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The Oman Border Fence project 2021 – a journey through the hydraulic, agricultural and funerary landscapes of Al Ain

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2. Collective tombs - Iron Age cemetery – PIR tombs – Aflaj – Iron Age Agriculture

3. Abstract

Over a six-month period from January to August 2021 the Historic Environment Department of DCT Abu Dhabi carried out archaeological monitoring and excavation along an 11.5km stretch of a project to renew the existing border fence between UAE and Oman.

The project produced a wealth of new data on the development of the historic oasis landscape of Al Ain. Some of the most significant features include a monumental stone tomb from the Late Bronze Age, an apparently extensive Iron Age cemetery and high-status tombs of Pre-Islamic Recent (PIR) date.

Along with this funerary landscape we have identified more than 50 ancient *aflaj* or underground water channels of various dates and techniques of construction, along with extensive evidence for distinct phases of Iron Age agriculture and the organization of their associated irrigation systems and agricultural plots.

This paper will provide an overview of the nature and progress of the fieldwork and initial study of the finds associated with the various feature groups, including a corpus of Iron Age and PIR ceramics from both funerary and agricultural contexts, a large number of chlorite vessels, PIR

iron weaponry, extensive environmental samples and information on the geology and wadi systems shaping this cultural landscape.

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INTRODUCTION - THE OMAN BORDER FENCE (OBF) PROJECT, JANUARY- AUGUST 2021

Building on the new insights into the ancient landscape of al-‘Ayn that were gained during work at Al Ain Museum in 2019-2020 (Sheehan *et al.*, 2022), this paper will present some further observations made during a rather rapid journey through more than eleven kilometers of that landscape in the spring and summer of 2021, during a project by the UAE Armed Forces to renew the border fence between al-‘Ayn and Buraimi. It will introduce the project and the archaeological response, describe the progress of works from south to north highlighting the major archaeological feature groups encountered along the way, offer some preliminary analyses of the associated finds groups and conclude with some brief observations on various aspects – hydraulic, agricultural and funerary – relevant to our understanding of the ancient landscape of al-‘Ayn.

Since 2019 we have recorded more than one hundred separate *aflāj* locations, of various dates and types, during construction and infrastructure projects in the old *shaabiyāt* housing areas around Hīlī and Qaṭṭāra oases. It was clear therefore when notification of this project was received in April 2020 that the border fence potentially had important archaeological implications, particularly to the east of the Qaṭṭāra, Jīmī and Hīlī oases, where a number of *falaj* alignments recorded previously would, if extended eastwards towards their source, cross the line of the border fence. Based on this information it was made a condition of the works that archaeological monitoring would be required from the southern edge of the concerned area, as defined by the Wādī al-Jīmī. From this point the changing alignment of the excavation for the new border fence as it proceeded northwards for 11.5km to the mountain allowed its division into six consecutive zones (Aa, Ab, B, C, D, E), together providing a series of cross-sections through the ancient landscape of al-‘Ayn (Fig.1).

Fig. 1 – Map showing the different zones Aa-E of the Oman Border Fence project

PROJECT AND ARCHAEOLOGICAL METHODOLOGIES

The scope and rhythm of the construction project determined the excavation and recording methodology employed. The trench was roughly straight-sided, 3.5m wide by 3-4m deep, and the design of the fence and its location predicated from the start that everything along its line would be removed¹. Work entailed machine excavation of more than a million cubic metres, with the spoil temporarily heaped to the external/Oman side of the trench and then used to backfill after the pre-cast fence foundations had been lowered in by crane (Fig. 2). For security reasons excavation was coordinated with the removal and replacement of the existing fence to minimize gaps left open overnight. In general, the archaeological works was not extended beyond the 3.5m width of the trench other than in a few locations of particular archaeological interest discussed below. From our side we approached it as a ‘rolling’ evaluation trench, proceeding at an average of 80m a day, which we hoped would inform our understanding of the landscape, identify locations for future archaeological work and assist our ongoing efforts to manage and protect the historic environment.

Fig. 2 – View looking south along the border fence in Zone Ab showing the sequence of works, with archaeological investigations and recording of a falaj in the foreground and in the distance backfilling around the fence foundations

Excavation and recording methodologies developed to follow this rhythm. In Zones Ab and B initial excavation after removal of the old fence used a smaller JCB with a ditching bucket and/or a larger excavator with a steel plate fitted over the bucket teeth to remove quite deep and very compact overlying sand deposits to the top of the underlying natural. Each newly revealed area was then carefully cleaned by hand and the limits of individual cut features were recorded by total station and photogrammetry. These cuts were then completely excavated and assigned to feature groups based on typology or function (Fig. 3). Deeper features such as wells were explored to as great a depth as could be safely achieved, and larger cut features which there was no time to fully excavate were explored with sondages. The broad strategy was to assign individual cuts to distinct feature groups (square tree pits, round tree pits, agricultural basins etc.) based on typology or function and then to try to date each of these feature groups, relatively

¹ An exception to this was made for the PIR tombs in Zone Ab discussed below, where the foundation design of a section of the trench was modified to allow these important structures to be preserved *in situ* beneath the fence.

using pottery and other finds and absolutely from any associated C-14/OSL samples. After a second round of photogrammetry of the excavated cuts the machine returned and completed excavation to the full depth of the trench. A third round of photogrammetric recording before the installation of the fence foundations recorded this additional lower part of the sections and deeper cut features like *aflāj* in plan. In the other zones excavation took place only once and was followed by cleaning and recording of the sections and excavation of any archaeological features noted in plan (Fig. 4). Together these digital photogrammetry sessions created a series of consecutive and overlapping 3D models (more than 200 in all) from which orthophotos in plan and elevation have been produced. Deeper *aflāj* shafts and tunnels that we were able to enter and explore outside the trench limits were recorded by 3D scanner.

