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Source: *Proceedings of the Seminar for Arabian Studies*, 2020, Vol. 50 (2020), pp. 321–332

Published by: Archaeopress

Stable URL: <https://www.jstor.org/stable/10.2307/27205773>

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## Assessing Kalba: new fieldwork at a Bronze Age coastal site on the Gulf of Oman (Emirate of Sharjah, UAE)

CHRISTOPH SCHWALL & SABAH A. JASIM

### Summary

Extended supra-regional networks reaching from the Aegean to the Indus region can be attested since the Early Bronze Age. In this context, due to its geostrategic location, the Arabian Peninsula offers optimal conditions for nodes of these networks and probably functioned as a mediator between the East and the West. New fieldwork conducted by the Sharjah Archaeology Authority (SAA) and the Institute for Oriental and European Archaeology (OREA) of the Austrian Academy of Sciences (AAS) was therefore started at the settlement of Kalba, situated in the alluvial plain in the coastal region of the Gulf of Oman. Apart from occupation layers of the second and first millennia BC, Early Bronze Age structures have been attested during previous investigations. However, information about the dimensions of the site and its geomorphological situation are still lacking. Consequently, systematic investigations, starting with detailed topographical documentation and basic geophysical analyses, were performed. The results of these first topographical and geophysical analyses of the site of Kalba have been used to conduct a small-scale excavation with the aim of providing more information on the Early Bronze Age occupation of the site. Finally, the new insights should offer the potential to assess the settlement's function as well as its position on the north-eastern Arabian Peninsula and, moreover, within the framework of third-millennium BC trading networks.

**Keywords:** United Arab Emirates, Kalba, settlement, Bronze Age, communication and trade

### Introduction

The first joint one-month field season between the Sharjah Archaeology Authority (SAA) and the Institute of Oriental and European Archaeology (OREA) of the Austrian Academy of Sciences (AAS) at Kalba site 4 (Emirate of Sharjah, UAE) was conducted in January and February 2019. The Kalba site (K4) is situated on the Gulf of Oman on the east coast of the United Arab Emirates, approximately 1.5 km from today's coastline (Fig. 1; GPS: 25.085539°; 56.345076°). The region is influenced by the northern foothills of the Al-Hajar mountain range, a Semail ophiolite complex resulting from an ocean-continent collision in the Late Cretaceous (Jacobs et al. 2015; Roberts, Thomas & Jacobs 2016). Hence, the terrain rises steeply from the coastline in the east to the west. Today, the landscape surrounding the site is characterized by alluvial sediments, deposited by wadis from the Al-Hajar mountain range. In general, due to its geostrategic position, the coastal site of Kalba offers ideal conditions for maritime communication and exchange systems. Its possible function as well as

its position on the Gulf of Oman should therefore be considered in detail within the framework of third-millennium BC trading networks.

Surveys and excavations in the region of Kalba have already provided some prehistoric evidence from the Neolithic to the Iron Age period (Jasim 1994; Carter 1997; Phillips & Mosseri-Marlio 2002; David & Phillips 2008; Eddisford & Phillips 2009; Phillips 2013; Lindauer et al. 2017). During these investigations, the Kalba site 4 settlement was discovered and subsequently excavated by C. Phillips during the 1990s. The fieldwork revealed that the site was diachronically settled from the third until the first millennium BC (for the subsequent description see Phillips & Mosseri-Marlio 2002: 202; Eddisford & Phillips 2009: 102–104). The Early Bronze Age occupation levels of the third millennium BC yielded a roughly circular mud-brick tower with a diameter of c.20 m and a preserved height of c.4 m (Fig. 4). Inside, the tower was subdivided by walls into small compartments with a central well measuring 1.20 m. The tower itself was surrounded by a mud-brick pavement and built on a terrace. During a later stage



FIGURE 1. A map showing the location of Kalba on the Gulf of Oman (M. Börner/OREA).

of the Early Bronze Age, a deep and massive retaining wall made of rounded boulders and beach rock was constructed, encircling the tower construction at a distance of up to 15 m. Moreover, there is evidence of a ditch surrounding the deep retaining wall. According to the published data, the current suggestion is that the Early Bronze Age occupation dates after 2500 BC, to the Umm an-Nar period. For the Late Bronze Age, a larger mud-brick tower measuring about 30 m in diameter was built around and upon the Early Bronze Age tower. The impressive outer wall of the tower is around 3.5 m thick and partially preserved to a height of c.2.6 m, and features a stone wall, mainly made of beach rock, in the centre.

