مجلة الدراسات العُمانية

مجلة علمية محكمة

The Journal of Oman Studies

العدد ٢١

مجلة الدراسات العُمانية

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Vol 21

The Journal of Oman Studies

Scholarly Refereed Journal

Volume 21

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Volume 21

Published by the Ministry of Heritage and Tourism
Sultanate of Oman

ISSN 0378-8180
Printed by Mazoon

MAP OF THE SULTANATE OF OMAN

GUIDE TO AUTHORS

The Journal of Oman Studies was established in 1975. It is published by the Ministry of Heritage and Tourism in the Sultanate of Oman. It is a scholarly journal that publishes original and refereed research in both Arabic and English in areas relating to natural and cultural heritage relevant to the Sultanate of Oman. The journal publishes research in various areas of tangible and intangible cultural heritage. For example, the journal publishes research in various kinds of movable and non-movable archaeology, rock art, inscriptions and writings, sculpture, traditional architectures such as forts, castles and old neighborhoods. The journal also publishes research on modern buildings with unique architecture specific to Oman. It also publishes research on intangible cultural heritage such as research in the areas of Omani traditions and customs, different forms of expression including language and oral practices, various forms of performance arts, rituals, ceremonials, social practices, various forms of interaction with nature such as agriculture, falaj and irrigation system, traditional medicine, skills related to Oman's traditional handcrafts and others. The journal also publishes research dealing with topics related to Oman's natural heritage and these include studies of natural landscape, geological structure, natural sites like mountains, wadis, caves, flora and fauna of Oman. The journal also invites book reviews in relevant areas.

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Contributions are submitted in Microsoft Word format with a margin of 3cm in all sides. The number of words of the manuscript should not exceed 10,000 words for a full paper and 1200 for the book review including footnotes. Submissions should be double-spaced with Times New Roman size 12. Submissions should be written in good academic language.

Submissions should be sent electronically with the following details provided on the cover page: title of the paper, author(s) full name(s), academic titles, their affiliation(s) and the type of submission (paper, translation, book review... etc.) in both Arabic and English, full address of the author(s) including email, P. O. Box, phone and fax number.

The submission should include an abstract in both English and Arabic and it should not exceed 250 words in each language. The abstract should give a summary of the content, significance, methodology, contribution and the main findings of the study. The abstract should also provide 5 keywords.

In-text citation of sources should be documented in the main text not as footnotes or endnotes. The surname(s) of the author(s), date of publication and page number should be provided between brackets as follows:

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  (Smith, 2005:22)
- **Two or three authors:**

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  e.g. Bailey K. and Damerow, R. (eds) (2014) Teaching and Learning English in the Arabic-Speaking World, London: Routledge

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- **Journal publication**

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  e.g. Nash, H., Al Musharifi, M., and Al Harthi, A. (2014) "Timing Falaj Water Shares in Al Hajar ash Sharqi", The Journal of Oman Studies, vol. 18, pp. 63 – 75.

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  e.g. Marquez, G. G. (1967) One hundred years of solitude, (G. Rabassa, trans.) (2006), New York: Harper Collins

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  The metric system should be used and this should be reflected in the text by using the following abbreviations: m = meter, g = gram, s = second, l = liter … etc.

- **Dates**

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Foreword

The Journal of Oman Studies, published by the Ministry of Heritage and Tourism in Oman, has been recognized over the last four decades by local, regional and international academics and researchers as a source of original research and scholarship on Oman's cultural and natural heritage. The Journal publishes solid research findings produced by many archaeological missions working in different parts of the Sultanate. These missions target the Journal as the main publishing venue for their research output. The Journal is thus a pioneer in publishing these archaeological discoveries and findings. The Journal also publishes research on various other topics related to Oman's cultural intangible heritage and on topics related to editing Oman's heritage manuscripts. It also publishes articles on Oman's natural heritage. These diverse areas of scholarship enrich the Arab and World academic libraries with significant academic studies on Oman and its cultural and natural heritage.

I am pleased to present to you issue 21 of this Journal, which includes 12 research articles in both Arabic and English addressing different historical and archaeological eras ranging from the Paleolithic through the Neolithic, Bronze Age, Iron Age, Pre-Islamic eras and Islamic eras. These research articles cover various topics related to palaeoclimatic and palaeoenvironmental in Al Hajar Mountains in northern Oman as well as early human dispersal in Oman. The articles also attempt to identify the nature and timing of human occupation and landscape change during the Stone Age period in the Western Hajar Mountains. The articles also shed light on prehistoric occupation of cave and rock shelters as well as ancient pastoral occupation. This issue of the Journal also includes articles on prehistoric settlements and cemeteries and the various archaeological artefacts such as pottery, metals, softstone, flint, stamp seals, coins and so on. In addition, the issue features some ethnographic and historical studies such as the one on the traditional banush boat and the one on aflaaj. The geographical framework of these studies is diverse and covers all regions of Oman from the north to the south.

On this occasion, I would like to extend my thanks to all the researchers who contributed to this issue and previous issues. The Journal will continue its mission of publishing rigorous, solid and original research, and I would like to invite researchers to submit their scholarly work whether in Arabic or in English to this Journal for publication in the upcoming issues.

Salim bin Mohamed Al Mahrouqi
Minister of Heritage and Tourism

First Assessment of The Research Potential of The Prehistoric Intermountain Site Hayl Al Ajah in The Al Hajar Mountains of Northern Oman (Project SIPO)[1]

Inna Mateiciucová, Maximilian Wilding, Max Engel, Jirí Otava & Miroslav Bubík

ABSTRACT:

This contribution presents preliminary results of a first archaeological assessment of an elevated palaeohydrological feature in the central part of the Al Hajar Mountains (Al-Jabal Al-Akhdar). The 2018 Test Season at the karstic polje Hayl Al Ajah yielded the first direct evidence of a prehistoric occupation of intermountain places in Northern Oman as high as 1000 m a.s.l. The deflated and sediment-embedded lithics found are techno-typologically dated to the Late Pleistocene and Middle Holocene, i.e. periods with longer arid phases. The evidence of a human presence at high-elevation places earlier than formerly thought, raises the question what role the sediment-filled depressions in elevated position in the Al-Jabal Al-Akhdar could have played during prehistoric times. The Project SIPO of Masaryk University (Brno, Czech Republic) will inquire when the utilization at the polje Hayl Al Ajah (1012 m a.s.l.) started and if some prehistoric groups could have held out in the interior of Oman during aridization phases, in refugia, by means of a long-term mountain adaption. The deep, layered sediment available at the site (polje fill) is a potential geo-archive suited for palaeoclimatic and palaeoenvironmental reconstruction. Together with the archaeological traces encountered the circumstances justify further systematic research at this intermountain site.

KEYWORDS: Al Hajar Mountains; Lithics; Karstic Polje; Late Pleistocene; Middle Holocene.

التقييم الأول لإمكانيات البحث في موقع ما قبل التاريخ في حيل العاجه في جبال الحجر بشمال عمان (مشروع SIPO)

إيانا ماتيكيوفا، وماكسيميليان، وماكس إيجل، وجيري أوتافا، وميروسلاف بوبيك

الملخص:

تقدم هذه المساهمة نتائج أولية للتقييم الأثري الأول للخاصية المائية العالية القديمة في الجزء الأوسط من جبال الحجر (الجبل الأخضر). لقد قدم موسم الاختبار لعام ٢٠١٨م في الحقل الكارستي في حيل العاجه أول دليل مباشر على استيطان ما قبل التاريخ للأماكن الموجودة بين الجبال في شمال عمان والتي يصل ارتفاعها إلى ١٠٠٠ متر فوق مستوى سطح البحر. ويمكن تأريخ الأدوات الحجرية الصغيرة المنكمشة والموجودة في الرواسب بواسطة التصنيف التقني إلى عصر البليستوسين المتأخر والهولوسين الأوسط، أي الفترات ذات مراحل الجفاف الأطول. إن العثور على دليل لوجود الإنسان في الأماكن المرتفعة من فترة أقدم مما كان يعتقد سابقًا يثير التساؤل عن الدور الذي كان يمكن أن تلعبه المنخفضات المليئة بالرواسب في موقع مرتفع في الجبل الأخضر خلال عصور ما قبل التاريخ. سيقوم مشروع SIPO التابع لجامعة مساريك (برونو، جمهورية التشيك) بالتساؤل عن الفترة التي بدأ فيها استخدام حقل حيل العاجا (١٠١٢ متر فوق مستوى سطح البحر)، وعما إذا كان من الممكن أن تصمد بعض مجموعات ما قبل التاريخ في داخل عمان خلال مراحل الجفاف في مناطق اللجوء عن طريق التكيف الجبلي طويل المدى. تعتبرٍ الرواسب الطبقية العميقة المتوافرة في الموقع (حشوة الحقل) هي محفوظات جغرافية ممكنة ومناسبة لإعادة بناء المناخ والبيئة القديمين. جنبا إلى جنب مع البقايا الأثرية التي تمت مواجهتها فإن الظروف تبرر إجراء مزيد من البحث المنهجي في هذا الموقع بين الجبال.

الكلمات المفتاحية: جبال الحجر، أداوت حجرية صغيرة، الحقل الكارستي، البليستوسين المتأخر، والهولوسين الأوسط.

1 To the memory of the Mesopotamian pottery expert Olivier Nieuwenhuijse (1966-2020), a passionate researcher, friend and family father in his lifetime.

1. Introduction

A decade ago, it was assumed that hominins originating in East Africa had performed the feat of crossing the Red Sea Strait at Bab el Mandeb at the MIS6/MIS5 transition - then only 10 km wide (Armitage et al, 2011). The "Blue Arabia Hypothesis" or "Southern Route Hypothesis" (Armitage et al, 2011; Bailey et al, 2015; Petraglia et al, 2010) suggested that the early arrivals on the Arabian Peninsula were bound and adapted to coastal living and that the hominins spread quickly to continental Asia along the Red Sea and Arabian Sea coasts (Stringer, 2000). The view of the Arabian Peninsula as a "corniche" reflected today's hyperaridity of the interior of the landmass.

As archaeological evidence emerged along with past climatic amelioration (Stewart et al, 2019), and palaeolakes and palaeorivers in the inner deserts of the Peninsula were identified (Breeze et al, 2015, 2016; Engel et al, 2017), the complementary "Green Arabia Hypothesis" took hold, which assumes that early population of Arabia's interior had likewise been possible (Petraglia, Breeze, and Groucutt, 2019).

