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SURINAME

Technical Report: Plan Outline for an Integrated Stone Development Project*

Prepared for the Government of Suriname
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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Vienna

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INTRODUCTION.

This report deals mainly with the progress made since the last visit of the expert in July 1982 when a plan outline for an integrated stone development project was submitted.

The principal follow-up was the preparation of a number of reports by Consulting Services N.V. Paramaribo and others, covering mainly several of the best known granite locations and their possible reserves and qualities.
These reports together with work done by the Geological and Mining Service (G M S) in identifying stone resources can be regarded as a start of the general stone resources inventory of Suriname. The most recent report has been prepared by Geoconsult in February 1985.

Due to a shift in priorities the follow-up project, which was originally foreseen and approved in a project-document by the government and UNIDO in 1982, was not carried out. However, a first stoneworking enterprise, N.V.Granite (N V G), involving considerable investments was set up in 1984 and enabled the government to reassess the situation in light of the experience of this enterprise, which is working granite resources presently for the domestic market. The present output of this plant is taken up completely for domestic consumption.

The reassessment included a decision by the government to reserve some deposits for a national dimension stone industry and to consider the establishment of a processing plant at a suitable location near the extraction site, to cut down transport costs.

Such a decision is in line with the interest of the government to diversify the exploitation of domestic mineral resources, especially for export. The present granite enterprise NVG, even without completing the geological investigations or paying attention to planning as required in modern quarrying, cannot meet the full domestic demand for granite, not to speak of export.

These facts underline the necessity to expand and speed up the phasing in the 1982 "plan outline". Action should now include the evaluation of granite prospects in the light of the 1982-1986 developments and to lay down guidelines for future activities by government and industry.
Due to the shortness of the present mission only the Patamacca granite deposit was visited.
The deposit is considered by government as a desirable prospect for reasons which include its workability, the nearness to the main market i.e. Paramaribo with a possibility of river transportation, and lastly the granite was acclaimed as the most popular of 9 varieties shown during a public poll at the 1984 Production Fair in Paramaribo.

Progress since the 1982 mission

Work recommended during that mission was carried out mainly by GMS and Consulting Services N.V. and inventories made along 1800 km of road, involving the checking of some 200 locations and 400 samples taken. Of these, 39 locations were recommended for additional examination resulting in a "short list" of 26 localities.
There are now some ten localities which warrant industrial investigations, including the Paris Jacob prospect which is presently quarried by N.V. Granite.

Present findings and potentials

In line with the request of the government main attention was focussed during the present short mission on a national stone industry based on the Patamacca"Kale Rots"deposit where a quarrying operation is presently being planned by the government.

The Patamacca granite at"Kale Rots"is a stock like feature which is part of an underlying granitic complex, probably a batholith consisting mainly of bi-mica granite of Trans-Amazonian Orogeny age, one of the younger in N.E. Suriname, a fact which accounts for the freshness of the material and makes it eminently suitable for industrial purposes.

The intrusive contact of the complex is visible on aerial photographs with a clear relief and predominantly westward drainage pattern, emphasized by tentacle-like sills and ridges at the "Kale Rots" outcrop.

The area has been investigated by GKS and surveyed by plane-table on a 1:1000 scale with a contour interval of 1 m.

There is no overburden to speak of, which facilitated the drilling programme designed to check the uniformity of the deposit, to enable the estimation of reserves and quality, and to prepare a mining programme.

The rock consists of about 30% free quarts, mainly rounded, often concentrated into clusters with as other main minerals, 60% feldspars in the form of megacrysts (roughly 25% albite-plagio-

clase and 35% microcline-alkalifeldspars, generally occurring as the larger crystals of the two) and 10% mica (about 3% muscovite and 7% biotite).
Accessory minerals include pyrite, apatite and tourmaline.
At a few places (e.g. near drill hole PA 16 see map) small pegmatitic pockets occur of quartz, feldspar, mica and tourmaline.