Although absolute dates for the Early and Late Bronze Age are so far not available, radiocarbon dates

are provided by the Middle Bronze Age occupation layers of the Wadi Suq period. Charcoal and shell samples have been extracted from two layers ('MBZ1': 1961–1752 calBC; 'MBZ2': 1770–1683 calBC; Lindauer et al. 2017: 111, table 3) stratigraphically underneath the bottom of the Late Bronze Age tower wall. Despite it not being known whether settlement layers were dug away in the course of the construction of this tower, the absolute dates reveal a *terminus post quem* for the construction of the Late Bronze Age tower after the first quarter of the seventeenth century BC. Within the Iron Age I (1300–1000 BC) and II (1000–600 BC) periods, the area of the former Bronze Age towers was enlarged and extended walls made of stones with a mud-brick superstructure were built around the presumably central area of the site. Moreover, outside the Iron Age I wall a ditch

surrounded the new constructions, with a possible gate in the west of the site. Based on the published data, the settlement was abandoned around the middle of the first millennium BC. So far, the investigations already conducted at Kalba site 4 have revealed evidence of different occupation phases, with a possible hiatus covering a time frame of at least 2000 years.

### Investigations from the 2019 campaign

The renewed fieldwork during the one-month season took different approaches to establish a basis for future research. In order to provide a systematic and detailed documentation of the Kalba site, aerial photography was used to generate a topographical plan on which all visible architectural remains could be mapped. Moreover, this georeferenced plan forms the basis for further studies and analyses on-site. Today, thick deposits cover large parts of the site and the former extent of the archaeological site therefore remains unclear. To gain insights into the size, geophysical analyses, magnetics, and geo-radar were applied on-site and off-site, performed under the direction of Cornelius Meyer by the company Eastern Atlas (Germany). Additionally, a trial excavation in an area measuring 7 x 7 m (trench E1) inside a former trench in the east of the site was undertaken. The aim was to gain more information about possible structural remains of the Early Bronze Age occupation outside the mud-brick tower.

### Topographical and structural documentation

At the beginning, systematic investigations focused on the topographical documentation of Kalba site 4 to provide optimal conditions for further fieldwork and analyses. With the help of a drone (DJI Phantom 4 Pro), aerial photographs of the entire site and its vicinity were taken. As a result of this work, the 147 obtained and merged pictures have enabled the processing of a digital elevation model (DEM) of the site via image-based modelling. The model consists of a dense point cloud (90 million), whereby each point has distinct measurable coordinates. The DEM will be used as a basis for all further fieldwork, geographic information system (GIS)-based analyses, and detailed documentation on-site. Furthermore, the documentation of the previously

uncovered architectural remains was a crucial aim for recording the state of preservation of the different occupation phases from the Early Bronze Age to the Iron Age periods. All visible architectural features have also been surveyed and documented in detail using the georeferenced image-based modelling technique. Finally, the aim was to map these structures on the topographical plan, presenting the precise current situation of the site. This approach was mandatory in order to provide an essential basis for geophysical surveys at Kalba site 4.

### Geophysical surveys

Geophysical investigations were performed to gain more information about the dimensions of the site which, to date, remain unclear. The prospections were conducted on-site and in the vicinity of the mound by using two methods: magnetics and ground penetrating radar (GPR). For magnetic surveys a LEA MAX magnetic gradiometer array with seven fluxgate gradiometer probes was used. In total, an area covering 2.4 ha was surveyed inside and outside the currently fenced area. The GPR system SIR-3000 from GSSI with a 400-MHz antenna was applied at selected, suitable locations on-site covering 460 m<sup>2</sup> in order to detect hidden structural remains. The results of both methods revealed anomalies. According to the course and depth, these result from hidden structures of the Bronze Age to Iron Age occupations at Kalba.

