised OSL sampling spot. This testing confirmed that the distinctive bladelet industry encountered in Trench 1 (Mateiciucová *et al.* 2020) extend-

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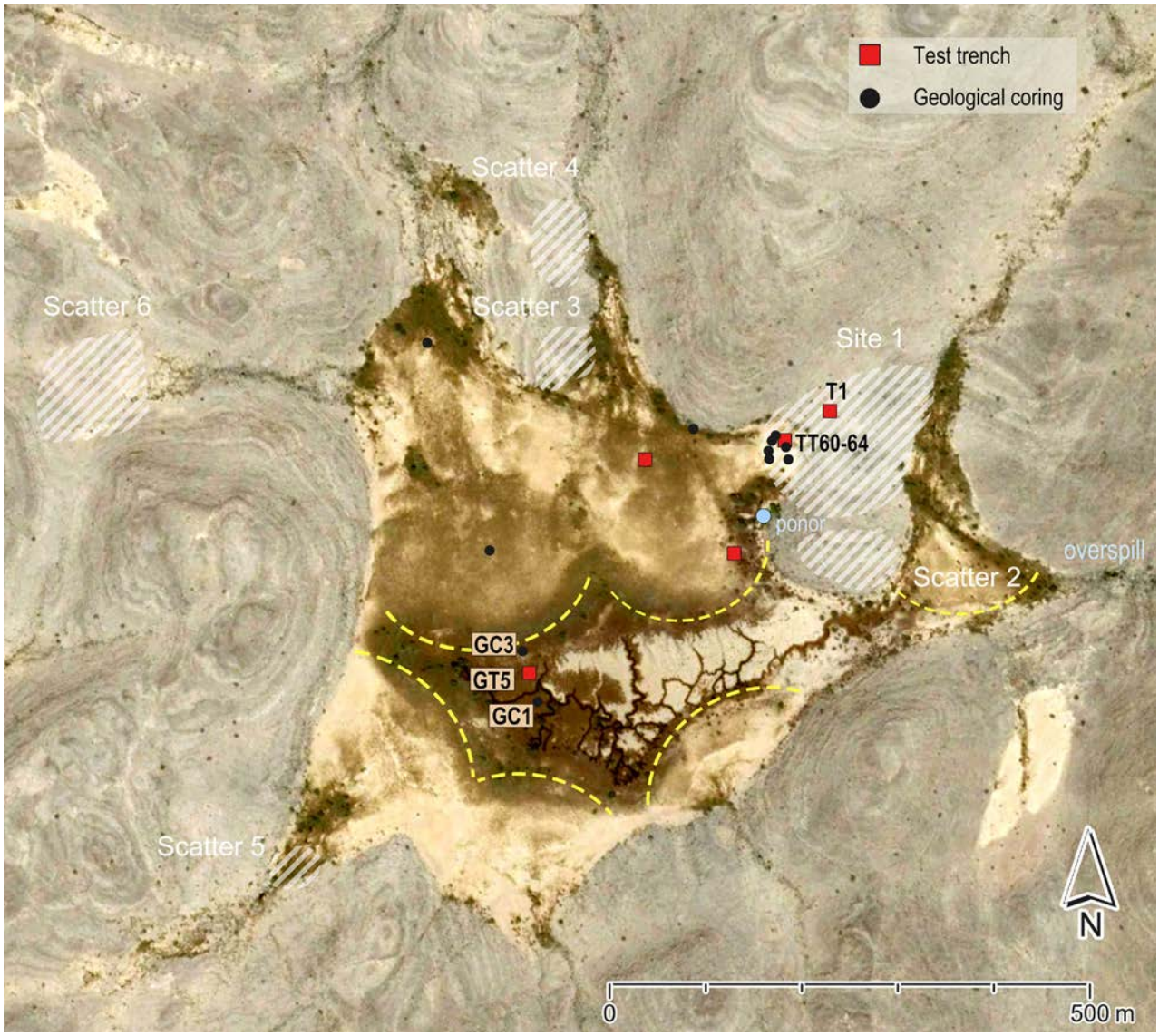

Figure 1. The sediment-filled karst depression Hayl Ajah with its lithic scatters 1 to 6. Visible are the almost level alluvial fans in front of seven run-off gullies shedding their water into the *ḥayl*, the central infiltration zone with a grid of water-filled shallow channels and the two clusters of trees. Main drillholes GC1 (depth 4.1 m, 2018) and GC3 (depth 3.3 m, 2022) and the main sedimentological sounding GT5 (2022). Subsidiary drill holes (black dots) and geo/archaeological trenches (red squares). - The OSL Sample S57 (2019) and examinations quadrants (2023) of the season are situated next to Trench 1 (2018). Basemap from 2017 (courtesy of Maxar Technologies, accessed through Google Earth pro).

ed as an archaeological horizon into Quadrant Q 15/67 (further to the north-east). OSL dating of the two distinct archaeological levels within this control quadrant will provide a first "fix" for establishing a stratigraphic control of the site's deposits. It will help to date the bladelet industry, which currently lacks true parallels elsewhere on the Arabian Peninsula.

To assess on the scale of deflation, a parallel small-scale survey of the lithic scatter at HA 1 has been initiated in 2023. For this purpose, alternating 1 x 1 m quadrants, subdivided into 0.1 x 0.1 m sub-quadrants, have been surveyed along the 260 m long Transect B, spanning much of the site. This task has been performed to specifically check on earlier observations of a morphological as well as petrological difference between the deflated lithics at the surface and the bladelet industry still preserved in the sediment of HA 1 (Trench 1; Mateiciucová *et al.* 2020). The tested survey method proved to be indicative (Fig. 5). A comparison of surface and embedded lithics will thus help to assess the dominant depositional process that has shaped Site HA 1.

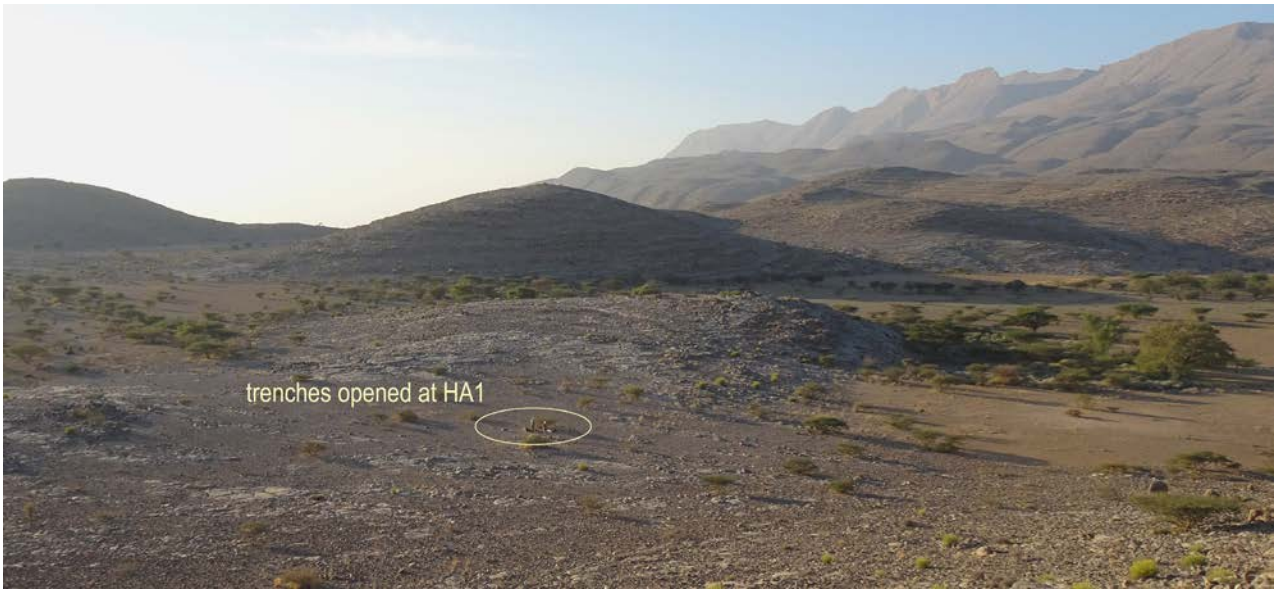

Figure 2. Site HA 1 at the northeastern edge of Hayl Ajah, view to south. The karst depression (1019 m a.s.l.) is found at the highest point of an intermountain corridor at the inner flank of Al Jabal Al Kawr (background). The circle marks the location of in-situ lithic artefacts (T1, 2018), the relevant OSL sample S57 (2019) and the three control quadrants (2023) in a shallow sediment remainder in a swale just outside the *ḥayl*.

Figure 3. Site HA 1; view to south-south-west. In the foreground the exposed rock bottom of Trench 1 (2018) that yielded a cluster of in-situ cores (Mateiciucová et al. 2020). In a former corner of Trench T1, the re-examination quadrant Q 08/25 marks the spot where the OSL sample S57 was retrieved in December 2019. In the rear: Q 99/14, one of the two flanking quadrants with well-documented control profiles (the other is Q15/67).

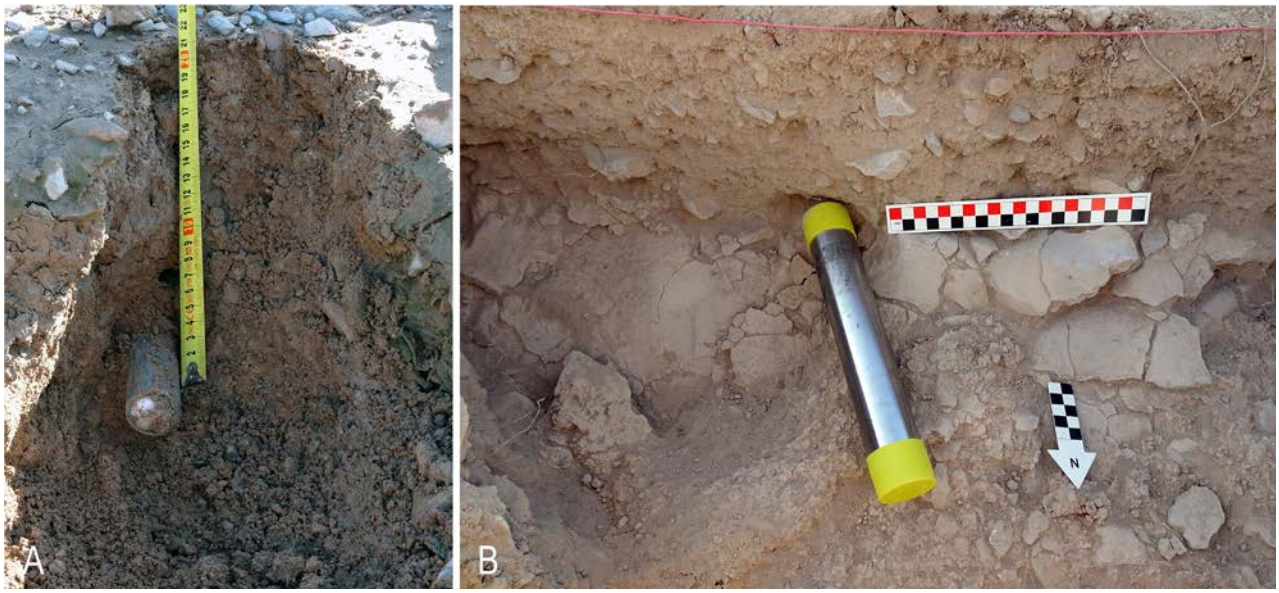

Figure 4. Site HA 1. A: The corner of Trench 1 where the OSL sample S57 was taken (2019). B: Details of the OSL sampling spot in re-examination quadrant Q 08/25 after careful stratigraphic investigation and thorough sampling.

Apart from these activities, in a separate effort, the mapping of the recent plant cover at Hayl Ajah has been continued to recognise larger-scale hydrological, sedimentological and depositional differences inside the vast karst depression (diameter: ca. 0.6 km). For this purpose, semi-quantitative data have been collected along 11 transects. The results revealed a six-fold, concentric distribution of different plant species.

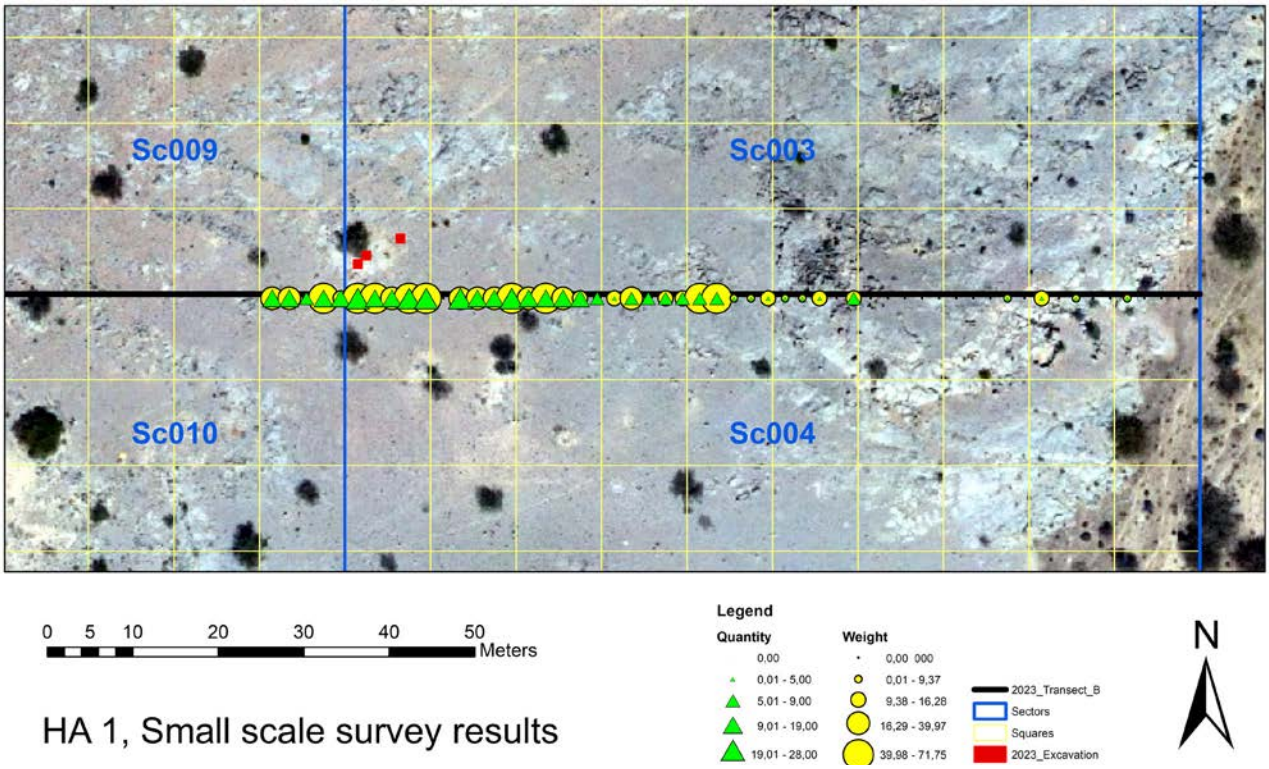

Figure 5. Site HA 1. Preliminary small-scale survey results. Weight and quantity distribution of surface artefacts sampled along Transect B, across the of the prehistoric mountain site. The examination and control quadrants (red squares) contain sediment-embedded artefacts.

Acknowledgments
For enabling our archaeological research in Oman, we are grateful to the Department of Classical Studies and the Dean of the Faculty of Arts, Mrs. Irena Radová at the Masaryk University (Brno, Czech Republic). The project owes thanks to the support by specialists investigating the depression Rakhat Al Madrh of the Bat Archaeological Project (dir. J. Swerida, Leiden University, NL & University of Pennsylvania Museum, Philadelphia, USA & E. Dollarhide, New York University Abu Dhabi, UAE.

Funding: Beatrice De Cardi Award (Society of Antiquaries, London, UK).

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PrehistOman – Italian-Omani Archaeological Project in Oman (2023-24): Archaeological Explorations at Hayy Al-Sarh (Rustaq, Al-Batinah South Governorate)

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During 2023, a survey was conducted to deepen our understanding of the prehistoric potential of the Southern Batinah. Among the recovered evidence, the Al-Hajar piedmont produced two previously unknown large lithic scatters. During the 2024 campaign, excavations were carried out at one scatter—at Hayy Al-Sarh in the suburbs of Rustaq—unearthing a well-preserved deposit featuring a circular/elliptical stone alignment with circular postholes. Both its interior and the adjacent area show abundant archaeological materials. Although interpretations remain open, the spatial organization and artifact assemblage point to a temporary campsite of the Neolithic period, offering new insights into settlement dynamics in the interior areas.

خلال العام 2023، أُجري مسح أثري لتعميق فهم الإمكانات ما قبل التاريخية في محافظة جنوب الباطنة. من بين أبرز نتائج هذا المسح الأثري، الكشف عن موقعين كبيرين لانتشار الأدوات الحجرية في سفح جبال الحجر لم يكونا معروفين من قبل. خلال موسم 2024، أجريت حفريات في أحد هذين الموقعين - في حي السرح بضواحي ولاية الرستاق - حيث كشفت عن طبقة محفوظة جيداً تضم ترتيباً دائرياً/بيضوياً من الحجارة مصحوباً بحفائر دائرية للأعمدة، وأظهرت كل من المنطقة الداخلية والمنطقة المجاورة وفرة من المواد الأثرية. وعلى الرغم من بقاء التفسيرات مفتوحة، فإن التنظيم المكاني وتجميعة القطع الأثرية تشير إلى مخيّم مؤقت من العصر الحجري الحديث، مما يقدّم رؤى جديدة حول أنماط الاستيطان في المناطق الداخلية.

Over the past decades, research on Omani prehistory during the Holocene has primarily focused on coastal fringes. Excavations of extensive shell-middens have revealed that, from the end of the 6th millennium cal BCE, hunter-fisher-gatherer communities settled along the coast and intensively exploited both offshore and inshore resources.

Settlement patterns remain debated, especially regarding sedentarization. Many scholars argue that abundant marine resources fostered year-round occupation. Exploitation of ecological niches—open water, reefs, estuaries, and mangroves—provided a stable food base: pelagic species complemented by demersal fish, small fish, and mollusks harvested from cliffs, estuaries, and mangroves. The discovery of large cemeteries at sites such as Ras Al-Hamra suggests a degree of social complexity and perhaps more permanent settlement than previously thought. In this context, nomadic movements between coast and highlands were probably limited; highland excursions likely occurred in summer, when temperatures moderated and water-rich plains were accessible (Biagi & Nisbet 2006).

Despite these advances, mobility patterns and territorial organization in inland northeastern Oman during the Middle Holocene remain poorly understood. Data from interior areas are far scarcer and more discontinuous than coastal evidence. Few inland sites have stratified deposits, and most information derives from surface finds lacking precise dating or context.

The joint PrehistOman project, "Excavations and Survey at Hayy al-Sarh-Rustaq (Al Batinah South Governorate, Oman)," conducted by the University of Pisa and Sultan Qaboos University, targets a newly identified inland site, Hayy Al-Sarh. Initially located during a broader survey of Al Batinah governorate and preliminarily tested by Bretzke et al. (2018), the site yielded four small test trenches revealing two main archaeological layers (AH-I, AH-II) with flaked stone tools and shells. Radiocarbon dates on marine shells place occupation ca. 5500–4800 cal BCE, confirming a Neolithic context as attested by bifacially retouched points in the lithic assemblage.

