UCLA ENCYCLOPEDIA of EGYPTOLOGY

ORNAMENTAL STONES

أحجار الزينة

James A. Harrell

Short Citation:
Harrell, 2013, Ornamental Stones. *UEE*.

Full Citation:
Harrell, James A., 2013, Ornamental Stones. In Willeke Wendrich (ed.), *UCLA Encyclopedia of Egyptology*, Los Angeles. http://digital2.library.ucla.edu/viewItem.do?ark=21198/zz002dwzs4

8754 Version 1, March 2013
http://digital2.library.ucla.edu/viewItem.do?ark= 21198/zz002dwzs4

UCLA ENCYCLOPEDIA of EGYPTOLOGY

ORNAMENTAL STONES

أحجار الزينة

James A. Harrell

Dekorative Steine
Pierre ornemental

The ornamental stones of ancient Egypt comprise a large and diverse group of rocks. Their attractive colors and patterns, and ability to take a good polish, made them sought after for decorative applications in art and architecture. At least 48 varieties of ornamental stone were used by the Egyptians and these come from 45 known ancient quarries, two in northern Sudan and the rest in Egypt.

تشكل أحجار الزينة بمصر القديمة مجموعة كبيرة ومتنوعة من الأحجار، ألوانها الجذابة وتصميماتها وإمكانية صقلها جعلتها المفضلة كعناصر زخرفية في الفنون والعمارة، ولقد استخدم المصري القديم ما يقرب عن أربعة وثمانون نوع من أحجار الزينة ، يأتي خمسة وأربعون منها من محاجر أثرية معروفة، إثنان منها بشمال السودان، والباقي من مصر.

The ornamental stones of ancient Egypt comprise a large and diverse group of rocks. Their attractive colors and patterns, and ability to take a good polish, made them sought after for decorative applications in art and architecture. Table 1 lists 48 varieties of ornamental stones, 44 definitely or probably from Egypt, and the rest from northern Sudan. The greatest selection of ornamental stones is found in the vessels made during the Predynastic and Early Dynastic Periods. Most of these are included in the table; those omitted, all rare, are discussed by Aston (1994). Table 1 also provides a description of the typical appearance of each stone variety along with its period of use and source. Locations of ancient quarries are plotted on the maps in Figures 1 and 2, and Figures 3 through 9 show typical specimens of ornamental stones collected from these quarries. Objects carved from the nine stone varieties for which quarries have not been identified are shown in Figures 10 and 11. Table 1 additionally supplies the ancient Egyptian names for the ornamental stones (Harris 1961). About half of the listed varieties were used during the Roman Period and exported to many parts of the Mediterranean region (Lazzarini 2004). Some of the Roman names for these stones are preserved and these are also included in the table, along with the traditional names given by Italian stonecutters (Borghini 1989; Price 2007). It is by the latter names that the Roman stones are mainly referred to today in the archaeological and art historical literature.

There is much confusion over the geologic names applied to Egypt's ornamental stones. Many of those now in common use were suggested over a century ago by archaeologists and other non-geologists with a poor understanding of the rocks they were describing, and still others were introduced by geologists following now disused or inappropriate rock classifications. Also, some stones are known by multiple names with different petrological meanings. For example, the famous "metagraywacke" from Wadi Hammamat (the third stone listed in Table 1) has been variously but incorrectly referred to as "basalt," "durite," "schist," "siltstone," and "slate," all rocks that are very different from metagraywacke. Another notable example of misused terminology is the widespread

practice of referring to "travertine" (the fifth stone listed in Table 1) as "alabaster." For geologists, alabaster is a variety of rock gypsum (also listed in Table 1) and consists of the mineral gypsum ($CaSO_4 \cdot 2H_2O$), whereas travertine is a rock composed of the mineral calcite ($CaCO_3$). To avoid this nomenclatural conflict, some writers have referred to travertine as "calcite," "calcite-alabaster," "Egyptian alabaster," or "oriental alabaster," but travertine is the only geologically correct name. These and other invalid geologic names are noted in Table 1. It is important that the geologic names be applied consistently and follow widely accepted, modern petrological conventions. Accordingly, the names employed for igneous rocks in Table 1 conform to the internationally adopted IUGS classification (Streckheisen 1973, 1979). There are no comparable global classification schemes for metamorphic and sedimentary rocks, but the terminology used here follows the popular norms reported by Brown and Harrell (1991) with, additionally, for some metamorphic rocks, compositional descriptors based on the IUGS classification. Modern petrological nomenclature allows for still other, equally valid, rock names for most of the ornamental stones and these are sometimes encountered in the literature. It is common practice to add a generalized color term to rock names (e.g., "red granite" from Aswan and "green metaconglomerate" from Wadi Hammamat) but, as Figures 3a-b and 7c show, such characterizations can be misleading and are, in any case, not a required part of a proper geologic name.

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

STONES FIRST USED DURING THE DYNASTIC PERIOD OR EARLIER
Major Use
granite, variety 1 (reddish to mainly pinkish, very coarse- to mainly coarse-grained, commonly porphyritic and occasionally gneissoid; figs. 3a-b). Used: from Early Dynastic to Roman Periods. Source: quarry in Aswan, Nile Valley (no. **42** in fig. 1). Ancient names: ***mꜣṯ*** [*matj*], ***jnr n mꜣṯ*** [*iner n matj*], ***jnr nfr n mꜣṯ*** [*iner nefer n matj*], and ***mꜣṯ ꜣbw*** [*matj abew*] (Egyptian); *lithos pyrrhopoecilos* (Greek); *lapis Aethiopicus*, *lapis Syenites,* and *lapis Thebaicus* (Roman). Italian name: *granito* [*rosso* or *roseo*] *antico* [*di Siene* or *di Assuan*]. Geologically incorrect name: syenite.
granodiorite, variety 1 (dark gray to nearly black with abundant to rare white, light gray, pale green, or pinkish phenocrysts, coarse- to mainly medium-grained, commonly porphyritic, occasionally gneissoid, highly variable in appearance; figs. 3e-i). Used: same as variety 1 granite above but in much smaller quantities. Source: quarry in Aswan, same as variety 1 granite above. Note that there are other stones from Aswan that are gradational between this

[1] The following grain-size scale is used for crystalline rocks, including all igneous and non-clastic sedimentary, and most metamorphic rocks: fine <1 mm, medium 1-5 mm, coarse 5 mm-3 cm, and very coarse (or pegmatitic) >3 cm. For the clastic rocks (metasedimentary and silicified sandstone), the Udden-Wentworth grain-size scale is used: boulder >25.6 cm, cobble 6.4-25.6 cm, pebble 4 mm-6.4 cm, granule 2-4 mm, very coarse sand 1-2 mm, coarse sand 0.5-1 mm, medium sand 0.25-0.5 mm, fine sand 0.125-0.25 mm, very fine sand 0.0625-0.125 mm, silt 0.004-0.0625 mm, and clay <0.004 mm.

[2] Porphyritic rocks consist of finer-grained material (matrix) surrounding larger crystals (phenocrysts). Gneissoid rocks (and gneiss) have parallel streaks or bands of alternating light- and dark-colored mineral grains.

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

granodiorite and the variety 1 granite. Veins of the pinkish to reddish variety 2 granite commonly occur in this granodiorite and so are present in some objects carved from it. Ancient names: ***jnr km*** [*iner kem*] and ***jnr km n mꜣṯ*** [*iner kem n matj*] (Egyptian); *lithos pyrrhopoecilos* (Greek); *lapis Syenites*, *lapis Thebaicus,* and *lapis Aethiopicus* (Roman). Italian name: *granito* [*nero* or *bigio*] *antico* [*di Siene* or *di Assuan*]. Geologically incorrect names: basalt, black or gray granite, diorite, dolerite, syenite, and tonalite.
metagraywacke, with three textural and color varieties (variety 1—greenish gray to mainly grayish green, fine- to very fine-grained sandstone; variety 2—dark gray, fine- to very fine-grained sandstone; and variety 3—grayish green, claystone to siltstone; figs. 7a-b). Used: from Predynastic to Roman Periods. Source: quarry in Wadi Hammamat, Eastern Desert (no. **32** in fig. 1). Ancient names: ***bḫn*** [*bekhen*] and ***jnr nfr n bḫn*** [*iner nefer n bekhen*] (Egyptian); *lapis basanites* (Roman). Italian names: *basanite*, *basalto verde antico,* and *pietre bekhen*. Geologically incorrect names: basalt, durite, schist, and slate. Marginally correct names: graywacke and siltstone (the latter is invalid for the sandy and clayey varieties, and both terms ignore the rock's metamorphic character).
silicified (or **siliceous**) **sandstone** (light gray, light to dark brown, yellowish brown, brownish black, purplish red or red, fine- to very coarse-grained but mainly medium- to coarse-grained, commonly pebbly and occasionally a sandy pebble conglomerate; figs. 4a-i). Used: from Old Kingdom to Roman Period. Sources: four quarries in the Nile Valley, on Gebel el-Ahmar near Cairo (no. **1** in fig. 1), in Wadi Abu Subeira (no. **39** in fig. 1), near Wadi Abu Aggag (no. **40** in fig. 1), and on both Gebel Gulab and Gebel Tingar opposite Aswan (no. **41** in fig. 1). Ancient names: ***bjꜣt*** [*biat*] or ***jnr n bjꜣt*** [*iner n biat*], ***jnr nfr n bjꜣt*** [*iner nefer n biat*], ***jnr n bnwt*** [*iner n benwet*], and ***jnr n ḏw dšr*** [*iner n djew desher*] (Egyptian). Marginally acceptable name: quartzite, a term more appropriately applied to a variety of metamorphic rock.
travertine (opaque white and translucent yellowish brown banded calcite with highly variable band thicknesses, fine- to medium-grained; figs. 8a-f). Used: from Predynastic to Roman Periods. Sources: nine quarries in the Eastern Desert and possibly others still undiscovered, in Wadi el-Garawi near Helwan city (no. **2** in fig. 1), in Wadi Araba near Wadi Askhar el-Qibli (no. **5** in fig. 1), in Wadi Umm Argub near Wadis Muwathil and Sannur (no. **9** in fig. 1), at el-Qawatir (no. **11** in fig. 1), in Wadi el-Barshawi near el-Amarna ruins (no. **12** in fig. 1), in central Wadi el-Zebeida (a.k.a. Abd el-Azziz Quarry; no. **13** in fig. 1), near Wadi el-Zebeida and Northern Tombs at el-Amarna ruins (no. **14** in fig. 1), at Hatnub near el-Amarna ruins (no. **15** in fig. 1), and near Wadi Assiut (no. **16** in fig. 1). Ancient names: ***šs*** [*shes*] and, in the Old Kingdom, ***bjt*** [*bit*] (Egyptian); *lapis alabastrites* and *lapis onyx* (Roman). Italian names: *alabastro cotognino* [and *venato*], and *alabastro* [*Egiziano* or *onice*]. Geologically incorrect names: alabaster and onyx. Marginally acceptable names: Egyptian or Oriental alabaster, calcite-alabaster, and calcite.

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

Minor Use
andesite porphyry, with at least two textural varieties (variety 1—fine-grained black matrix with scarce to common very coarse- to mainly coarse-grained, isolated, white, blocky phenocrysts; and variety 2—fine-grained black matrix with common to abundant, coarse-grained, isolated to clustered white to light gray, elongated phenocrysts; figs. 10a-b). Used: from Predynastic to Early Dynastic Periods. Source: no quarry known, but certainly from the Eastern Desert. Ancient name: unknown. Geologically incorrect name: breccia.
andesite-dacite porphyry, variety 1 (fine-grained reddish purple matrix with medium-grained, white to pink phenocrysts; figs. 8g-h). Used: from Predynastic to Early Dynastic Periods and rarely thereafter until the Roman Period when it was heavily used. Source: quarry at Mons Porphyrites on Gebel Dokhan, Eastern Desert (no. **18** in fig. 1). Ancient names: *lapis porphyrites* and *rubet porphyrites* (Roman). Italian name: *porfido rosso* [*antico* or *Egiziano*]. Other name: imperial porphyry.
anorthosite gneiss (light gray with greenish black specks and streaks, fine- to medium-grained; fig. 5e). Used: from Predynastic Period to Middle Kingdom. Source: "Chephren's Quarry" near Gebel el-Asr, Western/Nubian Desert (no. **43** in fig. 1). Ancient name: ***mntt*** [*mentet*] (Egyptian). Geologically incorrect names: diorite and diorite gneiss. Other name: Chephren gneiss.
basalt (dark gray to black, medium- to mainly fine-grained; fig. 5d). Used: in Old Kingdom, and from Late to Roman Periods. Sources: two quarries at Widan el-Faras on Gebel el-Qatrani, Fayum (no. **4** in fig. 1), and at Tilal Sawda near el-Behnasa/Oxyrhynchus, Nile Valley (no. **10** in fig. 1). Ancient name: possibly ***nmhf*** [*nemhef*] (Egyptian).
dolerite porphyry (fine- to medium-grained greenish black matrix with coarse-grained, light gray to greenish gray phenocrysts; fig. 3k). Used: in Late Period's 30th Dynasty and early Ptolemaic Period. Source: quarry in Rod el-Gamra near Gebel Urf Hamam, Eastern Desert [no. **38** in figs. 1-2]. Ancient name: unknown.
dolostone or **dolomite**, variety 1 (brecciated white with dark gray veins, fine-grained; fig. 11a). Used: from Early Dynastic Period to Old Kingdom. Source: no quarry known, but certainly from the Eastern Desert. Ancient name: unknown. Geologically incorrect name: magnesite.
gabbro gneiss (light gray with greenish black bands, fine- to medium-grained; figs. 5f-g). Used: from Old to Middle Kingdoms. Source and names: same as for anorthosite gneiss above.
granite, variety 2 (pinkish to reddish or, less often, light gray, medium- to mainly fine-grained; figs. 3c-d). Used: in New Kingdom and Roman Period. Source: quarry in Aswan, same as the

