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Ancient Quarry Techniques in the Ptolemaic Period in the Middle Egypt

Introduction

Ancient quarries around Akoris covering the area of Zāwiyat al-Sulṭān in Middle Egypt, which belong to the Ptolemaic and Roman periods, were investigated and excavated. We provide an introduction to the site and to our excavation, and offer a detailed assessment of the chronology of extraction techniques through observation of cutting trenches and analysis of wedge holes on the quarry faces. Dating of ancient quarries is difficult, however the evidence does not come only from the pottery but also a large number of Greek and Demotic graffiti were identified in Zāwiyat al-Sulţān, which provide a terminus post quem in the Ptolemaic period. Normally in those quarries, a block was defined at the quarry face by cutting trenches along the back and sides with a pointed chisel, and then split from the bedrock using wedges, or by applying levers to a continuous grove cut by a chisel. At the first appearance of wedges in ancient Egypt, the effect of the wooden wedges was limited, but due to the innovation of iron wedges the subsequent development gradually enhanced their power till stone blocks could be separate into required sizes and they introduced a mass production.

Fig. 1 - View of Zāwiyat al-Sulţān.

With the exception of a few sites in the Ptolemaic and Roman periods, such as Mons Claudianus and Mons Porphyrites, sites cannot tells us much about the date and the wider economy, but they can inform on demands both for extracting process and quarrying techniques. Although the quarry distribution almost strongly represents the main industry of Akoris, the existing data still makes it clear that the quarry of Zāwiyat al-Sulţān (fig. 1), which exists some 12km south of Akoris displayed considerable activity in the early Ptolemaic period (fig. 2). The quarry of Zāwiyat al-Sulţān consists of an undulating plateau of limestone denuded of the soil of fertile river plane and dissected by a tributary of Wadi Sheikh Yasin. The ancient quarry mainly shoes three parallel quarry faces running north to south and rising steeply, which reach heights of 2.5 to 7.5 m and are stepped back into the east mountainside. We offer a detailed assessment of the chronology of extraction techniques through observation of cutting trenches and analysis of wedge holes

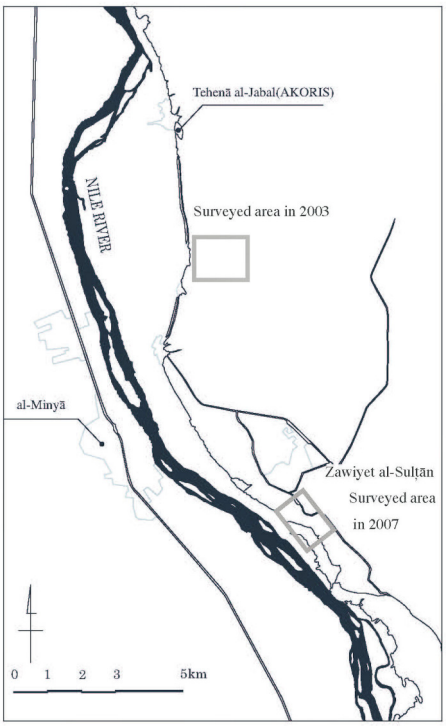

Fig. 2 - Southern Quarry surveyed in 2003 and Zāwiyat al-Sulṭān surveyed from 2004 to 2008.

trenches along the back and sides with a pointed chisel, and then split from the bedrock using wedges, or by applying levers to a continuous grove cut by a chisel. At the first appearance of wedges in ancient Egypt, the effect of the wooden wedges was limited, but due to the innovation of iron wedges the subsequent development gradually enhanced their power till stone blocks could be separate into required sizes and they introduced a mass production.

Reconstruction of extraction process

In the summer of 2007, we undertook limited excavations within the quarry with the specific purpose of clearing up some doubtable points of fact, including the inside of the cave, of which the top has been identified in 2006 (areas A and B in fig. 3).

on the quarry faces.

