

# Emerald mining in Sikait: organization and distribution of emerald production in Roman Egypt



**Abstract:** The Smaragdus region, currently in the Wadi Gemal National Park (Eastern Desert, Egypt) was well known in antiquity for the emeralds that could be found there. The exploitation of emerald mines, especially in the Roman period, led to the creation of an important network of settlements linked to the procurement and commercial distribution of this semiprecious stone, which was considered highly valuable in ancient times. The overview of the emerald trade in Roman antiquity presented in this paper will focus on Sikait, the most important and best known of the mining settlements in the Eastern Desert.

**Keywords:** *Smaragdus*, emerald mines, Sikait, beryl, emerald, Roman Egypt

This study is related to the start of a new project, the Sikait Project, with the main goal of resuming the archaeological works of survey and excavation conducted by teams led by Steven E. Sidebotham in the Wadi Gemal National Park. In fact, the main interest of this project is in the study of the most important ancient site documented in this region: Sikait. This will be the first approach to this area of the Eastern Desert, bringing to the fore the extraction of its main resource, the emeralds. In order to do so, let us first review the existing archaeological studies done in the region (for a summary, see Sidebotham, Gates-Foster, and Rivard 2019).

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## THE “SMARAGDOS” AND SIKAIT

The focus of this research is on the Wadi Gemal National Park area, which is located in a part of the Eastern Desert northwest of Berenike and directly southwest of Marsa Alam [Fig. 1]. This area can be identified with what in ancient times was known as the “Smaragdus”. It was the only region in the Roman Empire that produced emeralds and authors from different ages, such as Strabo (17.1.45), Pliny the Elder (*NH* 37.17.65, 37.18.69), Claudius Ptolemy (*Geog.* 4.5.8), Olympiodorus (*FHN* 3.309), the 4th-century monk and

bishop Epiphanius (*FHN* 3.305) and the 6th-century monk Cosmas Indicopleustes (11.21), referred to it and to the emeralds extraction process (Foster et al. 2007: 305–306). These classical sources leave no doubt as to the importance of this mining area within an operative period from at least the 1st to the 6th century AD.

In addition, archaeological research has uncovered an extensive number of sites directly linked with the exploitation of emerald mines in ancient times. These sites formed an important network of settlements and production sites [for the location of these sites see Fig. 2]. Of these Wadi Sikait is the most impressive site and, moreover, the only one where archaeological excavations have been conducted. However, the role of some other of these sites in the Smaragdus production network should also be considered.

Sikait is located in the Eastern Desert, 45 km inland from the Red Sea coast, along a branch road from Wadi Gemal. Interest in the exploration of this site grew from the seasons of survey, mapping and excavation performed by members of the Eastern Desert Survey Project between 2000 and 2003, conducted by Sidebotham and Jean-Louis Rivard.<sup>1</sup> The project had mapped the site, offering an overview of its size and extent: an extensive settlement, 560 m north–south by 270 m east–west, cut into two parts, eastern and western, by the wadi, comprising roughly 150–200 visible structures.

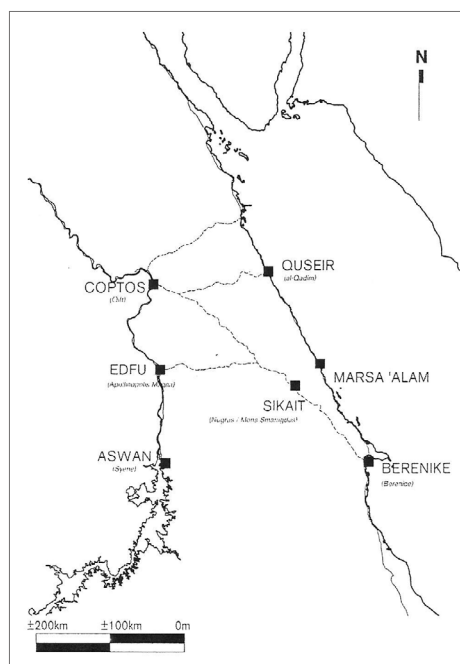


Fig. 1. Location of Sikait in Roman Egypt (Editing D. Fernández Abella)

<sup>1</sup> For the published data on the site of Sikait see Shaw, Bunbury, and Jameson 1999; Rivard, Foster, and Sidebotham 2002; Harrell 2004; Sidebotham et al. 2004; 2005; Harrell 2006; Foster et al. 2007; Sidebotham, Hense, and Nouwens 2008: 286–302; Sidebotham 2011; Sidebotham, Gates-Foster, and Rivard 2019: 136–145.

The overall chronology of the site covers a period from the 1st to the 6th century AD, but most of the archaeological levels excavated were related to the later phase of the site (4th–6th centuries). The size and state of preservation of the architectural remains suggest an exceptional archaeological site. However, what makes Sikait the most interesting mining settlement of the region from a scientific point of view is the intensity of documented ancient mining and remains related to the extraction process, in Roman times, of green beryl, including the gemstone variety known as emerald.

Previous survey work in Sikait identified more than 150 structures, including buildings and complexes of buildings, with a great number of these structures relatively well-preserved: walls as high as 4.50 m and elements of internal furnishings, like doors, windows, niches,

shelves, storage areas, etc. The structures rise up the slopes on either side of the wadi and most of them are oriented toward the wadi floor. They are mostly domestic spaces, offering some slight differences between structures located on the floor of the wadi and those on the slopes, the East and West Slopes of the settlement on either side of the wadi. Singular structures include a group of small, single-room structures, identified as watchtowers, which have been recorded high along the wadi slopes. There also exist groups of structures notable for their size and distinctive features, such as the so-called Three Windows Building, Six Windows Building [Fig. 4], Administrative Building [Fig. 3] and Tripartite Building. In all of these cases, the structures could have had a singular meaning for the settlement's inhabitants in relation to their function.