The colour of the rock is grey with a bluish sheen due to the feldspars. Occassionally xenoliths of mica are distributed throughout the outcrop.

Nearly everywhere on the "Kale Rots" the rock is exposed, except in the eastern part where an overburden of black clayey sand, not exceeding 1 meter in depth, is present.
The rocks are covered by lichens, the weathering being very superficial and mainly confined to a few centimeters as far as can be observed both on the surfaces and the drill cores (in the eastern section the weathering is deeper and referred to in the paragraph below on cores).
Faults and fractures are very rare, the rock apparently has not been tectonized.
Some joint-trends appear to be indicated, but no open joints have been observed. These trends may indicate easy splitting directions and require further examination, as they will facilitate quarrying.

To sum up, the granite is massive and coarse grained, with large feldspar crystals. No preferred orientation is obvious but may be present. The rocks seem fairly homogeneous although the amount of mica (biotite) and the size of the feldspar crystals is somewhat variable.

Small xenoliths, a few cms in size are a common feature, their composition being mainly biotite with some muscovite. Locally, especially near the margins of the outcrop, lenses of fine-grained porphyritic granite rich in biotite are found.

A drilling programme was carried out by GMS from January 1986 until April 1986.
Diamond drilling was performed on 22 holes with a total depth of 220.48 m, with diameter NX and BX sizes, 21 holes were drilled to a depth of 9 m and 1 hole to a depth of 30 m.
The latter to ensure information on the continuation of the granite prospect.

The core recovery was practically 100% and the cores are generally large unbroken pieces, with lenghhs of 3 meters which is a good indication of the soundness of the material. Fractures and faults are rarely encountered.
However, in one hole (PA 1 at 3,28 m depth) drilling water seepages were observed.

Generally the zone of weathering at the surface is not more than a few centimeters thick.
However, in the extreme eastern part of the prospect, overburden of black clayey sand is found (less than 1 meter thick) and there the rocks were found to be weathered up to 2.60 m (at an overburden of 85 cms.).
Where the granite reported is different from the generally observed rochtype, it is finer grained and contains more biotite. The feldspars megacrysts are smaller and scarcer. The porphyritic biotite granite occurs in lenses from a few centimeters up to 1 meter in thickness especially near the margins of the granite stock. The amount is rather subordinate. In general it can be

stated that the rocks look very sound and fairly homogeneous.

With reference to the various phases recommended in the 1983 report, starting with phase I, an adequate part of the preliminary inventory has been carried out except for the preparation of industrial samples. This was mainly due to the lack of appropriate sawing and polishing equipment available to the GMS.

Of phase II systematic mapping of selected outcrops has taken place, and the location, set aside for a national operation, has been surveyed by plane table and drilled for reserves estimation, this site will serve as a model pilot quarry for operation by the government. In addition to the drilling for the model pilot quarry another 200 meters have been drilled during the inventory investigation.
Of phase III the government is presently only interested in the model pilot quarry at Patamacca and detailed planning for this quarry including a processing plant is presently under discussion.

During the visit to the Patamacca prospect site, areas for the extraction of industrial sample blocks (80 x 80 x 100 cms.) were selected and marked to be removed by stitch-drilling.
Penetration rates should be recorded.
Also several possible convenient opening locations for the quarry were discussed and noted.

The volume of the visible granite mass is possibly around 340,000 cu m from which a weathering zone of 10,000 cu m should be deducted. This weathering zone accounts for 10% of the area which has an average weathering depth of 2 m as indicated by