Dating of Zāwiyat al-Sulṭān

The total of 274 Greek and demotic graffiti were examined and photographed (fig. 3). On the chronology of graffiti, the 39th regal year is attested on some graffiti at middle terrace of eastern and northern sides of valley. Although both Ptolemy II and VIII are still the candidates to determine under whose reign the quarry was operated, Ptolemy II is definitely favoured due to the absence of the 40th (and later) year and the appearance of the third regnal year of another (most probably next) king on neighbouring graffiti. Dating of ancient quarries is difficult, however the evidence does not come only from the pottery but also a large number of Greek and Demotic graffiti were identified in Zāwiyat al-Sulṭān, which provide a *terminus post quem* in the Ptolemaic period. Normally in those quarries, a block was defined at the quarry face by cutting

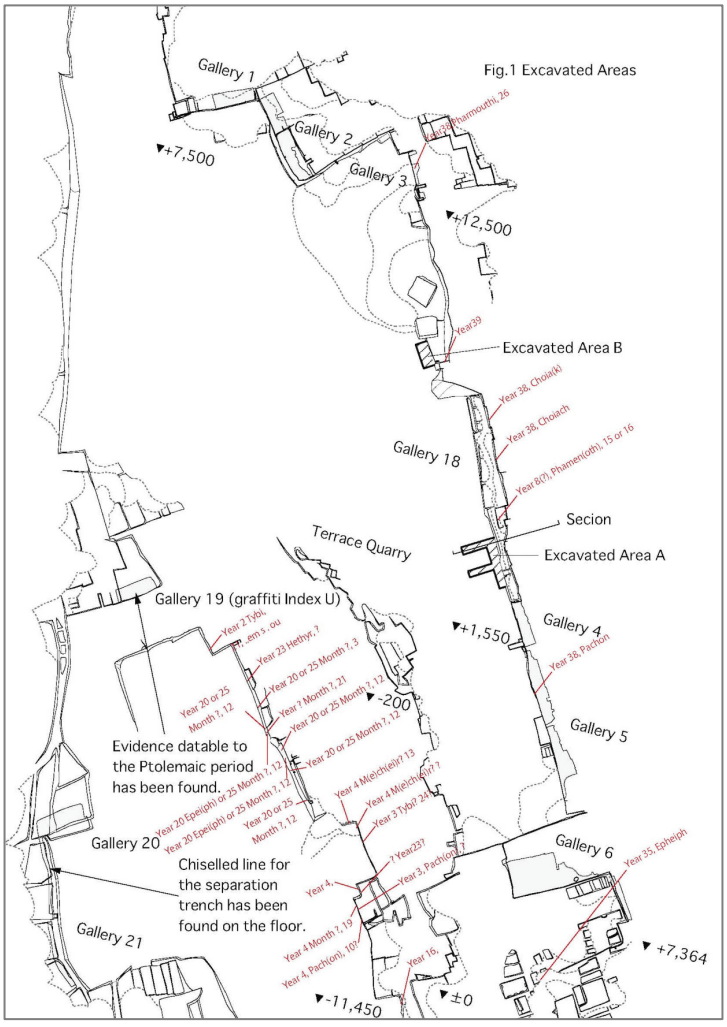

Fig. 3 - Greek and Demotic Graffiti found in Zāwiyat al-Sulṭān.

Normally a soft-stone block was defined at the quarry face by cutting separation trenches along the back and sides with a pick, and split from the bedrock, using wedges, or by applying levers to a continuous groove, however quarrymen actually begun to cut a hori-zontal trench beneath the top of the quarry face that limit the size of masses of extractable, usable limestone (fig. 4). The main purpose of the excavation is to reconstruct the process of making horizontal caves and to clarify their function, which occur at almost the same level through the whole quarry area. And then graffiti and the lines in red,

