QuarryScapes: ancient stone quarry landscapes in the Eastern Mediterranean

Geological Survey of Norway, Special Publication, 12

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Cover illustration:
Situated far out in the Eastern Desert in Egypt, Mons Claudianus is one of the most spectacular quarry landscapes in Egypt. The white tonalite gneiss was called *marmor claudianum* by the Romans, and in particular it was used for large objects such as columns and bathtubs. Giant columns of the stone can be seen in front of Pantheon in Rome. Photo by Tom Heldal.

Contents

Gypsum quarries in the northern Faiyum quarry landscape, Egypt: a geo-archaeological case study

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An ancient gypsum quarry is situated at Umm el-Sawan in the northern Faiyum desert, approximately 40 km southwest of the Giza Plateau. The gypsum was used largely in the Early Dynastic Period/Old Kingdom for ornamental purposes such as small vessels, as well as for utilitarian purposes such as wall plaster. Geologically, the gypsum occurs within the upper part of the Eocene Qasr el-Sagha Formation, in which deposits and smaller extraction sites are found also elsewhere in the northern Faiyum area. Blocks of gypsum were moved from the quarry to a number of workshops where the shaping of the vessels took place. Within the quarry and in nearby areas the ground is scattered with several types of stone tools. These have a bipartite provenance, originating partly from a local to semilocal source in other parts of the Tertiary rock successions, and partly from Upper Egypt. In the latter case, the presence of such exotic rocks links the vessel production at Umm el-Sawan with similar production elsewhere from the same period (3rd–4th Dynasties). The previous interpretation of a 'hut-circle' area for the workmen was proven to represent a group of grinding stone quarries, bearing implications for the interpretation of the social organisation of the gypsum quarrying. The remains from gypsum quarrying and working, extraction of secondary stone resources for tools, and quarries targeting domestic utensils, collectively illustrate the interaction between man and the geological resources throughout the landscape, and illuminate the problem of delineating a small part of this landscape for preservation.

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Introduction

In ancient Egypt, gypsum was used for several purposes (Aston 1994, Aston et al. 2000). Alabaster (massive, finely crystalline gypsum) vessels of various shapes and sizes were produced from the Predynastic Period (prior to 3100 BC) to at least the 4th Dynasty (2613–2494 BC). In the New Kingdom, it was used for kohl jars, and in the Late Period for alabastra. Selenite (coarsely crystalline gypsum) was applied for making gypsum plaster from the Predynastic onwards.

The only known Dynastic gypsum quarries in Egypt are found in the northern Faiyum (Aston 1994, Aston et al. 2000) (Figures 1 and 2), with the Umm el-Sawan quarry as the most heavily exploited (Figure 3). They are situated approximately 20 km northeast of Lake Qarun and 40 km southwest of the Giza Plateau. The quarry was found and investigated in detail by Caton-Thompson and Gardner (1934). They identified quarry areas, workshops for making alabaster vessels, and settlements for the workers. Numerous rough-outs of vessels as well as chert tools for making them were documented, but unfortunately were removed from the site.

The present paper builds on a QuarryScapes survey carried out in March 2006, the objectives of which were to put the archaeological infrastructure on the map, make fresh observations and interpretations, and provide the geological background to the gypsum quarrying. The mapping was carried out using a Quickbird satellite image combined with GPS.

Geology

The geology of the northern Faiyum desert comprises a series of Eocene to Oligocene sedimentary rocks overlain by Oligocene basalt (Widan el-Faras basalt) and Miocene sediments (Figure 2, Table 1). The gypsum deposits described below are situated in the upper part of

Figure 1. Location of the northern Faiyum area in Egypt (extent of Figure 2 indicated by red rectangle).

the Late Eocene Qasr el-Sagha Formation (Figure 4). This formation, and the overlying Early Oligocene Gebel Qatrani Formation, has been studied in detail by many authors (see Bown and Kraus 1988 and references therein). The Qasr el-Sagha Formation comprises a series of essentially nearshore marine and fluvial deposits. According to Bown and Kraus (1988) the upper part of the formation, the Deir Abu Lifa Member, consists of "*77 meters of nearshore marine sandstones*