Fig. 2. The "Smaragdus" region (Source Google | processing D. Fernández Abella)





Fig. 3. The so-called Administrative Building on the West Slope in Sikait (Photo J. Oller Guzmán)



Fig. 4. The so-called Six Windows Building, one of the best examples of a building complex (Photo J. Oller Guzmán)



The most spectacular structures in all probability are the two rock-cut temples identified at the site, on the eastern slope. The so-called Large Temple consists of a monumental temple structure of the *speos* type, cut almost entirely in the talc schist forming the steep wall of the wadi [Fig. 5]. The temple is composed of a main facade flanked by a pair of small shrines. The space inside the main chamber is divided by two massive columns. Three levels can be distinguished. Parts of three lines of a Greek inscription can be discerned on the main facade. The so-called Small Temple is found at the extreme southern end of the site. It has a 14-line-long Greek inscription on the facade, recording that the temple was dedicated to Serapis, Isis

of Senskis (Sikait) and Apollo in the reign of the Roman emperor Gallienus. Here, three doors give onto a central room. Also related to the religious/ritual sphere is a cemetery in the environs of the site, containing about 100 robbed graves.

The site is closely linked to nearby settlements with similar structure and/or function, for example, Middle and North Sikait, also clearly related to the extraction of emeralds. Gebel Umm Harba and especially Nugrus were also extensive settlements located in a parallel wadi (for Nugrus see Shaw, Bunbury, and Jameson 1999: 210–211; Sidebotham et al. 2004: 23–24; Sidebotham, Hense, and Nouwens 2008: 298–299; Sidebotham, Gates-Foster, and Rivard 2019: 130–136).



Fig. 5. The so-called Large Temple of Sikait (Photo J. Oller Guzmán)

## EMERALD PRODUCTION STRUCTURE

One of the first aspects of emerald production structure is the issue of ownership: Who actually owned the mines and who controlled the production and the distribution of the emeralds? There are no direct sources to clarify this point and the archaeological evidence from other, more extensively investigated sites in the Eastern Desert, like Mons Claudianus and Mons Porphyrites, does not resolve the issue either. The traditional historiographic view is that from the reigns of Augustus and Tiberius most of the mines and quarries were under the control of the state or the ruler's *familia* (Hirt 2010: 82–83). A well-known passage from Suetonius in his *Life of Tiberius* (49.2) speaks of the emperor removing *metalla* from private hands and from under the jurisdiction of the *civitates*. Nevertheless, this information, which is repeated by other writers like Tacitus, is not supported by later epigraphic and literary sources. Indeed, there is reliable testimony of private owners managing these production regions, either directly or under the tutelage of the imperial government in a lease contract (Hirt 2010: 86). However, in the case of the Egyptian quarries, it is difficult to determine ownership, because nothing explicit can be inferred from the surviving epigraphic texts and ostraca. Other aspects need to be considered to determine the owners. For instance, according to Alfred Hirt, the presence of certain population groups, such as imperial slaves and freedmen, need not imply imperial ownership, but a military presence could be good evidence of state property, the military being dedicated to serving the Roman state (Hirt 2010: 94–96).

In this light, the Eastern Desert quarries were most likely state-owned, although this is not tantamount to no influence on the part of the emperor's family. The well documented presence of members of the *familia Caesaris* in these quarries implies more or less direct control of the production and distribution processes.

Regarding ownership of the Smaragdus mines, there are no clues to go by, although, as will be shown later, there is some evidence of military presence at the mining sites. To develop this point, it is necessary to discuss other aspects regarding the structure and organization of emerald mining. It has been proposed that the quarries shown in Fig. 2 all belong to the same mining district, or to be more precise, a quarrying district in this case (Hirt 2010: 108). This type of organization is well-known from the Roman world thanks to the laws of Vipasca from Hadrianic times, recovered in Hispania, which describe the production region of Vipasca (related to metallurgy) as an administrative district with its own limits, called a *metallum* in the epigraphic and classical sources (Domergue 1983; Christol 1999; Lepore 2002; Ferrer 2005). Other sources, like some texts from Ulpian in the *Digest* (7.1.9.2–3), discuss *metalla*, suggesting that these production districts with their own juridical structure, could be related to the extraction of not only metals, but also stones and other mineral resources.

Following this view, both the quarries and the emerald mines in the Eastern Desert can be defined as *metalla*. In fact, the general opinion is that at least the imperial quarries of the Eastern Desert

(including Mons Claudianus, Mons Porphyrites, Mons Ophiates and Tiberiane) could have formed a unitary production district (Hirt 2010: 51–53). The evidence for this lies in the similarities of structure and organization of the quarries and especially in the epigraphic record of different officials linked to the control of these quarries: *procurator metallorum* and *epistropos metallos*. There are several *procuratores* identified in the ostraca who appear to be related to the supervision of several of these quarries. For example, Marcus Ulpianus Chresimus documented in Mons Claudianus and Mons Porphyrites or Ulpianus Himerus at Mons Claudianus and Mons Ophiates. Thus, the epigraphic data appears to favor the existence of a unique administrative region that included all of the imperial quarries.

What then of the Smaragdus region? The administrative organization of the emerald mines is equally difficult to understand. An important aspect to consider in this regard is the type of exploitation in quarries and in mines; the differences between these types of exploitation could result in differences of administrative structure, as is the case in the rest of the Empire to some degree. However, there are also evident similarities which could be due to the integration of the two regions into a single commercial frame and the same network of roads, as well as facing similar (but not exactly the same) logistical issues deriving from life in the desert. At this point it is impossible to say whether the Smaragdus region was included in the same production district as the imperial quarries, constituted a production district on its own, or even was not organized in this way at all.