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

variety 1 granite above. Commonly occurs as veins within the variety 1 granodiorite. Ancient names: possibly the same as for the variety 1 granite above. Italian names: *granito* [*rosso* or *roseo*] *minuto* and *granito Egizio carnino minuto.*
granite, variety 3 (moderate gray, fine- to medium-grained; fig. 5b). Used: in Sudan only, Late and Napatan-Meroitic Periods. Source: quarry at Tumbos, Third Nile Cataract, Sudan (no. **44** in fig. 1). Ancient name: unknown.
granodiorite, variety 2 (moderate gray, fine- to medium-grained with occasional nearly black xenolithic inclusions ; fig. 3j). Used: probably in Ptolemaic Period. Source: quarry in Wadi Abu Bokari (a.k.a. Bokari or Wadi el-Bakriya) near Wadi Miya, Eastern Desert (no. **36** in fig. 1). Ancient name: unknown.
granodiorite gneiss to mainly **granite gneiss**, variety 1 (pinkish gray, medium- to coarse-grained; fig. 5a). Used: Sudan only, from New Kingdom to Late and Napatan-Meroitic Periods. Source: quarry at Tumbos, same as variety 3 granite above. Ancient name: unknown. Geologically incorrect name: granite.
granodiorite gneiss to mainly **granite gneiss**, variety 2 (dark gray, medium-grained; fig. 5c). Used: Sudan only, in Late and Napatan-Meroitic Periods. Source: quarry at Daygah in el-Bellal district of Fourth Nile Cataract, Sudan [no. **45** in fig. 1]. Ancient name: unknown.
bituminous limestone, variety 1 (dark gray, fine-grained with foraminifera micro-fossils; fig. 11c). Used: from Predynastic Period to New Kingdom. Source: no quarry known, but probably from one or more sites among the limestone formations bordering the Nile Valley in the Helwan-Saqqara region. Ancient name: unknown.
buff limestone (orange to brownish yellow or pink, fine-grained, commonly with dark dendritic veins and spots; fig. 11e). Used: from Old to New Kingdoms. Source: no quarry known, but probably from one or more sites among the limestone formations bordering the Nile Valley. Ancient name: unknown.
limestone breccia (yellowish brown to mainly reddish brown or red calcitic matrix with white to light gray, angular chert to mostly limestone pebbles; fig. 7d). Used: from Predynastic to Old Kingdom and rarely thereafter. Source: no definite quarry known, but certainly from Egypt's limestone region in or near the Nile Valley with possibly one quarry near Wadi Abu Gelbana (no. **26** in fig. 1). Ancient name: unknown.
recrystallized (or **crystalline**) **limestone**, variety 1 (slightly translucent and brecciated, light yellow to white with gray streaks in parallel bands, fine-grained; fig. 11b). Used: from Early Dynastic Period to Old Kingdom. Source: no quarry known, but probably from the Eastern Desert. Ancient name: unknown. Geologically incorrect name: marble.

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

marble (white with even brighter white veins, fine-grained, calcitic with minor brucite and dolomite; fig. 4j). Used: in New Kingdom. Source: quarry on Gebel Rokham near Wadi Miya, Eastern Desert (no. **34** in fig. 1). Ancient name: unknown.
metaconglomerate (greenish coarse- to very coarse-grained sand matrix with multicolored, mainly well-rounded pebbles and cobbles of mostly volcanic rocks; fig. 7c). Used: in Predynastic Period but mainly from New Kingdom to Roman Period. Source: quarry in Wadi Hammamat, Eastern Desert—occurs with the metagraywacke above (no. **32** in fig. 1). Ancient names: possibly ***bḫn*** [*bekhen*] (Egyptian); *lapis hexecontalithos* and *lapis hecatontalithos* (Roman). Italian names: *breccia verde* [*antica* or *d'Egitto*], *breccia universale*, *breccia verde dura* and *centopietre*. Marginally correct name: conglomerate (this ignores the rock's metamorphic character). Geologically incorrect name: breccia.
pegmatitic diorite, variety 1 (mottled light gray, pale pink and greenish black, very coarse- to mainly coarse-grained with elongated dark crystals; figs. 6c-d). Used: from Predynastic to Early Dynastic Periods, and in Roman Period. Source: quarry in Wadi Umm Shegilat near Gebel Abu el-Hasan, Eastern Desert (no. **21** in fig. 1). Ancient names: unknown. Italian name: *granito della colonna* [and *della flagellazione*]. Geologically incorrect names: porphyry and breccia.
pegmatitic diorite, variety 2 (mottled moderate gray to white and black, very coarse- to mainly coarse-grained with elongated light crystals; figs. 6e-f). Used: from Predynastic Period to Old Kingdom, and possibly in Roman Period. Source: quarry near Gebel Umm Naqqat, Eastern Desert (no. **33** in fig. 1). Ancient name: unknown.
peridotite (speckled light gray to white and green, medium-grained; fig. 10c). Used: Sudan only, in New Kingdom. Source: no quarry known, but possibly from the Gebel Tundullah area north of the Third Nile Cataract, Sudan. Ancient name: unknown.
rock anhydrite, **blue anhydrite** or, simply, **anhydrite** (pale bluish gray, mainly fine-grained; fig. 11d). Used: from Middle Kingdom to Second Intermediate Period. Source: no quarry known, but probably from Gulf of Suez region. Ancient name: unknown. Geologically incorrect name: blue marble.
rock gypsum, **alabaster gypsum** or, simply, **alabaster** or **gypsum** (white with occasional dark gray or brownish streaks and veins, mainly fine-grained; fig. 4k). Used: from Early Dynastic Period to Old Kingdom, and in Roman Period. Source: quarry at Umm el-Sawan, Fayum (no. **3** in fig. 1). Ancient names: possibly ***qḏ*** [*qedj*] and ***qḥ*** [*qeh*] (Egyptian).
serpentinite, variety 1 (mostly black and speckled with gray, brown or pink, fine-grained to medium-grained; fig. 10d). Used: from Predynastic to Roman Periods. Source: no quarry known, but certainly from the Eastern Desert. Ancient name: unknown. Geologically incorrect names: breccia and serpentine. Marginally acceptable name: ophicalcite.

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

serpentinite, variety 2 (mottled light yellowish green, dark green with black veins and patches, fine-grained; fig. 9a). Used: from Predynastic to Roman Periods. Sources: Roman (and possibly earlier) quarry near Wadi Umm Esh, Eastern Desert (no. **30** in fig. 1), plus probably one or more other undiscovered sources. Ancient names: probably ***nmḥf*** [*nemhef*] (Egyptian); *lapis batrachites* (Roman). Italian names: *serpentina moschinata* and *verde ranocchia* [and *fiorito*].
steatite or **soapstone** (highly variable in appearance but generally greenish gray or grayish to brownish green, fine-grained; figs. 6g-k). Used: from Predynastic to Roman Periods. Sources: probably multiple undiscovered sites in the Eastern Desert plus two late quarries in Wadi Mubarak (no. **35** in fig. 1) and at Gebel Rod el-Barram (no. **37** in fig. 1), both of which are also medieval Islamic. Ancient names: probably ***nmḥf*** [*nemhef*] and also possibly ***shrt*** [*sehret*] (Egyptian); possibly the "*molle candid*" variety of *lapis ophites* (Roman).
tuff or **volcanic tuff** (moderate to dark green and occasionally slightly bluish, medium- to mainly fine-grained; fig. 6a). Used: in Early Dynastic Period. Source: quarry on Gebel Manzal el-Seyl, Eastern Desert (no. **17** in fig. 1). Ancient name: unknown. Geologically incorrect name: volcanic ash.
tuffaceous limestone (moderate bluish green, medium- to mainly fine-grained; fig. 6b). Used: in Early Dynastic Period. Source: quarry on Gebel Manzal el-Seyl, same as the tuff above. Ancient name: unknown.
STONES FIRST USED DURING THE ROMAN PERIOD
Major Use
metagabbro, varieties 1a (speckled white, moderate green and dark green, medium-grained; fig. 7e) and less abundant 1b (mottled white, moderate green and dark green, medium- to mainly coarse-grained; figs. 7f-g). Source: quarry in Wadi Umm Wikala near Wadi Semna, Eastern Desert (no. **27** in fig. 1). Roman names: *lapis ophites* and also probably *marmor Augusteum*. Italian names: *granito verde della sedia* with *di San Lorenzo* (1a) and *di San Pietro* (1b) sub-varieties.
tonalite gneiss, variety 1 (light gray with greenish black specks and linear streaks, medium-grained; figs. 9f-g). Source: quarry at Mons Claudianus near Wadi Fatiri el-Bayda, Eastern Desert (no. **22** in fig. 1). Roman name: *marmor Claudianum*. Italian name: *granito del foro*. Geologically incorrect names: granite and granodiorite.

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

Minor Use
andesite-dacite porphyry, variety 2 (fine-grained greenish black matrix with medium-grained white to pale green phenocrysts; fig. 8i). Source: quarry at Mons Porphyrites, same as variety 1 andesite-dacite porphyry above. Roman name: *lapis hieracitis*. Italian name: *porfido verde Egiziano*.
andesite-dacite porphyry, variety 3 (fine-grained black matrix with medium-grained pale green to mainly white phenocrysts; fig. 8j). Source: quarry at Mons Porphyrites, same as variety 1 andesite-dacite porphyry above. Roman name: *porphyrites melanos*. Italian name: *porfido nero* [*antico* or *Egiziano*].
bituminous limestone, variety 2 (moderate gray to black, fine-grained and non-fossiliferous; figs. 5j-k). Source: quarry in Wadi Abu Mu'aymil near Wadi Araba and St. Antony Monastery, Eastern Desert—mostly destroyed (no. **7** in fig. 1). Roman name: unknown. Note: possibly used from late Roman or Byzantine to Islamic Periods.
recrystallized (or **crystalline**) **limestone**, variety 2 (mottled white and moderate gray to pink or pale purple, coarse-grained with occasional large mollusk shells; fig. 5i). Source: quarry in Wadi Umm Damarana near Wadi Araba, Eastern Desert (no. **8** in fig. 1). Roman name: unknown. Note: possibly used from late Roman or Byzantine to Islamic Periods.
dolostone or **dolomite**, variety 2 (orange, fine-grained; fig. 5h). Source: quarry in Wadi Umm Zanatir near Wadi Araba and St. Antony Monastery, Eastern Desert (no. **6** in fig. 1). Roman name: unknown. Note: possibly used from late Roman or Byzantine to Islamic Periods.
granodiorite, variety 3 (pinkish gray, coarse- to mainly medium-grained; fig. 9k). Source: quarry at Bir Umm Fawakhir near Wadi Hammamat, Eastern Desert (no. **31** in fig. 1). Roman name: unknown. Italian names: *granito bianco e nero gabino*, and *granito [rosa] del Uadi Fawakhir*.
metagabbro, varieties 2a (mottled white or light gray, dark green and greenish black, medium- to very coarse-grained; figs. 7h-j) and 2b (mottled light gray and moderate green, medium-grained; fig. 7k). Source: quarry near Wadi Maghrabiya, Eastern Desert (no. **29** in fig. 1). Roman name: possibly the "*nigricantis durum*" variety of *lapis ophites*. Italian names: *gabbro eufotide* or simply *eufotide* (2a), and *granito verde plasmato* (2b).
quartz diorite, variety 1 (speckled white, pale green and dark green, fine- to medium-grained; fig. 9b). Source: quarry in Wadi Umm Balad near Gebel Dokhan, Eastern Desert (no. **20** in fig. 1). Roman name: unknown. Italian name: *granito verde fiorito di bigio*.
quartz diorite, variety 2a (yellowish white to mainly light gray spotted with blocky greenish black crystals, medium- to mainly coarse-grained; fig. 9c) and 2b (mottled light gray and greenish black, coarse- to mainly medium-grained; fig. 9d). Source: quarry near Wadi Barud,

Table 1. Ornamental Stones Used by the Ancient Egyptians[1, 2]

Eastern Desert (no. **23** in fig. 1). Roman name: *marmor Tiberianum*. Italian names: *granito bianco e nero* with *di Santa Prassede* (2a) and *di Cairo* (2b) sub-varieties.
quartz diorite, variety 3 (speckled light gray, pale green and dark green, medium-grained; fig. 9e). Source: quarry in Wadi Fatiri el-Bayda, Eastern Desert (no. **25** in fig. 1). Roman name: unknown. Italian name: probably same as for the variety 1 quartz diorite above given their similar appearance.
rhyolite porphyry (fine-grained pinkish brown matrix with medium- to coarse-grained pink and occasionally bluish phenocrysts; figs. 9i-j). Source: quarry in Wadi Abu Gerida, Eastern Desert (no. **28** in fig. 1). Roman name: unknown. Italian name: *porfido rosso laterizio*.
tonalite gneiss, variety 2 (light gray with greenish black wavy stringers, medium-grained; fig. 9h). Source: quarry near Wadi Umm Huyut, Eastern Desert (no. **24** in fig. 1). Roman and Italian names: probably same as for the variety 1 tonalite gneiss above given their similar appearance.
trachyandesite porphyry (fine-grained black matrix with medium- to coarse-grained pale gray phenocrysts; fig. 8k). Source: quarry in Wadi Umm Towat near Gebel Dokhan, Eastern Desert (no. **19** in fig. 1). Roman name: possibly *knekites*. Italian name: *porfido serpentino nero*.

