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Preliminary evaluation of selected granite and limestone deposits, Egypt

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REPORT

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Preliminary evaluation of selected granite and limestone deposits, Egypt

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Summary:
Together with consultant Arne Johansen, several deposits of granite and limestone in Egypt were visited. The deposits are either claimed by Granita, or the company is considering claims in the deposit areas.

Based on visual inspection of the deposits/quarry sites, recommendations for further exploitation and prospecting are given.

Keywords: Mineral resources	Dimension-stone	Granite
Limestone		

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1. INTRODUCTION

Several deposits of limestone and granite were visited between April 10th and April 17th 2000. The purpose of the investigation was to give a preliminary evaluation of the extraction potential and quality of these deposits. Localisation of the deposit areas are given in Fig. 1. This report focuses on some aspects of the deposits, and gives recommendations for future work by the Granita company. More technical features will be treated by consultant Arne Johansen: this report is intended to supplement his recommendations.

2. SHEIKH FADL LIMESTONE DEPOSIT

The area was visited April 11th, with the assistance of the ISO Marble company. The deposits are located 350 km from Cairo, and due to the distance, we were only able to use two hours in the area.

Several quarries operate in these deposits, following a horizontal, thick-bedded, massive limestone formation. The limestone in the area varies from yellow to almost white, the coloration depending on the content of iron-staining along stylolites (zig-zag 'lines'), grains and fossils. In most places, the limestone appears massive, with the spacing of vertical to sub-vertical fractures of more than 5 metres. The limestone formation is flat-lying, and the quarries seem to operate within the same level of the formation, concentrating along a specific level of altitude.

The deposits form smooth, rounded hills, easy accessible from the small valleys. On this trip, we were only able to take a closer look at one of these quarries, operated by ISO Marble.

Example: the ISO Marble quarry

The quarry visited is located on the northern part of a smooth, rounded hill. 6 metres of the limestone is worked. Most of the limestone in the quarry face consist of yellow limestone of good quality (Fig. 2 and 3). Only 1.2 metres (appr. 1.8 metres from the bottom of the quarry) is of the whitish type of poorer quality. The quality beneath the exploited part of the deposit is unknown.

Towards the south, ISO Marble's permit area continues appr. 175 metres, and several hundred metres towards the west. Estimated reserves of limestone by continuing the exploitation 100 metres towards the south in a 90 metres width reach a total of 54000 cbm. (yellow 43200 cbm, white 10800 cbm.). The whole permit area contains at least four times as much volumes of rock, and a possible continuation downwards would contribute to further increasing the reserves.

The thickness of the individual limestone beds (minimum block measure) are more than 1 metre, and the spacing of vertical fractures are more than 7 metres. In other words, the block yield seems high (low waste ratio).

Primary extraction is carried out by drilling/blasting of one vertical face, using natural vertical fractures as the other. The limestone splits easily along natural beds without the need for horizontal drilling. Secondary shaping of blocks is done by wedging.

Other quarries

There was no time for investigation of the other quarries in the area, but they all seem to operate in comparable formations of limestone. According to the ISO Marble, all the quarries exhibit the same type of limestone, e.g. a combination of yellow and buff white limestone, with the former as the most common type. There seem to be a large potential for reserves in the area, both inside and outside the existing quarries. With few exceptions, the quarries are exploiting massive limestone with a high spacing of fractures, and the potential for large commercial blocks looks promising.

Drilling and blasting is the most common extraction method, as described for the ISO Marble quarry. Most likely, the introduction of diamond wire sawing would contribute to increase the block yield and rate of extraction considerably.

Before opening of new quarries in the area, detailed geological investigations such as logging/mapping of vertical variations within the formation and the horizontal extension of the different types is of vital importance. Furthermore, as steeply inclined faults causing vertical emplacement of the marble beds are common in such deposits, a geological interpretation of possible fault occurrences within deposits should be carried out.

In such investigations, a core-drilling program would be extremely helpful. The core-drilling equipment owned by Granita will probably be useful for such prospecting, at least far more appropriate for limestone than granite.