In this regard, there are two inscriptions, one from Wadi Umm Wikalla and the other from Wadi Hammamat, which can advance our thinking on the subject. They two are similar and they can be dated to the first years of the 1st century AD. They are quite well known because of the person of the official charged with supervising production sites of Roman Egypt probably previous to the appearance of the office of *procurator metallorum* (see Bernand 1972: 80–92; 1977: 118–128; Sidebotham et al. 2001). This is Publius Iuventius Rufus, referred to once as *archimetalarches* and once as *metallarches*. Without more references it is impossible to know the exact prerogatives of his office, but the most interesting information in any case is that it was apparently linked with the supervision of all the *metalla* and mines of Egypt, as well as specifically control of “the mines of emeralds, peridot, pearls”. This links him directly with supervision of the Smaragdus region and offers the best evidence of state control of the emerald mines, with evident ties to the military sphere considering that the inscription is explicit about Rufus’s military rank, referring to him as a tribune of the Legio III Cirenaica and *eparchos* of Berenike. Epigraphical sources indicate the emergence later of another office: the *praefectus Montis Berenicidis*, an official of equestrian rank charged with territorial and military control of the desert region around Berenike. It is not known where this official resided, but his tasks probably were related to the protection of the roads and the commerce and probably he had some type



of relation with the supervision of the correct operating of the emerald mines, maybe mainly from a military point of view.<sup>2</sup> Finally, there are three ostraca coming from the *praesidium* of Didymoi, a fort on the road from Berenike to Koptos (Bülow-Jacobsen 2001), which mention some workers of the emerald mines who also carried messages between the *praesidia* on the roads leading to the Nile. Apart from the interesting information on the social status of these workers, these ostraca illustrate a link between the emerald mines and Koptos (or more generally the Nile valley), which is where the administrative seat of this entire production and commercial network was located.

Taking into consideration the imperial quarries and the inscriptions referring to Publius Iuventius Rufus, one could hypothesize that the emerald mining region was under the direct control of the Roman state. This would be logical considering the importance of the Smaragdus region as a unique source of this precious gem in the empire. However, in the current state of research, other options well identified in other areas of the Empire cannot be excluded, namely, direct ownership by the *familia Caesaris* or a lease contract implying that exploitation was in private hands. By analogy with the control exercised by the *metallarches/archimetallarches* over all of the *metalla* in Egypt, the most probable option is the first one. It also could imply that at least in the first decades of the 1st century AD the quarries and

mines of the Eastern Desert could have formed one great production district. It is unclear whether the office of prefect of Berenike, once it appeared, implied supervision of a reduced territory that included the Smaragdus, but maybe not the quarries of Mons Claudianus, Mons Porphyrites and Mons Ophiates.

However, assuming that the Smaragdus was a coherent mining district also has its problems. It is important to understand how this district was organized and, especially, where the administrative seat of the district was located. With regard to the imperial quarries, the presumed administrative center that acts as a seat for the civilian and military officials is usually distinguished by a similar set of features, like fortifications of some kind and control of the water sources. That is the case of the *hydreuma* of Mons Claudianus (Peacock and Maxfield 1997; Maxfield and Peacock 2001) and the *principia* of the fort at Wadi Umm Wikala (Sidebotham et al. 2001: 154–156). Facilities of this kind are hard to identify at the main sites in the Smaragdus region. For instance, in the case of Sikait, not one building could be identified as such. Some buildings have features that distinguish them among the rest, as for example, the Administrative Building or the Six Windows Building [see Figs 3, 4]. However, they do not stand comparison with structures identified at the quarrying sites. Thus, it is hard to establish an organization pattern like the ones found at Mons Claudianus or Mons Porphyrites.

2 The question of the *praefectus Montis Berenicidis* is discussed extensively in the literature in an effort to determine the different aspects of this office. For a discussion (without exhausting the issue) see Cuvigny 2000b; 2001; 2003b; Sidebotham 2011: 85–86, 140.

Of the different sites in the Wadi Gemal area there is one settlement that is most like an administrative seat. This is the Kab Marfu'a site, located 65 km southwest of Marsa Alam, at the entry to Wadi Gemal. Composed of more than 100 structures spread over an area of 300 m by 200 m, including what could be an administrative building and a temple. Chronologically, the site is dated between the 1st and the 5th century AD (covering all of the Roman period), and has been tied in with emerald extraction and production thanks to the abundant assemblage of beryl fragments and tools such as quartz pounders found there. Most importantly, Kab

Marfu'a is situated just 1 km away from the only strong fortification documented in Wadi Gemal, that is to say, the *praesidium* of Apollonos. Thus, in Kab Marfu'a we have a settlement that had some relevance during the Roman period (considering the number and type of structures identified); that was related to emerald mining and was near to a stronghold. As proposed already by other researchers (Sidebotham et al. 2005; Sidebotham, Hense, and Nouwens 2008: 299–301), it could therefore be the seat of the administration of the Smaragdus region, a hypothesis which can be proved only by extensive archaeological excavation.

## PRODUCTION PROCESS

The production process is another key element for understanding the structure of the Smaragdus region in ancient times. Sources for this include finds from archaeological surveys and excavations as well as literary mentions: Strabo and Pliny the Elder. A comparison with various quarries in the Eastern Desert can also be instructive, although one should always keep in mind the difference between the materials in question, which must affect the production process. Thus, one can look at the places in the Eastern Desert where gold and amethysts were exploited in the Roman period (for example, Wadi Bakariya or Bir Umm Fawakhir for the gold and Wadi el Hudi or Wadi Abu Diyeiba for the amethysts).

The problem with these sites is that most of them have barely been excavated archaeologically, hampering efforts to obtain data about the structure of production processes.

