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Wadi Shab (GAS-1, Oman): the Neolithic (4th/3rd mill. BC) cemetery and the settlement

Olivia Munoz and Donatella Usai

Abstract

Although heavily eroded and disturbed, Wadi Shab-GAS1 produced relevant evidence of a 4th and 3rd millennium BC prehistoric occupation. Packed in less than forty centimetres anthropogenic deposit, well-preserved stone structures, including huts and fireplaces, and a small group of burials, the site has provided a possibility to infer on the exploitation of a rich eco-system located on the north-eastern coast of Oman, near a permanent source of freshwater and close to key resources, by a prehistoric population of fishers living on a cliff facing the sea.

Introduction

Located north-west of Sur, on a cliff on the northeastern Oman Coast (**Figure 1**), and known since the early eighties (TOSI 1983), Wadi Shab GAS1 is a 4th/3rd millennium BC site whose investigation has been part of the Joint Hadd Project (TOSI and USAI 2003; GAULTIER *et al.* 2005; USAI 2006). After a brief exploration in 1992 by Paolo BIAGI (1994; 2004: 39), four field seasons were carried out at Wadi Shab GAS1, from 2001 to 2003 and a last one in 2005.

While badly affected, after its discovery, by road paving and house constructions, the site produced relevant data concerning the Middle Holocene human occupation of the area with structures relating to a settlement and a small group of burials. A first 5x5 m area was explored in 2001 (Area 1; TOSI and USAI 2003) and a northern extension opened in 2002 whose exploration was finished in 2003 (Area 100; GAULTIER *et al.* 2005); a further and last field season was forwarded at the site in 2005 (USAI 2006) when other 50 m² were excavated to the north-west of the Area1/Area100 (**Figure 2**).

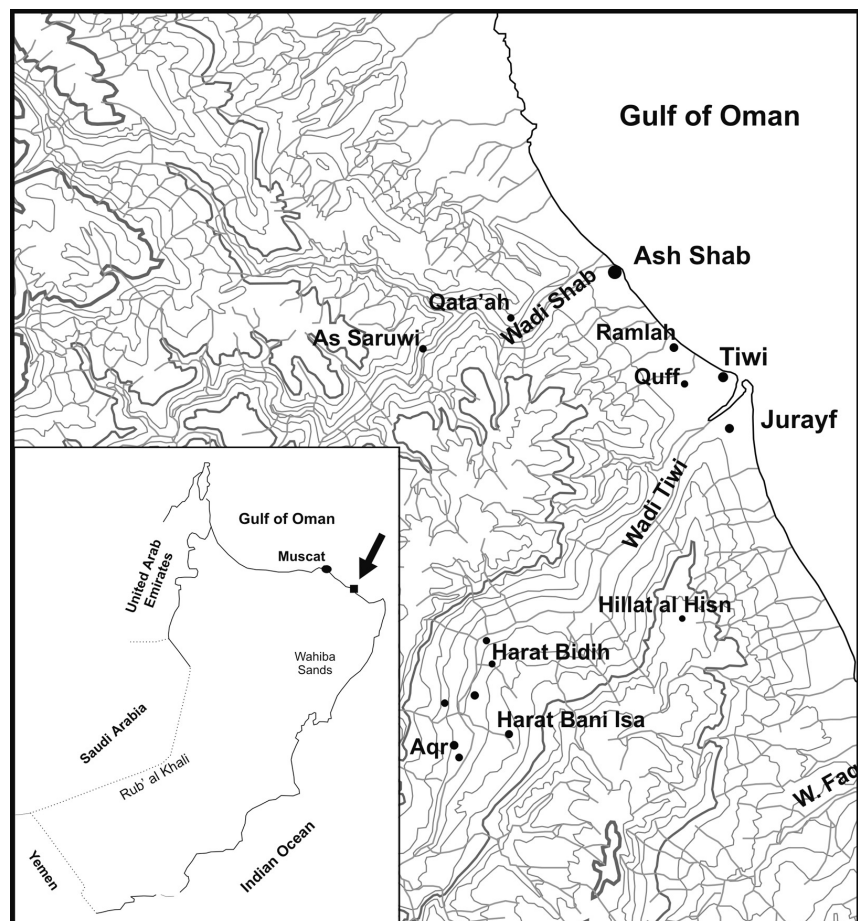


Figure 1: Map of the area.

Additional operations were made in the southern part of the site, corresponding more or less to the southern limit of the cliff, where some burials and another stone structure were noticed, brought to light by erosion. While the settlement structures located in the 2005 fieldseason (**Figure 3**) have been already the subject of a publication (USAI 2006; USAI and CAVALLARI 2008), this report will mainly concentrate on the description of the graves' group excavated in the southern part of the site, to provide a complete picture of the burial record. For the description of the first group of graves excavated in 2003 we refer to GAULTIER *et al.* (2005), but a summary of the main characteristics of all the graves is presented in **Table 2**. The anthropological close examination, instead, as well as the synthesis on funerary practices, concerns all the burials.

The burial phase and the settlements': the sequence.

Excluding the Islamic evidence identified almost on the surface of Wadi Shab GAS1 site (**Figure 3**), constituted by the foundation of two orthogonal walls associated to wheel-made and hand-made pottery (**Figure 4**) and vitreous materials, the best preserved settlement traces located at the sites were recovered under a deflational deposit made of small to medium size rubble and archaeological artefacts. They are made by circular stone structures with post-holes and associated fireplaces whose floors were paved by polygonal fire-cracked stones (USAI 2006). A sample of charcoal from one of this fireplaces provided a date in the 3rd millennium BC (**Table 1**, Beta-206089). Among the artefacts associated to this phase worth mentioning are the numerous fragments of copper (?) objects, quite few ascribable to anything definite except for a hook, and a steatite bead production that is similar to that of Ra's al-Hadd HD6 (ZAROS 2004), a site also dating at nearly the same period (CLEUZIQU and TOSI 2007). The burial phase recorded at the site, according to stratigraphic observations, should precede this 3rd millennium BC settlement phase and post-date another settlement phase producing more ephemeral structures, like wind-shelter (TOSI and USAI 2003: Fig. 3.b). Among artefacts associated to this phase are softstone jewels, earrings and beads (Tosi and Usai 2003), also in an unfinished stage that suggests that Wadi Shab GAS1 was a manufacturing place (**Figures 5 and 6**; Usai 2018).

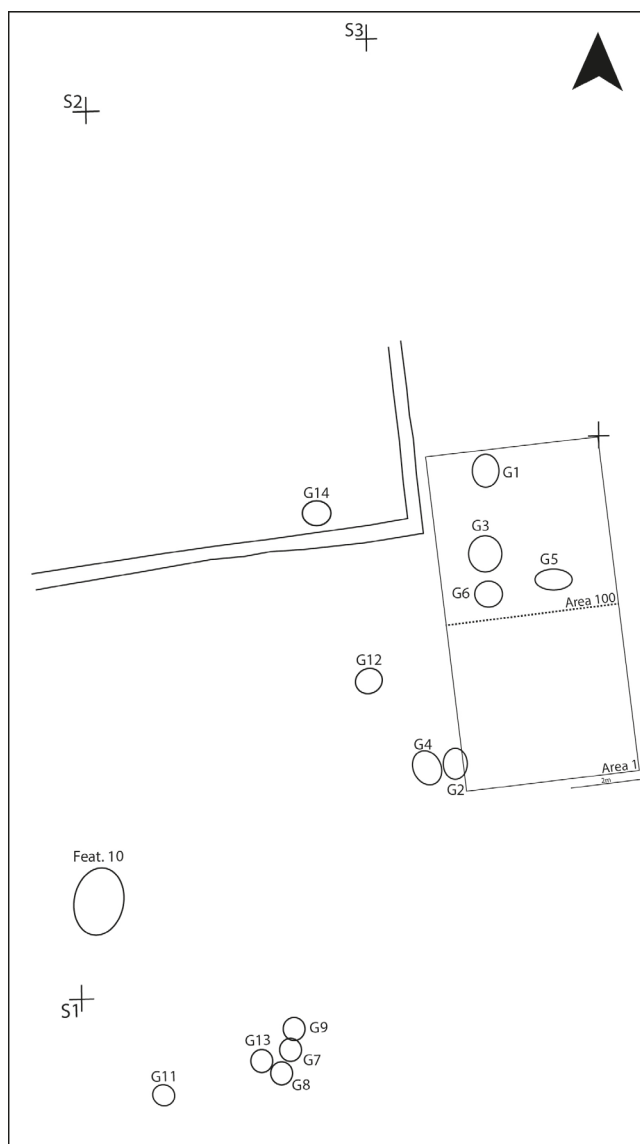


Figure 2. Distribution of the main areas and features recorded at Wadi Shab GAS1.