Initially, the existence of walkable corridors in the interior seemed to facilitate the connecting of prehistoric sites on the Arabian Peninsula with the Levant or Southern Asia. However, as researchers began to excavate the first stratified prehistoric sites, it became apparent that already a linking of the lithic traditions on the Peninsula itself was sometimes hard to achieve because of a relatively high degree of "autochthony" (see e.g. Bretzke, Yousif, and Jasim, 2018; Delagnes et al, 2012, 2013; Hilbert et al, 2015; Scerri et al, 2014).

Recently, the following pattern in the prehistory of the Arabian Peninsula emerged. *Humid phases* allowed an incursion and contact of people sharing similar material traits across vast areas (Armitage et al, 2011; Crassard et al, 2013, 2019; Rose et al, 2011, 2018). *Arid phases* thereafter made prehistoric groups focus more strongly on the exploitation of refugia (Bretzke et al, 2013; Bretzke, Conard, and Uerpmann, 2014:78f; Crassard, and Drechsler, 2013; Rose et al, 2019).

This contribution emphasizes the difference in the Arabian Peninsula between *sites on the lower-lying inland plains* and *high-elevation mountain-related sites*.

The State of Mountain-Based Prehistoric Research In The Southeast of The Arabian Peninsula

Open-air sites with important lithic assemblages and substantial sediment deposits dating to the Middle Palaeolithic have been mainly investigated in central, relatively open areas of the Peninsula (particularly Saudi Arabia), at sites occupied during humid phases: Jubbah palaeolake (Petraglia et al, 2012: figure 8), the site Umm al-Sha'al at a wadi confluence (Crassard et al, 2019: figure 5) and several others. For the current purpose, such sites are typified as *inland plain sites*.

In contrast, the prehistoric sites of the Al-Ḥajar Mountains (United Arab Emirates and Northern Oman) are clustered as *mountain-related inland sites* (**Figure 1**). Examples include the series of Palaeolithic sites in the Sharjah and Ra's al-Khaimah Emirates discovered by the PADMAC[2] Unit of Oxford (Scott-Jackson et al, 2008; Scott-Jackson, Scott-Jackson, and Rose, 2009; Scott-Jackson, and Scott-Jackson, 2013); the Palaeolithic and Neolithic site of Jebel Faya (Bretzke, Conard, and Uerpmann, 2014, Fig. 3; Bretzke, 2015; Uerpmann et al, 2012); the key Neolithic site of Al-Buhais 18 (Uerpmann, Uerpmann, and Jasim, 2010); or the prehistoric sites of the British-German project (PEARL) in the middle part of the Al-Ḥajar Mountains (at Ibri and Ar Rustaq) which is studying the endemism of natural habitats and the cultural interlock of mountain and coastal sites (Parton, and Bretzke, 2019). It is only in the South of the Arabian Peninsula (Yemen), however, that research has been unfolding at *places at high elevation*.[3]

2 *Acronym for research on "Palaeolithic Artefacts and associated Deposits in a Middle Eastern (Arabian) Context" based at the University of Oxford.*

3 *The excavation sites of the Yemen Highlands have yielded a wealth of intriguing data which can serve to outline the basics of a mountain adaptation of prehistoric humans in other parts of the Peninsula, if used carefully (inter alia: Amirkhanov, 2006; Fedele, 2009; McCorriston et al, 2002).*

Figure 1: *Map of northern Oman showing the location of the polje Hayl Al Ajah and sites mentioned in the text.*

In the United Emirates and northern Oman mountain-context research has taken another turn. The principal prehistoric sites are in piedmonts of the Western Al-Ḥajar Mountains, at elevations below 400 m a.s.l.[4] At Maqta in the Eastern Al-Ḥajar Mountains, 27 km from the coast, an archaeobotanical sounding 20 m into the sediment of a small depression ("*possibly the remains of an ancient collapsed cave*", perhaps a polje) has been made (Urban, and Buerkert, 2009) at a height (1050 m a.s.l.) comparable to the site presented here.

The grouping of sites according to the criterion of elevation is necessitated by the following tenet.

The relatively uniform topography of a level terrain will have made the problem of aridization more pressing in the interior of the landmass, whereas in mountainous areas, the vertical zonation and relief made it easier for humans to relocate to atmospheric regimes and environments that were *different*.

The discontinuity of human presence implied in the cycle of "*occupation, abandonment, and reoccupation*" (Bretzke, Conard, and Uerpmann, 2014:78) is therefore thought to have been more accentuated at open, level-terrain places in the Arabian Peninsula. Inversely, a more sustained — if faint — presence of humans is assumed for mountain-context raised places, because they could also be accessed during part of the dry phases when formerly occupied, outlying sites had to be abandoned.

This contribution presents preliminary results of a first archaeological assessment at a

4 *With the exception of the recently investigated Neolithic site at Qumayra (wadi bank) inside the Western Al Hajar Mountains at a height of 570 m a.s.l. (Białowarczuk, and Szymczak, 2019).*

palaeohydrological feature at greater height in the central part of the Al-Ḥajar Mountains (Al-Jabal Al-Akhḍar) (Figure 1). The 2018 test season at the karstic polje Hayl Al Ajah yielded the first direct evidence of a prehistoric occupation at intermountain sites as high as 1000 m a.s.l. The lithics found on the surface as well as embedded in sediment (Site 1/Trench 1) are techno-typologically dated to the Late Pleistocene and Middle Holocene — periods with longer arid phases.

2. Relevance of Poljes For Prehistoric Research In Semi-Arid Countries

Though their genesis in a rock landscape may vary (Ford, and Williams, 2007), poljes[5] in the current context are sediment-filled collapse or subsidence depressions formed through the coalescence of smaller-scale dolines in a mature karst region by underground drainage (by limestone solution) that measure several square kilometres (ibid, p. 181). Being essentially bowl-shaped, poljes have the paradoxical capability of accumulating water and sediment in the same degree as their near surrounding deteriorates and becomes barren rock. They are prone to ponding, as they often contain clay-rich, impermeable sediment horizons through limestone weathering, however, they are usually connected to the subterranean karst-hydrological system.

Accumulating many metres of sediment (see: Bartels, 1991; Posilović, et al, 2018; Siart, Ghilardi, and Holzhauer, 2009), poljes are uniquely fertile features in limestone regions, e.g. of the Dinaric Alps (Balbo et al, 2006; Šušteršič, and Šušteršič, 2003), and in Greece (Alevras et al, 2007; Bartels, 1991; Vött et al, 2009), Spain and France, with forms known also in various parts of Asia and the Americas (Bonacci, 2013). Not infrequently poljes are subject to flooding during the rainy season and temporary lakes may appear inside them (Ford, and Williams, 2007:181).

By their concentrations of water and soil, poljes attracted humans during the Mesolithic period at Polje Čepič in Croatia (Balbo, Komšo, and Miracle, 2004, 2009; Balbo et al, 2006), in the Middle Palaeolithic at Nesher Ramla, Israel (Frumkin et al, 2015; Prévost, and Zaidner, 2020), and in Minoan to Hellenistic periods at the town of Lato, NE Crete (Siart, Ghilardi, and Holzhauer, 2009).

Nevertheless, water input into a polje in the Near East will be significantly lesser than in the Balkans and in the Mediterranean, with repercussions on the drainage configuration underground, the erosion and sedimentation rate, and so on. Still, in relative terms a polje in Oman will have provided valuable extra resource in terms of moisture, soil and vegetation for prehistoric foragers facing either an aridization problem (dry climate phases)6 or reaping resource benefits in mountain environments during periods of increased rainfall (humid climate phases).

3. Launch of The Masaryk University Sint Polje Project (SIPO)

Invited by the late Prof. Maurizio Tosi in 2016, the Centre of Prehistoric Archaeology of the Near East, Faculty of Arts of the Masaryk University (Brno, Czech Republic), made an application for an excavation permit at the Ministry of Heritage and Tourism of the Sultanate of Oman in 2017.

While looking for a suitable prehistoric site, the authors were forwarded the satellite image of a polje in the Jabal Al-Kawr, by a countryman partly based in Oman, Roman Garba, together with the information that the geologist Goesta Hoffmann (Bonn University; co-author of the 2016 "Field Guide to the Geology of Northern Oman") had recently inspected the landscape feature.

The Czech team had been carrying out a polje survey project in Crete in 2015 with a strong archaeohydrological orientation[7].

5 *Polje is a geological term coined after the Slavic expression for "field" (ibid, p. 362).*

6 *For past precipitation trend see maps in Jennings et al. (2015: figures 1, 3, 9,10; note esp. the Al-Akhḍar region).*

7 *KALA-RA Survey (part of Project OXA, led by Vera Klontza of the Department of Archaeology and Museology, Masaryk University) in the valley of Kalos Lakkos above Elounda, Ephorate Lasithi.*

Judging from the forwarded Google Earth image (**Figure 2**), the floor and the slopes of the polje near Sint appeared to be free of the huge rubble screes, sub-recent hillside terraces, valley floor garden plots, wells and pits that, at the Cretan counterpart, had rendered much of the original bottom and polje slopes inaccessible to prehistoric investigation. Besides, the short description of the polje in Hoffmann et al. (2016:214f) pointed to lithic scatters along its rim, and a shallow seasonal lake that had possibly existed there in the past.

4. Characterization of The Hayl Al Ajah

Topography. The polje Hayl Al Ajah (Research Area 1; 500 m in diameter) is located on a small karstic plateau of layered Late Triassic dolomite (Research Area 2) above the mountain oasis Sint at an altitude of 1012 m a.s.l. The sediment-filled depression is separated from the towering Jabal Al-Kawr anticline by a deep gorge (**Figure 2**). The wadi at the bottom of the gorge runs from the wide basin of Sint (937 m a.s.l.), by the secluded Kawr oasis Sant (918 m a.s.l.) to its "opening gate" — the alluvial oasis Al Wadi Al Ala, (604 m a.s.l.) at the foot of the karst formation carbonate sequence (**Figure 3**).