Certain elements related to the production of emeralds in the Smaragdus region and specifically at Sikait can be analyzed. An area of 250 km<sup>2</sup> in the Wadi Gemal region was worked for emeralds in antiquity; this is attested by hundreds of shafts and tunnels showing traces of exploitation across time (Harrell 2004: 74). When we say emeralds, we are actually talking of the chromium and/or vanadium variety of beryl,<sup>3</sup> an aluminium-beryllium silicate that in its green-coloured version has attracted commercial interest since ancient times.<sup>4</sup>

3 Schwarz and Schmetzer 2002. However, the beryl from the Smaragdus region is colored only by chromium.

4 On the geology of this area and the geological characteristics of the Wadi Gemal emeralds see Shaw, Bunbury, and Jameson 1999; Rivard, Foster, and Sidebotham 2002; Sidebotham et al. 2004: 13; Harrell 2004; 2006; Foster et al. 2007: 312; Sidebotham, Hense, and Nouwens 2008: 286–302; Sidebotham 2011: 236.

The quality of the beryl present in the Wadi Gemal region is quite poor, hence the number of real emeralds extracted from the mines would have been imaginably modest (Sidebotham et al. 2004: 13). Still, the beryl extracted from this region was greatly appreciated by the Romans, who did not have any other source within the Empire for obtaining this hard-green gem.<sup>5</sup> Emeralds started to be extracted probably already in the Ptolemaic period and continued to be produced through the Islamic period until the discovery of emeralds of higher quality in Colombia in the 16th century put an end to the process in Egypt (Harrell 2006: 10).

The extracting process is quite well-known thanks to the preservation of most of these shafts and tunnels at sites like Sikait, Middle and North Sikait or Nugrus. The task first was to identify a vein of quartz with beryl within phlogopite schist. The vein was then followed, manually extracting the beryl. Tools used for the purpose resembled pointed iron picks or flat-edged chisels; marks on the rock insicate what these tools could have looked like (Harrell 2004: 74). The shafts were usually deep and tunnels followed the veins [Fig. 6]. Indeed, Strabo (17.1.45) explains that the local populations of this area dug deep tunnels to extract the emeralds. At Sikait, researchers have entered some of the tunnels, recording a huge variety,

from smaller ones of poorer construction to bigger ones with enough space for a standing person and even including supporting pillars (Shaw, Bunbury, and Jameson 1999: 214; Harrell 2004: 73–74). For example, a gallery identified in Sikait is 7 m long and 10 m deep, with steps carved into the rock to facilitate entrance. Open-cast mining, meaning extraction of the mineral directly from surface rocks, has also been attested at the site (Shaw, Bunbury, and Jameson 1999: 214).

Beryls typically occur in small clusters of crystals with individual crystals being a maximum 3 cm in length. This implies a fairly complicated process of extraction, in which probably a great deal of crystals would be broken, thus being lost for commercialization. These difficulties, along with the poor qual-



Fig. 6. Extracting shaft at Sikait (Photo S. García-Díls)

- 5 The Habachtal deposit near Salzburg has been suggested by some researchers as another source of emeralds in the Roman Empire, but for now exploitation prior to the Middle Ages has not been confirmed. The provenance of gemstones found in items of Roman jewellery is to be determined solely by an analysis of their geological composition. Some of the evidence related to the use of emeralds in the Roman Empire, like the so-called Fayum portraits from Egypt, emphasizes the importance of the Wadi Gemal mines in the distribution and commercialization of emeralds in antiquity (Sinkankas 1981: 371–377; Giuliani et al. 2000; Harrell 2004: 70).

ity of the beryl, probably enjoined the working of only the easiest veins, which would have been the most profitable in an economic sense. Once the crystal blocks were extracted, they would have been worked to obtain the beryl crystals. Abundant debris close to the shafts probably implies an *in situ* procedure of extraction of these crystals (Harrell 2004: 75).

The workers involved in the extraction were another important element of the production process. They are key to understanding how the mines were organized and managed. In the case of the Smaragdus region, there is almost no information directly related to this issue and the absence of ostraka evidence is telling, at least for the moment. Ostraka recovered from archaeological excavations of the quarries at Mons Claudianus and Mons Porphyrites have shed some light on this matter, questioning the traditional view, offered by classical sources such as Agatharchides, of a massive presence of slave workers in the Ptolemaic period, including convict labor (in this case in the gold mines). These documents seem to imply that most of the workers were free citizens with some degree of specialization, which is logical considering the complexity of the processes involved (Cuvigny 1996; 2000a; Sidebotham et al. 2001: 170; Hirt 2010: 206; Tratsaert 2012). Apart from that, the very structure of the quarrying and mining settlements, missing any fortifications or accommodations for a slave population, seems to argue against a massive presence of convict labor. There is, however, some archaeological evidence that could be interesting in this regard, for example,

the well-documented presence of military units in the quarries and the existence of numerous *skopeloi* or watchtowers. It has been noted at investigated sites, like Mons Claudianus, Mons Porphyrites and Mons Ophiates, that the *skopeloi* appear to be oriented inward, apparently to control the exploited area rather than protect it from external attacks (Peacock 1992: 18; Sidebotham et al. 2001: 168; Hirt 2010: 184). Both the military units and watchtowers thus oriented could be proof of the presence, to a certain extent, of slave and convict labor. Even so, it seems probable that most of the workers in the quarries and mines were free people. The same can be said of Sikait and the emerald mines. The said ostraca from the fort of Didymoi, referring to emerald workers acting as carriers of messages on the road from Berenike to Koptos (Bülow-Jacobsen 2001), are proof of their free status, because otherwise they could hardly have moved so freely along the road network in the region.

The process was evidently controlled by the presence of different civilian and military officials. The *procurator metallorum* and his probable function as supervisor of the mining and quarrying works in the Eastern Desert have already been discussed as well as other officials with a supervisory role, like the *archimetal-larches* or *metallarches* and the *praefectus montis Berenicidis*. These officials would have resided in the administrative seats of the region that most researchers tend to locate in the Nile Valley (usually in Koptos), although it cannot be excluded that some of these officials stayed in the main coastal settlements, such as Berenike or Myos Hormos (Cuvigny 2003a: 297).