The extensive surveys of the magnetics provide information about the general dimensions of the site (Fig. 2). At Kalba, the data are characterized by high amplitudes of the magnetic gradient due to the magmatic ophiolite stones used as construction material. The strong dipole anomalies dominate the data set; only the localization of stone constructions was therefore possible. Negative structures like pits and ditches were not recognizable in the data.

Significant anomalies were detected up to c.60 m around the mound indicating a minimum size of the site with a diameter of c.110 m. Additionally, magnetic measurements outside the fenced area in the southern vicinity of the excavation suggest no further indications of a continuation. In this area, only structures probably belonging to an Islamic graveyard were detected. However, it should be kept in mind that the enormous quantity of sediments covering the area today allows

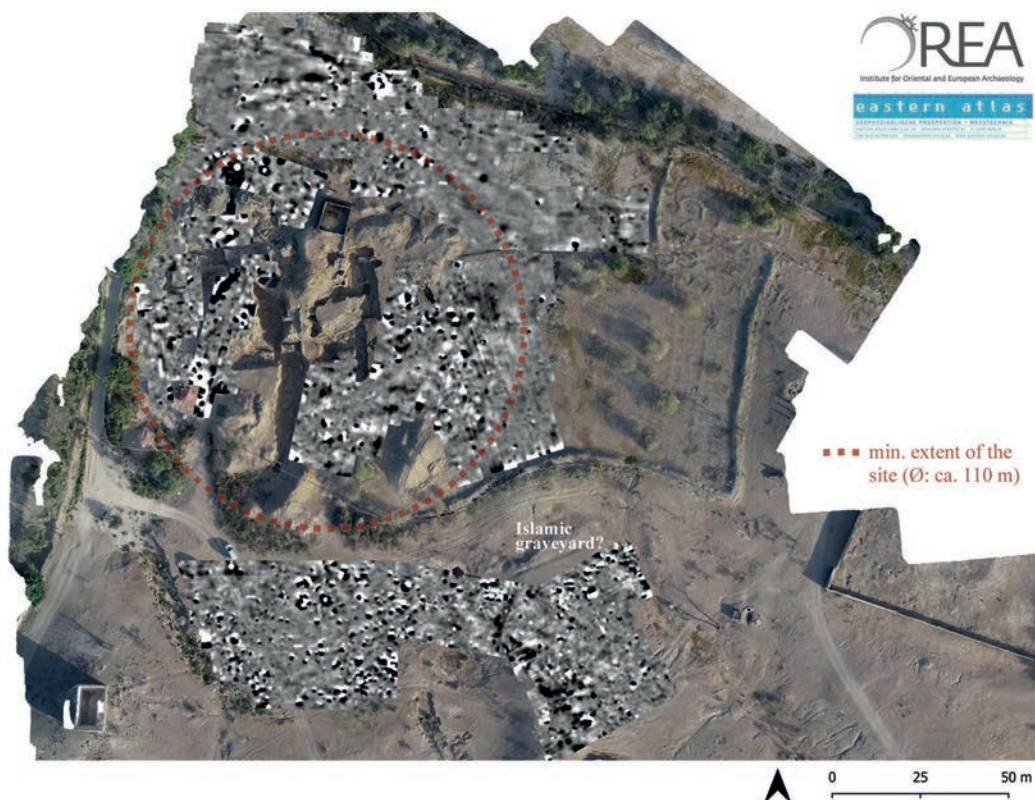


**FIGURE 2.**  
The results of  
the magnetic  
measurements  
(map: M. Börner/  
OREA; data:  
C. Meyer/Eastern  
Atlas; aerial  
photographs: M.  
Kamyab/SAA).



**FIGURE 3.**  
The results  
of the ground  
penetrating radar  
(map: M. Börner/  
OREA; data:  
C. Meyer/Eastern  
Atlas; aerial  
photographs: M.  
Kamyab/SAA).

only a limited assessment of former topographical conditions and, hence, the extension of the site through time. It must be assumed that, especially for the Bronze Age periods, structures could be hidden at some depth under the ground, which makes them impossible to detect by geophysical survey.