Table 2 summarizes the principal uses of ornamental stones. Non-ornamental limestone and sandstone, ancient Egypt's main building stones (see Harrell 2012a), were also employed for many of these same applications when the more costly ornamental stones were either unaffordable or unavailable. Other stones not included in Table 1 were sometimes used for small vessels and figurines, including agate, amazonite, amethyst, fluorite, hematite, jasper, lapis lazuli, obsidian, rock crystal, and silicified wood. These, however, are normally thought of as gemstones and are discussed in Harrell (2012b). Some applications in Table 2 derive more from a stone's non-visual attributes. For example, granite (var. 1), granodiorite (var. 1), and silicified sandstone were widely employed for door lintels, jambs, and especially thresholds because of their great durability, and in these applications they may be viewed more as building than ornamental stones. Although silicified sandstone is one of the ornamental stones, it was also widely employed in utilitarian applications, especially for grinding stones (see Harrell 2012c). The most heavily utilized ornamental stones of the Dynastic Period are sometimes given the sobriquet "monumental" (as in, for example, Aswan's "monumental granite") because of their widespread use in temples and for colossal statues and obelisks.

Dozens of ornamental stones from around the Mediterranean region were imported into Egypt during the Roman Period and used for statuary and especially architectural elements in villas, temples, and public buildings. Much of this material has been reused in Egypt's medieval mosques and other Islamic monuments, where it was employed for floor tiles, wall veneer, columns, and other decorative applications (Rogers 1976; Harrell 2004b; Harrell et al. 2002b). Some of it has also been reused in Coptic Christian churches. The imported stones are much less evident in Egypt's heavily plundered, Roman-era archaeological sites, but among these perhaps the greatest quantity and variety of such stones is seen in Alexandria's Kom el-Dikka.

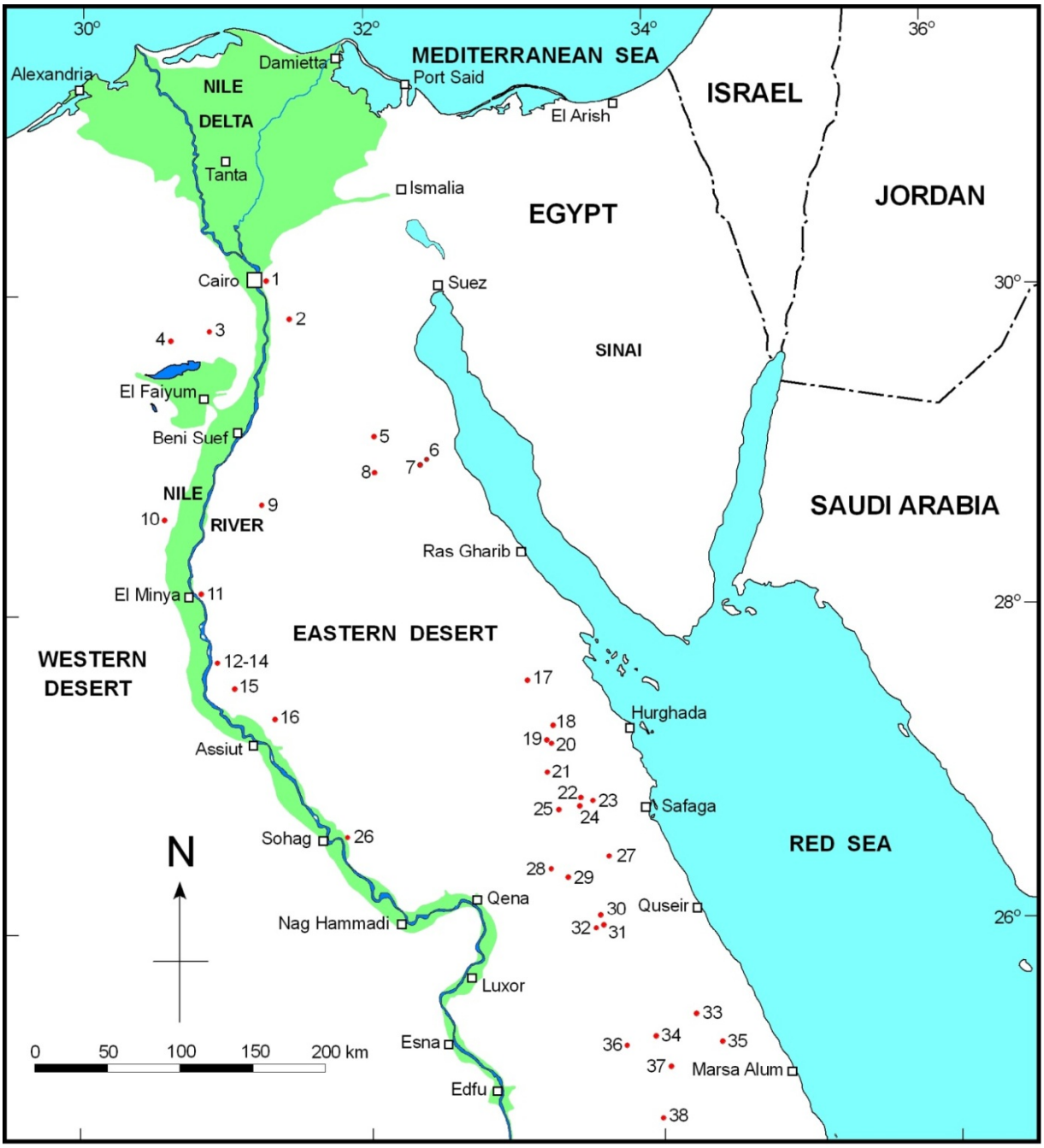


Figure 1. Map of ancient ornamental-stone quarries in northern and central Egypt (numbered).

1 Gebel el-Ahmar
2 Wadi el-Garawi
3 Umm el-Sawan
4 Gebel el-Qatrani
5 Wadi Araba
6 Wadi Umm Zanatir
7 Wadi Abu Mu'aymil
8 Wadi Umm Damarana
9 Wadi Umm Argub
10 Tilal Sawda
11 el-Qawatir
12 Wadi el-Barshawi
13 Wadi el-Zebeida
14 N. Tombs Amarna
15 Hatnub
16 Wadi Assiut
17 Gebel Manzal el-Seyl
18 Mons Porphyrites
19 Wadi Umm Towat
20 Wadi Umm Balad
21 Wadi Umm Shegilat
22 Mons Claudianus
23 Wadi Barud
24 Wadi Umm Huyut
25 Wadi Fatiri el-Bayda
26 Wadi Abu Gelbana
27 Wadi Umm Wikala
28 Wadi Abu Gerida
29 Wadi Maghrabiya
30 Wadi Umm Esh
31 Bir Umm Fawakhir
32 Wadi Hammamat
33 Gebel Umm Naqqat
34 Gebel Rokham
35 Wadi Mubarak
36 Wadi Abu Bokari
37 Gebel Rod el-Barram
38 Rod el-Gamra

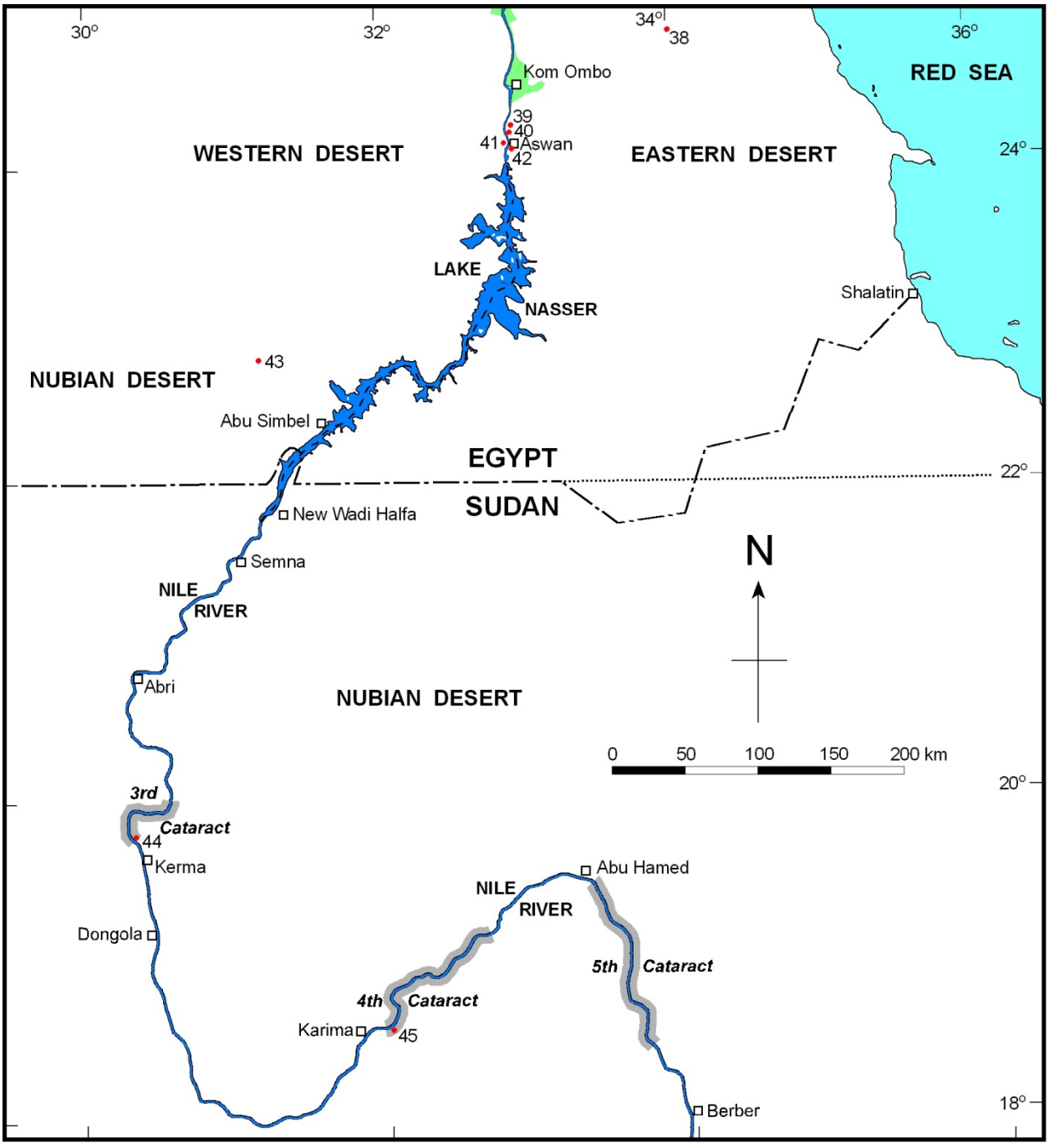


Figure 2. Map of ancient ornamental-stone quarries (numbered) in southern Egypt and northern Sudan (Nubia).

39 Wadi Abu Subeira
40 Wadi Abu Aggag
41 Gebel Gulab and Gebel Tingar
42 Aswan
43 "Chephren's Quarry"
44 Tumbos
45 Daygah

