
'A Place Full of Whispers': Socializing the Quarry Landscape of the Wadi Hammamat

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The wealth of inscriptions at the Wadi Hammamat greywacke quarries (Egyptian Eastern Desert) have made it a key place to pursue enquiries about the social organization of expeditions to procure resources. Analysis of this textual material alone has, however, given us only a partial view of the social milieu that maintained quarrying from the fourth millennium BC to the fifth century AD. This article presents a fresh perspective on Egyptian quarrying that aims to balance the more accepted (and persistent) perceptions of overriding state control of these activities with viewpoints gained from recent archaeological survey of the Wadi Hammamat quarries. Practically and theoretically, a holistic approach is taken that contextualizes the textual sources and other elements of the archaeological record within the quarry landscape as a series of material complexes. Cross-cultural and comparative approaches to interpreting the data have enabled both reappraisal and augmentation of the ways in which we understand the social interplay between local and regional kin-groups within notions of state control of these activities. The article argues for the essential roles played by kinship ties and linkages to place, through the continual inscribing of names, as parts of the underlying human narrative that maintained quarrying here for generations.

The Wadi Hammamat greywacke quarries in the Eastern Desert of Egypt (Fig. 1) contain one of the world's largest corpora of rock engravings associated with a place of ancient quarrying, spanning the major epochs of Egyptian history between the Early Dynastic and Roman periods (3000 BC–AD 395). Arthur Weigall (1909, 37), who was among the first travellers to rediscover the quarries in the early twentieth century, described the names carved on the rocks over the centuries as 'crowding the quarries with ghosts . . . the rocks, peopled with insistent entities, all muttering tales of long ago . . . the place is full of whispers'. Ever since then, philologists have been greatly attracted to this rare and well-preserved collection of rock engravings, particularly those in hieroglyphics, hieratic, demotic and Greek (Bernand 1972; Couyat & Montet 1912; Cruz-Urbe 2001; Gasse 1987; Goyon 1957; Gundlach 1986; Hikade 2001; 2006; Kayser 1993; Peden 2001; Posener 1936; Seyfried 1981; Simpson 1959; Thissen 1979). By comparison, however, only

very limited investigations have been made of the broader cultural landscape in which the inscriptions are embedded, including quarries, settlements and other domestic and logistical infrastructure. To date, these investigations have consisted of geological and geoarchaeological descriptions of the quarries (Harrell 2002, 238–40; Harrell & Brown 1992; Hume 1934, 258–66; Klemm & Klemm 1993, 355–76; 2008, 296–311), together with a small amount of archaeological research, primarily focused on the Roman Period remains (Cuvigny 2003; Zitterkopf & Sidebotham 1989) and, to a much lesser extent, on those of the Predynastic to Early Dynastic (Debono 1951).

Within this fragmented history of investigation, which in essence has largely isolated text from archaeology, we have an extremely limited vantage point on the underlying social and cultural milieu that maintained quarrying in the Wadi Hammamat for thousands of years. Of course inscriptions in quarries, where they occur, provide a valuable historical and

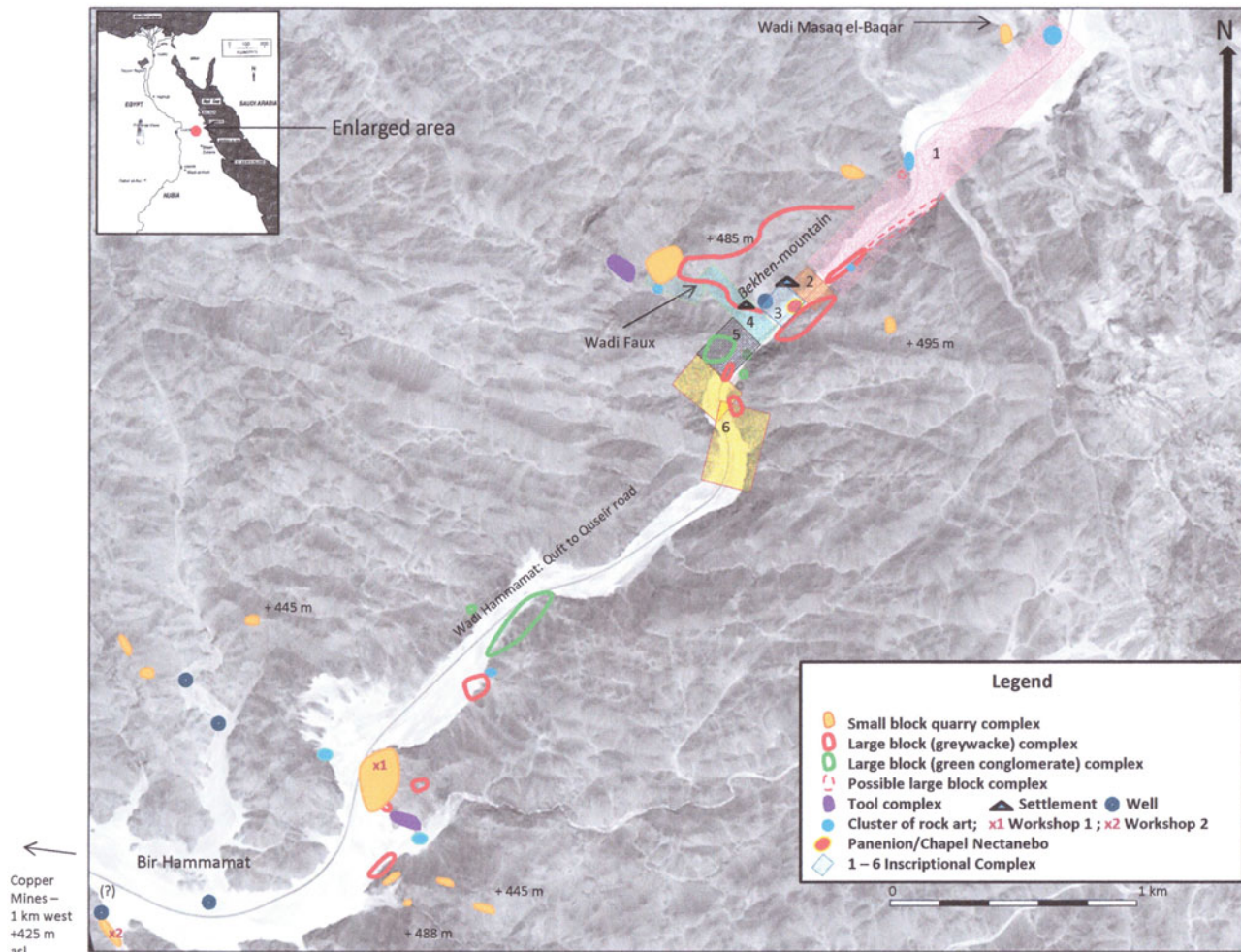


Figure 1. Satellite image showing the complexes of material remains across the main survey zone between the Bir Hammamat and Wadi Masaq el-Baqar.

chronological context around the exploitation of key resources. However, philological interpretation of textual data alone has arguably over-emphasized the extent to which these sources tell us about the way resources were procured in practice. This situation has therefore created a rather one-sided viewpoint that exaggerates the role that the king, state, administration and bureaucracy played in the quarrying process (Hikade 2006; Lloyd 2013, 361–82; 2014, 195–7; Seyfried 1981). We also contend with a lack of balance in archaeological investigations of Egyptian quarries, which in general have been biased towards description (often confined to just one historical epoch), technology and provenance studies (e.g. Klemm & Klemm 2008). Therefore, we have lacked a credible research strategy for practically and theoretically investigating the question of resource procurement, clearly a major activity in all early monumental cultures, particularly

in relation to the role of individuals at lower social levels.

A major problem in Egyptian and Near Eastern archaeology has been the tendency to pigeonhole quarries into much narrower research schemes than they deserve. In particular, such schemes emphasize the study of ancient ‘technologies’, rather than what quarries can also contribute to broader discussions about social and cultural change. What this article intends to do is to enrich our range of approaches to studying the social context of resource procurement, both practically and theoretically, by examining the chronological transformation of the Wadi Hammamat quarry landscape holistically as a series of material complexes. The objective is to apply an alternative methodological approach through which we might gain insights into social interactions among people at a stone source and into the ways in which these

interactions are reflected, not only through changes in procurement and production strategies, but also through their placement and the theme of inscribing the landscape. Essentially, I aim to examine whether kinship ties between local and regional stone-working specialists might have played a large part in ensuring access to, and the long-term procurement of, strategic resources over time.

This study will first consider some comparative and cross-cultural approaches to understanding social life in the past through the extraction of strategic resources and the ways in which these can provide additional interpretative strategies through which we can examine Egyptian data. Using the Wadi Hammamat greywacke quarries as a case study, the paper then considers the ways in which contact among people, locally and regionally, may have created the conditions for transmission of knowledge and technological know-how at the stone source.¹ It further considers the extent to which the continual inscribing of the landscape, as a social activity, may have been connected with the renewal of kinship ties and generational linkages with place. Starting with the earliest small-block quarries (fourth–third millennium BC), it interprets the archaeological and textual data together, as material complexes chronologically linked to the production of specific products. The paper initially focuses on the importance of stone tool importation and use during small-block quarrying. It then analyses the progression toward large-block quarrying, after 'state' formation (third–late first millennium BC), and the impact that changing logistics and regimes of contact had on pre-existing social networks. The article argues for a greater emphasis to be placed on holistic, comparative and cross-cultural examinations of archaeological, and textual, data in studies of resource procurement, if we are to incorporate this largely ignored aspect of social life in the past into general archaeological discourse.

Interpreting quarry landscapes

Identifying the time-depth of quarrying in the Wadi Hammamat is the key methodological issue in terms of investigating the transformation of the landscape over time. Adapting methods used in characterizing historic environments through time-depth as complexes of material (Fairclough 2008; Mason 2008) has been demonstrated as an effective way of temporally deconstructing quarry landscapes (see Abu-Jaber *et al.* 2009; Bloxam 2011; Bloxam & Haldal 2008, 118–33; Haldal 2009). All quarry/production landscapes share, within varying degrees of preservation,

common characteristics which for simplicity can be placed within four broad categories of data:

- (i) the *Resource* or actual stone deposit;
- (ii) *Production* remains such as quarries, tools, spoil and discarded products;
- (iii) the *Social infrastructure*, or the remains left by the people who worked in the quarry, such as settlements, inscriptions and ceramics;
- (iv) *Logistics* or infrastructure laid down to remove products from the quarry.

However, these four categories of data can be extremely problematic to associate temporally in terms of the chronological transformation of the landscape, because quarrying episodes for a specific object may be scattered across a wide area. The notion of the 'quarry complex' provides a generic template for identifying collections of material culture (sites or sub-sites) within varying degrees of preservation and visibility, that may be related to each other in time, space and/or function (Bloxam 2011, 152; Bloxam & Haldal 2008, 118–33). This method means that we remove the tendency to place a greater emphasis on analysing one specific type of data (e.g. textual evidence) but rather, construct a more holistic appraisal of all the material remains that represent human transformation of the landscape over time. The Wadi Hammamat quarry landscape is essentially a *mélange* of these four categories of data, spread across 10 sqkm of steep rocky terrain spanning a time depth from at least the early fourth millennium BC (Chalcolithic to Early Bronze Age) to Roman Period (fifth century AD). As Table 1 shows, four 'quarry complexes' have been designated the 'small block complex', 'large block complex', 'tool complex' and 'copper mining complex', and relate to products being produced according to resource type across a survey zone between the Bir Hammamat in the west and Wadi Masaq el-Baqar in the east; they are mapped onto the satellite image (Fig. 1).² The 'small' and 'large' block quarry complexes are chronologically distinctive because of their linkage to proven consumption patterns of specific objects over time (Aston 1994; Aston *et al.* 2000; Harrell 2002; Harrell *et al.* 2002; Klemm & Klemm 1993; 2008). The 'tool complex' has been broadly identified as contemporary with 'small block' quarrying because of their location in proximity to these quarries, as well as use for extracting and shaping objects. The 'copper mining complex' is included for the purposes of showing the range of resources being procured, but not discussed in detail owing to being only preliminarily surveyed. The inscriptional data that fall within the social infrastructure category of the 'quarry complexes' are derived mainly from published sources that have concentrated on a two-kilometre stretch in the region

Table 1. Quarry complexes of remains relating to small-block and large-block quarrying, tool quarries and copper mines examined between Bir Hammamat and Wadi Masaq el-Baqar. Data characterized during four survey seasons of the 'Wadi Hammamat Project' 2010–2014.