Sedimentation. The polje surface is soft, light-yellow and flat (**Figure 5**). At first glance a surveyor familiar with poljes will notice a mismatch of the modest surrounding hills and the excessive amount of fine sediment contained by the depression. Also, the desiccation cracks which are usually found at the lowest point of Cretan polje floors are lacking. A 2018 test coring 4.1 m down in the polje centre has not been able to reach down to polje sediments below the thick (allochthonous) silt layers on the top (see section 8). This cover layer is tentatively interpreted as evidence of a substantial, secondary filling-up of the original polje with aeolian (?) silt in sediment flushing. The upper boundary of the silt cover (- 0.1 to 0.8 m below surface) has a relatively low permeability and contributes to occasional "ponding" at the surface.

Vegetation. Nowadays two clusters of trees and shrubs grow inside the polje. After longer spells of rain grass starts to grow and to extend across one third of the polje surface in such a case (**Figure 5**).

Hydrology. Inlets: The polje depression surpasses the other small sediment-filled depressions on the karstic plateau (Research Area 2), not only in terms of size or volume. It also has no less than six inlets for the run-off from different directions (**Figure 2b**). Outlets: A small rock promontory has a gash (a cleft ca. 6 m long, 1.2 m wide and 3.5 m deep at the base), functioning as a drainage shaft (**Figure 6a**). The only other visible hydrological features are small, braided channels (ca. 0.4 m deep) on the surface in the inner part of the polje.

Puzzling during the 2018 test season has been the complete lack of water on the surface of the vast *ḥayl*[8] within only 1–2 days, after a longer spell of rain. Compared to H1 (**Figure 2b**), a small, dredged *ḥayl* near the road, with *terra rossa* no deeper than 2 m below the silt surface, has been able to hold surface water to the point of evaporation (for 15 days).

5. Rationale of The Masaryk University Sint Polje Project (Sipo)

Southern Oman has been recently characterized as "a land of total archaeological visibility, with few preserved sediments" (Rose et al, 2018) mainly due to a deflation (Edgell, 2006:297; Glennie, 2005; Wood, and Johnson, 1978). The wind-induced deficit of sediment causes a severe reduction of the heuristic possibilities of excavators at prehistoric open-air sites in the Arabian Peninsula[9].

Due to their concave, closed form, poljes constantly capture loose sediment from the karstic surrounding.

8 *Level portions of land (sediment) inside mountainous terrain would locally be called ḥayl, pl. ḥuyul (courtesy Dr. Abdullah Al-Ghafri of the Aflaj Research Unit, University of Nizwa).*

9 *"Most archaeological sites in the Arabian Peninsula cannot be correlated with past environments as they are known from surface contexts, where chronometric dates and ecological information is not recoverable." (Petraglia et al, 2012:2; analogous Delagnes et al, 2013:235).*

In the accumulating sediment package prehistoric human traces may become encased (Frumkin et al, 2015:49; Scott-Jackson, Scott-Jackson, and Rose, 2009:126). This process is, of course, far from linear. Colluvial, aeolian and drainage effects might cause secondary sediment reduction to a varying degree (palimpsests). In the long run, however, low-energy depositional processes in poljes (Siart, Ghilardi, and

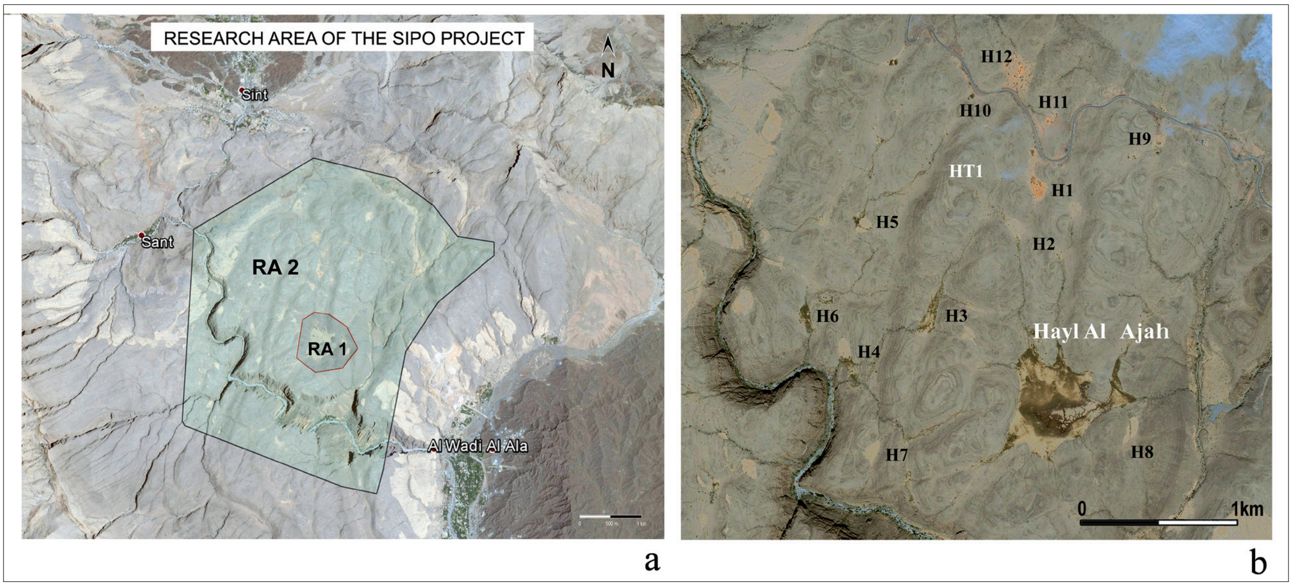


Figure 2: *a – SIPO Project Research Areas: RA 1 (polje) and RA 2 (karstic plateau). b – Small sediment filled depressions (H: ḥayl, pl. ḥuyul) around the polje Hayl Al Ajah and hill-top HT1.*

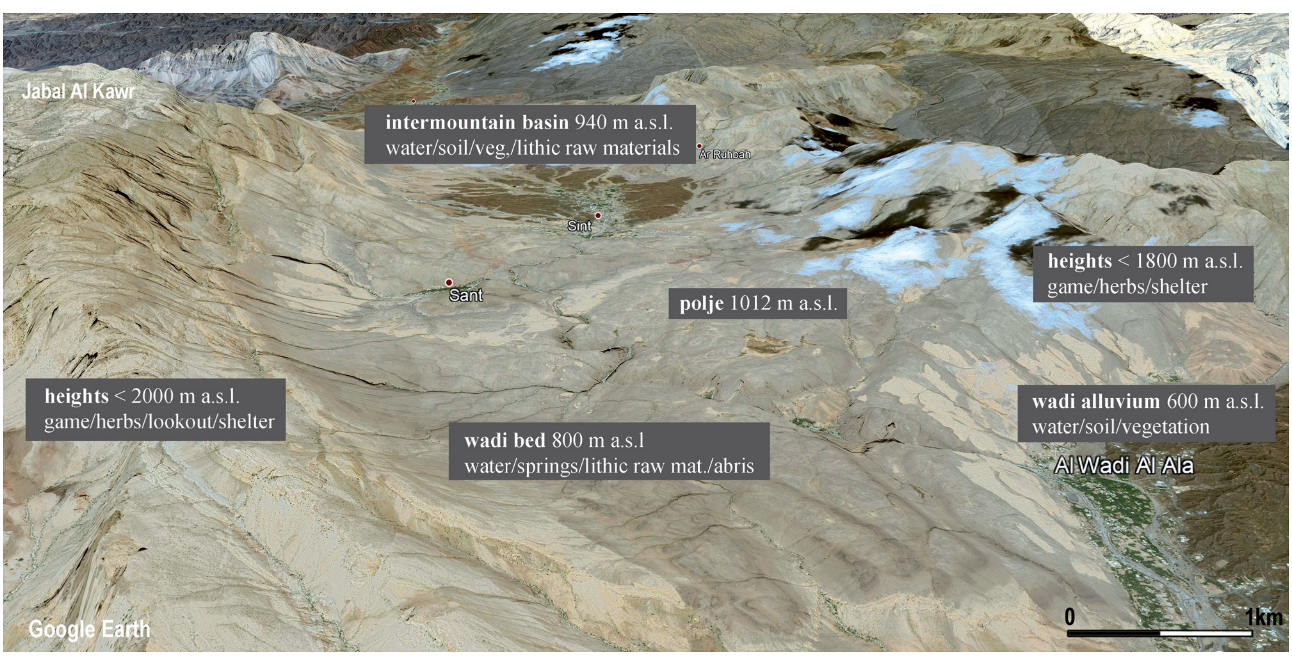


Figure 3: *Habitats around Hayl Al Ajah (radius 6 km). Hayl Al Ajah at the highest point of an intermountain corridor behind the Jabal Al-Kawr connecting two mountain oases. Wadi gorge (Sint–Sant–Al Wadi Al Ala).*