Table 1. Dates available for site Wadi Shab-GAS1. Calibrated with Calib7.0.4 software, with IntCal13 curve* and Marine13 curve**, with $\Delta R=215\pm 15$ (SALIÈGE *et al.* 2005) and considering 0-100% marine input into the diet (see MUNOZ 2014 : 39-40 for more details)

Context	Material	Lab. No.	Date bp	Cal. BC 1 σ	Cal. BC 2 σ
Unknown	Sediment	GX-17881	5127 \pm 80	4030-3800*	4220-3710*
Grave 4/fill	Charcoal	Beta-201729	4860 \pm 70	3710-3530*	3800-3530*
US114	Charcoal	Beta-206089	4070 \pm 60	2850-2490*	2870-2470*
Grave 3/individ. A	Enamel	AA-90259/P-974	5046 \pm 38	3940-3110**	3960-3040**
Grave 2	Bioapatite	SacA-11377	5070 \pm 30	3940-3140**	3950-3090**

The most ancient structures recovered at the site were incising into the limestone bedrock of the cliff, likely similar to those identified at Ra's al-Hamra RH5 by P. Biagi (BIAGI and SALVATORI 1986; MARCUCCI *et al.* 2011). Typical of other sites along the Oman and Gulf coast (CHARPENTIER 1998; MÉRY *et al.* 2008; MÉRY and CHARPENTIER 2013) shell hooks, finished and in different stages of manufacture, net-sinkers, and an interesting lithic industry were recovered in all phases and also in some burials (USAI and CAVALLARI 2008). Unfortunately, the faunal remains, within which fish is prominent, were never studied in detail although preliminary observations confirm the presence also of ovicaprines (TOSI and USAI 2003).

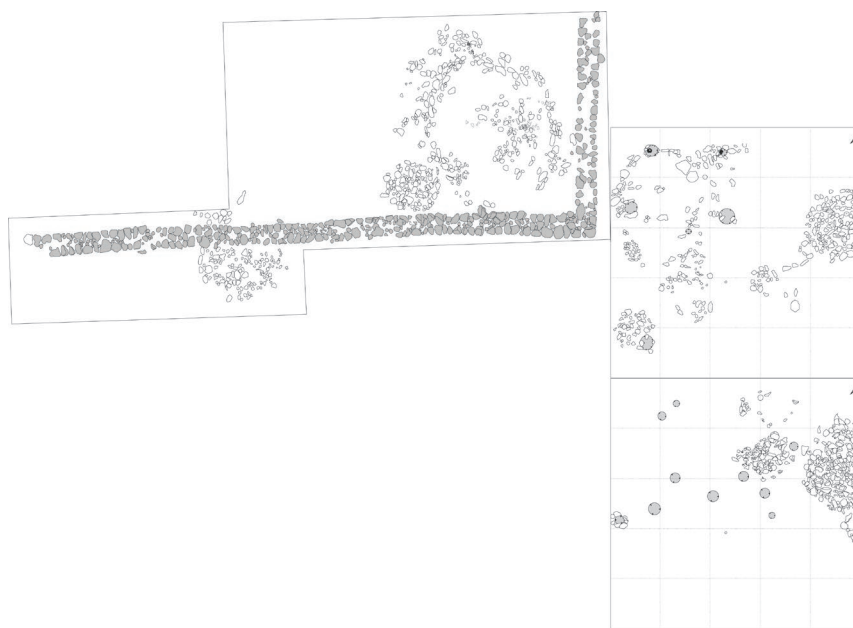


Figure 3. Islamic walls (dark grey) and 3rd millennium BC structures at Wadi Shab GAS1.

The burial phase

The first batch of graves were discovered at Wadi Shab GAS1 during 2002 and 2003 field seasons and a detailed report is provided in GAULTIER *et al.* (2005). These were seven graves, located most of them (except Grave 7) inside or close to Area 1/100 (Figure 2). It is in this context that it was possible to document the stratigraphic relationship between the burial and the settlement phases, placing the first chronologically as ante-dating the 3rd millennium BC structures. Conversely, it was not possible to figure out any relationship with the archaeological deposits for some of the graves excavated in 2005 in the southern part of the site, including Grave 7 that was the first of this group to be documented in the end of 2003 field season. These graves were emerging on the sloping part of the cliff and while some of them were still in good preservation condition, probably due to the elaborated covering stone superstructure, some were rather badly preserved. The typology of the graves however suggests their possible contemporaneity to the others.

Among the six graves excavated in the 2005 field season two, Grave 12 and 14, were located near Area 1/100 and the Islamic walls, not far from the first group (Figure 2). Altogether seven individuals were recovered in these graves.

A stone structure, originally also supposed to be a grave and therefore labelled Grave 10, turned out to have a different function, not yet fully understood (Figure 7).

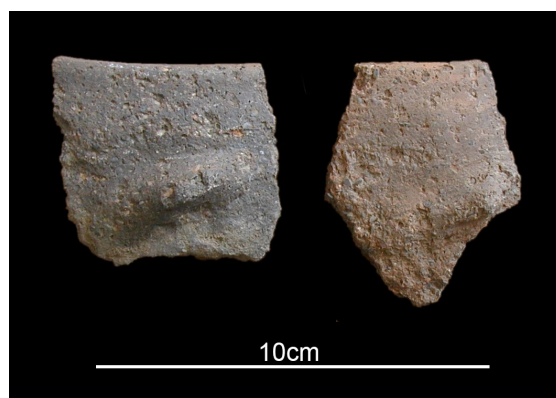


Figure 4. Handmade pottery from the Islamic phase at Wadi Shab.



Figure 5. A softstone plaquette found at Wadi Shab-GAS1.

The graves

Grave 8

This grave did not present any stone covering. It is highly likely that flat stones, like those documented in the other graves discovered at Wadi Shab GAS1, were present but had fallen down the scarp or had been removed by successive occupants of the site. In fact, the deceased's head rested against a dark grey stone, which could constitute the only vestige of a superstructure subsequently dismantled. The individual buried in this grave (**Figure 8**) was covered by a light brown sandy soil mixed with small white pebbles, was lying on the left side, in a strong contracted position, oriented NS, with the head to the N, facing SE. The arms were flexed at acute angle with the hands very close to the face. Whether poorly preserved all the bones of the skeleton were present except those of the left leg, maybe destroyed by further disturbance. They were largely covered by a whitish deposit, which could suggest the presence of clothes or a perishable covering, made with vegetal materials, that would have been mineralized, as observed at Ra's al-Hamra 5 (MUNOZ 2014: 169-70; MUNOZ 2018: Fig. 7.2).

A flint flake was found near the left hand, and a fragment of a shell and another flint flake were found on the right pelvis (**Figure 8b**). They may be grave goods but it cannot be definitely excluded that are part of grave refilling.

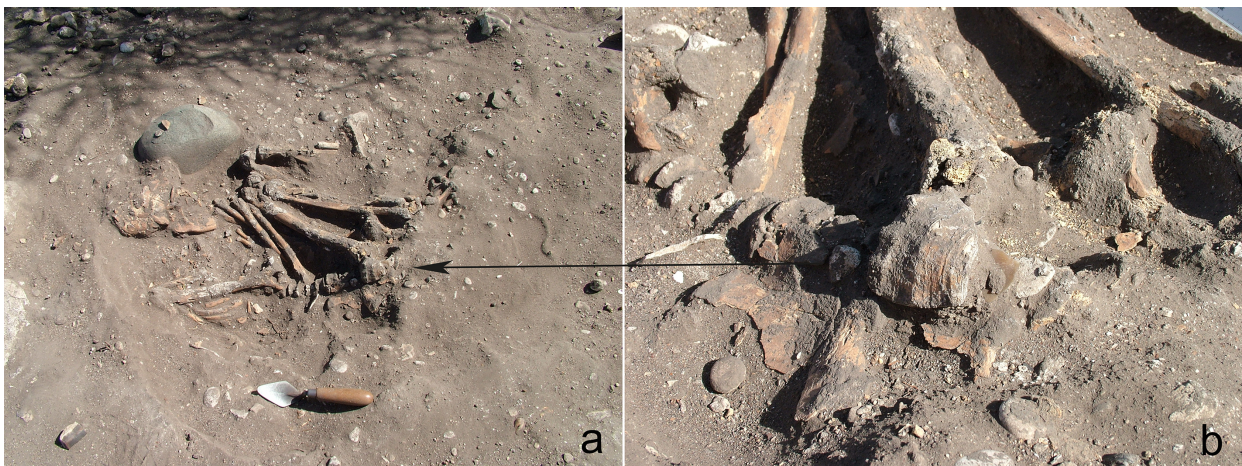


Figure 8. Grave 8 with a highlight (b) of the shell and flint deposited near the right pelvis.