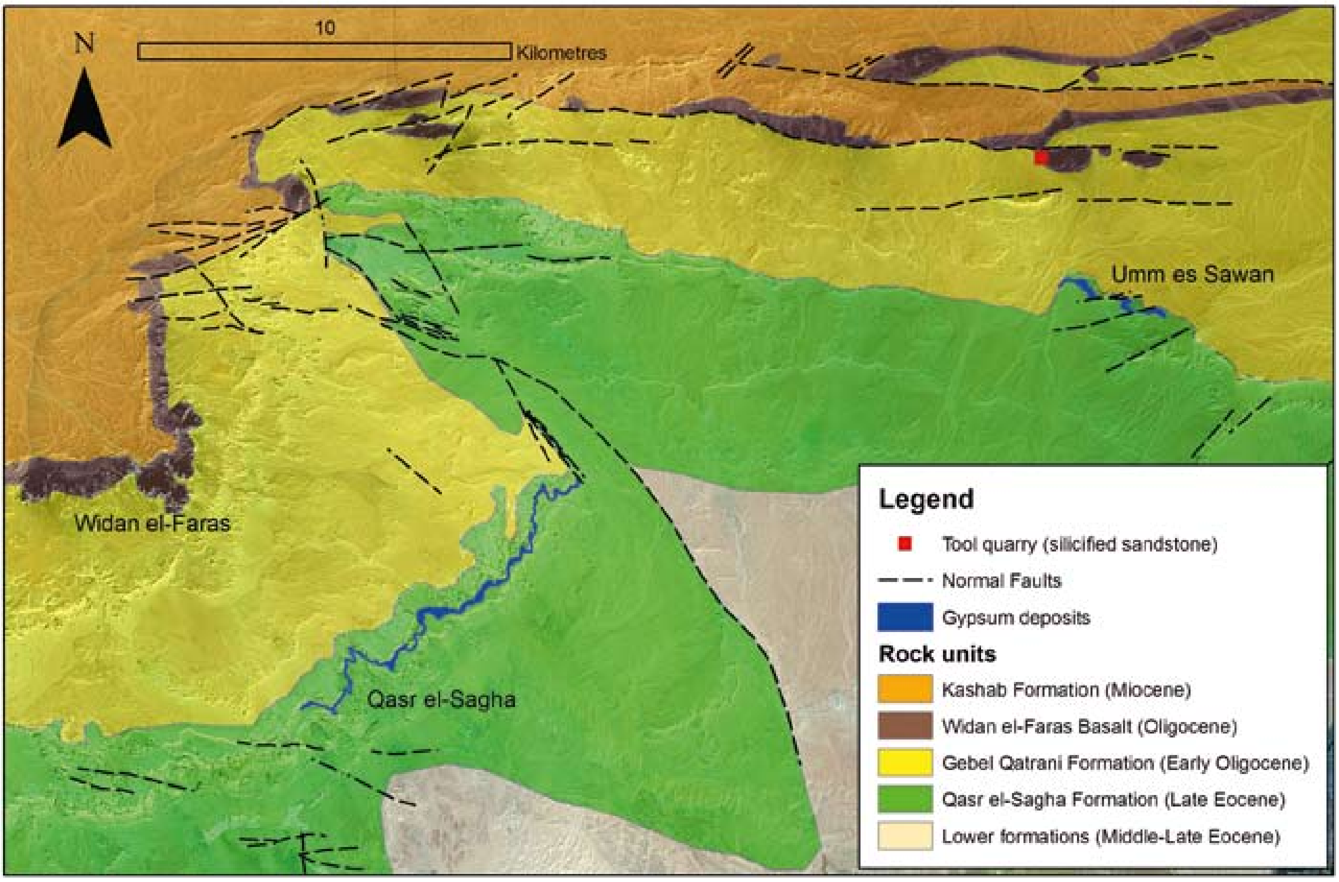

Figure 2. Geology of the northern Faiyum area. Background based on Landsat satellite imagery.

Table 1. Tertiary stratigraphic sequence in the Fayum area.

MIOCENE		Kashab Formation	>100 m
OLIGOCENE	Late	Widan el-Faras basalt (24–27 Ma)	0–10 m
	Early	Widan el-Faras basalt (31 Ma)	0–15 m
		Gebel Qatrani Formation	340 m
EOCENE	Late	Qasr el-Sagha Formation (Deir Abu Lifa Member)	77 m
		Qasr el-Sagha Formation (Temple Member)	123 m
		Birket Qarun Formation	50 m
	Middle	Gehannam Formation	70 m
		Wadi Rayan Formation	130 m

From Bown and Kraus (1988), based on the work of Beadnell (1905), Said (1962), Vondra (1974), Bowen and Vondra (1974) and Bown (1982).

and alluvial lateral accretion channel deposits that record sporadic but gradual Late Eocene regression of the Tethys Sea". Sandstone with gypsum is found in the upper part of the member. On top of the Qasr el-Sagha Formation follows the dominantly fluvial Gebel Qatrani Formation. The boundary between the two is described by Bown and Kraus (1988) as a "*conformable to minor erosional unconformity*". The Gebel Qatrani Formation contains several levels with petrified forests, and clusters of logs of fossil wood can be viewed at several localities.

Although there are some geological differences between the western (i.e., Qasr el-Sagha) and the eastern (Umm el-Sawan) parts of the area, the rock strata can be correlated. However, the characteristic upper part of the Deir Abu Lifa Member (the 'bare limestone' of Beadnell 1905 and the 'upper cross-bedded sandstone and mudstone' of Bown and Kraus 1988), as defined near Qasr el-Sagha, seems to be lacking at Umm el-Sawan. Furthermore, the upper boundary of the Gebel Qatrani Formation at Umm el-Sawan is clearly an erosional unconformity, displaying palaeosol development (Figure 5) and strong palaeotopography. Logs of petrified wood (Figures 6 and 7) and fluvial channels with silicified conglomerate are found on top of the un-

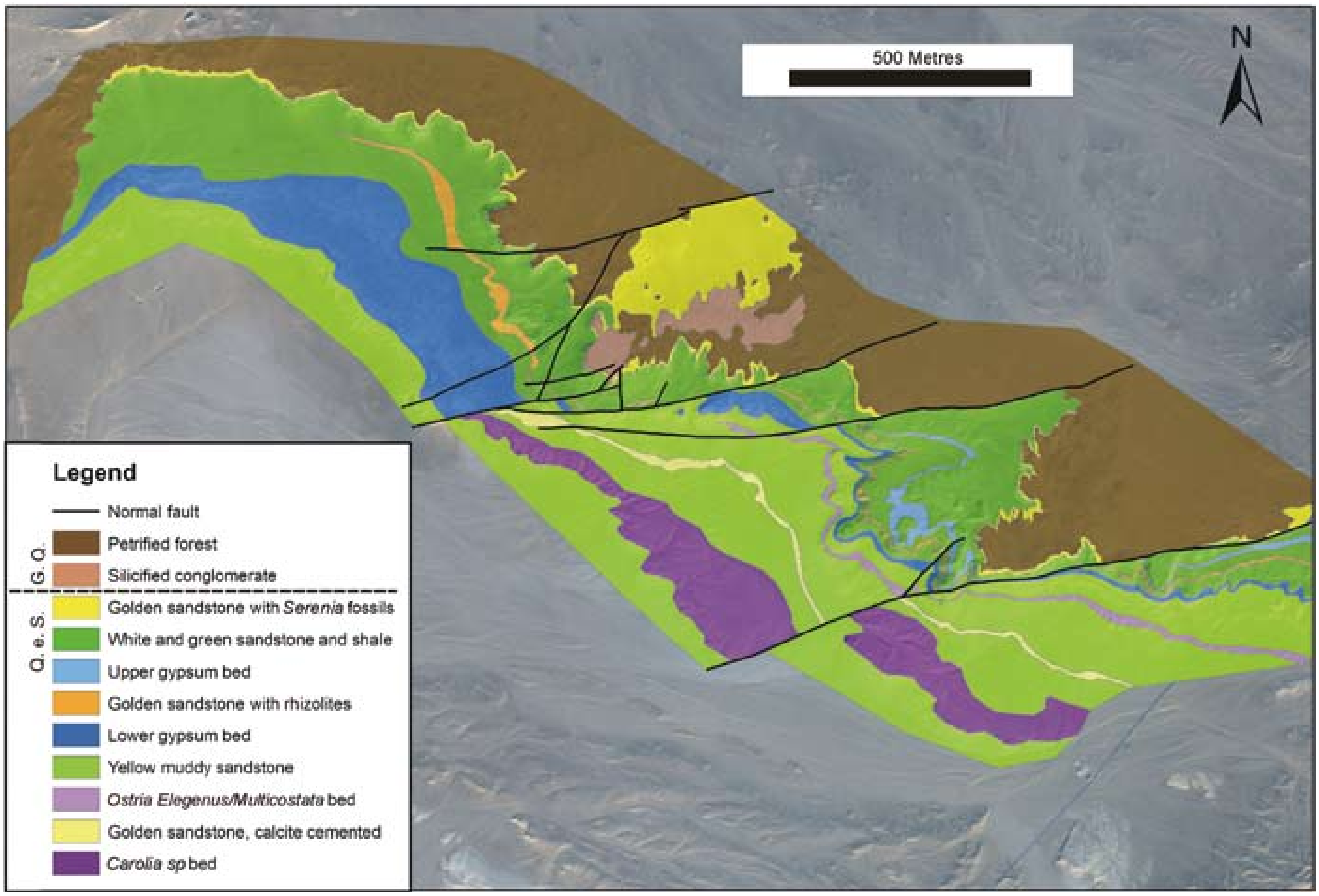

Figure 3. Geological map of the Umm el-Sawan area. Q. e. S.=Qasr el-Sagha Formation, G. Q. = Gebel Qatrani Formation. Background based on Quickbird satellite imagery.

conformity surface. In the Qasr el-Sagha area, such features are found higher up in the formation (Bown and Kraus 1988).