Fig. 3 – Plan of parts of Zones Ab and B, with detail of plan sheet 22 showing survey and orthophotos of tree pits and other cut features during different stages of excavation

Fig. 4 – Photogrammetry in progress in Zone C

ZONE Aa – AFLAJ AND CHANNELS

Zone Aa comprised the first 500m of the archaeological project and provided a swift introduction to its opportunities and attendant challenges. This first section through the ancient landscape revealed, as expected, mainly linear cut features such as covered *aflāj* or open channels coming from the southeast and heading towards Jimi Oasis. This type of feature continued into Zone Ab and around the 600m mark included the historic stone-lined Jīmī *falaj* whose location in plan (but not elevation) was broadly known from Al Ain Municipality mapping and the line of existing covered shafts (*thuqbah*, pl. *thuqb*) running towards the oasis. The stone roof of the *falaj* is intact and the channel consequently a void, which was explored and recorded by 3D scanner to a distance of around 85m to the west and around 10m to the east. Immediately to the north of the Jīmī *falaj* we recorded what appears to be an Early Islamic brick channel that we have now been able to trace in various locations since 2013 for a total length of more than 1200m. In all these locations it appears to have been a broad straight channel 1m wide and 0.45m deep, carefully built with red brick and lime plaster, open to the air and capable of transporting a significant

amount of water, perhaps reflecting a seasonal flow of run-off water from the Wādī al-Jīmī (Sheehan *et al.*, 2022: 362-3).

ZONES Ab and B – IRON AGE CEMETERY, IRON AGE FIELD SYSTEMS, PRE-ISLAMIC RECENT (PIR) TOMBS

Moving north from Zone Aa, Zones Ab and B presented a multi-period funerary, hydraulic and agricultural landscape with a dense array of well-preserved archaeological features and deposits. Around the 1km mark there are a number of walled modern and pre-modern cemeteries on both the al-‘Ayn and Buraimi sides of the border and at around 1135m a single Late Islamic burial was noted in the trench section. The longevity of this area as a funerary landscape was however soon indicated by three Iron Age graves, partially preserved within the west-facing section, which appear to indicate the southern extent of the Iron Age cemetery discussed below. In form these graves consisted of a narrow access shaft opening into a broader conical burial chamber, with the latter accessed in some cases by a step cut into the natural below the access shaft.

Whilst excavation of these three graves was proceeding, machine excavation was stopped around 70m further north having encountered a group of large, worked stones, which on further cleaning and investigation were shown to be part of the sloping entrance passage to a large stone-built collective tomb (Tomb A). This tomb is at least 25m long (its eastern extent beyond the limits of the border fence trench remains unknown) and 3m wide, with carefully built stone walls lining the side of the cut and remains of a corbelled roof. The overall preserved height of the tomb is around 1m, but the floor appears to have been excavated down below the bottom of the walls, perhaps in a secondary phase. The north side of the portal and entrance passage and the southern jamb (composed of a reused Umm al-Nār ashlar tomb facing) survived. Archaeological investigations here were extended beyond the border fence trench to define the western limits of the structure and establish the sequence of its construction, use and abandonment. This showed it had been disturbed by 2 machine-excavated modern service lines of unknown date², but careful cleaning of the sides of these trenches allowed us to reconstruct this sequence and indicated that the tomb survived largely intact until the Late Islamic period, when a robber trench removed the

² We understand one of these trenches to have been dug in 2006.

entire eastern and part of the western wall (ignoring the larger and perhaps therefore less useful stones of the portal). This apparent focus on the smaller stones from the walls of the tomb may link the robbing to the construction of the nearby Late Islamic Qaṭṭāra *falaj*. Only 6.3% of the ceramic assemblage from Tomb A can be dated to the Late Bronze Age, with 65% from the Iron Age, the most common shapes being bowls, storage jars, cups and spouted vessels, and 20% dated to the transitional period between the end of the Iron Age and the Late Pre-Islamic Recent (*Pre-Islamic Recent* or PIR) period.

Fig. 5 – Plan of the prehistoric cemetery between Tomb A and Late Islamic Qaṭṭāra falaj, with orthophotos of the part of Tomb A west of the border fence trench which have been derived from the photogrammetric model. Note the modern service lines and the robber trench dug to remove the stone from its eastern wall.

Fig. 6 - Table showing the ceramic distribution from the cemetery, divided between Tomb A, the second collective burial and the individual graves.

The northern limit of this prehistoric cemetery is indicated by another similarly aligned and rectangular collective tomb about 120m north of Tomb A. This rectangular cut {069} into the natural is 5m long, 2m wide and 1.4m deep and was originally roofed with stone slabs. Only 3.2% of the assemblage from this tomb can be dated to the Late Bronze Age, with 74% from the early Iron Age and 9% fast wheel-made ware characteristic of the Late Iron Age, suggesting that like Tomb A this tomb continued in use throughout the Iron Age. Excavation of the fill of the collective tomb in six vertical spits indicated some trends which included a higher concentration of Late Iron Age classes in the upper fill and a large amount of pottery imports associated with the Iron Age II (1100-600 BCE) in the lower spits.