Excavations at Hayy Al-Sarh

In 2023, a preliminary survey of the Rustaq area aimed to gather fresh data on both pre-Neolithic and Neolithic occupations. Several new lithic scat-

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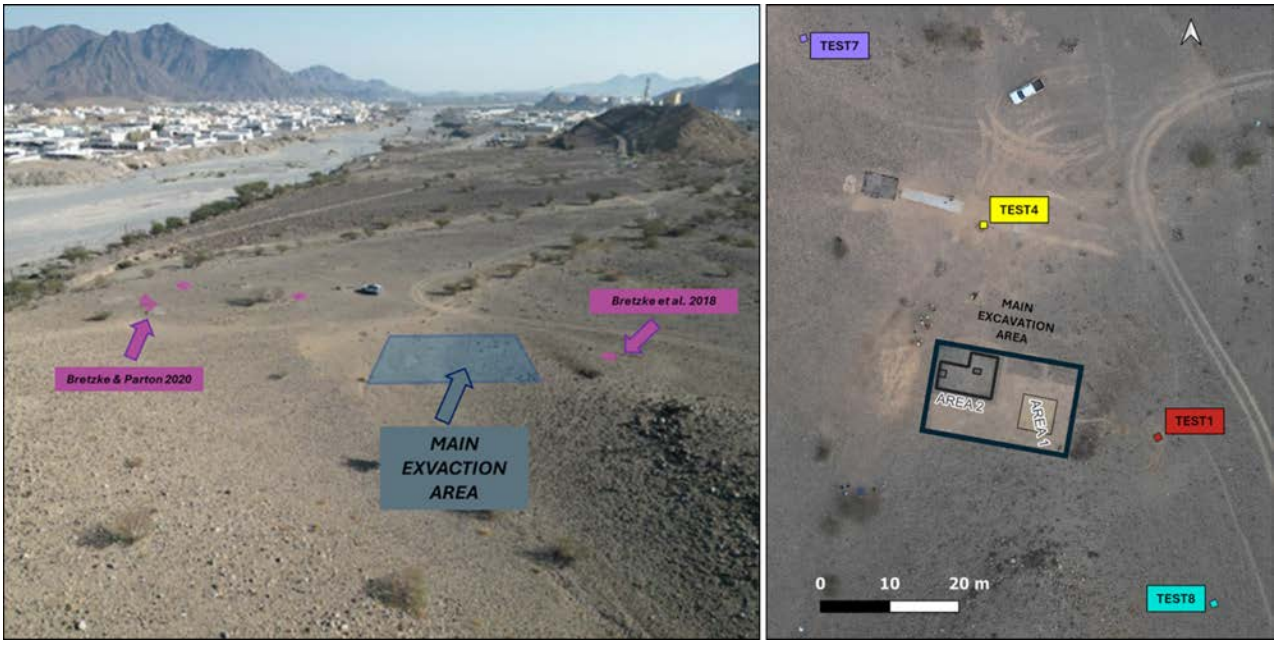

Figure 1. Location and surrounding of the Hayy Al-Sarh site, including the specific position of the TEST trenches and the two main excavations areas (A1, A2).

ters were identified—few along the coastal fringe and many more on the piedmont and in the interior of the Al-Hajar Mountains. Coastal and plain sites yielded scant prehistoric evidence, due in part to intense human impact and low archaeological visibility. By contrast, the piedmont scatters produced abundant lithic artefacts. Of these, the Hayy Al-Sarh locality proved the most promising and was selected for excavation in 2024.

As noted above, the site was previously tested by Bretzke et al. (2018). Given those promising results—and in hopes of uncovering a stratigraphically preserved archaeological layer—we opened a larger excavation area of about 20 × 10 m east of their test trenches. This expansion (Fig. No. 1) was aimed at:

- test the stratigraphic sequence identified by Bretzke et al. (2018);
- improve understanding of the site's spatial organization.
- explore possible domestic structures or dwellings.
- recover a larger sample of materials from stratified layers.
- collect samples for paleoenvironmental analysis.
- obtain new samples for radiocarbon dating.

Our methodology combined small-scale test pits to delimit the extent of the archaeological layers and assess the geomorphological setting, with the opening of two large trenches (A1 and A2) to expose potential anthropogenic features (Fig. No. 1).

Results

The two main excavation areas were opened at the foot of a gentle slope on a small hill that rests upon a Pleistocene terrace. Based on preliminary sedimentological and geomorphological reconstruction, we hypothesize that, since the terrace's formation, the slope has been progressively infilled by sandy sediment deposited by stream action and wind transport.

Of the two main excavation areas, only A2 yielded archaeological evidence. There, a superficial aeolian sand deposit, underlain by a compacted sandy layer—likely the result of water stagnation—sealed the principal archaeological horizon. Within this horizon, excavation revealed three categories of structural evidence. LOCUS 1 comprises a U-shaped alignment of two rows of large stones, flanked by smaller fill stones and opening to the northeast. The interior of this enclosure contained a few knapped flints, while the exterior produced a denser scatter. Although its function remains equivocal, it may represent either a dismantled dwelling or a terrace wall demarcating an occupational yard.

LOCUS 2 forms an arcuate stone alignment enclosing an internal layer rich in lithic debris, shell beads, fossil shells, and coral fragments. A ring of pseudo-circular postholes—small (25–40 cm diameter), sometimes bounded by stone circles—articulates the margin of this structure (Fig. No. 2). Only half of the feature has been excavated to date, but its form parallels Neolithic huts excavated at Ras al-Hamra (RH6) (Marcucci et al. 2014).

North of LOCUS 2, a charcoal-filled pit (US3009) with ashy sand fill and a nearby circular stone cluster may represent ancillary activities—perhaps hearth use—though its small size precludes firm functional assignment. Radiocarbon dating of samples from this pit yielded ca. 3600–3400 cal BCE, suggesting a slightly later occupation than that recorded by Bretzke et al. (2018). Area A2 also produced an abundant lithic assemblage of over 700 artifacts. Preliminary raw-material analysis confirms a complex economy, including radiolarite—sourced from nearby ophiolite outcrops in Rustaq—exotic flints in four different varieties, quartz, quartzarenite, and

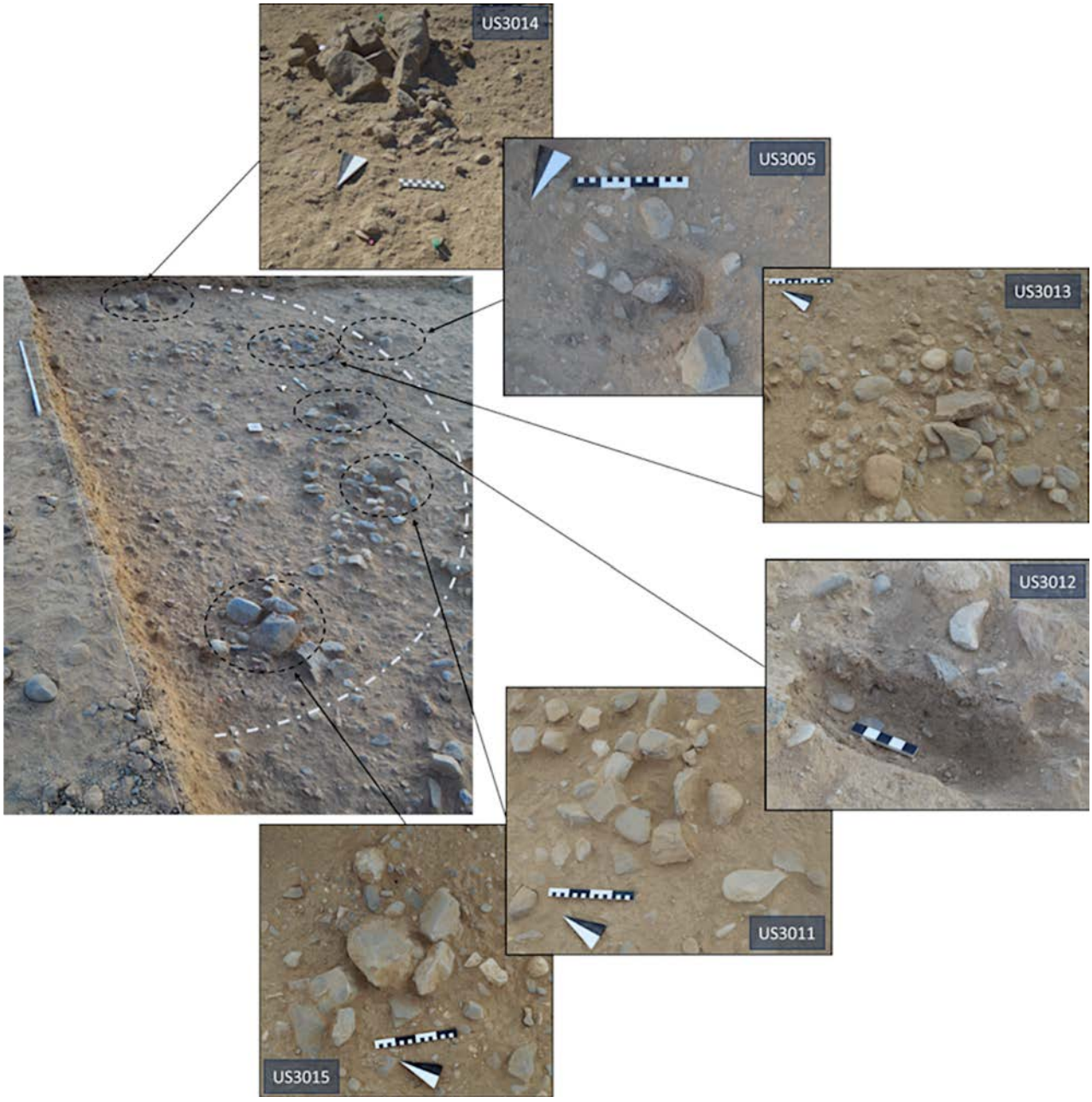

Figure 2. Overview of LOCUS 2, the main dwelling area, showing the pseudo-circular stone alignment and the series of post-holes and wedges.

hyaline crystal. Overall, retouched implements are rare and bifacial or trifacial points are absent, situating the assemblage firmly within a flake-oriented Neolithic industry.

Preliminary bioarchaeological results indicate that the site was established under more humid, wetter conditions than today. Pollen and charcoal analyses reveal temperate species such as oak, alongside alder—an indicator of nearby water bodies or riparian zones. This interpretation is further supported by the presence of tamarisk, which also signals proximity to wadi beds. The archaeobotanical study at Hayy al-Sarh thus enriches the sparse dataset on Neolithic vegetation cover and plant-resource use in Oman's interior. Although data remain very limited, these findings point to a more complex and varied environmental history than previously recognized.

Conclusions and Perspectives

The 2024 excavations at Hayy Al-Sarh confirm the existence of a temporary Neolithic campsite on the Al-Hajar piedmont, defined by a single occupation horizon sealed beneath aeolian and fluvial sands. Structural evidence—particularly the U-shaped LOCUS 1 and the arcuate, posthole-ringed LOCUS 2—demonstrates that Neolithic groups constructed stone enclosures or dwellings adapted to sloping terrain. The discovery of a solitary ashy pit containing charcoal indicates on-site processing or heating activities, although its precise function requires further study. Hayy Al-Sarh thus offers a rare inland Neolithic snapshot in southeast Arabia: its stone structures, stratified deposits, and lithic economy together illuminate temporary settlement strategies on the piedmont. Neolithic occupants chose stable terrace edges for their camps, exploiting ophiolite-sourced radiolarite locally and importing exotic cherts and quartzes from the highlands. Future work should complete excavation of the unexposed half of LOCUS 2 to clarify its plan and function, while targeted paleoenvironmental sampling will refine our understanding of the climatic and vegetational context of occupation.

Acknowledgments

PrehistOman is a joint Italian Omani project, between the University of Pisa, Department of Civilizations and Forms of Knowledge, and the Sultan Qaboos University, College of Arts & Social Sciences. This research has been funded by the University of Pisa, within the PROARCHEO program, under the patronage of the Italian Minister of External Affairs and the Omani Minister for Heritage and Tourism. We are also thankful to the Laboratoire d'Anthropologie Sociale (Collège de France) for their support.

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Australian Mission 2023-24: La Trobe Archaeological Research in Oman (LaRiO) – Archaeological Investigation of Lahem, Dhofar Governate

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In the 2023-24 season our team excavated the newly found prehistoric herding site of Lahem, Dhofar Governate, south of Tawi Atair. This site offers new insights into Neolithic and Bronze Age herding practices on the Arabian Peninsula and in Oman. The site is on the edge of the Dhofar Mountains, overlooking the sea; abundant bones of goat and cattle found at the site will be tested to determine whether the prehistoric peoples practised a similar seasonal transhumance undertaken by today's herders – whereby animals are seasonally moved from the coastal plains to the mountains.

في موسم 2023-2024، قام فريقنا بالتنقيب في موقع الرعي - الذي يعود إلى العصر الحجري الحديث - والذي تم اكتشافه مؤخرا في لَحِم بالقرب من طاقة في محافظة ظفار. يقدم هذا الموقع رؤى جديدة حول ممارسات الرعي في العصر الحجري الحديث في شبه الجزيرة العربية وفي سلطنة عُمان. يقع الموقع في أعلى الحافة المطلة على البحر، وقد تم العثور على كميات كبيرة من عظام الأغنام والأبقار في الموقع، وسيتم اختبارها لتحديد ما إذا كان سكان العصر الحجري الحديث يمارسون نمطًا مشابهًا للرعي الموسمي كما يفعل الرعاة المعاصرون حيث تُنقل الحيوانات موسميًا من السهول الساحلية إلى الجبال.

This is a report on fieldwork for the La Trobe Archaeological Research in Oman in 2023-24. The overarching research goal of the project is to investigate the timing and nature of Out of Africa dispersals and the peopling of Arabia, and specifically Oman. The project aims to put this in a regional context.

The aim of the 2023-24 season was a targeted excavation of the newly identified site of Lahem in the Dhofar Governate of the Sultanate of Oman. A detailed survey of the geology and geomorphology of the landscape led to the identification of Lahem as a place in the landscape where sediments are likely to accumulate. The local geology is limestone; the site sits within a sheltered cleft on the top of the hill call Lahem (Fig 1). The location is favourable for sediment accumulation, and was therefore targeted with a 5x5m trench, to a depth of 6m.

Methods

Standard excavation protocols were followed; a site grid was laid out and a stepped 5x5m trench excavated using hand tools (Fig. 1), excavated by layer recording using a Total Station Theodolite, and excavating by spit where layers were deeper than 5cm. All excavated material was sieved through a 5mm sieve.

Results

The trench was stepped with 1.2m steps for stability and excavated down to 6m (Figs. 2-3). The top 3.5m were relatively homogenous, being composed of organic rich brown sediment, often with traces of preserved dung at the top. A number of burning layers were identified as well as two hearth features. Abundant bone was present throughout the more humic material, with very occasional stone tools – predominantly small thinning flakes. The bones appeared to show signs of processing for consumption, with splits, cut marks, and damage observed during excavation that is consistent with this activity. A reasonable proportion of the bone was burnt, but it will not be clear until laboratory analysis whether this was post-depositional (intentional) or otherwise. Charcoal was observed throughout the sequence, concentrated in the burned payers/features, and was sampled for radiocarbon dating.

The lowest part of the sequence was sterile from an archaeological perspective and had much less organic content. There were, however, multiple snail shells, perhaps showing a wetter environment during deposition – though more research will be needed.

Discussion and Future Research

The faunal and lithic assemblages are indicative of the processing of animal carcasses. Lithics are few, a max of 2 to 3 per square meter, (n=224), show a diverse range of raw materials used with very few elaborate types and a dominance of expedient tools.

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Figure 1. A view of the excavation looking east.

Figure 2. View of the east facing section.

Preliminary use-wear analysis indicated that the cutting and scraping activities had been performed. The abundant and well-preserved fauna assemblage, unique for Dhofar, shows cut marks and intentional fractures that indicate processing for consumption. The amount of humic content in the sediments suggests that animals were penned at the site; this practice is continued today, and we encountered several herders during the excavations. The site is a cleft with vertical walls that would be impossible for a predator to descend from. The entries to the site are narrow and easily blocked with vegetation (e.g. acacia) or guarded. This makes the site ideal for housing animals overnight, or even for extended periods if fodder can be procured. The close availability of fresh water in the valley below is another benefit of the site; indeed, it was used by tribesmen during the conflict periods of the 1970's, evidenced by bullet casings and mortar fins strewn around the site.

The next steps for the research are to date the site (using radiocarbon dating), we strongly suspect the site to be of Neolithic to Bronze Age based on a number of lines of evidence such as the preliminary absence of species such as camel. We will also investigate the faunal assemblage to assess whether transhumance took place and if so that nature of it.

Figure 3. 3D photogrammetry model showing the east facing section (left) and west facing section (right).

Acknowledgments
This project is supported by staff and students from La Trobe University, Australia; Tubingen University, Germany; the Czech Academy of Sciences; Adelaide University, Australia; and Oxford Brookes University, England. The field seasons have been funded by Australian Research Council project DP230100152 and Praemium Academiae of the Czech Academy of Sciences. Yamandú H. Hilbert, Marya Soubra, Gabriele Ruso, Scott D. McLin are financed in the frame of the REVIVE project, European Research Council grant #101001889. Mathieu Duval is supported by the Spanish Ramón y Cajal Fellowship RYC2018-025221-I, funded by MCIN/ AEI/ 10.13039/501100011033 and 'ESF Investing in your future'. We are deeply grateful to the Ministry of Heritage and Tourism of the Sultanate of Oman for providing permission and support for fieldwork. The research was conducted in collaboration with the Czech expedition ARDUQ (Archaeological Landscapes of Duqm and Dhofar) active in Duqm. We thank the reviewers for their insight and comments that have greatly improved this manuscript.

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Bat Archaeological Project (2023–2024): Heritage Research and Outreach Programmes

Nugent S.,[1] N. Al-Aati,[2] J. Swerida[3] & R. Bryant[2]

The Bat Archaeological Project (BAP) works within the UNESCO World Heritage Site of Bat, Al-Khutm, and Al-Ayn, building on decades of foreign-led research. Since 2007, BAP has expanded its focus from the Bronze Age to community-centred approaches that integrate archaeology, heritage, and tourism. Through interviews and outreach initiatives, BAP addresses the historical disconnect between researchers and residents, foregrounding local perspectives on identity, preservation, and socio-economic development. This participatory model enhances understanding of archaeology's impacts while laying foundations for collaborative heritage management, responsive tourism planning, and sustainable community engagement in partnership with the Ministry of Heritage and Tourism.

يعمل مشروع بات الأثري ضمن نطاق مواقع بات، والخطم، والعين، المدرجة على قائمة التراث العالمي التابعة لمنظمة اليونسكو، مستندًا إلى عقود من الأبحاث التي قادتها بعثات دولية في المنطقة. ومنذ العام 2007، وسّع المشروع نطاق اهتمامه من التركيز الحصري على العصر البرونزي إلى تبنّي مقاربات تُعلي من دور المجتمع المحلي، من خلال دمج علم الآثار بإدارة التراث وبالتنمية السياحية. وعبر المقابلات الميدانية ومبادرات التوعية المجتمعية، يسعى المشروع إلى ردم الفجوة التاريخية بين الباحثين والسكان المحليين، مسلطًا الضوء على وجهات نظرهم تجاه الهوية، وصون التراث، والتنمية الاجتماعية والاقتصادية. ويعزز هذا النهج التشاركي فهم التأثيرات الاجتماعية لعلم الآثار، ويرسي أسسًا لإدارة تراثية تعاونية، وتخطيط سياحي متجاوب، ومشاركة مجتمعية مستدامة، بالشراكة مع وزارة التراث والسياحة العُمانية.

Building on successful community outreach and engagement programming developed during previous field seasons, the Bat Archaeological Project developed a new heritage research programme in community-based research to enhance the relevance of our archaeological research. The new research programme was trialed during the 2023 field season. The purpose of this programme is to systematically and regularly monitor our impact and relationship as a foreign-led project with the Bat community to better integrate resident's voices and preferences in how we conduct and communicate research on their heritage. This data will be used to continue developing relevant engagement and outreach activities and responsively align our archaeological research strategy and scholarly communication with local interests and needs (Fig. 1).