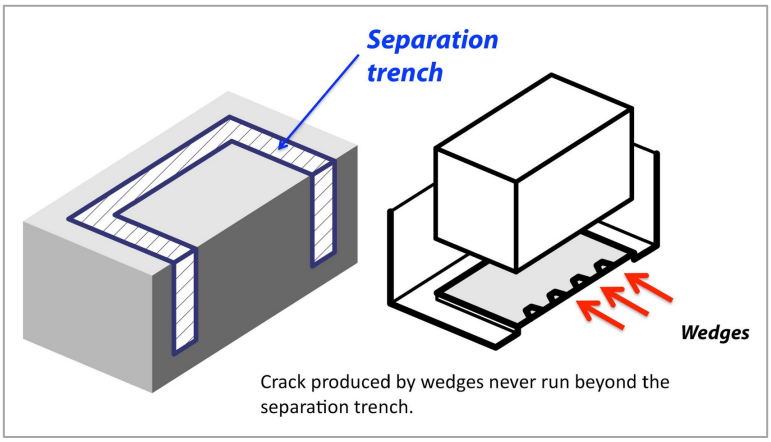

Fig. 4 - General Process of Extraction.

Fig. 5 - Photos of excavated areas and ceiling of the cav, Upper left: Excavated area A, Upper right: Narrow strip of holes (trapezoidal in section), Middle left: Excavated area B, Middle right: A stone block in the surveyed area of 2003, Lower left: Inside of the cave in area A, Lower right: Red lines and chisel marks on the ceiling of the cave.

which have been drawn with irregular spacing on the quarry faces and the ceiling of the cave, were carefully recorded and labelled to indicate where in the quarry they have been found, and finally we intend to elucidate their meanings. Removing the deposits covering the quarry floors was carried out, since any structural details which might further clarify the relationship between the quarry faces and the surface of the bedrock are hidden by the stone debris and later deposits.

Removing of deposits in two areas (A and B, fig. 3) revealed some of original construction and graffiti in the cave, but insufficient for dating evidence in removed deposits such as datable vessels; it was clear, however, that the cave is confirmed by the fact that on its ceiling we can observe graffiti readable as Year 38 and 39 and datable to the period of Ptolemy II or VIII in area A. Additionally datable evidence providing a terminus in the Ptolemaic period are the plates and jugs found during this season in the debris 5cm thick of Gallery 19 (fig. 5).

In area A, removed deposits covers three oblong trenches (Upper left in fig. 5); A-1 (measuring approx. 3.5 m by 0.80 m following the wall), A-2 (measuring approx 2.0 m by 0.80 m crossing at right angle to A-1), and A-3 (measuring approx. 2.0 m by 0.80 m running parallel with A-2).

Dumped over a large part of the removed area (fig. 6), directly on top of the quarry face, of which uneven surface at regular intervals helped ensure that stone blocks have been extracted from this bed rock, was a deposit 5-10 cm thick of sand and this layer is covered by a deposit 10-30 cm thick of sand including a