Quarry complex	Resource and product	Production	Social infrastructure	Logistics
<p>Small Block (prehistory – early/mid third millennium BC)</p>	<p>Products: palettes, bracelets, vessels</p> <p>Greywacke type: fine grained (mudrock), greyish-green, intensely fractured</p> <p>Occurrence: scattered between Bir Hammamat and Wadi Masaq el-Baqar – mostly high elevations +400 m</p>	<p>Primary extraction: levering along natural fractures (few tool marks) (Fig. 5)</p> <p>Secondary production: shaping to object rough-outs (pointillé pits and chisel marks visible), some final finishing at 2 workshops at Bir Hammamat)</p> <p>Tools in quarries: local: greywacke chisels, rods; non-local: dolerite hammers, pounders; some granite (Bloxam <i>et al.</i> 2014, 18, figs. 9–11) (Fig. 6)</p> <p>Waste products: pushed down hillside</p> <p>Stone workshops (Bir Hammamat): Workshop 1: bracelet rough-outs: unworked and partially worked discs; stone vessels 2 circular forms (14x14x5.5cm deep); tools: chert borers, microliths and drills, greywacke chisels, rods, copper needles (local and non-local) (Fig. 4)</p> <p>Workshop 2: rough-outs: mainly bracelets (as above), palettes x2; tools mainly silicified sandstone drills, finishing tools, some chert flakes (all non-local) (Bloxam <i>et al.</i> 2014, 21–4, figs. 17–19, 22–24)</p>	<p>Dwellings: connected with stone workshops Workshop 1: at least one semi-subterranean dwelling; some faunal/floral and some domestic remains (Debono 1951, 75–8); ceramics: mid fourth millennium BC–early/mid third millennium BC; some mid second millennium BC and fourth century AD (see Bloxam <i>et al.</i> 2014, 19–24)</p> <p>Workshop 2: one dwelling shallow circular depression; ceramics mainly mid–late fourth millennium BC (Naqada II); 2 wells (see Bloxam <i>et al.</i> 2014, 19–24)</p> <p>Petroglyphs: rock art (giraffe, ibex, dogs, ostrich); few hieroglyphs/graffiti (early third millennium BC?) name/titles across all zones and near quarries at Workshop 1 (Bloxam <i>et al.</i> 2014, 23–7, figs. 21, 27)</p>	<p>Paths Hilltop cairns</p>
<p>Large Block (mid third millennium BC– fifth century AD)</p>	<p>Products: sarcophagi, coffins, statues, naoi</p> <p>Greywacke type: coarse-grained sandstone variety, massive, wide fractures; greyish, brownish, greenish hues</p> <p>Occurrence: extensive between Bir Hammamat and Wadi Masaq el-Baqar</p>	<p>Primary extraction: levering, splitting (stone wedges); fire-setting (charcoal in ash layers, cracked surfaces); tool marks mainly from wedging (Fig. 7); 20+ quarries known – range of elevations most concentrated at <i>bekhen</i>-mountain; some deep underground pits with evidence of fire-setting (Fig. 8 Chapel of Nectanebo)</p> <p>Secondary production: shaping to object rough-outs in quarries and below in work areas (pointillé pits, wedging, fire, chisel marks)</p> <p>Tools in quarries: local: greywacke wedges; non-local: dolerite pounders, hammers</p> <p>Waste products: pushed down hillside and/or used to build walls around deep pit quarries; also to build nearby settlements</p>	<p>Settlement: at <i>bekhen</i>-mountain (20+ rooms), partial flood defence wall; entrance to Wadi Faux 2 interconnecting rooms, + single-roomed dwelling (Fig. 10)</p> <p>Ceramics: at large settlement mid first millennium BC to sixth century AD (El-Senussi 2011); in quarries Bir Hammamat from mid second millennium BC; mainly mid first millennium BC, some into fifth century AD (El-Senussi 2011; 2012)</p> <p>Well: between the two areas of settlement (Fig. 10)</p> <p>Petroglyphs: rock art, graffiti, hieroglyphs, hieratic, Greek, Demotic, Aramaic, iconography in region of <i>bekhen</i>-mountain (see Figs. 1, 11, 12, 13)</p> <p>Ritual/cultic areas: Chapel of Nectanebo/Paneion a 'shrine to Min' (a re-used quarry post-dates mid first millennium BC) (Fig. 8)</p> <p>Watchtowers: high elevations connected with trade route (Roman Period) (Zitterkopf & Sidebotham 1989)</p>	<p>Internal: ramps (from high elevation quarries) (Figs. 8, 9, 15)</p> <p>External: poorly preserved ground-level paved roads/ramps mainly at entrance to Wadi Faux. Stockpile midway to Nile valley</p>

Table 1. Continued.

Quarry complex	Resource and product	Production	Social infrastructure	Logistics
	Green conglomerate: sarcophagi, stelae	Primary extraction: splitting (wedges) most concentrated at entrance to Wadi Faux at the <i>bekhen</i> -mountain (Fig. 1); traces of modern metal tools (1960s) Secondary production: shaping to object rough-outs (wedging)	Settlement: stone huts relating to modern quarrying (1960s) Petroglyphs: iconography, hieroglyphs names/titles (Figs. 1, 11, 12)	Paved areas near, could be modern?
Tool (prehistory – early/mid third millennium BC)	Products: chisels, rods, wedges (?) Greywacke type: fine-grained dark grey to greyish-green Occurrence: Bir Hammamat, Wadi Faux	Primary extraction: levering small blocks; also pits Secondary production: rough shaping into rods, chisels, and perhaps wedges with stone tools (dolerite pounders) in quarries and workshops (Wadi Faux) (Bloxam <i>et al.</i> 2014, 18, fig. 11). Tools in quarries: non-local: dolerite pounders, hammers Workshops: at Wadi Faux reduction of rods to chisels/wedges	Petroglyphs: rock art in quarry, Bir Hammamat region (Bloxam <i>et al.</i> 2014, 23, fig. 21)	Paths quarries to workshops
Copper mining (mid second, first millennium BC–Ottoman Period)	Copper silicate (chrysocolla) Products: unknown Occurrence: Bir Hammamat	Primary extraction: south mines: series of 20 open-cut pits, some +10 m underground; elevation 425 m west of Bir Hammamat; tailings/spoil; no evidence of metallurgy; north mines opposite (Ottoman) low intensity Tools: local metaconglomerate (axes), greywacke (chisels), non-local granite, silicified sandstone and diorite pounders	Settlement: only associated with south mines, two small areas of interconnecting huts – smaller area New Kingdom pottery Ceramics: south mines: New Kingdom (18th–19th Dynasty; 1550–1186 BC); Persian Period (27th Dynasty; 525–359 BC); north mines Ottoman Period (El-Senussi 2012)	Paths; hilltop cairns/standing stelae

of the *bekhen*-mountain.³ Six zones of inscriptions relating to topographic features in the landscape, and quarries, form a contextual layer of data quantified in terms of motif genre (e.g. rock art, graffiti, lists, names, iconography) (see Figs. 1, 11, 12, 14).

Perspectives from 'world archaeology' that are cross-cultural and comparative have been the most influential in pursuing a more rigorous course to identifying the social context of quarrying at source (see Bloxam 2011). Studies of quarries, particularly in Europe and Australia, have significantly honed our theoretical approaches to analysing social life and resource procurement in the past. This impetus to get at the social aspects of quarrying, particularly in prehistory, has come from anthropology, social archaeology and landscape studies. What we have learnt from many of these studies is the extent to which quarries are essentially socially constructed places (Bradley 2000; Bradley & Edmonds 1993; Brumm 2010; Cooney 1998; Edmonds 1999; Fullagar & Head 1999; Hamilton *et al.* 2011; McBryde 1997; 2000; Taçon 1991). What is consistently argued from across this diverse range of archaeological contexts is that quarries were inherently centres of social interaction, as well as places where tech-

nological know-how could be transmitted and maintained across generations.

The instances where rock engravings are associated with quarries can provide additional insights into the ways in which production landscapes were socialized over time (Bradley 2000, 38–9; Brumm 2004, 152–7; Taçon 1991, 195; 1994). As a social activity, engraving on rocks might not only define access and control of specific landscapes and resources, but also represent how visual 'art' became an enduring medium of expression related to shared experience and group identity that linked the past with the present, as well as the future (see Bender 1993, 11; Bloxam 2011; Boivin 2004a, 48–50; Cooney 1999, 51–3, 60–61; Fullagar & Head 1999, 322–35; McBryde 1997, 599; Taçon 1994, 117–18).

The Wadi Hammamat quarries

Geographically, the valley of the Wadi Hammamat represents one of the shortest (150 km) overland routes across the Eastern Desert connecting the Nile valley town of Quft (ancient Koptos) with the Red Sea port of Quseir (ancient Myos Hormos) (Fig. 1).

The importance of the Wadi Hammamat as a trade route, as well as a region in which key raw materials such as greywacke, gold and granite are found, means that this landscape has been well travelled and well known since prehistory (see Arkell 1975; Debono 1951, 60–62; Vermeersch *et al.* 1989; Wilkinson 1995). Although there are several well-preserved ancient quarries in the Eastern Desert region that have been subject to detailed archaeological investigations, such as Mons Claudianus (granite: Peacock & Maxfield 1997) and Mons Porphyrites (purple porphyry: Maxfield & Peacock 2001), the surviving traces of these mostly relate to the Roman Period. The Wadi Hammamat quarries are somewhat different because we have relatively well preserved material traces of quarrying over a period of more than 4000 years from the Predynastic (fourth millennium BC) into the Roman Period (30 BC), complemented by a rich pictorial, iconographic and textual record engraved into the landscape over a corresponding time depth.⁴

Wadi Hammamat greywacke was one of the most highly prized stones in antiquity, because when cut and polished, it has a remarkably fine greenish-grey to brownish hue (Fig. 2). Of Late Precambrian age, the stone ranges texturally from fine-grained sandstone to siltstone with the abundant clay/mica matrix identifying it as the compositional variety known as greywacke (Harrell 2002; Klemm & Klemm 2008, 297–311). Finding stone classifications in ancient written records is difficult, although there is a general consensus that greywacke was known as the *bekhen* (*bhn*)-stone, from at least the Middle Kingdom onwards, with the topographic term ‘the mountain of *bekhen*’ emerging by the New Kingdom (Erman & Grapow 1926, 471; Harrell & Brown 1992, 91–2; Lucas & Rowe 1938, 155). These massive and widely jointed deposits of greywacke occur as a series of blackish-brownish hills at the midway point between the Nile valley and Red Sea (75 km east of Quft). Where the wadi narrows to less than 100 m is where the best quality deposits occur, and these are largely contained within a 4 km stretch from the Bir Hammamat in the west to the Wadi Masaq el-Baqar in the east (see Fig. 1). Targeted extractions from the greywacke deposits are most concentrated in the region of the *bekhen*-mountain, within a radius of 1 km north and south of the main Wadi Hammamat route (now a modern tarmac road). First discovered by Western explorers during the Napoleonic expeditions of the 1800s (De Rozière 1813), the wadi presents a visually dramatic picture of ancient quarrying, characterized particularly by waste products (or spoil) as well as naturally weathered scree, which cascades down these hills, some from a height of over 450 m (Fig. 3).



Figure 2. The Narmer Palette carved from Wadi Hammamat greywacke (height 63 cm) c. 3000 BC (Dynasty 0), found in the Main Deposit at Hierakonpolis.

Interlayers of a greenish conglomerate (often wrongly termed *breccia verde antica*/ancient green breccia) can occur within the greywacke in places. The green conglomerate is extremely coarse in comparison to the finer-grained greywacke, as it contains numerous different coloured rounded pebbles, in sizes upwards of 25 cm (Harrell *et al.* 2002; Klemm & Klemm 2008, 309–10). The best deposits of conglomerate where ancient quarrying took place are mostly on the western side of the Wadi Faux where it meets the main Wadi Hammamat (Harrell 2002, 239; Harrell *et al.* 2002; Klemm & Klemm 2008, 300, 304) (see Fig 1.).⁵

We can be reasonably sure from provenance studies that Wadi Hammamat greywacke was the only source used for a range of objects that were widely distributed throughout Egypt and beyond (Aston *et al.* 2000, 57; Klemm & Klemm 2008, 302).⁶ Because of this, we can construct wide distribution patterns of greywacke from this Eastern Desert source from as



Figure 3. Main areas of large-block quarrying in the bekhen-mountain region looking north, Wadi Hammamat.

early as the Neolithic (mid–late sixth millennium BC) into the Roman Period (30 BC) (Aston *et al.* 2000, 57–8; Harrell 2002, 239; Riemer *et al.* 2009). Trends in elite consumption can be broadly broken down into small objects (vessels, palettes, bracelets, beads), and larger objects (statues, coffins, sarcophagi, naoi) usually found in burial and votive contexts. It should also be noted that greywacke, like so many other hard stones, had an almost continuous utilitarian use as tools (e.g. chisels and wedges) primarily connected with the quarrying process (see below).⁷

Palettes, both cosmetic and ceremonial, were some of the first ornamental objects to be produced from greywacke, a trend that continued for several thousand years (see Fig. 2). Some of the earliest examples are known in Neolithic contexts (mid–late sixth millennium BC), until being phased out by the early–mid third millennium BC (Stevenson 2009; Riemer *et al.* 2009; Ciałowicz 1991; Midant-Reynes 2000, 192–4). As highly portable small objects, these were widely

distributed to places as far afield as the Western Desert of Egypt (see Wengrow *et al.* 2014, 105–6; Riemer *et al.* 2009) and probably further into southern Mesopotamia.⁸ By the mid fourth millennium BC the small object range increases to include bracelets and vessels, the latter becoming a more specific feature of early third-millennium BC consumption (Aston 1994, 28–32; Aston *et al.* 2000, 58; Brunton 1939, 420–21, pl. lxi; Brunton & Caton-Thompson 1928, pl. xxi; Debono 1951, 77; Lucas & Rowe 1938, 130–46; Reisner 1908, pl. 41).