several boreholes in the eastern part.
Considering the industrial life of the predictable hill side quarry to be a maximum of 1½ years the gross pay material would allow the quarrying of 340,000 - 10,000 cu m = $\frac{330,000}{15 \times 12}$ which is per month 1800 cu m.
Considering that an estimated 25% part of the outcrop is ridge-rill like with rounded edges, only an effective 1350 cu m per month of granite is quarryable. To calculate the amount of industrial granite blocks extractable, quarry waste of 70% including loss through cutting, topographical and tectonic features is to be taken into account and a monthly production of 405 cu/m industrial blocks of various sizes and qualities would then be possible. There remains a possiblity to extend the life of the quarry by considering the development of a pit quarry. This can be done while the present prospect is being developed or after the hillside quarry has reached the 30 meters contour level. In this case the watertable will have to be taken into account.
When considering the optional starting operations of the pit quarry, increased production costs due to greater working depths are to be taken into account. Taking into consideration the potential of the hillside prospect the production will enable the manufacture of 14,175 sq. m of mixed products (slabs, tiles and tombstones) per month i.e. 170,100 sq m per year.

Until a market is established it is doubtful that such quantity could be sold for export in the first year of production, especially as the colour is grey and not unique.
The ornamentation provided by the feldspar crystals may be a possible selling feature which can

only be proven by demand after the first slabs will have promoted and marketed. Assuming the price of rough blocks a granite could fetch on the international market US $ 150,- as suggested by the consultants and assuming that a full production would be sold in block form, which is unlikely, the maximum return from the quarry operation would be US $ 729,000,-.

Future actions

Since the government requested the assistance of the expert to give priority to examine the possibilities of starting an operation based on the Patamacca quarry, the few days stay in Suriname were mainly devoted to the above evaluation and involved the establishment of priorities in any future actions.
All the documentation prepared by local consultants and the GMS were examined, scrutinized and discussed with the Director of the Ministery of Natural Resources and Energy, the Director of Grassalco, the Consultants and the GMS Staff concerned. In addition an informal lecture on stone technology was presented to a group of interested parties including Association of Manufacturers (ASPA), Engineers, Architects, Potential Investors, University, Investment Center and Export Promotion (Centrum INDEX).

From the description of the Patamacca quarry, which was visited together with the Director and Chief-Geologist of the GMS, it appears that the government policy to follow-up the present potential of this project is recommendable. However, the investment estimated and scheduled should be revised together with the GMS staff and possibly in conjunction with an international Consultant not dependent of equipment Manufacturers as done presently.
It is imperative that the sawing and polishing equipment for testing should be ordered as top priority in order to be able to evaluate industrially, the large quantity of sample and stone material collected during the inventory activity by Consulting Services and GMS. In addition structural factures of the selected deposits of

the inventory should be reviewed by the GMS. The short list should be evaluated for priorities, plane tabling and further drilling. A start can now be made with a catalogue "Stone in Suriname". The GMS will review its requirements for additional missions of an international consultant to assist in the carrying out of the actions proposed and will submit its findings to the National Planning Office. At the same time it will also review the Integrated Stone Development Project of 23 October 1982, especially with regard to required fellowships and equipment.

The possibility has been discussed of a regional Stone technology workshop, to take place in the Caribbean and hosted by the Surinam government, in 1987.

Quarrying and processing needs will be identified when the evaluation of the prospects as, discussed with government during the present mission, is completed. The present extraction for industrial samples can be executed with equipment available in Suriname.

Summary of Recommendations

(in order of priority)