Grave 9sup

This grave had been discovered during the 2003 field season together with Grave 7. It soon revealed quite an elaborated superstructure that turned out to be made of two levels of flat stones (**Figure 9a, b**). In between the two levels of stones, a lot of animal bones, mainly fish, flint, some charcoal and two ochre pebbles were found. Furthermore, one of the stones of the second level was a grinding base. Under the second level of stones the pit appeared filled with small white pebbles (**Figure 9c**), these were covering the skeleton and often adhering to it so that removing could damage the bones.

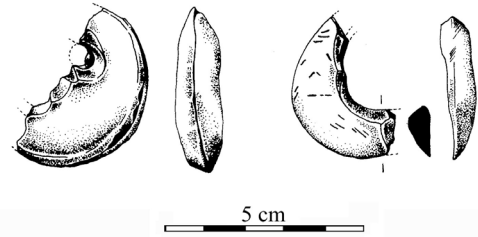


Figure 6. An unfinished chlorite earring with initial perforation (left) and a broken unfinished specimen.

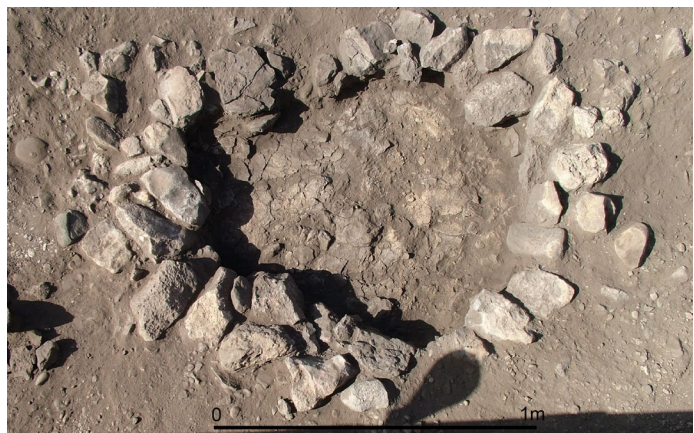


Figure 7. Structure 10, originally supposed to be a grave.

The individual was lying tightly flexed (**Figure 9d**), on the left side, oriented WE with the head to the W. The arms were flexed at an acute angle with the hands close to the face. Whether poorly preserved all the bones of the skeleton were present except those of the right foot, which probably had been eroded away.

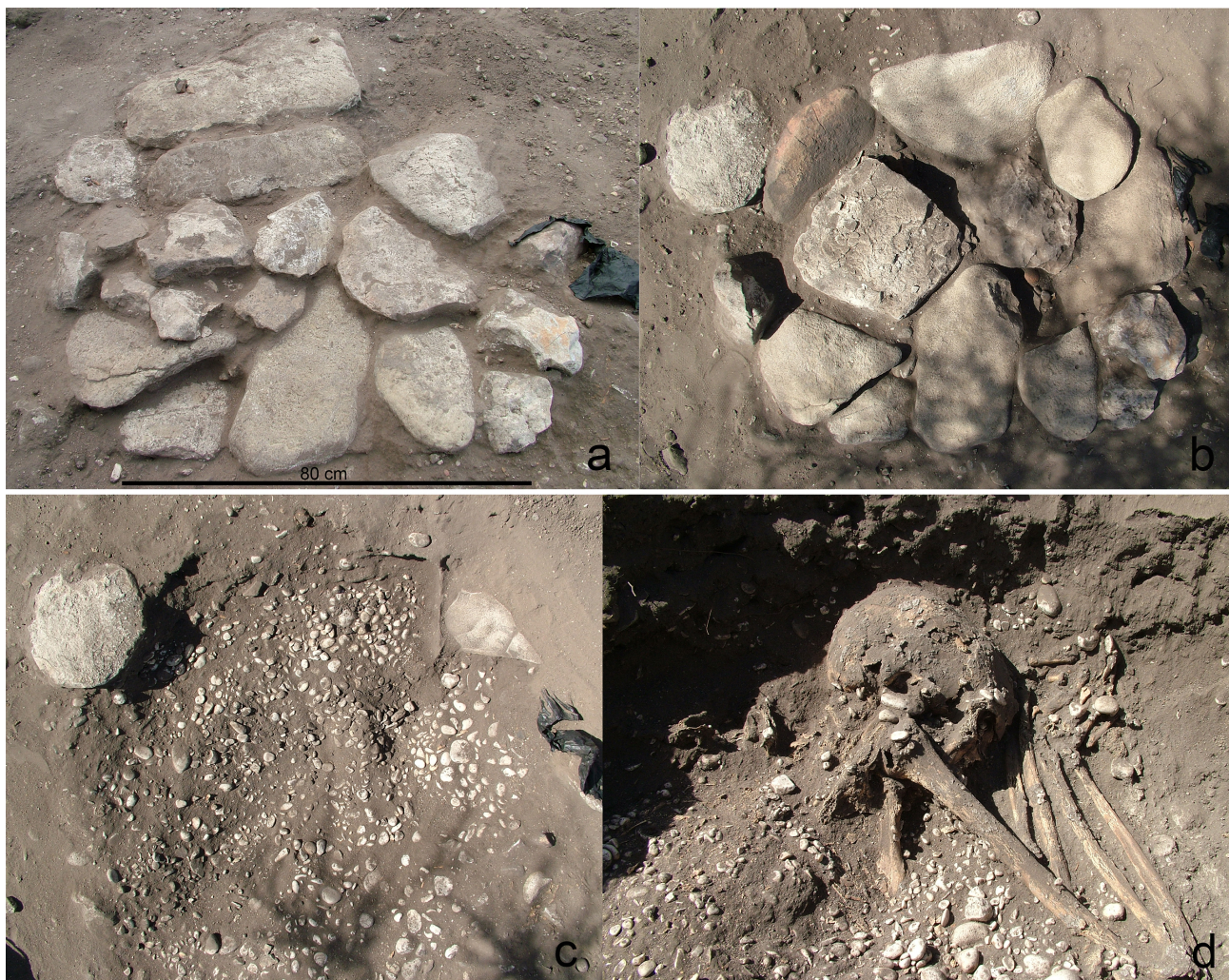


Figure 9. *Grave 9sup; different stages of excavation of the superstructure (a, b), the filling of small rubble (c) and the skeleton emerging under the filling (d).*

Grave 9inf

When removing the skeleton of Grave 9sup another long bone pertaining to a second individual appeared positioned between the two legs and the arms. It was clear that Grave 9 had disturbed a previous inhumation that was only partially left in place. Only the left part of the second individual buried in the same pit-grave was present but without the skull, the left arm and the left foot (**Figure 10**). Furthermore, other disturbance to the grave came from post-depositional animal burrow. Although disturbed it was possible to record the position of this individual that was lying flexed on the left side, oriented NS with the head to the N, facing E.



Figure 10. The partial skeleton of Grave 9inf.