The desire for larger greywacke products, such as life-sized statues and sarcophagi, outstripped that of small products after Egyptian state formation, by the mid third millennium BC. The rather sketchy consumption record shows this as an ebb and flow until a peak in the Late Period (mid first millennium, c. 664–380 BC) (Aston *et al.* 2000, 58). Distribution of larger products seems to have been mainly confined to Nile valley elite/royal contexts, although this

expands dramatically when Egypt was annexed into the Persian Empire. A greywacke statue of Persian king Darius found at Susa has been securely provenanced to the Wadi Hammamat (Klemm & Klemm 2008, 302; Trichet & Poupet 1974). Greywacke consumption was thereafter in decline and by the Roman Period, tastes had shifted to the green conglomerate, which until this point had only been minimally consumed.⁹ Any resurgent interest in consuming either of these stones in modern times has been connected only with the export of the green conglomerate to Italy in the 1960s (Klemm & Klemm 2008, 304).

The earliest quarries: small-block extraction, stone tools and generational work practices

In our survey zone between the Bir Hammamat and Wadi Masaq el-Baqar, we identified 20 small-block quarries mostly at elevations above 400 m asl (see Fig. 1; Table 1). Exploiting the finer-grained, intensely fractured variety of greywacke, object rough-outs in the quarry waste comprised a varied assemblage of palettes, vessels and/or bracelets. As these were the earliest product types consumed in greywacke, we could date the extractions to the period between Naqada II (mid fourth millennium BC) and the Early Dynastic (early third millennium BC) (see Table 1). Pottery in two associated stone workshops at Bir Hammamat further spanned this date range (see Bloxam *et al.* 2014, 21–2). As data collected in the quarries and workshops have already been described in a recent publication (Bloxam *et al.* 2014), the purpose here is to examine what this evidence might tell us about local and regional connections between kin groups.

Transport of stone materials and artefacts across landscapes has been the basis of numerous studies cross-culturally in terms of reconstructing group mobility and exchange networks in the past (Clarkson 2010; McNiven 1999). In relation to quarries, several studies have focussed on the sources of stone tools as a means to identify connections between people locally and regionally in the procurement of a resource (Boivin 2004b, 10–16; Bradley & Edmonds 1993, 96; Cooney 1998, 108–18; Edmonds 1995; 1999). In studying the stone tools found in the small-block quarries and workshops, we found that there was a consistent use of both local and regional materials for tools used to extract and finish greywacke products. Locally, we identified two greywacke tool quarries with work areas for the production of highly crafted chisels and wedges, these in close proximity to the small-block quarries (see Fig. 1; Table 1). However, the dolerite, chert and silicified sandstone tools were produced from materials not local to the area, and therefore

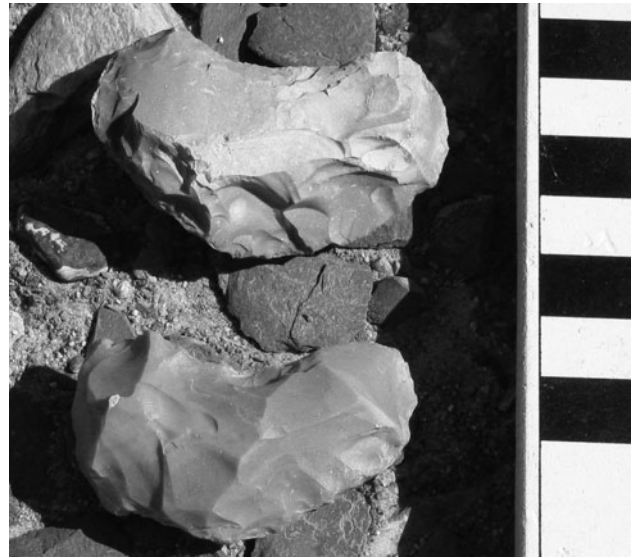


Figure 4. Chert crescent-shaped drills, Workshop 1, Bir Hammamat. Scale in 1 cm units.

had to have been brought into the quarries from other (regional) sources. So far we can only establish possible origins of the chert: one source 50 km east of the quarries at Gebel Duwi near the Red Sea coast, and another 75 km west, near Abydos (see Bloxam *et al.* 2014, 20–24). Whether the imported stones came in as finished tools or as raw material has yet to be fully established, although preliminary analysis suggests that some of the chert tools were worked from cobbles in the stone workshops. The crescent-shaped drills might well have been brought into the quarries as finished artefacts, as we could not identify corresponding debris for this size of object (Fig. 4).¹⁰

As Edmonds (1999, 46) describes, in the context of Neolithic axe quarrying in the UK, the idea of people working repeatedly at one confined place, and in close proximity, evokes several possibilities about the ways in which groups interacted with each other and the ties between them. Space in the earliest Egyptian quarries was certainly limited, given that a greywacke quarry of this date is usually only 30 m long, with a precipitous, less than 3 m wide bench on which to reduce blocks into transportable pieces (Fig. 5). Estimating numbers that could feasibly work in this confined space suggests that no more than 10 workers at any one time would have been possible. These small numbers are also backed up by the limited number of dwellings connected with the two workshops, and the relatively small amount of pottery, suggesting short-term occupations of probably less than 20 people at any one time (see Bloxam *et al.* 2014, 19–24).¹¹



Figure 5. Small-block quarries (for palettes and vessels) on the north side of the bekhen-mountain (circled)—mid-late fourth millennium BC to early third millennium BC—view towards the southeast. Circled area approximately 30 m long by 3 m deep.

In terms of extraction technology, levering and knocking-out of blocks with combinations of pounders, axes and chisels is consistent in all the quarries. Standardization is generally seen across the range of tools employed, in terms of size, shape and material used. Imported dolerite is the consistent stone used for the pounders, which are mainly hand-held, although some of the larger varieties shaped into axes were notched to attach a haft. The other standardized tools used were locally sourced greywacke rods and chisels, quarried and shaped in the associated 'tool complexes' (see Table 1 & Fig. 1) (Fig. 6). Used in combination with the hammers, the consistent marks left by these tools to reduce blocks termed 'pointillé pits' can be observed in practically all the quarries. The implications of this standardization in terms of tool size and material, as well as production methods, in all the small-block quarries which, from the consumption record, span a time range at least between the fourth to third millennia BC, suggests technological transmission across several generations. The 'pointillé pits' method of splitting rocks is particularly notable as a long-lived stone-working technology, previously thought to have originated in the Aegean region during the sixth century BC (Vandeput 1987–88, 94; Waelkens *et al.* 1990, 63–4), it is now clear that the technique was being used in Wadi Hammamat at least 2500 years earlier.

The possibility that these consistencies in technology and tool use were part of generationally repeated practices within kin groups that coalesced at the greywacke quarries, perhaps episodically, also seems to be reinforced by the ways in which the landscape was socialized over time. Hill-top cairns and well-worn paths to most of the quarries imply that repeated visits were made to these places. Panels of rock art occur at some of these entry points below the quarries in subsidiary wadis and in a few instances within them (see Fig 1; Bloxam *et al.* 2014). Although making a direct connection between this form of socializing the landscape and quarrying is difficult (see Storemyr 2009, 140–42), we cannot discard the numerous cross-cultural examples in which rock art and quarrying are linked together, typically as a nexus between people, marking a symbolic, even spiritual connection with places to which individuals and groups frequently returned (see Boivin 2004a, 49; Brumm 2004, 147; McBryde 1997; Taçon 1991).

On the basis of the range of imported materials found in the quarries, taken together with local knowledge of the source, the *chaîne opératoire* therefore extends outside the immediate quarry landscape to other quarries creating potential arenas of contact for people/kin-groups across the region. If we consider this from the perspective of the widespread distribution of greywacke products, particularly in



Figure 6. Reduction sequence to produce greywacke chisels in a tool workshop in the Wadi Faux.

the run-up to state formation by the mid fourth millennium BC, then it is tempting to make some linkages between imported materials within the logistics of broader networks of regional exchange. Considering that the workshops where products were finished lie directly on a well-travelled major trade route, it is possible to see them not only as ‘workshops’, but also as focal points where these interactions occurred. The extent to which social power operated between local and external groups in terms of access to the resource is beyond the scope of this article. However, as a future cross-cultural research strand, recent studies of ethnographic and ethno-historical sources have pinpointed how access to important quarry sites was often restricted by individuals, kin groups and/or custodians, not for economic benefit, but as a means of amassing social power and prestige (Boivin 2004b, 11–12; Brumm 2010; McBryde 2000).

Large-block quarrying: innovation, logistics and changing regimes of contact

The nucleus of the large-block quarrying complex is centred in and around the *bekhen*-mountain, where the quarries occur as highly visible deep extractions into the coarser-grained sandstone variety of greywacke (see Figs. 1, 3). Although we have yet to establish fully a chronological sequence of the quarries that make up the complex, we know from the consumption record that the transformation to larger block quarrying for statues, statuettes and sarcophagi began by the Old Kingdom (mid third millennium BC). Object blanks below some of these quarries, such as sarcophagi, naoi and an anthropomorphic coffin lid, give us a date range from the mid first millennium BC, although ceramics scattered in amongst waste heaps date from the second millennium BC (see Table 1). Changes in pro-

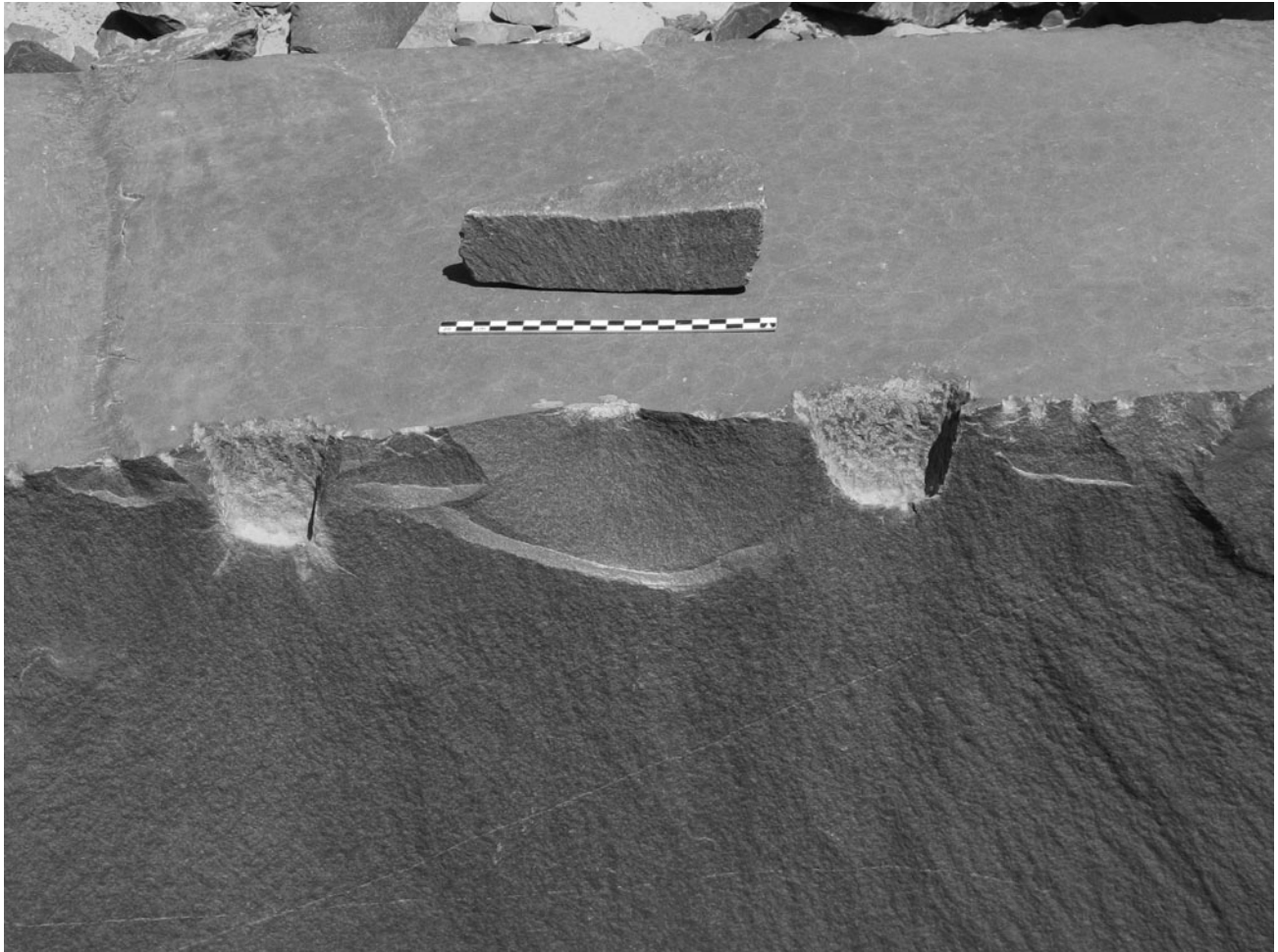


Figure 7. Large block of semi-worked greywacke showing both wedge-holes and pointillé pits—wedge of greywacke lies on top.