Conclusions:

- **The limestone deposits are considered to be highly interesting regarding the extraction of large volumes of commercial blocks.**
- **The possibility of locating large volumes of the yellow, most interesting type of limestone seems high**
- **The introduction of diamond wire sawing would probably be of considerable value**
- **Geological investigations of use for future quarrying will be easy to carry out, especially since Granita employ their own geologists, and seem of vital importance for securing the location of the best available quality of limestone**
- **It should be checked out if there exist geological maps of these deposits, e.g. by the Geological Survey of Egypt or other governmental institutions**

3. HADIDSOLB 2 GRANITE DEPOSIT

The deposit measures appr. 90 x 90 metres, and occurs on the slope of a small hill (Fig. 4). On the surface, it appears massive and homogeneous, compared with the surrounding hills of more fractured material. Trial quarrying is being carried out by Granita, and the first results of this has been available during the work with this report.

The colour of the rock (as seen on the recently opened quarry face) is pinkish grey with a yellow tone. It appears less 'yellow' and somewhat darker than the granite which is exploited in the nearby quarries (Fig. 5). In addition, hematite occurs within some grains of feldspar, resulting in dark red spots on a polished surface.

The yellow hue in granites, which are quite attractive on the market, is formed by alteration/weathering, in which iron from silicates or sulphides is 're-deposited' as iron hydroxides along grain boundaries or micro-fractures. Thus, the colour is dependant on grade of weathering or alteration, and can therefore be subject to significant variation within short distances. It seems that the Hadidsolb 2 deposit has undergone a slightly different alteration process, where iron rather is bound in dark red hematite 'dust' rather than as the yellow hydroxides.

Since the colour of the Hadidsolb granite deviates quite significantly from its neighbours, it would be of vital importance to clarify whether the colour is sufficiently attractive for the market or not. For this purpose, trial blocks from the deposit would, of course, be useful. When evaluating polished slabs of the granite, one should also look for a silver- to bluish play of colour within the feldspar grains.

The trial quarrying showed the occurrence of thin 'veins' (fractures filled with fine-grained dark material), closely spaced (less than 0.5 metres, multiple directions). These 'veins' are open at least down to 3 metres depth. Inspection of the weathered rock surface outside the trial quarry indicate that such 'veins' are common in the area (Fig. 6 and 7). Furthermore, they are formed by tectonic 'crushing' of the rock, and are therefore a phenomena which is not restricted to the surface part of the deposit. In our opinion, the occurrence of such 'veins' clearly reduces the possibilities of extracting large blocks and, even if they 'grow' towards the depth, will act as 'planes of weakness' in slabs and reduce the market value.

At the time of writing, the surface of a new area within the deposit has probably been cleaned by flame torch. If this surface shows the same close spacing of veins as seen in the trial quarry, we would not recommend any further work in this deposit.

Conclusions:

- **The colour of the Hadidsolb 2 granite deviates from quarries in the neighbourhood, and market conditions should therefore be investigated before a permanent quarry operation is set up**
- **The occurrence of 'hairline' veins acting as open fractures in the trial quarry is disturbing. If the same problem is present at the other area designated for surface cleaning, we consider the deposit to be of to poor quality for the extraction of blocks.**

4. HADIDSOLB 1 GRANITE DEPOSIT

This deposit occurs approximately 2 km from Hadidsolb 2, and is a granite boulder deposit (Fig. 8). Inspection of the granite surface indicate that this type is an attractive yellow granite, more comparable with quarries in the area operated by other companies than the Hadidsolb 2 deposit.

An almost unidirectional jointing (fracturing) is seen in the deposit. These joints are steeply inclined (appr. 70 degrees) and the spacing between them varies from 0.7 to 3 metres, averaging 1-2 metres.

The deposit is not optimal as a source of granite boulders, but we still consider that there are possibilities for economic sustainable exploitation.

Trial splitting of one boulder was recommended and will be carried out.

Conclusions:

- **The Hadidsolb 1 granite seems to be of attractive yellow colour**
- **The boulder deposit exhibits parallel, steeply inclined fractures, averaging 1-2 metres spacing**
- **Quarrying will not be as optimal as in some of the other quarries in the area, but possibly could still be economic**
- **Trial splitting of one boulder was recommended**

5. 'WHITE GRANITE DEPOSIT' CLOSE TO SHULEMAN

A pilot quarry of grey-white, coarse-grained granite close to the Shuleman quarry was visited (Fig. 9). During pilot extraction, rusty spots in the granite was discovered (Fig. 10). These spots are the result of weathering, where iron is leached from pyrite and iron silicates, and re-deposited as brown iron hydroxides in micro-cracks and along grain boundaries.

Since the brownish colour is unevenly distributed and contrasts much with the background colour, it is considered to have a negative effect on the market, in difference to the yellow granites described above.