Between these two collective tombs we recorded around 35 individual graves within the limits of the trench. Blocking of the burial chamber with stone or gypsum bricks was a feature of a number of the graves, whilst others had narrow slots tunneled into their sides which may have been for burial goods. The individual graves appear to all date to the Early Iron Age/Iron Age II

and included a relatively large number of complete or nearly complete vessels. Other finds included gold jewelry, copper arrow heads, beads and shell ornaments.

The cemetery also produced a significant assemblage of softstone vessels, most of them dating to the Iron Age. The assemblage from the project consists of 370 fragments of vessels and lids, the vast majority from the two collective tombs and the Iron Age cemetery at the southern end of Zone Ab. The majority of the fragments from Tomb A and the other collective grave can be dated to the Iron Age, with the most common shapes the conical/closed vessels, open and spouted bowls and beakers. One bowl from the collective grave {cut 069} retains a partial representation of a fish and another is made of a different kind of (mud)stone suggesting a provenance in Mesopotamia or the Levant. Vessels from the individual graves form part of the same Early Iron Age softstone assemblage, although one grave {cut 040} does contain fragments of a calcite vessel, probably a goblet or beaker with a stem, rarely found in Southeast Arabia during the Iron Age.

Fig. 7 – Examples of softstone vessels from the collective burials and individual graves in the Iron Age cemetery in Zone Ab.

Around 50m to the north of the cemetery a 5m deep and 1m wide open channel with subsidiary branches marks the southern edge of an extensive Iron Age agricultural landscape, characterized by intersecting channels with shallower rills branching off to feed rows of individual tree pits. Most of these tree pits were shown to be square cuts carefully excavated into the natural, and the impression that these were intended to function as ‘plant pots’ is supported by the presence in many of them of a small ‘bowl’ or depression at the centre, presumably to allow for drainage of excess irrigation water and to prevent waterlogging of the roots (see Fig. 3). There are also some deeper round tree pits (for palms?), also linked by channels, and in several places cutting the earlier square type, perhaps suggesting rather a short interval between different cultivars. Although cut or overlain by later activity, clear traces of this initial field system continue for at least a further kilometer to the north within Zones Ab and B. Between 1380-1560m in Zone Ab there was also evidence for later land use in the form of deep wells apparently reused as middens and filled with large quantities of PIR pottery, similar to those we had noted in 2019 at Al Ain Museum. (Sheehan *et al.*, 2022: 357-62, Figs. 4-7).

The funerary aspect of the landscape reappears at a slight rise around the 1620m mark, where the dense sand deposits that had accumulated over this earlier Iron Age field system are cut by two masonry-lined subterranean PIR tombs (Tombs B and C). The more southerly of these (Tomb B) is a roughly 2m square masonry-lined cut, while the construction technique of Tomb C appears very similar to that used in the PIR tomb revealed during excavations at Al Ain Museum in 2019 (Sheehan *et al.*, 2022: 362, Fig. 9). A triangular stone squinch at the northwest corner suggests a vaulted or perhaps a corbelled roof like that partially preserved in Tomb B. Lime mortar was used in the construction of the subterranean part of the tomb, with a 330mm thick filling of mortar poured or thrown into the gap between the foundation trench and the 300mm thick facing stones of the burial chamber. Almost all the superstructure of these tombs had vanished, leaving very thin mortar spreads between 50-250mm thick which appear to have been 'blinding' layers of this same lime mortar for the above ground structure. Later robbing of Tomb C for its stone appears to have been interrupted and defeated by a massive Umm al-Nār block that had been used to form most of the east wall of the subterranean chamber. The reverse of the stone is stained by burning and the associated ash appears to represent the fill of a firepit intended to heat and crack it.

Fig. 8 – Tomb C after excavation, with insets showing the numerous fragments of iron weaponry in situ and during conservation.

Distributed, apparently concentrically, around Tomb C are several quite deep (up to 0.85m) rectangular grave cuts, one roofed with stone slabs and more than one containing large bones of ungulates. These appear to represent archaeological evidence for the pre-Islamic *balīya* practice of slaughtering and/or burying camels around the grave to accompany the high-status occupant in death (Jasim 1999:69-101; King 2009: 81-93).

The lower fill of Tomb C contained numerous fragments of iron weapons and other grave goods. In relation to the iron material it was already apparent *in situ* that there was a mixture of arrow heads and larger sword (single edge) or spear heads. It was also clear that some of this material had mineral preserved structure of wood grain, likely from the scabbard of the sword, on the

surface. This material is most often described as Mineral Preserved Organics (MPO), and can be observed when while being in the ground, the metal ions diffuse into the organic materials adjacent to a metal part and crystallize while the organic material degrades. The organic material is mostly no longer present but the physical features can still be seen in the shape of the corrosion products. There were also around 200 ferrous arrow heads/small spears, most of which show the presence of mineral preserved wood on the tangs. Amongst the larger blades, either swords or spear heads, there appear to be about 15 tips and 4 pieces with the interface of blade and tang. There are blade fragments with a number of profiles, both single and double edged, or with a groove and ridge along the middle of the blade. There are also remains of scabbard and sword handles, including MPO such as wood, textile and skin product, as well as likely scabbard fittings, staples and rivets and two possible pommels. Much of the material shows brittle fractures, indicating that it broke after it was already entirely corroded and suggesting that the tomb may have remained undisturbed for a considerable time.