duction methods between small-block and large-block quarrying are, however, a lot less obvious and more nuanced than would be expected. In general there is a sense that existing techniques were simply enhanced, rather than being radically transformed. In essence, production techniques still deployed local greywacke tools (both as chisels and wedges) that left the long-lived 'pointillé pit' tracks (from the chisels), but in the large-block quarries these begin to combine with the characteristic 'u'-shaped holes made for wedges as a necessary step towards controlling splitting for bigger objects (Fig. 7). The recent discovery of wedges of greywacke therefore gives us a contrary perception to the long-held view that the 'wedging technique' was a development in quarrying technology linked with the introduction of metal tools/wedges by the mid-late first millennium BC.¹² Crucially, we also lack evidence of smithies, furnaces or other such installations relating to metallurgy at Wadi Hammamat. Even though

copper was mined in the area (see Table 1), particularly during the Persian Period (27th Dynasty), we cannot necessarily connect this with tool production.¹³

Rather than metal tools being the defining technological transformation to quarry large blocks, the use of fire-setting may have been crucial, although previous research into the Wadi Hammamat quarries failed to recognize this technique. Although we have yet to date quarries where fire-setting occurs and therefore when this technology was introduced, this long-lived, and highly skilled, technique was widely deployed to quarry hard stones such as granite (Aswan), gneisses (Gebel el-Asr) and silicified sandstone (Aswan) in Egypt from at least the mid third millennium BC (Heldal & Storemyr 2015). Although the technique becomes much more visible during the transformation to large-scale procurement of resources by the early Old Kingdom, it is known widely in other archaeological contexts (particularly in



Figure 8. View towards the south side of Wadi Hammamat showing Zone 2 (south) area of inscriptions (circled left) and the Chapel of Nectanebo (Shrine to Min, Paneion) within Zone 3 south (circled right). Arrow points to a major ramp ascending above inscription zone in large-block quarries above, dating to between Late Period to Roman Period (mid–late first millennium BC to fifth century AD).

Europe) to have origins that are pre-Neolithic (Bloxam 2007, 23; Darvill & Wainwright 2014, 1103–09; Heldal *et al.* 2005, 15–21; Storemyr *et al.* 2002).¹⁴ The technique was used to extract, exfoliate and split hard stones into large blocks and rough-outs, these processes leaving behind considerable ashy deposits containing charcoal. In the Wadi Hammamat this waste can lie up against rock faces and in some instances was used to create walls around deeper extractions. One of these walled quarries was re-used by the late first millennium BC as a secluded setting for the veneration of the local god Min and is variously known as the ‘Chapel of Nectanebo’, ‘Shrine to Min’ and/or ‘Paneion’ (Zone 3 south: see Figs. 1, 8).¹⁵

Although fire-setting becomes a more visible aspect in terms of extracting large blocks, we remain unsure when it was introduced and therefore cannot

suggest that it superseded previous technologies, but was rather used alongside them in certain instances. Perhaps more significant is that the logistics of transporting large blocks out of the quarries meant that transport infrastructure appeared at the point when objects were no longer finished *in situ*. Ramps constructed from quarry waste, rather than paths, became a new aspect of the transformed landscape, these leading down from some quarries and working platforms where objects were semi-finished into rough-outs (Fig. 9). Correspondingly, the suites of stone tools do not display the diversity in form or materials seen earlier, but instead, there is a contraction to just local greywacke and non-local dolerite which was shaped into hammers and pounders. Although fragments of ground-level paved areas are visible, it remains unknown whether a purpose-built road out of the

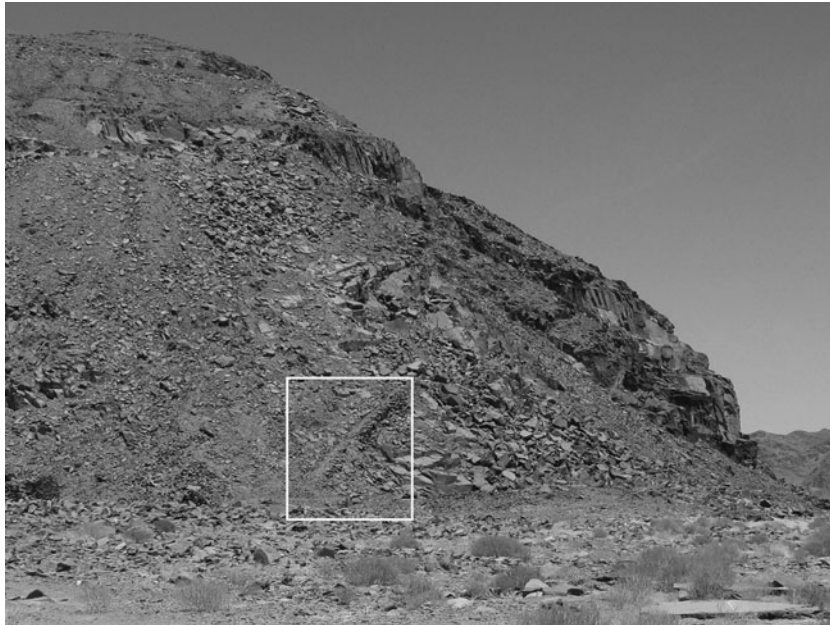


Figure 9. Ramp (in black rectangle) leads from a large-block quarry (bekhen-mountain, view to the east) to a ground level paved area.

quarries was ever constructed, as in the case of other notable examples at Widan el-Faras (Bloxam & Storemyr 2002, 29–31; Harrell & Bown 1995), Hatnub (Shaw 2010, 109–24) and across the Aswan West Bank (Storemyr *et al.* 2013).

The impact that logistics can have on pre-existing local and regional kin-group networks, acting as the conduit through which innovation may occur, is rarely given the attention it deserves. Fresh perspectives on the contexts through which technological invention and transmission can occur in the past, particularly from studies of Palaeolithic and Stone Age societies, argue that this stimulus can come via extended social networks and relationships, as well as changing demographics that may aggregate previously remote groups (Gamble 2007; Shennan 2001; Wadley 2013, 175–7). The arguments postulate that knowledge sharing and technological innovation are socially constructed through contact. The logistics of moving large blocks out of the quarries was probably in itself the first radical change at Wadi Hammamat, which, in one way or another, brought about new arenas of contact between people.

One possible indicator of changes in regional contact is the diminishing range of imported materials coming into the quarries as well as specialist tools to finish products. Then, if we consider the innovations in quarrying and transporting larger blocks in terms of production (the additional use of fire-setting) and logistics (ramp building), then these factors may

allude to different regional groups importing specialisms from elsewhere. The conduit for these innovations, either direct or indirect, between local groups working in the quarries and others connected with centres of craft specialisation is most likely to have come from the logistics of channelling greywacke to Nile valley 'royal' funerary contexts. Evidence from other hard-stone quarries in Egypt tends to support this viewpoint because similar examples of innovation come at the point when there is a transition to large-block quarrying by the mid third millennium BC that links these sources to 'royal' construction projects (Bloxam & Heldal 2007; Bloxam *et al.* 2007; Shaw & Bloxam 1999). Yet, as we observe from the continuation of long-lived stone-working practices, any imported specialisms did not necessarily revolutionize existing local work practices, but instead caused there to be adaptation at a larger scale (see Bevan & Bloxam *in press*; also Heldal 2009, 148 in relation to silicified sandstone quarrying at Aswan).

When it comes to defining the role of the 'state' in quarrying, the evidence discussed here, in my view, suggests that we need to move away from an 'all or nothing' approach to centralized control, but instead, consider ideas of 'state' intervention in a more nuanced way. Essentially, what we can read archaeologically is a mixed picture of interaction in terms of changing regimes of contact between local and regional specialists in which transport logistics probably played the most central role. In analysing specialist



Figure 10. Areas of settlement in bekhen-mountain region: (1) two-roomed dwellings in Wadi Faux; (2) well, equidistant from both settlements; (3) main settlement (20+) interconnecting rooms with parts of flood defence wall remaining, multi-occupation from Late Period into Roman Period (mid-late first millennium BC to fifth century AD).

craft mobility in the Bronze Age Eastern Mediterranean (Bevan & Bloxam in press), it can be argued that logistics perhaps constitute the arena where we need to look for larger organizational structures used to channel materials.¹⁶ Whether contact through logistics should be regarded as within the demands of a single mega-project, linked with the royal funerary monument, or if the tempo was slower and on-going is an aspect yet to be established.

Socializing the quarry landscape: settlement and inscriptions

Turning finally to the social infrastructure such as settlement, inscriptions and ritual spaces after the time of small-block quarrying, then it is of course the overwhelming amount of rock-cut texts that dominate (Figs. 8, 14, 15). Firstly, in terms of settlement evi-

dence connected with large-block quarrying, the only known remains date to the mid first millennium BC, these being located beside the *bekhen*-mountain (see Table 1; Figs. 1, 10). Although we have yet to establish if these settlements grew up on any earlier foundations, the general lack of ceramics dating to earlier periods of large-block quarrying here suggests that any temporary/permanent presence must have been limited and certainly well below 100 people. In relation to ritual/cultic spaces, the re-used quarry established as a setting for veneration of the local god Min (the Chapel of Nectanebo as described above) by the late first millennium BC is the only remaining evidence we have for such places (see Fig. 8).¹⁷ Future research needs to investigate the linkages that might have existed between the establishment of what appears to be the first permanent settlement in the quarries with the emergence of a new ritual setting.

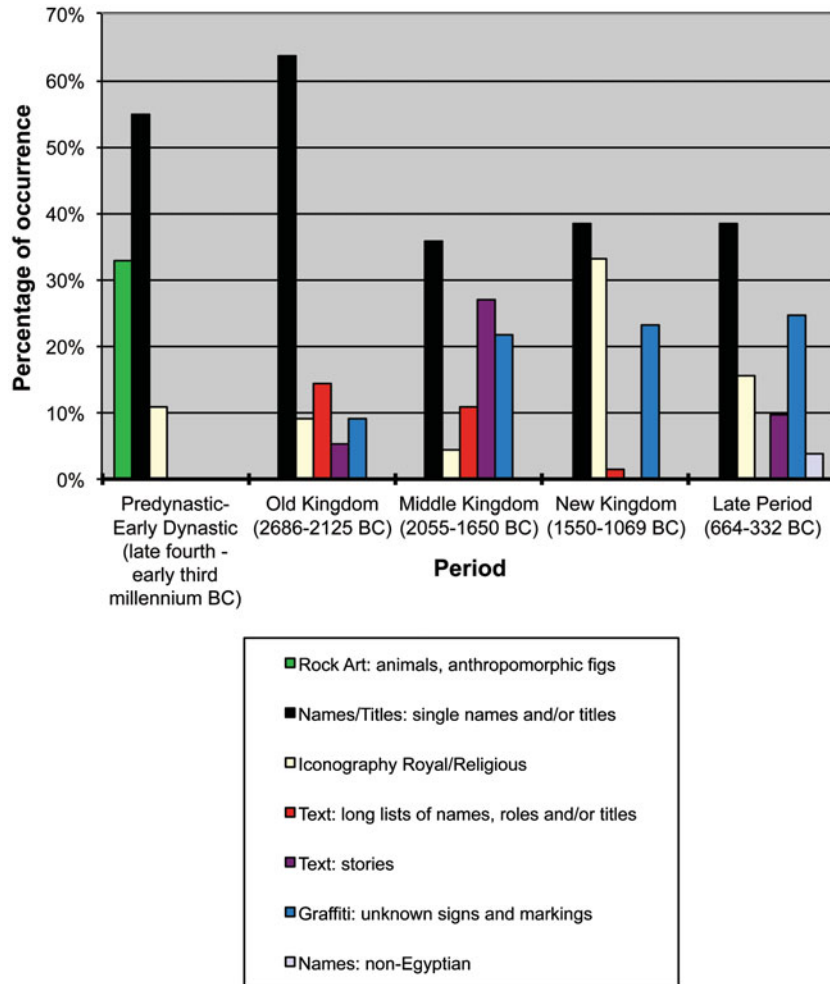


Figure 11. Percentage occurrence of rock engraving themes from late third millennium BC (Predynastic) into the Late Period occurring in the region of the bekhen-mountain (zones 1–6 north and south). Sample size of 359 inscriptions. Sources: Couyat & Montet 1912; Goyon 1957. See also Fig. 1 for locations.