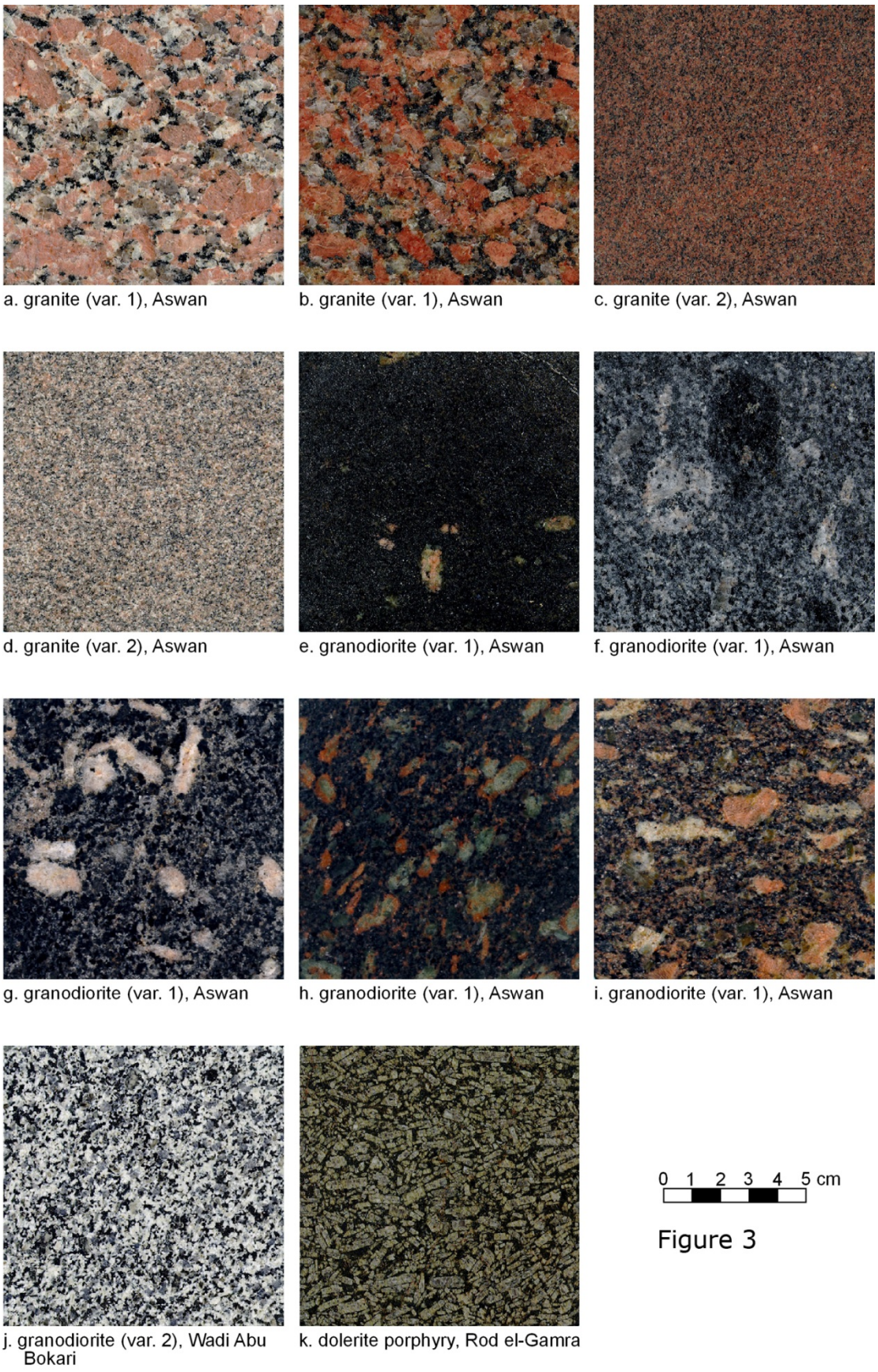
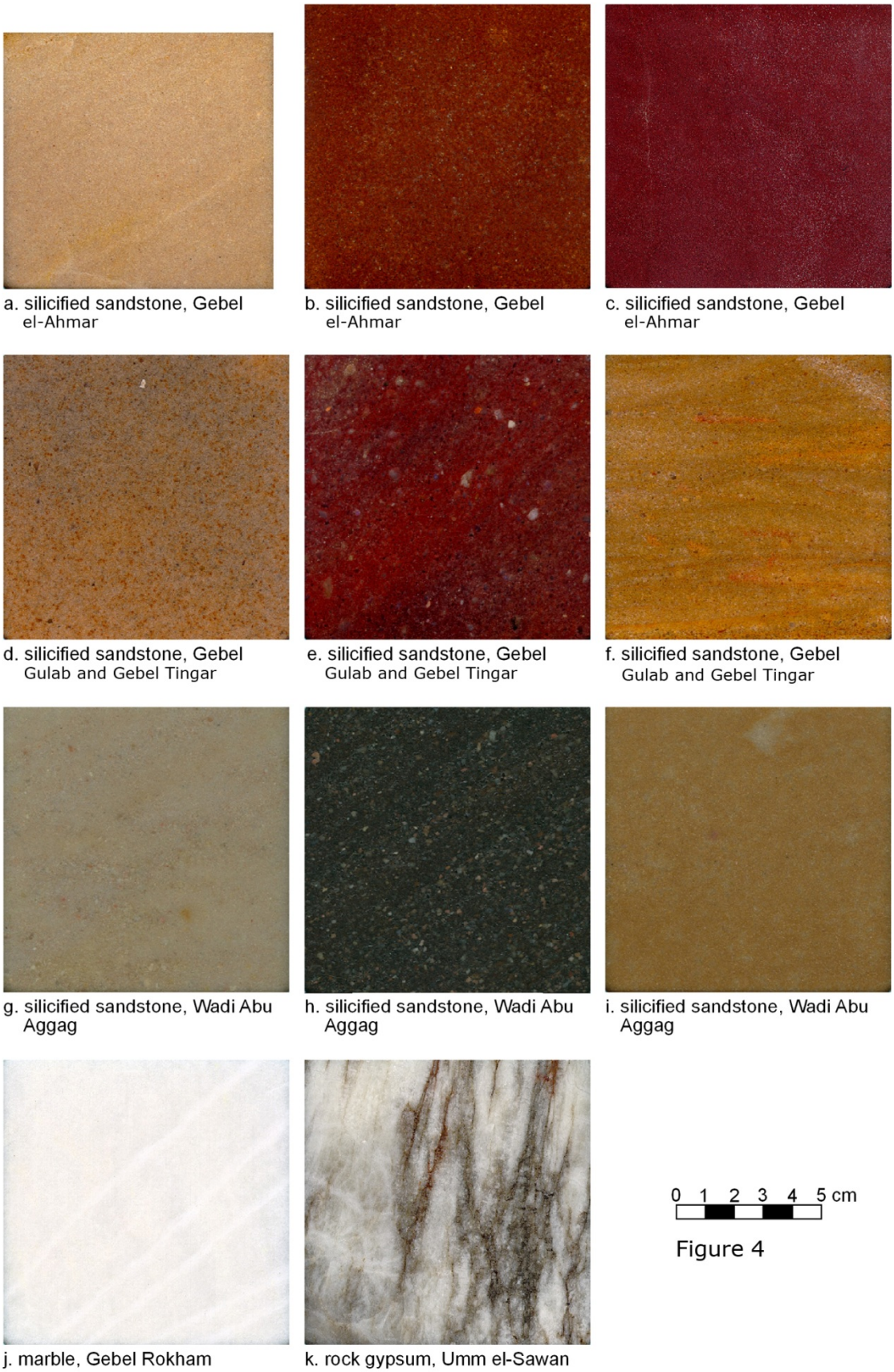

a. granite (var. 1), Aswan
b. granite (var. 1), Aswan
c. granite (var. 2), Aswan
d. granite (var. 2), Aswan
e. granodiorite (var. 1), Aswan
f. granodiorite (var. 1), Aswan
g. granodiorite (var. 1), Aswan
h. granodiorite (var. 1), Aswan
i. granodiorite (var. 1), Aswan
j. granodiorite (var. 2), Wadi Abu Bokari
k. dolerite porphyry, Rod el-Gamra
0 1 2 3 4 5 cm

Figure 3



a. silicified sandstone, Gebel el-Ahmar

b. silicified sandstone, Gebel el-Ahmar

c. silicified sandstone, Gebel el-Ahmar

d. silicified sandstone, Gebel Gulab and Gebel Tingar

e. silicified sandstone, Gebel Gulab and Gebel Tingar

f. silicified sandstone, Gebel Gulab and Gebel Tingar

g. silicified sandstone, Wadi Abu Aggag

h. silicified sandstone, Wadi Abu Aggag

i. silicified sandstone, Wadi Abu Aggag

j. marble, Gebel Rokham

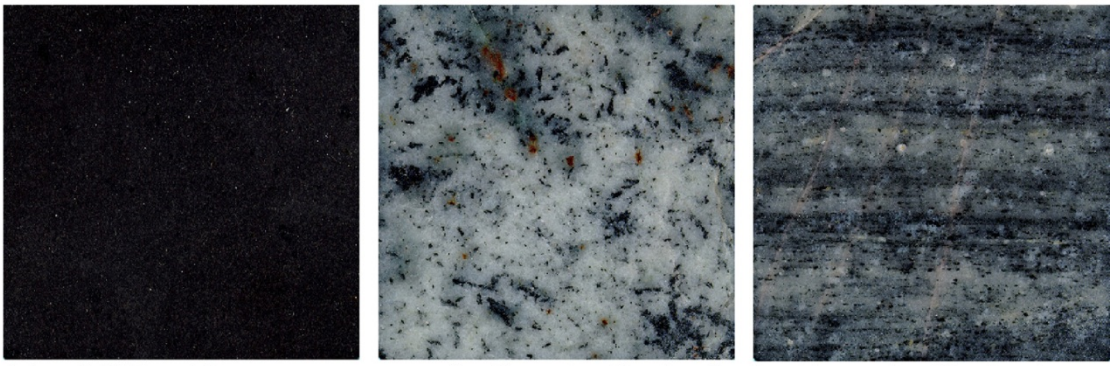
k. rock gypsum, Umm el-Sawan

Figure 4

a. granodioriote-granite gneiss (var. 1), Tumbos

b. granite (var. 3), Tumbos

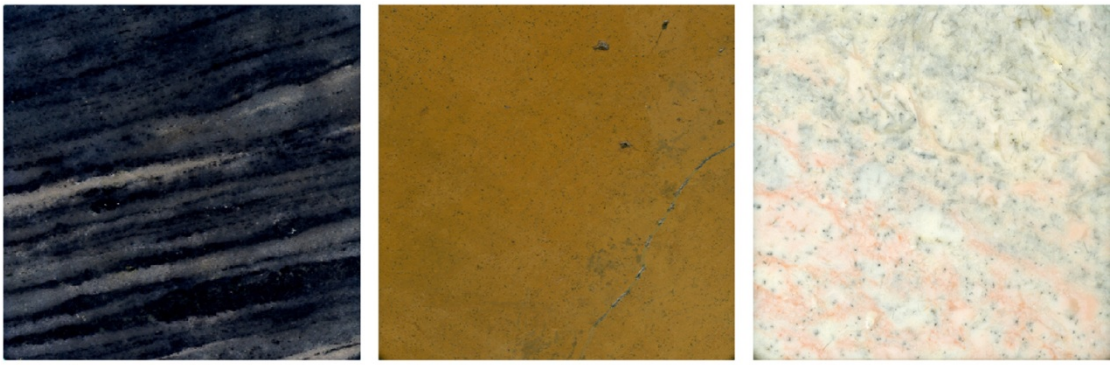
c. granodioriote-granite gneiss (var. 2), Daygah