A typology of PIR ceramics had previously been developed during the Al Ain Museum project and was used as the basis for the study of the PIR assemblage from the border fence (Power, 2015; Power *et al.*, 2019; Sheehan *et al.*, 2022: 361-62, Figs. 5-7). A chronological framework was provided by the presence or absence of type fossils documented at key regional sites, especially Mleiha and ed-Dur (Mouton, 1992; de Paepe *et al.*, 2003; Haerinck & Overlaet, 2016). The PIR funerary assemblage comes from Tombs B and C and from a large ashy dump about 50m to the north, which we have interpreted as evidence for ritual feasting contemporary with Tomb C and associated with funerary rites or visitation. This material comprises almost half (47.20%) of the total PIR assemblage from the project and includes a greater portion of prestige imports, particularly wine jars and serving bowls, deposited as grave goods. Initial analysis of the ceramics has suggested that the tombs may belong to different phases of activity within the PIR.

To the north of the PIR tombs the Iron Age agricultural landscape continues, now however with evidence for two distinct phases. Here surviving ‘islands’ of bedrock preserving the earlier arrangement of tree pits and channels alternate with deeper and apparently roughly rectangular basins cut through this bedrock that are watered, and perhaps linked by, deeper V-shaped channels at one end of each basin. What seems to be a broadly similar orientation of the basins to that of the earlier irrigation channels might suggest a degree of continuity. There is however a distinct

character to the fill of the basins, with darker silty deposits containing copper fragments suggestive of a manuring layer reusing domestic refuse.

The ceramic assemblages from both agricultural phases are dominated by Iron Age common wares, with only a single sherd from each of fast wheel-made ware which is considered the main chronological marker for the Late Iron Age. The development of organic wares and some differences between the shapes of bowls found in the tree pits and the later basins points to a discrete evolution, but overall the similarity between the assemblages means that dating these different phases and understanding the reasons for the change for now remains a work in progress.

The relative paucity of Late Islamic ceramics was a feature of the whole length of the border fence trench. Traces of the field wall system known from historic archive photographs were noted at either end of Zone Ab, very close to modern ground level and lying above the thick layer of compact windblown sand that seals the Iron Age agricultural landscape. One activity that does seem to date to the Late Islamic period based on the ceramics is an area in Zone Ab between the 1845 and 1950m marks containing a dense series of intercutting pits, apparently for the mining of green clay deposits in this area. These clay mining pits clearly cut through and post-date the earlier array of tree pits, a few truncated examples of which survive in section or between adjacent claypits.

ZONES C-E

The eastward extent of the Iron Age basins in Zone B lies around the 2600m mark of the border fence trench. Beyond this, natural deposits come gradually closer to the modern surface and a large section of Zone C produced no archaeological material until around the 4.8km mark, where a pair of very large and deep *thuqb* filled with loose sand form part of a *falaj* that was clearly known into modern times, as part of it appears on the municipality mapping. Around 100m further north a quite different *falaj* was noted, consisting of three rectangular *thuqb*, 5m deep and with a gravel layer in the side of the falaj collecting and directing water into the rock-cut channel below. This type of relatively shallow *falaj* tapping subsurface flows appears to be the earliest typology we have encountered in various locations in in al-‘Ayn over the last couple of years.

Zone D presented a 4km long section through the landscape as it approaches the rocky hills north and east of the archaeological site of Hīlī. Here, where ancient ground levels are sealed by increasingly thick layers of colluvium and deep deposits of windblown sand, we recorded the upstream sections of more than thirty *aflāj* of various typologies and depths, with similar typologies broadly arranged in groups, most running southwest towards Hīlī but at least three actually heading northwest in the direction of al-Fû‘ah.

Fig. 9 – Excavation was extended to the east in Zone D to establish the direction of a falaj encountered in the border fence trench and explore a pair of 12m deep thuqb and the connecting tunnel.

Zone E lies north of a buried spur of the adjacent hills cut through by the border fence trench. Here we noted three more *aflāj* but perhaps the most notable features of the landscape in this section are the dark silty deposits overlying a layer of greenish clay, a product of oxido-reduction indicating ancient groundwater levels. These silt deposits occur from around the 10.5km mark and perhaps extend westward from the mountains to form the agricultural hinterland north of the Bronze Age and Iron Age settlements of Hīlī.

THE HYDRAULIC LANDSCAPE

The primary evidence for the transport of water within the landscape is the 50+ *aflāj* of various dates and techniques of construction recorded during the project. Although most of these linear features were noted in the harder natural deposits of Zones C-E, *aflāj* were found in every zone. Other important evidence was recorded in the form of natural channels and watercourses (Arabic *wudyān*, sing. *wādī*) that appear to have strongly influenced the overall direction and functioning of the *aflāj*, and on the micro level by the regular network of minor distribution channels or rills within the agricultural areas. There are few finds from the *aflāj*, but a number of distinct typologies can be identified, including relative shallow (up to 5m) tunnels with closely spaced rectangular access shafts, extremely deep circular shafts with winding tunnels, and broad open

ghayli channels, in addition to the Early Islamic brick *falaj* and the stone lined *aflāj* of the Late Islamic and early modern period.

For the Iron Age there are clearly a large number of *aflāj*, including broad open *ghayli* channels directing surface flow from the nearby mountains and tunnels with rectangular shafts collecting shallow subsurface flow from the natural gravels. Whether there is a development from one type to the other in response to changing technology or groundwater levels remains to be clarified by ongoing investigations. Most of these Iron Age *aflāj* are found in Zones C-D, coming from the northeast and heading towards Hīlī and Rumaila. Some can be tentatively linked from their alignment and level to locations that we have recorded during stormwater works in the old *shaabiyāt*, including one that can probably be identified as the upstream part of Hīlī 15 (al-Tikriti, 2002).