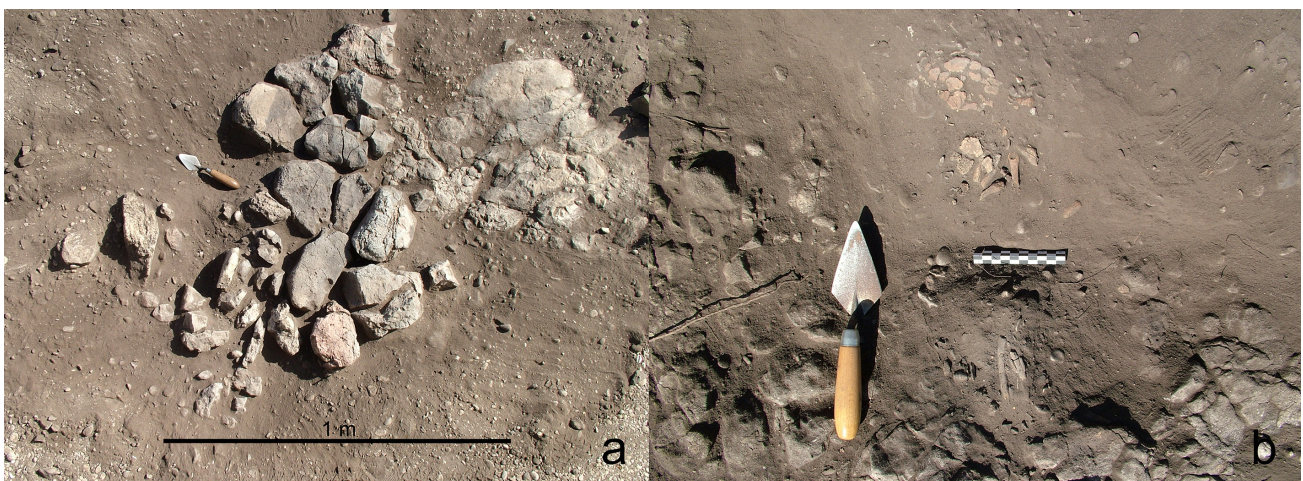


Figure 11. Grave 11 superstructure (a) and the few human remains recovered underneath (b).

Grave 11

This grave was covered by a round concentration of polygonal stones, not flat as usual (**Figure 11**). The concentration was partly lying on the bedrock and this indicated, from the very beginning, that the pit grave could not have been very deep. The conservation of the grave was actually worse than expected as the filling of the pit had eroded almost completely together with the human bones of which very tiny pieces were preserved (fragments of skull, ribs, long bones, metacarpals and phalanges; **Figure 11b**). Nothing else could be recorded of this grave.

Grave 12

of big flat limestone slab and other polygonal stones at the edge signalled the presence of a grave (**Figure 12**). This was disturbed by a small fireplace, full of charcoal chunks and flakes, which had cut through it on one side. The original preparation of the grave must have included also the small white beach pebbles that were still present under the stone covering but confined to one side of the grave (**Figure 12b**). This filling was then removed to check if part of the grave was hidden underneath but nothing else was preserved apart from few rib bones (**Figure 12c**) and other scanty part of the skeleton that had appeared soon after removing the limestone slabs. They were lying very near to the limestone bedrock. As for Grave 9 (and for Grave 4, GAULTIER *et al.* 2005) one of the stone forming the covering superstructure was a grinding stone (**Figure 13**).

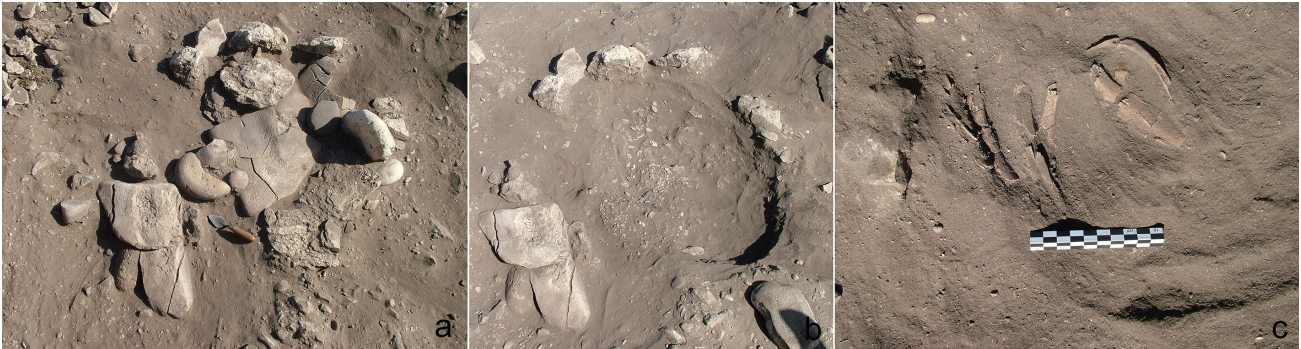


Figure 12. Grave 12: the apparently well preserved superstructure (a), the filling of small rubble (b) and the few human remains recovered underneath (c).



Figure 13. A grinding stone that was part of the superstructure of Grave 12.

Grave 13

A single surface stone slab (**Figure 14**), probably what was left of a more elaborate superstructure, was covering this grave. In fact, the bones of a skull pertaining to an individual here buried were eroding on the surface. After a careful brushing the other bones pertaining to the inhumation of an adult individual were brought to light; they were only partially covered by the flat stone slab. Preserved only in one part, a filling made of small white beach pebbles, as documented in other graves, mixed to a black powdery soil was covering the bones. These appeared coated by a hardened gangue with part of the small pebbles ‘glued’ to them, making the excavation and cleaning very difficult, indeed the preservation condition of the skeletal remains resulted very bad.

The few skull fragments found almost on the surface, thought to pertain to a young individual (Ind. A; **Figure 14a**), were lying at an higher level compared to the rest of skeleton found in this grave and positioned more or less on top of its chest. The more complete skeleton (Ind. B; **Figure 14b**) was buried in a flexed position, on the right side. It was oriented NE-SW, with the head at NE, facing NW. The arms were flexed at an acute angle with the hands close to the face.

Although the skeleton is completely represented, the bones were very poorly preserved: only the right half of the mandible and the right part of the skull were recovered for the study; also the right foot was missing, probably due to animal disturbance.

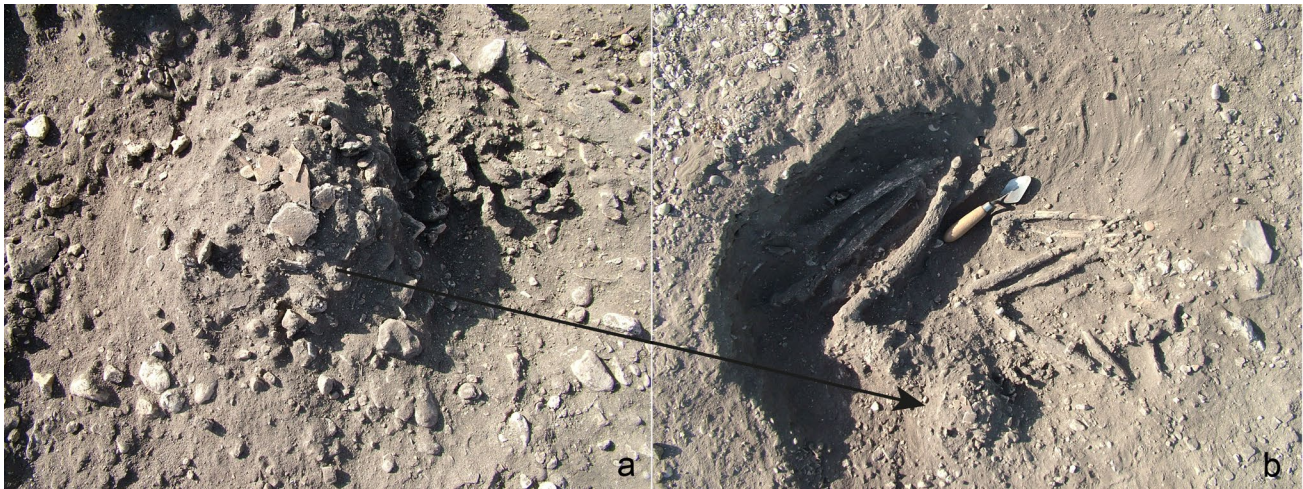


Figure 14. Skull remains of a first individual (a) lying on top of the second individual recovered in Grave 13 (b).

Grave 14

Grave 14 was located north of the west-east wall of the Islamic structure (**Figure 15**), near a well preserved fireplace made of burnt polygonal cracked stones. Here a round concentration of small white beach pebble suggested the possible presence of a prehistoric grave (**Figure 15a**). In spite of the time-shortage, Grave 14 was excavated in order to ascertain its chronological position in relation to the circular stone structure. Some of the stone pertaining to the ellipsoidal structure were visible in the wall of the pit grave and few bones were recovered under them. Therefore it is confirmed that the grave is antedating the stone structure. Any upper covering had been clearly removed and the grave appeared completely disturbed.