The weathering causing such staining can go much deeper than the exposed part (appr. 2 metres), and before any more exploitation is done, core drilling at 2-3 localities should be carried out.

Conclusions:

- **The granite contains rusty spots caused by weathering/alteration, probably extending downwards to at least 5-6 metres**
- **Vertical extension of such spots could be investigated by core drilling at 2-3 localities**
- **Alternatively, no more exploration work should be done on this deposit**

6. HEIMAR GRANITE DEPOSIT

The Heimar granite is a white, medium- to coarse-grained tonalite, composed of plagioclase feldspar, quartz and black and white mica as the main minerals. Two trial quarries have been opened on either side of a small hill (Fig. 11).

Veins and pegmatite bodies are abundant. The former include straight, vertical pegmatite veins and veins of fine-grained tonalite. The pegmatite bodies can have a highly irregular shape, and the second trial quarry is established in the middle of one of these pegmatites. However, immediately behind this opening, 'clean' rock is found.

Cleaning of weathered surfaces by flame torch would be the best method of evaluating the occurrences of veins and pegmatite, and is highly recommended on both sites.

More diffuse colour variations may be found in the area. Small variations in the content of dark minerals change the appearance of the rock, where a high amount of dark minerals gives a more greyish colour. In addition, zones of layering (interchanging grey and white granite) are seen, predominantly in the lower part of the first trial quarry (flame torch channel – Fig. 12). Such colour variations can be difficult to predict, but core drilling would be the best method.

Conclusions:

- **There are interesting possibilities of finding sufficient volumes of white granite in the deposit, but diffuse variations in colour (white and slightly more greyish) may occur**
- **Cleaning of weathered surfaces by flame torch is of vital importance in both trial areas before deciding which place to start, to investigate the content of veins and pegmatites**
- **For obtaining more knowledge of diffuse colour variations, core drilling (e.g. 2 holes of ten metres in each area) is preferable**

7. BOULDER DEPOSIT CLOSE TO THE HEIMAR AREA

A small boulder deposit occur close to the formerly described white granite at Heimar. This granite has a higher content of black minerals than the Heimar one, giving a more greyish appearance. Diffuse banding (white 'veins') seems to be quite common.

Conclusion:

- **This boulder deposit is small (maybe five months of production) and does not exhibit the same attractive white colour as the Heimar granite**

8. SHULEMAN QUARRY

The quarry contains massive deposits of a dark grey, fine-grained tonalite 'granite', but is commonly 'infected' by irregular pegmatite 'pockets', regular (straight) pegmatite veins, fine-grained veins and a diffuse banding (lamination). In a regular production of commercial blocks, such features cannot be avoided; only small portions of the deposit consist of 'clean' grey granite without such. Thus, the Shuleman granite will be most suitable for purposes where some content of veins etc. could be tolerated. For export, we believe the possibilities are less interesting.

The 'cleanest' part of the deposit seems to be in the central part, i.e. the part which at present time is being worked. There are no indications that the opening of new quarry sites in the surrounding part of the deposit will give any better results.

Both for the remaining production for the library and for continuous extraction we regard the best potential to be present in this central part.

Conclusion:

- **Veins and lamination are common features in the Shuleman quarry, reducing the possibilities of exporting raw blocks**
- **The cleanest area of the deposit is within the central part, in the continuation of today's production area**

9. TRIAL QUARRY CLOSE TO THE SHULEMAN QUARRY

Approximately 500 metres away from the main quarry, trial production has been carried out on a smooth, low hill. Inspection showed that veins and irregular pegmatites are common, as well as a distinct 'gneissic' banding. In addition, large inclusions of gabbro occur in the granite.

All in all, this deposit appears to contain less 'clean' granite than the main quarry.

Conclusion:

- **The possibilities of finding 'clean' grey granite are considered to be lower in this deposit than in the main quarry area**

10. SOME COMMENTS ON EXPORT POSSIBILITIES

For export of commercial blocks, it is of vital importance that the blocks do not contain veins and inclusions, and that they exhibit a uniform colour and structure. Prices on the export market are somewhat difficult to predict, since they are subject to 'fashion' and customers taste. However, we will try to estimate a price range for the different qualities of granite pr. cbm, based on large blocks (at least 120 x 100 x 240 cm) delivered nearest port.

The Shuleman granite will compete in a highly competitive segment in the market, and would give a low price, probably less than 400 USD. Veins and lamination would not be tolerated.