Beside magnetics, the GPR measurements applied in specific areas (A–C) confirmed assumed structures detected by the magnetics (Fig. 3). In the south-eastern direction of the mound (A), some curvilinear structures were recorded, most probably belonging to the Iron Age occupation of the site. Three areas in the north and west of the mound (B) were surveyed by GPR to determine the predicted course of the Late Bronze Age tower. The north and north-western areas provided strong indications for the course of the mud-brick wall with stone core, both showing a bright circular segment located in the south/

south-east, most probably resulting from the mud-brick architecture. Moreover, a small narrow anomaly was found inside the bright circular segment, presumably representing the stone core of the tower wall. This becomes clear by mapping the GPR results on the architectural plan of the site (Fig. 4).

Additionally, in the eastern part of the mound, inside a previously excavated trench (C), GPR was used, providing preliminary information about hidden structures in the selected excavation area (E1).

### Trial excavations (Trench E1)

The aim of the trial excavation in this trench was to detect Early Bronze Age occupation layers and possible remains of structures that were built in the area between the tower and the steep retaining enclosure wall ('wall

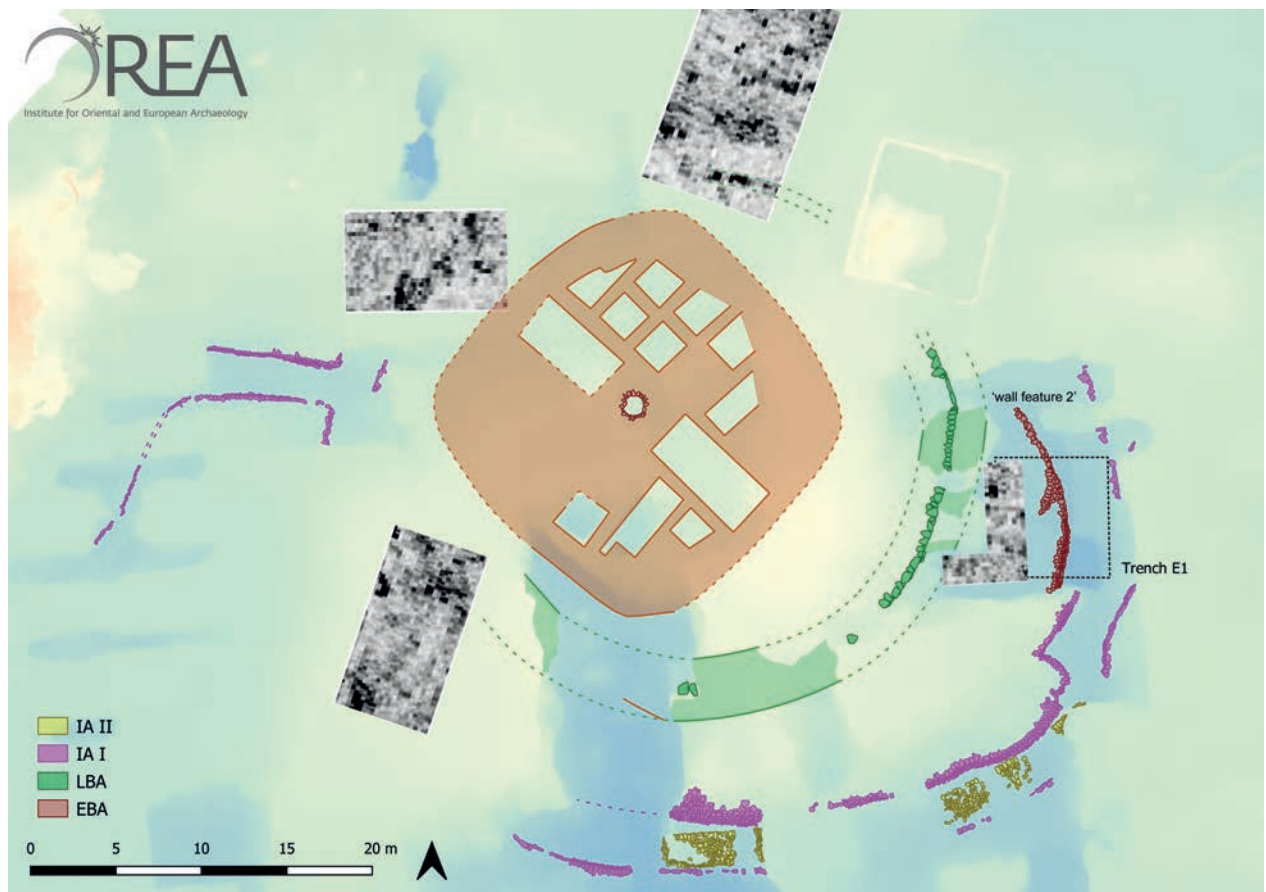


FIGURE 4. A topographical plan including the recorded architectural remains, the result of the ground penetrating radar, and the locations of trench E1 (map: M. Börner/OREA; data: C. Meyer/Eastern Atlas).



FIGURE 5. The western part of trench E1 with defined features (photograph: M. Börner/OREA).