The ‘pit-grave’ contained the inhumation of a small child. A heavily disturbed skull, the mandible, some vertebrae and an undetermined long bone were recognised (**Figure 15b, c**). Teeth were also recovered but, unfortunately, they didn’t preserve. It was not possible to record the position and the orientation of the deceased.

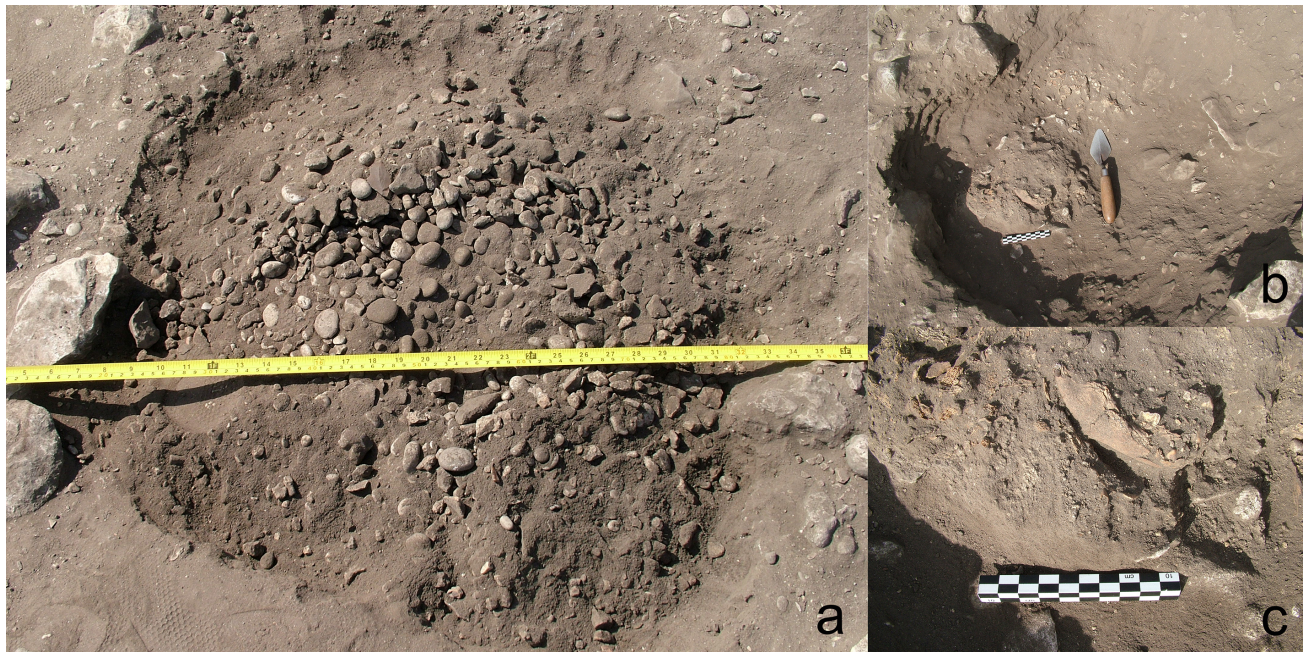


Figure 15. Remains of the individual buried in Grave 14 (b) in spite of an apparently untouched filling (a).

Table 2. Summary of the characteristics of the graves from Wadi Shab-GAS1.

Grave n°	Covering	Burial type	Side	Orientation	Gravegoods	Faunal remains
1	2 flat stones and stone circle	Primary, individual	Left	W-NW/S-SE	-	-
2	Several slabs	Secondary	-	NW/SE	-	-
3	Several large flat pebbles and small white pebbles	Primary, perturbed, multiple (3 individuals)	Left (Ind. C)	N/S (ind.A)	Mother-of-pearl hook	Turtle bones
4	2 layers of large stones and half-circle of small stones	Primary, individual	Right	NE/SW	2 grinding stones in the covering	Fish and turtle bones
5	Small white pebbles	Primary, individual	Right	W/E	Flint blade, stone tool	-
6	3 layers of flat stones	Primary perturbed? individual	Left?	E/W	Flint tools in the covering	Fish and turtle bones
7	Large slabs and small white pebbles	Primary, individual	Left	E/W	Small oval pebble under the right hand,	Fish and turtle bones, <i>Pinctada margaritifera</i> valve in the pit
8	No covering preserved, a large pebble close to the skull	Primary individual	Left	N/S	Flint tool in the right hand, big gastropod	-
9sup	2 layers of flat stones, small white pebbles	Primary, individual	Left	W/E	Flint tools in the filling, 2 balls of ochre	Fish bones
9inf	See 9sup	Primary, perturbed, individual	Left	N/S	-	-
11	Several irregular stones	Perturbed, individual	-	-	-	-
12	Several slabs in limestone and small white pebbles	Perturbed, individual	-	-	-	Fish and other faunal bones
13	1 slab and small white pebbles	Primary, perturbed, multiple (2 indiv.)	Right (ind.B)	NE/SW (ind. B)	Stone earring fragment	-
14	Irregular stones and small pebbles	Perturbed, individual	-	-	-	-

The anthropological study

We present here the data relating to all the individuals discovered at GAS-1, in order to give a complete overview of the results of the analysis of the osteological collection.

Due to the very poor overall preservation of the human remains from GAS-1, and despite a rigorous examination, it was difficult to systematically consider each of the characteristics usually recorded in an anthropological study. The absence of remarks in some cases is therefore often linked to the condition of bone and tooth material, which in most cases has reached a very fragmentary form.

Place of storage

The human remains are currently kept partly at the *Maison René Ginouvès*¹ (Nanterre, France) and partly in the storage of the Ministry of Heritage and Culture of Oman (Muscat).

State of preservation

The general condition of the bones is very poor, most of them preserved in the form of pulverulent fragments. On average, for all individuals whose bones have been studied in the laboratory, the average Anatomical Preservation Index (API, or ICA in BELLO *et al.* 2003) is 12% and the extent of fragmentation reaches 94% (see **Table 3**, and preservation forms in MUNOZ 2014: figs. A4.92-107).

However, for several graves, it was found that the skeleton was quite well represented, with each of the anatomical parts represented by at least one fragment. The poor preservation of the remains can be attributed to natural (erosion, climate, burrowers) and anthropogenic factors (deposit mode, trampling, disturbance, looting). In some graves, skeletons are very poorly represented, which can be attributed to intense post-depositional alterations.

Several fragments of long bone diaphysis had gnawing stigmas due to the action of animals. In cases where these traces are found to affect several anatomic parts (Graves 1, 2, 3B, 3C, 8, 9sup, 9inf) they reflect a fairly systematic nibbling that indicates that access to the remains was possible. On the basis of these elements, it is possible that some bodies were not buried in the strict sense of the term, as the decomposition took place in a confined space, subsequently filled by sedimentary input (DUDAY 1990: 193-194). The possibility of subsequent intervention by burrowing and rodent animals cannot be ruled out, as a burrow has been identified in Grave 2. However, if it is monitored elsewhere, it has not caused bone migration outside the volume of the corpse in graves 1, 8, and 9sup, suggesting that the action of the animals occurred before the complete dislocation of the various elements of the skeleton.

In addition, the bones were sometimes covered with an indurated grey gangue - whose formation process was not identified - preventing observation of their surface.

In spite of these limitations, the remains observed *in situ* - when the anthropological team² was present during the removal of the skeletons- made it possible to record certain metric or morphological characters. In the laboratory, the preserved dental remains were observed after identification of the fragments, reassembly and restoration, when it was possible.

Age and sex

In rare cases, sex could be assessed in the field based on the morphology of the coxal bones (BRUZEK 2002), and in one case measurements were made using the metric method (MURAIL *et al.* 2005). Skull morphology was also observed (FEREMBACH *et al.* 1979). Where applicable, we mention in the Table 3 the sex and age of the individuals, the results being detailed in MUNOZ 2014 (Tables A3.4-5).

¹ Since January 2020 the former *Maison René-Ginouvès de l'Archéologie et de l'Ethnologie* has been renamed *Maison des Sciences de l'Homme « Mondes »*

² During the field season 2003, the anthropological team included one of the authors (OM), as well as Matthieu Gaultier and Hervé Guy.