The Qasr el-Sagha Formation is mapped in detail at Umm el-Sawan (Figures 3 and 4). The lower part of the strata in the outcrop area is composed of yellowish muddy sandstone with two distinct fossiliferous beds, one with *Carolia sp.* (Figure 8) and the other with *Ostria Elegenus-Multicostata*, and a distinctive, calcite-cemented golden sandstone. In the middle part of the succession, two gypsum beds (in the following referred to as the upper and lower, respectively) occur and these are separated by greenish and golden rhizolitic sandstones (Figure 9). Above the upper gypsum bed is a white to greenish sandstone, partially displaying tabular cross stratification with thin ferruginous layers (Figure 10). The uppermost part of the formation is defined by a distinct bed of gypsiferous golden sandstone containing *Serenia* (manatee) bones. Because the lower boundary of this sandstone bed defines an angular unconformity with the substrata (Figure 11), it should be recognised as a separate member.

The Qasr el-Sagha Formation thins towards the northwest, against the unconformity developed on the base of the Gebel Qatrani Formation. On the irregular surface of the unconformity, calcrete (Figure 5), channels of silicified conglomerates, and logs of fossil wood are found. It seems likely that the disappearance of the upper part of the Qasr el-Sagha Formation (including the gypsum layers) between Umm el-Sawan and the Qasr el-Sagha areas (see Figure 2) is caused by erosion prior to deposition of the Gebel Qatrani Formation. Thus, there seems to be a pattern of uplift and erosion characterising the upper part of the Qasr el-Sagha Formation. There are numerous normal faults in the area (Figures 2–3, 12) (predominantly related to Oligocene faulting, Bown and Kraus 1988), disrupting the continuity of the layers, and causing local rotation of the beds.

The lower gypsum bed is by far the richest and thus most heavily exploited both at Umm el-Sawan and near Qasr el-Sagha (Figure 13). The upper bed is thin or completely absent and only minor extractions are seen. Within the gypsum beds there are two types (or generations) of gypsum: veins of impure gypsum (alabaster with minor calcite and barite) cutting across the strata, and sheets of coarsely crystalline gypsum (selenite) parallel to the strata (Figure 13a). The alabaster gypsum veins are generally steeply inclined and measure up to 50 cm in thickness, and from above their distribution resembles a honeycomb pattern (Figure 6). The veins seem to have been the most important target for the production of vessels. The selenite gypsum can only be collected in thin flakes that are too small for vessels; however, piles of such gypsum suggest that it was collected for use, possibly for gypsum mortar.

Gypsum quarries and workshops

The gypsum workings are predominantly shallow, and in several places it is difficult to separate them from natural depressions in the desert surface (Figure 13b, see also map in Figure 14). Because the quarrying targeted mainly the randomly distributed veins, there are no clear quarry walls but instead irregular pits and trenches (Figure 13c) of varying size scattered across the outcrops of the main gypsum deposits. Hence, despite the workings giving the impression of a haphazard distribution, it seems clear that all the gypsum deposits in the area were subjected to systematic prospecting and trial quarrying in order to locate the best quality rock. In fact, traces of small-scale quarrying and/or trial quarrying are seen in most places where there are outcrops of gypsum, including the Qasr el-Sagha area (Figure 13d).

Within the quarry, as well as in nearby areas, the ground is scattered with several types of stone tools (Figure 15), including stone hammers (pounders) of different sizes and types. Most frequently observed are rounded cobbles of chert. These are not found in natural occurrences in the quarry area, and are assumed to have been brought to the place either from bedrock deposits in more distant parts of the Gebel Qatrani Formation or (more likely) from concentrated alluvial deposits of chert cobbles that exist in the eastern part of Fayium (the Faiyum–Nile divide, Sandford and Arkell 1929).

Other stone hammers from local and semilocal sources include the silicified conglomerate described above, basalt (nearest source is approximately 4 km to the north), and a characteristic silicified sandstone believed to come from a small quarry discovered during the survey 3.5 km to the northwest (see below). Rod-shaped pieces of silicified wood are abundant in the gypsum quarries, and collection places as well as small quarries of silicified wood are found in the vicinity (Figure 16). Thus, silicified wood seems to have been used in the quarrying, probably as chisels and wedges.

Blocks of gypsum were moved from the quarry to a number of workshops (Figure 17), where the shaping of the vessels took place. These comprise three mounds designated A, B and C (see Figure 14) by Caton-Thompson and Gardner (1934), who excavated them in the mid

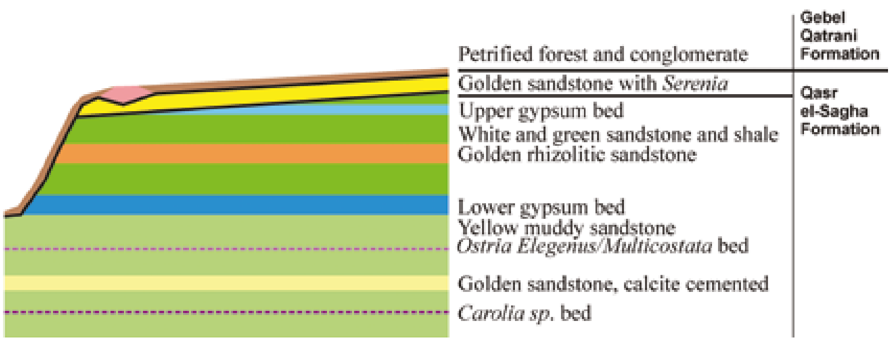

Figure 4. Stratigraphy of rock units in the Umm el-Sawan area. See legend in Figure 3 for colour coding of units.

Figure 5. Palaeosol development at the base of the Gebel Qatrani Formation.