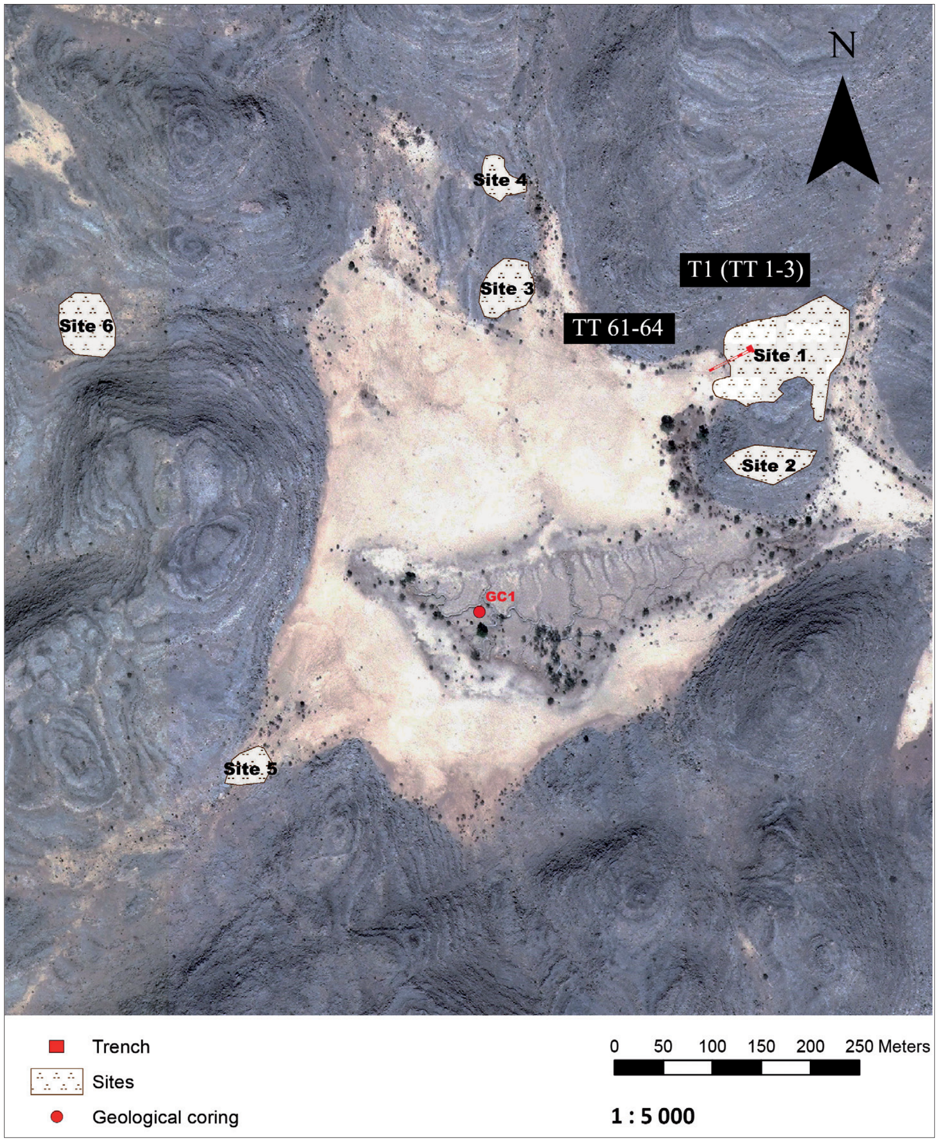


Figure 4: *Research Area 1 (polje): Sites 1 – 6 (lithic clusters). Site 1 (rock terrace): Transect (red line). Test coring GC1. Site 2 (promontory): Vertical drainage shaft (6.0 m long; 1.2 m wide; 3.5 m deep).*

Holzhauer, 2009) will have the effect of burying artefacts, rather than exposing them, setting poljes apart from any other kind of open-air prehistoric places in the Peninsula.[10]

Choosing a sediment-rich, palaeohydrological feature (polje) as a starting point for mountain-based research has field-archaeological advantages. The artefact-embedding soil remains and the potential geo-archive for palaeoclimatic and palaeoenvironmental proxies available at the open-air site allow one to apply a greater range of analytic methods, both in the field situation and in the laboratory.

10 *Scott-Jackson, Scott-Jackson, and Rose (2009:125) point to the fact that sites in karstic depressions or fissures in raised parts of a limestone landscape ("high-level sites") experience greater soil stabilization than sites at low-levels. Though all the taphonomic processes may be at work on high-level sites that cause palimpsests, and though they are not primary contexts, the authors state, Palaeolithic scatters at raised karstic places may be less scattered out, and they are "in a geomorphological sense, essentially in-situ" (ibid, p. 126).*

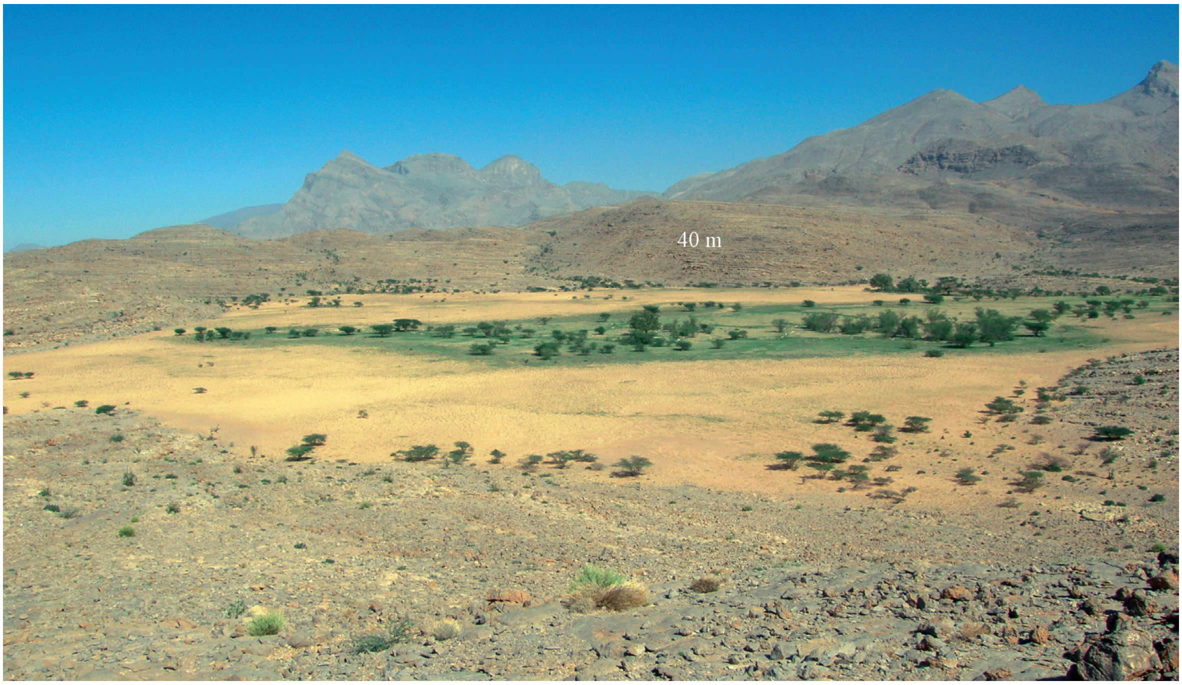


Figure 5: *Polje Hayl Al Ajah (RA 1). Low hills surrounding the polje and the level polje surface. Green spreading out in the zone of braided channels after late autumn rain. GC1 coring position (arrow). In the background, to the right: mountain flanks (source area of animal species).*

6. Main Task of Season 1 (2018)

Being able to draw only on scant information related to the archaeology of raised areas of inner Oman, the decision was made to perform field-archaeological tests during Season 1. The gist of the season's activities was to assess, by minimally invasive and effective means, the research potential of the polje Hayl Al Ajah[11]. The field activities at the polje during the test season were focused on three assessment goals:

Goal 1: Field-archaeological condition

Have prehistoric artefacts survived in a more contextualized, stratified and coherent way at the polje site?

Goal 2: Palaeohydrological situation

Has the polje had a (seasonal) lake or wetland during the more humid phases in the past?

Goal 3: Spatial function

What might have been the function of the polje at the high-point of an intermountain corridor for prehistoric people in the Al Ḥajar Mountains?

7. Assessing The Archaeological Potential (Goal 1)

On the denuded rock along the polje margin, six places with lithic scatters were identified (**Sites 1-6; Figure 4**). The most extensive lithic concentration was found to the northeast, on a rock surface adjacent to a small sinus of the polje fill, at a place flanked on one side by a hill slope, and by a low rock promontory on the other (**Site 1**).

7.1. Archaeological situation at Site 1

Surface lithics. On a moderately sloping surface of roughly 200 m^2, stone artefacts (most of them made

11 Overall duration of Test Season 1: 17 days (10 field days by a team of 4 pers.).

of red and yellowish radiolarite) were scattered on the deflated rock surface. The artefacts were usually very small (less than 25 mm) with a considerable degree of utilization and reutilization indicated by a high proportion of splintered pieces, *ad-hoc* flakes, reworked pieces and a predominance of tools. The most common tool types — besides splintered pieces — were end-scrapers, micro-drills and notched or denticulate pieces. Three bifacially shaped projectile point fragments were collected as well.

Sediment-embedded lithics. Some artefacts were found sticking inside a shallow sediment layer covering a part of the eroded rock terrace. Apparently, remains of prehistoric deposits had been kept in place by the cascading, slightly upward angled steps of the low limestone bedding planes (**Figure 6a**), which made the rock surface of Site 1 serrated. Within an interspace between rock cascades a cache-like feature (Feature A) was discovered that has escaped full erosion. Closer to the margin of the *polje* fill, the sediment pockets on the eroded terrace become increasingly wider and interconnected.

Hence, a ***64 m long transect*** (TT1 to TT64) has been laid out to tie in the sediment remains on the rock terrace with the peripheral sediment infill of the polje. At either end of the transect initially 2.0 x 0.5 m test trenches (afterwards enlarged) were set out (**Figure 6a**):

- Test Trench TT 1-3 (later: Trench T 1), 3.0 x 3.0 m; ca. 0.2 m deep sediment overlying the bedrock; *in-situ* Feature A.
- Test Trench TT 61-64, 3.0 x 1.5 m, lowered 0.9 m into the *polje* fill; *in-situ* Feature B.

7.2. Trench 1

Clearing a spot 30 m up the rock terrace of a thin desert pavement resulted in hitting an *in-situ* feature in the 12–15 cm of sediment overlying the bedrock (Feature A). T1 was excavated fully down to the rock bottom (**Figure 6b**)

Feature A (0.3 m in diameter) contained exclusively unipolar blade cores and pre-cores (n = 12) made of a good quality grey chert, that were tightly packed (**Figure 6b**). Accidental forming of the feature can be ruled out. The cache-like Feature A was embedded in a layer that contained a rich bladelet debitage, residual cores and some retouched tools (burins, end-scrapers, backed pieces, fine retouched bladelets and two fragments of bifacial shaped projectile points), lithics that correspond stylistically and by the raw material to the cores and pre-cores of Feature A (Mateiciucová et al, in press). The lithic assemblage in T1 was accompanied by splintered animal bones and three beads — two made of shell and one of stone.

Because of the similarity of the Feature A cores with artefacts in the surrounding cultural layer two interpretations are possible: a) as a lithic heap or a container deposited upon the living horizon buried by sudden sediment flow or b) as the base of a pit dug out to serve as a depot for heavier lithic items.

Important is the observation that the sediment-embedded lithic finds from the Trench 1 on the rock terrace radically differ (in raw material, and techno-typologically) from the chipped stone artefacts that are visible on the deflated surface.

7.3. Description of Test Trench TT 61-64

Test trench **TT 61-64** was intended as a quick sounding into the polje floor. After digging to a depth of 0.6 m, three layers (Loci 21, 22, 23) became discernible. The composition of the layers varied to a degree that indicated different (colluvial) events, with the flanking hill to the north as the likely contributor.