1. Procurement of testing equipment, cut off sawing and polishing machines.

2. Commencement of Catalogue "Stone in Suriname"

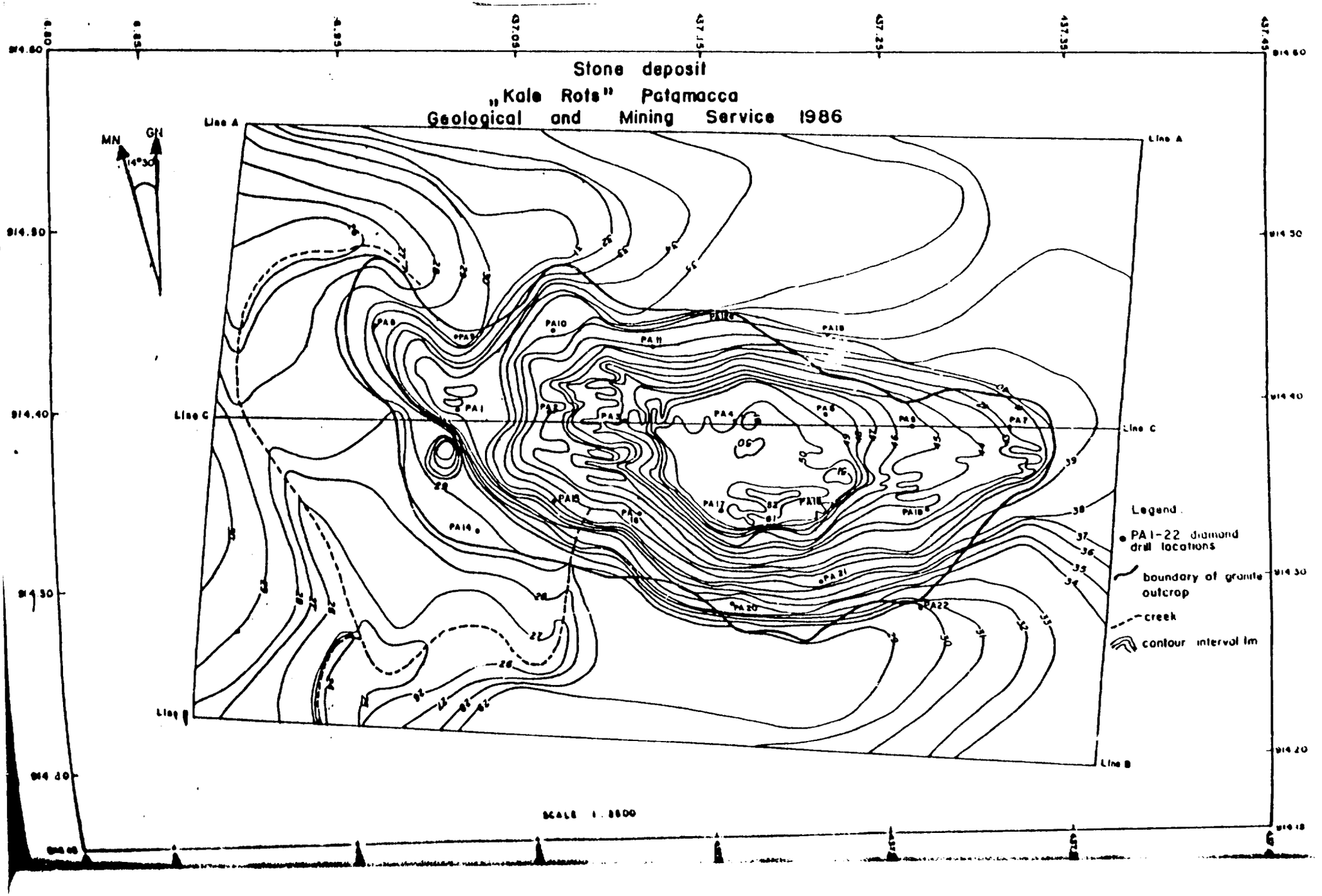
3. Evaluation of the local consultant proposals of the national quarry and processing plant

4. Industrial evaluation of inventory samples

5. Provision of fellowships for further training in stone technology

6. Regional workshop in stone technology for the Caribbean

7. Consideration of small-scale "spin-off" manufactures like stonecraft, building and construction components (kerbstones, cobblestones, sills, lintels etc.).


Stone deposit
„Kale Rots" Patamacca
Geological and Mining Service 1986
MN
GN
14°30
Line A
Line C
Line B
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
PA10
PA11
PA12
PA13
PA14
PA15
PA16
PA17
PA18
PA19
PA20
PA21
PA22
Legend.
PA1-22 diamond drill locations
boundary of granite outcrop
creek
contour interval 1m
SCALE 1:5000