Age estimation was often restricted to the distinction between osteologically adult or sub-adult individuals, except when teeth were present. We can therefore mention the presence of children, women and men. According to the observations made during the excavation, and those resulting from the anthropological study, at least four sub-adults would be represented, out of a total of 17 individuals. We could only reliably estimate in the laboratory the age of two sub-adult individuals whose teeth were preserved (7-15 years and 0.6-3.7 years). The age of a third (Grave 14: 3-5 years) was estimated from the stages of dental formation on the basis of a field photograph (estimate to be reviewed if the remains from this grave are found). Apart from the child from Grave 14, the youngest subjects are buried with an adult, in contexts that are difficult to specify from the available documentation.

We note the absence of individuals less than one year old, which we do not know if it is due to differential conservation, practices excluding the youngest children from this sepulchral space, and/or partial recovery due to limits of excavated area.

Table 3. Anatomical Preservation Index, fragmentation rate, age, sex and stature of the individuals recovered at Wadi Shab-GAS1 (for further details, see MUNOZ 2014)

Grave/Individual	Anatomical Preservation Index (%)	Fragmentation rate (%)	Age (yrs)	Sex	Stature (cm)
1	8.9	91.4	>20	F	
2	4.4	98.6	>20	-	
3/A	6.6	91.4	7-15	-	
3/B	1.1	95.5	0.6-3.7	-	
3/C	17.2	94.1	>20	-	
4	-	-	>20	-	158 ± 4.1
5	-	-	>20	M	162.9 ± 4.1
6	16.9	97.7	>20	-	
7	-	-	20-30	F?	150.9 ± 4.1
8	-	81.4	>20	M?	
9Sup	29.3	86.9	>20	F	
9Inf	5.2	96.4	>20	-	
11	4.8	97.3	>17	-	
12	0.3	100	>15	-	
13/A	-	-	subadult	-	
13/B	26.7	84.2	>20	M	
14	0.6 %	100	3-5 ?	-	

Stature

Some long bones could be measured in the field, and allowed an estimation of the size stature (CLEUVENOT and HOUËT 1993) of three individuals (**Table 3**). The stature estimated from the femoral lengths of three individuals is 157.3 ± 4.1 cm on average for all sexes combined.

Anatomical variations, discrete traits

Some traits have been noticed several times. However, given the state of preservation of the skeletons, it was not possible to systematically check the presence or absence of these traits for the entire collection. We mention them here for the record in decreasing order of occurrence: Olecranon perforation of the humerus (3 present/5 observable); Lateral notch on the patella (3/3); Allen's pit (2/2); Spina bifida (1/2); Distal tibia squatting facet (1/1); Vestigial metope suture (1/1). The small number of observations and their non-exhaustive nature do not allow for interpretation.

Pathologies

Degenerative diseases

Five individuals showed signs of degenerative pathologies (osteophytes, subchondral cysts, eburnation) that were moderate to severe (Graves 1, 2, 3C, 8, 9sup). Given the conservation of the remains, it was not possible to systematically check the presence of such signs throughout the skeleton. It should be noted that when they were observed, they were more often located on the upper

limbs. That being said, it is very likely that differential conservation could have biased this observation.

Fractures

In five individuals (Graves 2, 3C, 8, 9sup, 13), bone calluses were found (**Table 4**), associated with periosteal changes on some long bone fragments, interpreted as consolidated fractures; radiographs would probably be required to confirm this. This frequency seems quite high if we reduce it to the number of adults, especially since not all skeletons are equally represented, and other traumas may have been missed due to the poor preservation of the bones.

It should be noted that the fractures involving the two forearm bones (radio-ulnary), observed for the subjects of Grave 2 and 13 are supposed to be characteristic of a trauma caused in case of defence against an assailant (parade fracture) (CHARLIER 2008: 299). In this case, they would likely indicate a violent episode during the individual's lifetime. However, since the parry is an instinctive protective reaction, it can be mobilized in the face of dangers other than aggression. Traumas involving the lower limbs may have been disabling and have probably required the rest of the group to assume the care of the individual during convalescence.

Oral conditions

The retained dental fragments, once reassembled, have enabled the recording of several pathologies, summarized in the **Table 5**; recording and scoring methods are detailed in MUNOZ 2017.

Wear is average to severe (average degree = 4.1), and more pronounced on the anterior teeth. All teeth have light to moderate calculus (average degree = 0.98, with 88.5% having calculus). No carious lesions were observed. The observable alveoli (n=42) show a slight to severe resorption of the alveolar bone (mean degree=1.8). Abscesses are visible on 11.8% of the alveoli (**Figure 16**). One is associated with the loss of an upper central incisor (Grave 8), and others, periapical, probably result from intra-vitam fractures of the underlying teeth (Graves 8 and 9sup).

Three cases of ante-mortem loss of teeth were observed, two of which were on the same individual (Grave 9sup), which represents 11.1% of the total number of observable alveoli. Given the state of preservation of the material, their occurrence is probably underestimated. Finally, 37% of the anterior teeth observed have linear enamel hypoplasia (LEH), which is rather a moderate rate compared to other coastal neolithic groups (MUNOZ 2017).

Many teeth had micro-fractures (41.9% of teeth) or fractures (21%), that

Table 4. Occurrence and localisation of bone calluses interpreted as consolidated fractures.

For further details, see MUNOZ 2014.

Localisation	Occurrence (Grave n°)
Skull	-
Vertebra	-
Rib	-
Humerus	-
Radius/Ulna	3 (G.2 ;13)
Hand	1 (G.9sup)
Femur	1(G.3C)
Tibia/fibula	2(G.8, 9sup)
Foot	-
Total	7

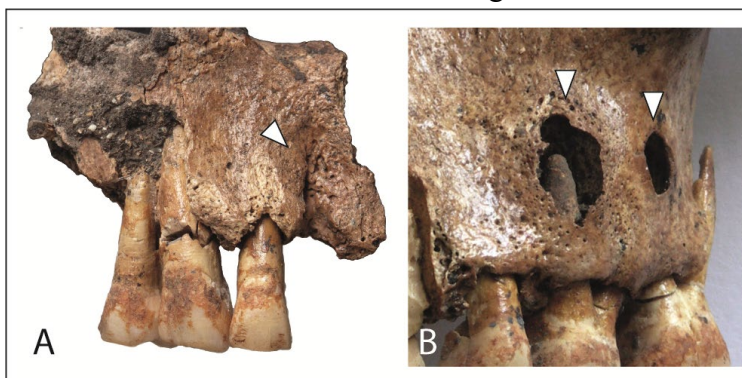


Figure 16. Abscesses on a right upper central incisor in Grave 8 (A) and left upper molars in Grave 9sup (B).

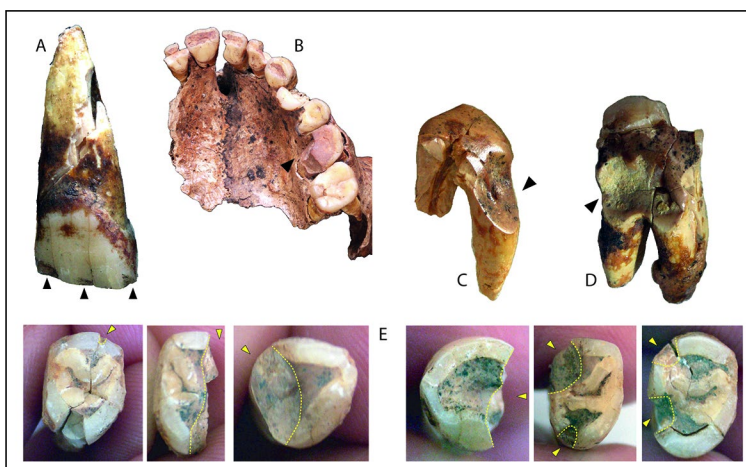


Figure 17. Chipping on an upper central incisor in Grave 9sup (A), fractures on the upper dentition in the same grave (B), fractures and wear on right lower molars in Grave 1 (C, D), and polished fractures, grooving and notches on upper canines and premolars in Grave 1 (E).

occurred intra-vitam (patinated, calculus-covered, or polished, **Figure 17, C-E**). Some micro-fractures (**Figure 17, A**), such as those located on the interproximal margins of teeth, could be attributed to abrasion caused by the introduction of hard particles into the food (sand, shellfish) or as a result of extra-masticating activities such as food preparation (fracturing of bones to remove marrow, seeds or nuts). According to several studies, dental chipping is more frequent in populations