At 0.7 m below the surface, a sloping layer (Locus 24 b) of angular stones (size < 6 cm) was encountered fully superimposing an oblong pit (Feature B, ca. 1.2 m x 0.7 m). **Feature B** was easily distinguishable in the surrounding sediment (Locus 24 c) as an *in-situ* feature by a clear-cut rim, a bold dark-grey ashy fill (Locus 25) with larger-sized (< 10-16 cm) stones inside (**Figure 6c**).[12] Due to time

12 *Uerpmann, Uerpmann, and Jasim (2000:229) describe a flat stone midden at Buhais 18 as a pile of "fist-sized limestone cobbles, often cracked by fire, embedded in a grey-to-black matrix of ash and aeolian sand".*

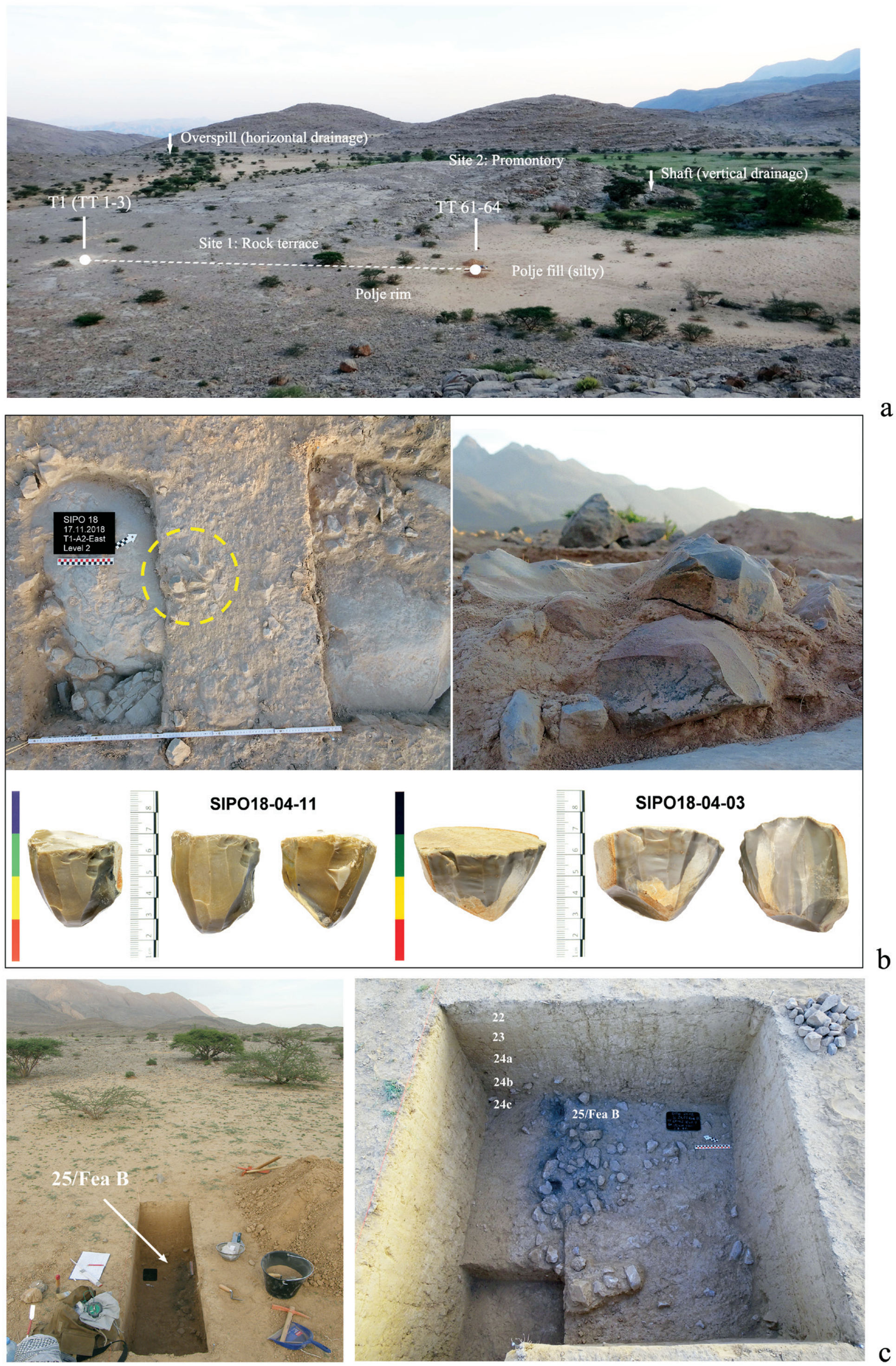


Figure 6: *Polje Hayl Al Ajah, Site 1. a – View from the adjacent hill-top. Transect (64 m long) linking the eroded rock rim with the peripheral polje fill. 2018 test trench positions. One of two tree clusters. In the background: overspill level only approx. 2 m above the polje level. b – Trench 1 (TT 1-3). In-situ feature on the rock terrace. Feature A, a cache of pre/cores (n = 12). c – Partly excavated Test Trench TT 61-64. Upper part of Feature B/ Locus 25 (80 cm b.s.). Layer of angular stones in the cross-section (= interface Locus 24b/24c). Dark spots along the original trench cross-section: sediment sampling spots.*

constraints Feature B could only be sampled. At the time the work ended, the dark fill inside the feature proved to be 8 cm thick, becoming darker with depth (bottom not yet reached). The fill material contained small pieces (clay?) of orange colour, black (mineral) particles, three snails, a dark-red ochre fragment of millimetre size, and three worn lithic artefacts. Despite two fire-related signs (bold, dark ashes; orange particles), charcoal or a thermally altered surface were missing. The stones did not appear to be cracked. At the present stage Feature B would rather fit the mould of a pit that has been filled with the refuse of a fire-installation somewhere else (implying re-use of the latter).

In terms of Goal 1, the test trenches of 2018 showed that the most important *criteria for a meaningful prehistoric project* were met at this site: (1) the depositional palimpsests inside and outside the polje of a kind that can be studied when using a meticulous excavation and documentation technique, and (2) well-defined prehistoric *in-situ* features can be found at better protected positions.

7.4. Tentative dating of the lithic artefacts

After a preliminary investigation of the lithics it is assumed that the lithic scatter on the surface (made mainly of radiolarite) with the bifacial retouched pieces belong to the **Middle Holocene**. Until now no parallels to the unidirectional blade cores and the sediment-embedded lithic assemblage from Trench 1 (made mainly of chert) have been found. We suppose, however, that they date to the terminal phase of the **Late Pleistocene (Upper Palaeolithic/Epipalaeolithic?)** rather than to the Holocene. The two fragments of bifacial retouched projectile points do not stylistically fit to the sediment-embedded assemblage and we assume that they are a later intrusion (Mateiciucová et al, in press). On the last day of the test season, a few artefacts manufactured in a Levallois tradition (**Middle Palaeolithic**) and made from trachybasalt and chert with a strong varnish were collected from the surface of the western part of the site.

8. Assessing The Depositional and Hydrological Situation During The Test Season 2018 (Goal 2)

Poljes are potential "geo-archives" as outlined above. The thickness of the layered sediment and its relative stability (low-energy sedimentation in closed depressions) have impelled researchers to attempt coring of polje fills in areas like Croatia (Balbo, 2006; Balbo, Komšo, and Miracle, 2009), northwestern Greece (Vött et al, 2009), southern Greece (Walsh et al, 2017) or Crete (Siart, Ghilardi, and Holzhauer, 2009). During Season 1 the Masaryk University team performed a test drill (**GC1**) in the central part of the polje (**Figures 4 and 5**) using a manual Eijkelkamp-type device. A series of 49 consecutive soil samples were collected down to a depth of 4.10 m.

The following five strata could be differentiated during the work in the field (Table 1).

Table. 1: *The* five strata differentiated during the work in the field

Stratum	Depth (cm b.s.)	Colour	Mechanical resistance
I	0–8	yellowish	very soft
II	8–85	dark-brown	hard
III	85–145	light-brown	very soft
IV	145–325	yellowish	very soft
V	325–410	light-pinkish	hard

Besides what was a dark-brown (clayey?) layer (**II**), the cored polje sediments were generally light-coloured, silt-dominated and soft down to a depth of 325 cm b.s. (**III + IV**). Below 325 cm b.s., the substrate abruptly became hard to penetrate. Eventually this pinkish, compact layer at the bottom (**V**) could be drilled for another 85 cm down to an overall depth of 410 cm b.s. (end of the test coring[13]).

Apart from **II** only gradual/minor colour transitions were observed across the entire profile. The fine texture of the samples and the lack of coarse sand and gravel suggested a low-energy deposition process at the centre of the *polje*. The ease of mechanical drilling in the centre implied a thick, soft stratum, different to the clay found in this part of other poljes, e.g., in northeastern Crete (Lasithi Prefecture) or at other places (Iacoviello, and Martini, 2013).

One of the key observations during the test season has been that silty sediment similar to the surface of the polje fill occurred at the top of the denuded hill HT1 (1.5 km NNW of the polje; 1064 m a.s.l., **Figure 2b**). The existence of the sediment on one of the highest points on the karstic plateau prompted the idea of a possibly aeolian origin of the similar silty sediment found at the centre of the polje Hayl Al Ajah.

8.1. Preliminary results of the laboratory analysis of the GC1 coring samples (polje centre)

The initial analyses of selected samples of the GC1 coring in the polje centre have been carried out in the Laboratory for Physical Geography, University of Cologne, Germany, including *grain-size distribution and total organic carbon (TOC)*. Grain-size distribution was measured using a Beckman Coulter LS 13 320 laser particle analyzer. Pre-treatment of samples includes air-drying, careful hand-pestling, dry-sieving at 2 mm, and the addition of H_2O_2 (30%) in order to remove organic carbon. After neutralization, 0.5N $Na_4P_2O_7$ (55.7 g l^{-1}) was added for dispersion. TOC was measured using ground sample material and a Vario EL Cube elemental analyser.