Apparently they did not live at the quarries or mines save for regular visits during the year to check the proper functioning of these facilities. Different subaltern officials, documented in Imperial mines like Ampelum (Romania) and in ostraca from the Eastern Desert quarries—*vilicii*, *dispensatores/oikonomos*, *procuratores*, *tabularii*, etc. (Hirt 2010: 150ff.)—could be expected to reside in the administrative buildings of the Eastern Desert quarries and mines. Assuming that the Smaragdos mines were indeed under the control of the Roman state, then some of these officials should be expected in buildings like the Tripartite Building in Sikait or the complex at Kab Marfu'a and the *praesidia* of Apollonos. These civilian officials would have been accompanied by some military officials, too (see below).

Another aspect to consider is how the production was registered. This issue is of particular significance knowing how important to the Roman government were these products from the Eastern Desert. There are several recording systems depending on the type of production and the process of extraction. In the case of the Eastern Desert quarries, marks on stones and columns are the best docu-

mented, e.g., the marks from Mons Claudianus with a system of abbreviations including the area of extraction within the quarry from where the stone comes, the person in charge of this area, the dimensions of the extracted block, the quantity of blocks extracted from this area, etc. (Bülow-Jacobsen 1996: 51ff.; Peacock and Maxfield 1997: 223–224; Hirt 2010: 307–309). Obviously, this system could not be used in the mines, where other ways of registering production were developed, including transformation of the mineral into ingots with different information marked on them. Ingots, however, were not an option for the emerald mines, which needed another registering system. For the moment there is not enough evidence for tracing this system, but a *tabula rasa* carved outside a mining shaft in Middle Sikait is probably the best example of how this system worked. Basically, the idea is that the number of the gallery, the number of workers and the quantity of product extracted would have been noted on this *tabula*, this being the easiest way to facilitate control of the emerald mines by the Roman administration (Sidebotham, Hense, and Nouwens 2008: 297).

## POPULATION

A third area of research interest concerns the population that lived in the emerald mining settlements. The workforce was evidently the most important component of this population. Workers were responsible for the main activity in the settlement, the extraction of emeralds, hence it is only to be expected that they were the main resident group. A mas-

sive presence of slave or convict labor has already been discussed and rejected as a possibility, even though the presence of smaller groups or individuals cannot of course be excluded. On the whole, the archaeological and epigraphic evidence leads to the assumption that most of the inhabitants were free laborers, mostly coming from the Nile valley.

The dwellings of these workers were similar in the different settlements of the Smaragdus region, starting with simple stone huts and moving to impressive buildings with several rooms. The best-known examples, some of which were excavated, come from Sikait. These buildings include some high-status houses with several rooms and stores as well as adjacent open courtyards (Sidebotham et al. 2004). Overall, the layout and style of these houses reinforces the idea of the inhabitants being free laborers rather than slave labor, at least in the later phases of occupation at Sikait [see Fig. 4], simply because slaves could not have been accommodated in structures of this kind.

A similar situation is observed in the nearby settlements of Nugrus and Middle Sikait, but also in the more distant sites like Kab Marfu'a (Sidebotham et al. 2005; Sidebotham, Hense, and Nouwens 2008: 288ff.). In the case of Sikait, Middle Sikait or Nugrus, the extracting points are not far from the buildings, sometimes in the middle of the residential areas, indicating the proximity of industrial and living areas, which obviously was an advantage from a logistical point of view.

This is also the case of other studied production settlements in Roman Egypt, such as the quarries of Mons Claudianus, Mons Porphyrites, Mons Ophiates and Tiberiane, where several villages, composed of stone huts, served to accommodate workers near the industrial areas. Settlements like Wadi Bakariya and Bir Umm Fawakhir, accompanying the gold mines (Sidebotham, Hense, and Nouwens 2008: 221–222; Meyer et al. 2011; Tratsaert 2012; Meyer 2014), seem to keep the same structure. As for other kinds of mines, for

instance the amethyst mines at Wadi Abu Diyeiba, nothing like a settlement of regular buildings was noted in the vicinity. The absence of anything like small huts near the mining trenches only goes to suggest tents as accommodation for the workers; tents seldom leave extensive and recognizable archaeological traces (Harrell et al. 2006; Sidebotham, Hense, and Nouwens 2008: 284–285). The obvious conclusion is that workers were housed as close to the industrial areas as technically possible, making this one of the principal characteristics of these settlements.

The presence of workers' families at the sites has been attested in the sources. Hélène Cuvigny's study of ostraca from the *praesidia* along the route from Myos Hormos to Koptos gives undeniable proof of the presence of women and children (Cuvigny 2003b: 374–376). In Sikait, excavations have also unearthed evidence pointing in this direction. Finds include imported beads and bangles next to major quantities of local beryl beads; toys, like carved stone camels and dolls; gaming counters, weights, and spindle whorls (Sidebotham et al. 2004: 16–17). Even if these artifacts are not necessarily age- and gender-specific, they complement the epigraphic data, suggesting that women and children could have lived in Sikait as well. The presence of people of some affluence can also be deduced.

Another social group that could have made its presence felt at the emerald mining sites are traders or private entrepreneurs. This last category should be considered in particular in light of evidence coming from other mining districts around the Empire, and the Vipasca laws are again a principal source of knowledge

on this subject. It turns out that even in the state mines the Roman administration was apt to hand over part of the organizational issues into private hands, thus helping to reduce the burden on imperial officials. These partners, usually designated as *occupatores* or *coloni*, would take over tasks such as paying the workforce, collecting rent or fees, and delivering supplies to the resident population (Hirt 2010: 266–269). While there is no direct evidence of such private partners at Sikait, it is not impossible to envisage their presence in the life of the desert settlements.