feature 2' in Eddisford & Phillips 2009: 104, fig. 7) (Fig. 4) in the east of the site. The area of investigation was inside an area that had previously been excavated by Phillips, where it was possible to reach Early Bronze Age layers without first removing the later occupation phases. Trench E1 measures 7 x 7 m (Figs 4 & 5) and covers the inside and outside of the curvilinear Early Bronze Age retaining wall, offering the opportunity to study this construction and the adjacent areas in detail.

After removing the mixed surface layers, structures, most probably already excavated by Phillips, came to light, consisting of a small curvilinear wall section with remains of dried and stamped clay (Fig. 5: SU 4 & 5) built on the Early Bronze Age retaining wall (Fig. 5: SU 7). The clay was located above an extended sandy layer (Fig. 5: SU 6) which had already been excavated in former times and covered areas next to the massive retaining wall. SU 6 is quite important because it

provides stratigraphical insights. The uppermost level that is preserved and visible today clearly shows that SU 6 abuts the large Early Bronze Age retaining wall. It can therefore be assumed that the layer consists of material that was built up in the course of the construction of the wall, covering even older sediments of earlier occupation layers cut by the retaining wall. This assumption is favoured because structures were detected in the south-western part of the trench, consisting of a partially preserved, possibly circular or semi-circular fireplace (Fig. 6: SU 8 & 9) and a nearby shallow pit (Fig. 6: SU 11) situated on an occupation level (Fig. 6: SU 13).

The fireplace itself was a stone-clay construction, with a burned sandy layer (Fig. 6: SU 10) inside this feature containing a large amount of charcoal and a small fragment of an Umm an-Nar ceramic sherd (Fig. 9: KAL19/10/1/1). Anthracological analyses by Barbara