d. basalt, Widan el-Faras

e. anorthosite gneiss, Chephren's Quarry near Gebel el-Asr

f. gabbro gneiss, Chephren's Quarry near Gebel el-Asr



g. gabbro gneiss, Chephren's Quarry near Gebel el-Asr

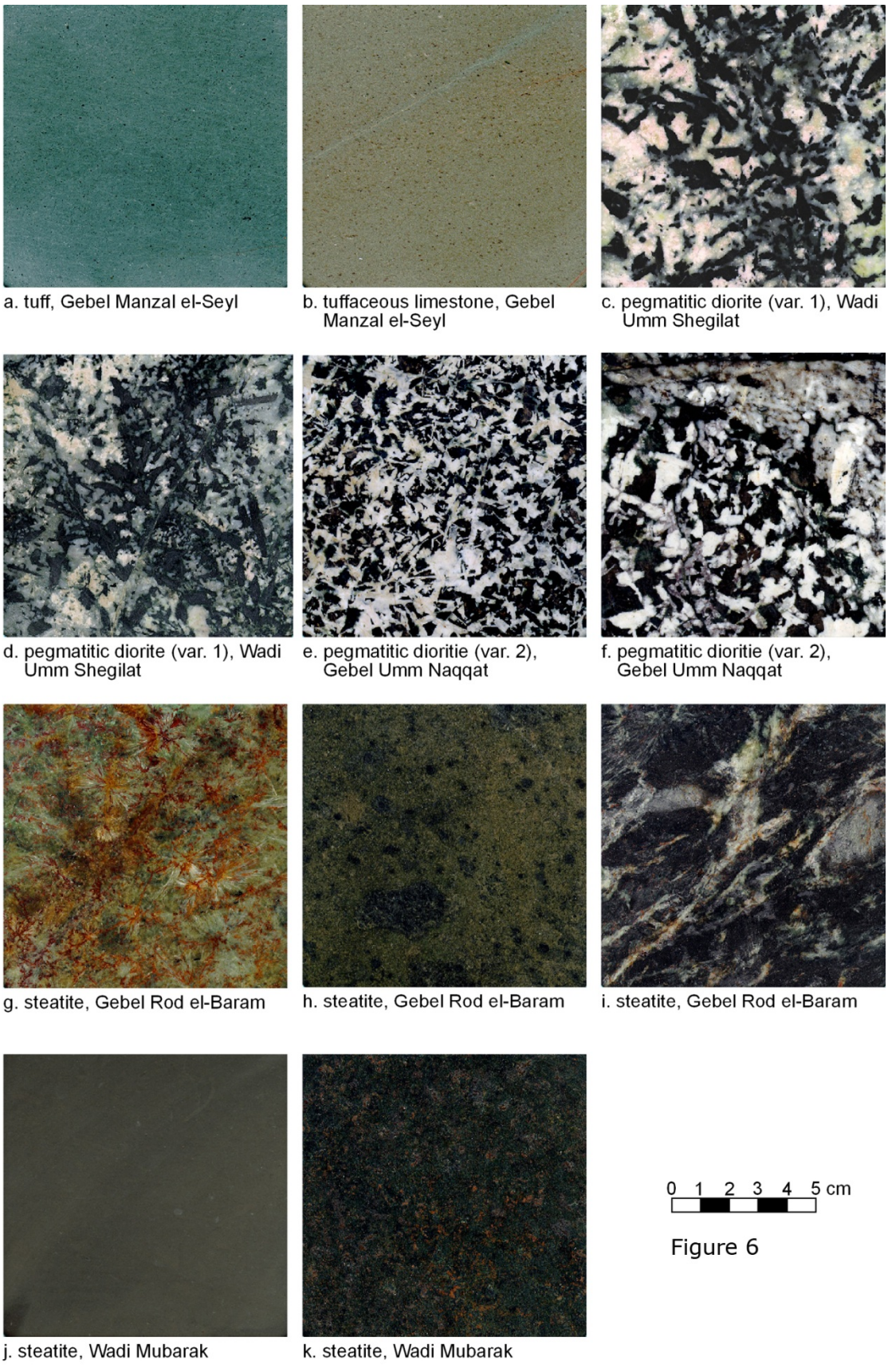
h. dolostone (var. 2), Wadi Umm Zanatir

i. recrystallized limestone (var. 2), Wadi Umm Damarana

j. bituminous limestone (var. 2), Wadi Abu Mu'aymil

k. bituminous limestone (var. 2), Wadi Abu Mu'aymil

Figure 5



a. tuff, Gebel Manzal el-Seyl

b. tuffaceous limestone, Gebel Manzal el-Seyl

c. pegmatitic diorite (var. 1), Wadi Umm Shegilat

d. pegmatitic diorite (var. 1), Wadi Umm Shegilat

e. pegmatitic dioritie (var. 2), Gebel Umm Naqqat

f. pegmatitic dioritie (var. 2), Gebel Umm Naqqat

g. steatite, Gebel Rod el-Baram

h. steatite, Gebel Rod el-Baram

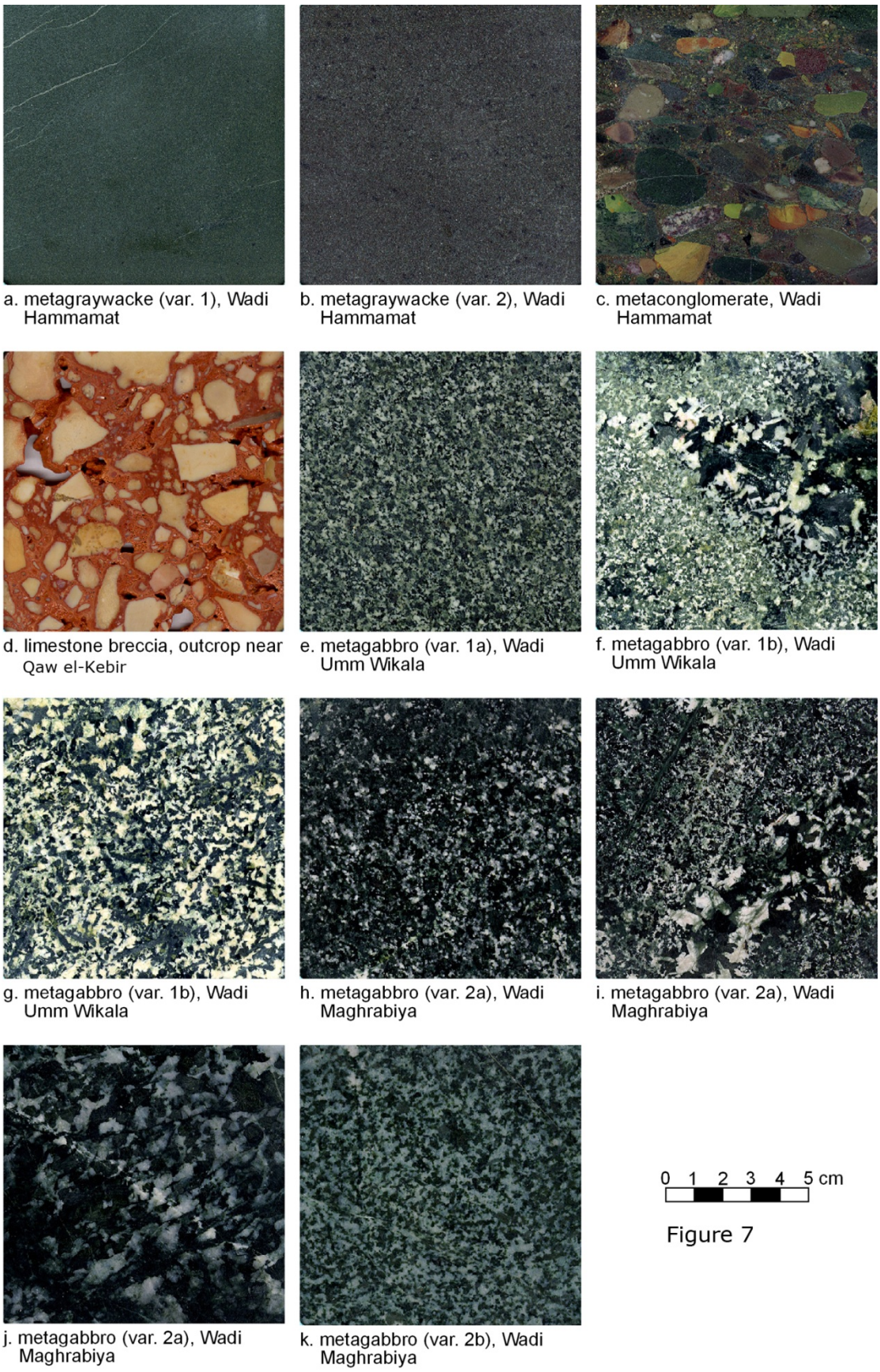
i. steatite, Gebel Rod el-Baram

j. steatite, Wadi Mubarak

k. steatite, Wadi Mubarak

0 1 2 3 4 5 cm

Figure 6



a. metagraywacke (var. 1), Wadi Hammamat

b. metagraywacke (var. 2), Wadi Hammamat

c. metaconglomerate, Wadi Hammamat

d. limestone breccia, outcrop near Qaw el-Kebir

e. metagabbro (var. 1a), Wadi Umm Wikala

f. metagabbro (var. 1b), Wadi Umm Wikala

g. metagabbro (var. 1b), Wadi Umm Wikala

h. metagabbro (var. 2a), Wadi Maghrabiya

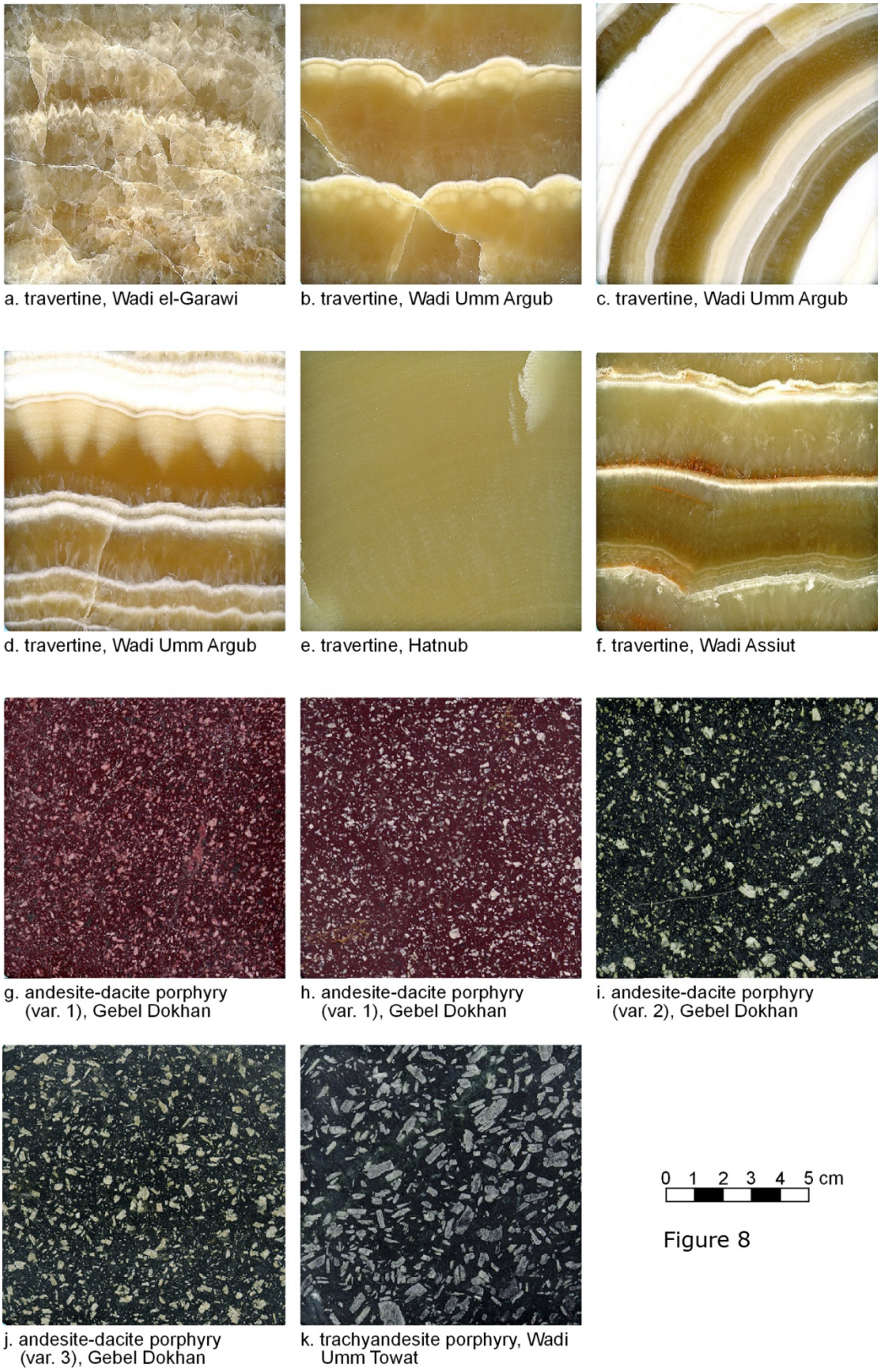
i. metagabbro (var. 2a), Wadi Maghrabiya

j. metagabbro (var. 2a), Wadi Maghrabiya

k. metagabbro (var. 2b), Wadi Maghrabiya

0 1 2 3 4 5 cm

Figure 7



a. travertine, Wadi el-Garawi
b. travertine, Wadi Umm Argub
c. travertine, Wadi Umm Argub
d. travertine, Wadi Umm Argub
e. travertine, Hatnub
f. travertine, Wadi Assiut
g. andesite-dacite porphyry (var. 1), Gebel Dokhan
h. andesite-dacite porphyry (var. 1), Gebel Dokhan
i. andesite-dacite porphyry (var. 2), Gebel Dokhan
j. andesite-dacite porphyry (var. 3), Gebel Dokhan
k. trachyandesite porphyry, Wadi Umm Towat
0 1 2 3 4 5 cm

Figure 8

a. serpentinite (var. 2), Wadi Umm Esh

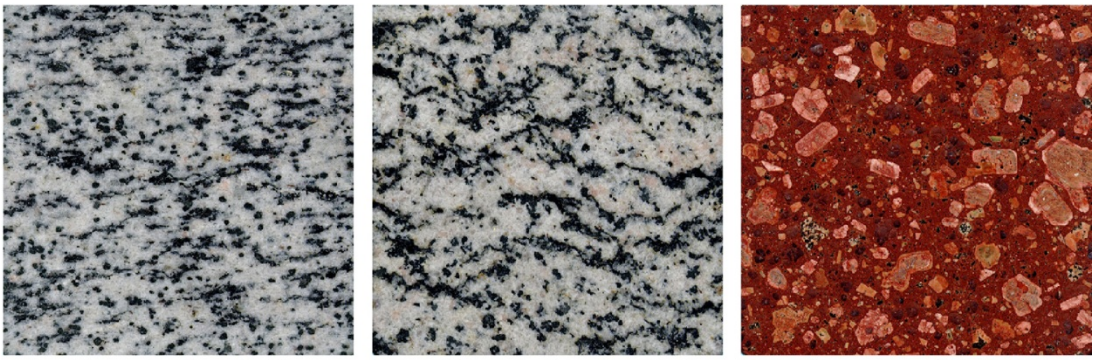
b. quartz diorite (var. 1), Wadi Umm Balad

c. quartz diorite (var. 2a), Wadi Barud

d. quartz diorite (var. 2b), Wadi Barud

e. quartz diorite (var. 3), Wadi Fatiri el-Bayda

f. tonalite gneiss (var. 1), Mons Claudianus



g. tonalite gneiss (var. 1), Mons Claudianus

h. tonalite gneiss (var. 2), Wadi Umm Huyut

i. rhyolite porphyry, Wadi Abu Gerida

j. rhyolite porphyry, Wadi Abu Gerida

k. granodiorite (var. 3), Bir Umm Fawakhir

Figure 9

From the Predynastic through Ptolemaic Periods, most of the ornamental stones, in terms of volume, were quarried in the Aswan region (vars. 1-2 granite, var. 1 granodiorite and silicified sandstone). The rest of the stones came from Cairo's Gebel el-Ahmar (silicified sandstone), the Western Desert's Fayum (basalt and rock gypsum) and Gebel el-Asr area (anorthosite gneiss and gabbro gneiss), and the Eastern Desert's limestone plateau (travertine) and Red Sea Hills (var. 1 andesite-dacite porphyry, dolerite porphyry, var. 2 granodiorite, marble, metagraywacke, metaconglomerate, vars. 1-2 pegmatitic diorite, var. 2 serpentinite, steatite, tuff, and tuffaceous limestone). Quarries are known for all of these stones, and they are identified in Table 1 and shown in Figure 1. Most of the other stones listed in the table for which quarries have not been found almost certainly come from the Sinai or, more likely, the Eastern Desert, including vars. 1-2 andesite porphyry, var. 1 dolostone, buff limestone, limestone breccia, var. 1 recrystallized limestone, rock anhydrite, and var. 1 serpentinite. The source of the var. 1 bituminous limestone is perhaps to be found in the Helwan-Saqqara region, where such rocks have been reported in geological surveys. Two known quarries in northern Sudan's Third and Fourth Nile Cataracts for the var. 3 granite and vars. 1-2 granodiorite-granite gneiss were primarily sources of stone for the Napatan and later Meroitic kingdoms, but they were also employed for royal statues and stelae of Egypt's 25th Dynasty and, in the case of the var. 1 granodiorite-granite gneiss at Tumbos, an 18th Dynasty stela (Harrell 1999 a and b). Peridotite was used for a few 18th Dynasty royal statues found at sites in northern Sudan, and its quarry is perhaps north of the Third Cataract, where outcrops of this rock occur. Many of the Dynastic quarries for ornamental stones continued to be worked during the Roman Period, but most of the activity at this time involved new quarries producing a wide variety of colorful rocks in the Red Sea Hills (vars. 1-3 andesite-dacite porphyry, var. 2 dolostone, var. 2 bituminous limestone, var. 2 recrystallized limestone, var. 3 granodiorite, vars. 1-2 metagabbro, vars. 1-3 quartz diorite, rhyolite porphyry, var. 2 serpentinite, vars. 1-2 tonalite gneiss, and trachyandesite porphyry).