The Heimar granite will probably belong to a medium price range (appr. 6-800 USD). Veins will not be tolerated, diffuse colour variations will reduce the price.

The yellow variety of the Hadidsolb granite could obtain higher prices (appr. From 600 to 1000 USD). The darker type would probably give a much lower price.

We emphasise that these price estimates are based on comparison with similar rock types in the market, and that prices may be subject to fluctuations and to highly 'irrational' and unpredictable changes due to varying personal taste among customers.

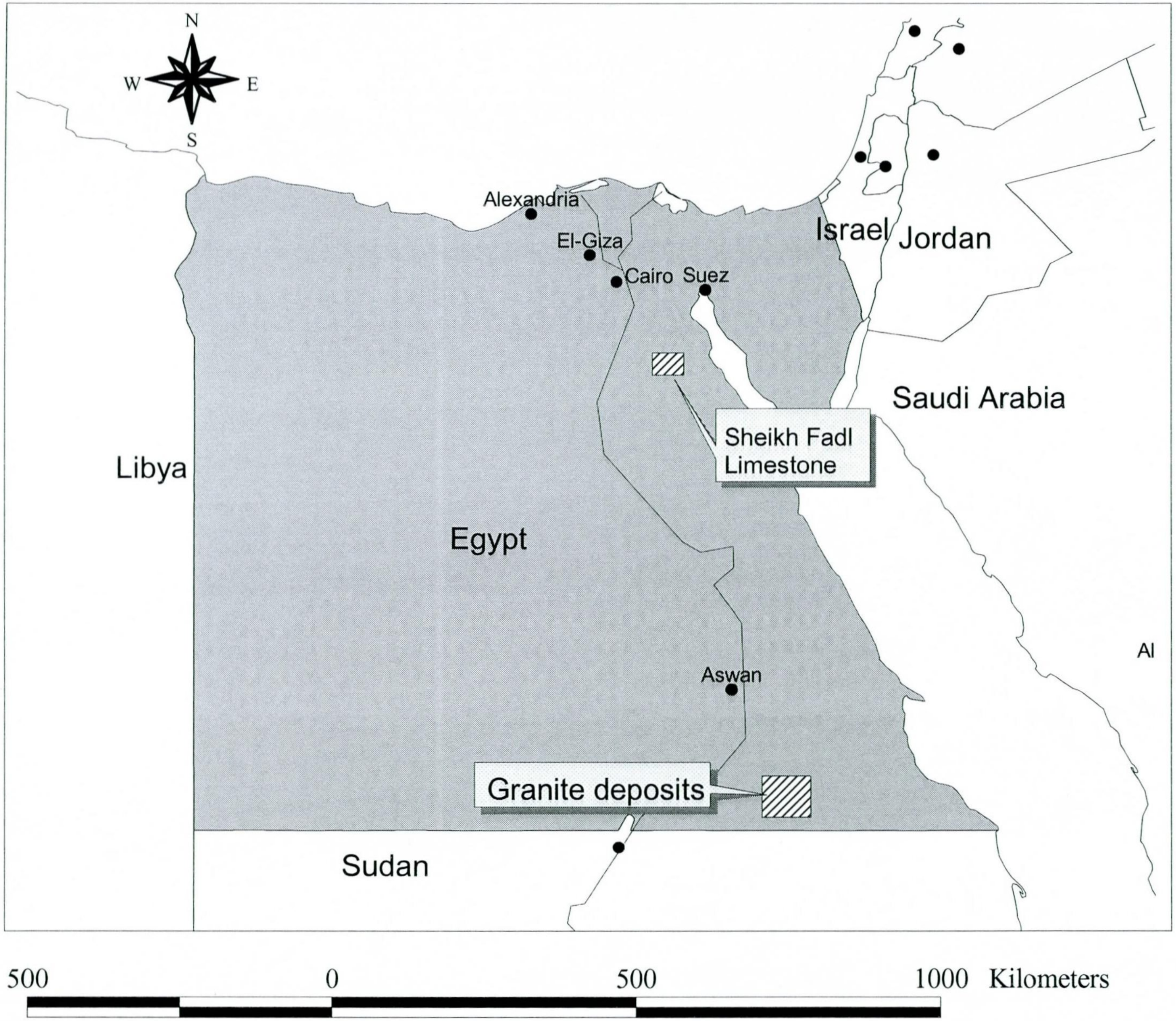

Fig. 1
Location map showing deposit areas visited april 2000.