For the Pre-Islamic Recent period perhaps the most interesting question is whether the origin of the deep circular shafts and tunnels noted in Zones C & D can be linked to the creation of the northern oasis cores in the PIR, as we have previously suggested may have been the case for al-‘Ayn Oasis (Sheehan *et al.*, 2022: 367). There is now evidence that wells formed a significant element of the PIR agricultural landscape from both the border fence and Al Ain Museum, but at the museum site we also dated the large rock cut Falaj 1 and the associated cut for a large *bustan* palm grove to the creation of the oasis core in the PIR, with both the *falaj* and the oasis landscape subsequently repaired and revitalized in the Early Islamic period. Ongoing monitoring of infrastructure work in the Kuwaitāt area of downtown al-‘Ayn to the east of the Al Ain Museum site (notable for graves containing PIR weaponry found in 1984 and again in 2022) is providing additional evidence for more PIR *aflāj*, with large circular shafts and tunnels at an intermediate depth between the extremely deep ones (15m) of the Late Islamic period and the shallower rectangular shafts of the Iron Age.

For the Early Islamic period we recorded a number of relatively shallow *aflāj* in Zone Aa and the beginning of Zone Ab, including the brick channel discussed earlier. These do not extend much beyond the 650m mark and appear to be largely heading towards the southeastern end of Jīmī Oasis which may represent its core. In Zones C-E the border fence trench produced no direct evidence for Early Islamic *aflāj* but in 2020 in the Hīlī Misbah area northeast of Hīlī Oasis we

were able to trace 55m of a *falaj* that is likely to have been the westward continuation of one of the Iron Age *aflāj* recorded in Zone D that was re-excavated and given a vaulted roof with fired gypsum bricks in the Early Islamic period. For the Late Islamic period we have the two stone-lined and roofed historic *Jīmī* and *Qaṭṭāra aflāj*, both apparently built with reused stone from nearby prehistoric tombs.

THE AGRICULTURAL LANDSCAPE

For the Iron Age agricultural landscape the most striking evidence relates to its scale, its regular layout and orientation and the existence of at least two distinct phases of activity. The orientation of the border fence trench and the alignment of features noted within it in Zones Ab and B allows us to estimate an irrigated cultivated area of at least 100 hectares. However the similarity of these features to those revealed in earlier works like the 2009-11 excavations at the Bayt Bin Ati House in *Qaṭṭāra* Oasis and during geophysical survey in *Buraimi* in 2014, and more recently the monitoring of infrastructure and housing projects in *Hīlī* and *Qaṭṭāra* oases, indicates that the maximum extent of the area under cultivation during the Iron Age was probably closer to 500 hectares (Power et al, 2019; Power et al 2015). This agricultural landscape extends from the present *Sa'āra* Oasis in the east to the western edge of *Qaṭṭāra* Oasis. To the south it is delimited by the Iron Age cemetery, whilst to the north its extent is suggested by the junction of irrigated fields with the numerous *aflāj* passing through and south of the present *Hīlī* Oasis towards *Rumaila*. The second striking aspect is the orientation and regular layout of this field system, which runs broadly southeast to northwest, following the direction of its associated irrigation network, and appears to be reflected in the similar alignments of the tree pits and basins within the border fence trench to those indicated by geophysics carried out in *Buraimi* in 2014.

There is clear stratigraphic evidence in a number of locations that this Iron Age agricultural activity can be divided into two major phases, with surviving 'islands' of bedrock preserving the earlier and shallower arrangement of rows of tree pits and channels, alternating with a series of deeper and apparently rectangular basins that have cut through this bedrock to a lower level. This sequence is broadly supported by the initial pottery and finds analysis but the similar orientation of features from both phases might suggest a relatively narrow timescale, a point which we hope

will be addressed by forthcoming C-14 analysis from the different phases. The earlier of these phases extends perhaps 200m further to the south, where it is apparently delimited by the contemporary cemetery. The southern extent of the second (basin) phase is sealed by a thick layer of hard compacted windblown sand and ends just north of the PIR tombs described earlier, which are located at a slightly higher level than the first phase of Iron Age fields to the south.

Fig. 10 – Plan showing the likely extent of the Iron Age field systems based on recent observations, with inset a sample of magnetometry survey in adjacent areas of Buraimi showing similar features to those revealed during excavation of the border fence trench

If, as we have suggested was the case for Al Ain Museum, there is a PIR proto-oasis centred around the southern end of the present Jīmī and Qaṭṭāra oases, the deep wells we noted in Zone Ab may lie within the classic middle zone of fields and villages of Wilkinson's oasis schema, with tombs on a slight eminence above them (Wilkinson 1977: 68). In the Early Islamic period the revitalization of the agricultural landscape appears confined to the area of this proto-oasis, with little activity in the earlier Iron Age fields. This appears to have changed in the Late Islamic period when previous archaeological work in Buraimi and the evidence of historic photographs showing an expansion into this area is supported by the deflated field walls which were noted at both ends of Zone Ab, close to the surface and high above the earlier Iron Age fields. The same historic photographs show that this Late Islamic landscape was itself clearly in retreat by early modern times.