History of the Bat Archaeological Project

The Bat Archaeological Project (BAP) operates within the UNESCO World Heritage Site of Bat, Al-Khutm, and Al-Ayn in northwest Oman. Foreign-led missions have shaped both scholarship and local memory since the early 1970s, when Danish, British, German, Japanese, French, and American teams began documenting the site's Bronze Age tombs, towers, and settlements. During the 2023–24 season, BAP welcomed Jens Vellev, photographer on Karen Frifelt's 1972 Danish expedition, who shared images from those early investigations leading up to the site's 1989 World Heritage designation.

Founded in 2007 by Gregory Possehl, BAP initially focused on tower excavations (Thornton, Cable, & Possehl 2016) but has since broadened to address themes from the Neolithic to the present. In 2013, Ruth Young introduced ethnographic studies of Bat village, integrating archaeology, heritage, and tourism (Young 2019). By 2020, the "Beyond the Oasis" initiative expanded research beyond the ancient core, pairing new landscape studies with community events, art projects, and school collaborations (Swerida *et al.* 2023). These activities laid the groundwork for a new phase, *Beyond the Oasis and Within the Community*, developed with Oman's Ministry of Heritage and Tourism.

This phase responds to critiques of extractive, foreign-led archaeology by centring community-based practice. Its guiding questions are:

1. How has long-term archaeological research influenced community identity and heritage in Bāt?
2. What social, economic, and environmental impacts has it had?
3. How can future research, outreach, and tourism support local priorities?

During Winter 2023–24, BAP conducted interviews with Bat residents to assess perceptions of past research and aspirations for tourism and heritage development. These dialogues inform future strategies and model how large-scale projects can adopt

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Figure 1. View from the Bat Archaeological Project excavation house, facing the Bat Necropolis and children playing football.

participatory approaches that advance scholarship while supporting community regeneration and sustainable outcomes (Fig. 2).

Research Design and Methodology

As a new programme, BAP's community-based research was designed to ease both researchers and residents into this approach through outreach activities and interviews using structured and unstructured questions. These aimed to: 1) evaluate the cultural impact of long-term archaeological research at Bat, 2) ensure community priorities inform tourism and visitor planning, and 3) establish a practice of integrating community voices into project management.

Participant Selection: Up to 20 adult residents were interviewed during excavations (2–15 January). While not representative of the town's 2,500 residents, this first season lays groundwork for broader sampling. Participants were long-term residents (5+ years) and selected to balance gender and age groups (18–30, 30–50, 50+).

Recruitment: Participants were invited through word-of-mouth, community events, and bilingual flyers (English/Arabic). Recruitment respected gender norms: male assistants (Burgess and Das) approached men, while women interviewers (Al-Aati and Nugent) recruited women. Contact details were collected only for scheduling, and all study materials are openly available via OSF (Nugent 2024).

Interview Structure: Interviews, about one hour each, took place in ministry offices, the BAP house, or participants' homes. Conducted in Arabic by Al-Aati (with English where preferred), interviews combined structured prompts with open discussion around themes such as community identity, perceptions of archaeology, economic and social impacts, heritage, collaboration, concerns, involvement, aspirations, and the planned Visitor Centre. Core and follow-up questions are available via OSF (Nugent 2024).

Data Management and Analysis: Interviews were recorded, transcribed in Arabic, translated into En-

Figure 2. The Bat Archaeologists Football team pitch demonstrates how deeply connected and knowledgeable the community is to archaeology through years of archaeological research taking place in their backyard

glish, checked for accuracy, and anonymised. Notes and transcripts were analysed in NVivo using coding, thematic, and content analysis.

Results

Between 2 and 15 January 2024, we interviewed 13 Bat residents (7 men, 6 women) across all target age groups. Although fewer than the expected 20, the short recruitment period limited numbers. These preliminary findings highlight key themes emerging from the interviews.

Heritage, Identity, and Perceptions

Reflecting the pride captured in the town's football team name, *The Archaeologists*, participants expressed deep attachment to Bat's heritage. Initially modest about their knowledge, many offered detailed narratives of tombs, towers, and mudbrick houses, even recalling material culture from Karen Frifelt's mid-20th-century excavations.

Two sites stood out: the Early Bronze Age funerary monuments and Ḥiṣn Al-Wardi, both considered central to local history and identity. Residents voiced a desire for more research and outreach, yet also frustration at feeling excluded from past findings. Many noted that by the time they realised fieldwork was underway, archaeologists were preparing to leave. Participants urged earlier engagement, use of local communication channels, and open days where residents could observe excavations.

As one young man, Tamir (pseudonym), remarked: "*We do hear that every year historical information is being updated, but there isn't that much of a development that makes us feel that there is something new being discovered at Bat.*"

Heritage Management and Outreach

Concerns about preservation were prominent, especially climate change and flooding. The Ḥiṣn Al-Wardi mudbrick village was seen as highly vulnerable, with residents calling for support in its conservation. As Ramza (pseudonym) described: "*The*

Figure 3. Residents hoped that preserving and celebrating traditional crafting practices would be featured alongside ancient heritage as a multi-faceted reflection of Bat community identity within the new Bat Visitor Centre.

dust [...] *through wind, it collapses if it is strong wind [...] and the rain it collapses the same thing. Because they are old, they don't have lots of maintenance, they collapse*."

Financing such preservation was not addressed, though respondents suggested training local contractors in mudbrick restoration. Participants also stressed protecting contemporary heritage, such as traditional crafts, alongside archaeological monuments (Fig. 3).

Those who had joined outreach events spoke positively and encouraged more hands-on activities, particularly for youth. These were seen as effective ways to strengthen community connections with Bat's heritage.

Social and Economic Needs

Residents consistently linked archaeology with education and economic opportunity. Delays in developing the Bat Visitor Centre were seen as a major missed chance to attract tourism, improve infrastructure, and support small businesses—echoing findings by Benkari (2018). Business owners, parents, and youth expressed frustration that decades of research and UNESCO status had yet to yield direct community benefits.

One teacher, Amima (pseudonym), described the educational value of site visits: "*The student should not only study theoretical things.* [...] *They witnessed the process of excavation and increased their knowledge, their awareness, and increased their pride* [...] *and belonging to their homeland*." Similarly, Haidar (pseudonym), a young man, suggested archaeologists could employ local youth: "*by employing the unemployed youth in assisting the archaeologists in excavating or tidying the archaeological areas*."

Notably, participants did not comment on current employment of adult residents as excavators, raising questions about whether such work is viewed as beneficial or simply overlooked. Overall, residents expressed a strong desire for archaeological projects

Figure 4. Students visiting excavations at Rakhat Al-Madrh during the 2024 School Day Event.

Figure 5. Students excavating during their visit to Rakhat Al-Madrh during the 2024 School Day Event.

to contribute more directly to education, jobs, and local enterprise.

Community Outreach and Cultural Programming

Alongside its research, BAP continued to create opportunities for residents to engage with archaeology. With support from Ms. Sumaia Al-Marmarri, a group of high school students visited excavations at Rakhat Al-Madrh. Activities included art-based interpretation, practice excavations using prepared backdirt trenches seeded with ceramics and toys, and handling selected finds. Students worked with professional tools alongside archaeologists before sharing snacks and conversation. These activities not only introduced excavation techniques but also fostered personal connections between the students and researchers (Figs. 4-5).

Summary

The Bat Archaeological Project (BAP) is advancing participatory approaches that embed community voices in research and engagement, setting a new benchmark for foreign-led archaeology in Oman. Through interviews and cultural programming, BAP has begun to bridge the long-standing gap between researchers and residents. These efforts have deepened understanding of archaeology's impacts, while laying foundations for future work that aligns with community needs. In partnership with the Ministry of Heritage and Tourism of the Sultanate of Oman, BAP aims to ensure its research supports heritage preservation, tourism development, and socio-economic benefits through initiatives such as the Bat Visitor Centre.

Acknowledgments
We would like to thank His Excellency Salim bin Mohammed Almahruqi, Minister of Heritage and Tourism, His Excellency Eng. Ibrahim bin Said Al-Kharusi, Undersecretary for Heritage Affairs, the Advisor to the Minister of Heritage Mr. Sultan bin Saif Al-Bakhri, Director General of Antiquities Eng. Yousra Al-Subhi, Director of World Heritage Department Ms. Ibtisam Al-Mamari, Director of Excavations and Archaeological Studies Mr. Ali Al-Mahroqi, Mr. Ibrahim Al-Maqbali, Ms. Samiya Al-Shaqsi, and all the staff members of the Department of Excavations and Archaeological Studies, the Ministry of Heritage and Tourism, Sultanate of Oman, for their support to our mission. We are also grateful Ministry of Heritage and Tourism Representatives at Bat, Mr. Mohammed Al-Kaabani, Mr. Mohammed Al-Essai, Mr. Suleiman Al-Jabri, Mr. Badr Al-Badi, and Ms. Sumaia Al-Marmarri. Our project was supported by the Omani Ministry of Heritage and Tourism, the US National Endowment for the Humanities (grant RFW 279340-21), and the Penn Museum Director's Field Funds of the University of Pennsylvania. We are especially grateful to Bat's residents for their hospitality, friendship, and partnership in learning from the region's deep past.

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Omani-Italian Archaeological Expedition at Al-Tikha (2024 season)

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The Omani-Italian Archaeological Expedition at Al Tikha is a joint project initiated in 2022 through a collaboration between Sultan Qaboos University and the University of Pisa, under the supervision of the Ministry of Heritage and Tourism of Oman (MHT). The mission aims to investigate the archaeological site of Al Tikha, first identified during the survey in the Rustaq region led by Derek Kennet (2013-2018), and strategically positioned on the Batinah plain, near the modern city of Al-Rustaq, approximately 42 km south-west of the coast. The 2024 excavation season concentrated on four distinct areas: Building S1 – within the settlement, the copper-processing area (Mound C – S66), and two Umm an Nar towers (Mound E – S38 and Mound F – S42).

البعثة الأثرية العُمانية-الإيطالية في موقع الطيخة هي مشروع مشترك انطلق في العام 2022 من خلال تعاون بين جامعة السلطان قابوس وجامعة بيزا، تحت إشراف وزارة التراث والسياحة في سلطنة عُمان. تهدف البعثة إلى دراسة الموقع الأثري في الطيخة، والذي تم تحديده لأول مرة خلال المسح الأثري في ولاية الرستاق بقيادة ديريك كينيت (2013-2018)، ويقع في موقع استراتيجي على سهل الباطنة بالقرب من مدينة الرستاق الحديثة على بُعد نحو 42 كم جنوب غرب الساحل. ركز موسم التنقيب لعام 2024 على أربع مناطق متميزة: المبنى S1 داخل المستوطنة، ومنطقة معالجة النحاس (التل C - S66)، وبرجان من فترة أم النار (التل E - S38 والتل F - S42).

The archaeological site of Al Tikha is located in the Al Batinah Governorate, along the eastern foothills of the Al-Hajar Mountains (UTM40Q 544200/2592100), within the northern fringe of the urban center of Al Rustaq. It lies on an alluvial terrace located on the western edge of the Wadi Al-Ghashab near its confluence with Wadi Al-Sahtan, the main hydrological axis of the area, which traverses the alluvial plain from the southwestern mountain zone to the sea in the north-east. It lies on a flat terrace c. 4 m above the adjacent *wadi* bed, providing a commanding position for settlement and resource exploitation. The widespread distribution of Umm an Nar and Iron Age pottery across the area suggests an estimated extension of the site of approximately 70 ha.

The 2024 season focused on four main excavation areas. These included one area within the settlement (Building S1), one designated for metallurgical activities, immediately outside of it (Mound C – S66), and two Umm an Nar towers located on the western bank of the wadi Al Ghashab (Mound E – S38 and Mound F - S42) (Fig. 1).

Building S1

Building S1 represents the largest structure identified within the Umm an Nar settlement, covering an area of approximately 500 sqm (c. 22 x 25 m). The building exhibits walls with double-faced stone foundations supporting mudbrick superstructures, alternating with entirely mudbrick walls. First excavated in 2022, the area was further investigated in 2024 through an eastwards extension of the excavation area, with a new 11 x 5 m trench, while work also continued across the previously explored 283 sqm. Moreover, a 10 x 2 m sounding in the eastern sector of the squared courtyard exposed the complete stratigraphic sequence of the building, which comprises five main phases of occupation.

The earliest phases identified (Phases 4 and 5) are documented exclusively within the sounding opened in the squared courtyard. Phase 5 consists of a cobblestone pavement associated with an open space—the courtyard itself—featuring two mudbrick platforms (PL.726, PL.732) set against the western peripheral wall and a small circular fireplace (H.735). The subsequent Phase 4 is characterized by a cobblestone repaving of the courtyard, overlain by a circular *pisée* platform (PL.731).

During the following Phase 3, documented across the entire excavated area (Fig. 2), the architectural layout comprises the square courtyard (9 x 10 m) paved with cobblestones, and a small mudbrick vestibule set into its north-western corner, providing a direct connection to the adjoining sectors of the building. Installations within the courtyard consist of a circular well along its northern side, a stone platform (PL.781), a mudbrick bench (B.771), and two circular hearths (H.44, H.772). Immediately to the east, a large open area (F.794) containing several stone platforms abuts the courtyard's eastern limit

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Figure 1. Orthophoto of Al Tikha showing the excavation areas of the 2023 season

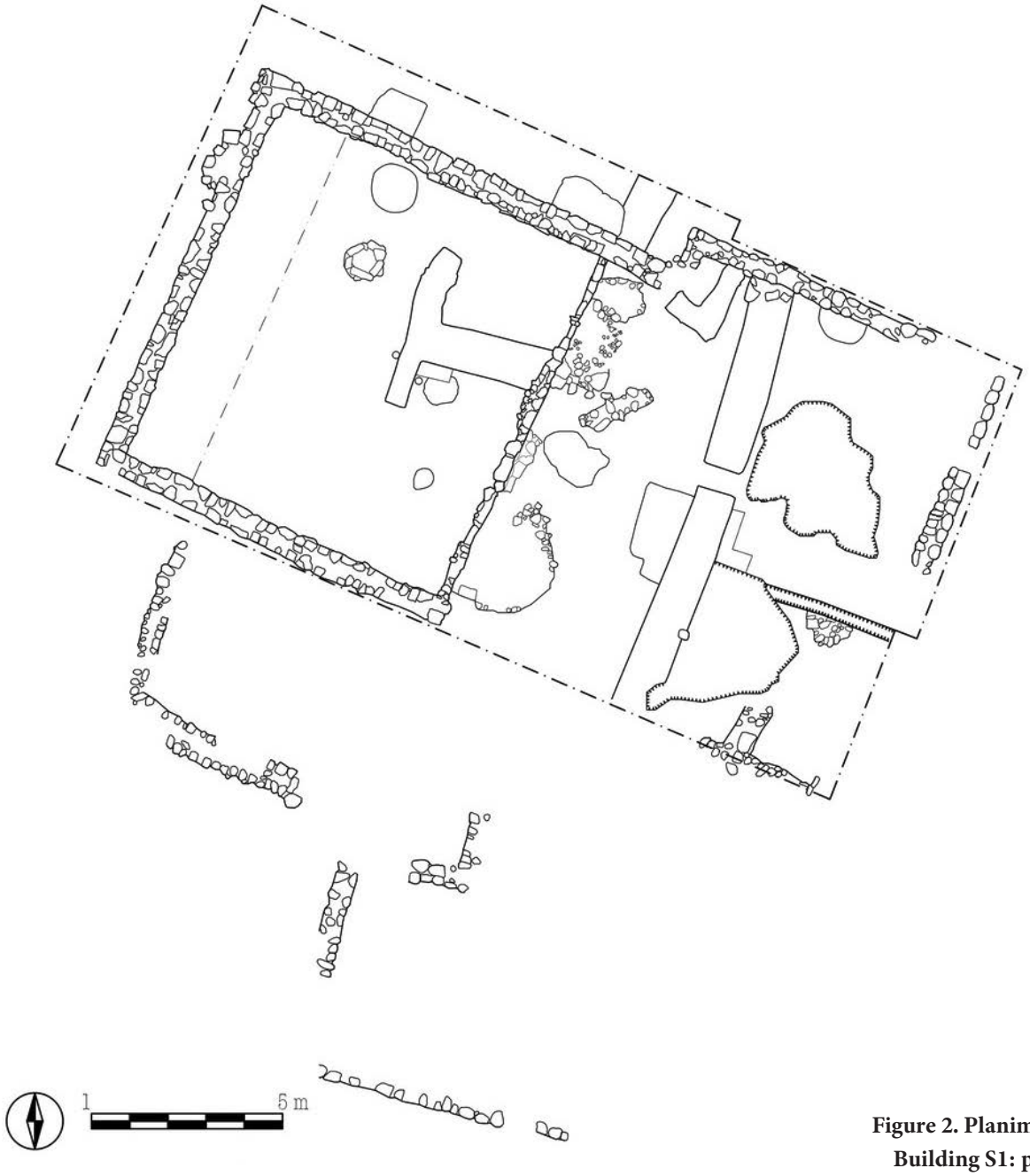

Figure 2. Planimetry of Building S1: phase 3.

and communicates with three adjoining rooms and a small storeroom, the latter located in its north-eastern corner.

During Phase 2, the courtyard and adjoining rooms were completely repaved, and the disused well was filled with a clay-rich sediment containing small pebbles; in the southern sector, a circular platform (PL.751) with three associated hearths (H.748, H.749, H.750) was installed. No features attributable to Phase 1 were identified within the area excavated in 2024. The recovery of two notable Umm an-Nar stamp seals directly from the Phase 3 occupation surfaces provides compelling evidence for an administrative function of Building S1. The first specimen is a finely crafted parallelepiped seal (h. 0.9 cm; l. 2 cm), engraved on all four sides and longitudinally perforated. The decorative program comprises: (1) a pair of confronted oryxes rendered in profile; (2) two stylized anthropomorphic figures with elongated torsos and short, overlapping arms; (3) a triad of stylized human figures, one of which is larger in scale and depicted holding a distinct object; and (4) an abstract geometric motif (Douglas, Pizzimenti, Quaggio 2025: fig. 35).

Figure 3. The copper-processing area (Mound C-S66).

The second specimen is an unfinished triangular prism seal, with only one face engraved and showing traces of an incomplete longitudinal perforation (Douglas, Pizzimenti, Quaggio: fig. 34).

The Copper-Processing area (Mound C - S66)

Mound C is an artificial circular mound, approximately 30 m in diameter, interpreted as a large-scale copper-processing area dating to the Umm an-Nar period. Initially investigated during the 2022 excavation season, in 2024 a 15 x 8 m trench was opened to connect previously explored sectors, revealing two phases of occupation and a complex architectural unit (Fig. 3).

The earliest phase so far identified (Phase 2) consists of a building with a 70 cm-high stone retaining wall supporting a mudbrick superstructure. Adjoining this, in a later construction stage (Phase 1), a second structure was set in place, employing a similar building technique but incorporating large cobbles—likely collected from the adjacent *wadi*—resting on a platform defined by a substantial retaining wall. Despite significant degradation and erosion, it has been possible to reconstruct the inner spatial arrangement, which included both enclosed and open areas, articulated by the presence of platforms and associated installations. On the western side of the complex, an external staircase was identified, presumably providing access to the upper levels and suggesting that primary activities took place in an elevated open-air area. A second, inner staircase was built with pebbles and subsequently coated with a thick clay plaster.

The open area, located in the easternmost sector of the adjoining structure, contains a large circular stone platform on which numerous furnace fragments were recovered. These, together with significant quantities of unprocessed copper ore, various slag types, and roasted mineral remains (e.g., gabbro and *chrysocolla fragmentosa*), by-products of copper smelting, provide strong evidence for interpreting Mound C–S66 as a locus of metallurgical production.

