Archéo-Nil

Revue de la société pour l'étude des cultures prépharaoniques de la vallée du Nil

Prédynastique et premières dynasties égyptiennes. Nouvelles perspectives de recherches

numéro
24
Janvier 2014

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Lectures

Investigating the Predynastic origins of greywacke working in the Wadi Hammamat

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The Wadi Hammamat greywacke quarries in the Eastern Desert are the source of some of Egypt's most important cultic objects, such as the ceremonial palettes of the Predynastic to Early Dynastic period. Research of the quarrying region has usually been polarised between Egyptological attention to the wealth of inscriptional data, with more sporadic investigations made by geologists and archaeologists of the quarries and other material culture. The Wadi Hammamat Project is first of its kind to undertake a holistic, multi-disciplinary study of the quarry landscape, its initial objective being to understand the linkages between changes in resource procurement and emerging social complexity in early monumental states. Focussing on the first phases of elite stone production in the Predynastic, this article discusses our discovery of the Predynastic to Early Dynastic quarries and adds fresh data to Debono's 1949 investigations of a greywacke workshop in the Bir Hammamat region. Investigating the origins of raw materials brought into the quarries and workshops has been the main basis for our understanding of the social dynamics surrounding early stone production in the area. These

1. We gratefully acknowledge the help and assistance from the SCA in providing us with the opportunity and permission to carry out this work. Special thanks go to members of the Permanent Committee, Dr Mohamed Ismail Khaled, Director of Foreign Missions, SCA Cairo, Hany Abu El Azzam, SCA Cairo Mr Helal General Director, Red Sea, Yassin Mahmoud, Director Red Sea and Ahmed Morsey, Director Quseir region. We would also like to acknowledge the contribution of our other colleagues whose input has been important to the project: Ian Shaw, Hannah Pethen and Tim Anderson. Thanks also to our inspector Amr Safa Khalid and also to those at the GIS Centre in Cairo who have consistently supported this work: Azza Shawarby, Rawda Yousri and Waleed Youssef.

investigations have illuminated the extent to which the quarry landscape was a central place of interaction between local and regional social networks, either directly or indirectly involved in stone crafting. The article also assesses how these networks were central to the flow of materials into the quarries, as well as outwards in terms of finished products. It further looks at the extent to which more intensive production of stone vessels, by the Early Dynastic, may have impacted on these networks, and therefore what we can deduce in terms of ideas about the increasing centralisation of stone-working by elites in the run-up to state formation.

Les carrières de grauwacke du Ouadi Hammamat dans le désert Oriental sont la source de certains des plus importants objets de culte de l'Égypte, comme les palettes cérémonielles de la période pré- et protodynastique. Les recherches menées dans cette région se sont surtout focalisées sur la richesse des données épigraphiques, avec des études plus sporadiques de géologues et d'archéologues sur les carrières et autres questions touchant à la culture matérielle. Le Wadi Hammamat Project est le premier de son genre à entreprendre une étude globale et multidisciplinaire de cette région de carrières, son objectif initial étant de comprendre les liens entre les modifications des sources d'approvisionnement et le développement de la complexité sociale des premiers états émergeants. Cet article est consacré aux découvertes que nous avons réalisées dans les carrières pré- et protodynastiques. Il s'intéresse aux premières phases de production de pierres destinées à l'élite du Prédynastique et complète les données initiales fournies par Debono en 1949 lors de la prospection d'un atelier de grauwacke dans la région de Bir Hammamat. Enquêter sur l'origine des matières premières utilisées dans les carrières et les ateliers a été *le principal élément qui a permis une meilleure compréhension de la dynamique sociale entourant les débuts de la production de pierre dans cette région. Ces recherches révèlent de quelle manière le paysage de carrière était le lieu central des interactions entre les réseaux sociaux fonctionnant à l'échelle locale ou régionale, directement ou indirectement impliqués dans l'artisanat de la pierre. Elles montrent également la place de ces réseaux concernant la distribution des matériaux* à al fois *au sein des carrières et vers l›extérieur pour les produits finis. Cet article évalue enfin l'impact sur ces réseaux de la production plus intensive des vases en pierre durant la période protodynastique, et les conséquences d'une centralisation accrue des élites sur le contrôle de l'artisanat de la pierre durant la période de formation de l'État.*

Introduction

The linkages between changes in resource procurement and emerging social complexity in early monumental states, is an area of research that usually receives only glancing attention. A principal objective of the Wadi Hammamat Project[2] has been to explore this, and other questions, relating to ways in which transformations in greywacke quarrying can illuminate theories concerning broader social, cultural and technological change at key stages in history and prehistory. Quarrying of greywacke in the Wadi Hammamat was an almost continuous operation from the Predynastic (4th millennium BC) to the Roman Period (4th cent AD), which has left behind one of the world's richest sources of archaeological and textual material relating to this activity (**Fig. 1**). As the source of Egypt's most iconic cultic objects associated with early kingship, such as the Narmer Palette (Dynasty 0-1), this stone has a much longer history of consumption, dating back to Badarian culture (Lucas & Rowe 1938: 130-146; Aston 1994: 28-32; Aston *et al.* 2000: 57-58; Midant-Reynes 2000: 192-194). Rhomboidal and zoomorphic palettes, beads, bracelets and later stone vessels, all carved from greywacke, had a wide distribution across Egypt, particularly from the Naqada period, and are found in both Upper and Lower Egyptian contexts at Naqada, Abydos, Maadi, Hierakonpolis, Tarkhan and Naga-

2. The Wadi Hammamat Research Project is a co-operation between University College London and the SCA (Supreme Council of Antiquities) Ancient Quarries and Mines Department, Aswan, Egypt.