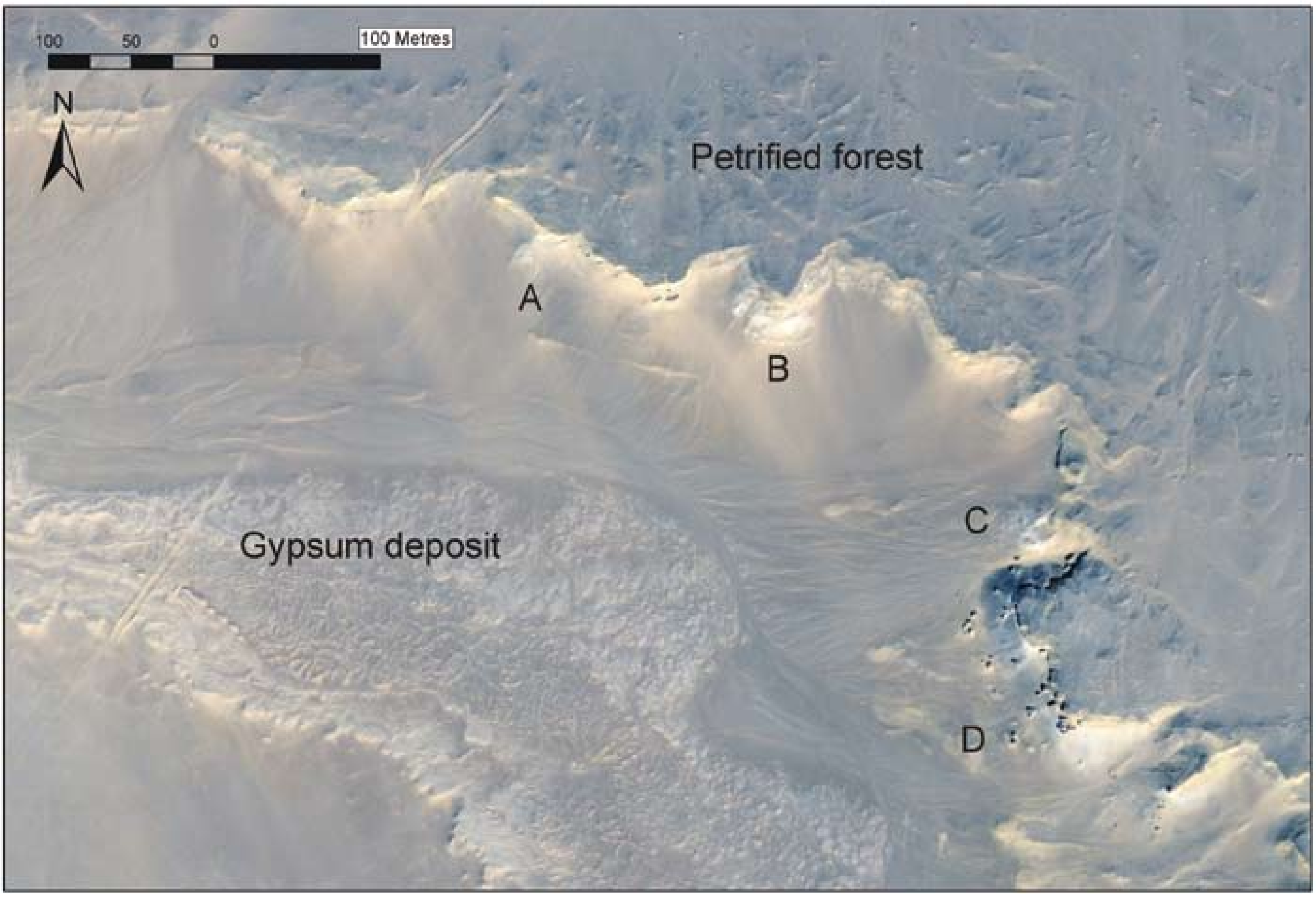

Figure 6. Gypsum deposits/quarries (lower left), petrified forest (randomly oriented logs at top right) and gypsum workshops (white areas along the escarpment, labelled A, B, C and D) as seen on Quickbird satellite image.

Figure 7. Log of petrified wood on the desert surface with smaller pieces in the inset at lower right.

Figure 8. Carolia sp. *bed at Umm el-Sawan.*

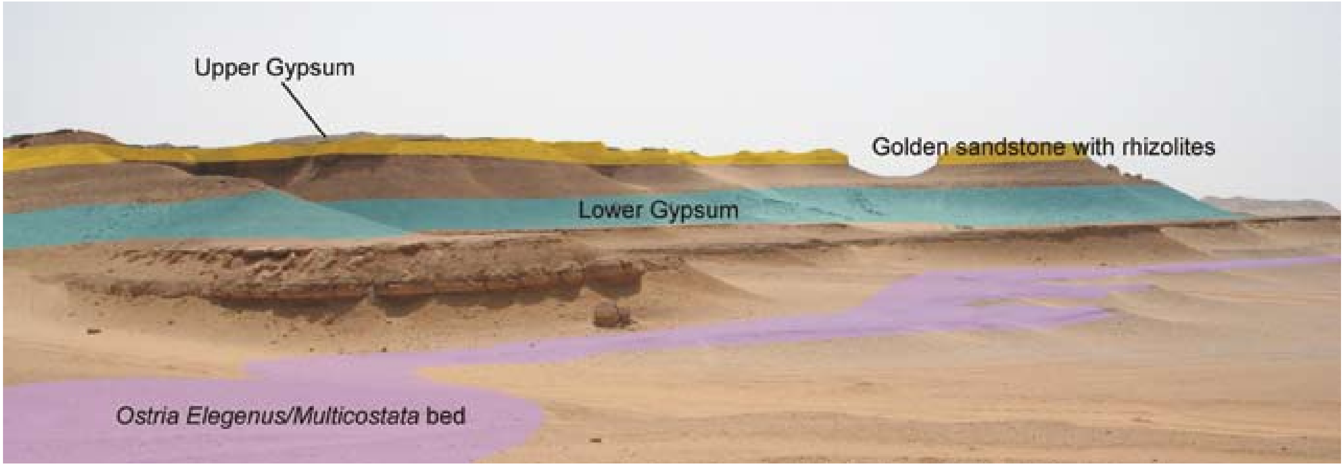

Figure 9. The middle part of the succession at Umm el-Sawan. Drawing on field photo.