That at least part of this population lived permanently in Sikait is indicated by the burial areas situated in the surrounding hills. Permanent occupation naturally implied several major logistical challenges. The provisioning and management of food and water were among the crucial ones. Hard desert conditions necessitated import of most of the food from the Nile Valley and, to a lesser extent, from the Red Sea coast (Foster et al. 2007: 341). Nonetheless, there is a certain amount of evidence for some kind of food production on the spot. Excavation of some houses in Sikait has yielded several small stone boxes, which archaeologists have interpreted as holding wooden trellises used as supports for plants, bushes or small trees. This proves a certain degree of cultivation taking place at Sikait, probably to grow produce complementing the food that arrived from the Nile. It is also probable that some limited animal husbandry—probably goats, sheep, and camels—could have been possible in the open courtyards (Sidebotham et al. 2004: 15–16).

Water would have been a major issue. The location of permanent sources of water in Wadi Sikait, and generally in the Smaragdus region, is not entirely clear. Two possible wells have been documented in Sikait and there are reports from ancient travelers identifying other wells or basins in the vicinity (Sidebotham 2003: 96; Sidebotham et al. 2004: 15). It should be assumed that most of the water supply consisted of limited amounts of collected rainwater and also wells sunk in the wadi floor. For the moment, however, it is difficult to reconstruct the water management system of the site, which of course had to exist as water in this area is a matter of life or death. The importance of water management is also clearly demonstrated in other settlements of the Eastern Desert. A network of *hydreumata* along the routes connecting the important ports of Berenike and Myos Hormos to the Nile Valley was part of the system and the military played a key role in its control and supervision. Ostraca from quarries or *praesidia* like Didymoi or Krokodilo reveal how involved the Roman administration was in the issue of water supply and illustrate strict and perfectly organized management of these water supplies. In fact, the main function of the forts in question was probably not the protection of the region as much as the protection and management of these water sources (Cuvigny 2003a: 322–323; Sidebotham 2003: 95, 101; Hirt 2010: 180–182; Sidebotham 2011: 124).

The uses of the water could be diverse, but were related especially to human and animal consumption, cultivation and industrial works, as well as leisure activities. The first aspect is the more evident and in

an extensive settlement like Sikait, where a considerable part of the population had to be regularly supplied with set amounts of water, the need for constant provisioning was nonnegotiable. This necessity would have been even more pressing in the case of bigger cities like Berenike, with a large population, industrial zones and the presumed existence of leisure facilities like baths.<sup>6</sup> It is not certain for the moment how Sikait was supplied with water, but in the case of Berenike it seems quite probable that a network of fortified wells, like Wadi Kalalat or Siket, acted as permanent sources of water, with periodic camel caravans taking the water to the city (Sidebotham 2003: 99–101; Haeckl 2007; Pintozzi 2007). Further archaeological investigations could presumably help in gaining a better understanding of the water management systems in the Smaragdus region.

The military were another important factor in the Eastern Desert settlements. Evidence from ostraca and inscriptions found in the imperial quarries and the *praesidia* (especially Maximianon and Krokodilo on the Myos Hormos–Koptos road) shows the key role of military officials in the structure and organization of this region (Hirt 2010: 180). For example, each of the *praesidia* are known to have been under the control of a *curator praesidii*, controlling an auxiliary unit of 15 to 25 soldiers (Cuvigny 2003a: 308–309; Hirt 2010: 180–181). However, the epigraphic documentation shows these soldiers not only in a military function within the *praesidia*, but also participating in extracting activities in the quarries

and mines. For example, in the case of Mons Claudianus, documents containing “water distribution list” uncovered in the excavations, indicate better water rations for soldiers than for the other inhabitants of the quarry settlement (Cuvigny 2005: 334–336). This implies an active and important role in the administrative structure of the quarry. Indeed, it seems that the quarry at Mons Claudianus was under the supervision of a *centurion* and sometimes a *decurion*, a situation that is also recognized in the quarries of Mons Porphyrites and perhaps Mons Ophiates. Regarding their function, Mons Claudianus is again the main source of information, with a record of a *courator metallo Klaudianoi* who resided in the fort of Mons Claudianus. His most important task was to ensure supplies of food, water, equipment, animals, etc. for the quarry (van Rengen 1997: 219; Maxfield 2001: 159). He was probably also in charge of the organization of production, a job that can be inferred based on the fact that some of these military officials assigned to the quarries had previous experiences in other quarries. So, it seems that the imperial government designated these officials taking into account their knowledge of industrial activities acquired on the job. Cases known from the sources include Annius Rufus in Mons Claudianus, but also Tiberius Sergius Longus in the quarry of Karistos in Euboea and Tullius Saturninus and Aellius Antoninus in the quarry of Dokimeion in Turkey (Hirt 2010: 170–173 with references). These officials would have had a unit of soldiers (usually both cavalry and infantry) under

6 Already identified at sites like Mons Claudianus and Abu Sha’ar (Sidebotham 2003: 109).



their command to assist them in their duties. In the case of Mons Claudianus, for example, the *curator* had 30 infantry soldiers, six cavalrymen and 22 recruits (Hirt 2010: 168ff.).

The question is whether any kind of military presence can be traced in Sikait. The answer is difficult, because there is on one hand some evidence coming from the excavations, such as, for instance, a Roman scale armour made of a copper alloy and arrowheads of iron and bronze, all items that could be related to the presence of a military population (Sidebotham et al. 2004: 17). In addition, several watchtowers or *skopeloi* are known at or near the ridgelines of the wadi slopes in visually advantageous locations. These watchtowers are one of the most characteristic structures identified in the Eastern Desert quarries and mines. The Sikait examples are on the whole small, roughly square single-chamber structures, measuring 3 to 4 m by 3 to 4 m (Foster et al. 2007: 340). They are identified in other settlements like Mons Claudianus, Mons Porphyrites and Mons Ophiates, among others, and their function must have been linked to the protection of these sites, although in some cases their orientation seems remarkably to imply a major interest in control over the site itself, rather than control against incursions from outside. Some researchers have proposed to see the main role of these watchtowers as facilitating communication between the different production areas at the quarries and mines, using a system of signals to transmit messages between towers (Brun, Cuvigny, and Reddé 2003). Whichever the case, the *vigiles* working in these *skopeloi* could have been part of the military at

Sikait, although it is not entirely sure that these guards were always officially linked with the army. In conclusion, it is possible that some military units were stationed at Sikait, but their presence there cannot be confirmed based on the currently available data.