Table 2. Principal Uses of Egyptian Ornamental Stones

Exterior veneer on pyramids and mastabas: Old Kingdom—granite (var. 1) and granodiorite (var. 1).
Pyramid capstones (pyramidions): Old and Middle Kingdoms—granodiorite (var. 1) and possibly basalt.
Linings of burial chambers and passages, and false doors in pyramids and mastabas: Early Dynastic Period to Middle Kingdom—granite (var. 1), granodiorite (var. 1), and silicified sandstone.
Door lintels, jambs, and thresholds of temples: Early Dynastic to Roman Periods—granite (var. 1), granodiorite (var. 1), and silicified sandstone.
Temple columns: Old and Middle Kingdoms—granite (var. 1).
Temple pavements: Old Kingdom—basalt, bituminous limestone (var. 1), and travertine.

Temple walls:
Old Kingdom—basalt, bituminous limestone (var. 1), granite (var. 1), and granodiorite (var. 1).

Interior wall veneer, pavement, columns, and other architectural elements for temples and other buildings:
Ptolemaic Period—granodiorite (var. 2); Roman Period—andesite-dacite porphyry (vars. 1-3), granite (var. 1), granodiorite (vars. 1-3), metaconglomerate, metagabbro (vars. 1-2), metagraywacke (vars. 1-2), pegmatitic diorite (vars. 1-2), quartz diorite (vars. 1-3), rhyolite porphyry, tonalite gneiss (vars. 1-2), and trachyandesite porphyry.

Basins:
Roman Period—granite (var. 1), andesite-dacite porphyry (var. 1), and tonalite gneiss (vars. 1-2).

Barque shrines:
Middle and New Kingdoms—granite (var. 1), silicified sandstone, and travertine.

Statue shrines (*naoi*):
Old Kingdom to Roman Period—granite (var. 1), granodiorite (var. 1), metagraywacke (var. 1), and silicified sandstone; Middle Kingdom—travertine; Late Period—dolerite porphyry; Roman Period—metagraywacke (var. 2).

Obelisks:
New Kingdom—metagraywacke (var. 1) and silicified sandstone. New Kingdom and Roman Period—granite (var. 1).

Offering tables:
Old Kingdom to Roman Period—granite (var. 1), granodiorite (var. 1), metagraywacke (var. 1), silicified sandstone, and travertine.

Vessels and figurines:
Predynastic Period to Old Kingdom and occasionally later—andesite porphyry (vars. 1-2), anorthosite gneiss, gabbro gneiss, basalt, granite (var. 1), metaconglomerate, metagraywacke (var. 3), pegmatitic diorite (vars. 1-2), bituminous limestone (var. 1), buff limestone, limestone breccia, dolostone (var. 1), rock gypsum, serpentinite (vars. 1-2), travertine, tuff, and tuffaceous limestone; Early Dynastic Period to Old Kingdom—recrystallized limestone (var. 1); Middle Kingdom and Second Intermediate Period—rock anhydrite.

Canopic jars:
Old Kingdom to Roman Period—travertine.

Sarcophagi:
Old to New Kingdoms—travertine; Old Kingdom and Late to Ptolemaic Periods—basalt; Old Kingdom to Roman Period—granite (var. 1), granodiorite (var. 1), metagraywacke (var. 1), and silicified sandstone; New Kingdom to Late Period—metaconglomerate; Roman Period—metagraywacke (var. 2).

Sarcophagus plinths:
New Kingdom—travertine.

Embalming tables:
Late Period—travertine.

Small to colossal statues and other sculptures:
Early Dynastic to Roman Periods—granite (var. 1), granodiorite (var. 1), metagraywacke (var. 1), limestone breccia, silicified sandstone, and travertine; Old and Middle Kingdoms—anorthosite gneiss and gabbro gneiss; Old to New Kingdoms—buff limestone; New Kingdom—granite (var. 2; also sometimes as a vein in variety 1 granodiorite, especially in the crown or head portion of a statue), marble, and peridotite; New Kingdom to Roman Period—granodiorite-granite gneiss (var. 1); Late Period—dolerite porphyry; Late to Roman Periods—basalt, granite (var. 3), granodiorite-granite gneiss (var. 2), and metaconglomerate; Roman Period—andesite-dacite porphyry (vars. 1-3), granite (var. 2), and metagraywacke (var. 2) .

Scarab and shabti figures:
New Kingdom to Roman Period—metagraywacke (var. 1), serpentinite (vars. 1-2), steatite, and travertine.

Stelae:
Old Kingdom to Roman Period—granite (var. 1), granodiorite (var. 1), metagraywacke (var. 1), and silicified sandstone; Late Period—granodiorite-granite gneiss (vars. 1-2) and metaconglomerate; Roman Period—granite (var. 2) and metagraywacke (var. 2).

Cosmetic and ceremonial palettes:
Predynastic to Early Dynastic Periods—metagraywacke (vars. 1-3).

Headrests:
Old to New Kingdoms—travertine.

Ceremonial maceheads:
Predynastic to Early Dynastic Periods—andesite porphyry (vars. 1-2), granite (var. 1), granodiorite (var. 1), limestone breccia, metagraywacke (vars. 1, 3), pegmatitic diorite (vars. 1-2), recrystallized limestone (var. 1), travertine, and occasionally other stones.

a. andesite porphyry (var. 1) jar, Early Dynastic period (provenance unknown; in Toledo Museum of Art 1993.48). Height: 17.9 cm.

b. andesite porphyry (var. 2) jar, Early Dynastic (Naqada II) period (from Abydos ?, Egypt; Brooklyn Museum of Art 09.889.11). Height: 8.1 cm.

c. peridotite head of Queen Tiy, Dynasty 18 (probably from Sedeinga, Sudan; Boston Museum of Fine Arts 21.2802). Height: 20.3 cm.

d. serpentinite (var. 1) shabti of Amenhotep II, Dynasty 18 (from Valley of the Kings, tomb 35, Egypt; British Museum EA 35365). Height: 29 cm.

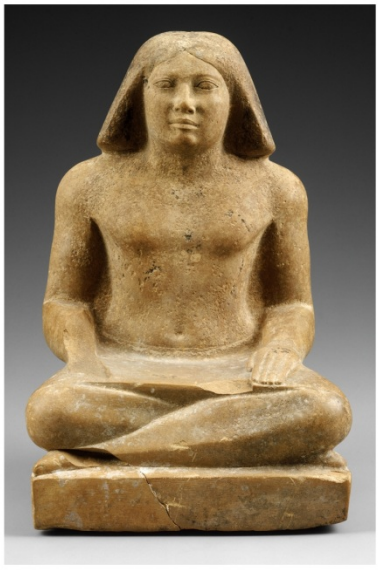
Figure 10. Objects made from andesite porphyry (vars. 1-2; a-b), peridotite (c), and serpentinite (var. 1; d), which have no known quarries.

a. dolostone (var. 1) jar with gold lid, Dynasty 2 (from Abydos, Egypt, tomb of Khasekhem; British Museum EA 35568). Height: 5.7 cm.

b. recrystallized limestone (var. 1) jar, Dynasty 1 or 2 (from Abydos, Egypt, cemetery G. 1900; Boston Museum of Fine Arts 00.686). Height: 8.4 cm.

c. bituminous limestone (var. 1) used in a wall in the pyramid temple of Pepy I, Dynasty 6, at Saqqara, Egypt.

d. rock anhydrite kohl jar and lid, Dynasty 12 or 13 (provenance unknown; Brooklyn Museum of Art 58.78.1a-b). Height: 7.8 cm.



e. buff limestone statue of Prince Khuenre, Dynasty 4 (from Giza, Egypt, Menkaure Cemetery MQ 1; Boston Museum of Fine Arts 13.3140). Height: 30.5 cm.

Figure 11. Objects made from dolostone (var. 1; a), recrystallized limestone (var. 1; b), bituminous limestone (var. 1; c), rock anhydrite (d), and buff limestone (e), which have no known quarries.

Quarrying, Carving, and Transport

The quarrying of ornamental stones was usually done in surface pits and trenches, and occasionally on loose boulders. In addition to such open-cut workings, some travertine quarries went underground and formed cave-like galleries. From Predynastic times into the Late Period, quarrying of hard stones (all igneous and most metamorphic rocks plus silicified sandstone) was done with stone tools (Arnold 1991: 36 - 40, 258 - 264; Harrell 2012c). These tools, known as pounders or mauls, were hand-held, purpose-shaped pieces of exceptionally hard, tough rock, of which dolerite was the most popular variety (Kelany et al. 2010). The pounders were used to knock off corners and edges of bedrock outcrops when only relatively small pieces were required, to hack out trenches and undercuts to isolate larger blocks from the bedrock, or to reduce and reshape loose boulders resting on the bedrock. Fire-setting was occasionally employed during the Dynastic Period to either induce fracturing in hardstones or weaken their surfaces prior to pounding with a stone tool. Where the ancient quarrymen could exploit natural fractures in the bedrock, metal gads and also possibly wedge-shaped rock splinters were hammered into the fractures to widen them. Stout wooden poles used as levers would have been employed to help detach blocks along fractures or cut trenches.

Stone pounders are known to have been used for rock gypsum and travertine, and probably were used for some of the other softer ornamental stones (i.e., colored limestones, marble, rock anhydrite, and steatite). All of these would also have been worked at times with the same metal tools employed for the similarly soft building stones (limestone and sandstone). Throughout the Dynastic Period until near the end of the Late Period, these tools were copper and later bronze chisels (Arnold 1991: 27-36, 257-259; Aston et al. 2000: 7). Chert or flint (microcrystalline quartz) picks were probably also sometimes used. Although copper and the harder bronze were tough enough to work the softer stones, these tools were quickly blunted and abraded in the process. They were entirely unsuited for quarrying hardstones, and for these the stone tools were far superior.

Certainly by the 30th Dynasty of the Late Period but possibly as early as the 26th Dynasty, the Egyptians used "iron" (actually low-grade steel) tools for quarrying, including hammers, chisels, picks, and wedges (Harrell and Brown 1999: 19 - 20; Harrell et al. 2002a: 211; Harrell 2009: 179, 181). When extracting blocks from bedrock or boulders, a line of wedge-shaped holes was first chiseled into the surface. Iron wedges were then inserted into the holes and these were hammered until the rock split along the line of holes. Thin pieces of iron called "feathers" may have been placed on each side of the wedges to increase the lateral, expansive force of the hammer blows. The iron-wedge technology improved through the Ptolemaic Period and reached its zenith in Roman times with little change to the present day. A fiction often repeated in the popular archaeological literature is that the wedge holes were cut for wood wedges which, when wetted, would expand and so split the rock. In reality, this cannot work for the sizes and shapes, spacings, and often inclined orientations of wedge holes found in ancient hardstone quarries. Another quarrying technology that became commonplace in Egypt beginning in the Ptolemaic Period is the "pointillé" technique, which is still in use today. This technique, like the use of iron wedges, is conventionally thought to have originated in the Greek Aegean region during the sixth century BCE (Vandeput 1987 – 1988: 94; Waelkens et al. 1990: 63 - 64), but there is new evidence in Wadi Hammamat's metagraywacke quarry suggesting it was employed there as early as the Predynastic or Early Dynastic Periods (Harrell and Bloxam 2012). Whereas wedging is useful for rough splitting, lines of pointillé pits are employed for more precise, controlled separation. In this method, a straight line of small, shallow, closely spaced pits is chiseled across a rock surface. The quarryman then hammers a chisel back and forth along the line of pits until the rock splits. In the case of the early Wadi Hammamat workings, the chisel was apparently fashioned from metagraywacke. Fire-setting and levers continued to be used, but the levers were probably of iron as well as wood.

The extracted rock masses were dressed (trimmed) in the quarries with the same tools used to remove them. A new stone-dressing technology was introduced by the Romans in the Wadi Umm Shegilat quarry for pegmatitic diorite (var. 1). Here they used a toothless iron saw blade along with the locally available quartz sand as the abrasive to cut

the sides of rectangular blocks and the ends of column drums (Harrell and Brown 2002). Surprisingly, there is no evidence that this technology was employed in any other Roman quarry except for one at Felsberg in Germany. During all periods of Egyptian history, the quarry products were usually roughed out to something approaching their final form on site, and occasionally were carved to a nearly finished state. This not only reduced the weight of stone requiring transport, but also had the benefit of revealing any unacceptable flaws in the stone prior to its removal from the quarry.