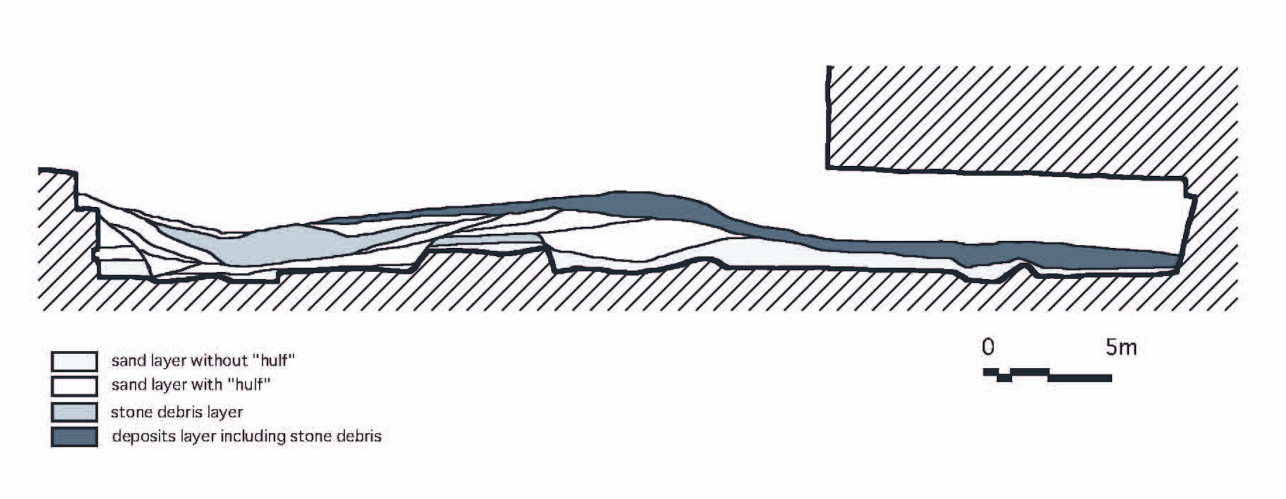

Fig. 6 - Stratigraphy of Trench A3.

Fig. 7 - The Floor of Gallery 20.

number of small and scattered piece of a plant, which has been called “hulf” by the natives. It is possible to see this late unknown activity after the termination of quarrying in the Ptolemaic period in the complex sequence of activities in this area.

It is still difficult to know how deliberate the whole process of the extraction was in detail, but the stage of making the horizontal cave is indeed clear (Upper right in fig. 5): two holes in the course of digging on the exposed vertical face has been guided by chiselled line on the top and trimmed to shape with a pointed chisel, on the rest of the face graffiti and a horizontal line have been left.

Inside of the cave, cleaving marks still remain around the innermost recess of the cave (Lower left in fig. 5) and masons could be more comfortable in working on uneven but roughly smoothed quarry floor. That an small stone block (measuring approx. 30 cm by 60 cm, 50 cm in height), the cleaving marks of which correspond exactly with a red line on the ceiling above (lines in Photo 4), was deliberately extracted and that its exact location position could be traceable would have been a very natural solution to the problem with production control and quality assurance. The ceiling has been trimmed by a flat chisel, the edge of which has approximately 0.6-0.8 cm blade.

In area B (Middle left in fig. 5), unfortunately, no direct comparison of the lines in red on the quarry face with the surface of the bedrock seems to be possible since the whole area is covered only by a deposit 30cm thick of sand lightly discoloured, and there no stone debris (chippings). And also a small stone block, which is abandoned in the half way of extracting, contains untrimmed wedge holes in shape of oval that could belong to the later period, which have been investigated in 2003 (see fig. 2 and middle right in fig. 5). The fact that the stone blocks have been extracted from quarry floor independently of a vertical separation trench running along the quarry face and a deeper trench crossing in right angle with it does encourage us to accept different periods of production of stone blocks. Generally speaking, as in soft-stone working, the separation trenches had to be carried deeper than the intended cleavage level. However this area does not follow this principle.

Additionally a chiselled line (not line in red) has been found on the floor of the Gallery 20 (fig. 7). However we may jib at specific suggestions, as to the process of extraction; cutting separation trenches and

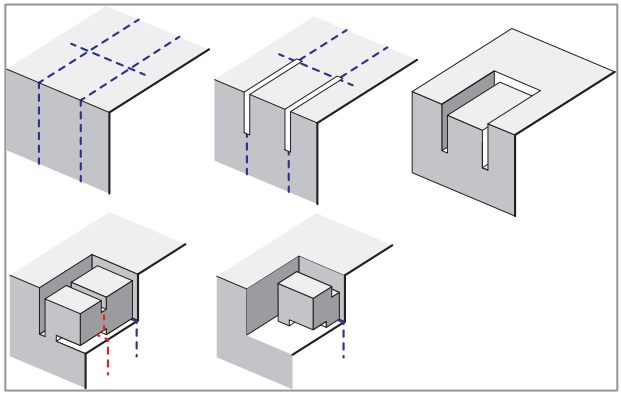

Fig. 8 - Reconstructed Process of Extraction.

splitting from the bedrock, we should endorse that general hypothesis, and relish the way this evidence brought the Greek-fashioned technique to the Middle Egypt in the Ptolemaic period.