THE FUNERARY LANDSCAPE

There is now a third major prehistoric cemetery to add to those of Hīlī and Hafīt, with the difference that this funerary landscape has continued in use from the Late Bronze Age to the present day, shifting at times in relation to the agricultural landscape and reusing or fetishizing elements from earlier periods. The modern walled cemeteries on both sides of the border are attempts to delimit and manage a huge area of Late Islamic and pre-modern burials which have continued to use this ancient burial ground. Clearly the location of the Iron Age cemetery at the southern edge of the earliest phase of the contemporary field system is significant, as too the

relationship between the collective tombs and the satellite individual graves. The relationship between the funerary and agricultural landscapes extends to the famous Qaṭṭāra Tomb , excavated in the 1970s. Bedrock here is close to the modern ground surface, suggesting that it was located on another slight rise, whilst the absence of any Iron Age tree pits or features for about 50m in the section of the trench as it passes the tomb indicates that at this time it was probably covered still by a mound and formed a marker in the landscape which for reasons of cult or convenience remained undisturbed.

The 2019 discovery at Al Ain Museum of the first monumental PIR tomb to be found in al-‘Ayn has now been followed by others, located on a slight rise marking the southern edge of the second phase of Iron Age agricultural landscape and, as with the museum site, in relative proximity to a putative Jīmī /Qaṭṭāra proto-oasis. Can we see in both cases the choice of prominent locations acting as territorial markers in the oasis landscape similar to the towers and forts of the Late Islamic period?

CONCLUSION

The border fence project has peeled off a long and revealing strip through the heart of the complex and shifting palimpsest of land use that is the cultural landscape of al-‘Ayn. In doing so it has shown once again that although the advent of the bulldozer and rapid urbanisation from the 1970s onwards truncated the ancient landscape, it did not destroy it. This paper has aimed to give a necessarily broad overview of the project, essentially a very long evaluation trench, and to highlight the nature and extent of the new information it has provided. Further progress towards what this means for our understanding of the landscape will be provided by the ongoing work on the finds assemblages briefly presented here, as well others including the human bone from the tombs and in particular the extensive geoarchaeological samples taken during the project. Along with informing targeted future archaeological work or remote sensing in areas adjacent to the border or along the line of *falaj* alignments, these new insights into landscape archaeology in al-‘Ayn can now inform some of our earlier observations, which began with excavations at the Bayt Bin Ati in 2009 (Power & Sheehan 2011, Power & Sheehan 2012) and included a season on the other side of the fence in Buraimi in 2014, as well as those made during work in progress on

ongoing construction or infrastructure projects like the Al Ain Museum and the installation of new stormwater networks in the old *shaabiyāt*. Like these projects, the OBF has demonstrated once again the extent to which evidence for previous episodes of site formation survives, and how the ongoing process of urban transformation and the archaeological response to it will doubtless continue to transform too our understanding of the origins and development of the oasis landscape of al-‘Ayn.

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FIGURES

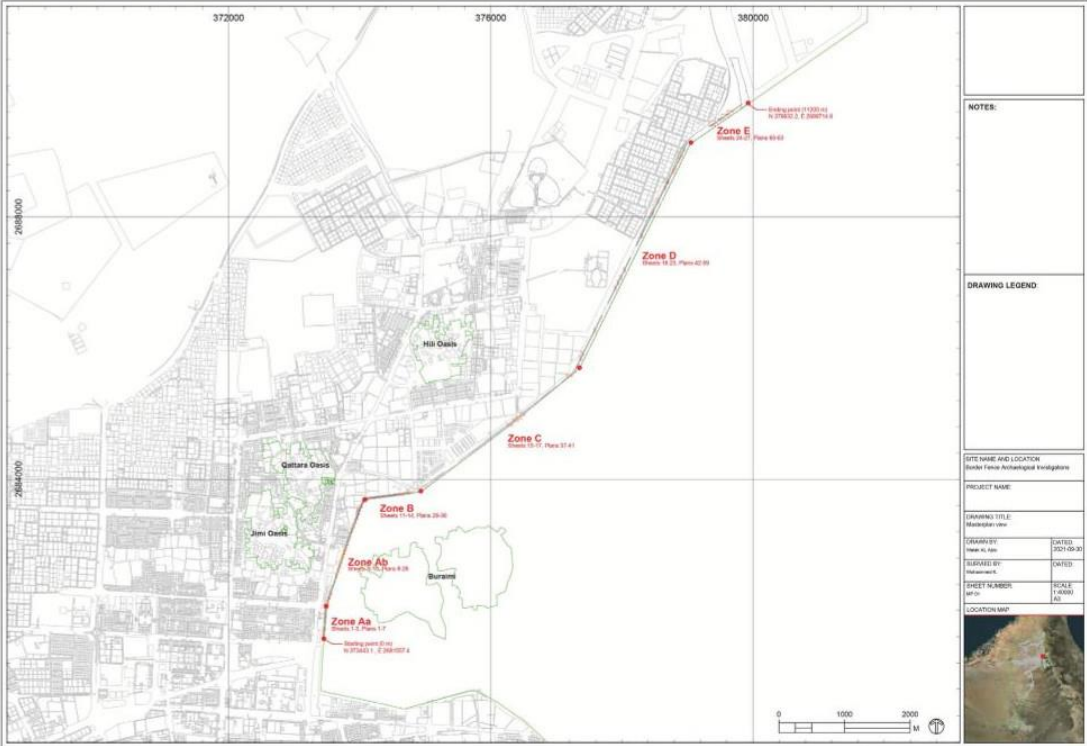


FIGURE 1. A map showing the different zones Aa-E of the Oman Border Fence project.