The laboratory analysis of GC1 indicates moderate texture variation and poor sorting in the entire sediment column (**Figures 7 and 8).** The highest amount of TOC and a relatively low mean grain size was found in Stratum **I** (0–8 cm b.s.). Stratum **II** (8–85 cm b.s.) and Stratum **III** (85 –145 cm b.s.) were slightly better sorted, with a smaller sand component and the lowest mean grain size of the entire profile. TOC is between 0.4–0.6%. The clay content only varies between 7 and 10% in the entire profile. The fine texture and better sorting may point to temporary standing water and distal sheet flows, but coarse silts to fine sand representing 30–40% in total also relate to a significant aeolian component. Stratum **IV** (145–325 cm b.s.), however, is clearly coarser with sand reaching up to 20% and two samples even containing clasts >2 mm (up to 8%). TOC is significantly lower in this stratum, compared to strata **I–III**. These values may indicate stronger aeolian sedimentation and more erratic sheet floods, but a reduced time of standing water. The compact Stratum **V** (325–410 cm b.s.) is characterized by a reversal to finer sediment, even though it is coarser and more poorly sorted than strata **I–III** and shows a small gravel component in one sample. TOC values are lowest of the entire profile.

The sediment deposition in the central part of the polje seems to result from a combination of processes, i.e. from the bedload of sheet floods, suspension of limited time windows of ponding, and aeolian sedimentation. Strata **II** and **III** seem to reflect the highest amount of sediment resulting from sheet floods and ponding. Whether this can be confirmed, whether soil formation plays a role and also the time scale associated with the sequence of GC1, will be subject to a future multi-proxy sediment analysis.

Translucent heavy fraction analyses as well as *microfossil analyses* of two samples (Sample 23, 203 cm b.s. and Sample 47, 395 cm b.s.) have been carried out by the Czech Geological Survey,

13 *Courtesy of the group of archaeologists of Oman led by Mr. Khamis Al-Asmi, MHC Muscat, who helped with the deepest coring at Hayl Al- Āja (Sample 49, Nov. 27th 2018) before closing the field excavation.*

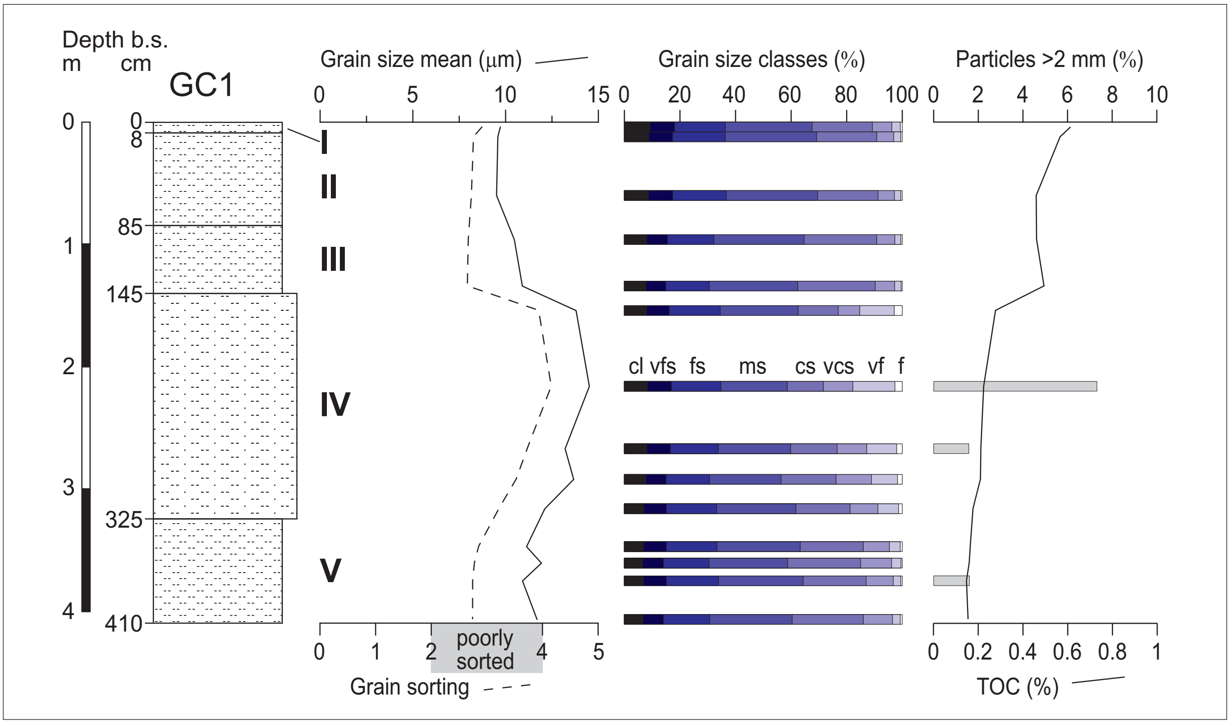


Figure 7: *Core log of GC 1 with sedimentary data (abbreviations: cl=clay, vfs=very fine silt, fs=fine silt, ms=medium silt, cs=coarse silt, vcs=very coarse silt, vf=very fine sand, f=fine sand).*

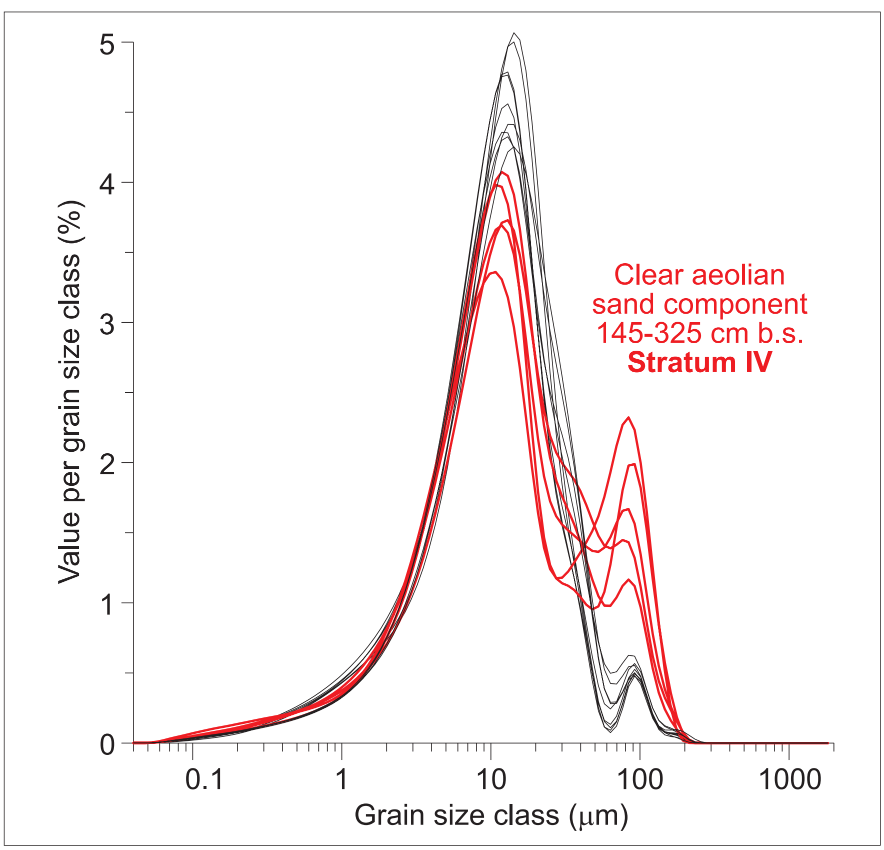


Figure 8: *Grain size distributions of samples from GC 1 (black: strata I–III, V; red: Stratum IV).*

Brno, Czech Republic. Samples for the translucent heavy fraction analysis were washed and sieved to fraction 0,06-0,25 mm. Later on, after drying, they were separated in heavy liquid LST (specific weight = 2,96 g/cm^3). The first step of evaluation was a general counting of ratios of translucent heavy minerals, opaque minerals, light and dark micas. The main counting was done on the assemblage of translucent heavy minerals, because of the highest possible provenance information. Identification and counting of minerals were done via the polarizing microscope Amplival, Karl Zeiss, in the laboratories of the Czech Geological Survey (Brno). Ca. 400 – 500 grains were counted for each sample. The results are evaluated in modal %, i.e. the number of grains without relation to their size or weight.

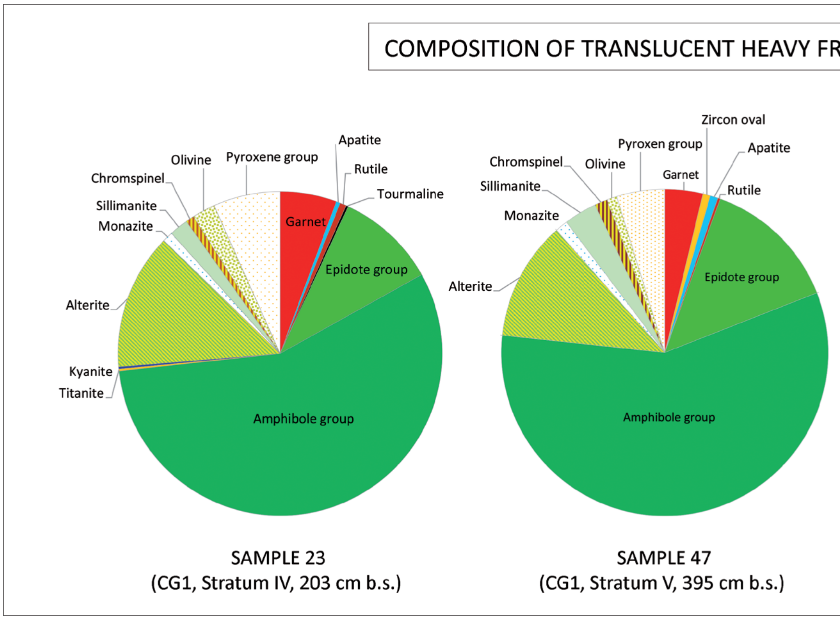
According to the Brno analysis for the assemblage of translucent heavy minerals of two sediment samples from GC1 (**Figure 9**), one at a depth of 203 cm b.s. (Sample 23/Stratum **IV**) and one at a depth of 395 cm b.s. (Sample 47/Stratum **V**), the source rocks are as follows: a) Both samples reflect as a main source the bodies of mafic and ultramafic rocks (amphibolites, peridotites) which are widespread in all directions in wider vicinity of the polje. b) There are no visible differences in qualitative and quantitative compositions between samples from Stratum **IV** (203 cm b.s.) and Stratum V (395 cm b.s.).[14] c) The proportion from other sources is relatively small (garnets and sillimanites from metamorphic rocks).