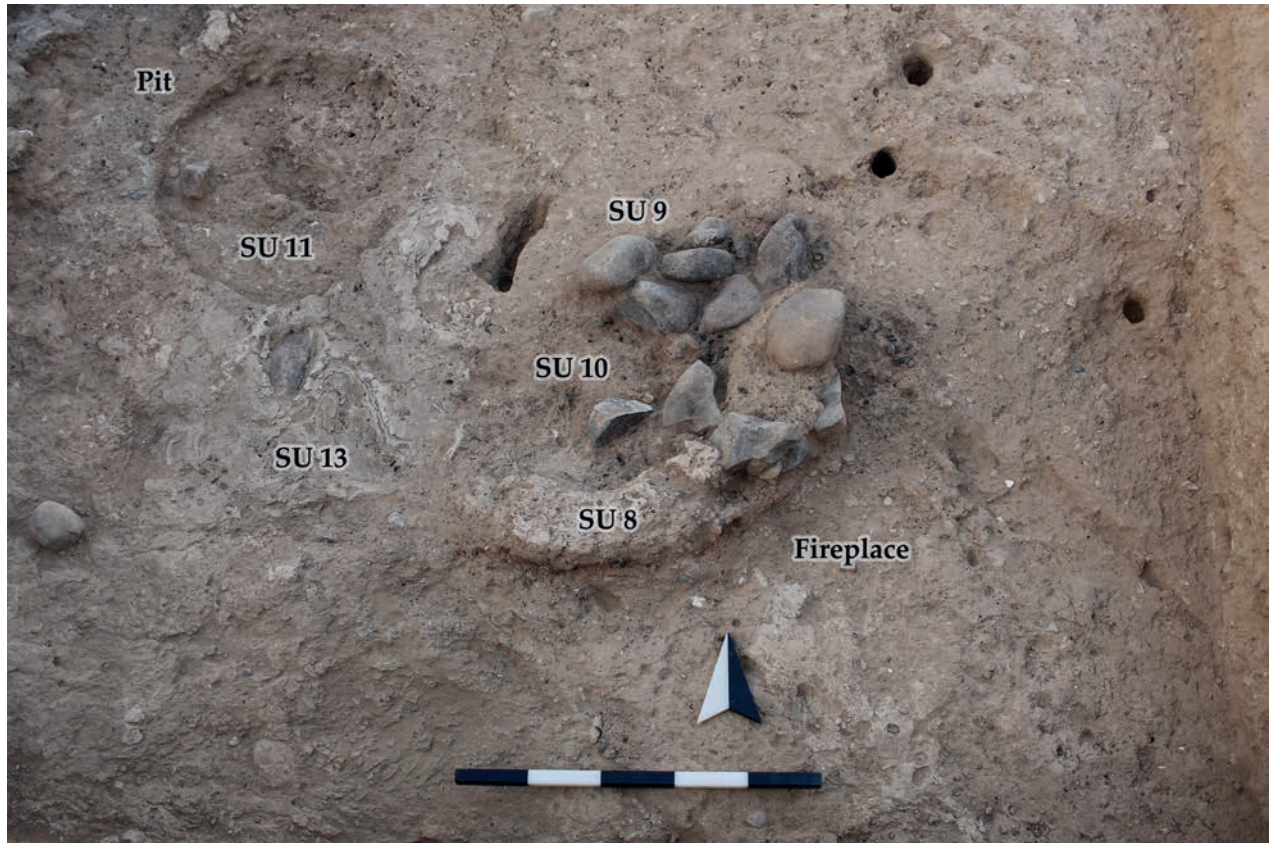


FIGURE 6. A fireplace and pit situated in the south-western area of trench E1 (photograph: M. Börner/OREA).

Eichhorn of a charcoal sample revealed that mangrove wood (*Avicennia marina*) was burned in the fireplace. A calibrated radiocarbon date of this sample proves the presumed dating of the fireplace by pottery to the Umm an-Nar period in the late third millennium BC (lab code: MAMS 42622; sample name: KAL19/10/14/1; radiocarbon age:  $3772 \pm 25$ ; 2-sigma range: 2288–2064 calBC; 1-sigma range: 2274–2141 calBC; radiocarbon data calibrated with IntCal13 using OxCal v4.3.2; Bronk Ramsey 2017; Reimer et al. 2013). The use of this plant species is not surprising, as previously conducted palaeo-environmental studies in the vicinity attest. It transpired that during the Early Bronze Age period, the mangroves in coastal areas were used as a source of both nutrition and wood (Phillips & Mosseri-Marlio 2002: 614; Eddisford & Phillips 2009: 109).

Besides the inner part of the massive Early Bronze Age retaining wall, excavations were started in the outer

area. Here, two mud-brick wall sections were discovered underneath a fill (SU 3) in the north-eastern profile of trench E1, presumably belonging to the post-Early Bronze Age occupation of the site. In the south-eastern part, a test pit was opened in order to reveal more about the surface level on which the Early Bronze Age retaining wall was built and, thus, its total height (Fig. 7). In the course of the trial excavations, the monumental wall was uncovered to a height of 3.35 m, but the surface level on which it was constructed has not yet been unearthed. The test pit is still partially covered with the backfill of Phillips's investigations, but it was possible to determine a  $56^\circ$  angle for the steep Early Bronze Age retaining wall.