Mound E (Tower S38)

Mound E–S38 corresponds to an imposing circular structure, 18 m in diameter, identified as an Umm an-Nar tower. It is located approximately 420 m north-east of the settlement, along the eastern bank of Wadi Al-Ghashab. Two trenches—one on the summit (Trench 3) and one on the northern side (Trench 2)—exposed its entire perimeter and construction technique (Fig. 4).

The structure comprises a massive double-curtain stone retaining wall, c. 1 m in height, enclosing an

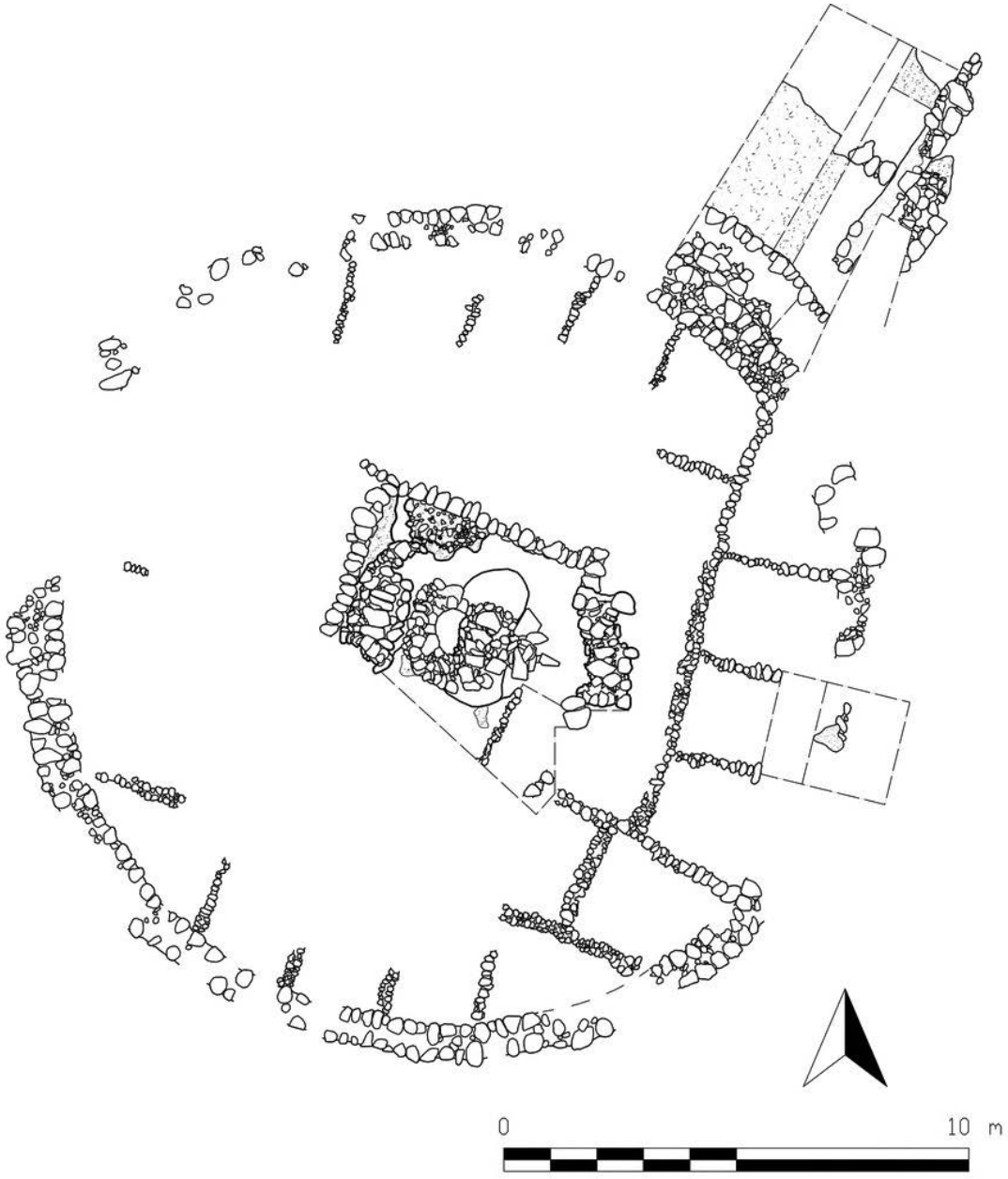

Figure 4. Mound E (S38).

earthwork levelled and stabilized by a grid of small walls filled with pebbles sourced from the nearby *wadi*. At its summit, a quadrangular room (5.30 x 5.30 m) lined with stone blocks set in regular rows contains a circular well built with limestone slabs. The entire tower rests on a circular earthen platform bounded by a single-curtain stone retaining wall.

Mound F (Tower S42)

Mound F (Tower S42), located immediately north of Tower S38 (Mound E), constitutes a prominent architectural feature within the site. Oval in plan (23.5 x 19.3 m) and rising approximately 7.5 m above the bed of the adjacent *wadi*, the structure stands out for its considerable size and elevated position, forming a dominant element in the surrounding landscape (Fig. 5).

Analysis of the Digital Elevation Model (DEM), corroborated by field survey, identified a ditch encircling the tower, two segments of which were excavated: a northern section measuring 1.20 x 4 m and a broader southern section measuring 1.85 x 11.5 m. The ditch was cut directly into the natural bedrock of the *wadi* terrace, with its original base

Figure 5. Mound F (S42).

lying approximately 1 m above the present level of the *wadi* bed. Within the northern section, a small circular pit (1 m in diameter, 0.30 m deep) was recorded—possibly representing the initial stage of an unfinished well. On the western side of the tower, facing the main settlement area, the ditch is no longer visible at the surface, likely having been infilled with sediment and subsequently reused as an Islamic-period burial ground.

Over time, the ditch underwent significant structural modifications. In the northern portion, a single-curtain stone blocking wall, c. 1.3 m high, was constructed directly onto the bedrock and internally lined with a thick clay layer. This intervention appears to reflect a spatial re-organization in which the western segment of the ditch was intentionally sealed, while the eastern portion, still connected to the *wadi*, remained functional. In a subsequent phase, this wall was heightened to a total of c. 2.2 m. Atop the raised wall, a chamber with a clay floor was set in place; within it, copper-smelting slag was recovered, indicating metallurgical activity in a later phase of occupation.

The southern segment of the ditch was likewise sealed with a substantial fill of clay and stone, reaching a thickness of up to 2.5 m. Surface evidence allows for a tentative reconstruction of the tower's overall configuration: the lower part of the structure consisted of a large circular platform composed of compacted earth and stone, bounded by a retaining wall approximately 0.80 m thick, built with medium- to large-sized stones. This platform lay approximately 0.50 m from the edge of the ditch and likely paralleled its perimeter. Centrally positioned atop this base was the upper structure, presumably the main tower, circular in plan and possibly serving multiple functions.

Conclusions

The 2024 excavations at Al Tikha have significantly enhanced the understanding of the site's scale, organization, and socio-economic role during the Umm an-Nar period. The detailed stratigraphic sequence of Building S1, with evidence of administrative functions, the specialized metallurgical installations at Mound C, and the imposing defensive and symbolic architecture of Towers S38 and S42 collectively portray Al Tikha as a major regional hub. Its integration of residential, industrial, and monumental components reflects a complex settlement system strategically positioned within the landscape, engaged in both local resource exploitation and broader exchange networks.

Acknowledgments
The authors wish to thank the Ministry of Heritage and Tourism of the Sultanate of Oman for granting excavation permits and providing continuous support throughout the project. We are also grateful to the local authorities and community of Al Rustaq for their assistance and hospitality during the fieldwork. Funding was generously provided by the Sultan Qaboos University, the University of Pisa (Progetto ProArcheo 2024) and of the Italian Ministry of Foreign Affairs and International Cooperation (MAECI).

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Sapienza University of Rome Archaeological Mission in the Arabian Peninsula and the Gulf Area (MASPAG): Archaeological Excavations and Surveys in Wadi Al-Maʿawil 2023–2024

Ramazzotti M.[1]

The multidisciplinary research that the Sapienza Archaeological Mission in the Arabian Peninsula and the Gulf (MASPAG) has been carrying out in the South-Eastern Arabian Peninsula since 2019 thanks to the funding of the University's Great Excavations and since 2022 to the co-financing of the Ministry of Foreign Affairs and International Cooperation was also concentrated from 20 October to 20 December 2023 and from 14 October to 20 December 2024, in the province of Wadi Al-Maʿawil, in the Muḥāfaẓat of Ǧanūb Al-Bāṭina (Sultanate of Oman), in a vast alluvial plain west of Nakhal and furrowed by the flow of paleoriverbeds (*widyān*) that from Afi converge towards the major tributary that reaches the coast, interposed between the eastern slopes of Jebel Akhḍar and the Western Al-Ḥajar chain and the Gap Semail fault.

تركزت الأبحاث متعددة التخصصات التي أجرتها بعثة سابينزا الأثرية في شبه الجزيرة العربية والخليج (MASPAG) في جنوب شرق شبه الجزيرة العربية منذ عام 2019 بفضل تمويل الحفريات الكبرى للجامعة ومنذ عام 2022 بفضل التمويل المشترك من وزارة الخارجية والتعاون الدولي، من 20 أكتوبر 2023 إلى 20 ديسمبر ومن 14 أكتوبر 2024 إلى 20 ديسمبر، في ولاية وادي المعاول، في محافظة جنوب الباطنة (سلطنة عمان)، في سهل رسوبي شاسع غرب نخل، ويتخلله تدفق الأنهار القديمة (الوديان) التي تلتقي من أفي نحو الرافد الرئيسي الذي يصل إلى الساحل، ويتوسط المنحدرات الشرقية للجبل الأخضر وسلسلة الحجر الغربية وفجوة سمائل.

In this macro-area, south-east of the village of Muslimat, where the Wādī Jahfan, Wādī Al-Ayn and Wādī Al-Misim converge, which flow into the large Wādī Al-Maʿawil reservoir, a completely unexplored ecotope had been discovered with traces of ancient human frequentations widespread on the south-west and west edges of the oasis, a capillary network of underground canals (*aflaj*) between the oases of Muslimat and Tawiya, an extensive and long river terrace covered by a dense series of mounds on the south-western edge of a composite settlement, later identified with the Southwestern Cemetry (ca. 100 hectares), and a second, even larger funerary landscape located on the western slope of the oasis of Muslimat (ca. 500 hectares), interposed between Wādī Jahfan and the sloping rocky hills of Jebel Sahmah, recognized now as the great Western Cemetery of the Bronze Age and Iron Age.

Settlement, Jennat Manqal, Area A

On Mound 1 (2.27 hectares ca), the southwestern settlement of five mounds, in 2022 we collected diagnostic material and in 2023 (Worksite 1) we confirmed the presence of a collapsed mud-brick structure wall adapted to the southwestern slope of the settlement as a retaining wall of a fortified system reused for other industrial activities. In 2024 we opened a new large excavation area on the south-western slope of the Mound 1 (Worksite 2 and Worksite 3). Even though we will attend radiocarbon dates for the new area, here we started to collect extensive architectural data and many diversified archaeological contexts to detail the inner spatial organization of the settlement as well its different occupation phases (Fig. 1).

The extensive and stratigraphic excavation in the southern corner of the Mound 1 (Worksite 2) revealed a large pre-Islamic funerary area of a multiple chamber grave, morphologically and planimetrically similar to that contemporary discovered in the Southwestern Cemetery. One of the ogival chamber grave L2 was particularly rich and in association with a female deposition we discovered gold and bronze earrings as well many different circular bronze rings. Locus L2 contains an almost complete skeleton in its primary deposition. Several finds were found around this skeleton: loom weight, 2 composites earrings (bronze, gold and semiprecious sone), 7 complete bronze rings, 3 broken bronze rings, and 7 fragments of other bronze rings. The grave is oriented East-West. The skeleton has the head at the eastern side and the legs extended on the western part. The anthropological analysis showed that the skeleton belongs to a woman (27 – 32 years old). The hypothesis we have to test next year is that the upper north-western sector of the fortified settlement was reused as a funerary

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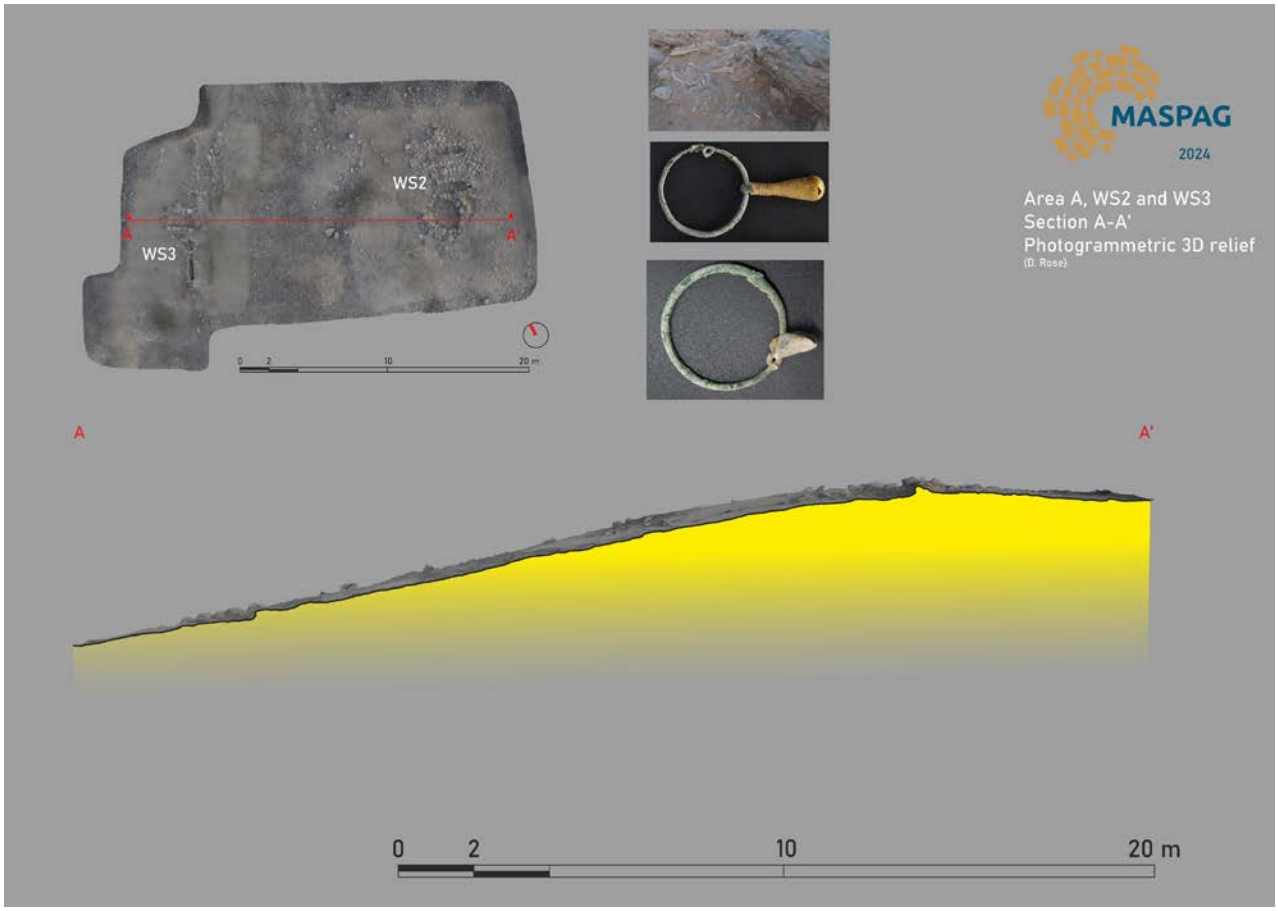

Figure 1. Area A, WS 2 and WS3 photogrammetric 3D reconstruction by Dario Rose and grave L2 gold and bronze Iron Age earrings (MASPAG).

area at the last end of the Iron Age Period. Although the archaeological deposit is very thin and strongly exposed to wind erosion, our hypothesis is that the central and north-western part of the fortified settlement may preserve at least two phases: an older one with a fortified and multifunctional settlement and a more recent, but pre-Islamic one, characterized by the presence of multiple chambers graves from the Late Iron Age period.

The extension of our research on the northwestern slope of Mound 1 (Worksite 3) has then exposed, just below the surface of the Mound 1, a vast area of the settlement composed of a dense series of small architectural structures adapted to the slope and contained downstream by mighty retaining walls. The study of this context is ongoing, but the unregular spaces of this area in between the slope and the outer retaining walls seem to be functional for productive activities, perhaps suggested by the presence of a circular oven, by burned lung shape pottery which could belong to an oven/tannur, by soils that would seem to have concentrations of sulphur, by rare traces of coal and lastly by grinding stones and pestles. It is possible that this industrial sector extended along the slope of the fortified citadel of the Iron Age was therefore located on the edge of the upper settlement. In the years to come, it will be necessary to relate this industrial area to that of higher pre-Islamic multiple-chamber graves. Our hypothesis is that this district is peripheral to the upper town and that it is therefore in phase with / contemporary to the archaeological contexts of the citadel that only later, in the late Iron Age, were covered by some pre-Islamic graves.

Western Cemetery, Area B

Excavation Area B was opened on the northern slope of the large Western Cemetery, where intensive reconnaissance had geolocated 376 archaeological contexts, mainly circular tombs, which can be divided into three groups (Hafit 92 / Umm an Nar / Wādī Suq 5 – Wādī Suq / Iron Age 284). The excava-

Figure 2. Area B, Western Cemetery, Grave 1, Grave 2 and Grave 5 topographic assets by Cesare Schiatti (MASPAG).

tions involved Grave 1, the northernmost of the five tombs interposed between the Hafit tombs located on the rocky ridges of Jebel Al-Ḥalah, south-western offshoot of the Hajar, and the Wādī Sūq / Iron Age tombs at the western limits of the alluvial plain in front of the oasis (Fig. 2). The stratigraphic excavation has exposed and revealed a monumental tomb of the Early Bronze Age, probably datable to the Hafit / Umm an-Nar transition, with a circular plan (dia 10 m) morphologically similar only to four other funerary structures located to the south between the slope and the plateau, with two burial chambers side by side in an almond shape. The northern chamber had no material, while the southern chamber contained, together with a few scattered and heavily damaged bones, an imposing bronze axe, a flint instrument and a small biconical globular jar, typologically attributable to the cultural facies of Jemdet Nasr, therefore probably residual parts of a rich funerary equipment.

Moreover, since in the same stratigraphic context of the bronze and flint axes we collected the fragments of a small globular jar possibly dated back to Jemdet Nasr period, the Early Bronze Age funerary context of the Grave 1 in Area B, seems not so chronologically distant from those of the Hafit cultural milieu. As opposed to what we have in Bat (for example), this Umm an Nar grave is completely different from those of the Hafit period and was filled with some objects stolen / sacked or simply reused originally placed in some of the monumental Haft tombs. In 2004, the excavation of the Grave G2 in Area B, next to tomb G1 exposed a mighty funerary structure diameter of around 8 m that was made in concentric rings like G1, but which had at its centre a single, deep burial-chamber (long 2.27 m and wide 1.8 m) with almond-shaped plan very similar to the two chambers of G1. The main chamber extends deep by 3 courses of stones from the northern side, instead in the southern side it raised by another two courses to be 5 courses in total. The Locus 1 in G2 was completely empty, without any grave goods and the very few fragments of pottery collected, not diagnostic, were placed in the shuffled soils of the surface cover. Grave G2 was originally intended to be monumental in character and the burial chamber preserved for a height of 70 cm was built to house a single burial inside a vault (Fig. 3).