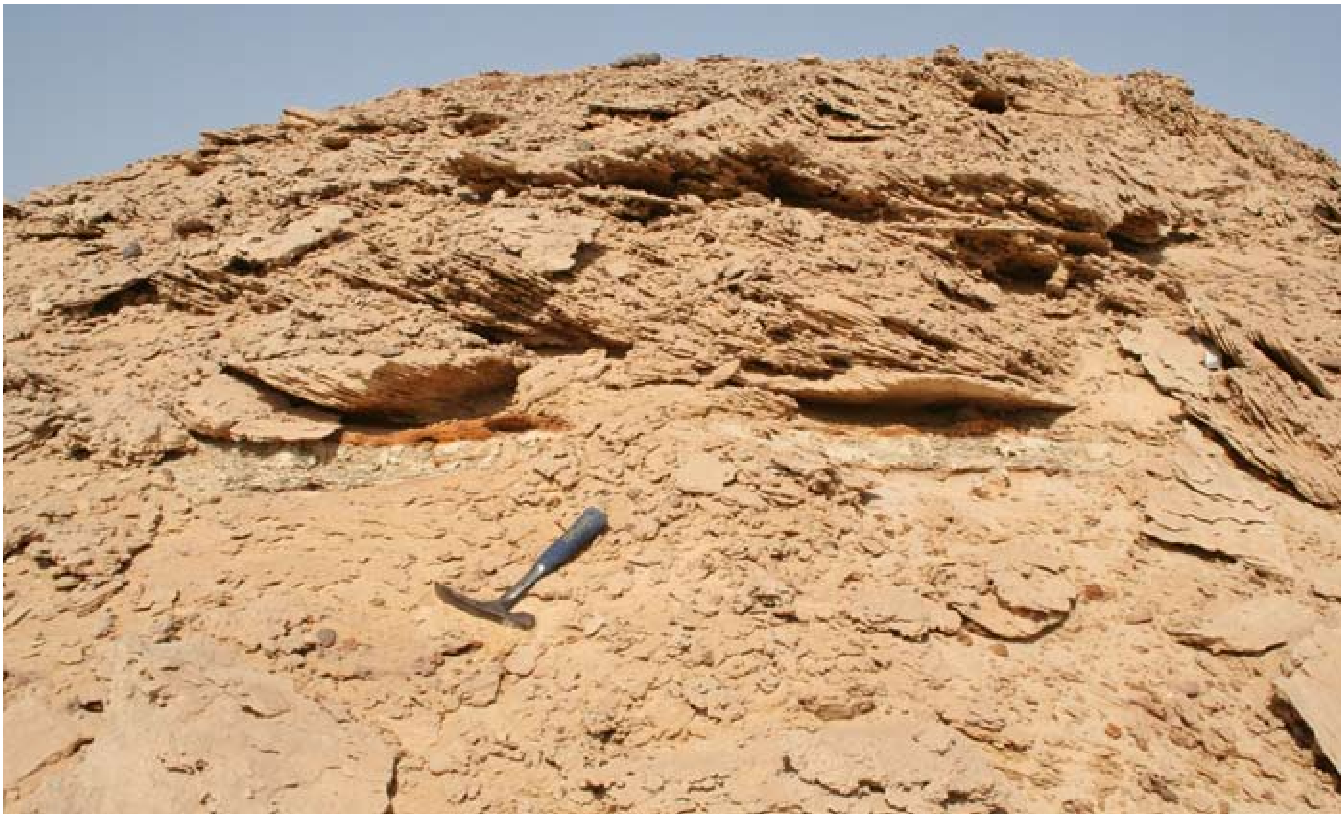

Figure 10. Cross-stratified sandstone and shale layers in the upper part of the Qasr el-Sagha Formation.

Figure 11. Unconformity between the golden sandstone with Serenia *(above dotted line) and the underlying strata.*

Figure 12. Normal fault showing down-throw towards north (right-hand side of the photo).

Figure 13. (a) Gypsum outcrop displaying selenite layers (greyish, just behind the hammer) and thick veins of milky-white alabaster. (b) Shallow gypsum quarry with scattered small extraction pits. (c) Trench quarry in gypsum deposit with a spoil heap to the right. (d) Gypsum deposit with small extraction pits near Qasr el-Sagha.

1920s, and a smaller mound (D). The mounds consist of a matrix of gypsum debris produced by working the stone into circular, cylindrical vessel blanks. Two smaller mounds, also documented but not excavated by Caton-Thompson and Gardner, were the subject of closer examination during the March 2006 survey. These mounds generally consist of chert cobbles, some shaped into picks, gypsum debris, fragments of non-local stones, fossilised wood chips and pottery (Figure 17).

In addition to using cobbles as natural hammers, chert cobbles have also been worked into finer tools for cutting and carving gypsum, such as crescent drills (Caton-Thompson and Gardner 1934). Several such chert chipping floors (Figure 17d) are found in the area, close to some of the workshops. The occurrence of such chipping floors, together with all the chert tools scattered across the quarries and workshops, was probably the reason for the name Umm el-Sawan. 'Haggar sawan' means chert in Arabic, and so Umm el-Sawan means the 'mother of chert'.

The tools and many of the vessel blanks were removed by Caton-Thompson and Gardener when the major quarries were excavated in the mid 1920s, but similar chert tools fitting their description have been found by the present authors near Qasr el-Sagha (Figure 17e). In some of the quarries there are stockpiles of alabaster gypsum (Figure 17f), which may relate to later periods of quarrying (see below).

Workmen's camp, or not?

Near the workshops along the escarpment at Umm el-Sawan are several natural shelters, some of which were clearly used as temporary settlements for the quarrymen (Caton-Thompson and Gardner 1934) (Figure 18). Caton-Thompson and Gardner also recorded approximately 250 'hut circles' located on top of a plateau, 700 m southeast of the main gypsum quarry, which they interpreted as representing an area of settlement for the gypsum-quarry workers (Figure 19). This area of 'hut circles' was surveyed in 2006 and can be more accurately visualised as a series of shallow, sand-filled depressions surrounded by mounds of worked stone (Figure 20). The stone is a silicified conglomerate of fluvial origin that occurs at the base of the Gebel Qatrani Formation. Within the spoil mounds, it was possible to identify fragments of grinding stones and bases, diagnostically similar to those found at the Gebel Gulab silicified sandstone quarries on the West Bank at Aswan (Heldal et al. 2005). Planning and spot clearing was undertaken at one of the sand-filled depressions and this work confirmed that the area was not a hut but rather a quarry pit, mainly for the production of grinding stones. This observation clearly changes the previously held view (Caton-Thompson and Gardner 1934, p. 120) that a large labour force, as many as several hundreds, dwelt here. Caton-Thompson and Gardner (1934, v. 1, p. 121–122) also reported finding exotic pieces of 'diorite' (i.e., the Chephren gneiss) and ash/charcoal layers in the excavated 'hut circles'. This may well relate to quarrying; the 'diorite' pieces being tool fragments, and the charcoal remains