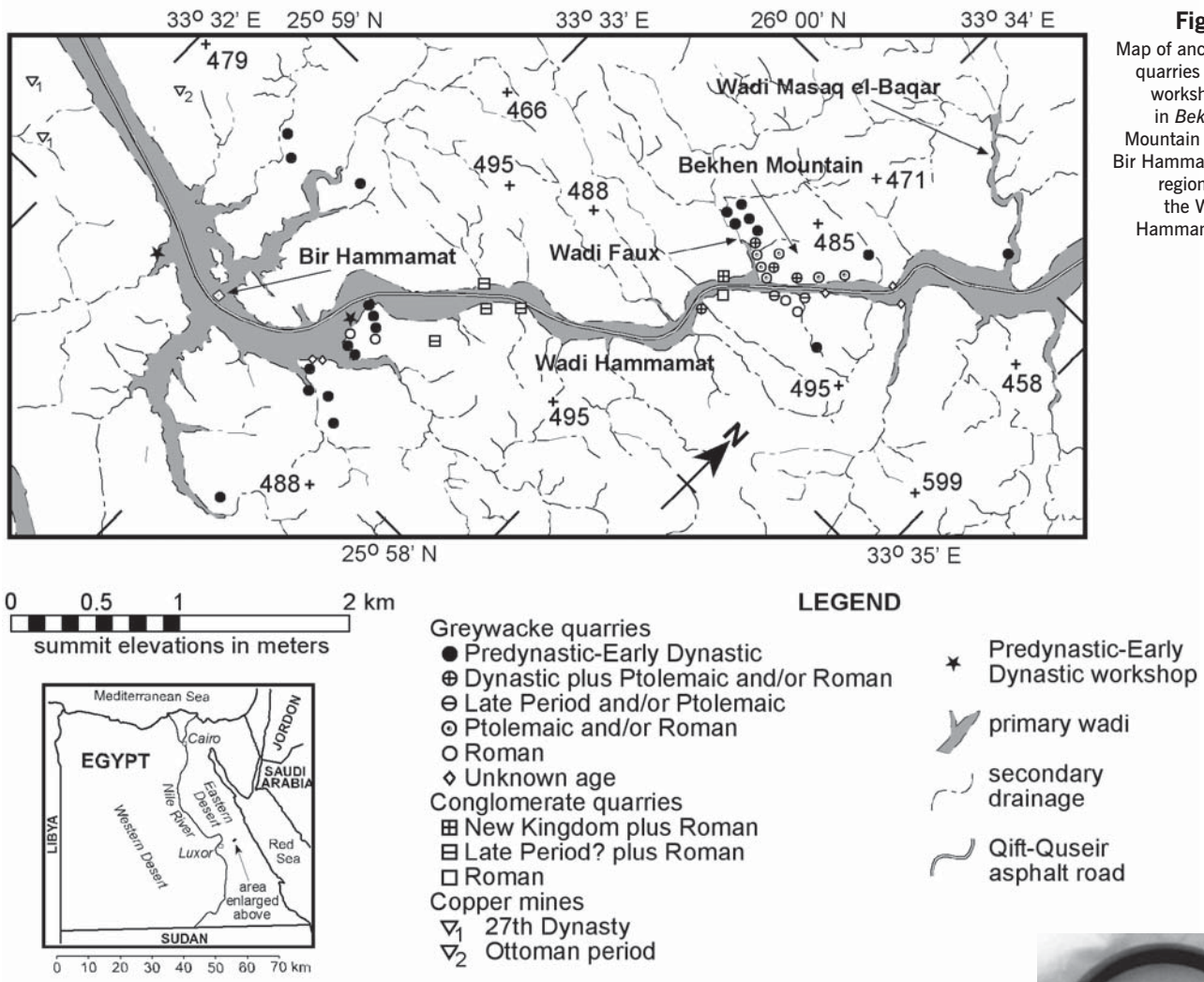


Fig. 1
Map of ancient quarries and workshops in *Bekhen* Mountain and Bir Hammamat regions of the Wadi Hammamat.

ed-Dêr (**Fig. 2**) (Petrie 1902; 1903; Reisner 1908; Ciałowicz 1991)[3].

Since the unprecedented longevity of resource exploitation in the Wadi Hammamat has its origins in the prehistory of the region, our initial survey work has focussed on locating the earliest quarries and settlements. This article describes our discovery, during the 2010 to 2012 survey seasons, of the earliest greywacke quarries associated with the production of Predynastic to Early Dynastic ornamental objects. It also revisits the bracelet workshop discovered by Debono in 1949 (Debono 1951) at Bir Hammamat, and compares this with fresh data obtained from another workshop located in the same region. From discussion of this material, the article aims to present some fresh perspectives on the social organisation and technological aspects behind the creation of some of Egypt's earliest cultic objects, at a crucial period of political transformation in the run-up to state formation.

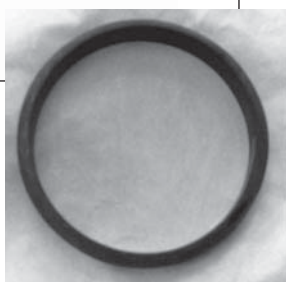


Fig. 2
Greywacke bracelet: Predynastic Naqada context at Tarkhan, Petrie Museum, UCL; UC 17103 – diameter 6.7 cms (after Petrie 1913).

Background to the Wadi Hammamat quarrying region of the Eastern Desert and status of research

Fernand Debono (1914-1997) was one of the few archaeologists of his generation to venture into the Wadi Hammamat region of the Eastern Desert in search of its prehistoric origins (Tristant 2007: 120). Under the auspices of the *Service des Antiquités de*

3. Petrie (1913) discovered several greywacke bracelets in Naqada III contexts at Tarkhan and 1st Dynasty contexts at Abydos (Petrie 1903: 26, pl.VIII); see also Brunton, 1939: 419-424 concerning bracelets in elite 1st Dynasty graves at Maadi.

l'Égypte, he launched the first 'royal' prehistoric expedition, at the time of King Farouk, into the Wadi Hammamat. The expedition followed the 200 km route from Quft in the Nile Valley to Quseir on the Red Sea coast, of which his report in the *Annales du Service des Antiquités de l'Égypte* is the only publication (see Debono 1951). His excavations of prehistoric sites, particularly at the Lakeita Oasis, and at Bir Hammamat, attested to the long history of human activity in the Wadi Hammamat region (Debono 1951: 66-69, 75-78). His discovery of a Predynastic workshop where greywacke (or, as he termed it 'schiste'[4]) was crafted into bracelets at the Bir Hammamat, midway between Quft and the Red Sea coast, was of key importance for understanding early production of high-status objects (**Fig. 1 & 2**) (Debono 1951: 75-78). However, Debono did not fully realise the potential of these findings having failed to make the crucial link between the places where the material was crafted and its actual source.

Debono's work in the Wadi Hammamat has now been rather eclipsed by the more well-known Egyptological studies of the inscriptional record that have dominated work in the region since the early 20th century. Spanning a period from at least the 4th millennium BC into the Roman Period (4th cent AD), the rock-cut inscriptions are some of the world's best preserved, and most widely known petroglyphs, associated with an ancient trade route and quarries. Weigall (1909: 37) was one of the first travellers to describe these texts as, '…crowding the quarries with ghosts…' but the enormity of the inscriptional record was not fully realised until the pioneering work of French Egyptologists Jules Couyat and Pierre Montet (1912), followed by Georges Goyon (1957), who documented most of the hieroglyphic texts and graffiti. Since then, smaller discoveries and interpretations of the pharaonic period texts have been made by Simpson (1959), Bernand (1972), Seyfried (1981), Bell *et al.* (1984), Gundlach (1986), Gasse (1987) and Gérard (1988). Some of the rock art has been documented in more general surveys of the Eastern Desert (Winkler 1938; 1939; Rohl 2000; Morrow & Morrow 2002; Judd 2008), and our project has also added a significant amount to this corpus[5].

Apart from Debono's work as described, not much interest has been shown in the archaeology of the region. Even those scholars that have worked at the Wadi Hammamat have tended to focus more on the numerous and well-preserved Roman remains, particularly the watchtowers, hydreumata and settlements that lined the trade route connecting ancient Myos Homos on the Red Sea coast (near modern Quseir) with Koptos (modern Quft) in the Nile Valley (Zitterkopf & Sidebotham 1989; Cuvigny 2003). Although descriptions of pharaonic and Roman Period greywacke quarries have been made (Rozière 1813; Hume 1934: 258-66; Harrell & Brown 1992a; 1992b; Klemm & Klemm 1993: 355-76; 2008: 296-311; Harrell 2002: 238-40), research of the broader archaeological landscape has significantly lagged behind.

The Wadi Hammamat Project is therefore the first of its kind to undertake a holistic archaeological study of the quarrying region that covers an area of approximately 10 km^2 from the Bir Hammamat in the southwest to the Wadi Masaq el-Baqar to the northeast (see **Fig. 1**). Bringing together several interdisciplinary research strands, the project's fieldwork aims have been to document and contextualise the material culture into a series of thematic maps and archaeological, geological and textual databases relating to procurement of greywacke, and other strategic resources in the region, since prehistory.

The greywacke quarries of the Wadi Hammamat

Ancient quarries have long been known in Wadi Hammamat's *Bekhen* Mountain area, where the largest concentration of rock-cut inscriptions is found (e.g., Rozière 1813)

4. Greywacke is still often misidentified as schist, slate, siltstone and basalt – see below for more discussion of this.

5. Since the Wadi Hammamat Project commenced in 2010 we have added a considerable amount of previously undocumented rock art, and other inscriptions – publication of these is in progress.

(**Fig. 1**), although it was not until the 1990s that the first detailed description of these quarries was published (Klemm & Klemm 1993: 355-376; 2008: 297-311). One of the Wadi Hammamat workings is shown on the only depiction of a quarry to survive from ancient Egypt (Harrell & Brown 1992b: fig. 5), on the Turin papyrus map dating to the reign of Ramesses IV in the 20th Dynasty. This map refers to the quarrying site as the "Mountain of *Bekheny*" (Harrell & Brown 1992a: tab. 1; 1992b: tab. 1). Other quarries in Wadi Hammamat were more recently discovered about 1.5 km to the southwest of *Bekhen* Mountain (Harrell *et al.* 2002). The Wadi Hammamat Project has now greatly extended the known distribution of ancient quarries in this wadi region, not only in the *Bekhen* Mountain area, but also further to the northeast at the mouth of Wadi Masaq el-Baqar and especially to the southwest in the Bir Hammamat area (**Fig. 1**).