Once the stone was taken to a Nile Valley workshop or construction site, it underwent additional dressing and carving followed by polishing. The same cutting tools used for quarrying were brought to bear, but in the Dynastic Period, especially during the Old Kingdom, copper or bronze saws and tube drills were also used. Quartz sand served as the abrasive for the softer copper and bronze tools, as it did later for the iron saws of the Romans. The principal application of the earlier saws was for cutting basalt paving stones in several of the Old Kingdom pyramid temples, with saw marks also seen on some of the hardstone sarcophagi of this period (Arnold 1991: 266 - 267; Moores 1991). The tube drills were used to cut recesses within blocks, including hollow interiors, sunken relief scenes, and hieroglyphic texts (Arnold 1991: 265 - 260; Stocks 2003: 101 - 178). Chert drill bits have been found in association with drilled rock gypsum (Heldal et al. 2009a: 54, 59) and the much harder metagraywacke (Debono 1951: 75 - 78), and were surely used to drill other ornamental stones as suggested by the fact that hieroglyphs showing a hand drill with a stone bit (signs U24 and U25) were ideograms for "craft" (Gardiner 1976: 519). The effectiveness of chert tools (chisels, gravers, and especially drill bits) on granite has been experimentally demonstrated by Gorelick and Gwinnett (1990) and Stocks (2003: 74 - 99). Polishing was the final step in preparing an object carved from ornamental stone. Hand-held pieces of silicified sandstone ("rubbing stones") are known to have been used for rough smoothing, but a fine-grained quartz sand paste applied with a piece of cloth or leather was almost certainly employed to produce the highly polished surfaces.

During the Dynastic Period, quarried pieces of stone too large to be carried on the backs of men or animals (mainly donkeys but also camels from perhaps the Late Period onward) would have been placed on wooden sledges, which were pulled by teams of either draft animals or men (Arnold 1991: 276 - 280). Friction between the sledge and ground was sometimes reduced, as depicted in numerous tomb scenes, by pouring water on the ground in front of the sledge, but this would only work if the surface material had abundant hydrophilic clay. It is not clear what, if any, aids were used when sledges were pulled over sandy or rocky ground. Lehner (1985: 123 - 124, 132 - 133) suggests that clay-rich material or "tafla" (either Nile mud or sedimentary shale) was applied to the surface of 4th-Dynasty construction roads and ramps at Giza, and it is known that closely spaced wood beams were laid crosswise on the 12th Dynasty construction roads at el-Lisht and el-Lahun (Arnold 1991: 85 - 92). It is conceivable that such friction-reducing practices were used for sledges brought from quarries near the Nile Valley. It has also been suggested that sledges were sometimes pulled over wooden rollers, although this is unlikely as these would only be effective on ground that was hard, smooth, and relatively flat. Such ground conditions may have existed within some quarries and construction sites, but in most cases the sledges traveled over uneven rocky or soft sandy ground where the rollers would be ineffective. The best-attested means of preparing ground surfaces for sledges was the construction of quarry roads. Some were paved with a single course of dry-laid, unshaped, and loosely fitted pieces of locally available rocks, the most notable being the 12 km-long road leading from the Old Kingdom basalt quarry at Widan el-Faras in the Fayum (Harrell and Bown 1995). A 20 km-long network of paved and partially cleared roads of New Kingdom and Roman date is found in the silicified sandstone quarries near Aswan at Gebel Gulab and Gebel Tingar (Klemm et al. 1984, Heldal 2009: 142 - 144; and Storemyr et al. forthcoming). Most of the Dynastic quarry roads were unpaved and consisted only of cleared tracks, where the coarser surface gravel was swept to the sides. Where these roads crossed steep declines or surface dips, their bases were built up (and often supported by stone revetments) to reduce and even out the gradients. An outstanding example of this kind of road leads

from the travertine quarry at Hatnub to the Nile River near the modern village of el-Amarna (Shaw 2010: 109 - 124).

Although the Egyptians knew of the wheel from the earliest Dynastic times, they had no wheeled wagons until the early New Kingdom. It is not known if these were ever used to transport quarried stone, but it is unlikely because, without relatively broad roadways with firm, flat surfaces, the heavily laden wagons would either get stuck in the sand or break their wheels on the rocks. In Roman times, however, and possibly as early as the Ptolemaic Period, wagons pulled by draft animals were the primary means of land transport for quarried stone and other materials, and this method was made practical by an extensive, well-built network of roads (cleared, unpaved tracks) linking the Eastern Desert quarries with the Nile Valley (Murray 1925; Adams 2001).

Bibliographic Notes

The most comprehensive treatments on ancient Egyptian stones and quarries are Aston et al. (2000) and Harrell and Storemyr (2009), the former reference replacing the still useful Lucas (1962). DePutter and Karlshausen (1992) provides numerous examples of objects made from specific Egyptian stones, along with good color photographs. Aston (1994) and Bevan (2007) are the most authoritative sources on stone vessels, and Klemm and Klemm (2008), a revised English edition of Klemm and Klemm (1993), provides detailed descriptions of many of the stone quarries. Arnold (1991) is the primary reference on Egyptian quarrying and stoneworking technologies as well as the use of ornamental (and building) stones in monumental architecture, and Stocks (2003) provides important insights into Egyptian stoneworking technology based on experiments. Borghini (1989) and Price (2007) provide the best summaries, with excellent color photographs, of Roman ornamental stones, including those from Egypt. The source for the images in Figures 3 through 9 is the author's website, http://www.eeescience.utoledo.edu/egypt/, which includes additional examples of ornamental and other stone varieties from Egyptian quarries. All images on this website come with standard color guides for color corrections when viewing or printing. Studies of specific Dynastic quarries or their ornamental stones are provided by Harrell and Brown (1994), Harrell and Bown (1995), Brown and Harrell (1998), Harrell and Brown (1999), Harrell et al. (2000), Bloxam and Storemyr (2002), Harrell (2002), Harrell and Brown (2002), Storemyr et al. (2002), Harrell (2004a), Bloxam and Storemyr (2005), Heldal et al. (2005), Harrell and Madbouly (2006), Harrell et al. (2007), Harrell and Brown (2008), Bloxam et al. (2009), Harrell (2009), Heldal (2009), Heldal et al. (2009a, 2009b), Kelany et al. (2009), Knox et al. (2009), and Storemyr et al. (2009). The Roman quarries are described by Brown and Harrell (1995), Peacock and Maxfield (1997), Harrell et al. (1999), Maxfield and Peacock (2001), Sidebotham et al. (2001), Harrell and Brown (2002), Harrell and Lazzarini (2002), Harrell et al. (2002a), Bagnall and Harrell (2003), Harrell (2005), and Klemm and Klemm (2008: 269 - 314). Related *UEE* articles are Bloxam (2010) on general quarrying and mining, and Harrell (2012 a, b, and c) on building stones, gemstones, and utilitarian stones, respectively.

References

Adams, Colin E. P.
2001 Who bore the burden? The organization of stone transport in Roman Egypt. In *Economies beyond agriculture in the classical world*, ed. David Mattingly and John Salmon, pp. 171 - 192. London: Routledge.

Arnold, Dieter
1991 *Building in Egypt: Pharaonic stone masonry*. Oxford: Oxford University Press.

Aston, Barbara
1994 *Ancient Egyptian stone vessels: Materials and forms*. Studien zur Archäologie und Geschichte Altägyptens 5. Heidelberg: Heidelberger Orientverlag.

Aston, Barbara, James A. Harrell, and Ian Shaw
2000 Stones. In *Ancient Egyptian materials and technology*, ed. Paul T. Nicholson and Ian Shaw, pp. 5 - 77. Cambridge: Cambridge University Press.

Bagnall, Roger, and James A. Harrell
2003 Knekites. *Chronique d'Égypte* 78, pp. 229 - 235.

Bevan, Andrew
2007 *Stone vessels and values in the Bronze Age Mediterranean.* Cambridge: Cambridge University Press.

Bloxam, Elizabeth
2010 Quarrying and mining (stone). In Willeke Wendrich (ed.), *UCLA Encyclopedia of Egyptology*, Los Angeles. http://digital2.library.ucla.edu/viewItem.do?ark=21198/zz0026jkd5

Bloxam, Elizabeth, and Per Storemyr
2002 Old Kingdom basalt quarrying activities at Widan El-Faras, northern Faiyum Desert. *Journal of Egyptian Archaeology* 88, pp. 23 - 36.
2005 Recent investigations in the ancient quarries of Gebel Gulab and Gebel Tingar, Aswan. *Egyptian Archaeology* 26, pp. 37 - 40.

Bloxam, Elizabeth, Per Storemyr, and Tom Heldal
2009 Hard stone quarrying in the Egyptian Old Kingdom (3rd millennium BC): Rethinking the social organisation. In *ASMOSIA VII: Proceedings of the 7th International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Thassos, 15 – 20 September 2003,* Bulletin de Correspondance Hellénique supplement no. 51, ed. Yannis Maniatis, pp. 187 - 201. Athens: École française d'Athènes.

Borghini, Gabriele
1989 *Marmi Antichi.* Rome: Leonardo-De Luca Editori.

Brown, V. Max, and James A. Harrell
1991 Megascopic classification of rocks. *Journal of Geological Education* 39, pp. 379 - 387.
1995 Topographical and petrological survey of ancient Roman quarries in the Eastern Desert of Egypt. In *The study of marble and other stones used in antiquity: ASMOSIA III: Proceedings of the 3rd International Symposium of the Association for the Study of Marble and Other Stones in Antiquity, Paraskevi, May 17 – 19, 1993*, ed. Yannis Maniatis, Norman Herz, and Yannis Basiakos, pp. 221 - 234. London: Archetype Publications.
1998 Aswan granite and granodiorite. *Göttinger Miszellen* 164, pp. 33 - 39.

Debono, Fernand
1951 Expédition archéologique royale au Désert Oriental (Keft-Kosseir): Rapport préliminaire sur la campagne 1949. *Annales du Service des Antiquités de l'Égypte* 51, pp. 59 - 91, pls. 1 - 18.

DePutter, Thierry, and Christina Karlshausen
1992 *Les pierres utilisées dans la sculpture et l'architecture de l'Égypte pharaonique: Guide pratique illustré.* Brussels: Connaissance de l'Égypte Ancienne.

Gardiner, Alan
1976 *Egyptian grammar.* 3rd edition. Oxford: Griffith Institute, Ashmolean Museum.

Gorelick, Leonard, and A. John Gwinnett
1990 Innovative lapidary craft techniques in Neolithic Jarmo. *Archeomaterials* 4, pp. 25 - 32.

Harrell, James A.
1999a Ancient stone quarries at the Third and Fourth Nile Cataracts, northern Sudan. *Sudan and Nubia* 3, pp. 21 - 27.
1999b The Tumbos quarry at the Third Nile Cataract, northern Sudan. In *Recent research in Kushite history and archaeology: Proceedings of the 8th International Conference for Meroitic Studies*, British Museum Occasional Paper No. 131, ed. Derek Welsby, pp. 239 - 250.

2001 Ancient quarries near Amarna. *Egyptian Archaeology* 19, pp. 36 - 38.
2002 Pharaonic stone quarries in the Egyptian deserts. In *Egypt and Nubia: Gifts of the desert*, ed. Renée Friedman, pp. 232 - 243. London: British Museum Press.
2004a A stone vessel quarry at Gebel Umm Naqqat. *Egyptian Archaeology* 24, pp. 34 - 36.
2004b Ornamental stones used in the zawiya/sabil of Farag Ibn Barquq in the Bab Zuwayla area of Cairo. *Bulletin of the American Research Center in Egypt* 185, pp. 18 - 23.
2005 Porfido rosso laterizio and the discovery of its source in Wadi Abu Gerida, Egypt. *Marmora: International Journal for Archaeology, History and Archaeometry of Marbles and Stones* 1, pp. 35 - 46.
2009 The Bokari granodiorite quarry in Egypt's Eastern Desert. In *ASMOSIA VII: Proceedings of the 7th International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Thassos, 15 – 20 September 2003,* Bulletin de Correspondance Hellénique supplement no. 51, ed. Yannis Maniatis, pp. 175-186.
2012a Building stones. In Willeke Wendrich (ed.), *UCLA Encyclopedia of Egyptology*, Los Angeles. http://digital2.library.ucla.edu/viewItem.do?ark=21198/zz002c10gb
2012b Gemstones. In Willeke Wendrich (ed.), *UCLA Encyclopedia of Egyptology*, Los Angeles. http://digital2.library.ucla.edu/viewItem.do?ark=21198/zz002czx1r
2012c Utilitarian stones. In Willeke Wendrich (ed.), *UCLA Encyclopedia of Egyptology*, Los Angeles. http://digital2.library.ucla.edu/viewItem.do?ark=21198/zz002bqsfg

Harrell, James A., and Elizabeth Bloxam
2012 The Wadi Hammamat Quarryscapes Survey. In *Program and abstracts: 63rd Annual Meeting of the American Research Center in Egypt, Providence, Rhode Island, April 27 – 29, 2012*, pp. 42 - 43.

Harrell, James A., and Thomas M. Bown
1995 An Old Kingdom basalt quarry at Widan el-Faras and the quarry road to Lake Moeris in the Faiyum, Egypt. *Journal of the American Research Center in Egypt* 32, pp. 71 - 91.

Harrell, James A., Maarten Broekmans, and Dorothy Godfrey-Smith
2007 The origin, destruction and restoration of colour in Egyptian travertine. *Archaeometry* 49, pp. 421 - 436.