### Material studies

During the excavation, a small number of finds (pottery, molluscs/bones, and small finds) were unearthed. The



FIGURE 7. The test pit outside the Early Bronze Age retaining wall in trench E1 (photograph: M. Börner/OREA).

bulk of the material is represented by pottery (186 sherds) and derives from the mixed surface layer SU 2 (56 diagnostic sherds out of 96). Additionally, metal slags, a tiny corroded metal object, fragments of crucibles, a lithic flake made of chert, a stone vessel fragment (Fig. 10), burned clay, and a ceramic disc were found in this context. Outside the retaining wall, the (presumably) post-Early Bronze Age layer SU 3 produced twenty-three diagnostic sherds out of sixty-seven pieces as well as a ceramic disc. Thirteen diagnostic pieces out of twenty-two pieces were discovered in the Early Bronze Age filling layer SU 6. The few sherds dating to later Iron Age periods (Fig. 8: KAL19/6/1/7) seem to derive from the mixed upper excavated layer. As already mentioned, one small decorated sherd was discovered inside the fireplace (SU 10; Fig. 9: KAL19/10/1/1).

The material studies are not yet complete, but most of the pottery recorded from the excavation deriving from the uppermost mixed layers can be associated with the

Iron Age periods. In particular, pottery of the Iron Age II period (Fig. 8) was found with significant shapes and decorations, such as fragments of storage jars with criss-crossed incised lines (Fig. 8: KAL19/2/1/22), a fragment with snake appliqué decoration (Fig. 8: KAL19/2/1/47; KAL19/6/1/7), and fragments of a bridge-spouted vessel with black decoration comprising rounded meander motifs framed by horizontal lines and short vertical lines (Fig. 8: KAL19/2/1/16; KAL19/2/1/26). Similar items are well known from Iron Age excavations, such as the recent investigations in the Emirate of Dubai at Saruq al-Hadid (Weeks et al. 2017: 44–47, figs 13a, 14b, 16).

Only a small amount of pottery was discovered during the excavation, in what are presumed to be Early Bronze Age layers. This correlates with the general information provided by Eddisford and Phillips that '[a] relatively small assemblage of pottery was recovered from the sealed third-millennium deposits' (2009: 105). A selection of Early Bronze Age pottery from different



**FIGURE 8.** A selection of diagnostic Iron Age pottery (photograph: M. Börner/OREA).



**FIGURE 9.** A selection of diagnostic Early Bronze Age pottery (photograph: M. Börner/OREA).

contexts presented here shows typical decoration of the Umm an-Nar period. The sherds are made of fine red wares decorated with dark-brown to black ladder motifs (Fig. 9: KAL19/3/1/16; KAL19/3/1/19) composed of wavy parallel lines with inner vertical lines, multiple parallel crossing lines forming chevrons (Fig. 9: KAL19/2/1/27; KAL19/6/1/8), and parallel horizontal

and wavy lines (Fig. 9: KAL19/2/1/46; KAL19/3/1/3; KAL19/3/1/16; KAL19/10/1/1). A rim fragment of a bowl shows alternating horizontal and wavy lines (Fig. 9: KAL19/3/1/3). The sherds can be compared with the local pottery of Kalba already published by Phillips (Eddisford & Phillips 2009: 105–106, figs 9–12), dating to the third millennium BC.



**FIGURE 10.** A fragment of an Early Bronze Age stone vessel with incised decoration (photograph: M. Börner/OREA).

Apart from pottery, a fragment of a stone vessel (Fig. 10) was found during the excavations in the test pit in trench E1 (Fig. 7) but unfortunately, it derives from layers of backfill from a previous investigation. The fragment belongs to a shallow bowl with incised decoration directly underneath the rim in the form of a horizontal line and double-dotted circles. The shape and decoration are quite typical of the Umm an-Nar-style stone vessels dating to the second half of the third millennium BC (David et al. 1990: 953, figs 1b, 2b; David 1996: 34–38, fig. 5).