What is greywacke?

The stones obtained from the Wadi Hammamat quarries are greywacke (also spelled graywacke) and, to a lesser extent, conglomerate. The first geological description of these rocks was given by Andrew (1939: 163-176) with subsequent accounts provided by Klemm & Klemm (1993: 368-376; 2008: 306-311), Brown & Harrell (1995: tab. 2), Holail & Moghazi (1998: 231, tab. 1), and Harrell *et al.* (2002: 213-214). There is much confusion in the archaeological literature over the petrological terminology for these stones. The greywacke is commonly misidentified as schist, slate, siltstone, and basalt. It is actually a mildly metamorphosed sedimentary rock that varies texturally from fine- or very fine-grained sandstone to three varieties of finer-grained mudrock (or shale) – siltstone, mudstone and claystone in order of decreasing silt/clay ratio – following the petrological definitions in Brown & Harrell (1991: chart 2), as well as in standard reference works such as Potter *et al.* (1980: tab. 1.2), Tucker (1991: fig. 3.1), Blatt (1992: tab. 6.1), Boggs (1992: tab. 7.8), and Stow (2005: tab. 6.1). There is no one geological rock name that encompasses all these textural varieties. For convenience, we refer to them here collectively as "greywacke," a term already widely employed in Egyptology, although "metagreywacke" would be more technically correct given the metamorphic imprint on these rocks.

Although finding ancient names that relate to particular rocks can be problematic, inscriptional evidence strongly suggests that greywacke was known as "*bekhen*-stone" in antiquity (Lucas & Rowe 1938; Shiah 1942; Harris 1961: 78-82). This name is still the only one that truly applies to all the textural varieties. Wadi Hammamat's "conglomerate," or better, "metaconglomerate," is just a coarser-grained version of the greywacke sandstone where gravel clasts are embedded within a matrix of clay minerals and sand grains. This rock, which has well-rounded gravel clasts, is commonly misidentified as breccia, a rock with angular clasts. No ancient name for conglomerate has been identified, and it is possible that it was merely considered a variety of *bekhen*-stone. It is the ubiquitous presence of two green metamorphic minerals, chlorite (a variety of mica) along with lesser amounts of epidote, that give the greywacke and conglomerate their characteristic colours: greenish-grey to greyish-green for the greywacke, and an overall greenish hue for the conglomerate, with its multicoloured gravel clasts representing many different rock types. In some quarries the greywacke is dark grey to nearly black due to abundant haematite, and in such cases the rock superficially resembles volcanic basalt.

The Predynastic and Early Dynastic Quarries

The distribution of quarries in Wadi Hammamat, with the individual workings coded according to rock type and age of exploitation, is shown on the maps (**Fig. 1 & 3**). However, the focus for this article are those greywacke quarries dating to the Predynastic and Early Dynastic periods that produced rough-outs for vessels and palettes plus, in the Bir Hammamat area, bracelets.

It is also in the latter area that bracelet workshops are found (see next section). These products were roughly fashioned within the quarries – deep to mainly shallow circular blocks for vessels (**Fig. 4**), rectangular slabs for palettes (**Fig. 5**), and circular disks for bracelets (**Fig. 6**) – and then further carved in the workshops on the wadi floor.

The Predynastic to Early Dynastic quarries in the Bir Hammamat region of the quarry landscape are in the surrounding hills, at distances of up to 1 km from the main well, the remains most visible today belonging to the Roman Period and later (**Fig. 3**). With no pottery in any of these quarries, we have applied the date range between Predynas-

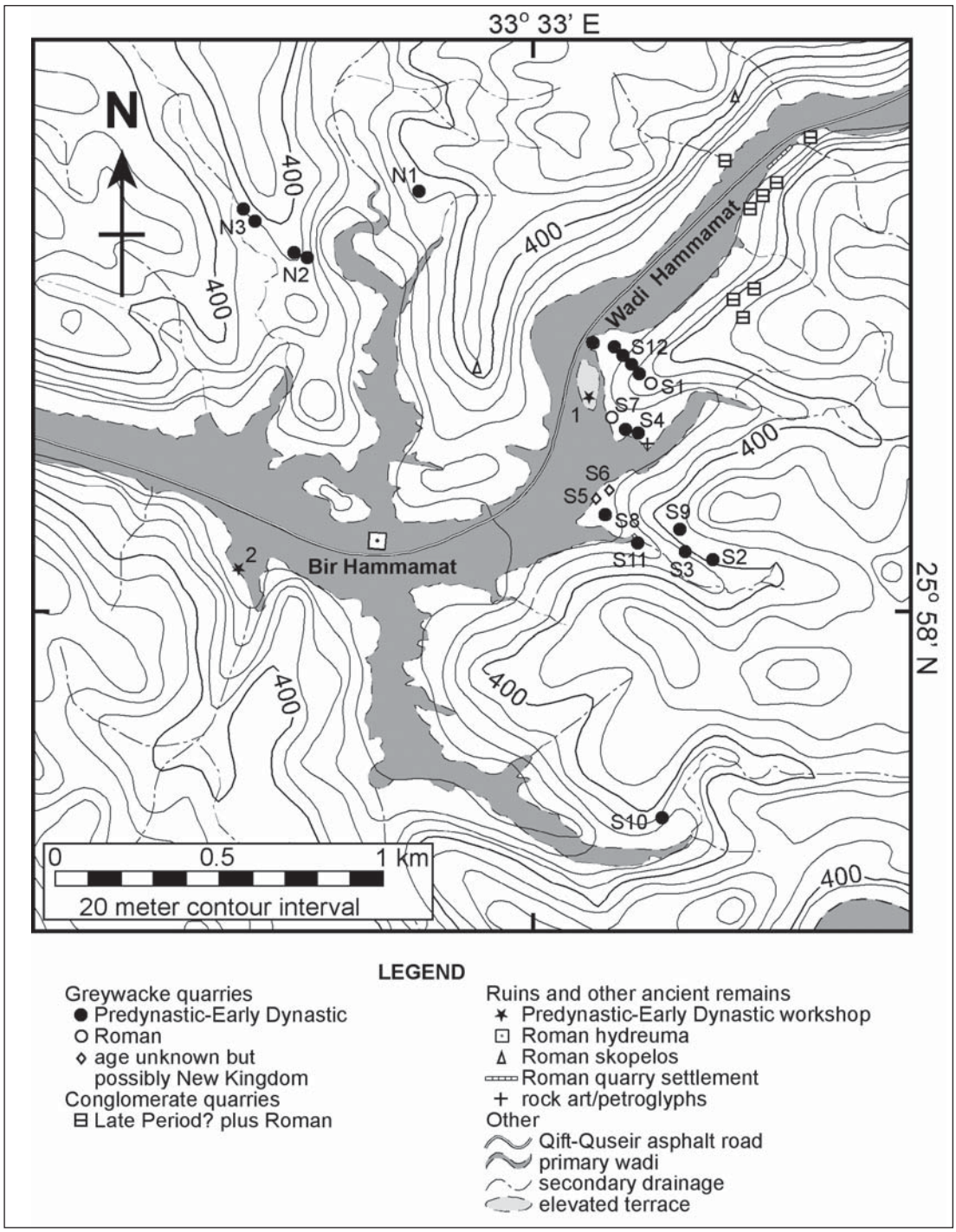


Fig. 3
Map of ancient quarries and workshops in the Bir Hammamat region of the Wadi Hammamat.

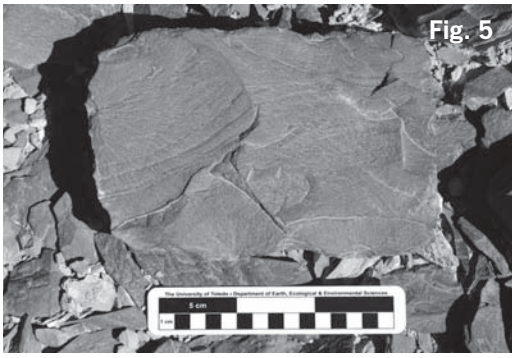


Fig. 4
Twenty greywacke stone vessel rough-outs as found (Predynastic to Early Dynastic) in quarry N1, Bir Hammamat.