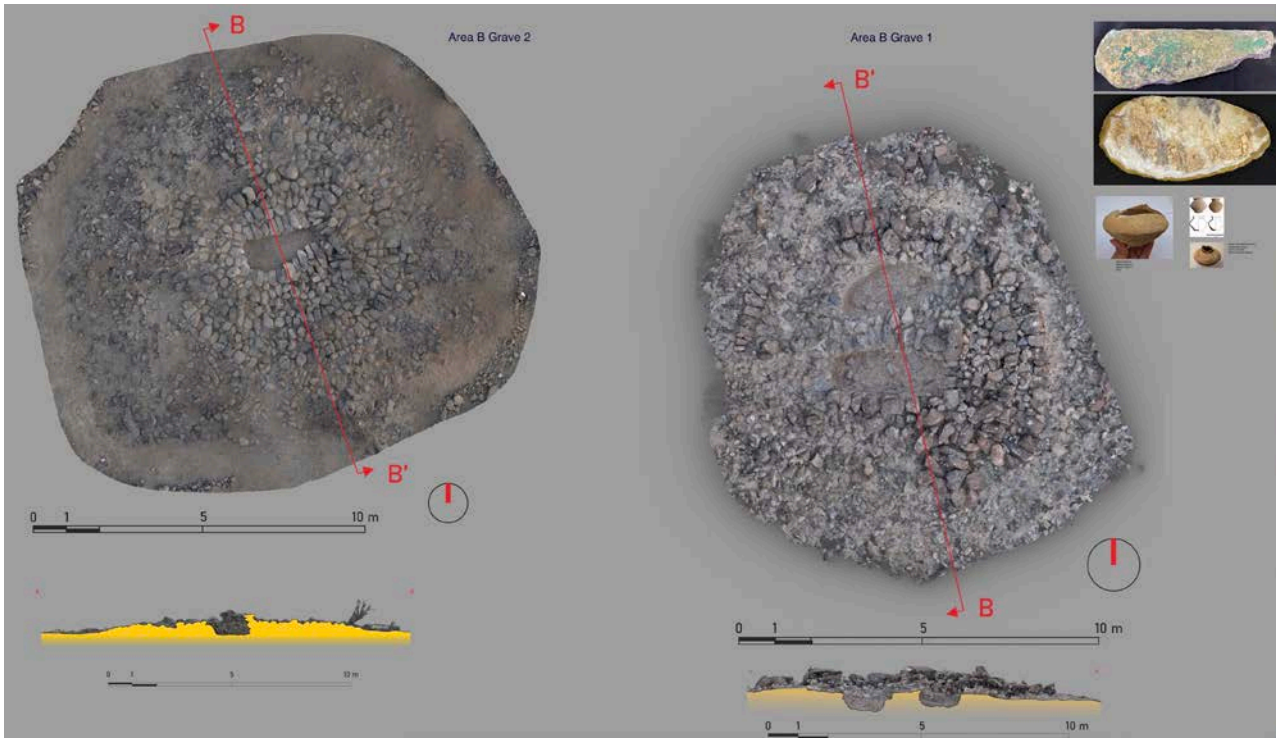

Figure 3. Area B, Western Cemetery, Grave 1 and Grave 2 photogrammetric 3D reconstruction by Dario Rose, bronze axe and flint blade associated with a small Bronze Age biconical globular jar (MASPAG).

The complete absence of grave goods indicates that G2, like the northern chamber in G1, was completely looted in ancient times, but this complete looting would seem to have been carried out with care when the building was still in elevation and would seem to have taken place at a time not too distant from its construction. G2 in Area B is then constituted as another special monumental architectural structure attributable to the final phase of the Umm an Nar period, which documents yet another type of funerary monuments with a single chamber and – for this peculiarity very similar in plan (but not in construction technique and morphology) to some graves of the Late Bronze Age period, that here in South Batinah, it is the beginning of the Wādī Suq period.

At the end of November 2024, after concluding the excavation of G2, we began the excavation of Grave G5 in Area B, which was also apparently similar in layout and morphology to G1 and G2, but unlike the latter two arranged on the slope of the rocky mountain. The cleaning of the structure has highlighted a funerary context that is still slightly different from the others and that will necessarily have to be investigated next year. The foundation plan of Grave G5, certainly looted and destroyed in ancient times, was used and adapted to accommodate at least two small circular pits cut inside the outer ring, a ring made of concentric rings like that of Graves G1 and G2. These two circular pits, also almost entirely devoid of archaeological material, suggest that the G5 was used after its first collapse and / or looting, therefore much later than that which occurred in the G2. The careful cleaning, excavation and documentation work that has been carried out this year will be the starting point for further investigating of this Bronze Age grave of which, most likely, at least one burial chamber wit filling or collapsed stones that we have not removed has been identified.

Southwestern Cemetery, Jennet Hesseneiat, Area C

In 2022, South-West of the Mound 1, a monumental cemetery has been identified and surveyed, the Southwestern Cemetery (Jennet Hesseneiat), which extended on a long terrace over three kilometres and half (ca. 92 ha) with 185 feature points cairn tombs, hut tombs, circular, ogival, rectangular, enlarged, and overlapped. The 2023 and 2024 stratigraphical archaeological excavations of the Grave 1, Grave 2 and Grave 3 in the Area C have successfully confirmed our first hypothesis, but the relevant discoveries also detailed a very intriguing research scenario on the Late Bronze – Iron Age funerary landscape (Fig. 4).

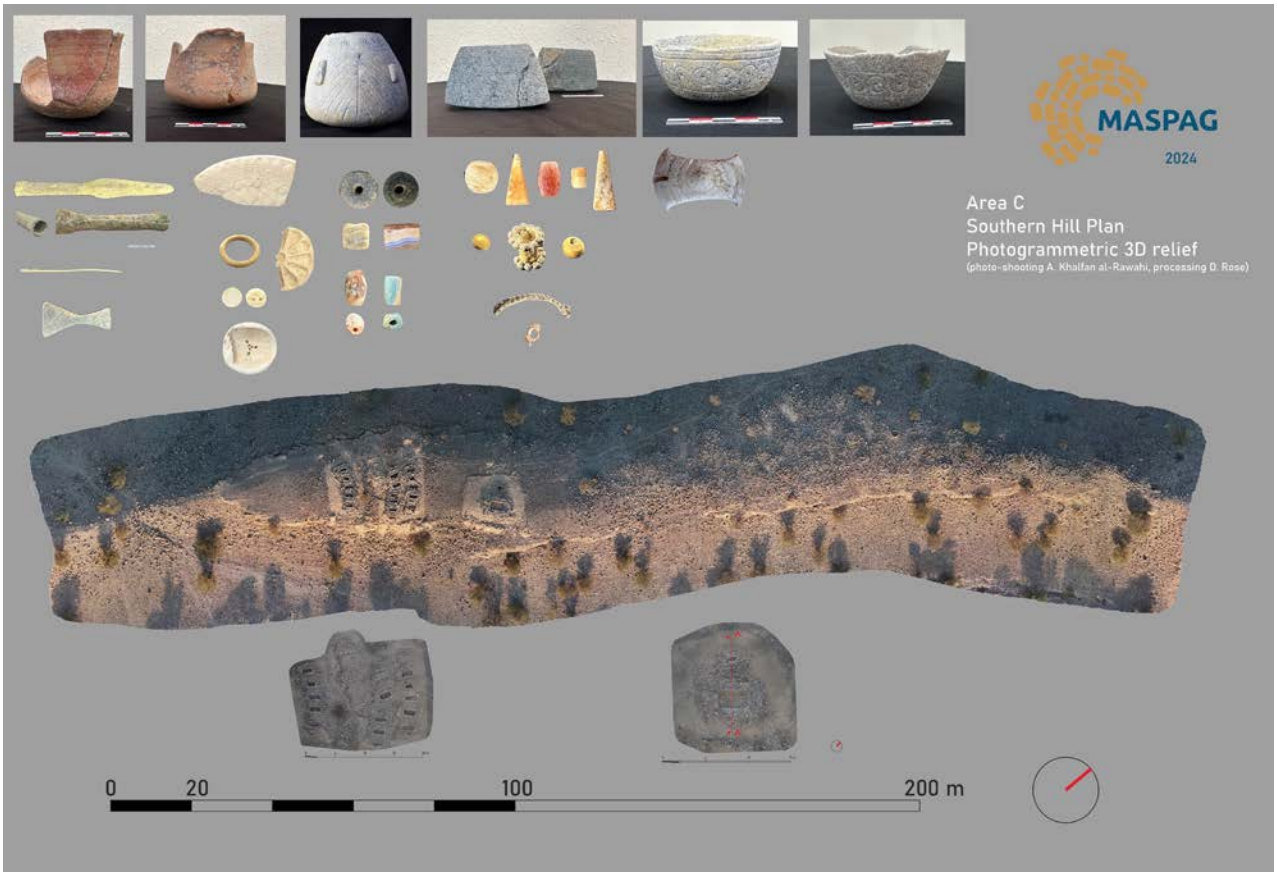

Figure 4. Area C, Southwestern Cemetery, Grave 1, Grave 2 and Grave 3a, 3b and 3c photogrammetric 3D reconstruction by Dario Rose and pottery, stone vessels, bronze weapons, shell inlays, semiprecious beads and fragmentary gold jewels from Late Bronze and Early Iron Age funerary contexts (MASPAG).

In 2023 the Grave 1 in Area C was opened in the funerary area where we discovered on the surface a very precious and fine shell inlay. The excavation here revealed a monumental, stratified grave with an inner single rectangular room oriented North-South. The outer perimeter of the inner rectangular chamber was surrounded by different irregular pits later adapted to the north-eastern limit of the massive structure, but a very regular ogival small grave was placed on the collapsed stone of the main structure at the eastern side. In the thick filling deposits of the main chamber, we collected hundreds of fragmentary human bones, dozens of fragmentary incised stone vessels, three extraordinary gold beds and four fragment of a gold slag, residual part of a very precious composite jewel.

It is just an hypothesis that needs to be confirmed by radiocarbon dates, but the most precious gold objects (gold laminas, gold beads, gold rings) coming from the thick mixed layer filling the main rectangular chamber of the Grave 1 are highly sophisticated female jewels both typologically and technologically similar to those discovered in LC-G1 Grave in Daba Al-Baya in Musandam (Oman) and in Grave 76/1 in Dibba in Fujairah (EAU). However, for some technological characteristics (metallurgy of coating, metallurgy of granulation, metallurgy of gold-coated silver) the jewels of the *Princess's Grave* are also similar – but according to our stratigraphical reconstruction a little bit earlier – to some precious gold beads and gold-coated silver jewels found in Saruq al Hadid ranging from ca. 1200 up to 800 BCE.

In 2023 Grave 2 in Area C revealed a large funerary context with five small chambers close to each other, NE – SW oriented, with each chamber almost empty except for some scattered bones and fragmentary semi-precious and precious materials, very few pottery fragments, and traces of charcoal at the base of two graves. The highly heterogeneous materials from the grave it is almost fragmentary, but this "multiple grave" was realized in a time sequence step by step when the complex was encapsulated in a single funerary area marked with standing stones on the western end. The typological plan of this Wādī

Suq – Iron Age funerary contexts is unknown, and it can be defined as a large multiple grave (not collective), but a quite complete pottery typologically comparable with some attested in Hili 8 and some soft-stones lids also could be associated to the Wādī Suq period.

In 2024 excavation involved the vast area between Grave 1 and Grave 2 where another particular and unique cluster of three multiple (non-collective) graves close together and parallel was investigated (G3A, G3B and G3C). This cluster called Grave 3 in Area C consists of three separate units, each morphologically similar to Grave 1, but side by side and parallel each consisting of 7 small ogival chambers (G3A), of 7 small ogival chambers (G3B), 5 small ogival chambers (G3C) and 1 small ogival chambers at the southern corner between G3B and G3C. The investigations underway on Grave 3 are still preliminary, but this enormous funerary complex with almost 20 chambers seems constituted as a systemic unit different from those recognized until now in the Southwestern Cemetery: Grave 3 is in fact not far from Grave 2 and well distanced from Grave 1 although morphologically similar.

The three G3 'banana shaped' funerary units (3A, 3B and 3C) are similar and close together and a quick observation suggests that this funerary sector was an interconnected funerary area, but decidedly and voluntarily separated from the *Princess's Grave* (G1), whose original layout could be dated to the earlier to Wādī Suq period. The materials found inside the G3A and G3B, which will continue to be investigated next year (G3C), are very similar to those of G2 and could date this funerary complex to the Late Bronze / Early Iron Age period. It is necessary to stress that, as in the G2, many semiprecious grave goods founded in the chambers of the G3A and G3B (painted pottery sherds, soft-stones vessels, bronze fragments and beads) could be dated back to the end of the Wādī Suq and perhaps they were objects that the deceased had kept for a few generations.

If so, the funerary complex of Grave 3 and Grave 2 could be dated to an early phase of the Iron Age period, or at the transitional phase in between Wādī Suq and Early Iron Age period. Although it is premature to draw conclusions, it is now necessary to point out that the complex funerary system of G2 and G3 reveals a new type of multiple greaves from the Early Iron Age (banana shaped) that can be close together (G3A, G3B, G3C) or spaced (G2), but completely different from those such as G1 which contained a single large burial chamber whose original layout and plan is probably to be ascribed to the Wādī Suq period.

Wādī Al-Maʿawil Landscape Archaeological Project

According to the results of the previous surveys and the integrating geodata in an open-source Geographical Information System (Q-GIS), in 2024 we continue our landscape archaeological project in Wādī Al-Maʿawil working contemporary and complementary on a macroscale and on a microscale. On a macroscale, thanks to the extensive surveys we discovered, identified and mapped new settlements, sites, cemeteries and petroglyphs revealing until know over 1896 feature points or ancient anthropic contexts and enormously enlarging the integrated knowledge of the core area we are working under Ministry's institutional permit.

In 2022 we discovered a multiple settlement system in Muslimat and two large cemeteries (Southwestern Cemetery and Western Cemetery); in 2023 we identified a fortified settlement near Afi possibly covered by two impressive circular graves and in 2024 we placed other possible ancient pre-Islamic frequentations near Muslimat, Hasnat and Afi, at the meantime we documented and georeferenced other 43 petroglyphs reaching until now a total of 186 petroglyphs and rock-art documentation (Fig. 5). Intensive surveys on a microscale are revealing new archaeological records and are integrating the first maps we realized. In the South-Western cemetery where in 2022 we located over 160 feature points, at the end of the season we mapped, identified and verified other 25 graves and reaching a total number of an impressive cemetery with 185 graves subdivided in four specific morphological class.

To enhance Oman's tourism potential, the MASPAG project has proposed a project that aims to create a natural and archaeological park in Wādī Al-Maʿawil. This park will start including at least two archaeological areas, a settlement and a cemetery with several graves, and provides for the enhancement of the historical area through cultural tourism initiatives. In a second step this core area (Muslimat) will be linked to the hinterland and in

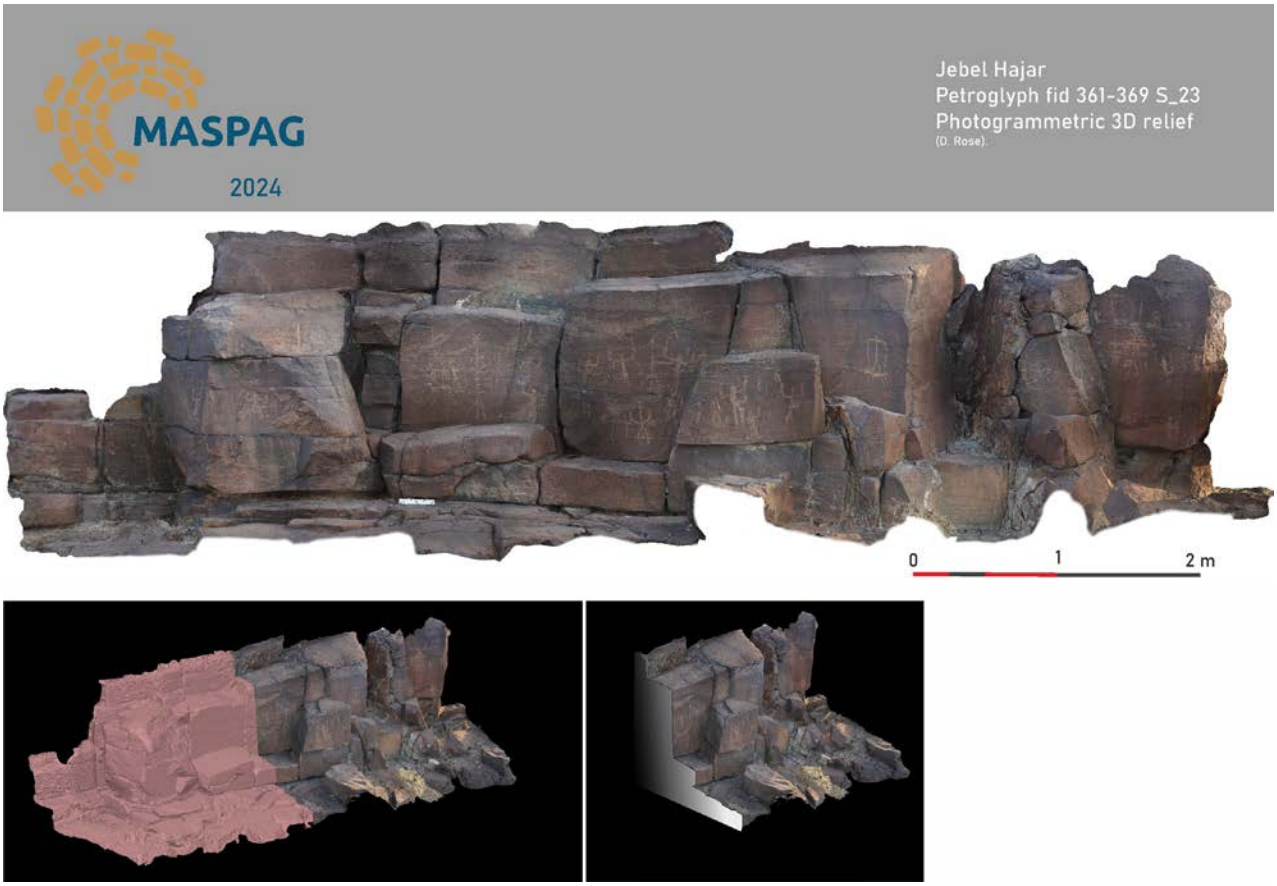

Figure 5. Jebel Ajar, photogrammetric 3D reconstruction by Dario Rose of a large petroglyphs wall (MASPAG).

connection with the diffuse well known and unknown tangible and intangible heritages of Nakhal, Al Awabi, Khatum and Mahalil. Proposed actions include the future visitor centre, the archaeological restoration of the excavated monumental graves, the development of an interactive space to explore the multimillennial landscape and its historical deepness, and training activities with schools and local community to promote the sustainable tourism practices.

The main objective is to create a park that preserves the rich heritage of the Wādī Al-Maʿawil Wilaya increasing its tourist attractiveness, integrating the real visit on the naturalistic and archaeological landscape through immersive experiences for visitors and the adoption on innovative technological tools. According to our research in the field of the local needs and comparing the proposal with the tourist flows reaching the area of Nakhal from Muscat, our proposal project, which aligns with Omani strategic objectives, will take place over about five years.

The project has been planned according to the leading expertise of Sapienza University of Rome in the sciences of antiquity and in the sciences of soustanible tourism, and it is adapted to needs and the perspectives of the local communities. However, it is necessary pointing out that the project represents a strategic investment in Oman's tourism sector, leveraging the rich cultural heritage and natural beauty of the place to attract visitors, while ensuring sustainable development. The project was born with the intention of balancing the preservation and promotion of heritage, aims to unveil the full potential of the Wādī Al-Maʿawil region as a leading tourist destination near Muscat, contributing to the economic growth and cultural enrichment of the South Batinah.

Acknowledgments
Ministry of Cultural Heritage and Tourism of the Sultanate of Oman; Al Batinah South Governorate; Sapienza University of Rome Large Excavations Fund Programm; Sapienza Department of Sciences of Antiquity; Italian Ministry of Foreign Affairs and Cooperation; Capitoline Superintendence for Cultural Heritage of Municipality of Rome; Italian National Institute of Geophysics and Volcanology.