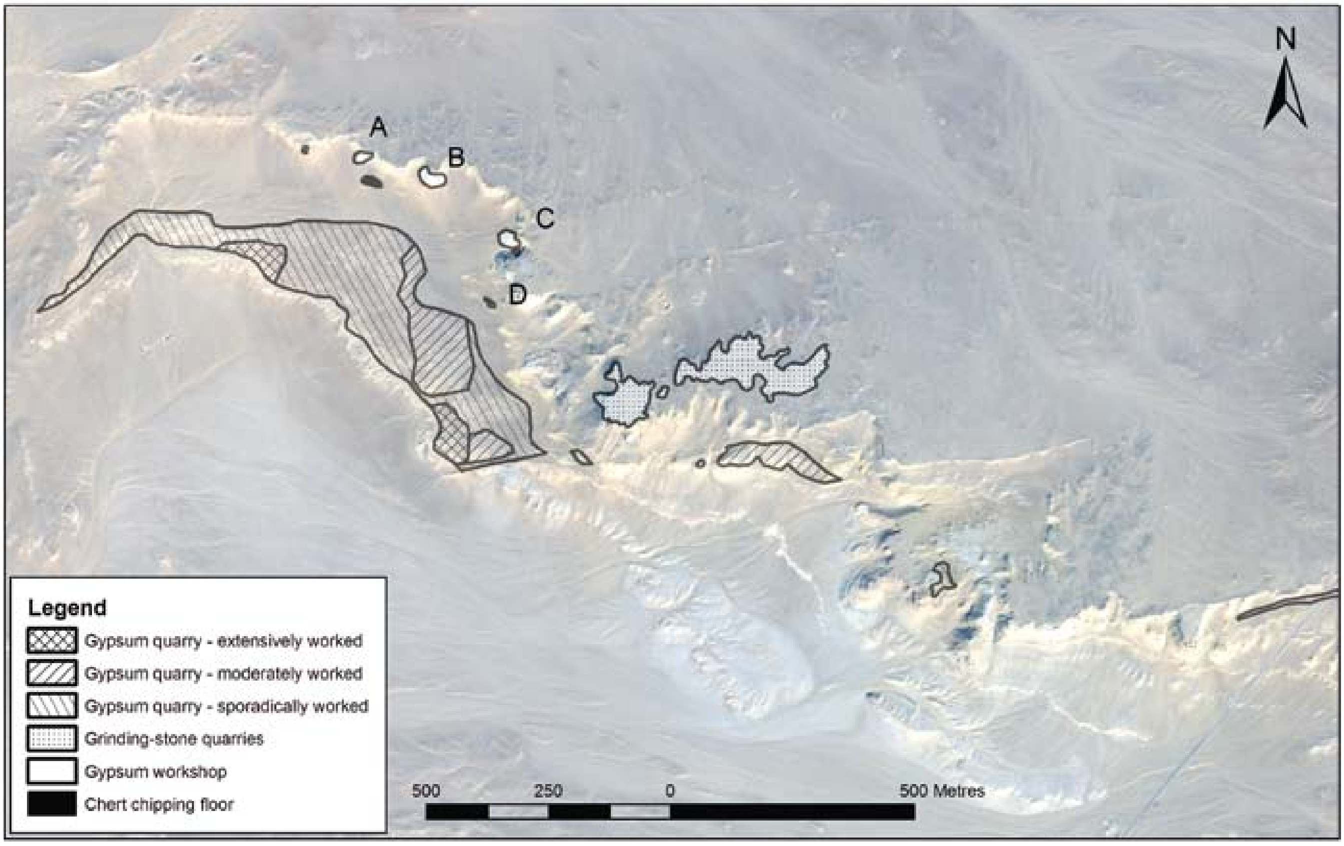

Figure 14. Archaeological features recorded at Umm el-Sawan. Background based on Quickbird satellite imagery.

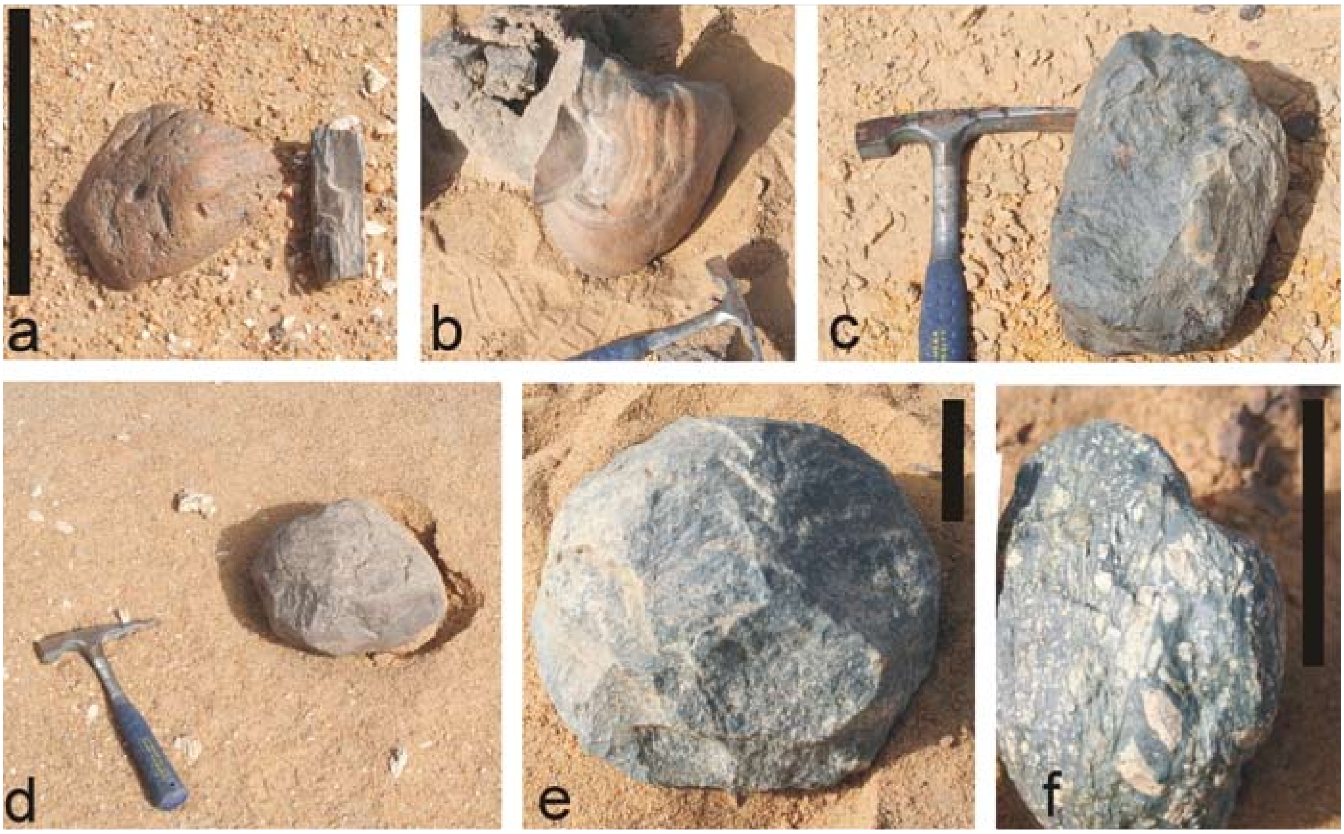

Figure 15. Variety of stone tools: (a) hammer of chert cobble and chisel of petrified wood (black line=10 cm); (b) broken pounder made from silicified sandstone (see Figure 22); (c) basalt pounder; (d) pounder of silicified conglomerate; (e) vessel blank(?) made from Chephren gneiss, brought from Lower Nubia (black line=10 cm); and (f) pounder of mylonitic granitoid, probably from the Aswan area (black line=10 cm).