Fig. 5
Greywacke palette rough-out (Predynastic to Early Dynastic) in quarry N1, Bir Hammamat.

Fig. 6
Rough-out of a greywacke bracelet (Predynastic) in quarry S8, Bir Hammamat.

tic and Early Dynastic based on the presence of object rough-outs of products that were consumed at this time. Each of these early quarries usually consists of a group of either hillside benches up to 30 m long by mostly less than 3 m wide or, on more level ground, oval to circular pits that are mostly less than 5 m across and up to 1-2 m deep (**Fig. 7-8**). They were all excavated in the coarser (sandstone), greyish-green variety of greywacke except in the quarry just southeast of Workshop 1 (S4), which produced dark grey to mainly greyish-green mudrock varieties of greywacke. The greywacke in all these early quarries is intensely fractured and so could only produce small blocks for vessels or thin slabs for palettes and bracelets.

Dolerite pounders, not local to the site, were employed to knock out pieces of rock along natural fractures and then to shape the rough-outs (**Fig. 9**). Such pounders were the principal quarrying tool for hard stones from Predynastic through to Dynastic times, and they have survived in many quarries of this era across Egypt (see Kelany *et al.* 2010; Bloxam *et al.* 2007; Bloxam & Heldal 2008; Heldal 2009). In Wadi Hammamat most of the pounders were hand-held forms but some had notched waists to take a wooden handle (**Fig. 10**). Another type of stone tool, made from local greywacke, was first reported by Debono (1951: 79-80, pl. xiii a. b.) at an unknown location (**Fig. 11**). He wrongly deduces that these must date to the pharaonic period quarrying, between the Middle and New Kingdoms. Our investigations have confirmed that these tools are much older, as we identified them in several Predynastic

Fig. 8
Predynastic to Early Dynastic quarry pit at N1 looking south towards the main road, Bir Hammamat.

Fig. 7
View of Predynastic to Early Dynastic quarry bench (marked by an arrow) S2, looking north-east, Bir Hammamat.

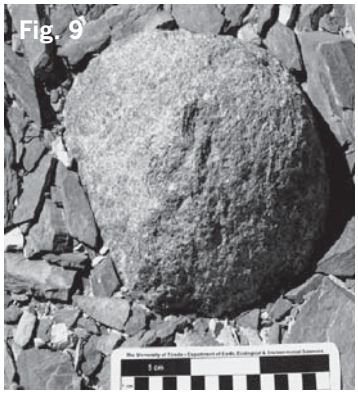


Fig. 9
Dolerite pounder in quarry N1, Bir Hammamat.

Fig. 10
Broken dolerite pounder/axe notched to attach a wooden haft, quarry S2, Bir Hammamat (Predynastic to Early Dynastic).

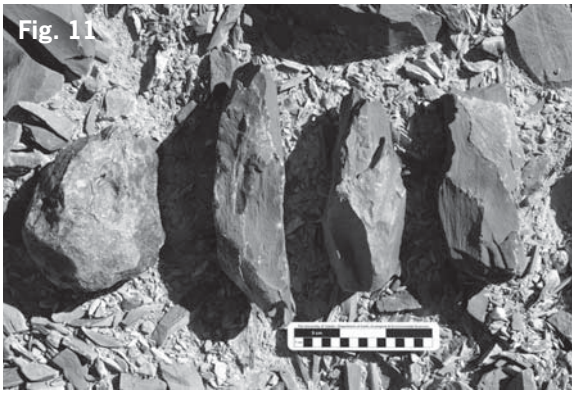


Fig. 11
Greywacke chisels and rods in stages of manufacture (centre and right) and a dolerite pounder fragment (at left) in quarry S4, Bir Hammamat.

and Early Dynastic quarries both at *Bekhen* Mountain and near Bir Hammamat.

The greywacke tools were manufactured in the quarry just southeast of Workshop 1 (S4) and were used in the quarries just north and northeast of this workshop. Some of these tools are roughly cylindrical or rod-shaped with blunt rounded or square ends, while others are similarly elongated, but tapering to a rough point at one end (**Fig. 11**). It is possible that the rod-shaped pieces of greywacke are an intermediate step in the production of the tapered tool, given that we found a workshop for producing these near to Predynastic and Early Dynastic quarries in the *Bekhen* Mountain region, west along the Wadi Faux (**Fig. 1**). We found these tools also in Workshop 1, but not in Workshop 2.

Debono (1951: 79-80) referred to the tapered tool as a "pic" (or pick) but this is unlikely to have been its function because there is no indication that it was ever shaped to take a wooden handle. It seems more likely that this tool was actually used like a 'chisel', where it was held in one hand and then struck with a stone hammer or wooden mallet wielded by the other hand. The hammer could have been a dolerite pounder, but it also may have been a greywacke rod. The rods are of a convenient size, shape and heft to serve as hammers for the greywacke chisels. These chisels are undoubtedly the tools used to make the 'chisel tracks' so commonly observed on vessel and palette rough-outs in the Predynastic-Early Dynastic quarries, and they must have also produced the lines of 'pointillé pits' (**Fig. 12**). 'Pointillé pits', a technique used to split rocks (along the line of pits) was previously thought to have originated in the Aegean region during the 6th century BC (Vandeput 1987-88: 94; Waelkens *et al.* 1990: 63-64). It is now clear that the technique was being used in Wadi Hammamat at least 2500 years earlier.

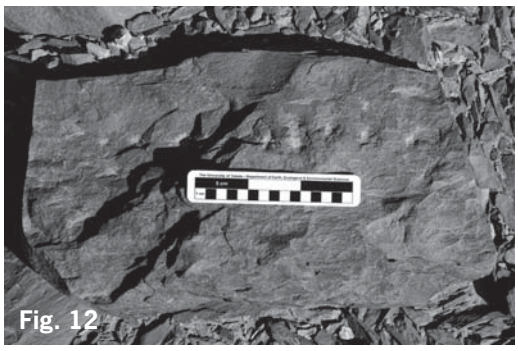


Fig. 12
Pointillé pits from greywacke tool on a block of greywacke in quarry S12, Bir Hammamat.

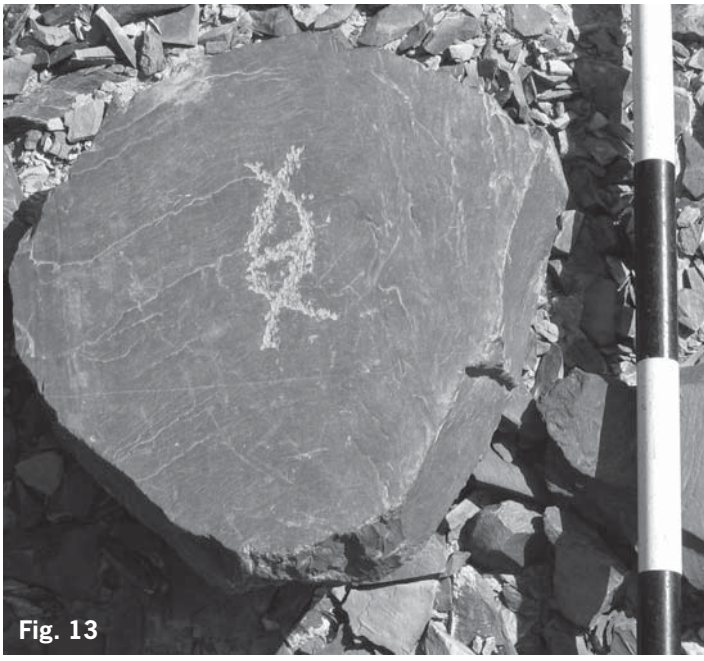


Fig. 13
Mason mark (?) on vessel rough-out in quarry S2, Bir Hammamat.

Incised on the upper surfaces of a few of the abandoned vessel rough-outs in two of the quarries near Bir Hammamat (N1 and S2) are single signs ⌒, ╳ (**Fig. 4**) or ⋈ (**Fig. 13**). It is of course extremely difficult to determine the meanings of these signs. The first of these might arguably be the hieroglyph for the numeral ten for recording every tenth vessel rough-out produced, a reasonable suggestion given that the sign appears on two of the twenty rough-outs (see **Fig. 4**), and/or these may just be random mason marks[6].

