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RAW MATERIALS FOR THE MANUFACTURE OF CEMENT IN THE PORT MORESBY AREA, PAPUA.

by

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I. INTRODUCTION

A. General :

The writer received instructions to commence the Geological Mapping of the Port Moresby Area with special attention to economic aspects, such as, New materials for the manufacture of Cement, Materials for concrete aggregates, road surfacing materials, etc. This work was commenced on November, 30th, 1949, and a general rapid reconnaissance of the more readily accessible areas carried out. Instructions have now been received that Dr. L.P. Glaessner, of Australasian Petroleum Company is about to publish the results of several years' stratigraphic and structural spare-time studies in the area. His map, which will be of reconnaissance character will be available and will form a very useful basis for further more detailed work, if this should be required.

B. Previous Work :

The following publications have been available for study and reference :-

(i) "A Contribution to the Tertiary Geology of Papua" by J.H. Montgomery, being Part V, Volume IV of "Oil Exploration Work in Papua and New Guinea, Conducted by the Anglo-Persian Oil Company on behalf of the Government of the Commonwealth of Australia, 1920-1929."

(ii) "New Materials for the Manufacture of Cement in the Port Moresby Area, Papua," by H.J. Ward, Geologist, Bureau of Mineral Resources.

(iii) "Collected Results of Analysis, Argillite Samples," and "Collected Results of Analysis, Limestone and Coral Samples," both reports by Avery and Anderson, Melbourne.

C. Problems of Special Interest :

(i) The extensive network of roads shown on the Defence Maps was constructed during the late war. Owing to

heavy floods during 1946 and lack of subsequent repair and maintenance, these are now mostly impassable, the only road at present suitable for heavy transport being the Rouna Road. Sections of the older roads are in good order.

(ii) Water Supply :

Abundant water is available from the Laloki River. It is pumped from a station near Bomana to a high level reservoir in the Town area from which it is reticulated. Branches from the mains supply outlying areas. Neither the pumping station nor the Town Reservoir is adequate to supply the needs of the present population. Underground water supplies can and have been obtained in adequate amount at shallow depth almost anywhere in the lower areas.

(iii) Fuel :

At present all fuel, other than wood, must be imported and there is no indication that local fuels will be produced in the near future.

D. Raw Materials required for the Manufacture of Cement:

Cement is made by calcining a finely ground mixture consisting of 70%-80% Calcium Carbonate and 20%-30% of clayey materials consisting of silicate of Alumina, Iron oxide and various impurities such as magnesia and alkalies, which should not exceed 5%.

Undesirable impurities in materials are free silica such as chert or quartz grains, contact metamorphic silicates, and metallic sulphides such as pyrite.

The rocks to be sought in the Port Moresby District are non-siliceous limestones, and argillites and shales, possibly also lateritic residual decomposition products of some of these, from which weathering and solution have removed silica, etc. It has been suggested verbally by

Dr. Glaessner to Dr. Fisher that clay rocks in particular in the Port Moresby Area are much too siliceous, but that abundant suitable limestones and clay rocks are available in the Miocene Areas to the West of Port Moresby. There is no doubt that abundant suitable materials exist in these Miocene areas but their use involves either the establishment of a factory in the vicinity or else shipping of material to Port Moresby, both involving considerable difficulties and expense. The writer believes that a suitable mixture can be obtained in adequate amount in the Port Moresby District.

II General Geology.

No geological map of the Port Moresby District has as yet been produced. Mr. J.W. Montgomery has carried out very valuable petrological investigations but some of his stratigraphic conclusions are in error. Dr. K. Glaessner will shortly produce a reconnaissance map. In view of the above, the writer will give a generalised account only, dealing largely with features of economic aspect, and omitting his recently formed conclusions of academic interest.

The rocks in the area consist of limestones, calc grits, siliceous argillites, and tuffs, ranging in age from Upper Cretaceous to Lower Miocene. The series has been steeply folded and intruded by a large Gabbro intrusion which has in some places caused a contact mineralisation, and elsewhere has caused the formation of calcsilicate materials in impure limestones, with little or no magmatic additions.

In general, except for the Cretaceous, the whole series is highly siliceous, consisting largely of precipitated colloidal silica with minor detrital clays, etc, but with considerable fine tuffaceous material, volcanic glass, felspars and other minerals of explosive volcanic origin. Sedimentary Manganese is a constituent of parts of the sequence and is in places of economic value.