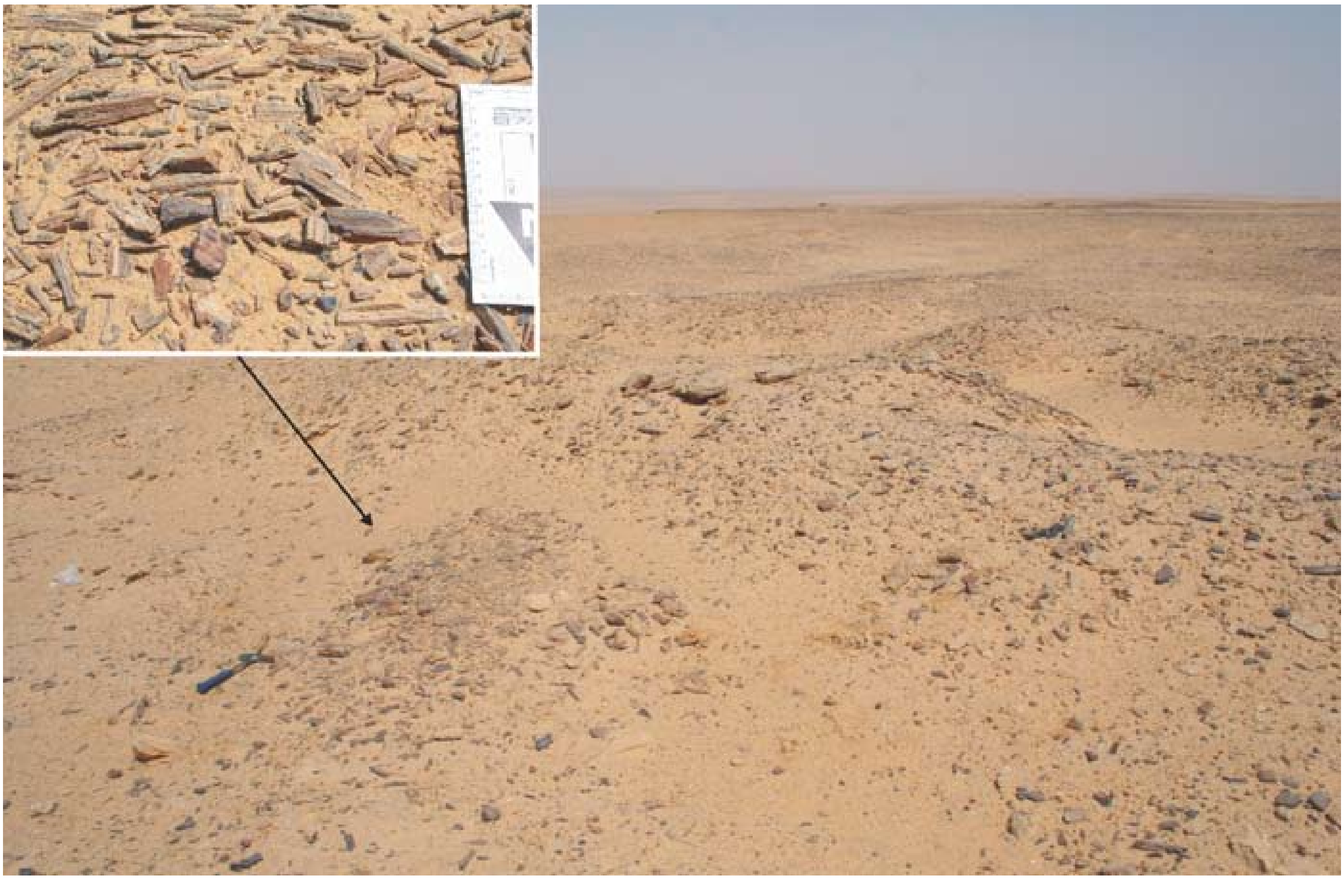

Figure 16. Small quarry for petrified wood with the small pieces shown in the inset (at upper left) probably designated for quarry tools.

Figure 17. (a) One of the main workshop mounds (workshop C), containing debris from gypsum production, tool fragments and pottery. (b) Remaining blanks from gypsum vessel production, workshop C. (c) Consolidated debris from one of the workshops (B) with gypsum fragments and chert flakes from working the gypsum. (d) Chert chipping floor. (e) Chert flakes and crescent drills found near Qasr el-Sagha in a small gypsum quarry. (f) Stockpile of alabaster blocks possibly dating to the Graeco–Roman Period.

from the use of fire during quarrying, as reported from other areas with grinding stone quarries (Heldal and Storemyr 2007, p. 93–94). Moreover, this finding adds significantly to a growing body of data from other Old Kingdom quarries, which suggests that quarry labour forces consisted of relatively small groups of specialists, probably less than one hundred (Bloxam 2003, Bloxam and Heldal 2007).

The slopes leading up to the plateau with grinding stone quarries are covered with extensive scree or waste from the working of silicified conglomerate. Some working platforms could be seen on these slopes as well as footpaths and a shallow, oval paved feature of unknown purpose. Several varieties of stone of exotic origin were found on the waste slopes, most significantly small blocks, pounders, a large vessel blank of Chephren gneiss (from Chephren's quarry near Abu Simbel), black granodiorite and mylonitic granitoid (probably from the Aswan region), and other stones that have a possible source in the Eastern Desert. Local material was also found and included fossilised wood, a few cobbles of chert/flint (source yet unknown), and another type of silicified sandstone, the source of which was found during the survey (see below). The exotic rocks in the quarry area could

Figure 18. Natural shelters that served as temporary habitation areas for the quarry work force, beneath the Golden sandstone with Serenia *fossils at the top of the Qasr el-Sagha Formation.*

Figure 19. Caton-Thompson and Gardener's 'hut circles'. The area with 'crater-like' structures in the middle part of the photo turned out to be grinding stone quarries. Background based on Quickbird satellite imagery.

Figure 20. Shallow grinding stone quarries with a grinding stone blank shown in the inset at lower right. The quarries are pseudocircular, with a central, sand-filled extraction area surrounded by a ring of debris from the production.

either have been brought to the site as tools (as in the case of the Widan el-Faras basalt quarry, Harrell and Bown 1995, Harrell 2002) and/or as blanks of vessels or other objects. In either case, it is likely that they were connected to the gypsum quarrying and then reused for grinding-stone production. Pottery was limited to a few scattered fragments, and although the pottery report is not finalised, spot identification suggests the majority to be of Old Kingdom date and to a lesser extent from the Roman Period.