The Bir Hammamat bracelet workshops

The importance of the 'Bir Hammamat' region of the Wadi Hammamat ('Valley of the baths'), as the Arabic name 'bir' meaning 'well' implies, was due to the easy accessibility of groundwater here. The most well-preserved ancient wells remaining date to the Roman Period when a series of watchtowers and praesidia/hydreumata (fortified water points) with permanent settlements, were constructed along the Wadi Hammamat (Zitterkopf & Sidebotham 1989; Cuvigny 2003). It is unknown when the region first sustained human populations, however, with the area being not only a source of good quality greywacke, and water, but strategically at the midway point along the Nile Valley – Red Sea trade route, we can speculate on a time depth well into prehistory[7]. Debono's discoveries of archaeological sites dating from the Badarian at the Lakeita oasis (Debono 1951: 66-68) and his discovery of a Predynastic workshop for making bracelets (plus a small settlement), has been important in establishing some of these earlier antecedents in the Bir Hammamat region.

Although Debono mentions a number of settlements and workshops near Bir Hammamat, his report only describes excavation of one that we have called Workshop 1 (Debono 1951: 75-78; see **Fig. 3,1***). Extremely difficult to find, even though it is only 50 m south of the main road, the workshop covers 15,000 m^2 of gravelly terrace, approximately 0.5 m above the floodplain (**Fig. 14**). There is a smaller but better preserved second Predynastic workshop (called Workshop 2) 1.2 km west of Workshop 1, and 200 m south of the main road up a short wadi (**Fig. 3,2* & 15**). This positioning protected it from the effects

Fig. 14
View of Workshop 1 terrace (marked by an arrow) looking to the north, Bir Hammamat.

Fig. 15
View of Workshop 2 main terrace (marked by an arrow) looking to the north-east, Bir Hammamat.

6. See Arnold 1990 for more information about early masons marks.

7. Products such as shells from the Red Sea are known in Nile Valley contexts, and therefore the inter-relationship between people across the region has been long established since at least the Upper Palaeolithic (see Debono 1951: 60-62, Arkell 1975; Vermeersch et al. 1989). For a concise discussion about these links and the Eastern Desert in Prehistory see Majer (1992: 227-234); also Hoffman (1980: 243-248); Midant-Reynes (2000: 215).

of modern road building and also the ferocity of flash floods through the Wadi Hammamat. Similarly, material culture relating to production of greywacke, although mainly into bracelets, is strewn along this raised terrace 0.15-0.20 m above the wadi floor. Here, workshop debris is concentrated in a smaller area comprising a 'main workshop' of approximately 270 m^2, which extends for 55 m alongside the base of the gebel (see **Fig. 16**). It is difficult to say at this stage whether this was the original extent of the workshop, but the gully that now separates the 'main workshop' from the rest of the site indicates the potentially destructive forces of water run-off from the hills behind.

By comparing the material culture in both workshops, as set out in the table (**Tabl. 1**), analysing quarrying techniques and contextualising this information within the broader cultural landscape, we have been able to make some preliminary observations about Predynastic to Early Dynastic greywacke production and crafting.

Regional social networks and stone crafting

One of the most notable aspects of the material culture in the workshops is the amount of imported tools and raw materials, in particular chert and silicified sandstone (often termed 'quartzite'), which found their way into the sites (see **Tabl. 1**). The origin of stone tools and their materials is particularly important in establishing the possible extent of regional mobility and social networks existing around

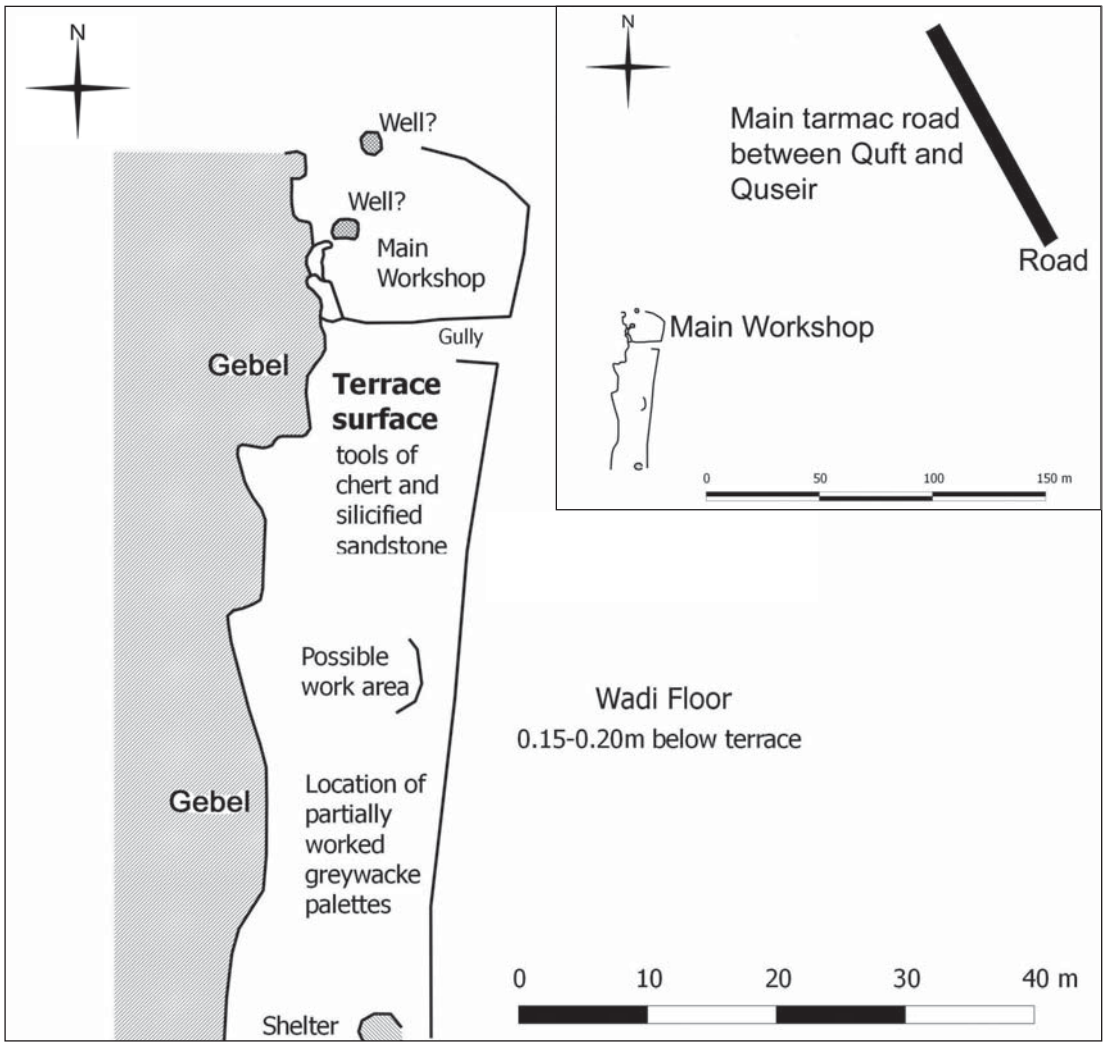


Fig. 16
Plan of Workshop 2, Bir Hammamat.

the production of greywacke[8]. The source of the silicified sandstone is unknown, but it is not local to the immediate area. In the case of chert, the nearest deposits from which the primary camel-coloured (yellowish-brown) variety might derive are 50 km east at the Gebel Duwi limestone range, near the Red Sea coast. This material could not have arrived by natural processes, carried as gravels by water, because the wadis associated with these deposits do not drain in the direction of the Bir Hammamat. Smaller amounts of tan (light brown), chocolate (dark brown) and banded pinkish chert are present at the workshops. In the case of the pinkish chert, its origins seem to be from a more westerly direction, along the desert plateau near Abydos (Hikade 2000: 18)[9].