In summarizing analysis of the inscriptional data, the most unexpected and significant finding was the extent to which the recording of names and titles outweighed that of any other type of notation (see Figs. 11, 12). The ways in which these inscribed names may be expressing kinship ties are unclear, although by the New Kingdom and Late Period increasing numbers can be identified as father and son, and genealogies begin to be appended to them (Cruz-Uribe 2001; Peden 2001). Of the 359 texts studied, 85 per cent belonged to this category and were written in several forms such as graffiti, hieroglyphs and hieratic. Then, by the mid first millennium BC, demotic and Greek dominates with some occurrences in Aramaic. The remaining 15 per cent of so-called 'expeditionary texts', lists of personnel, and stories that usually fall into the genre of 'monumental discourse' are

a surprisingly minor element in terms of the ways in which people recorded their presence.¹⁸ What is most significant about this finding is the realization of the extent to which we have relied upon interpretation of 'monumental discourse' to understand the social organization of quarrying expeditions to Wadi Hammamat (and in general), yet largely ignored the implications of why the majority of people recorded their presence, for posterity, into the landscape in such an individual way. Because this aspect of the personal way that people socialized the landscape has received little or no attention, I focus on what we might understand about the social milieu at Wadi Hammamat through the changing forms and locations of names, titles and lists in the landscape.

The most significant turning point in terms of changes to where inscriptional data occur is during the

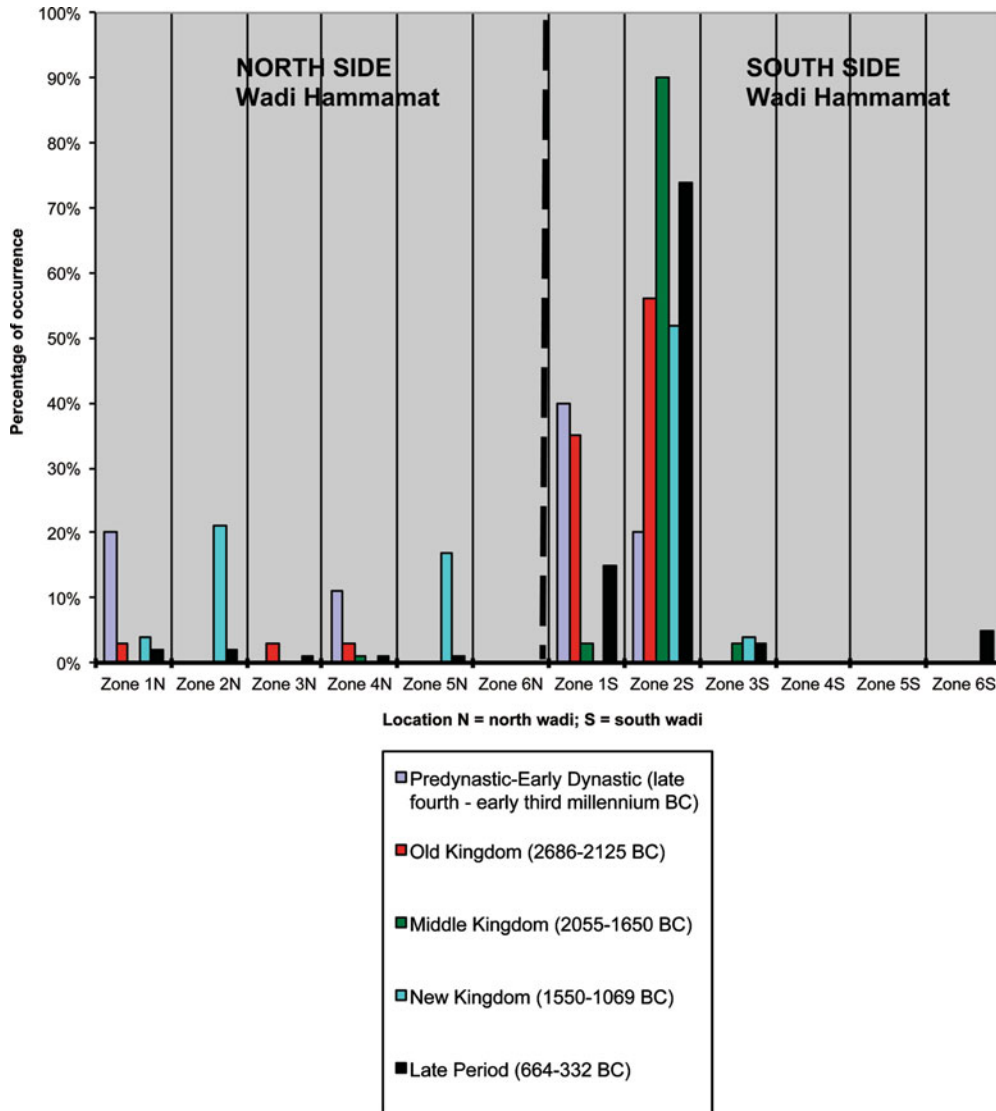


Figure 12. Percentage occurrence of names and titles in each location (zones 1–6 north and south). Sample size of 359 inscriptions. See also Fig. 1 for locations.

transition to large-block quarrying by the Old Kingdom. Before the Old Kingdom the landscape in Wadi Faux (Zone 4) and at the far eastern end of Zone 1 south was scattered with rock art and Early Dynastic writing of names and titles (Fig. 13). From the Old Kingdom (mid third millennium BC) onwards, these texts are densely clustered in Zone 2 south—this setting remains the focal point for inscribing a presence into the mid to late first millennium BC (Figs. 8, 14, 15).¹⁹ But why are these inscriptions clustered here, when there were numerous other suitable places to inscribe? Aspects of visibility and locale perhaps came into play. Prior to inscribing, when this rock-face was viewed/approached from the main route through the

wadi, it would have presented a highly visible arena-like aspect of widely fractured blocks of greywacke, rising in a series of steps up to a height of more than 20 m into the hills opposite the *bekhen*-mountain region of quarries (Figs. 8, 14, 15).

There is no obvious earlier connection with quarries in this exact location because the greywacke deposits that had been inscribed from at least the Old Kingdom onwards are all unworked, and although later quarries (and a large ramp) surround the zone, great pains must have been taken to avoid quarrying into this area. Regardless of the motivations that impelled people to inscribe this particular zone over successive generations, it is clear that what we have

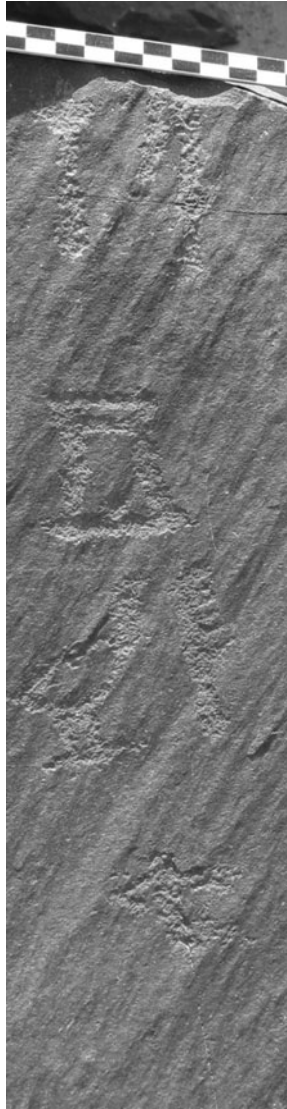


Figure 13. Name of an individual called 'Giw' preceded by the title 'controller/inspector' written in two hieroglyphs, one of which is a mace; dating to the Early Dynastic (early third millennium BC) at Zone 1 south (see Goyon 1957, 43, pl. II; Jones 2000, no. 3336, 910).

been left with is a layered message board that mingles highly crafted texts with sketchily drawn images, names and titles spanning a period of over 2000 years. Philological analysis of the longer texts, largely omitting their archaeological context, has interpreted these as evidence for the extent to which state administration, bureaucracy and economic accounting from the top ultimately drove quarrying expeditions (Coyat & Montet 1912; Goyon 1957; Hikade 2006; Lloyd 2014; Mueller 1975; Peden 2001; Simpson 1959; 1963).²⁰ What I would like to consider, however, are the ways in which this long-lived tradition of notation

may also underlie a broader choreography of relationships at source between social groups.

One of the key aspects is what we can read from the clustering of the formulaic and elaborate highly crafted lists of names and titles suggestive of access to royal/elite centres of knowledge, with the more long-lived generational aspect to individual recording of presence. Lists as a genre of texts are particularly interesting because they were the common developing form of early writing associated with a rising literary/scribal class connected with changing political authority (see Baines 1988, 124–33; Eyre 2013, 249–354; Ross 2010; Shaw 2012, 31–8). Eyre (2013, 353–4) argues cogently that early writing was more related to ritual and performance than administrative reference, which therefore in practice was about oral communication and social hierarchy. Ross (2010, 80–98) takes a similar position when examining metals lists (in Mesopotamian Uruk Period contexts) because these seem to offer a scribal construction of reality far removed from practice. Rather, as Ross (2010, 88) argues, those with scribal knowledge shared a set of values and perceptions with those who practised metal working, even though these techniques and practices did not align.

If we consider the highly crafted lists of names in quarrying contexts, we are confronted with a similar sense that these are about on the one hand demonstrating shared purpose (i.e. procuring greywacke), but on the other, expressing connections to outside power structures and other forms of knowledge. Within the scenario of contact argued above, which places logistics and gaining access to the resource at the heart of social interactions at source, then socializing the landscape through inscribing could have been central to the ways in which local and regional groups mediated these relationships. Inscribing the landscape appears to have been an activity open to everyone and not, so far as we can tell, socially restricted. This equality is particularly apparent given that there is no seemingly deliberate separation in placement of lengthy and elaborate 'royal' inscriptions in the landscape from the less formal individual recording of names and titles. This process of agglomeration and association is also a chronological one, in that being close to the notations of previous generations was apparently paramount, given the enormous amount of suitable rock faces in the landscape that were never inscribed. Therefore, in the case of the Wadi Hammamat lists, names and titles, perhaps we need to add more weight to these as expressing social identities within a complex set of relationships continually played out over generations at the material source, which in this instance is greywacke.



Figure 14. Part of Zone 2 (south) cluster of inscriptions covering a time range from the Early Dynastic to Late Period.

Even when Egypt was annexed into the Persian Empire during the mid first millennium BC, continuity and multi-generational linkages in the ways that the landscape was socialized with names, titles and lists were maintained. Other languages such as Aramaic became entangled into the narrative, which has expanded by this date to practically all other zones (1–6 north and south), but still mainly clusters at Zone 2 south. An inscription by a high-ranking foreigner ‘Ariyawarta’ is particularly interesting, because although he wanted to reveal his Persian ethnicity, it was important to be socially included into the fabric of landscape by also being remembered by his Egyptian name ‘Djeho’ (Peden 2001, 284–5; Posener 1936, no. 33), which, in this context, reinforces his links with earlier individuals and texts at the site.

Change in this dynamic of notation over time as large-block quarrying declined by the end of the first millennium BC did not so much alter the continual theme of recording names and titles, but rather changed its location. Socializing of the landscape from this point onwards becomes almost completely confined to the secluded Chapel of Nectanebo, as described above (Fig. 8). We cannot help but assign this in some way to broader social, cultural and geopolitical changes that occurred after Egypt’s annexation

into the Persian Empire, and prior to the Greco-Roman period (332 BC), discussion of which are unfortunately beyond the scope of this article.