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Survey in the Ja'alan and archaeological excavation at Ras Al-Jinz RJ 108

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A new period/archaeological culture, situated at the transition between the Neolithic and the Bronze Age, may have been identified at the necropolis of Khor Jarama, in the Ja'alan region of Oman (Ash-Sharqiyyah South), following four years of excavations carried out between 2018 and 2021. To confirm these initial findings, a survey campaign conducted during the winter of 2022–2023 led to the discovery of several other necropolises very similar to that of Jarama. The aim of this new program is therefore to excavate and study a selection of these tombs, each located in different areas, in order to determine whether they represent a previously unknown prehistoric culture. The first year of this new project focuses on the site of Ras al Jinz (RJ 108).

تم التعرف على مرحلة ثقافية جديدة، تقع في الفترة الإنتقالية بين العصر الحجري الحديث والعصر البرونزي، قد تم تحديدها في مقبرة خور جراما، بولاية صور في عُمان (الشرقية)، وذلك بعد أربع سنوات من التنقيبات التي أجريت بين عامي 2018 و2021. وللتأكد من هذه النتائج الأولية، أجريت حملة مسح خلال شتاء 2022–2023، وأسفرت عن اكتشاف عدة مقابر أخرى مشابهة جدًا لمقبرة جراما. وبالتالي، يهدف هذا البرنامج الجديد إلى حفر ودراسة عينة من هذه القبور، يقع كل واحد منها في منطقة مختلفة، وذلك من أجل التحقق مما إذا كانت تمثل ثقافة ما قبل تاريخية غير معروفة سابقًا. تركز السنة الأولى من المشروع على موقع رأس الجنز (RJ 108).

The archaeological campaigns carried out over the past four years at the necropolis of Khor Jarama 1, located in the Ja'alan region, have brought to light what is likely a previously unknown prehistoric culture in Oman.

Indeed, the excavation of seven tombs situated near the Jarama lagoon led to the discovery of the earliest known funerary monuments in Oman. These monuments have been dated to the mid-4th millennium BCE for the oldest examples—that is, several centuries earlier than the monumental tombs of the Hafit period. These tombs, almost certainly built for chiefs and/or highly important members of the community, are distinguished by new architectural forms as well as new funerary practices observed in Oman.

This discovery fills a gap in the archaeological record previously noted in Oman, sometimes referred to by scholars as the "Dark Age," spanning between 3600 and 3200 BCE—the transitional phase between the end of the Neolithic and the beginning of the Hafit period.

It significantly alters our understanding of Oman's earliest prehistoric societies: long before the first contacts with the city-states of Mesopotamia and the Indus Valley, there already existed here highly organized, likely hierarchical groups, led by individuals buried in monumental tombs.

Following a survey campaign, the recent discovery of other necropolises probably belonging to this same period—which will be excavated in the coming years—will help define this new culture characteristics more precisely (Fig. 1).

Thus, this project aims to excavate these necropolises in the Ja'alan region in the coming years in order to understand why, when, and how this transitional period emerged. The central question is to identify the actors behind this major transformation: was it the result of an evolution in the organization of local coastal communities? Or should we instead consider the arrival of new groups bringing with them different funerary traditions?

Furthermore, the project seeks to determine whether this phenomenon was specific to the coastal area of Ja'alan, or whether this new culture extended across the whole country. To this end, fieldwork will each year be complemented by an additional survey mission specifically dedicated to locating new, similar necropolises. The strategy for these annual surveys will consist of following the wadis from the coast toward the interior, since necropolises and/or settlements were always established in proximity to water resources.

The first phase of this project consisted of conducting a survey across the Ja'alan region (Al Sharqiya) in order to identify necropolises with characteristics apparently similar to those of the Jarama necropolis. The survey mission, which took place over three weeks in the winter of 2023, led to the discovery of seven new necropolises displaying exactly the same architectural features as the tombs excavated at the Jarama necropolis. These are circular tombs, usual-

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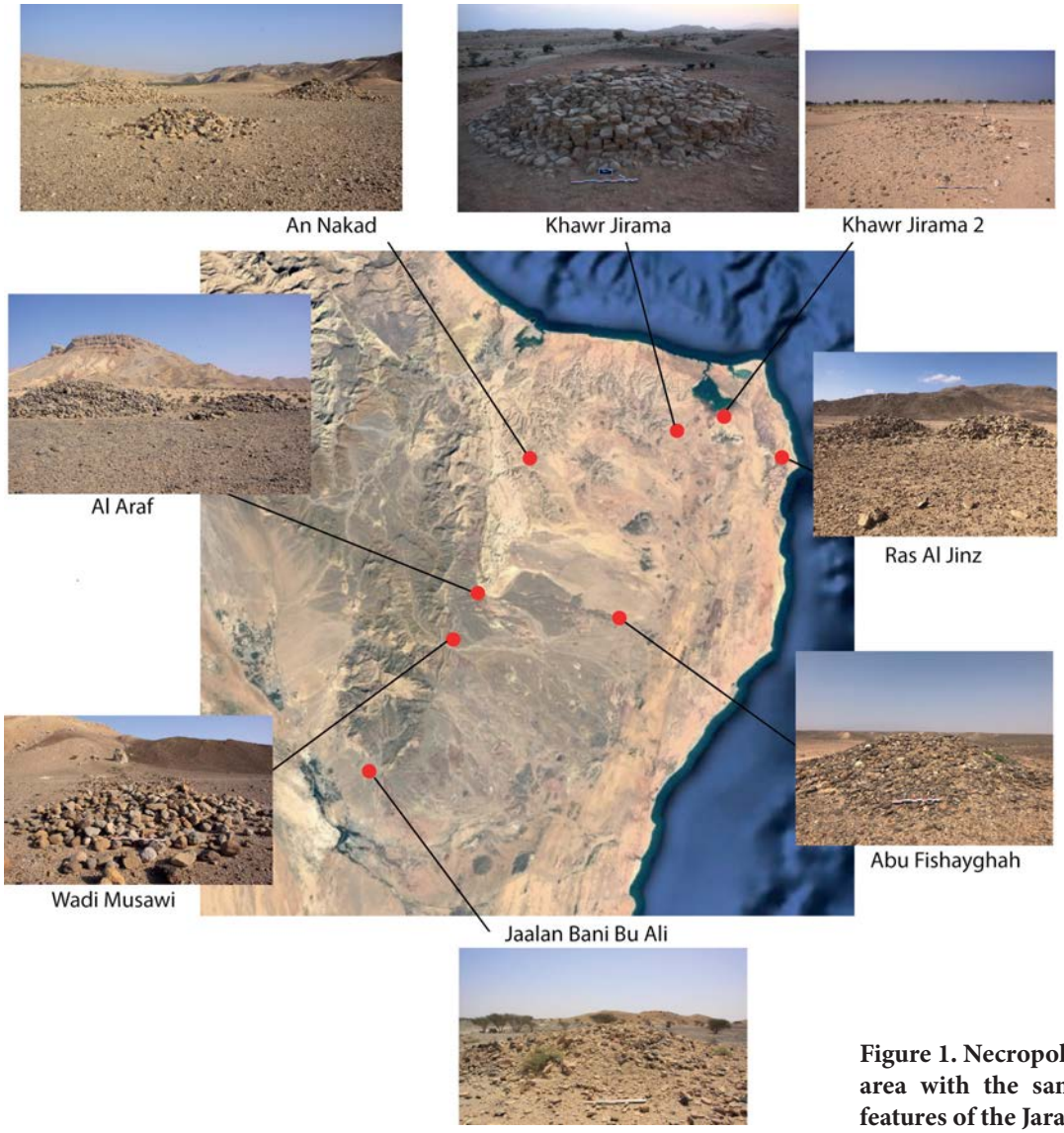

Figure 1. Necropoleis in the Ja'alan area with the same architectural features of the Jarama Necropolis

Figure 2. Necropolis RJ 108 at Ras al Jinz (© Jarama Tombs Project).

Figure 3. Tomb 1 of the necropolis RJ 108 of Ras al Jinz (© Jarama Tombs Project).

ly arranged in pairs (less often in threes), built in dry stone, each containing a central corbel-vaulted chamber. Some of these tombs reach more than two meters in height and up to ten meters in diameter. In certain cases, small alignments of hearths were uncovered near the tombs, although at this stage their contemporaneity cannot be confirmed. These necropolises are distributed throughout the Ja'alan region, near the villages of Ras al Jinz, Khor Jarama (Necropolis 2), Jalan Bani Bu Ali, Bu Feshka, Iref, Neked, and Wadi el Masawi (Fig.1).

The first excavation campaign of this project in 2023 focused on four monumental tombs at site RJ 108 of the Ras al Jinz necropolis (tombs 1 to 4). This necropolis, located a few hundred meters inland from the coast, contains a total of 17 tombs (Fig.2).

Tomb 1 was the largest, measuring nearly 11 meters in diameter and 1.8 meters in height

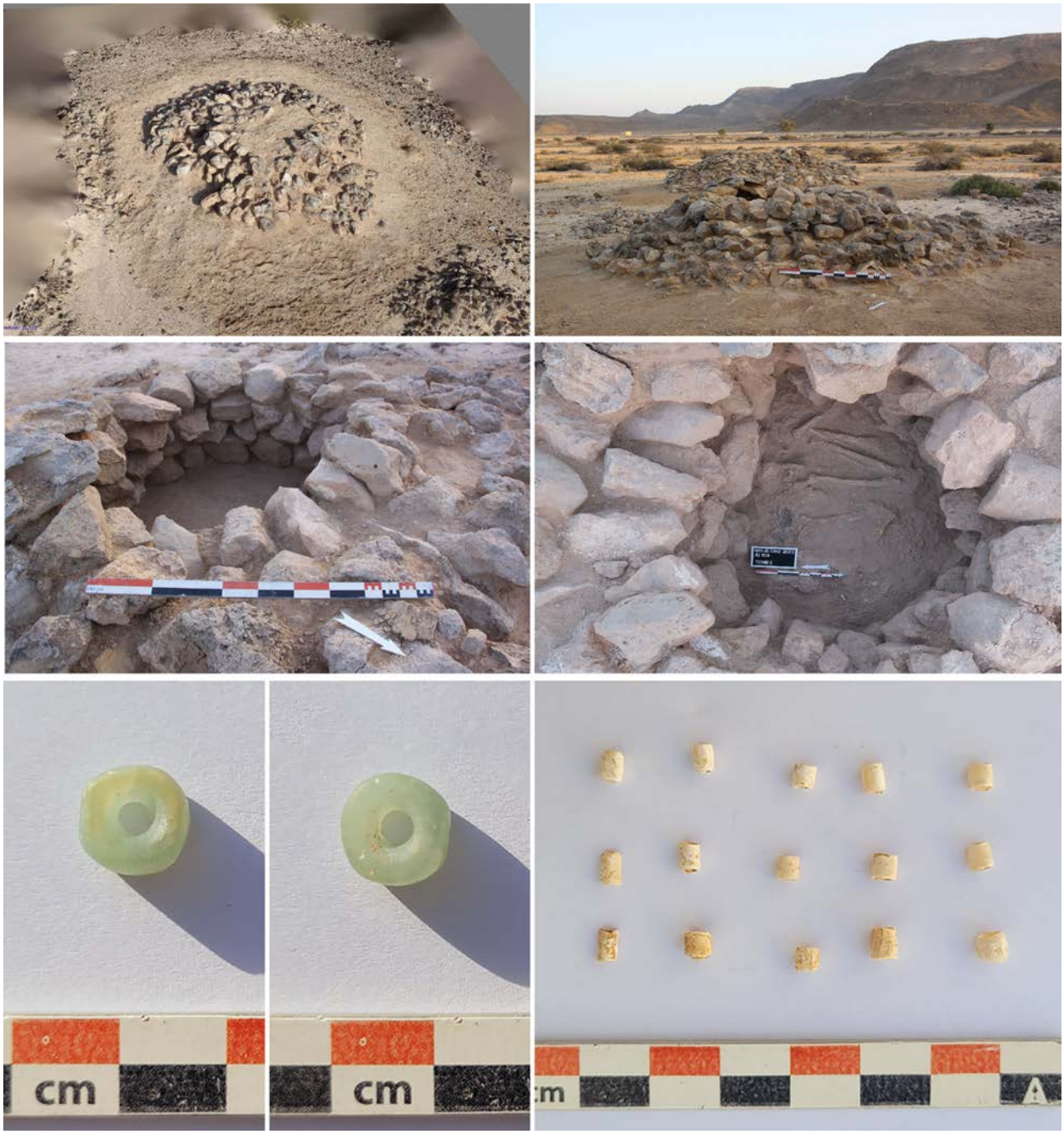

Figure 4. Tomb 2 of the necropolis RJ 108 of Ras al Jinz (© Jarama Tombs Project).

(Fig.3). Inside the chamber, the remains of an adult individual were found, dated to the very end of the 4th millennium. Lithic artifacts characteristic of the Late Neolithic, as well as several shell beads, were also present in the tomb. Tomb 2, much smaller and adjoining Tomb 1, measured 5.2 meters in diameter and 1.2 meters in height. It contained the remains of a single adult individual in a contracted position. Grave goods included fluorite and shell beads (Fig.4). Dating of this tomb likewise placed it at the end of the 4th millennium. The excavation and study of these two tombs thus confirm both the chronological framework and the funerary practices observed at the Jarama necropolis, with which they are very likely contemporary. Tombs 3 and 4 were also located side by side. Tomb 3 was completely devoid of funerary deposits, except for a few beads, while Tomb 4 is still under excava-

Figure 5. Tombs 3 and 4 of the necropolis RJ 108 of Ras al Jinz (© Jarama Tombs Project).

tion (Fig.5). Although smaller, measuring around 5 meters in diameter and 1.3 meters in height, their architecture is similar to that of Tombs 1 and 2.

Further investigations are to be carried out at the Ras al Jinz site before turning our attention to another necropolis. However, it can already be stated, in light of the excavation of these four tombs, that the funerary characteristics observed at the Jarama necropolis are also present here—not only in the strikingly similar architecture, but also in the funerary practices and in the consistently very early datings obtained.

Archaeological Water Histories of Oman Project (2023–2024): Survey of Ancient Chlorite Quarries and Vessel Production Sites

Shannon J.L.,[1] H. David-Cuny[2] & M.J. Harrower[1]

During the 2024 season, the Archaeological Water Histories of Oman (ArWHO) Project conducted geoarchaeological field research on ancient soft-stone (chlorite) quarries and sites of vessel production. Our team acquired and exported chlorite samples for mineralogical and geochemical analysis. Architectural plans of two predominantly Iron Age sites, Aqir Al-Shamoos and Hayy Ukur, were updated and surface survey of Hayy Ukur confirmed the presence of chlorite vessel production in association with a nearby quarry identified in 2023.

خلال موسم 2024، أجرى مشروع تاريخ المياه الأثرية لعمان (ArWHO) أبحاثا ميدانية على شكل مسح جيوأثري لمحاجر الحجر الاملس القديم (شيست الكلوريت) ومراكز إنتاج السفن. أسفر هذا البحث عن اقتناء 125 عينة من الكلوريت (60 منها نتيجة تعاون مع مشاريع أثرية أخرى) تم تصديرها إلى الولايات المتحدة للتحليل المعدني والجيوكيميائي. كما تم تحديث المخططات المعمارية لموقعين، عقير الشمس وحي العقور. أكد مسح مستوطنة حي العقور من العصر الحديدي أيضا وجود إنتاج أوعية الكلوريت المحلية في الموقع.

Introduction

In 2024, ArWHO field research focused on three primary objectives: 1) Acquire additional samples for mineralogical and geochemical analysis; 2) refine the architectural plans of Aqir Al-Shamoos and Hayy Ukur, and 3) conduct a preliminary surface survey at Hayy Ukur to more conclusively evaluate the evidence of chlorite vessel production. Additionally, while the artifacts and geological samples discussed in this article may be more correctly referred to as chloritite or chlorite schist, this article employs the term chlorite for the sake of brevity and consistency with other archaeological publications.

Background

A key ArWHO goal involves investigating the relationships between natural resource extraction, social organization, and exchange. The Omani-Polish team has written briefly on the role of mineral resources in ancient Oman (Bieliński *et al.* 2023: S36–S37), and the 2023 discovery of an ancient chlorite quarry less than 1km from the predominately Iron Age settlement of Hayy Ukur reinforces the interpretation that proximity to mineral resources was important to ancient populations of northern Oman. The ArWHO project is also currently analyzing chlorite artifacts and geological samples from Oman through whole rock geochemistry and spatially resolved microanalysis in Baltimore, MD, USA.

Chlorite Sample Collection

In 2024, 125 archaeological and geological samples were exported for analysis, including 65 samples from Adh-Dhahirah Governorate from the sites of Hayy Ukur, Shwaghy, and ʻWaby Al-Zady, and 60 samples in collaboration with other archaeological projects including the Missione italiana nella Penisola di Musandam (Oman), the Bat Archaeological Project, and the Wadi Al-Jizi Archaeological Project.

Survey in Adh-Dhahirah Governorate

In 2024 the ArWHO project revisited five sites to conduct geoarchaeological survey and double-check architectural plans, including Aqir Al-Shamoos, ʻWaby Al-Zady, and Tawi Zaba, (Fig. 1), as well as Shwaghy and Hayy Ukur.

Aqir Al-Shamoos

Aqir Al-Shamoos is an Iron Age settlement and chlorite vessel production center. Fieldwork included the revision of the site's architectural plan, primarily focused on walls recognized during the 2023 field season. These walls, largely in the northern area of the site, are in a poor state of preservation due to erosion and their function (as building or terracing) remains unclear. Three chlorite samples were also collected from the surface of Aqir Al-Shamoos, complementing those already obtained.

ʻWaby Al-Zady and Tawi Zaba

The site of Tawi Zaba was discovered in 2016 and

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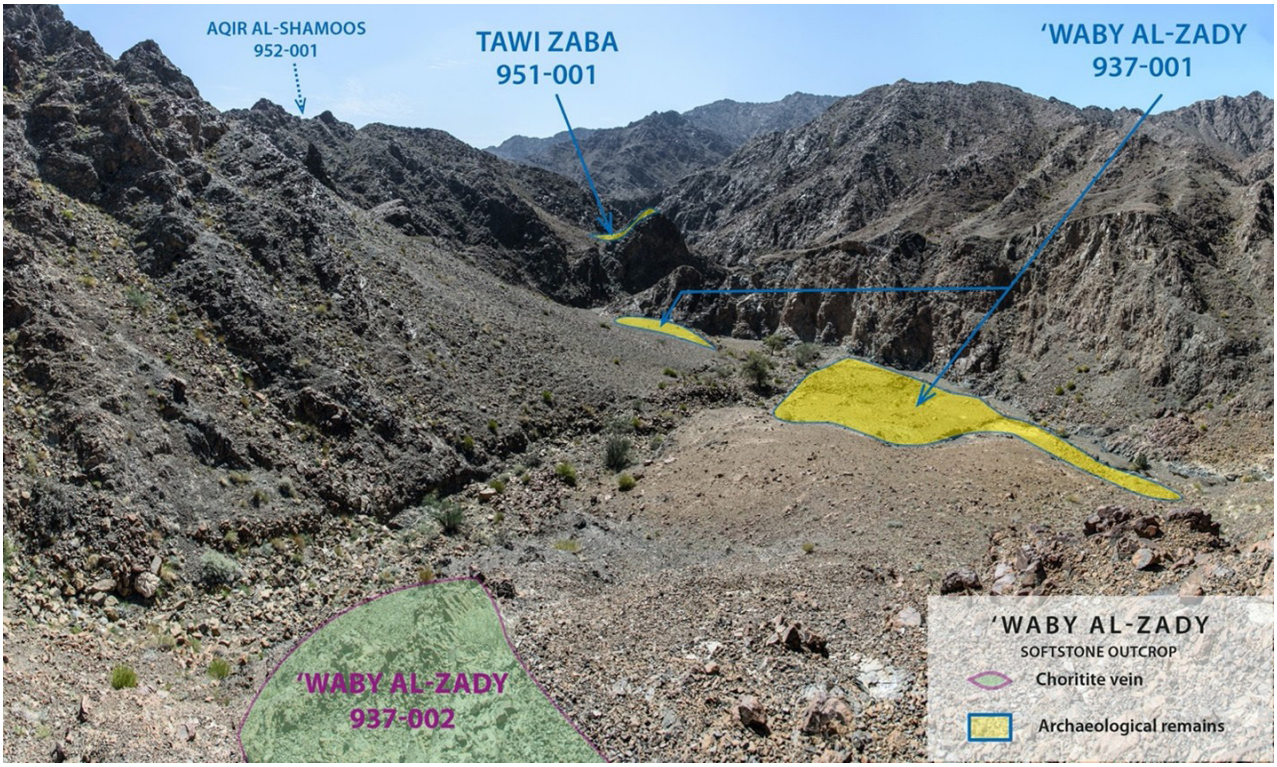

Figure 1. Annotated landscape photo of Aqir Al-Shamoos, Tawi Zaba and 'Waby Al-Zady (image by H. David-Cuny).

is perched on a sharp ridge overlooking the wadi between Aqir Al-Shamoos and ‘Waby Al-Zady. The site consists of several small terracing walls and a scatter of pottery. In 2024 a single decorated Iron Age chlorite vessel sherd was recorded on the surface (Fig. 2). Nine geological samples were also collected from the nearby ‘Waby Al-Zady chlorite outcrop.