Tabl. 1. Material culture documented at Workshop 1 (includes findings from Debono 1951: 75-78) and Workshop 2 (exclusively from Wadi Hammamat Project survey 2011-2012).

	Tools	Object rough-outs in greywacke	Settlement/Domestic Remains/Ceramics/ Petroglyphs	Comments
Workshop 1	**Chert:** microliths, knives, crescent-shaped drills, small flake borers, bladelets, cores **(Fig. 17**). Mainly camel-coloured (yellowish-brown), but some grey, tan (light brown) and chocolate (dark brown) **Silicified Sandstone:** fragment of a borer **Greywacke:** rods and chisels **Copper:** needles	**Bracelets:** unworked discs, broken and partially worked (**Fig. 18**) **Stone vessels:** 2 circular forms (14 x 14 x 5.5 deep) (**Fig. 19**)	**Settlement:**at least one semi-subterranean dwelling (Debono 1951: 75-78, pl.X) **Faunal and floral remains:** ostrich egg shell, mother of pearl, carbonised wood, animal bones, fish vertebra (Debono 1951: 75- 78) **Ceramics:** Naqada II; 3rd-4th Dynasty; some Middle Kingdom to Late Period; Roman Period **Rock art:** giraff, ibex, dogs, ostrich – Predynastic **Hieroglyphs:** *Ii-k3(i)* - rock eut name and dating to Old Kingdom, near Workshop 1 (S4).	Debono (1951: 75-78) excavated the settlement feature (only a vague imprint now remains) and found a much larger range of tools than visible today, in particular of chert, and also copper for drilling beads. However, he did not record the greywacke tools or notice the stone vessel rough-outs. Most importantly he did not find the quarries directly behind (see **Fig. 3** for locations) that were the source of greywacke. Our investigations found Naqada II pottery - jars and bowls (see **Fig. 20**) clustered near a settlement feature, other sherds from later periods in south-west corner of workshop; some Old Kingdom pottery brought to the site from Nile Valley (**Fig. 20**). The rock art and hieroglyphs are clustered close to a quarry at S4 (**Fig. 21**) (see **Fig. 3+**)
Workshop 2	**Chert:** circular, cortical and retouched end scrapers, cores, flakes, bladelets. Mainly camel-coloured (yellowish-brown). **Silicified Sandstone:** numerous and 3 types: (i) hand-held rubbing/jgrinding tool with flat surfaces from use; (ii) small tapered round-ended tools (**Fig. 22**); (iii) crescent-shaped borers (**Fig. 23**).	**Bracelets:** unworked dises, broken and partially worked (**Fig. 24**) **Palettes:** 2 rough-outs	**Settlement:** shallow circular depression into terrace floor surrounded by a low highly weathered stone wall (**Fig. 25**) **Wells (?):** 2 sand-filled depressions surrounded by weathered spoil close to main workshop (**Fig. 26**) **Ceramics:** mainly Naqada II (rim sherds of bowls and jars, but some Naqada III (see **Fig. 20**)	There were no quarries close to the workshop or any rock art, this may be due to the poor quality of greywacke here. Probable source of greywacke from quarries near Workshop 1, in particular quarry S8 (see **Fig. 3**).

8. For more discussion of early/prehistoric stone tool circulation between kin-groups see Bradley & Edmonds 1993: 96; Cooney 1998: 108-18; 1999: 49-51; Edmonds 1999: 47-8; Bradley 2000: 86-7; Boivin 2004: 10-16; Bloxam & Heldal 2007; 2008.

9. Hikade's (2000) analysis of lithic assemblages at Hierakonpolis in Predynastic to Early Dynastic contexts noted a high proportion of this specific chert.

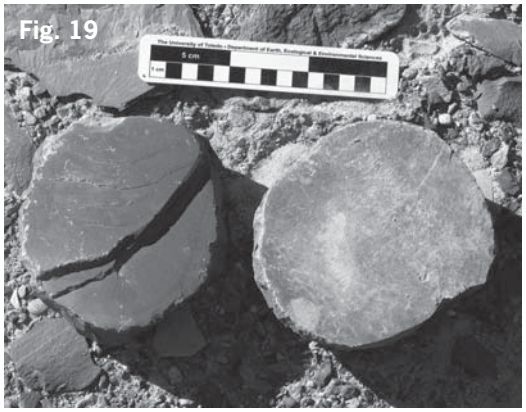


Fig. 17
Chert crescent-shaped drills, Workshop 1, Bir Hammamat.

Fig. 18
Broken and partially hollowed out greywacke bracelet showing concentric rings from drilling, Workshop 1, Bir Hammamat.

Fig. 19
Greywacke vessel rough-outs, Workshop 1, Bir Hammamat.

Fig. 20
Pottery from Workshop 1 and 2.

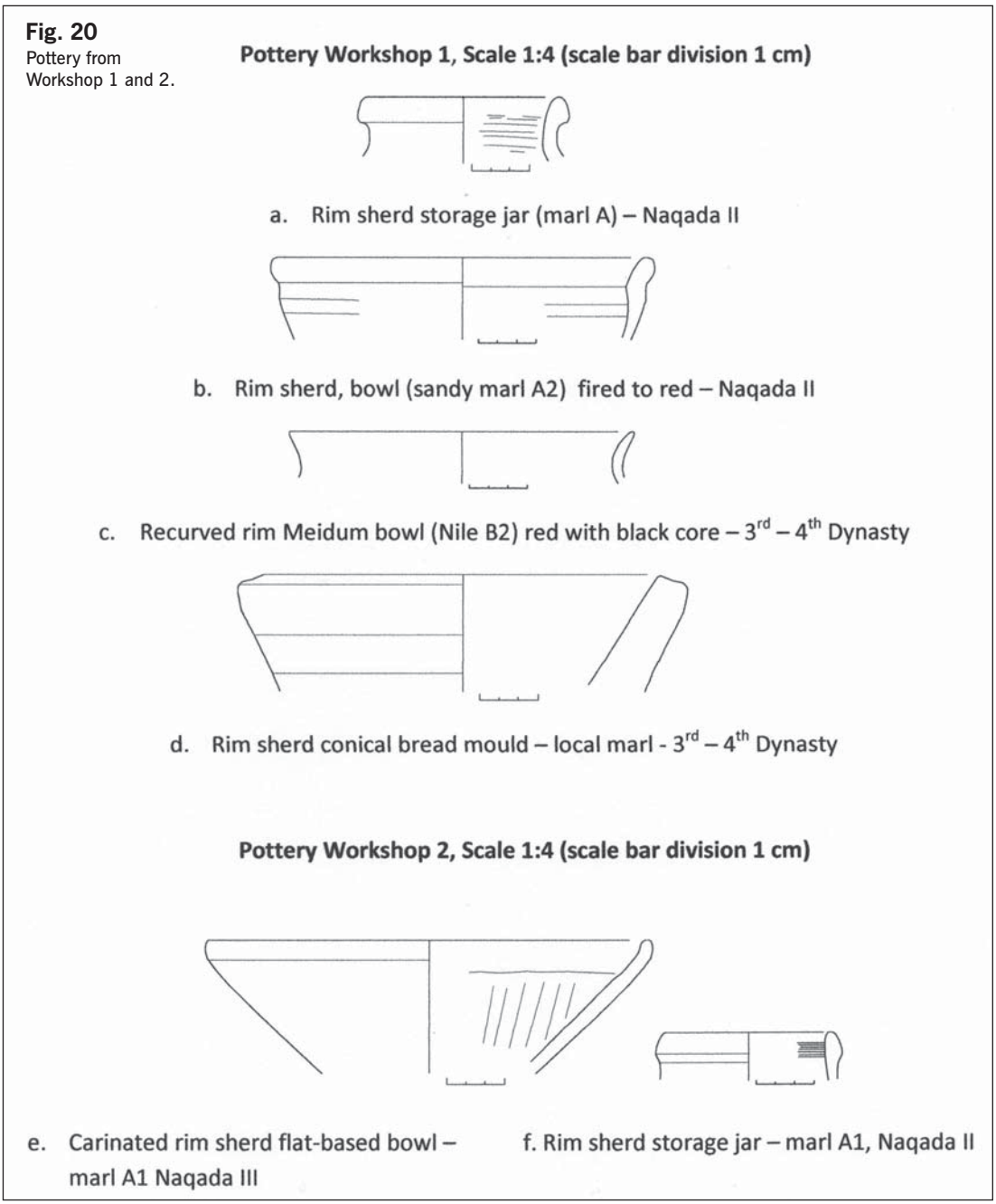


Fig. 21
Predynastic rock art (dogs and ibex) in a cluster of other depictions at quarry S4, Bir Hammamat.