The results of the translucent heavy mineral analyses confirm that the mineral assemblage is not produced by the surrounding Triassic carbonates and may point to a dominant aeolian origin. Their rhythmic stratification probably reflects seasonal and/or episodic intervals of higher precipitations or floods.

For the *microfossil analysis* two samples were selected: Sample 23 from the middle of the soft Stratum **IV** (203 cm b.s.) and Sample 47 from the hard Stratum **V** (395 cm b.s.). The samples were washed in tap water on a 0.063 mm sieve and then dried. The microfossils were taken from a picking tray under a binocular microscope. The microfossil content of both samples is similar and can be characterized as a mixture of foraminifers, ostracods, and less frequently radiolarians, sponge spicules and echinoid spines from various sources, mostly worn by maritime wave action and/or wind transport. The microfossils came apparently from various palaeohabitats and stratigraphic levels. Abundant rotaliid, miliolid, buliminid foraminifers, ostracods and echinoids indicate a near-shore normal marine setting, the planktonic foraminifera point to open marine surface waters and the radiolarians to deep-sea oceanic sediments (perhaps from pelagic limestones). Most of the foraminifers are approximately Miocene in age (*Ammonia* sp., *Pseudotriloculina* cf. *consobrina*, *Bolivina* spp., *Elphidium* spp., Planulinoides sp.) or even Plio-Pleistocene (*Bulimina marginata*). The planktonic foraminifers come from Upper Cretaceous sediments (*Spiroplecta americana, Guembelitria cenomana*) and from the late Aptian (*Blowiella duboisi, Globigerinelloides maridalensis*). Considering the fact that area surrounding the polje Hayl Al Ajah is built of Triassic limestones and dolomites, the microfossils are not local (probably aeolian origin). Only the radiolarians may be weathered off the limestones (not studied in detail). Rotaliid and miliolid foraminifers, ostracodes and echinoid spines are reported also from aeolianites of the Wahiba dunes and Goudie et al. (1987) assumed a coastal origin. The large inland areas of Oligo-Miocene sediments south-west of the locality should be taken into account also as a possible source. Sources of Lower and Upper Cretaceous foraminifers can perhaps be found in the mountain area of northeastern Oman.

The outcome of the preliminary laboratory analyses seems to support the assumption that the sediment of the first 4 m below the surface at the polje centre (strata **I–V**) is mostly silty, allochthonous and wind-related. The potentially lacustrine to palustrine layer of the Stratum **II** could have formed in a shallow position on top of the slightly coarser, medium to coarse silt-dominated Stratum **III**. Standing water and fine suspension load settling

14 *During the drilling Stratum IV was perceived as very soft, Stratum V as much harder.*



Mineral	number	%	number	%
Garnet	27	5,6	15	3,8
Zircon idiomorphic	0	0,0	0	0,0
Zircon oval	0	0,0	3	0,8
Apatite	2	0,4	3	0,8
Rutile	3	0,6	1	0,3
Tourmaline	1	0,2	0	0,0
Epidote group	48	10,0	54	13,5
Staurolite	0	0,0	0	0,0
Amphibole group	270	56,4	230	57,6
Titanite	1	0,2	0	0,0
Kyanite	1	0,2	0	0,0
Alterite	65	13,6	47	11,8
Andalusite	0	0,0	0	0,0
Monazite	5	1,0	5	1,3
Sillimanite	9	1,9	13	3,3
Chromspinel	4	0,8	5	1,3
Olivine	11	2,3	4	1,0
Pyroxene group	32	6,7	19	4,8
Total	**479**	**100,0**	**399**	**100,0**

Figure 9: *Composition of translucent heavy minerals of two coring samples from GC1.*

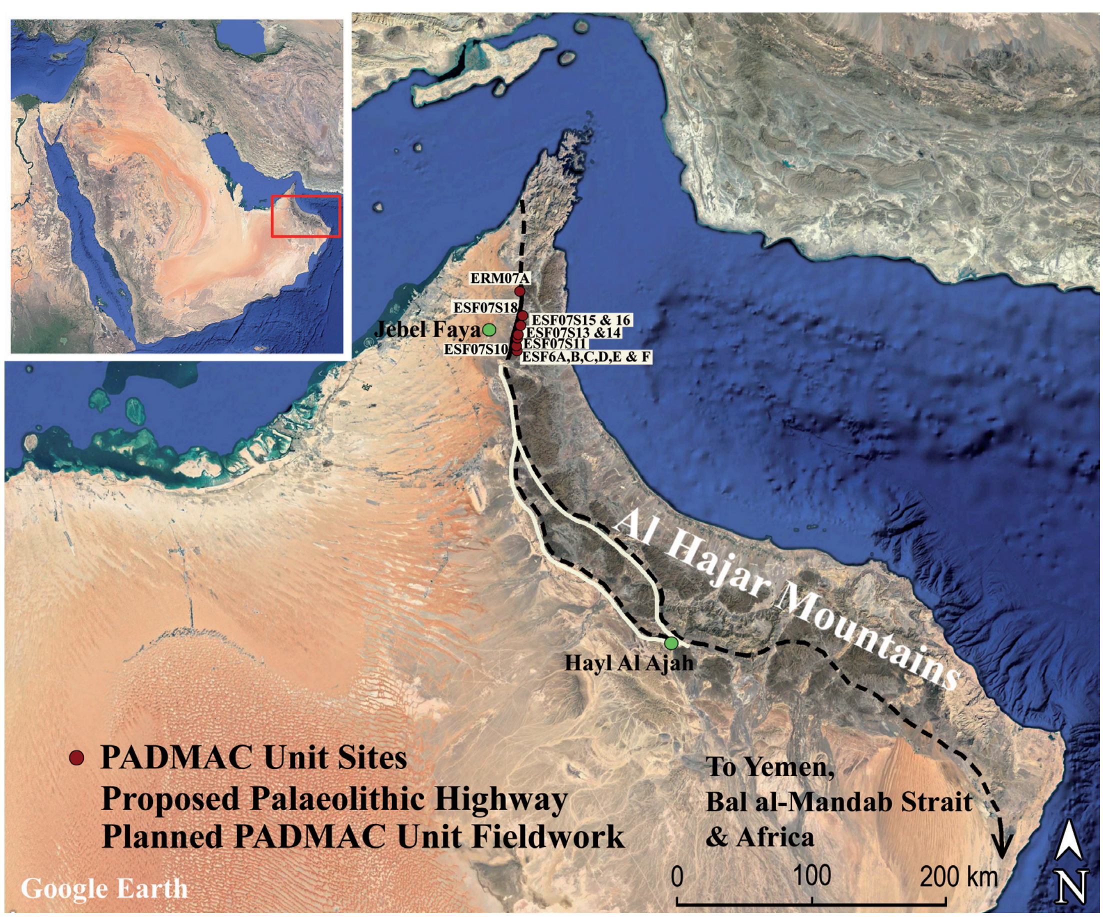


Figure 10: *PADMAC Unit: Palaeolithic Highway Concept. A string of Palaeolithic stations with the same site characteristics/UAE with the trajectory of intermountain corridors (modified after Scott-Jackson et al, 2009; Scott-Jackson, and Scott-Jackson 2013: Fig. 1).*

may have reinforced the water retention of the polje and the establishment of palustrine and short-term lacustrine conditions (cf. Bartels, 1991:31-34,37; Veress et al, 2015).

8.2. Hydrological situation

The drilled silty layers are obviously permeable. Only the dark-coloured Stratum **II** close to the surface is able to hold back run-off to the extent that water becomes visible in the braided, shallow channel system in the centre of the polje for a short while.

A crucial hydrological observation is that at under certain conditions *a horizontal flow on the surface* can occur. The reason is that the level of the polje fill reaches to within 2 m of the overspill-height of the enclosing rock, at a place ca. 200 m east (**Figure 6a**). Judging from traces found at the surface, the runoff entering the polje from several directions simultaneously during heavy rains (flash-flooding?) causes a transient outflow across the rim of the polje, down to the bottom of the adjacent gorge (**Figure 2**). With the height of the polje floor being almost the same as that of the overspill, the accommodation space of the polje is practically filled. Any further amount of sediment will be flushed out of the polje in the event of heavy rain.[15]

ASSESSING THE SPATIAL FUNCTION OF THE INTERMOUNTAIN SITE (GOAL 3)

For reasons of topography and the presumed exploitative practice[16], we can rule out that the landscape feature escaped the attention of prehistoric people roaming the southern front of the Al-Ḥajar Mountain Range. Lézine et al. (2010:427) suggest that "*small human groups, splitting or merging according to the season and the quantity of available resources followed lines of freshwater points (temporary water courses and fluctuating lake shores)*" for the period 8.000 BP. The behaviour is perhaps replicating a long-standing pattern of a grid of resource areas in the Arabian Peninsula, accessed by small-sized foraging groups possessing a range of extractive skills.

Some of the motives of the prehistoric individual(s), that hoarded the artefacts in Feature A, may be inferred. The cache served the safekeeping of lithics too heavy to be carried along and too valuable to be left unattended ("possession", "temporal abandonment"). The cached objects would serve the making of stone tools on the spot ("longer stay"). The caching of the (pre-)cores would serve a local use ("strategic-extractive") in an act of longer provision ("revisiting"). The (pre-)core cache found at Site 1 in a way represents *resident storage* "telescoped" to the smallest scale.

The polje Hayl Al Ajah has a strategic position on the high point of an intermountain corridor near the landmark Jabal Al-Kawr (**Figure 3**). Due to a combination of landscape features (sheltered topography, vistas, surface water, vegetation[17], mountain game) and its threshold position to routes and habitats within a radius of 6 km (Wadi Alluvium; mountain slopes; piedmont oases; mountain oases; mountain ridges), the polje presumably served as a "stopover site" in the mountains. The conditions, no doubt, would have supported prehistoric activities of extraction and mobility directed towards habitats as well as resources in the vicinity. Conducive to the view of the spatial function has been the observation during the test season that the intermountain place is visited by a number of people using ancient trails[18], that lead to the polje from multiple directions, and it could be considered a hub.