Shwaghy

Additional chlorite samples were collected from the ancient quarry site of Shwaghy, which is comprised of a central mine shaft and a quarry face following a chlorite vein. Shwaghy is notable for the absence of an associated ancient settlement or workshop. While it remains unknown where the blocks quarried from Shwaghy were worked, the absence of a workshop or settlement nearby suggests that

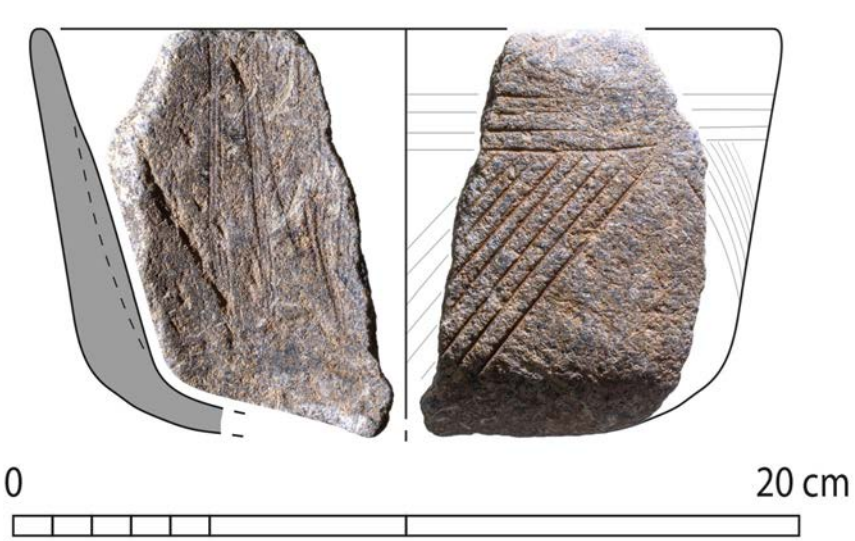

Figure 2. Iron Age chlorite vessel fragment from Tawi Zaba. (image by H. David-Cuny).

Figure 3. Annotated landscape photo of the quarry near Hayy Ukur, updated with the location of material from the upper slope (image by H. David-Cuny).

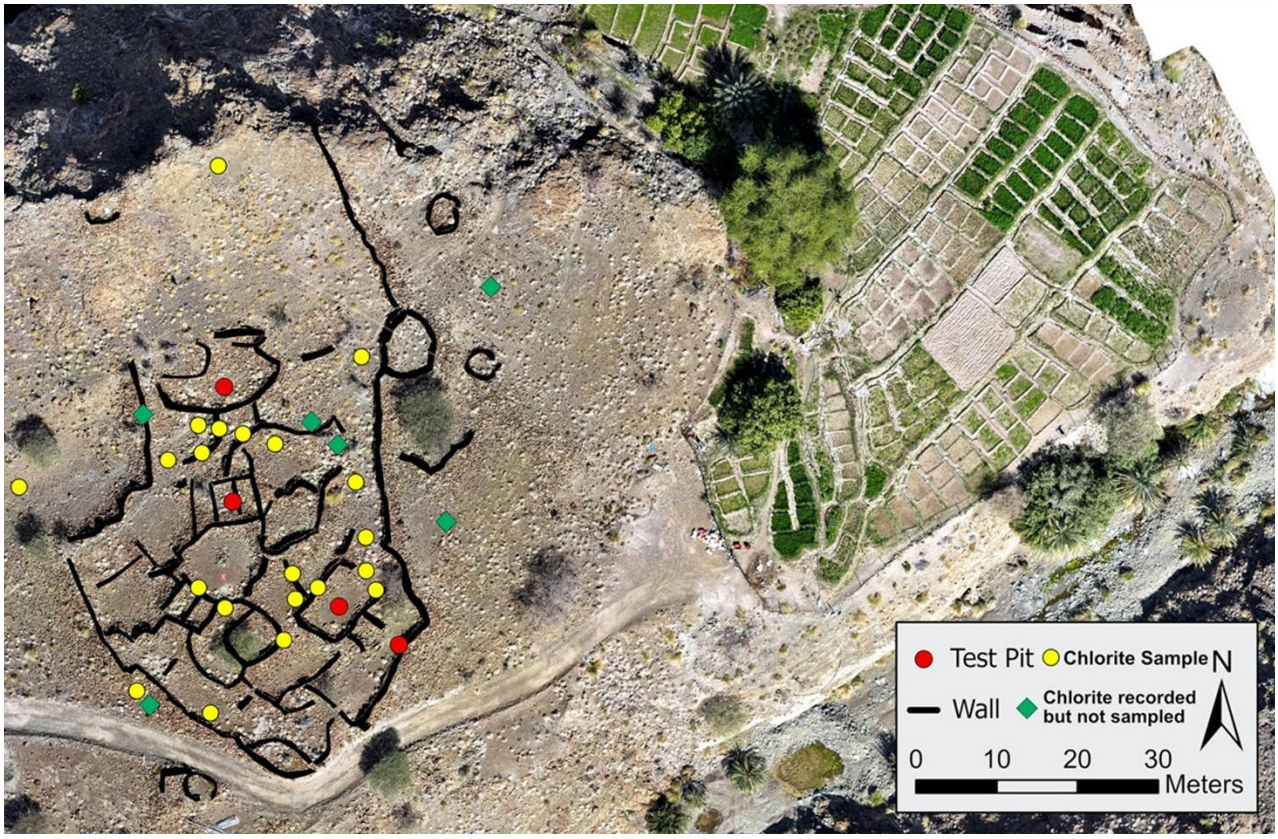

Figure 4. Architectural plan of the Hayy Ukur settlement with the locations of chlorite objects recorded during the 2024 survey (image by P. Paulsen & J. L. Shannon).

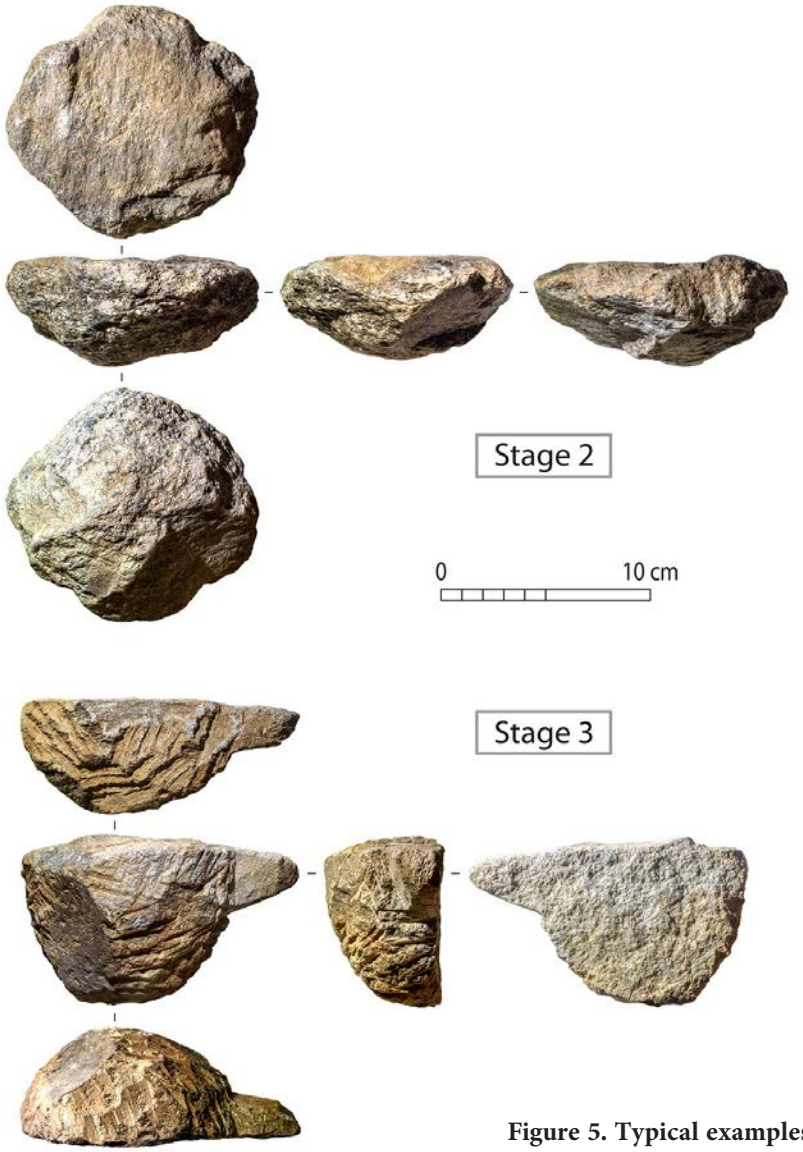

Figure 5. Typical examples of unfinished Iron Age chlorite vessels from Hayy Ukur (image by H. David-Cuny)

chlorite was a valuable enough material (culturally or economically) to justify the labor required for such extraction and transportation.

Hayy Ukur

The architectural plan of Hayy Ukur was edited to clarify poorly preserved walls and doorways previously mapped using drone imagery. Survey at the Hayy Ukur settlement and its nearby quarry also yielded new information related to the extraction of chlorite and production of vessels. In 2024, geological survey identified several unworked chlorite fragments on the upper slope to the west of the quarry, suggesting that the outcrop is more substantial than initially assumed (Fig. 3).

Chlorite Vessel Production

Archaeological survey at the Hayy Ukur settlement generated new information about production of chlorite vessels in Iron Age northern Oman. Despite the presence of a chlorite quarry 800m upstream, previous archaeological surveys identified relatively few chlorite artifacts on the surface of the settlement (Paulsen *et al.* 2024). Due to time constraints during the 2024 season, only a preliminary survey was conducted over the course of two days. Nevertheless, the identification of 40 chlorite objects confirmed the production of vessels at the site (Fig. 4).

The scale of production at Hayy Ukur is far less substantial than that of Aqir Al-Shamoos, located less than 20 km away (Harrower *et al.* 2016). Of the 7707 objects recorded at Aqir Al-Shamoos in 2023,

only 16 fragments of finished (i.e. decorated) vessels were identified, and no intact, finished vessels were recovered. Of these 16 decorated fragments, 15 are consistent with the 'Late' Iron Age I (Olijdam and Velde 2023) or Iron Age II vessel forms, with the lone outlier being an Umm an-Nar style bowl that was likely brought to the site from elsewhere. The rarity of decorated fragments at Aqir Al-Shamoos may be the result of some or most of the completed vessels being decorated elsewhere, with Aqir Al-Shamoos producing blanks that were only later incised by craftspeople. It cannot be ignored, however, that Aqir Al-Shamoos's assemblage is comprised almost exclusively of discarded objects; either vessels broken during production, abandoned blocks and cobbles, or debris. Moreover, the archaeological assemblage is likely not a representative sample of all the production activities occurring at the site. It may have been vessels at the incision stage were less likely to break than those in earlier stages of production, resulting in the underrepresentation of finished vessels. While such explanations remain speculative, the paucity of decorated vessels at Aqir Al-Shamoos warrants comparison with other sites to clarify whether this type of assemblage is typical or exceptional.

Conclusions and future research

Prior to the 2024 field season, the ArWHO project had investigated and collected chlorite samples from Aqir Al-Shamoos, a chlorite vessel production center without an associated quarry, and Shwaghy, a quarry without an associated workshop or settlement. The identification of vessel production at Hayy Ukur in 2024 therefore represents a critical opportunity to investigate the relationship between quarries and sites of production. Ongoing mineralogical and geochemical analyses of samples from Hayy Ukur and its associated quarry seek to determine whether this quarry was the geological source, or one of the geological sources, of Hayy Ukur's chlorite vessel industry.

Decades of archaeological research in Southeast Arabia have recovered many hundreds of finished chlorite vessels, but the remnants of chlorite vessel production are easy to overlook and thus underreported. The sites of Aqir Al-Shamoos and Hayy Ukur, had both been visited and surveyed on multiple occasions before chlorite vessel production was identified. Factors that inhibit identification of chlorite debris include irregularity of fragment size and shape, low artifact density, erosion, and weathering. Based on ArWHO results, it may be that small-scale chlorite extraction and vessel production, like that at Hayy Ukur, may have occurred at some or many other sites in northern Oman. We encourage other investigators to be on the lookout for the remnants of chlorite production and quarrying.

Acknowledgments

This research was funded in part by the Alexander Grass Humanities Institute (AGHI) of Johns Hopkins University. We would like to thank Drs. Francesco Genchi, Jennifer Swerida, and Bleda Düring as well as the Ministry of Heritage and Tourism for sharing archaeological samples and their enthusiastic support of our ongoing research.

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Heidelberg Archaeological Project in Oman: Mihlya, November 2024, 'Oman's Late Iron Age – which one?'

Yule P.A.[1]

Oman's largest Samad Late Iron Age (SLIA) cemetery lies near Mihlya village in Ash-Sharqiyyah North. In 2004, excavators cleared approximately 111 graves at the partially excavated funerary site 'M1'. The excavators described the date of the site variously as 'Hellenistic', 'Late Iron Age' and 'Samad'. Unpublished, typologically diverse grave goods differ from, but resemble those from the SLIA type-site at Samad Ash Shan S10, located a mere 17 km south-east. Our new project realised remote and pedestrian surveys and excavation in the site's western half. Assemblage diversity highlights the relative isolation and uniqueness of various contemporary populations.

تقع أكبر مقبرة سمد من العصر الحديدي المتأخر في عُمان بالقرب من قرية محلية بمحافظة شمال الشرقية. في عام 2004، نقّبت فرق التنقيب حوالي 111 قبرًا في موقع الدفن "M1" الذي حُفر جزئيًا. وصنفت فرق التنقيب تاريخ الموقع على أنه "هلنستي"، و"عصر حديدي متأخر"، و"سمد". تختلف المقابر غير المنشورة، ذات التنوع النمطي، عن تلك الموجودة في موقع سمد الشان S10، الذي ينتمي إلى العصر الحديدي المتأخر، ولكنها تُشبهها. وقد أجرى مشروعنا الجديد مسوحات عن بُعد وأخرى للمشاة، بالإضافة إلى أعمال تنقيب في النصف الغربي من الموقع. ويُبرز تنوع المجموعات الأثرية العزلة النسبية والتفرد الذي تتسم به مختلف المجموعات السكانية المعاصرة.

Support for the project *'Oman's Late Iron Age – which one?'* began on 13 June 2023, conceived for 24 months. For years now, the SLIA chronology has not kept pace with that of neighbouring PIR sites in the UAE. Our primary method is to define artefact classes more precisely, document unpublished artefacts, and structure both the relative and absolute chronology. As work progressed, the need for more structured data regarding our SLIA assemblage increasingly dawned on us, prompting an adaptation of our research strategy. Success in our profession relies heavily on the extent of contact with the host

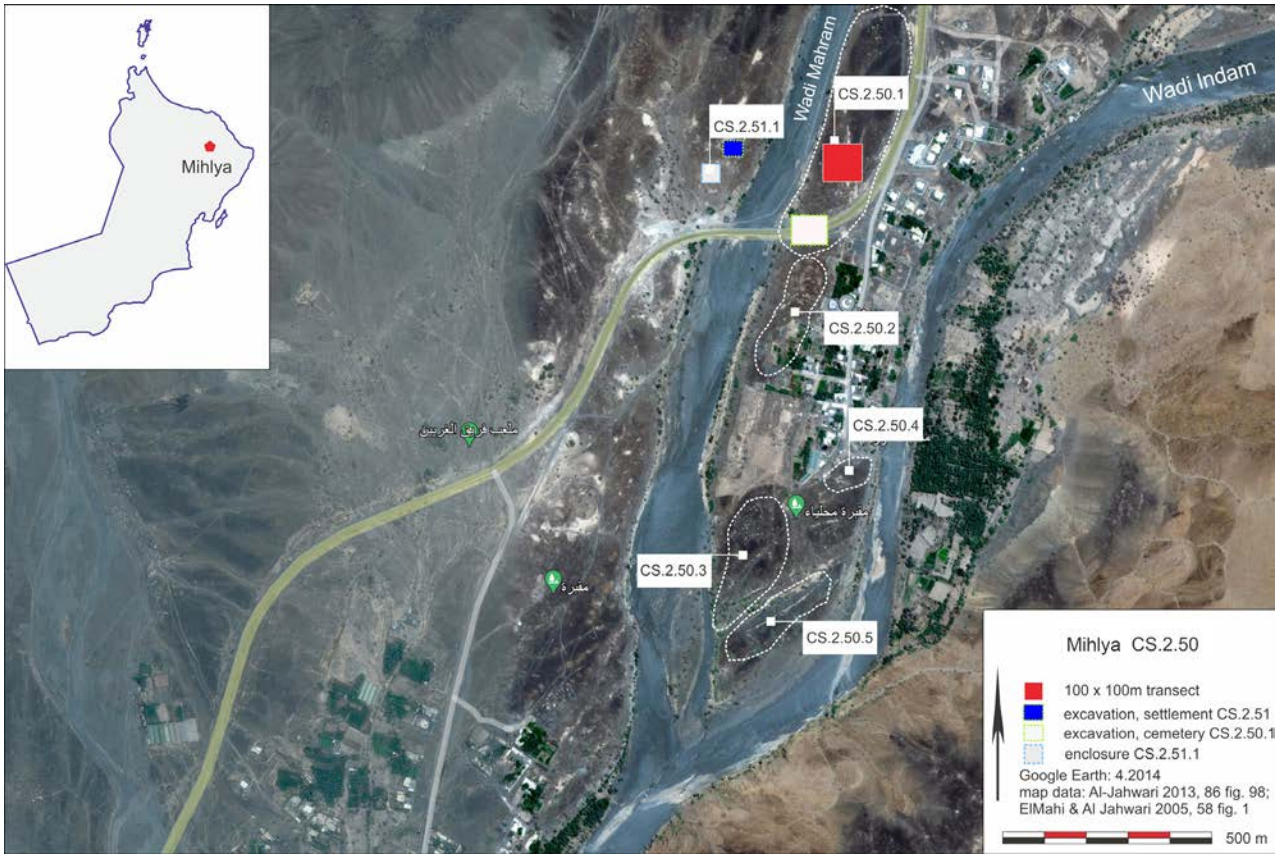

Figure 1. The SLIA cemeteries and settlement at Mihlya lie 11.6 km on the Wadi Indam road, north of Khadra Bani Daffaa town in the northern part of Oman's eastern governorate (source: Google Earth, Yule).