Harrell, James A., and V. Max Brown
1994 Chephren's Quarry in the Nubian Desert of Egypt. *Nubica* 3(1), pp. 43 - 57.
1999 A late-period quarry for naoi in the Eastern Desert. *Egyptian Archaeology* 14, pp. 18 - 20.
2002 Rock sawing at a Roman diorite quarry, Wadi Umm Shegilat, Egypt. In *ASMOSIA 5: Interdisciplinary studies on ancient stone: Proceedings of the Fifth International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Museum of Fine Arts, Boston, June 1998*, ed. John Herrmann, Jr., Norman Herz, and Richard Newman, pp. 52 - 57. London: Archetype Publications.
2008 Discovery of a medieval Islamic industry for steatite cooking vessels in Egypt's Eastern Desert. In *New approaches to old stones: Recent studies of ground stone artifacts*, ed. Yorke Rowan, and Jennie Ebeling, pp. 41 - 65. London: Equinox Archaeology Books.

Harrell, James A., V. Max Brown, and Lorenzo Lazzarini
1999 Two newly discovered Roman quarries in the Eastern Desert of Egypt. In *ASMOSIA IV: Archéomatériaux: Marbres et autre roches: Actes de la IVe Conférence Internationale de l'Association pour l'Étude des Marbres et Autres Roches Utilisés dans le Passé, Bordeaux, 9 – 13 Octobre 1995*, ed. Max Schvoerer, pp. 285 - 292. Bordeaux: Presses Universitaires de Bordeaux.
2002a Breccia verde antica: Source, petrology and ancient uses. In *ASMOSIA VI: Interdisciplinary studies on ancient stone: 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. Lorenzo Lazzarini, pp. 207 - 218. Padua: Bottega d'Erasmo - Aldo Ausilio Editore.

Harrell, James A., V. Max Brown, and Masoud Saleh Masoud
2000 Early Dynastic quarry for stone vessels at Gebel Manzal el-Seyl, Eastern Desert. *Journal of Egyptian Archaeology* 86, pp. 33 - 42 and pls. IV - V.

Harrell, James A., and Lorenzo Lazzarini
2002 A new variety of granito bianco e nero from Wadi Barud, Egypt. In *ASMOSIA 5: Interdisciplinary studies on ancient stone: Proceedings of the Fifth International Conference of the Association for the Study of Marble and Other Stones in*

Antiquity, Museum of Fine Arts, Boston, June 1998, ed. John Herrmann, Jr., Norman Herz, and Richard Newman, pp. 47 - 51. London: Archetype Publications.

Harrell, James A., Lorenzo Lazzarini, and Mathias Bruno
2002b Reuse of Roman ornamental stones in medieval Cairo, Egypt. In *ASMOSIA VI: Interdisciplinary studies on ancient stone: 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. Lorenzo Lazzarini, pp. 89 - 96. Padua: Bottega d'Erasmo - Aldo Ausilio Editore.

Harrell, James A., and Mohamed I. Madbouly
2006 An ancient quarry for siliceous sandstone at Wadi Abu Aggag, Egypt. *Sahara* 17, pp. 51 - 58.

Harrell, James A., and Per Storemyr
2009 Ancient Egyptian quarries: An illustrated overview. In *QuarryScapes: Ancient stone quarry landscapes in the Eastern Mediterranean*, Geological Survey of Norway, Special Publication 12, ed. Nizar Abu-Jaber, Elizabeth Bloxam, Patrick Degryse, and Tom Heldal, pp. 12 - 48.

Harris, John Raymond
1961 *Lexicographical studies in ancient Egyptian minerals*. Berlin: Akademie Verlag.

Heldal, Tom
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*, Geological Survey of Norway, Special Publication 12, ed. Nizar Abu-Jaber, Elizabeth Bloxam, Patrick Degryse, and Tom Heldal, pp. 125 - 153.

Heldal, Tom, Elizabeth Bloxam, Per Storemyr, and Adel 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, pp. 11 - 35.

Heldal, Tom, Elizabeth Bloxam, Patrick Degryse, Per Storemyr, and Adel Kelany
2009a Gypsum quarries in the northern Faiyum quarry landscape, Egypt: A geo-archaeological case study. In *QuarryScapes: Ancient stone quarry landscapes in the Eastern Mediterranean*, Geological Survey of Norway, Special Publication 12, ed. Nizar Abu-Jaber, Elizabeth Bloxam, Patrick Degryse, and Tom Heldal, pp. 51 - 66.

Heldal, Tom, Per Storemyr, Elizabeth Bloxam, Ian Shaw, Richard Lee, and Abdou Salem
2009b GPS and GIS methodology in the mapping of Chephren's quarry, Upper Egypt: A significant tool for documentation and interpretation of the site. In *ASMOSIA VII: Proceedings of the 7th International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Thassos, 15 – 20 September 2003,* Bulletin de Correspondance Hellénique supplement no. 51, ed. Yannis Maniatis, pp. 227 - 241. Athens: École française d'Athènes.

Kelany, Adel, James A. Harrell, and V. Max Brown
2010 Dolerite pounders: Petrology, sources and use. *Lithic Technology* 35(2), pp. 127 - 148.

Kelany, Adel, Mohamed Negem, Adel Tohami, and Tom Heldal
2009 Granite quarry survey in the Aswan region, Egypt: Shedding new light on ancient quarrying. In *QuarryScapes: Ancient stone quarry landscapes in the Eastern Mediterranean*, Geological Survey of Norway, Special Publication 12, ed. Nizar Abu-Jaber, Elizabeth Bloxam, Patrick Degryse, and Tom Heldal, pp. 87 - 98.

Klemm, Dietrich, Rosemarie Klemm, and Livia Steclaci
1984 Die pharaonischen steinbrüche des silifizierten sandsteins in Ägypten und die herkunft der Memnon-Kolosse. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 40, pp. 207 - 220 and pls. 11-12.

Klemm, Rosemarie, and Dietrich Klemm
1993 *Steine und Steinbrüche im alten Ägypten*. Berlin: Springer Verlag.
2008 *Stones and quarries in ancient Egypt*. London: British Museum Press.

Knox, Robert W. O'B., Rainer Stadelmann, James A. Harrell, Tom Heldal, and Hourig Sourouzian
2009 Mineral fingerprinting of Egyptian siliceous sandstones and the quarry source of the Colossi of Memnon. In *QuarryScapes: Ancient stone quarry landscapes in the Eastern Mediterranean*, Geological Survey of Norway, Special Publication 12, ed. Nizar Abu-Jaber, Elizabeth Bloxam, Patrick Degryse, and Tom Heldal, pp. 87 - 98.

Lazzarini, Lorenzo
2004 *Pietre e Marmi Antichi: Natura, Caratterizzazione, Origine, Storia d'Uso, Diffusione, Collezionismo*. Milan: Casa Editrice Dott. Antonio.

Lehner, Mark
1985 The development of the Giza necropolis: The Khufu project. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 41, pp. 109 - 143.

Lucas, Alfred
1962 *Ancient Egyptian materials and industries*. 4th edition, revised by John Raymond Harris. London: Edward Arnold.

Maxfield, Valerie, and David Peacock
2001 *The Roman imperial quarries: Survey and excavation at Mons Porphyrites 1994 – 1998, Volume 1: Topography and quarries*. London: Egypt Exploration Society.

Moores, Robert G., Jr.
1991 Evidence for the use of a stone-cutting drag saw by the Fourth Dynasty Egyptians. *Journal of the American Research Center in Egypt* 28, pp. 139 - 148.

Murray, George William
1925 The Roman roads and stations in the Eastern Desert of Egypt. *Journal of Egyptian Archaeology* 11, pp. 138 - 150.

Peacock, David, and Valerie Maxfield
1997 *Survey and excavations: Mons Claudianus 1987 – 1993: Volume 1: Topography and quarries*. Cairo: Institut français d'archéologie Orientale.

Price, Monica
2007 *The sourcebook of decorative stone: An illustrated identification guide*. Buffalo: Firefly Books.

Rogers, J. Michael
1976 The stones of Barquq: Building materials and architectural decoration in late fourteenth-century Cairo. *Apollo* 170, pp. 307 - 313.

Shaw, Ian
2010 *Hatnub: Quarrying travertine in ancient Egypt*. London: Egypt Exploration Society.

Sidebotham, Steven, Hans Barnard, James A. Harrell, and Roberta Tomber
2001 The Roman quarry and installations in Wadi Umm Wikala and Wadi Semna. *Journal of Egyptian Archaeology* 87, pp. 135 - 170.

Stocks, Denys
2003 *Stoneworking technology in ancient Egypt*. London: Routledge.

Storemyr, Per, Elizabeth Bloxam, Tom Heldal, and Abdou Salem
2002 Survey at Chephren's Quarry, Gebel el-Asr, Lower Nubia 2002. *Sudan and Nubia* 6, p. 25 - 29.

Storemyr, Per, Elizabeth Bloxam, Tom Heldal, and Adel Kelany
fc. Ancient desert and quarry roads on the West Bank of the Nile in the First Cataract region. In *Desert road archaeology*, ed. Heiko Riemer and Frank Förster Cologne: Heinrich-Barth-Institut.

Storemyr, Per, Tom Heldal, Elizabeth Bloxam, and James A. Harrell
2009 New evidence for small-scale Roman basalt quarrying in Egypt: Widan el-Faras in the northern Faiyum Desert and Tilal Sawada by El-Minya. In *ASMOSIA VII: Proceedings of the 7th International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Thassos, 15 – 20 September 2003,* Bulletin de Correspondance Hellénique supplement no. 51, ed. Yannis Maniatis, pp. 243 - 256. Athens: École française d'Athènes.

Streckheisen, Albert
1973 Plutonic rocks: Classification and nomenclature recommended by the IUGS Subcommission on the Systematics of Igneous Rocks. *Geotimes* 18 (10), pp. 26 - 30.
1979 Classification and nomenclature of volcanic rocks, lamprophyres, carbonatites, and melilitic rocks: Recommendations and suggestions of the IUGS Subcommission on the Systematics of Igneous Rocks. *Geology* 7, pp. 331 - 335.

Vandeput, Lutgarde
1987- Splitting techniques in quarries in the Eastern Mediterranean. *Acta Archaeologica Lovaniensia* 26-27 (1987 – 1988), pp. 81 - 107.

Waelkens, Marc, Paul De Paepe, and Luc Moens
1990 The quarrying techniques of the Greek world. In *Marble: Art historical and scientific perspectives on ancient sculpture*, pp. 47 - 72. Malibu: J. Paul Getty Museum.

Image Credits

Figure 1. Map of ancient ornamental-stone quarries in northern and central Egypt (numbered). Drawing by author.

Figure 2. Map of ancient ornamental-stone quarries (numbered) in southern Egypt and northern Sudan (Nubia). Drawing by author.

Figure 3. Ornamental stones from the Aswan (a-i), Wadi Abu Bokari (j), and Rod el-Gamra (k) quarries. Computer-scanned by author.

Figure 4. Ornamental stones from the Gebel el-Ahmar (a-c), Gebel Gulab and Gebel Tingar (d-f), Wadi Abu Aggag (g-i), Gebel Rokham (j), and Umm el-Sawan (k) quarries. Computer-scanned by author.

Figure 5. Ornamental stones from the Tumbos (a-b), Daygah (c), Widan el-Faras (d), Gebel el-Asr (e-g), Wadi Umm Zanatir (h), Wadi Umm Damarana (i), and Wadi Abu Mu'aymil (j-k) quarries. Computer-scanned by author.

Figure 6. Ornamental stones from the Gebel Manzal el-Seyl (a-b), Wadi Umm Shegilat (c-d), Gebel Umm Naqqat (e-f), Gebel Rod el-Baram (g-i), and Wadi Mubarak (j-k) quarries. Computer-scanned by author.

Figure 7. Ornamental stones from the Wadi Hammamat (a-c), an outcrop near the Qaw el-Kebir (d), Wadi Umm Wikala (e-g), and Wadi Maghrabiya (h-k) quarries. Computer-scanned by author.

Figure 8. Ornamental stones from the Wadi el-Garawi (a), Wadi Umm Argub (b-d), Hatnub (e), Wadi Assiut (f), Gebel Dokhan (g-j), and Wadi Umm Towat (k) quarries. Computer-scanned by author.

Figure 9. Ornamental stones from the Wadi Umm Esh (a), Wadi Umm Balad (b), Wadi Barud (c-d), Wadi Fatiri el-Bayda (e), Mons Claudianus (f-g), Wadi Umm Huyut (h), Wadi Abu Gerida (i-j), and Bir Umm Fawakhir (k) quarries. Computer-scanned by author.

Figure 10. Objects made from andesite porphyry (vars. 1-2; a-b), peridotite (c), and serpentinite (var. 1; d), which have no known quarries. Photograph (a) courtesy of the Toledo Museum of Art; photograph (b) courtesy of the Brooklyn Museum of Art; photograph (c) courtesy of the Boston Museum of Fine Arts; photograph (d) courtesy of the British Museum.

Figure 11. Objects made from dolostone (var. 1; a), recrystallized limestone (var. 1; b), bituminous limestone (var. 1; c), rock anhydrite (d), and buff limestone (e), which have no known quarries. Photograph (a) courtesy of the British Museum; photographs (b) and (e) courtesy of the Boston Museum of Art; photograph (c) courtesy of Per Storemyr; photograph (d) courtesy of the Brooklyn Museum of Art.