Discussion

The process of examining greywacke procurement as a phenomenon that leaves a series of overlapping quarry complexes of material traces allows us to analyse continuity and change broadly through a time depth not undertaken before for the Wadi Hammamat. Via a comparative and cross-cultural approach, I have developed a dialogue within Egyptian archaeology to enhance the ways in which we can understand social and cultural change from the perspective of resource procurement. Although philological contributions have been important in terms of providing an historical and chronological foundation to studies of resource procurement, such contributions rarely examine the complexities of interactions between skilled local and regional kin groups at a stone source. The holistic approach taken here has aimed to enhance the methods through which we can explore the dynamic interplay of the state with acts of resource procurement, and in a way that avoids the pitfalls caused by placing unwarranted emphasis on literal readings of

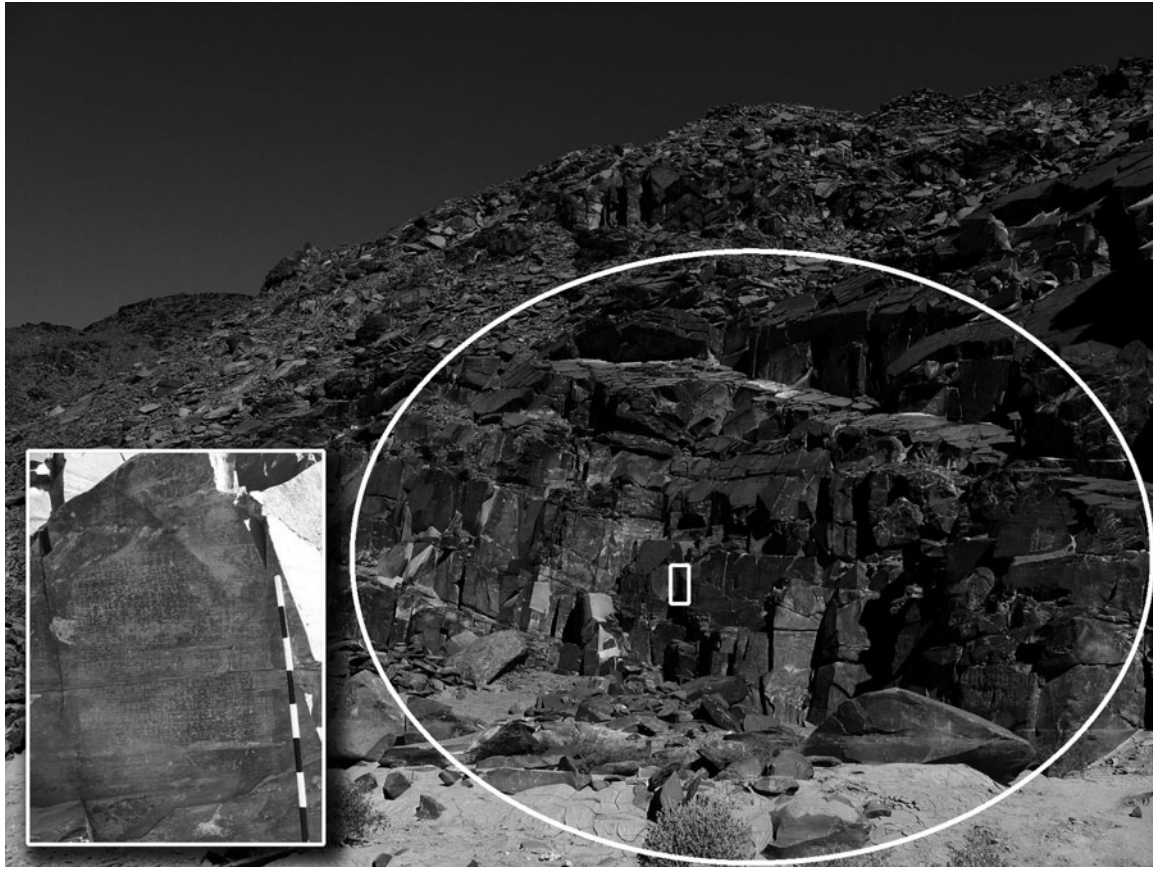


Figure 15. Zone 2 (south) main area of inscriptions circled; inset shows G61 (Goyon 1957) Middle Kingdom (early second millennium BC) list of personnel, location marked by a white rectangle on main photo, elevation approx. 15 m above ground level.

textual data. Contextualizing all rock engravings for the first time into the landscape, in terms of location, theme and connection with quarrying, means we can gain extra insights into the linkages between people, quarrying and place that hitherto have not been attempted.

The most important theme raised in this article has been recognition that long-lived methods in extracting the resource underlie a repeated, generational transmission of technological know-how that shows only subtle adaptations and variations to quarry larger blocks. The idea that kinship ties were at the nexus of the social milieu through which exploitation and distribution of greywacke products emerged during the earliest phases of small-block quarrying is the key ingredient in our reading of the production continuities. Then, as large-block quarrying emerged, the range of contacts between local and regional groups pivoted around new, logistical, transport-driven arrangements necessary to move bigger products out of the quarries. It is argued here that these broaden-

ing connections could have been the stimulus through which knowledge sharing with other places of craft specialization, in particular monumental construction sites, could have occurred.

At the heart of these relationships, however, is a shared sense of connection with place by the ways in which people included themselves into the fabric of the landscape. Although this inclusion was executed in a variety of ways, it tends to send us the same message that being there, and being connected to those who were there before, was uppermost. The more subtle and place-sensitive sense in which we can read the 'royal' and elaborate texts is, I think, more about disclosing connections and access to arenas of knowledge through which social identity was forged. Engaging with local 'producers' at source was a means of gaining access to the resource, which may have been socially restricted, rather than being controlled or monopolized by the 'state'. Mediating these relationships over generations through repeated and shared social practices at important places in the landscape,

particularly notable at Zone 2 south, has left us with one of the world's most enduring records of human engagement with a strategic resource.

Notes

1. The Wadi Hammamat Research Project is a multi-national, interdisciplinary co-operation between University College London and the SCA (Supreme Council of Antiquities) Ancient Quarries and Mines Department, Aswan, Egypt. We have been surveying the quarry landscape from the Bir Hammamat to the Wadi Masag el-Baqar since 2010.
2. The data described in these complexes come mainly from fresh survey undertaken between 2010 and 2014, in some instances supplemented by previously published accounts (Debono 1951; Harrell 2002; Harrell *et al.* 2002; Klemm & Klemm 1993; 2008). Only the 'copper mining complex' falls outside the range of the satellite image, 1 km west of the main quarrying areas and at 425+ m asl.
3. The French epigraphers Jules Couyat, Pierre Montet and Georges Goyon documented the majority of the rock engravings in this region of the Wadi Hammamat, making it possible for us to undertake a basic numerical analysis of 359 of these inscriptions, covering a period from the Predynastic (mid fourth millennium BC) to the end of the Late Period (31st Dynasty, late first millennium BC). Couyat & Montet (1912) assigned numbers (each with the prefix 'CM') to the inscriptions on both sides of the Wadi Hammamat, but they neither gave precise locations nor provided a map. Subsequently, Goyon (1957) used a system of letters to define these locations, additionally including a number of engravings (prefaced by G) previously omitted by Couyat & Montet. Although our current survey work is adding to this corpus in some places, these published sources are detailed enough to provide a workable, and datable, sequence of inscriptional data for the purposes of this article.
4. The quarry landscape is relatively well preserved because major quarrying of greywacke has not occurred since the end of the Roman Period. Quarrying of green conglomerate took place in the 1960s, but this has had a relatively minor impact on the landscape as a whole. Natural disturbance of the area from increasing flash floods is now the major transformative process, as well as losses of some material culture (ceramics and inscriptions) from unsupervised tourism and theft. Steps are under way, in collaboration with the SCA, to produce a site-management plan to conserve and protect the area.
5. Gold was also exploited in the region from the New Kingdom (mid second millennium BC) onwards at Bir Umm Fawakhir, 10 km to the east of the greywacke quarries. Settlement remains here date mainly to the Roman and Byzantine periods when gold was most intensively exploited (Harrell & Brown 1992, 97–9; Klemm & Klemm 2008, 295; Zitterkopf & Sidebotham 1989, 177–8).
6. Studying the extent of greywacke consumption and distribution has been hampered by its frequent erroneous classification either as slate, schist, siltstone or basalt (Aston *et al.* 2000, 58; Brown & Harrell 1991; Harrell 2002, 239).
7. The use of prestige stones for tools used in the quarrying process has been well documented at several ancient quarries in Egypt, in particular along the Aswan West Bank silicified sandstone quarries (Bloxam *et al.* 2007) and at Chephren's Quarry, Gebel el-Asr (Chephren gneiss) (Bloxam & Heldal 2007; Shaw & Bloxam 1999).
8. Although the stone used for the 'Blau Monuments' has not yet been subject to petrological analysis, their classification as 'schist' (rather than greywacke— see note 6 on misclassification) raises questions as to whether the high quality of the Wadi Hammamat source of this stone was distributed into Mesopotamia to create such objects? These flattish oval-shaped objects that blend together early Mesopotamian writing and iconography (Moorey 1999, 24, pl. VIA) bear a resemblance to the early iconic greywacke palettes of the same period, e.g. the Narmer Palette (see Fig. 2). Note also that the Wadi Hammamat would have been important to such contacts, given that it is the most direct route to the Nile Valley from the Red Sea. Debate still surrounds the likelihood of maritime contact via the Red Sea between Egypt and late fourth-millennium BC Sumer and Susa, although Red Sea shells, probably exported from Egypt, have been found in early elite contexts elsewhere in the Near East (see Arkell 1975; Debono 1951, 60–62, 75–8; Hoffman 1980, 243–8; Majer 1992, 227–34; Midant-Reynes 2000, 215; Vermeersch *et al.* 1989; Wilkinson 1995, 209).
9. Green conglomerate was used for at least two sarcophagi in the mid second millennium BC (New Kingdom, Ramses VI) and late first millennium BC (Late Period, Nectanebo II) (Aston *et al.* 2000, 58; Harrell *et al.* 2002; Klemm & Klemm 2008, 304).
10. For a more detailed discussion of the workshop stone tools and other lithic material, see Bloxam *et al.* 2014, 19–24.
11. Our current knowledge of more permanent local habitations is so far reliant on Debono's (1951, 66–9) discovery of habitations with associated burial sites dating from Naqada I into the Early Dynastic in the Lakeita oasis region (although he did not provide a map), approximately 35 km west of the greywacke quarries. Evidence of greywacke working into bracelets and lithic material were discovered at these sites, as well as shells and fish vertebrae in domestic remains, connecting these with trade coming from the Red Sea.
12. The traditional view is that the wedging technique is usually connected with later phases of quarrying, around the mid to late first millennium BC, when metal (iron) technology is believed to have superseded the more 'primitive' use of stone tools, reaching its zenith

- in the Roman Period (see Harrell & Storemyr 2009, 29; Klemm & Klemm 2008, 247; Röder 1965). Also known as iron-wedge technology, metal wedges were supposedly inserted into 'u'-shaped holes, then hammered until the rock split (Harrell & Storemyr 2009, 29). This technique leaves behind the highly characteristic trapezoidal tool marks/tracks that are most commonly seen in the Roman Period, e.g. at the Aswan granite quarries.
13. A few fragments of copper ore were found in the early stone workshops (mid fourth–early third millennium BC) at Bir Hammamat, although these may have fallen from the hill above, where several mines were located. So far we have not located copper mines dating to this period; those discovered, as described (see Table 1), date to the mid second millennium BC, first millennium BC and Ottoman Period. However, we cannot rule out the possibility that earlier mining took place, because recent discoveries of small copper mines in the Eastern Desert at Wadi Semna, dating to the late fourth–early third millennium BC, are known. The suggestion is that these might have been linked to the production of pigment, as no metallurgy installations or slag were found (Abdel-Motelib *et al.* 2012, 33–4).
 14. Recent research at the Carn Menyn quarries in southwest Wales (the source of some of the Stonehenge pillar-stones) presents some interesting comparisons in terms of the extremely early use of fire-setting to quarry hard rocks. At Carn Menyn the technique was first deployed to quarry a meta-mudstone in the first half of the sixth millennium BC, making it one of the earliest known securely dated stone quarries in Britain. Later dolerite quarrying for the pillar-stones (used at Stonehenge) by the third millennium BC stresses the longevity of this method and its implications in relation to the ancestral significance of the Carn Menyn quarry landscape (Darvill & Wainwright 2014, 1103–13). In Egyptian contexts we have yet to fully explore the origins of fire-setting and its implications in terms of understanding the social mechanisms through which this technology was transmitted.
 15. This ritual space for veneration of the local god 'Min' contains a layered array of names, titles and other graffiti in hieratic, hieroglyphs, Greek and demotic, together with highly crafted iconography and reliefs dating from the late first millennium BC (Late Period) reign of Nectanebo II (see Bernand 1972; Couyat & Montet 1912; Cruz-Uribe 2001; Goyon 1957, 21, 77, pls. xx, xxxii; Lichtheim 1973, 114–15, 202; Thissen 1979). This re-used quarry became a focal point for inscriptions through to the Roman Period. European travellers/explorers of the nineteenth century also inscribed their names here (Fig. 9).
 16. Without exception, the logistics of transporting materials from quarries and mines are the only aspect of resource procurement depicted in tomb iconography, suggesting therefore that an amount of social prestige surrounded this aspect. The best known of these is the early second-millennium BC (Middle Kingdom, 12th Dynasty) depiction of Djehutihotpe's completed statue being transported from the Hatnub travertine quarries, presumably to the Nile valley (Arnold 1991, 61; Clarke & Engelbach 1930, 85; Newberry 1895, 16–26, pls. XII–XIX). The idea of logistics being a more structured and organized aspect of resource procurement may be implied from masons' marks found on stone blocks at pyramid construction sites in the Faiyum at Lisht (in the early to mid second millennium BC Middle Kingdom). Team marks (made by stone masons) and control notes (made by scribes) found on stone blocks are mainly concerned with transport and they form patterned combinations of 'verb/locality/workmen' in the inscriptions, suggesting that stone-working teams came from both local communities and elsewhere in Egypt (see Arnold 1990, 14–29; Bevan & Bloxam *in press*).
 17. The Turin Mining Papyrus of the Wadi Hammamat is believed to be the oldest geographical and geological map in the world, dating to the late second millennium BC (New Kingdom) (Goyon 1949; see Harrell & Brown 1992 for most recent description and interpretation). Dating to the reign of Ramses IV, it presents a pictorial, stylized view of the Wadi Hammamat region, depicting, amongst other aspects of the landscape, what are thought to be the greywacke quarries as well as the gold-mining settlement at Bir Umm Fawakhir. A temple to Amun is thought to be depicted, although it is unclear exactly where this is, as no such structures are known in the region. Goyon (1949, 351) suggested that the temple depicted is the settlement opposite the Chapel of Nectanebo at the base of the *bekhen*-mountain, but it remains unknown (and rather unlikely) as to whether this settlement lies on top of any earlier cultic foundations.
 18. Commemorative stelae in quarrying and mining contexts, whether cut into rock faces or free-standing, have not received special attention within the literary sphere of Egyptology; although Enmarch (2011, 105–7), in a rare example, remarks on inscription CM19 of the Middle Kingdom as referring to the building of a ramp by an official. For more analysis of what constitutes 'monumental discourse', see Assmann (1996, 63); Eyre (1996, 431); Parkinson (2002, 62).
 19. Some of the earliest names and titles in hieroglyphics dating from the Early Dynastic into Old Kingdom occur in the Wadi Faux (Zone 4) and at the eastern extremity of the quarrying region (Zone 1 south) (e.g. Goyon 1957, G25 pl. XII and G4; see also Bloxam *et al.* 2014, 27).
 20. The hieroglyphic inscriptions of the early second millennium BC (Middle Kingdom) such as G61 (Goyon 1957, 81–5) (Fig. 14) and CM87 (Coyat & Montet 1912, 64–6, pl. xx) are particularly interesting because we have so far failed to reconcile the archaeological record of this period with the lists of people, over 18,000, detailed in these texts. Several attempts have been made to interpret these, but rarely in their context, as providing us with factual accounts about the economics and labour organization that lay behind resource procurement. For instance, Simpson (1963, 24, 35, 38) compared these lists with the hieratic 'account' papyrus 'Papyrus