From the range of chert pieces with cortical cover, cores, fragments and other debris, it seems as if the camel-coloured (yellowish-brown) variety of the material was brought to the site as small pebbles, then worked into tools *in situ*. Dolerite was also imported to the area, but tools from this material are found mainly in the nearby quarries, shaped into pounders and axes for use in the quarrying process (**Fig. 9-10**). An easterly source of this material can also be speculated, about 10 km away in the Wadi Abu Fannani, where there are numerous dolerite dikes. Here the stone occurs naturally as slightly rounded pieces that could have been immediately used without much shaping.
So, in similar fashion to the chert and silicified sandstone, this material, whether worked or unworked, was brought into the quarries by people. It is difficult without more detailed analysis of these assemblages and their sources to assess the mechanisms by which this material might have arrived, however, we can speculate on three possible scenarios: (i) as part of a more planned organisational operation, (ii) via mobile groups of skilled craftspeople, or (iii) through long established regional distribution and exchange networks. In the case of the latter, the longevity and widespread nature of these contacts could go back at least to the Badarian, given the central role that the Wadi Hammamat played as the conduit for contact between people who populated the Eastern Desert and Red Sea coast, with those in the Nile Valley, as already mentioned.
The idea of mobile groups of crafts workers coming to specific resources, perhaps from centralised workshops with prepared toolkits, might have some foundation given the presence of crescent-shaped chert drills at Workshop 1[10] (**Fig. 17**). There is the possibility that these arrived as ready-made tools at Workshop 1 (apparently the only part of the Wadi Hammamat in which

10. These are the largest chert tools in the assemblage (>50 mm) found at Workshop 1. They were hand-held and used in a rotary action to hollow out the centre of stone vessels since the Predynastic (Stocks 2003: 139). Some partially worked and broken bracelets show concentric rings which may also have been made using this type of tool (see Fig. 18). Tubular drills in metal (copper) (see Stocks 2003: 142) were also used to hollow out stone vessels, (see also Arnold 1991: 266, fig. 6.21) but of course none have been found.

Fig. 22
Pointed-ended small tools in silicified sandstone, Workshop 2, Bir Hammamat.

Fig. 23
Silicified sandstone crescent-shaped borer/drill showing wear marks, Workshop 2, Bir Hammamat.

Fig. 24
Unworked bracelet rough-out next to slotted silicified sandstone tool/ rubber to smooth outer edges, Workshop 2, Bir Hammamat.

they occur), given the absence of corresponding debris from working this size of object. Chert crescent drills are associated elsewhere in Egypt with the production of stone vessels, and have been found in Predynastic to Early Dynastic contexts at site 10N5W at Hierakonpolis (Hikade 2000: 15) and the early Old Kingdom gypsum quarries at Umm es-Sawan in the Faiyum (Caton-Thompson & Gardner 1934: 105, 131, pls LXVIII: 1-25, LXIX: 1-12). Although it is tempting to link the crescent drills with mobile crafts workers centrally based at Hierakonpolis, this is difficult to substantiate because blends of different working deployments to quarries can exist. These teams can be more localised where long-term craft traditions in stone-working may already exist, but could also have been part of centrally controlled shorter-term projects[11].

Given that chert could have arrived at the workshops via a range of social networks operating from both the east and west, might this also be the way that the silicified sandstone was brought into the Bir Hammamat? As the dominant material in Workshop 2, and with there being no obvious evidence that tools were produced from raw material *in situ*, it presents us with some intriguing options. At the moment we do not know where the specific sources of the silicified sandstone might be, since it is a material common to both the Eastern and Western Deserts (Aston *et al.* 2000: 53-54). The abrasive properties of silicified sandstone made it an important material for hollowing out stone vessels and also for finishing stone products[12] (**Fig. 22-24**). It is difficult to know at this stage whether all these tools, including the crescent-shaped borers, came into the site as part of toolkits. In stone vessel making contexts at Hierakonpolis, the drilling tools are generally in a figure-of-eight shape to which a forked shaft was attached (Quibell & Green 1902; Stocks 2003: 142-3)[13] whereas a hand-held variety is found in Workshop 2 (**Fig. 23**)[14]. However, rather like the chert drills at Workshop1 these tools similarly share a remarkable diagnostic conformity (60 mm x 49 mm x 35 mm) and use-wear in the form of concentric rings (**Fig. 23**).

A landscape of contact

The idea of quarries being places of contact between groups of people, often over many generations, has been a fresh departure in the study of production sites that addresses not only the technological specifics of resource extraction, but also a wider social and organisational context (Bradley & Edmonds 1993; Cooney 1998; Bloxam *et al.* 2009; Shaw *et al.* 2010; Bloxam 2011; Hamilton *et al.* 2011; Bevan & Bloxam in press). Thus it is worth emphasising that quarries are rarely singu-

11. For a larger discussion of stonemason mobility in the Bronze Age Eastern Mediterranean see Bevan & Bloxam (in press).
12. For instance, we found several small pointed tools for finer work and a grooved piece of the material was clearly used for smoothing the outside of bracelets (Fig. 22, 24).
13. Our investigations so far have not found a borer that is exactly comparable.
14. A fragment of a silicified sandstone borer was also found at Workshop 1.

lar archaeological 'sites' but rather comprise whole 'landscapes', transformed by exploitative practices that ebb and flow in relation to how highly rated a particular stone's properties were at a given time (see for instance Heldal 2009; Bloxam *et al.* 2007; Cooney 1999). Some stone sources can also be important meeting places that draw in groups from a wide geographical area and are maintained over several generations. As pointed out for European Neolithic contexts, the maintenance and transmission of stone working traditions is often mediated at the stone source through successive generations of local people, and hence by certain forms of unbroken cultural memory, including the multi-generational preservation of craft knowledge[15] (Edmonds 1999: 47-8). Inscribing the landscape is another way in which people socialised the landscape in important, long-term ways (Taçon 1991: 195; 1994; Bradley 2000: 38-9; Boivin 2004; Bloxam 2011: 156-61), and might range from figurative imagery such as rock art, to specialist marks to narrative inscriptions.

From our observations we can envisage a blend of both regional and local groups converging at the site, either directly or indirectly engaged in the stone-working process. On the one hand there appears to have been established local long-duration knowledge in terms of accessing suitable deposits of greywacke for specific objects and use of tools to extract it, and on the other hand, the requirement of specialist tools from materials that were not immediately local and would have required more regional knowledge of the broader landscape and resources. How this focal point of contact between people can be further acknowledged is through the ways in which the landscape has been consistently inscribed since at least the 4th millennium BC. Although the creation of rock art can be attributed to a range of activities across the landscape (see Storemyr 2009: 140-2) clusters of petroglyphs close to quarries, or strategically on the route to them, imply a direct connection between rock art and quarrying. Most prominent in the vicinity of Workshop 1 and its quarries is a cluster of petroglyphs depicting a giraffe, ostrich, ibex and dogs, most likely belonging to the Predynastic (Huyge 1998: 9-10; 2002: 195; Judd 2006a: 156-158; 2006b; 2009) (**Fig. 21**). Without delving too deeply into this broad subject area, it is worth mentioning later Aramaic texts and names in the Wadi Hammamat greywacke quarries that imply the presence of non-Egyptian stone workers (Couyat & Montet 1912; Moorey 2001: 9; Simpson 1959: 35-6; Gérard 1988: 33-36). There are also formal records and graffiti found along trade routes in the Eastern Desert and Lower Nubia that refer to specialist prospectors and gemstone importers called the *sementiu* (Yoyotte 1975: 44-55). Thus we cannot discount the extent to which the dynamics of stone working drew in various groups of people, including foreigners, to one place, whether as skilled craftspeople engaged in the actual process, or others who brought in raw materials as part of a network of exchange[16]. The time

Fig. 25
Dwelling/shelter at Workshop 2, Bir Hammamat.