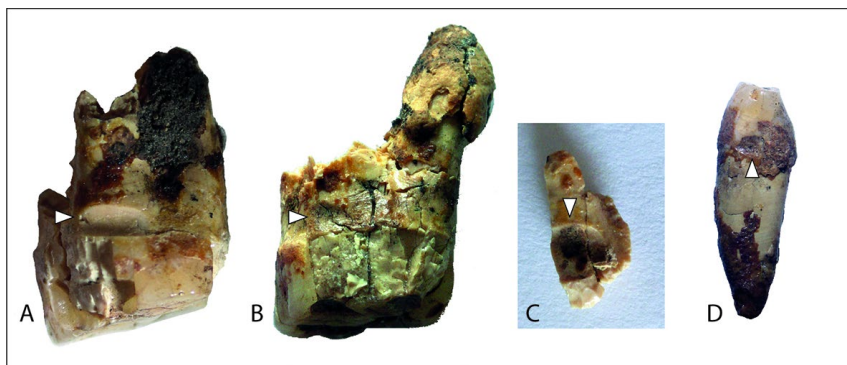


Figure 18. Interproximal grooving on left upper molars (A, B), a molar fragment (C) and a left lower canine (D) in Grave 1.

that consume meat than in populations whose livelihood depends on intensive agriculture (TURNER and CADIEN 1969; SCOTT and WINN 2010). Other stigmas can testify to the use of teeth as tools (Graves 1, 8, 9sup). This is probably the case for occlusal notches or grooves characterized by enamel loss and having a polished appearance (21% of the observed teeth). Indeed, these modifications can be produced by a flexible or rigid cylindrical object, simply held between the teeth, which are then used as pliers or whose repeated passage in an identical orientation alters the enamel (Consiglio 2008). Interproximal grooving (**Figure 18**) are visible on 11.3% of the teeth at the base of the collar.

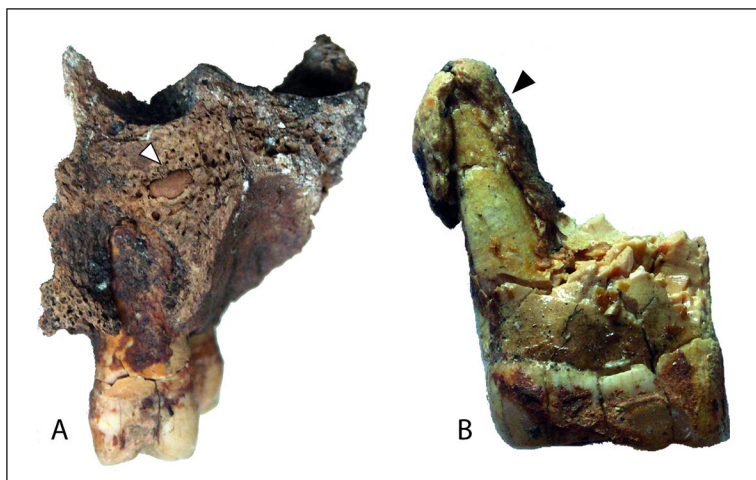


Figure 19. Cementicle between the left upper second premolar and the first molar in grave 8 (A) and hypercementosis on the left upper first molar in grave 1 (B).

be produced by a flexible or rigid cylindrical object, simply held between the teeth, which are then used as pliers or whose repeated passage in an identical orientation alters the enamel (Consiglio 2008). Interproximal grooving (**Figure 18**) are visible on 11.3% of the teeth at the base of the collar.

On the other hand, paradoxically, the poor conservation of the alveolar bones has been an advantage: the roots are often observable, as are cementicles that would have gone unnoticed without X-rays if the teeth had remained in place in their well-preserved alveoli. We were thus able to observe several pathologies rarely mentioned in the archaeological literature: a cases of severe hypercementosis (TANG *et al.* 2016) was remarked for the individual from Grave 1, and cementicles were found on two individuals (**Figure 19**; Graves 8 and 13). As both formations are due to chronic periodontal inflammations that can be caused by repeated mechanical stress (occlusion forces), they could result of an intense use of teeth both for alimentary and occupational purposes. The intra-vitam loss of two teeth, observed for the individual buried in Grave 9sup, may also result from significant stress.

All these elements suggest that the population of Wadi Shab - or at least the individuals whose dental remains we observed - also used their teeth as tools. These include the crushing of hard materials for food preparations (bone, shell, nuts, seeds, etc.) that may have caused fractures of the posterior teeth, but also the preparation or treatment of fibres, which could be seen in some occlusal and labial grooves on the anterior teeth, although they are much less obvious than some published cases (e.g.: BOCQUENTIN *et al.* 2005; on this subject see also MOLNAR 1972). The significant abrasion of some teeth, with a rounded vestibular edge, may be related to skin treatment (SCOTT and TURNER 1988).

The interproximal grooving observed in several individuals could attest to the recurrent use of a toothpick for palliative purposes. They are very commonly observed in all regions of the world, dating

back to the early Paleolithic, and seem closely related to the human lineage (for a review, see Ungar *et al.* 2001). Several etiologies have been proposed, ranging from dental hygiene to cultural or idiopathic habits (FORMICOLA 1988; FRAYER 1991; BONFIGLIOLI *et al.* 2004). However, in California, Australia and Pakistan, interproximal grooving have sometimes been interpreted as being related to activities such as intertooth fibre treatment (SCHULZ 1977; BROWN and MOLNAR 1990; LUKACS and PASTOR 1990), a possibility that should not be excluded for GAS1 individuals. On this site, they are more marked on the neck of the posterior teeth, but grooving also appear on the occlusal surfaces of observed at al-Buhais BHS-18 (KIESEWETTER 2006: 218-219), at Ra's al-Hamra RH-5 (MUNOZ 2014), or on the other side of the Persian Gulf, at Mehrgarh (LUKACS and PASTOR 1988, 1990).

However, the macroscopic observations we were able to make do not allow us to go any further in the interpretation of these stigmas (materials worked or gestures made) and would require further indepth analyses (optical and electron microscopy, experimentation).

Table 5. Rate of dental pathologies observed on permanent dentition in the study sample (number of observed teeth/alveoli). (For further details on the recording methods and raw data, see MUNOZ 2014; 2017).

Wear mean grade (1-8)	Heavy wear (%)	Calculus mean grade (1-3)	Calculus (%)	Caries (%)	Alveolar resorption mean grade (1-3)	Alveolar Resorption (%)	Abscesses (%)	Ante-mortem Tooth Loss (%)
4.1 (64)	46.9 (64)	0.98 (61)	88.5 (61)	0.0 (63)	1.81 (42)	71.4 (42)	11.8 (34)	11.1 (45)

Synthesis on funerary practices and biological data

Burial structures

The 14 graves excavated at Wadi Shab GAS1 consist of semi-circular pits, about one meter in diameter, most of which are covered with a more or less elaborate assemblage of stones. Most of the time, the deceased are covered with medium sized stones (flat pebbles and polygonal limestones) or large flat slabs. Some coverings seem more elaborate than others and include several layers of carefully arranged stones; this is the case for Graves 6 and 9. In half of the graves, small beach pebbles were included in the covering.

Treatment, position and orientation of the deceased

Many of the graves have experienced disturbances that may have led to the alteration of the human remains they contained, damaging both the study of the funerary context and the study of the bones. When the bone remains were still in the primary position, it could be seen that the deceased were placed in a flexed position on the side, with variations in the side on which they rest, and a more or less significant constriction of the body. In four cases, the skeletons were in an extremely crouched position, suggesting that the bodies had originally been artificially constrained. Hands are almost always placed close to the face. However, one of the individuals (Grave 4) had both arms placed under the legs and the one in Grave 8 had the right hand under the right thigh. In both graves, there is ample evidence to suggest that the body was restrained by ties or a flexible envelope. Grave 4 in particular raises questions about the practices related to the burial of the deceased: why does the body, artificially forced, occupy only half of the grave? The probable presence of basketry objects, as detected from excavation documentation and/or gypsum remains still present on the bones (Graves 7, 8, 9^{sup}, 13), would confirm the hypothesis of the existence of an envelope, clothing, or vegetable covering.