Reisner I' (Middle Kingdom) to explain the exceptionally high numbers of personnel. He deduced that these are bureaucratic registers of titles and rations to calculate 'man-days' in order to determine the number of 'bread ration units' to be allocated to labour-force personnel engaged in specific projects, such as quarrying. Mueller (1975, 249) similarly attempts to rationalize the large numbers of people, roles and rations in text G61, which for instance refers to '17,000 recruits', by suggesting that these extraordinary numbers are referring to 'man-days' rather than individuals, but in this instance in terms of wages. Hikade (2006, 164–7) takes a similar administrative, economic perspective in his most recent analysis of the expedition lists relating to the New Kingdom reign of Ramses IV, e.g. Couyat & Montet (1912, CM12) and Goyon (1957, G89). For instance, CM12 lists personnel totalling 8350 and although no objects in greywacke dating to this reign are known, these lists are discussed as if they actually provide factual accounts through which we can grasp the economic implications and risks of deploying such a large expeditionary labour force (recruited by the state administration) in terms of rations and provisions (food, water, clothes, etc.).

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References

- Abdel-Motelib, A., M. Bode, R. Hartmann, U. Hartung, A. Hauptmann & K. Pfeiffer, 2012. Archaeometallurgical expeditions to the Sinai Peninsula and the Eastern Desert of Egypt (2006, 2008). *Metalla (Bochum)* 19(1/2), 3–59.
- Abu-Jaber, N., E. G. Bloxam, P. Degryse & T. Heldal, 2009. *QuarryScapes: Ancient Stone Quarry Landscapes in the Eastern Mediterranean*. (Geological Survey of Norway Special Publication 12.) Trondheim: Geological Survey of Norway.
- Arkell, A.J., 1975. *The Prehistory of the Nile Valley*. Leiden: Brill.
- Arnold, D., 1991. *Building in Egypt: Pharaonic stone masonry*. Oxford: Oxford University Press.
- Arnold, F., 1990. *The South Cemeteries of Lisht Volume II: The control notes and team marks*. New York (NY): Metropolitan Museum of Art.
- Assmann, J., 1996. *The Mind of Egypt: History and meaning in the time of the Pharaohs*. New York (NY): Metropolitan Books.
- Aston, B., 1994. *Ancient Egyptian Stone Vessels: Materials and forms*. Heidelberg: Heidelberger Orientverlag.
- Aston, B., J. Harrell & I. Shaw, 2000. Stone, in *Ancient Egyptian Materials and Technology*, eds. P. Nicholson & I. Shaw. Cambridge: Cambridge University Press, 5–77.
- Baines, J. 1988. An Abydos list of gods and an Old Kingdom use of texts, in *Pyramid Studies and Other Essays Presented to I.E.S. Edwards*, eds. J. Baines, T.G.H. James, A. Leahy & A.F. Shore. London: Egypt Exploration Society, 124–33.
- Bender, B., 1993. Introduction: landscape – meaning and action, in *Landscapes Politics and Perspectives*, ed. B. Bender. Oxford: Berg, 1–17.
- Bernard, A., 1972. *De Koptos à Kosseir*. Leiden: Brill.
- Bevan, A. & E. Bloxam, in press. Stonemasons and craft mobility in the Bronze Age eastern Mediterranean, in *Human Mobility and Technological Transfer in the Prehistoric Mediterranean*, eds. E. Kiriatzi & C. Knappett. Cambridge: Cambridge University Press.
- Bloxam, E., 2007. Who were the pharaohs' quarrymen? *Archaeology International* 9, 23–7.
- Bloxam, E., 2011. Ancient quarries in mind: pathways to a more accessible significance. *World Archaeology* 43(2), 149–66.
- Bloxam, E., J. Harrell, A. Kelany, N. Moloney, A. El-Senussi & A. Tohamey. 2014. Investigating the Predynastic origins of greywacke working in the Wadi Hammamat. *Archéo-Nil* 14, 35–55.
- Bloxam, E. & T. Heldal, 2007. The industrial landscape of the Northern Faiyum Desert as a world heritage site: modelling 'outstanding universal value' of 3rd millennium BC stone quarrying in Egypt. *World Archaeology* 39(3), 305–23.
- Bloxam, E. & T. Heldal, 2008. Identifying heritage values and character-defining elements of ancient quarry landscapes in the Eastern Mediterranean: an integrated

- analysis. Geological Survey of Norway, QuarryScapes report. www.quarryscapes.no
- Bloxam, E., T. Heldal & P. Storemyr (eds.), 2007. *Characterisation of Complex Quarry Landscapes: An example from the West Bank Quarries, Aswan*. (QuarryScapes report.) Trondheim: Geological Survey of Norway. www.quarryscapes.no
- Bloxam, E.G. & P. Storemyr, 2002. Old Kingdom basalt quarrying activities at Widan el-Faras, Northern Faiyum Desert. *Journal of Egyptian Archaeology* 88, 23–36.
- Boivin, N., 2004a. Rock art and rock music: petroglyphs of the south Indian Neolithic. *Antiquity* 78, 38–53.
- Boivin, N., 2004b. From veneration to exploitation: human engagement with the mineral world, in *Soils, Stones and Symbols: Cultural perceptions of the mineral world*, eds. N. Boivin & M.A. Owoc. London: UCL Press, 1–29.
- Bradley, R., 2000. *An Archaeology of Natural Places*. Routledge: London.
- Bradley, R. & M. Edmonds, 1993. *Interpreting the Axe Trade*. Cambridge: Cambridge University Press.
- Brown, V.M. & J.A. Harrell, 1991. Megascopic classification of rocks. *Journal of Geological Education* 39, 379–87.
- Brumm, A., 2004. An axe to grind: symbolic considerations of stone axe use in ancient Australia, in *Soils, Stones and Symbols: Cultural perceptions of the mineral world*, eds. N. Boivin & M.A. Owoc. London: University College London Press, 143–63.
- Brumm, A., 2010. The falling sky: symbolic and cosmological associations of the Mt William greenstone axe quarry, Central Victoria, Australia. *Cambridge Archaeological Journal* 20(2), 179–96.
- Brunton, G., 1939. A first dynasty cemetery at Maadi. *Annales du Service des Antiquités de l'Égypte* 39, 419–24.
- Brunton, G. & G. Caton-Thompson, 1928. *The Badarian Civilization and Prehistoric Remains near Badari*. London: Bernard Quaritch.
- Ciałowicz, K., 1991. *Les palettes égyptiennes aux motifs zoomorphes et sans décoration: Etudes de l'art pré-dynastique*. Krakow: Jagiellonian University.
- Clarke, S. & R. Engelbach, 1930. *Ancient Egyptian Masonry: The building craft*. London: Oxford University Press.
- Clarkson, C., 2010. Lithics and landscape archaeology, in *Handbook of Landscape Archaeology*, eds. B. David & J. Thomas. Walnut Creek (CA): Left Coast Press, 490–501.
- Cooney, G., 1998. Breaking stones, making places: the social landscape of axe production sites, in *Prehistoric Ritual and Religion*, eds. A. Gibson & D. Simpson. Stroud: Sutton Publishing, 108–18.
- Cooney, G., 1999. Social landscapes in Irish prehistory, in *Archaeology and Anthropology of Landscape: Shaping your landscape* eds. P.J. Ucko & R. Layton. London: Routledge, 46–64.
- Couyat, J. & P. Montet, 1912. *Les Inscriptions Hiéroglyphiques et Hiératiques du Ouâdi Hammâmât*. Cairo: Institut français d'archéologie orientale.
- Cruz-Urbe, E., 2001. Demotic graffiti from the Wadi Hammamat. *Journal of the Society for the Study of Egyptian Antiquities* 28, 26–54.
- Cuvigny, H. (ed.), 2003. *La Route de Myos Hormos: L'armée romaine dans le désert Oriental d'Égypte*, Vol 1. Cairo: Institut français d'archéologie orientale.
- Darvill, T. & G. Wainwright, 2014. Beyond Stonehenge: Carn Menyn Quarry and the origin and date of bluestone extraction in the Preseli Hills of south-west Wales. *Antiquity* 88, 1099–114.
- Debono, F., 1951. Expédition archéologique royale au desert oriental (Keft – Kosseir). *Annales du Service des Antiquités de l'Égypte* 51, 59–91.
- De Rozière, M., 1813. Description minéralogique de la Vallée de Qoceyr in *Description de l'Égypte, Histoire Naturelle*, Vol. 2. Paris: L'Imprimerie Impériale, 83–98.
- Edmonds, M., 1995. *Stone Tools and Society*. London: Batsford.
- Edmonds, M., 1999. *Ancestral Geographies of the Neolithic: Landscapes, monuments and memory*. London: Routledge.
- El-Senussi, A., 2011. Pottery of the Wadi Hammamat greywacke quarries, in E. Bloxam, A. Kelany, J. Harrell, N. Moloney & A. el-Senussi, *Final Report to The Supreme Council of Antiquities, Second archaeological survey of the greywacke quarries of the Wadi Hammamat*.
- El-Senussi, A., 2012. Pottery of the Wadi Hammamat greywacke quarries, in E. Bloxam, A. Kelany, J. Harrell, N. Moloney & A. el-Senussi, *Final Report to The Supreme Council of Antiquities, Third archaeological survey of the greywacke quarries of the Wadi Hammamat*.
- Enmarch, R. 2011. Of spice and mine: the tale of the shipwrecked sailor and Middle Kingdom expedition inscriptions, in *Narratives of Egypt and the Ancient Near East: Literary and linguistic approaches*, eds. F. Hagen, J. Johnston, W. Monkhouse, K. Piquette, J. Tait & M. Worthington. (Orientalia Lovaniensia Analecta 189.) Leuven: Peeters, 98–121.
- Erman, A. & H. Grapow (eds.), 1926. *Wörterbuch Der Ägyptischen Sprache*. Vol 1. Berlin: Akademie-Verlag.
- Eyre, C.J., 1996. Is Egyptian historical literature 'historical' or 'literary'?, in *Ancient Egyptian Literature History and Forms*, ed. A. Loprieno. Leiden: Brill, 415–33.
- Eyre, C., 2013. *The Use of Documents in Pharaonic Egypt*. Oxford: Oxford University Press.
- Fairclough, G. 2008. The long chain: archaeology, historical landscape characterization and time depth in the landscape, in *The Heritage Reader*, eds. G. Fairclough, R. Harrison, J.H. Jameson, Jr, & J. Schofield. London: Routledge, 408–24.
- Fullagar, R. & L. Head, 1999. Exploring the prehistory of hunter-gatherer attachments to place: an example from the Keep River Area, Northern Territory, Australia, in *Archaeology and Anthropology of Landscape: Shaping your landscape* eds. P.J. Ucko & R. Layton. London: Routledge, 322–35.