Assuming that the Smaragdos region was under the control of the Roman state, at least during the 1st century AD, then it is quite probable that a military official with a dependent garrison operated in the area. However, if that was the case, then where would this garrison be stationed? Because apart from the only strong fortification identified in the region, that is, the already quoted *praesidium* of Apollonos, there is no other evident military installation in the region. Interestingly, the same is true of the other extracting regions in the Eastern Desert, such as the gold and amethyst mines (Shaw 2007; Tratsaert 2012). It thus seems to be generally the situation with regard to the exploitation of precious materials in the region. One possible explanation is that security in the region was sufficient not to require an extensive and expensive army presence in all of the mining districts. Such an explanation would also promote the theory of free labor; without extensive use of slave or convict labor there was little need for manning strong garrisons *in situ* (Meyer et al. 2011: 177). Yet this hypothesis hardly fits in with the fortified road network between the Red Sea coast and the Nile, which was maintained from the Flavian dynasty onwards. Nor does it match up with the references made in some of the ostraka from the *praesidium* of Krokodilo, mentioning na-

tive raids on a Roman garrison at the beginning of Hadrian's reign (De Romanis 2003). This is an unsolved question for the moment, but it may actually offer a clue regarding issues involving the ownership and management of these mines. The absence of fortifications and scarce evidence of a military presence,

signifying the absence of regular Roman troops or auxiliary units in the region could reflect a situation in which the mines in question were in private hands, as opposed to the quarries which were state property. Only further investigations in the field can hope to address these issues in the future.

## DISTRIBUTION AND COMMERCIALIZATION

A brief discussion of emerald distribution and commercialization is in order here. This distribution has its own characteristics, differing for example from that of the imperial quarries. The difference naturally lies in the nature of the products obtained: one can hardly compare the transport of big stone blocks or columns to that of precious or semiprecious stones like emeralds. From this difference draw the logistical

advantages and disadvantages of the process. It is obviously easier to transport beryls/emeralds, whereas the products of the quarries required a complicated transportation system that called for big wagons moved by animal force down the Eastern Desert roads to the Nile (Sidebotham et al. 2001: 168; Hirt 2010: 30–32; Sidebotham 2011: 170–172). Beryl could be carried simply on camel- or donkey-back, in small caravans; trans-



Fig. 7. Fragments of beryl recovered in Sikait (Photo J. Oller Guzmán)

port of gold and amethyst would not have been any different [Fig. 7]. Thus, a simpler infrastructure was needed. Regarding the disadvantages, the most relevant would be security: it was easier to attack and rob a caravan full of minerals or gems than to divert a line of wagons packed with heavy columns or stone blocks. Therefore, the transport of emeralds probably needed more intensive protection, possibly by ensuring the presence of guards, be they official troops coming from the *praesidia* or private guards.

Setting aside these differences, let us look at some similarities in the distribution of material from the quarries and from the emerald mines. Surveys of sites like Mons Claudianus, Mons Porphy-

rites, Mons Ophiates and Tiberiane have revealed the presence of stony slipways, which allowed movement and transportation of stone blocks and columns from the quarries to the wagons that would take them to the Nile. Once on the wagons, the stones would be pulled down the roads to their destination in a process that is well documented thanks to traces left by these heavy wagons in the desert. In the Smaragdus region, there are several examples of the use of such slipways to permit access to the mines and easier movement of the extracted product. Undoubtedly the best example is a massive artificial ramp, 400 m long, built in the Middle Sikait settlement, going up from the wadi floor [Fig. 8], to reach the mining areas and a cluster



Fig. 8. Roadway leading to Middle Sikait (Photo J. Oller Guzmán)

of buildings located on the wadi slopes (Sidebotham et al. 2004: 10; Sidebotham, Hense, and Nouwens 2008: 297; see also Sidebotham, Gates-Foster, and Rivard 2019: 146–156). Other tentative artificial ramps can also be identified in Sikait (specifically, behind the Administrative building) and in Gebel Umm Harba. Thus, the transportation process started when the extracted beryl crystals were carried down these ramps and slipways to the main settlement on the wadi floor. Once there, the crystals would be loaded onto a caravan and moved to the road, in the direction of the Nile Valley.

The road network has been well documented thanks to surveys conducted in recent years in the Eastern Desert (Sidebotham and Zitterkopf 1995; Sidebotham, Hense, and Nouwens 2008: 329–344; Sidebotham 2011: 125–174). A main road ran is known to have run near Wadi Sikait and some of the wadis from Wadi Gemal surely connected Sikait and the other sites with this main road which continued through the Eastern Desert, ultimately to separate into two branches, one leading to Apollinopolis Magna and the other to Koptos. Thus, caravans leaving the Wadi Gemal region joined the main road and continued for a few days until they arrived at the Nile Valley. This journey was secured by the said line of *praesidia* which provided protection and shelter for travellers, but especially the most precious good of the desert, water, obtained from the wells in the *hydreumata*. The inscriptions on ostraka recovered from some of these *praesidia* indicate that this water was not free of charge and that water rations were strictly controlled by the military (Cuvigny 2003a: 332–333).

Not everyone would thus have been provided with these water resources and it must be assumed that the experience of caravan guides was also a key factor in ensuring the survival of these passing groups, especially as many of the *praesidia* had already been abandoned in the later phases of emerald exploitation in the region.