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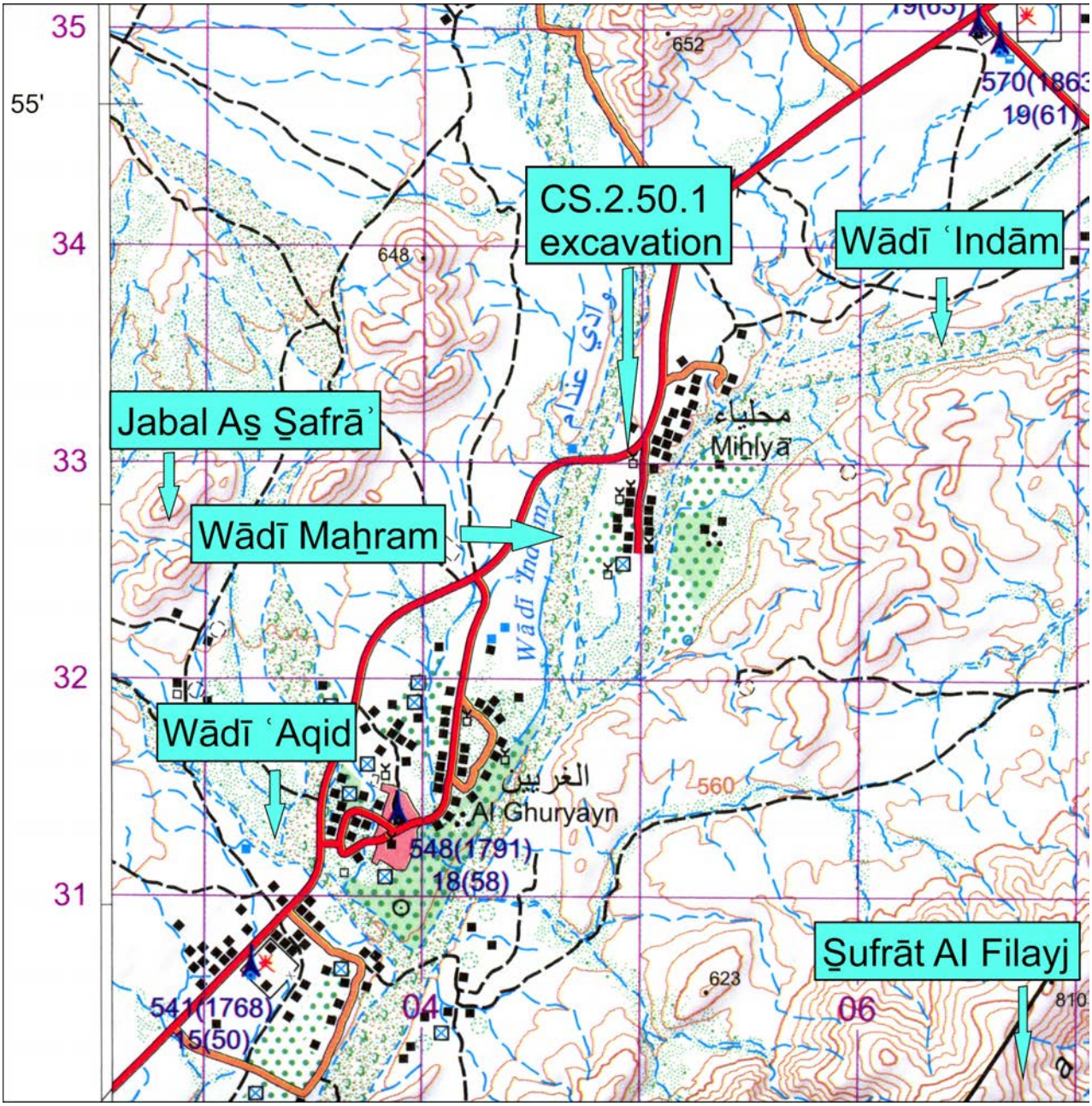

Figure 2. Cemetery site CS.2.50.1 lies 1190 m NNE of the most significant confluence of Wadi Indam and Wadi Mahram above Al Ghuryayn. 'Wadi ʿIndām' is mislabelled and actually is the wadi which meanders ENE-WSW turning SW-ward just south of 'Mihlyā" (source: 1:50.000 sheet NF4007C1; El-Baz 2004, 24).

country. Consequently, the PI applied for two visits but travelled three times for recording purposes (February–March 2023, November 2024, February 2025).

Results exceeded stated goals. First, he proved that, in fact, SLIA dates begin from c. 300 BCE, since several ^{14}C dates now exist. However, most antiquarian datings cluster in the first centuries of the CE. By means of more intensive cataloguing, the PI refined the definitions of the various ceramic ware/shape combinations, in part through Moh's hardness testing. The team documented numerous artefacts lost in ministry storage for publication. A year before the beginning of the project, the PI excavated and documented several so-called hut tombs at the site of Ḥor Al-Ḍabʿ. We recorded finds of subsequent excavations at that site during our final season. It is now clear that traditional Early Iron Age dating is increasingly difficult for them to defend. This fact dramatically alters the chronology of the late pre-Is-

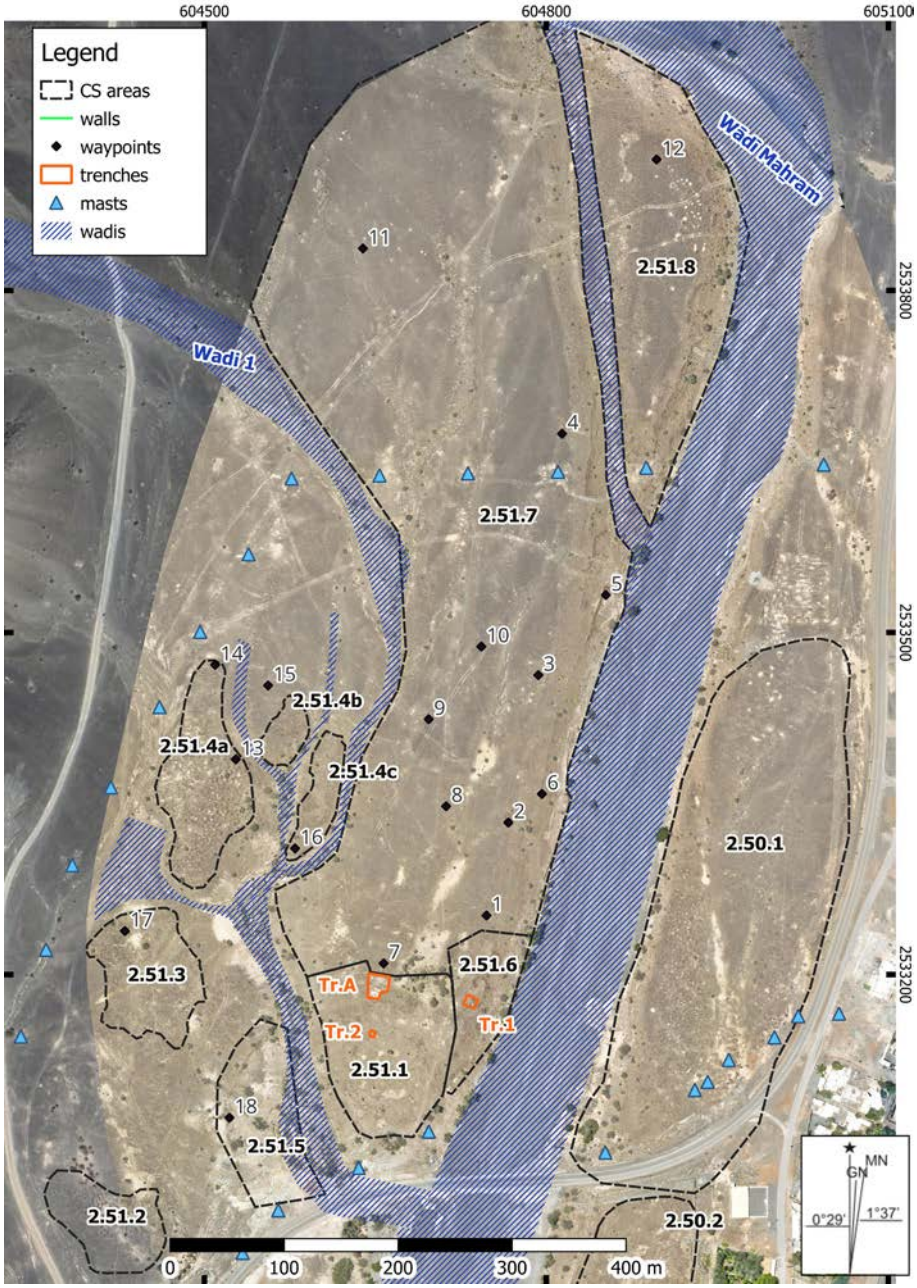

Figure 3. Survey and excavation area of western Mihlya (CS.2.51). 'Tr. A' refers to the excavation of 2004. 'Tr. 1 & 2' were excavated in 2024 (source: National Rocks, data Ayash).

lamic period. We raised the catalogue standard in Oman by working with the Omanis on this task. The PI also documented the unpublished grave inventories at the late pre-Islamic site of Al Fayha, dating back to the 3rd century CE (Yule in press). In general, the chronology of the SLIA is now more robust and better structured. Finally, the PI re-structured the SLIA pottery chronology, making it easier to understand. This restructuring aided new composite drawings.

On the basis of a new ongoing site gazetteer with site names, locations, descriptions and bibliography, the PI and his co-workers integrated these data into the internet with the help of the online Deutsche Bibliothek and the French Thematic Dictionary of ancient Arabia. The PI's research yielded a large number of unrecognised artefacts. Elaborate networking with colleagues enabled getting expert opinions on the origin of artefacts from various sites in Oman, some of which originated in the UAE. We also had the advan-

Figure 4. Abiel coin excavated from Mihlya Trench 2 (source: Yule).

tage of other consultants, such as Dr Michel Mouton (CNRS) and Prof. Tara Beuzen-Waller (University Perpignan). Close relations with the members of the Department of Archaeology led to a constant flow of new information. The PI refined the documentation of the SQU/Ministry excavation of 2004 at Mihlya for publication, but no grave documentation was possible. Our excavation in Mihlya was of a settlement that dates as early as the three centuries before the Common Era. The team's two test trenches shed little light on the fortification architecture, but yielded pottery and an Abiel coin, possibly dating to the 2nd–3rd century CE. The intensity of the documentation and publications strengthens knowledge of the SLIA and an understanding of how to proceed. Arguably, the first publications document the ability and engagement of student participants for further work in the archaeology of Oman. Aside from recording interesting stray finds, the next move should be to document grave architecture and further study human skeletal remains. As for the hypothesis stated in the grant proposal, the dating questioned before the year 0, no longer can be doubted. The other half: the PI failed to show a population decline in the mid-2nd century CE. In its initial discovery phase, the SLIA still lags behind other sub-fields.

Acknowledgments
A grant from the Fritz Thyssen Foundation made this project possible. Prof. Michael Waltisberg, provided a place to work in the Seminar for Semitic Studies of Heidelberg University. The Ministry of Heritage and Tourism also lent their time, talent and partial financing.

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The Sallut and Bisya Archaeological Mission (2023–24): Reconstructing the Ancient Agricultural Landscape

Zerboni A.,[1] M. Degli Esposti[2] & S. Bizzarri[3]

This article presents the results of an archaeological survey conducted around the Bisya and Sallut oases, surrounding the Sallut Archaeological Park (Sultanate of Oman). The investigation focused on archaeological and traditional water management systems, including *aflaj*, wells, and canals, as well as the remains of the oasis agricultural landscape. The survey documented the current state of these features, identified conservation needs, and highlighted the ongoing shrinkage of the oasis since the Islamic period. Finally, the study proposes a sustainable approach to the restoration, maintenance, and potential integration of these systems into the region's cultural tourism.

يعرض هذا المقال نتائج المسح الأثري الذي أُجري في منطقة واحتي بسياء وسلوت، المحيطة بمنتزه سلوت الأثري (سلطنة عُمان). ركزت الدراسة على أنظمة إدارة المياه الأثرية والتقليدية، بما في ذلك الأفلاج والآبار والقنوات، بالإضافة إلى بقايا المشهد الزراعي الواحي. وقد وثّق المسح الحالة الراهنة لهذه العناصر، وحدد احتياجاتها من حيث الحفظ، وسلط الضوء على الانكماش المستمر في الواحة منذ الفترة الإسلامية. وأخيرًا، يقترح البحث نهجًا مستدامًا لأعمال الترميم والصيانة، مع إمكانية دمج هذه الأنظمة في السياحة الثقافية للمنطقة.

The Bisya and Sallut oasis, which extends across the fluvial plain facing the archaeological site of Sallut, began to form during the Middle Holocene and has undergone a continuous reduction in green areas due to the progressive decline in water availability over the past millennia (Cremaschi *et al.* 2018). The oasis has been inhabited by human communities since its early phases, and from the Bronze Age onward, systems were developed to exploit its agricultural potential (Degli Esposti *et al.* 2025a, 2025b).

Figure 1. Recently abandoned farm south of the Archaeological Park of Sallut.

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Figure 2. Part of agricultural and water managment implements along an abandoned district of Bisya.

A comprehensive archaeological and architectural survey conducted in the area surrounding the Bisya and Salut Archaeological Park made it possible to assess the evidence of past exploitation of the oasis, as well as the state of preservation of the *falaj* systems, wells, and canals. The data collected point to a complex evolution of technologies for agricultural use and water management within the oasis.

Methodology

The survey employed integrated techniques, including field inspections, 360° photography, preliminary measurements, and internal well-shaft surveys to assess the state of preservation of agricultural features. A total of 51 hydraulic structures were recorded, and each was evaluated for structure type, condition, visibility, and dimensions.

Agricultural landscape

A considerable amount of information on the ancient environment, water management, and soil exploitation in the Bisya and Sallut oasis has been collected over the years. However, the nature and modalities of agricultural exploitation in the Bisya and Sallut plain—particularly during the Iron Age—remain poorly understood. Initial investigations of buried soils dated to the Bronze and Iron Ages have revealed features related to cultivation practices, confirming the use of land for agriculture in the vicinity of the main site of Husn Sallut (Cremaschi *et al.* 2018).

During the most recent survey, we were able to reassess key evidence related to the agricultural use of the oasis and its more recent development. The latest traces of cultivation are still visible around recently abandoned villages, likely deserted within the past 300 years (Fig. 1). In many locations, numerous mudbrick buildings remain standing, interspersed with ancient cultivation plots delineated by low earthen walls — designed to retain soil moisture — or rows of palm trees. This layout suggests that the traditional agricultural system practiced in

Figure 3. Evidence of field partitioning in the areas of the nudud.

the Bisya oasis was based on agroforestry, a land-use strategy that integrates trees with crops or pasture to enhance productivity. In arid environments, such a system is used to mitigate soil erosion and limit water evaporation from the soil. It is likely that this strategy, combined with careful water management through the *aflaj* network, sustained the oasis until recent times.

Significant evidence of past agricultural land use is preserved just outside the Sallut Archaeological Park, where remnants of abandoned settlements and former cultivated fields are widespread. These fields are primarily characterised by a network of irrigation channels and low stone or earthen walls, which served to retain fertile soil and prevent both erosion and water loss (Fig. 2). These features are clearly identifiable in the field and are also visible in high-resolution satellite imagery.

The surface of these former cultivated areas is scattered with green and blue-glazed Abbasid pottery, splashed ware, and early and late sgraffito wares, dating from the 9th/10th to the 14th/16th centuries CE. These traces of cultivation surround more than twenty anthropogenic mounds, locally known as nudud, which consist of soil upcast during the excavation of sunken fields. Only one of these nudud has been previously investigated through a small trench, which revealed a series of superimposed layers of loose sand containing organic material and gravel. The deposits of the nudud include reworked archaeological materials, predominantly Islamic-period pottery, with a smaller quantity of Iron Age sherds, suggesting that the formation of these mounds involved the reworking of soils and sediments from earlier Iron Age occupation levels (Fig. 3).

Water infrastructure

The artificial waterscape of the area has been investigated for several years, and recent studies have made it possible to radiometrically date the introduction of the *aflaj* system in the region (Cremaschi *et al.* 2018). Water management technologies were

Figure 4. An abandoned *falaj* east of the Archaeological Park of Sallut.

Figure 5. Internal view of a well preserved shaft made of stone stone bricks along the *falaj* of Figure 4.

Figure 6. A surface canal damaged by floods.

introduced as early as the Bronze Age, when canals and towers surrounded by moats were constructed. These structures represent the first attempts by an agricultural community to conserve water and create reserves for domestic use and cultivation.

Key water-management facilities — often monumental in scale — have been identified and studied, with particular attention to the Early Bronze Age hydraulic features associated with the ST1 tower and the Early Iron Age *aflaj* network (Degli Esposti *et al*. 2025a, 2025b). One of the *aflaj* provided the first direct radiometric date for such structures in the region.

During the Iron Age, the *aflaj* system and its associated terminal canals were introduced to tap into deeper water resources located near elevated areas (Figg. 4, 5). In the following centuries, these systems were repeatedly maintained and expanded, at least until the Islamic period, when they likely reached their maximum extent, possibly in response to population growth and decreasing precipitation, as indicated by regional climate records such as those from Al Hoota Cave (e.g. Fleitmann *et al*. 2007).

The 2023–2024 survey revealed that most hydraulic structures in the Bisya and Sallut area are currently inactive, and the majority are in poor condition due primarily to natural deterioration processes and discontinued maintenance (Figure 6). To date, no significant restoration or consolidation work has been carried out on the ancient *aflaj*, except in a few areas where interventions involved concrete and modern materials. Overall, the state of preservation of hydraulic features is highly variable, mostly depending on their proximity to modern settlements. Human activity poses an additional threat to their conservation: many *aflaj*, for example, are used for waste disposal. In addition to anthropogenic factors, natural processes have had a major impact on the preservation of these structures. Following the spring 2024 rainfall, exceptional flooding in the main wadi crossing the Bisya and Sallut area dam-

Figure 7. The shaft of a *falaj* exposed by the 2024 strong rainfall.

aged the shafts of some *aflaj*, exposing them and accelerating their degradation (Fig. 7). The same applies to wells and canals, many of which — whether built of masonry or earth — have been displaced or broken by floodwaters.

Oasis sustainability and potentiality for tourism

The recent survey of the oasis confirmed the significance of the Bisya and Sallut area in the development of the local cultural landscape, shaped by centuries of interaction between humans and the environment. While many key features related to land cultivation and water management are already known, some require further investigation to fully understand their role in shaping the present-day landscape. Moreover, most of the observed features are in urgent need of preservation measures and should be regarded as central elements in support of the area's potential UNESCO World Heritage nomination. A deeper understanding and effective enhancement of the region's cultural heritage will also contribute to the development of tourism in Bisya and Sallut and, more broadly, to the growth of the local economy. Preserving the *falaj* systems and the agricultural landscape holds both cultural and practical value. These features are not only historical assets but also models of sustainable water management and agriculture. Their revival would strengthen traditional knowledge and improve resilience to environmental challenges. Properly restored *aflaj* and architectural remains could serve as key attractions for cultural tourism. Developing interpretive trails, signage, rest areas, and educational programs would create immersive visitor experiences while promoting local economic benefits. This integrated approach ensures that preservation efforts are aligned with community engagement and long-term sustainability.

Acknowledgments
The Ministry of Heritage and Tourism of the Sultanate of Oman in Muscat, the regional office in Nizwa, and the Archaeological Park of Bisya and Sallut and all their staff are warmheartedly thanked for their support. The constant help of the Italian Embassy in Muscat is deeply appreciated. The Sallut and Bisya Archaeological Mission of the University of Milan is financially supported by the Italian Ministry for Foreign Affair and the University of Milano.

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