The extraction process could be reconstructed in fig. 8.

Additional survey in environs of akoris

In the summer of 2007, we conducted an additional investigation of the caves, of which the entrances could be observed and identified some graffiti on those ceilings, which could not be read for the reason that a deposit have prevented from entering in the southern area lying on the hilltop beyond a hill from Akoris (fig. 9), which has been reported to be datable to the late Roman period in Akoris 2001. In this summer of 2008, we undertook limited excavations within the quarry with the specific purpose of clearing up some doubtable points of fact, including the inside of the caves (A, B, and C in fig. 10).

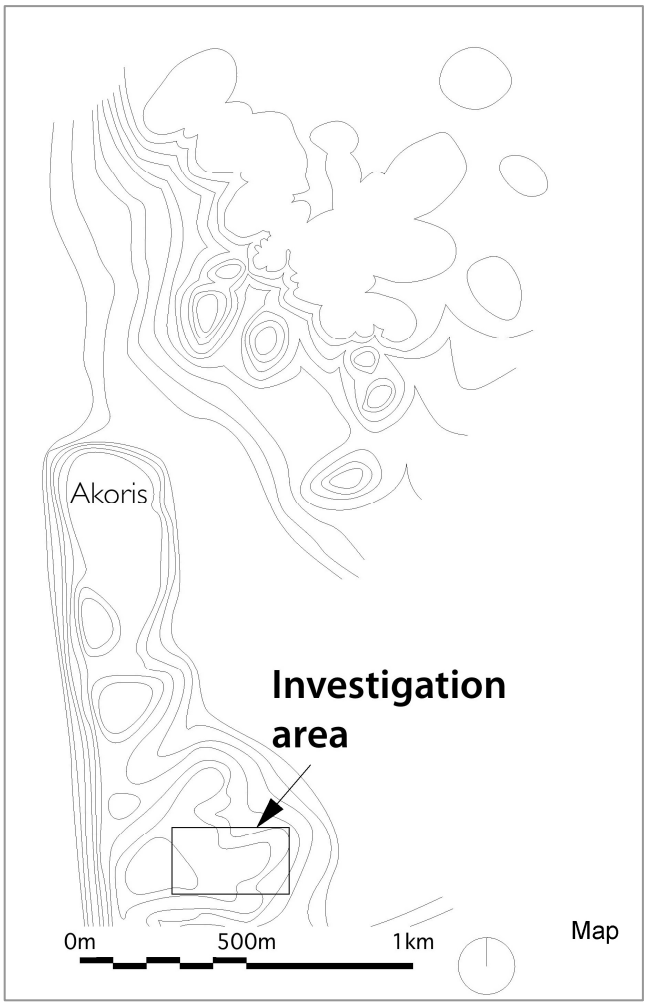

Fig. 9 - Surveyed Area in 2008.

Fig. 10 - Investigated Caves in Surveyed Area in 2008.

Fig. 11 - Roman Quarry in Surveyed Area in 2008.