In the documented cases, there is a preference for deposition on the left side (n=7), but some deceased were deposited on their right side (n=3). This does not seem to be sex-related since two individuals whose sex could be determined in the field - probably two women - each rested on a different side. For seven of the individuals, it was not possible to determine the initial position of the body due to disturbances to the skeleton.

The orientation of the bodies as it could be inferred for 11 cases is variable and it is difficult to draw interpretations on a possible link with the solar trajectory, as proposed for Ra's al-Hamra 5 (SALVATORI 2007). The most frequent position is the deposition on the left side with the head to the north but it only concerns three cases; it can then be assumed that the face was facing the East. But in two cases, the body deposited on the right side follows a NE/SW orientation, and then the face is turned towards the NW, while in another case, the body follows a W/E axis, the face towards the south. It should be added that when you are on site, the sea is visible at an angle of about 180° (from NW to SE). In any case, given the small size and variability of the orientations observed, it is not possible to discuss this further.

Burial types

As we have seen, many graves are disturbed. Some disturbances may be due to post-depositional alterations of natural or anthropogenic origin (burrows, looting, overlapping...), while others seem to be related to mortuary practices in several stages. Some graves have undergone post-depositional interventions: Grave 2 could be the result of a reduction (rearrangement with secondary deposit of selected defleshed remains), while Grave 6 could be the site of the primary deposition of a corpse, from which certain bones would then have been removed. This variety of burial methods certainly reflects the complexity of mortuary practices, that could be accomplished over a fairly long period of time, as also observed at al-Buhais BHS-18 (KIESEWETTER 2006), Ra's al-Hamra RH5 (SALVATORI 2007; MUNOZ 2014: 299).

Most of the graves are individual but two of them contained the remains of several individuals: Grave 3 provided the remains of at least three individuals, two children and an adult; Grave 13 contained the remains of an adult and a child. In both cases, the disturbed context prevent a clear reading of the primary or secondary nature of the deposits. In Grave 3, some skeletal parts still had anatomical connections, and many small bones are present, suggesting that it contains highly disturbed primary deposits; however, it is also possible that it is the result of time-deferred deposits, the latter of which would have disturbed the previous one(s).

In any case, this example shows the intention to group the three deceased together in the same grave. In Grave 13, a completely altered child's skull is present, which appeared under the covering, and above an adult in the primary position. Again, the state of preservation of the remains make it impossible to know whether the tomb contained the entire bodies of these two individuals, one of whom suffered intense post-depositional destruction, or whether a child's skull was deposited, alone, on the adult.

It should be noted, however, that documented graves containing the remains of more than one subject contain an adult associated with one or more children. However, Grave 14, contains the remains of a child (3-5 years old), alone. This suggests that young subjects could, in some cases, be treated individually without being systematically associated with an older individual.

Grave goods and faunal remains

Furniture is rare, only a few graves have delivered objects, and no ornaments were clearly associated with the deceased notwithstanding the large quantity of chlorite beads and earrings that were recovered at the site (TOSI and USAI 2003; USAI 2018). Similarly, as ISETTI and BIAGI (1989) also pointed out, in RH5, where a large number of graves have been excavated, out of 308 items found so far, only a very small proportion of earrings (6.8%) have been found whole associated with the deceased in the graves, 3.2% being present as a fragment in the filling, and the overwhelming majority (89.9%) in the settlement layers (MUNOZ 2014: 179).

The few associated objects can be described more as utilitarian (bone points, flint tools, mother-of-pearl hooks), although the meaning of their presence in the graves remains unknown. The function of other objects, such as the large gastropod fragment from Grave 8, remains difficult to interpret. We notice the presence of remains of articulated fish in some graves, which could testify to the deposition of food with the deceased. Were they a viaticum, intended to accompany the deceased in

death and beyond? Are they the reliefs of a meal celebrated around the grave in homage to the deceased? Or do they represent a symbolic gesture accompanying the funeral ceremony whose meaning escapes us?

Other faunal remains are frequent in the filling (bone fragments of marine turtles and land mammals) without being it possible to know whether their presence is accidental or deliberate. A grave also produced a valve of *Pinctada sp.* lying between the levels of covering stones, whose presence is probably not accidental. In several cases (Graves 4, 7 and 9sup) the excavation revealed the probable presence of a fireplace containing faunal remains in the pit, between the deceased and the stone roof that sealed the grave.

Biological data

Given the very poor preservation of the bones, the sex and age of the burials could only be estimated in rare cases, and no one can pronounce on the recruitment of this burial area, except for the presence of men, women and children. It is noted that no remains belonging to children under one year of age have been identified.

Five adults had bone calluses or swellings of the diaphyseal shaft on some long bones, which we interpreted as consolidated fractures. X-rays would undoubtedly make it possible to refine the description of these pathologies. Some of them, located on the lower limb, must have been disabling; this suggests that the group was able to manage for a while the convalescent subjects affected by these traumas. Other fractures could reveal violent episodes in people's lives.

The study of dental remains, where possible, has been informative. The population buried at Wadi Shab GAS1 is globally characterized by a high dental wear, more important on anterior teeth, combined with moderate calculus rates, moderate LEH frequency, and frequent periodontal diseases as demonstrated by the high rates of alveolar resorption. On the other hand, they show rather low abscesses and AMTL frequencies, and a total absence of carious lesions. It denotes a diet relying basically on protein rich, unprocessed food requiring intensive mastication, with an abrasive consistency. In addition to the severe attrition related to the abrasive nature of the food, the high frequency of chipping and fractures affecting the teeth in this group indicates the widespread and intense solicitation of the teeth for processing hard components. Such heavy use of teeth is also attested by cases of severe hypercementosis, as well as some cases of cementicles. These observations indicate a food probably rich in hard particles, and a probable use of teeth for paramasticatory tasks, sometimes causing tooth fractures, and possibly causing tooth loss and/or periodontal disease (abscesses, cementicles, hypercementosis).

Conclusion

The Wadi Shab GAS1 graveyard is of particular interest for the knowledge of the mortuary practices and lifestyles of Omani coastal Neolithic groups, as it contains a fairly large number of tombs, which provide a representative overview. Indeed, apart from the funeral complexes of Ra's al-Hamra (RH4, RH5, RH6 and RH10), the other Omani Neolithic sites excavated have so far delivered only a few graves or the partial remains of individuals (2 at Ra's al-Khabbah KHB1, MUNOZ *et al.* 2010; 4 at Suwayh SWY1, CHARPENTIER *et al.* 2003, MUNOZ 2014; 3 at Khuwaymah KHU2, CHARPENTIER *et al.* 2012:69-70; 6 at Ra's al-Hadd HD5, BORGHI and MAINI 2018; 1 at Wadi Wuddaya WD58, Cleuziou and TOSI 2000:15; 4 at Ra's al-Jinz RJ1, MONCHABLON *et al.* 2003:36; 5 at Ruways RWY1, BERGER *et al. in press*).

The graves have suffered many disturbances that have affected both the reading we could have of the modalities of the mortuary deposits, but also the state of preservation of human remains, which makes it more difficult to study them. However, it was possible to obtain several important information about the population buried in Wadi Shab. First, there is a certain diversity in the treatment of the dead, with the presence of mortuary practices in several stages (reopening of graves and removal of remains, secondary repository of selected remains), although individual primary burial seems to be

the most common practice. Complex practices of this type have also been recorded at other sites on the Oman Peninsula, such as Ra's al-Hamra RH5 (SALVATORI 2007; MUNOZ 2014), Ra's al-Khabbah KHB1 (MUNOZ *et al.* 2010) or al Buhais BHS18 (KIESEWETTER 2006). There is also a certain variety in the funerary arrangements and treatment of the deceased (complexity of the cover, side, position and orientation of the deceased) that does not seem to be related to the sex of the individuals and which may also find parallels in the other two major Neolithic cemeteries known. The material culture of GAS1 is similar to that of Ra's al-Hamra, especially net-sinkers, fish hooks and stone earrings (SALVATORI 2007; TOSI and USAI 2003; USAI 2018) but substantial differences may be noticed between the lithic industries produced at the two sites (USAI 2006) part of which may have been determined by the more favourable location of GAS1 and its vicinity to good quality flint sources.

Finally, the biological data collected made it possible to determine the lifestyle of the group living in Wadi Shab, both on dietary practices and on the violent episodes that may have marked the life of the group.

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