### Discussion

The site of Kalba (K4) with diachronic occupations from the Early Bronze Age until the Iron Age gives us the opportunity to study the development of a coastal site through the millennia.

In particular, the massive tower constructions of the Bronze Age are raising questions about their

function, which is still under debate. The recent paper by Stephanie Döpper about the possible function of towers and ditches in third-millennium BC eastern Arabia, summarizes the possibilities of interpretation and current suggestions such as ‘protections against floodwater, defence against attackers, and irrigation systems’ (Döpper 2018: 128–129). Although there are towers indicating a height of up to 5 m, the bulk of these constructions are interpreted as a kind of platform rising just a few metres above the surrounding terrain (2018: 128). So far, the function of the towers and ditches has not been determined, but further investigations could help to improve our knowledge of these constructions. Significantly, aside from Kalba there are only two other sites with towers situated near the coastline on the north-eastern Arabian Peninsula: Tell Abraq (Potts 1990: 22–32; 1991: 21–25; 2000: 41–43) in the Gulf region, and Bidya (al-Tikriti 1989) in the Gulf of Oman. This raises the question of whether these sites represent nodes within Early Bronze Age maritime interregional trade

networks. In this context, the site could have functioned as a mediator between routes by sea and land enabling connections and a distribution of goods further south in the interior of the Arabian Peninsula. Former excavations by Phillips at Kalba have already provided evidence that, during the Early Bronze Age period, the site participated in interregional trade networks attested by imported pottery from Mesopotamia, Iran, and the Indus region (Eddisford & Phillips 2009: 108–109).

Besides the optimal geostrategic position for maritime trade, the location of the site could possibly be explained by nearby copper sources. During field investigations in upper Wādī al-Ḥilo, the copper smelting site HLO1 was studied in a joint cooperation between today's Sharjah Archaeology Authority and the University of Tübingen (Kutterer & Jasim 2009; Kutterer 2013; Kutterer, Neureiter & Jasim 2013). It transpired that at HLO1 directly accessible copper deposits had been exploited since the Early Bronze Age period (Kutterer & Jasim 2009: 249–250; Kutterer 2013: 163–164). The copper sources are situated c.15 km (as the crow flies) from Kalba and copper could have been transported to the coastal region of the Gulf of Oman via Wādī al-Ḥilo (Kutterer 2013: 34–36, fig. 4.3). Excavations and archaeometallurgical analyses revealed that mining activities and metal production at HLO1 have to be seen in the context of a larger exchange or trade network during the Bronze Age periods (Kutterer 2013: 104–105). Taking this into account, the site of Kalba could have functioned as a distributor of copper procured from the nearby mountains, perhaps site HLO1, as part of an interregional trade network already detectable in the third millennium BC. This hypothesis is supported by the imported pottery found at Kalba, mentioned above. Additionally, the site's importance and its far-reaching contacts could also be indicated by the presence of Umm an-Nar-style stone vessels. According to Eddisford and Phillips, there is evidence of the manufacture of such stone vessels at Kalba (2009: 109) — although detailed analyses of the raw materials of the vessels at Kalba have not yet been conducted — and the accessibility of suitable raw material sources could have contributed to the establishment of the site in this region. Further research at Kalba and its vicinity should enable us to answer currently open questions about this early dating coastal community.

## Acknowledgements

The investigations in Kalba were conducted with the authorization and support of the Sharjah Archaeology Authority and the Ruler of Sharjah, H.H. Shaykh Dr Sultan bin Muhammad al-Qasimi. Furthermore, we would like to thank the Institute for Oriental and European Archaeology (OREA) and the 'Dr. Anton Oelzelt-Newin'sche Stiftung' of the Austrian Academy of Sciences for funding and the Austrian Embassy Abu Dhabi, especially H.E. ambassador Dr Andreas Liebmann-Holzmann, for their support during our fieldwork in 2019. Additionally, we would like to thank Dr Barbara Eichhorn, University of Frankfurt for determining the species of the charcoal sample and we are very grateful to Nicola Wood for proofreading this paper.

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