FIGURE 2. View looking south along the border fence in Zone Ab showing the sequence of works, with archaeological investigations and recording of a falaj in the foreground, and in the distance backfilling around the fence foundations.

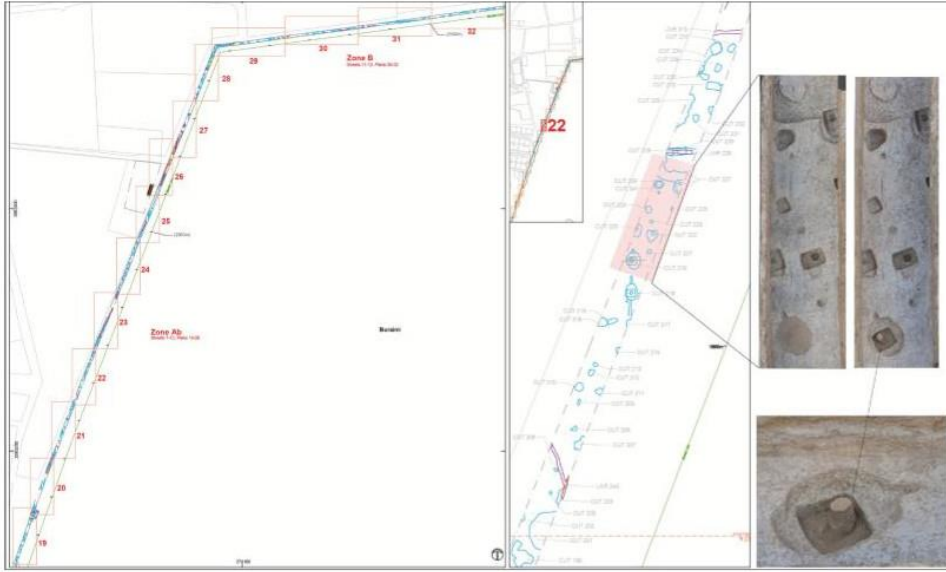


FIGURE 3. Plan of parts of Zones Ab and B, with detail of plan sheet 22 showing survey and orthophotos of tree pits and other cut features during different stages of excavation.



FIGURE 4. Photogrammetry in progress in Zone C.



FIGURE 5. 3D scanning and photogrammetry in progress inside the historic Jīmī falaj.

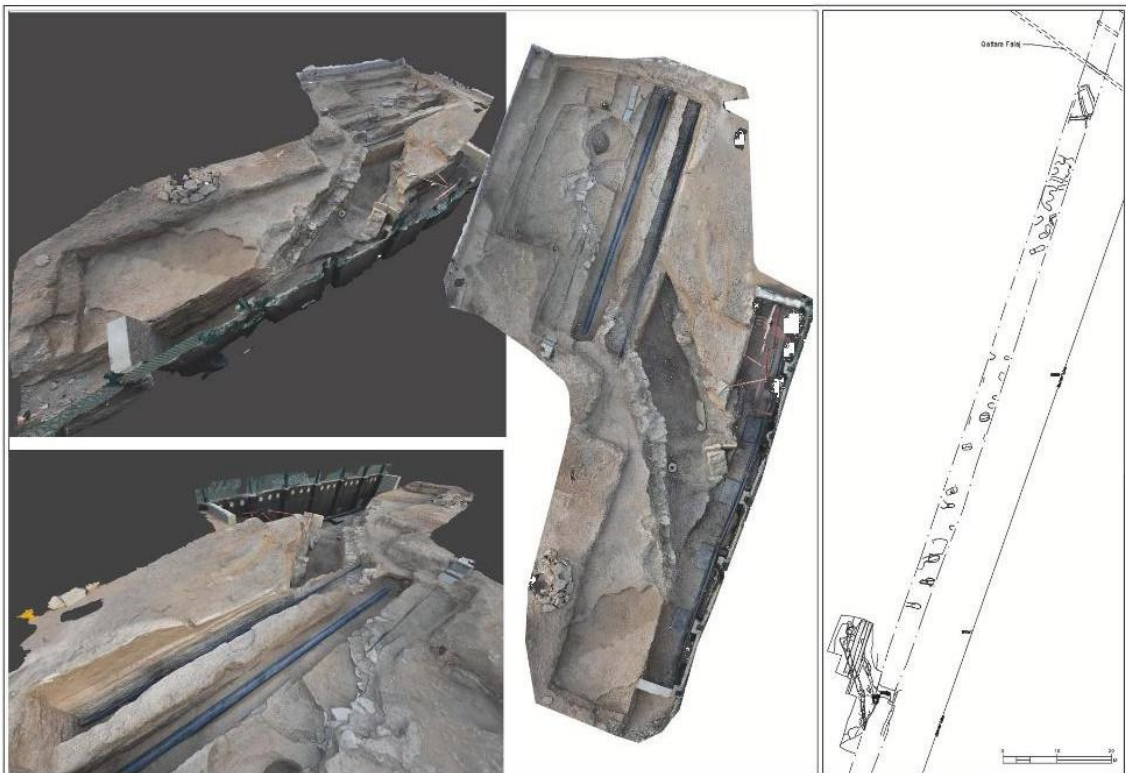


FIGURE 6. A plan of the prehistoric cemetery between Tomb A and the late Islamic Qattāra falaj, with orthophotos of the part of Tomb A west of the border fence trench, derived from the photogrammetric model. Note the modern service lines and the robber trench dug to remove the stone from its eastern wall.