- Gamble, C. 2007. *Origins and Revolutions: Human identity in earliest prehistory*. Cambridge: Cambridge University Press.
- Gasse, A., 1987. Une expédition au Ouadi Hammâmât sous le règne de Sebekemsaf Ier [avec 4 planches]. *Bulletin de l'institut français d'archéologie orientale* 87, 207–18.
- Goyon, G., 1949. Le Papyrus de Turin dit 'des mines d'or' et le Wadi Hammamat. *Annales du Service des Antiquités de l'Égypte* 49, 337–92.
- Goyon, G., 1957. *Nouvelles Inscriptions Rupestres du Wadi Hammamat*. Paris: Imprimerie Nationale Librairie d'Amérique et d'Orient Adrien-Maisonneuve.
- Gundlach, R., 1986. Wadi Hammamat. *Lexikon der Ägyptologie*, Vol. 6, 1099–113. Wiesbaden: Otto Harrassowitz.
- Hamilton, S., M. Seager Thomas & R. Whitehouse, 2011. Say it with stone: constructing with stones on Easter Island. *World Archaeology* 43(2), 167–90.
- Harrell, J., 2002. Pharaonic stone quarries in the Egyptian deserts, in *Egypt and Nubia: Gifts of the desert*, ed. R. Friedman. London: British Museum Press, 232–43.
- Harrell, J.A. & T.M. Bown, 1995. An Old Kingdom basalt quarry at Widan el-Faras and the quarry road to Lake Moeris in the Faiyum. *Journal of the American Research Center in Egypt* 32, 71–91.
- Harrell, J.A. & V.M. Brown, 1992. The oldest surviving topographical map from ancient Egypt (Turin Papyri 1879, 1899, and 1969), *Journal of the American Research Center in Egypt* 39, 81–105.
- Harrell, J.A., V.M. Brown & L. Lazzarini, 2002. Breccia verde antica – source, petrology and ancient uses, in *Interdisciplinary Studies on Ancient Stone – ASMOSIA VI, Proceedings of the Sixth International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Venice, June 15–18, 2000*, ed. L. Lazzarini. Padua: Bottega d'Erasmus – Aldo Ausilio Editore, 207–18.
- Harrell, J.A. & P. Storemyr, 2009. Ancient Egyptian quarries – an illustrated overview, in *QuarryScapes: Ancient stone quarry landscapes in the eastern Mediterranean*, eds. N. Abu-Jaber, E.G. Bloxam, P. Degryse & T. Haldal. (Geological Survey of Norway Special Publication 12.) Trondheim: Geological Survey of Norway, 7–50.
- Haldal, T., 2009. Constructing a quarry landscape from empirical data. General perspectives and a case study at the Aswan West Bank, Egypt, in *QuarryScapes: Ancient stone quarry landscapes in the eastern Mediterranean*, eds. N. Abu-Jaber, E.G. Bloxam, P. Degryse & T. Haldal. (Geological Survey of Norway Special Publication 12.) Trondheim: Geological Survey of Norway, 125–53.
- Haldal, T., E. Bloxam, P. Storemyr & A. Kelany, 2005. The geology and archaeology of the ancient silicified sandstone quarries at Gebel Gulab and Gebel Tingar, Aswan, Egypt. *Marmora: International Journal for Archaeology, History and Archaeometry of Marbles and Stones* 1, 11–35.
- Haldal, T. & P. Storemyr, 2015. Fire on the rocks: heat as an agent in Ancient Egyptian hard stone quarrying, in *Engineering Geology for Society and Territory – Vol. 5*, eds. G. Lollino, A. Manconi, F. Guzzetti, M. Culshaw, P. Bobrowsky & F. Luino. Cham: Springer International Publishing, 291–5.
- Hikade, T. 2001. *Das Expeditionswesen im ägyptischen Neuen Reich. Ein Beitrag zu Rohstoffbesorgung und Außenhandel*. (Studien zur Archäologie und Geschichte des Alten Ägypten 21.) Heidelberg: Orientverlag.
- Hikade, T., 2006. Expeditions to the Wadi Hammamat during the New Kingdom. *Journal of Egyptian Archaeology* 92, 153–68.
- Hoffman, M.A., 1980. *Egypt Before the Pharaohs*. London: Routledge & Kegan Paul.
- Hume, W.F., 1934. *Geology of Egypt II: The fundamental Precambrian rocks of Egypt and the Sudan, 1: The late Plutonic and minor intrusive rocks*. Cairo: Geological Survey of Egypt.
- Jones, D., 2000. *An Index of Ancient Egyptian Titles Epithets and Phrases of the Old Kingdom, Vol II*. (BAR International series S866.) Oxford: Archaeopress.
- Kayser, F. 1993. Nouveaux textes grecs du Ouadi Hammamat. *Zeitschrift für Papyrologie und Epigraphik* 98, 111–56.
- Klemm, D. & R. Klemm, 1993. *Steine und Steinbrüche im alten Ägypten*. Berlin: Springer-Verlag.
- Klemm, D. & R. Klemm, 2008. *Stones and Quarries in Ancient Egypt*. London: British Museum Press.
- Lichtheim, M., 1973. *Ancient Egyptian Literature, Vol. 1: The Old and Middle Kingdoms*. Los Angeles (CA): University of California Press.
- Lloyd, A.B., 2013. Expeditions to the Wadi Hammamat: context and concept, in *Experiencing Power, Generating Authority: Cosmos politics, and the ideology of kingship in ancient Egypt and Mesopotamia*, eds J.A. Hill, P. Jones & A.J. Morales. Philadelphia (PA): University of Pennsylvania Press, 361–82.
- Lloyd, A.B., 2014. *Ancient Egypt: State and society*. Oxford: Oxford University Press.
- Lucas, A. & A. Rowe, 1938. The ancient Egyptian bekhenstone. *Annales du Service des Antiquités de l'Égypte*, 38, 127–56.
- Majer, J., 1992. The Eastern Desert and Egyptian prehistory, in *The Followers of Horus: Studies dedicated to Michael Allen Hoffman*, eds. R. Friedman & B. Adams. Oxford: Oxbow, 227–34.
- Mason, R., 2008. Assessing values in conservation planning: methodological issues and choices, in *The Heritage Reader*, eds. G. Fairclough, R. Harrison, J.H. Jameson, Jr, & J. Schofield. London: Routledge, 99–124.
- Maxfield, V. & D. Peacock, 2001. *The Roman Imperial Quarries Survey and Excavation at Mons Porphyrites 1994–1998. Vol. I: Topography and quarries*, ed. A. Leahy. (EES memoir 67.) London: Egypt Exploration Society.
- McBryde, I., 1997. The landscape is a series of stories. Grindstones, quarries and exchange in Aboriginal Australia: a Lake Eyre case study, in *Siliceous Rocks and Culture*, eds. A. Ramos-Millán & M.A. Bustillo. Granada: Editorial Universidad de Granada, 587–607.

- McBryde, I., 2000. Travellers in storied landscapes: a case study in exchanges and heritage. *Aboriginal History* 24, 152–74.
- McNiven, I. 1999. Fissioning and regionalisation: the social dimensions of change in Aboriginal use of the Great Sandy region, southeast Queensland, in *Australian Coastal Archaeology*, eds. J. Hall & I. McNiven. (ANH Publications 31.) Canberra: Department of Archaeology and Natural History, Australian National University, 157–68.
- Midant-Reynes, B., 2000. *The Prehistory of Egypt: From the first Egyptians to the first pharaohs*. Oxford: Blackwell.
- Moorey, P.R.S. 1999. *Ancient Mesopotamian Materials and Industries: The archaeological evidence*. Winona Lake (IN): Eisenbrauns.
- Mueller, D., 1975. Some remarks on wage rates in the Middle Kingdom. *Journal of Near Eastern Studies* 34, 249–63.
- Newberry, P.E., 1985. *El Bersheh Part I*. London: Egypt Exploration Fund.
- Parkinson, R.B., 2002. *Poetry and Culture in Middle Kingdom Egypt: A dark side to perfection*. (Athlone Publications in Egyptology and Ancient Near East Studies.) London: Continuum.
- Peacock, D. & V. Maxfield, 1997. *Mons Claudianus Survey and Excavation 1987–1993. Vol. I. Topography and quarries*. (Fouilles de l'IFAO 37.) Cairo: Institut Français d'Archéologie Orientale.
- Peden, A.J., 2001. *The Graffiti of Pharaonic Egypt: Scope and roles of informal writings*. Leiden: Brill.
- Posener, G., 1936. *La première domination perse en Égypte*. Cairo: Institut français d'archéologie orientale.
- Reisner, G.A., 1908. *The Early Dynastic Cemeteries of Nagad-Der I*. Leipzig: J.C. Hinrichs.
- Riemer, H., K. Kindermann & M. Atallah, 2009. Die "Schminkpaletten" des 6. Jahrtausends v. Chr. Kulturbeziehungen zwischen Wüste. Ein Beitrag zu den prähistorische Zeit. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 65, 355–71.
- Röder, J., 1965. Zur Steinbruchgeschichte des Rosengranits von Assuan. *Archäologischer Anzeiger* 3, 467–552.
- Ross, J.C., 2010. The scribal artefact: technological innovation in the Uruk Period, in *Agency and Identity in the Ancient Near East: New paths forward*, eds. S.R. Steadman & J.C. Ross, London: Equinox Publishing, 80–98.
- Seyfried, K.J., 1981. *Beiträge zu den Expeditionen des Mittleren Reiches in die Ost-Wüste*. (Hildesheimer Ägyptologische Beiträge.) Hildesheim: Gerstenberg.
- Shaw, I., 2010. *Hatnub: Quarrying travertine in ancient Egypt*. London: Egypt Exploration Society.
- Shaw, I., 2012. *Ancient Egyptian Technology and Innovation*. London: Bloomsbury.
- Shaw, I. & E. Bloxam 1999. Survey and excavation at the ancient Pharaonic gneiss quarrying site of Gebel el Asr, Lower Nubia. *Sudan Archaeological Research Society Bulletin* 3, 13–20.
- Shennan, S. 2001. Demography and cultural innovation: a model and its implications for the emergence of modern human culture. *Cambridge Archaeological Journal* 11(1), 5–16.
- Simpson, W.K., 1959. Historical and lexical notes on the new series of Hammamat inscriptions. *Journal of Near Eastern Studies* 18, 20–37.
- Simpson, W.K., 1963. *Papyrus Reisner I. The records of a building project in the reign of Sesostris I*. Boston (MA): Museum of Fine Arts.
- Stevenson, A., 2009. Social relationships in predynastic burials. *Journal of Egyptian Archaeology* 95, 175–92.
- Storemyr, P.A., 2009. Prehistoric geometric rock art landscape by the First Nile Cataract. *Archéo-Nil* 19, 121–50.
- Storemyr, P., E. Bloxam, T. Heldal & A. Salem, 2002. Survey at Chephren's Quarry, Gebel el-Asr, Lower Nubia. *Sudan Archaeological Research Society Bulletin* 6, 25–9.
- Storemyr, P., E. Bloxam, T. Heldal & A. Kelany, 2013. Ancient desert and quarry roads on the west bank of the Nile in the first Cataract Region, in *Desert Road Archaeology in Ancient Egypt and Beyond*, eds. F. Förster & H. Riemer. Cologne: Heinrich-Barth-Institut, 399–423.
- Taçon, P.S.C., 1991. The power of stone: symbolic aspects of stone use and tool development in western Arnhem Land, Australia. *Antiquity* 65, 192–207.
- Taçon, P.S.C., 1994. Socialising landscapes: the long-term implications of signs, symbols and marks on the land. *Archaeology in Oceania* 29, 117–29.
- Thissen, J., 1979. Demotische Graffiti des Paeion im Wadi Hammamat. *Enchoria* 9, 63–92.
- Trichet, J. & P. Poupet, 1974. Étude pétrographique de la roche constituant la statue de Darius découverte à Suse en décembre 1972. *Cahiers de la Délégation Archéologique Française en Iran* 4, 57–9.
- Vandeput, L., 1987–88. Splitting techniques in quarries in the Eastern Mediterranean. *Acta Archaeologica Lovaniensia*, n. 26–27, 81–107.
- Vermeersch, P.M., E. Paulissen & W. Van Neer, 1989. The Late Palaeolithic Makhadma sites (Egypt): environment and subsistence, in *Late Prehistory of the Nile Basin and the Sahara*, eds. L. Krzyzaniak & M. Kobusiewicz. Poznan: Polish Academy of Sciences, 87–114.
- Wadley, L. 2013. Recognizing complex cognition through innovative technology in Stone Age and Palaeolithic sites. *Cambridge Archaeological Journal* 23(2), 163–83.
- Waelkens, M., de Paepe, P & Moens, L., 1990. The quarrying techniques of the Greek world, in *Marble: Art Historical and Scientific Perspectives on Ancient Sculpture*, Malibu: 47–72.
- Weigall, A.E.P., 1909. *Travels in the Upper Egyptian Deserts*. Edinburgh/London: William Blackwood & Sons.
- Wengrow, D., M. Dee, S. Foster, A. Stevenson & C. B. Ramsey 2014. Cultural convergence in the Neolithic of the Nile Valley: a prehistoric perspective on Egypt's place in Africa. *Antiquity* 88 (339), 95–111.
- Wilkinson, T.A.H., 1995. A new king in the Western Desert. *Journal of Egyptian Archaeology* 81, 205–10.
- Zitterkopf, R.E. & S.E. Sidebotham, 1989. Stations and towers on the Quseir-Nile Road. *Journal of Egyptian Archaeology* 75, 155–89.

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