15. For further enlightening Australian examples, see also Brumm 2010: 191-93; McBryde 1997; Taçon 1991; Fullagar & Head 1999.

16. For more discussion on flows and distribution of products from mines across the Eastern Desert see Bloxam 2006: 295-296.

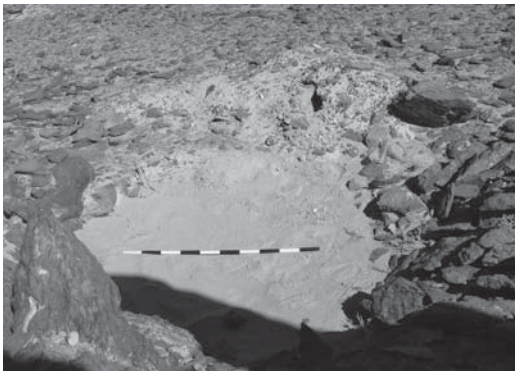
depth to these inter-relationships through the movement of commodities and people between the Nile valley and Red Sea has existed since at least the Badarian period, given the range of artefacts from the region found in such contexts (Majer 1992: 228).

So, when we come back to the idea of quarries as important places of contact between groups, whether directly involved in the quarrying process or not, we must also think about how these connections were key to the widespread flow and distribution of greywacke products, particularly during the Predynastic. The location of the workshops is particularly interesting in this regard, given that they were clearly intended to be visible to people passing through the Wadi Hammamat. The sources quarried were also within a 1 km radius of the workshops and thus we can envisage this focal point of relationships between people working the stone and others passing through the landscape as taking place directly on the trade route. Trade, exchange, gift-giving are all possible ways in which specialist raw materials, and other commodities, may have moved into quarries, and probably how greywacke products moved out. We know from the workshop evidence that the bracelets were certainly finished locally, and there is the probability that this also applied to palettes. However, it is impossible to know at this stage how many hands these products passed through on their way to the Nile Valley and beyond. As Stevenson (2009: 191) discusses in relation to Predynastic palettes, these can be passed on, as finished objects, through a variety of social interactions before being consumed in a funerary context.

It is difficult to assess at what point this more flexible flow of finished products through the Eastern Desert, centred on networks of local and regional interaction changed and perhaps became more restricted by an emerging 'state' elite. There are, however, some hints of subtle change, particularly if we look at work practices surrounding the production of stone vessels, which became a specific feature of elite greywacke consumption by the 1st Dynasty (Aston 1994: 32). At some point during Naqada II to Naqada III Workshop 2 became redundant, given that pottery is confined within this date range (see **Fig. 20**)[17]. There is also no evidence of working stone vessels here, just bracelets and possibly palettes. It therefore seems as if stone crafting at some point in the late Predynastic became centred at Workshop 1, because this is where we find stone vessel rough-outs, 3rd-4th Dynasty pottery, and also numerous quarries for these products in the surrounding hills (see **Fig. 3**). In these quarries we find the distinctive greywacke chisels, as well as workshops where these were made (see **Fig. 11**). This type of tool and the chert crescent drills that feature so distinctively in the assemblages at Workshop 1 are both conspicuously absent in Workshop 2. As we speculated earlier, whether the chert cresent-drills entered Workshop 1 as finished tools is another aspect of the imported materials that might suggest changing work practices. In particular, it might be argued that craft specialists from established centres of stone vessel production in the Nile valley, such as Hierakonpolis, brought these into the quarries during the intensive period of production of these in the 1st Dynasty.

The extent to which stone vessels were finished in the workshop is also important to establishing changes in work practices, and assessing whether final crafting shifted to more centralised places in the Nile valley. Hints of such change might explain the lack of silicified sandstone tools used for finishing of products in Workshop 1, as opposed to their ubiquity in Workshop 2. The enigmatic signs on some stone vessel rough-outs stockpiled in the quarries, as described above (see **Fig. 13**) might also point towards this if we subscribe to Arnold's (1990) idea of mason marks on quarried blocks signifying spheres of interaction through which unfinished objects passed from quarries to places of final crafting. Whether these subtle changes point us towards a different social organisation, particularly when the explosion in consumption of stone vessels becomes asso-

17. Although the majority of sherds date to Naqada II, a sherd from a flat-based bowl (see Fig. 20e) dates to Naqada III (Buchez 2011) suggesting some later activity.



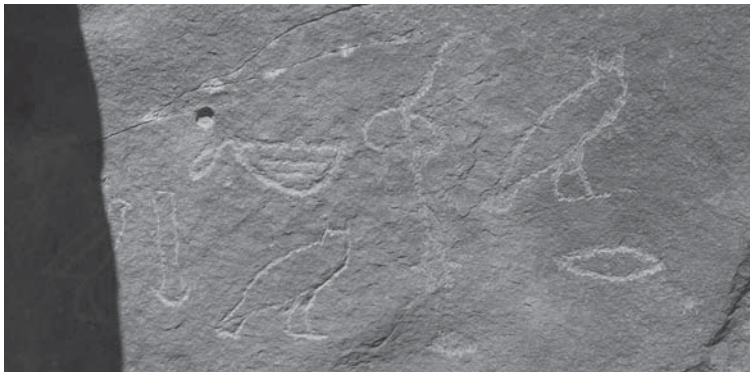


Fig. 26
Sand-filled depression at Workshop 2, most likely a well (?).

Fig. 27
Rock cut inscription of '*Kʿi-m-mdw*' 'overseer of stoneworkers', Wadi Faux (east side) at Bekhen Mountain.

ciated with the first royal tombs at Abydos, needs more investigation.

Although we have yet to fully establish the location of the later Old Kingdom quarries associated with production of ornamental statues at Wadi Hammamat (although these are more likely to be in the region of the 'Bekhen Mountain' see **Fig. 1**), we have not found any conspicuous workshops, or other places, suggesting these larger objects were finished in the quarries. Thus, we might argue for a gradual trend towards final crafting of products, from the Early Dynastic into Old Kingdom, becoming centred in Nile Valley workshops. As a consequence, this would have created quite a rupture in the social dynamics, as well as exchange networks, in which the quarries played a central role in relation to the distribution of finished products. By the Old Kingdom, hieroglyphic inscriptions begin to occur including one naming '*Kʿi-m-mdw*' as 'overseer of stoneworkers' (in Wadi Faux see **Fig. 27**) (Goyon 1957: 60, no. 25 pl. XII) and another name of the same period *Ỉi-k3(i)* occurs clustered amongst earlier rock art near Workshop 1 in Bir Hammamat (Goyon 1957: 49, no. 11). These occurrences could be the defining moment, within an increasingly socially complex society, when we see the appearance of a clearly distinct group of craftspeople within an emerging hierarchy. By the Old Kingdom, we can also see the beginnings of an unprecedented phenomenon of inscribing names and titles across the quarry landscape, which continues into the Roman Period (Bloxam forthcoming).

Conclusion

This paper has attempted to bring together several research strands to understand the Predynastic origins of greywacke working and how these laid the social foundations for the unprecedented exploitation of this, and other stones, in one of the world's most important monumental cultures. By taking a holistic landscape perspective, we believe that we can add a greater depth to our enquiries through placing the quarries at the centre of social networks, rather than at their periphery. Although our fieldwork has so far only involved preliminary surface survey, we have tried to show, within these obvious limitations, how examining origins of raw materials in particular can give us a starting point to understanding the complexity of social networks that surrounded production sites.

Quarries in regions outside the Nile valley have had a very strong survival record and thus have a time-depth that renders them essential places to study. However, we are now seeing increasing losses of material from these landscapes, in particular the rock inscriptions at Wadi Hammamat, which in some instances appear to have been 'cherry-picked' by collectors. Thus, apart from building on hypotheses raised in this article through more detailed survey and excavation, we will be putting in place a site management plan for the quarrying areas and inscriptions as a step towards protecting this global heritage in an increasingly fragile landscape.

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