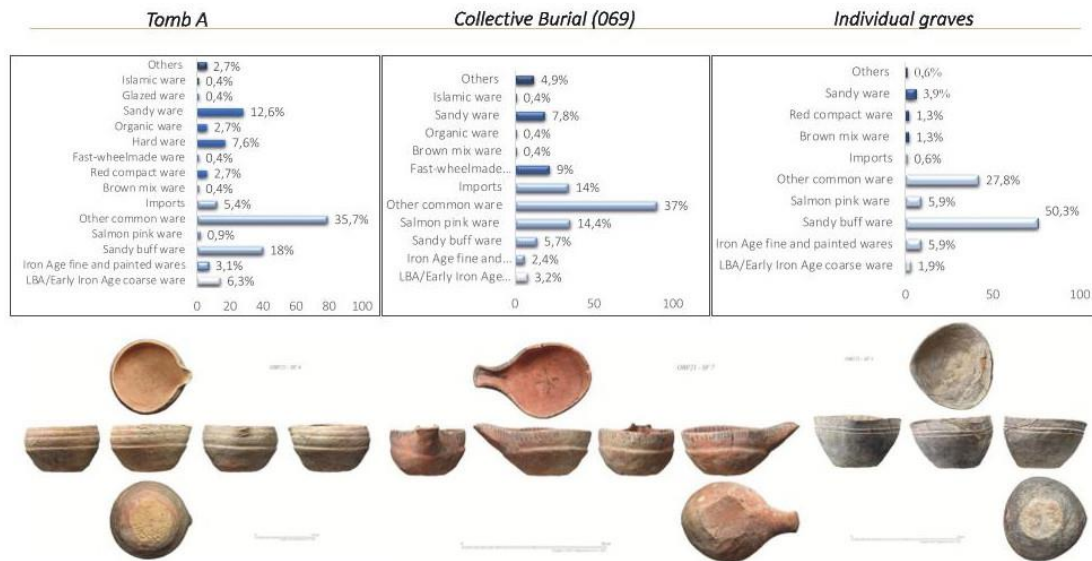


FIGURE 7. A table showing the ceramic distribution from the cemetery, arranged in ascending chronological order and divided between Tomb A, the second collective burial, and the individual graves.



FIGURE 8. Tomb C after excavation, with insets showing the numerous fragments of iron weaponry in situ and during conservation.



FIGURE 9. Zone C showing three consecutive falaj thuqb (one in plan and one in each section) crossing the line of the border fence trench in Zone C.

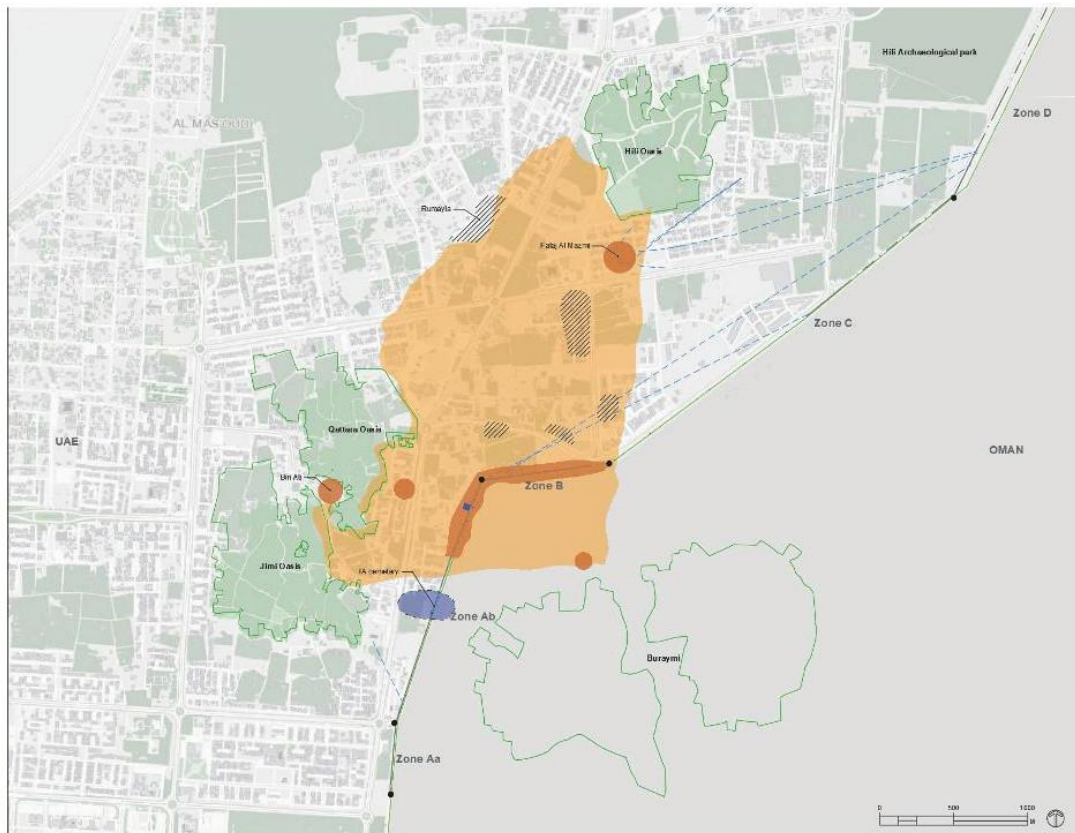


FIGURE 10. A plan showing the likely extent of the Iron Age field systems based on archaeological observations, with the Iron Age cemetery, previously identified locations of Iron Age settlement, and some aflāj alignments also shown.