It is important to note that this commercial network involving the products of the stone quarries and the emerald, gold and amethyst mines, among others, was directed mainly to the Nile Valley. It seems that most of these products, and definitely the stone extracted from the Eastern Desert quarries, were not headed for the Red Sea harbors. The roads that led from the Nile to the imperial quarries mostly finished in these quarries and did not cross the desert to the coastal settlements. Regarding emerald production, the relative scarcity of beryl finds in the coastal sites of Myos Hormos, Marsa Nakari or Berenike, and the lack of any mention of emeralds among the products commercialized in the *Periplus Maris Erythraei*, could stand in confirmation of this unidirectional commerce. This situation is logical in view of the trade in precious gems, emeralds and aquamarines among others, from the Indian subcontinent, which made it an unprofitable market for these products (Sidebotham 2011: 236). However, judging by the mentions in late sources like *Cosmas Indicopleustes* (6th century AD), there was a change of paradigm during this late period, with emeralds being sent to India, probably through the Axumite kingdom (Power 2012: 155).



Animals used in the caravans also provide information about the emerald distribution system. Donkeys and camels are the most important animals in this form of transport. Camels were appreciated because they were better prepared to travel through the desert on smaller amounts of water, and also because they had a larger load capacity. Yet donkeys were more reliable on rocky surfaces (Bülow-Jacobsen 2003; Sidebotham 2003: 88). In any case, these caravans needed a constant supply of food and water, as well as closed spaces for the animals when not on the move. Animal tethering lines, intensively documented near the quarries and consisting of large areas usually closed by cobblestones walls catered at least in part to the lattermost need (Sidebotham 2011: 121–122). They are interpreted as areas dedicated to the accommodation of animals used in the caravans that brought supplies, exported the extracted products and gave the inhabitants of the quarrying and mining settlements the means to move. Usually, there was access to water sources like troughs, although not close to where the animals stood, presumably as a measure against excessive water consumption by the animals (Sidebotham 2003: 111–112).

Interestingly, these animal tethering lines are present in the quarries, but not as a rule near mining areas, like the gold mines. One possible explanation is that gold and amethyst were not like the heavy stone blocks that needed a large number of animals to move the heavy wagons, hence the lack of animal tethering lines at the mines (Sidebotham 2011: 121). The emerald mines are the only exception, because different examples of such ani-

mal tethering lines have been recorded in the Smaragdus region (Sidebotham 2003: 108–112; Foster et al. 2007: 309). An example can be found in the environs of the Sikait and Nugrus settlements, specifically at the crossing of Wadi Nugrus and the main road to the Nile passing through Wadi Gemal. It consists of five or six huge enclosures used as animal corrals and watering points. Another example lies in Wadi Gemal East, a few kilometers farther down the road to the Nile. It is not quite clear why structures of this kind were included in this emerald mining region and not in the gold or amethyst mines. Perhaps it was related to the volume of production or to the fact that the Egyptian emerald mines were unique, while gold and amethyst could be exploited in several other areas within the Roman Empire.

Last but not least, there is the value of Egyptian emeralds to consider. There are many examples of either pieces of beryl or ornaments incorporating beryls found all over the Roman Empire, especially in tombs, demonstrating thus the status-related significance of this semi-precious stone. In view of the recently proposed source of beryl in Europe, specifically in Austria, some researchers have come to think that the emeralds found in the European provinces may have come from there rather than from Egypt. The matter is under debate, especially as there is nothing to show the antiquity of the Austrian mines. Geological analyses of the beryl are needed to provide a definitive answer.

Undeniable proof of the commercial relevance of emerald mining in the Smaragdus region is offered by yet another,

fairly unusual source, namely, a group of funerary portraits coming from the so-called Fayum mummies. This is a huge repertory of funerary portraits painted on linen or wooden supports that were discovered in Fayum—hence their appellation—and in several other ancient Egyptian sites, their timeframe extending back to the first half of the 1st century AD and lasting through the end of the 4th century AD.<sup>7</sup> These portraits represent members of mainly middle class families associated

with the Greco-Roman bureaucracy in Egypt. They are relevant to the issue at hand in the case of the female portraits, in which the women are shown dressed in their finery, including their best and most valuable jewels. Some of the more frequent elements identified are gold pieces, amethysts, pearls and emeralds. The Fayum portraits are thus one of the best ways of proving how appreciated in Roman Egypt were emeralds extracted from sites like Sikait.

## CONCLUSIONS

The Wadi Gemal region offers a magnificent example of the organization and management capacity of the Roman Empire in arid lands. The exploitation of emeralds in mining settlements such as Sikait involved the creation of a complex network of structures in which free workers, slaves, civilian officers, military men and traders worked and lived under Imperial control. Thanks to the excavations and surveys carried out at sites, such as Sikait, but also in comparison with other Eastern Desert extracting areas, that is to say, the impe-

rial quarries, we can begin to understand how this network worked. Issues such as ownership of the mines, organization of production, living conditions of the resident population and control and distribution of extracted products have been addressed in a general way, yet the most obvious conclusion is that, for the moment, there are still more questions than answers regarding the functioning of the Smaragdus region in antiquity. More can be said once there is input of new data from continued archaeological excavations.

7 These portraits have attracted the attention of Western travelers and archaeologists since the 19th century. For the most part, however, they do not come from regular excavations and were purchased by museums and private collectors worldwide without proper documentation. This importunes their chronological classification, for instance, forcing most of them to be dated on the grounds of stylistic criteria alone. On these portraits, among others, see Parlasca 1969–2003; Corcoran 1995; Bailly 1997; Doxiadis 2000; Walker 2000; Uytterhoeven 2009. For a portrait *in situ* in a tomb from the early 2nd century AD in Marina el-Alamein in Egypt see Daszewski 2011: 452 and Fig. 30 (with references); Wilkinson 2003: Fig. 4.

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