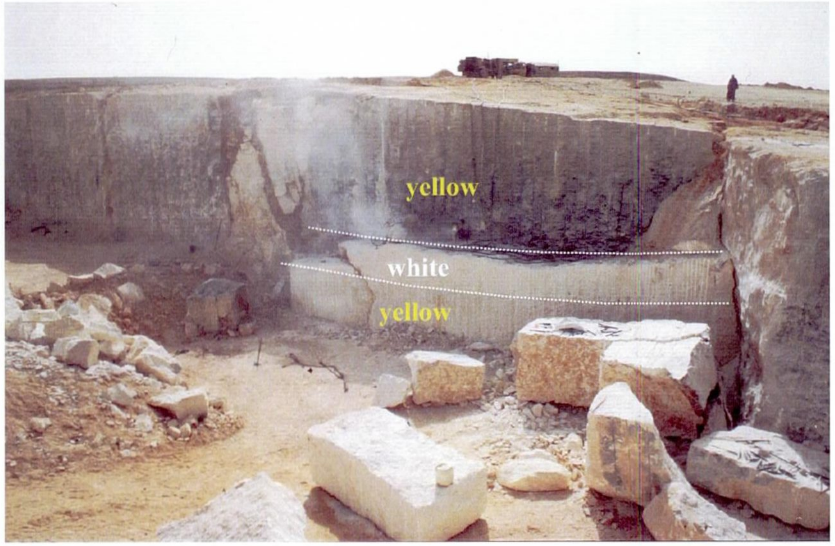

Fig. 2. ISO Marble limestone quarry, Sheikh Fadl. Distribution of limestone types in the quarry is shown on the photo.

Fig. 3. Typical section of yellow, attractive limestone in the ISO Marble quarry, Sheikh Fadl (wet, rough surface). Diametre of drill holes are appr. 35 mm.

Fig. 4. Trial quarry in the Hadidsolb 2 granite deposit.

Fig. 5. Colour difference between yellow granite from the 'Mohammed-quarry' (centre, marked by white line) and typical samples from the Hadidsolb 2 deposit. Diameter of the white circle is appr. 20 cm.

Fig. 6. Thin black veins (cataclastic) in the Hadidsolb 2 granite (see red lines close to arrows). Red pencil (5 cm) for scale.

Fig. 7. Detail of black cataclastic veins in the Hadidsolb 2 granite. Colour pencil for scale.

Fig. 8. The Hadidsolb 1 deposit, seen from the top of a small hill.

Fig. 9. Trial quarry, 'white granite deposit', close to Shuleman.

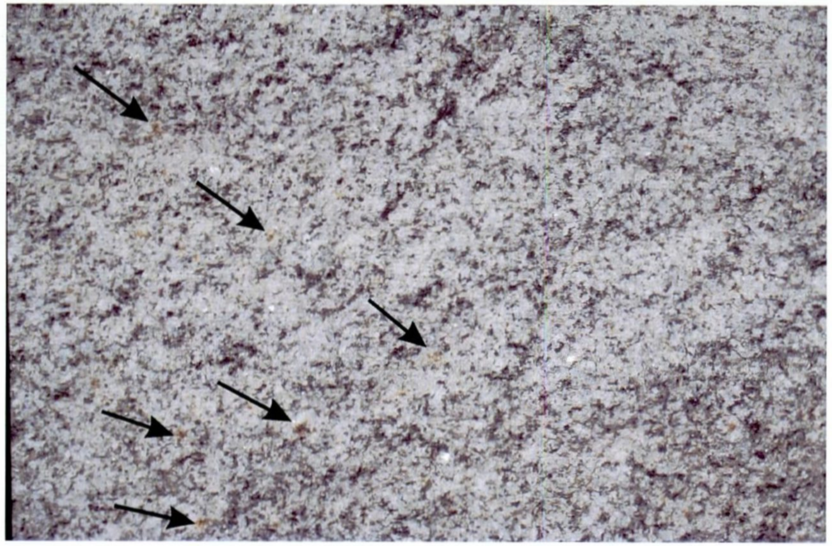

Fig. 10. Rusty spots in white granite close to Shuleman (see arrows). Width of photographed area appr. 50 cm.

Fig. 11. Exposed area in the Heimar deposit (site 1), looking down towards trial quarry.

Fig. 12. Diffuse grey-white banding in white granite, Heimar deposit in a flame torch channel (site 1). The channel is appr. 20 cm wide.