15 *If sediment flushing (silt?) into the polje should have happened in the past via the multiple inlets, at a time when the polje floor was still lower, then the sediment volume inside the polje could have increased quickly (our working hypothesis).*

16 *Cf. the alleged resource exploitation of Middle Palaeolithic hominins at Jubbah Palaeolake, Nefud Desert, Northern Arabia (Petraglia et al, 2012:16)*

17 *For the broad range of plants at high-elevation lacustrine sites in Yemen, refer to the palynological data of Lézine et al. (2010) from the 7th mill. B.C. On the botany of high-elevation places in the Al-Jabal Al-Akhḍar (recent mountain oases): Gebauer et al. (2007).*

18 *Before the times of tarmac, a dromedary path from Sint to Bahla seems to have led right through the Hayl Al Ajah, and the beasts of burden under way were allowed grazing in the polje (courtesy M.M.H., an elder of the Sint Community).*

THE SIGNIFICANCE OF HIGH-ELEVATION SITES IN THE CONTEXT OF CONTEMPORARY PREHISTORIC RESEARCH IN OMAN

Palaeohydrological features (Breeze et al, 2016) were instrumental in the emergence in the paradigm shift towards a more hospitable interior of the landmass (e.g. Crassard et al, 2019; Petraglia, Breeze, and Groucutt, 2019). The dynamic natural milieu of Arabia, however, meant that phases of greater expansion, influx and contact of prehistoric people (humid climate phases) were followed by arid phases which forced a withdrawal from the interior during aridization, towards the coastal margin [19]. Due to the specific orography of the Peninsula, a de-peopling of the interior ("*refugium effect*", Crassard, 2009; Crassard, and Drechsler, 2013) resulted in a *migration towards the relief of mountains* in several parts of the Peninsula, implying a moving "up the drainage".

An ascent counter to the waterflow, to places of greater height, can serve a thermoregulatory purpose with respect to subsistence requirements. This is shown by the ethnography of seasonal pastoral nomadism (Barth, 1961; Hole, 1978). Finding lithic artefacts at the raised site in the Al-Jabal Al-Akhḍar which techno-typologically belong to periods with intense arid phases (Late Pleistocene and Middle Holocene; Mateiciucová et al, in press), we assume that the same altitudinal effect has played a role in coping with aridization by prehistoric human populations in the Arabian Peninsula.

Prehistoric communities in the Arabian Peninsula apparently managed to stay inland only via exploiting *two or more contrastive habitats*. Moving in higher terrain can put this into effect (Moran, 2016:158) most easily:

- Relatively short moves in steep terrain give access to differing atmospheric conditions and biota (vertical zonation; Veteto, 2010).
- Mountain topography particularly tends to create a multitude of varied habitats ("*complex nested mosaics of habitat conditions*", Haslett, 1997:3).

19 *Towards "stable refugia during environmental downturns" (Parker, and Rose, 2008:35).*

The Neolithic site of Jabal Al-Buhais in the Western Al-Ḥajar Mountains (Jasim, 2012; Uerpmann, Uerpmann, and Jasim, 2000) can illustrate the principle for the Holocene. The herders of the 5th mill. B.C. apparently occupied the main (burial) site of Buhais 18 in spring, when the run-off of foothills contributed to a high water table and supplied the foot plain with green pastures (*below 200 m a.s.l.*). In winter the pastoralists are thought to have moved to places on the coast (*near sea level*). Since the culling of young ovicaprids has obviously not taken place at Buhais 18, the excavators call in a third site — thereby bringing in a vital element of mountains (verticality) into the binary combination of inland–coast mobility:

"*It is plausible, therefore, to postulate at least one further area inhabited during a major part of the yearly cycle. This may have been the higher elevations of the Al Hajar Mountains, where pastures would have been available in summer, and where the high temperatures of that season would have been bearable*" (Uerpmann, Uerpmann, and Jasim, 2000:232).

Moving along a gradient connecting different ecological zones would have allowed humans of the past to stay within the range of acceptable physiological parameters (as defined in Moran, 2008) and to stick to their way of subsistence partly also in the face of tangible climate change. The adaptive value of altitudinal mobility surely deserves to be acknowledged also for foraging prehistoric groups in the Al-Ḥajar Mountains antedating institutionalized pastoralism.[20]

STRUCTURING HIGH-ELEVATION PREHISTORIC RESEARCH IN OMAN

Finally, a trial is being made to identify a conceptual baseline suited for research at *high-elevation* places inside the Al-Ḥajar Mountains.

Prehistoric research at high elevation inside the Al-Jabal Al-Akhḍar could instantly use the "Palaeolithic

20 *Recent evidence of a more sustained residence at great height in Ethiopia, at Ficha Habera rock shelter; 3469 m a.s.l., during the period 47–31 ka BP/MIS 3 (Ossendorf et al, 2019).*

Highway" concept which was developed by the PADMAC Unit (Oxford) for Palaeolithic sites at the western end of the Al-Ḥajar Mountains (Scott-Jackson, and Scott-Jackson, 2013).

In our opinion, research by the PADMAC Unit has performed a major feat of anticipation, with regards to: (1) the importance of *serial prehistoric stations* close to the front of the Al-Ḥajar Mountain Range (Scott-Jackson, Scott-Jackson, and Rose, 2009), (2) the relevance of *mobility corridors inside the Al-Ḥajar Mountains* (Scott-Jackson, and Scott-Jackson, 2013) and (3) the special relevance of prehistoric sediment depositions at (*karstic) high-level sites* (Scott-Jackson et al, 2008; Scott-Jackson, Scott-Jackson, and Rose, 2009:125f).

The Palaeolithic Highway hypothesis predicts the existence of a string of Middle Palaeolithic stations with roughly the same site characteristics, from the western reaches of the Al-Ḥajar Mountains to the Al-Jabal Al-Akhḍar of Oman (**Figure 10**).

The attributes of the PADMAC sites in the Emirates of Sharjah and Ra's Al- Khaimah[21] — *close to lithic sources, wadis and small caves or abris, a presence of game and good vistas over alluvial plains (and, potentially lakes)* — match the Hayl Al Ajah site parameters (including Middle Palaeolithic occupation – see section 7.4.) remarkably well. This gives support to Scott-Jackson and Scott-Jackson's (2013) idea of a "mould of resource anticipation" — that is, intent — of those prehistoric groups that turned to, and gradually explored, the Al-Ḥajar Mountains.

IN CONCLUSION

A first test in Season 2018 has confirmed the archaeological and sedimentological potential of the karstic polje Hayl Al Ajah for intermountain prehistoric research in the Al-Jabal Al-Akhḍar region (Northern Oman). The evidence of human occupation at the site at 1012 m a.s.l. during the Late Pleistocene and Middle Holocene and the finding of *in-situ* human occupation (Mateiciucová et al, in press), together with the option to obtain palaeoenvironmental proxies from the sediment inside the polje, justify further systematic research at this raised karstic site.

21 *Tentatively assumed also for Jebel Faya, see Bretzke, Yousif, and Jasim (2018:31).*

ACKNOWLEDGEMENT

Throughout our three stays, from the entry into Oman till moments before we left, Omani from all walks of life have assisted us with the same dignity, understanding, interest and resolve instilled by the enlightened example of the late Sultan Qaboos bin Said al Said.

We are grateful to the Ministry of Heritage and Culture of the Sultanate Oman for permissions and support during our research. In particular we would like to thank His Excellency Undersecretary for Heritage Affairs Shaykh Salim bin Mohamed Al Mahrouqi, Director General for Archaeology and Museums Mr. Sultan bin Sayf Al-Bakri, and the Director of Excavations and Archaeological Studies, Mr. Khamis Al-Asmi. If new archaeological results materialize inside the Al-Ḥajar Mountains, it will be their merit.

For patient care we owe thanks to Ms. Sumaya Al-Mamari, Ms. Shaikha Kh. Al-Rasbi, and Mr. Mohammed Al-Waili. Mr. Sulaiman Al-Jabri, MHC (Bat) representative at our site, motivates us, with his genuine interest in archaeology and resourcefulness. Deep commitment to science we have found in SQU's Dr. Rahma al Mahrooqi (D.V.Ch. P.S. & R.), Prof. Khalifa Al-Jabri (Dept. of Civil and Architectural Engineering), Dr. Khaled Douglas (Head of Dept. of Archaeology), Dr. Nasser Said Al-Jahwari (Chief Ed. JOS, ibid.), and at Nizwa University Dr. Abdullah Saif Al-Ghafri and Dr. Dennis Powers (Al Aflaj Research Unit).

Mr. Jiří Slavík**,** the Czech Ambassador to the UAE (formerly Saudi Arabia) has been a man of the first hour. Roman Garba and Mansoor Al-Shabibi have been instrumental in getting the logistics and research permit underway. We are very grateful to Goesta Hoffmann (University of Bonn), who made available to us his field coring-equipment in Muscat. For suggestions and positive feedback, we thank our colleagues M. Beech, R.

Crassard, Y. Hilbert, K. Bretzke, D. Pickwood, M. P. Maiorano, E. Olijdam, U. Ochs and C. Schmidt. R. Loretto, University of Naples, would always share with us his professionalism in leading a field-archaeological mission in Oman. We are grateful to all team members: Denis Štefanisko (Ph.D. student Brno), Gerhard Trnka (University of Vienna) and Thomas Goetzelt (Berlin) and our committed students: Anna-Marie Ourodová and Ján Marko. Anna Chytilová (Spálov, Czech Republic), 14, has performed admirably as a chaperone for our child, and as a young ethnographer and medic. In Sint we received a warm welcome by teacher Saif Mohanna Al-Hinei, the elder Mohammad Ibn Mohanna Al-Hinei and the family of Khalifa Hammad Mohanna Al-Hinei. Kristýna Štorková and her family in Athaiba have become altruistic supporters of the Czech research project, at all levels.

For enabling the 2018 archaeological testing at the Hayl Al Ajah, we owe gratitude to the Department of Classical Studies at the Faculty of Arts of Masaryk University (Brno, Czech Republic) under its director, Irena Radová.

The realization of the project would not have been possible without the support from the Alexander von Humboldt Fellowship (2015-18) and the encouraging atmosphere at the Freie Universitaet Berlin/Institute for Near Eastern Archaeology.

The authors wish to thank the two anonymous reviewers who have made useful comments on an earlier draft of the article. For English language correction and proofreading we are very grateful to Alasdair Whittle.

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