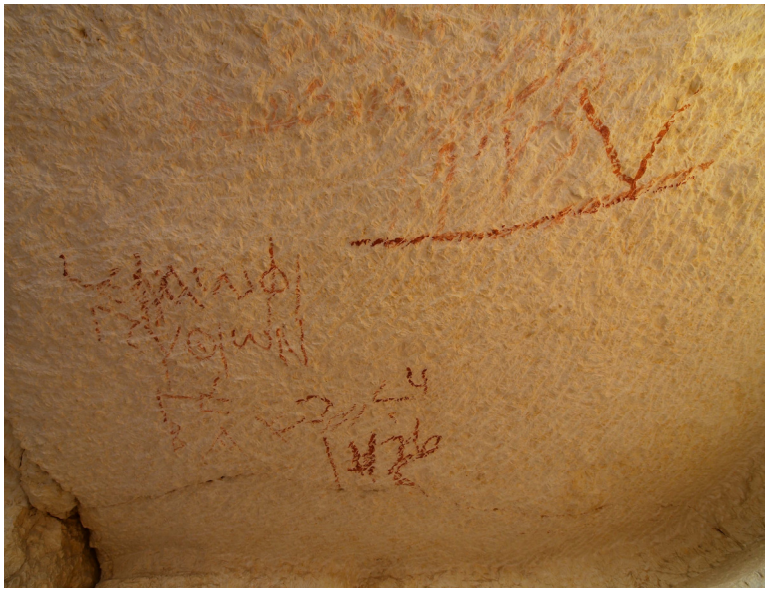

Fig. 12 - Greek and Demotic Graffiti on the Ceiling of Cave B, which is similar to those in Zāwiyat al-Sulṛṭān.

As it has been reported, in this area a white marble block was defined at the quarry face by cutting separation trenches along the back and sides with a pick, and split from the bedrock, using wedges, or by applying levers to a continuous groove. Here quarrymen actually begun to cut a horizontal separation trenches following the cracks, which have been produced by wedges (fig. 11) in the Roman period. However the caves which are similar to those in Zāwiyat al-Sulṭān datable to the years of Ptolemy II, have been identified and, as a consequence, we should not dismiss the possibility that a quarry which belongs to the Ptolemaic period could be included in this area.

The main purpose of the excavation is to collect the graffiti and to clarify their date, which occur on the ceiling of the caves, the other two entrances of which have been identified on the south of the cave found in the last season and the whole quarry area has been additionally briefly measured. And in this season the graffiti and the lines in red, which has been drawn with irregular spacing on the quarry faces and the ceiling of the cave as observed in Zāwiyat al-Sulṭān, were carefully recorded (fig. 12), and finally we intend to elucidate their meanings and to compare with those in Zāwiyat al-Sulṭān. Removing the deposits covering the quarry floors was carried out, since any structural details which might further clarify the relationship between the quarry faces and the surface of the bedrock are hidden by the stone debris and later deposits (fig. 13). That the later Roman activity of the quarry, the essential characteristic of which is the wide application of wedges, resumed on the upper part is confirmed by the fact that the deposit contains a couple of fragments of pottery datable no earlier than the early Roman period (fig. 14).

The Greek and demotic graffiti were examined and photographed. On the chronology of the graffiti, the 5th regal year is attested on some graffiti on the two ceilings. Although Ptolemy III is the candidates to determine under whose reign the quarry was simultaneously operated with Zāwiyat al-Sulṭān, the caves of which have ceiling (65-70 cm in height) under the average height in this area (75-80 cm), the conclusion that Zāwiyat al-Sulṭān has been operated at the same time cannot be drawn from the preliminary result of the inve-

stigation in this report. We need further analysis of the graffiti and have to wait the result of excavation of a huge stone block located on the north end of this area, which could be expected to be the colossus under operation[1].

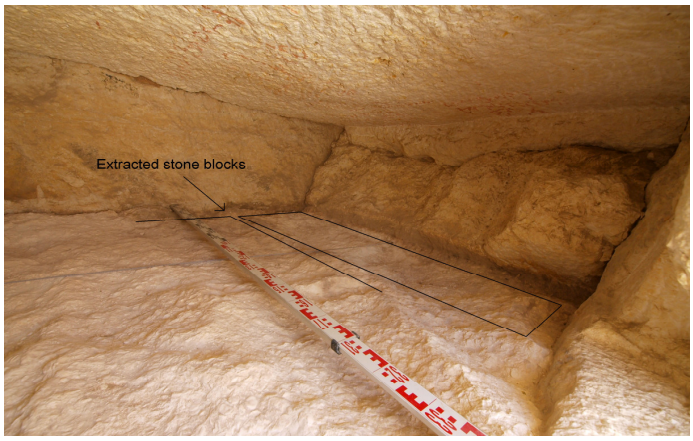

Fig. 13 - Inside of the Cave B, which is also similar to that in Zāwiyat al-Sulṭān.

Fig. 14 - The Wedges in Roman Quarry in Surveyed Area in 2008.

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