A peculiar tool quarry

Pounders of a particular variety of silicified sandstone are found in both the gypsum and the grinding stone quarries at Umm el-Sawan and in gypsum workings near Qasr el-Sagha. The sandstone pounders display a peculiar concentric pattern reminiscent of onion shells (Figure 17b). During the 2006 survey season, the source of this sandstone was located approximately 3.5 km north of Umm el-Sawan (Figure 2). The deposit consists of a 50 m-long hill composed of hard, silicified sandstone (Figure 21) displaying the same concentric pattern as the pounders (Figure 22). The pattern is most likely caused by the migration of fluids responsible for the silicification. As the sandstone hill occurs as an 'island' in the lower basalt flow, it is likely that the fluids originated beneath the hot lava and 'escaped' through the sandstone hill, creating a particularly hard rock suitable for stone tools. Collection and simple shaping of pounder-sized pieces was carried out at numerous small quarries and work areas exploiting the blocky sandstone outcrops around the hill.

Dating the gypsum quarrying

Pottery found at the site confirms the observation made by Caton-Thompson and Gardener (1934), indicating a strong presence during the Old Kingdom (especially 3rd to early 4th Dynasties) (El-Senussi 2006). This group of pottery dominates in most of the quarry area, as well as in the vessel workshops, suggesting peak vessel production occurred during the early to middle Old Kingdom (Figure 23). However, Aston (1994) argues for a 1st to 4th Dynasty date for Umm el-Sawan based on the use of the gypsum vessels. The fact that there is no 1st or 2nd Dynasty pottery does not mean there was no activity here at these times! Another group of pottery is from the Graeco–Roman Period. The latter fits observations of the stockpiles of gypsum blocks in some of the workings, which seem to have been collected for transport to places other than the nearby workshops (Figure 17f). One piece of white marble, most likely from mount Pentelikon, Greece, was found in one of the workshop mounds. As this rock was not introduced into Egypt before the Graeco–Roman Period, it also supports a later date. Small amounts of pottery associated with the grinding stone quarries,

Figure 21. Hill with silicified sandstone and small quarries along the perimeter (stone piles).

suggest the same chronology of activity; a peak in the Old Kingdom and renewed small-scale activity in the Roman Period.

Discussion

Revisiting the Umm el-Sawan gypsum quarry has added new information about the site that requires revision of Caton-Thompson and Gardner's (1934) earlier interpretations. Firstly, their so called 'hut circles' are in fact an area with numerous shallow grinding stone quarries. This has major implications for interpretations of social organisation of the quarrying, because our reinterpretation rejects Caton-Thompson and Gardner's evidence for a large labour force. The pottery evidence suggests that grinding stone quarrying was simultaneous with—and may have been related to—gypsum quarrying in the Old Kingdom Period. Furthermore, a reinterpretation of quarrying techniques highlights the likely use of stone hammers and silicified wood to extract the gypsum. Of particular interest is the presence of rocks from Upper Egypt, linking the site with Chephren's quarry, as previously suggested by Bloxam (2003) and Bloxam and Heldal (2007, p. 317). There is also a clear connection with the Widan el-Faras basalt quarries further to the west with respect to pottery (Bloxam and Storemyr 2002, El-Senussi 2006, Bloxam and Heldal 2007, p. 315–317). This link is supported by the geographical distribution of quarries, since the same gypsum beds are found close to the Qasr el-Sagha Temple and the ancient basalt quarry road, and several small gypsum workings comparable with the ones at Umm el-Sawan are found in the area. Some of the workings were described by Caton-Thompson and Gardner (1934), others were observed by us during the 2006 field season. These gypsum deposits are of poorer quality than at Umm el-Sawan, yet it is tempting to suggest that the establishment of the latter as the main production site resulted from a more or less systematic search along the whole length of the gypsum deposits in the Qasr el-Sagha Formation, from Widan el-Faras in the west to Umm el-Sawan in the east.

Thus, Umm el-Sawan clearly demonstrates a strong link between Old Kingdom production sites in different parts of Egypt. As previously hypothesised by Bloxam (2003), foreign stone tools at Umm el-Sawan might imply trading between specialists in prized stone tools, or alternatively, northern Faiyum was a centre where such people resided and from where they were deployed (Bloxam 2007). A closer examination of the data from Umm el-Sawan may add significantly in developing further hypotheses into the social context of stone quarrying during the Old Kingdom.

The survey at Umm el-Sawan and related areas has also illuminated some challenges regarding the future protection of the site. How can it be delineated? The gypsum beds stretch at least 25 km to the southeast, and there are important, related quarries (stone tools) several kilometres from the quarry site. Moreover, the spatial link between the ancient gypsum and basalt quarry sites, and the discovery of grinding stone and tool quarries, show how important it is to move out of the main sites and see the resource

Figure 22. Silicified sandstone with concentric 'shells' as occurring in the deposit.

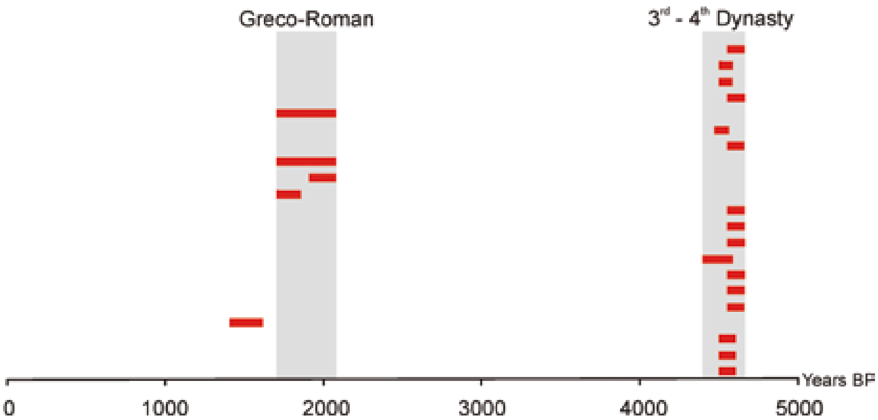

Figure 23. Pottery recorded at Umm el-Sawan during the 2006 field season (El-Senussi 2006). The red lines each represent one piece of pottery and its maximum period of use. The grey fields are the assumed maximum time span displayed by the pottery findings.

acquisition in the landscape in its totality. Such issues in relation to the northern Faiyum quarry landscape as a whole, and current attempts for its nomination as a World Heritage Site, has recently been discussed by Bloxam and Heldal (2007). Finally, it is important to focus on the remarkable interaction between geology and archaeology displayed in the northern Faiyum. The quarrying itself, as well as the exploitation of secondary resources, are spectacular illustrations of human utilisation of a wide spectrum of resources in a geological landscape.

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