The siliceous material consists of chert, with more or less aluminous and ferruginous material; bedded, indicating

primary colloidal deposition, also in ellipsoidal concretionary structures indicating solution and re-deposition. In some of the cherts, thin contorted clay laminae indicate movements while the sediments were still unconsolidated. Consolidation of the sediments and formation of the concretionary nodules preceded the intense folding of the sediments. In addition to these obviously siliceous rocks, all argillites and tuffs of the series contain a very high proportion of micro-crystalline silica. Indeed, the writer would prefer the designation "Argillaceous chert," to replace "Argillite," in most instances. These materials are therefore generally unsuitable for our present purpose.

III. Possible Raw Materials examined :

A. Limestones

Attention was directed to the locality from which Mr. Ward collected his sample No.76, since this was the only sample collected (other than coral) of suitable composition. It is described as a Pink limestone, map reference to position being 009338, Bogoro Inlet Area.

In this area there is a pink to brownish-red calcite veined calcareous formation at least 500 feet thick, but including minor thin argillites, cherts, and grey gritty beds. The pink coloration is due to foliae of clayey material the amount of which varies considerably. The variety with little clay resists crushing and weathering and forms rocky hilltops. The more clayey varieties have the appearance of a sheared reddish shale, weathering to platy fragments, and this material being less resistant occurs in the saddles and valleys. No doubt the formation originally consisted of an interlamination of calcareous mud and clays. Small pelagic foraminifera, including the Cretaceous form Globotruncana were noted. Careful examination failed to disclose free silica, mineral or rock fragment of tuffaceous origin, contact metamorphic minerals or pyrite. Several

acid digests of the shaly types gave residues of from 20% to 30% of fine red clay.

Mr. Ward's sample No.76 was apparently collected from a nearly pure limestone outcrop. The writer has forwarded two samples, 007347B from the hard limestone and 007347A, from the softer more argillaceous material.

This formation has been followed to near the Laloki River where it is similar in character and thickness. There is here a ridge some ¼ mile in length consisting of similar calcareous rocks. This occurrence is within a half mile of the Rouna Road and approximately 1½ miles from the Laloki River which makes it of greater interest than the relatively inaccessible Bogoro Inlet occurrence. Sample 942438 was obtained from the more argillaceous limestone of this locality.

The strike of the formation from Bogoro Inlet to near the Laloki is fairly constant about N40W with dips to the S.W. at angles from 60% to vertical. The resistance to shearing and weathering which depends on calcium carbonate content varies irregularly in the general direction of the strike, possibly due to numerous small transverse faults also suggested by the general appearance of the formation on aerial photographs. Considerable lateral variation in calcium carbonate content may also be an original sedimentary characteristic and some transportation by percolating solution is certainly suggested by calcite veining, a prominent feature in the formation.

E: ARGILLITES:

Results of chemical analysis show that all the samples collected by Mr. Ward are unsuitable. The writer has observed dark grey to brown grey bedded argillite-like rocks of exceedingly fine grain, which are probably fine glassy tuffs in two localities.

(i) Locality 0.5 miles from Old Hector Mine on the Bootless Road.

Here in a shallow excavation east of the road is an outcrop of thin-bedded fine grained rock with about 10 feet thickness exposed. It strikes approximately N.30E and is vertical. Associated with it is a rather massive argillite. Sample 010440 was obtained here.

(ii) Locality 1.0 miles from the junction of the Napa Napa-Barrune Road Junction.

Some 30 feet or more thickness of a grey thin bedded rock which would be classed in the field as argillite, but which is probably also a tuff, is exposed in a rock cutting. Strike is approximately N10W and dips are to the ENE at 40° Associated rocks are some thin calcareous grits and siliceous argillites. Sample 856421.

It is probably that neither of these occurrences are suitable for our purposes, since they weather into small angular chips, as do the siliceous green tuffs. But since they are of unusual appearance and not obviously highly siliceous as are most argillites in the district, samples have been forwarded for determination.

f. Clays washed from Products of Rock Decomposition :

Consideration has been given to the possibility of washing clays from residual products of the decomposition of certain formations.

(i) A thickness of some hundreds of feet of a formation consisting largely of siliceous argillite, and bedded cherts, thin bedded, with frequent thinner beds of reddish and yellowish clay rock and odd thin manganiferous beds outcrops in many localities due to repetition by folding. It is also possible that stratigraphic repetition of this type occurs with intervening tuffs. At all events, particularly where it is steeply folded, and thus somewhat shattered, it weathers readily to considerable depth though it is sufficiently resistant to form long strike ridges, whereas the wide intervening valleys are underlain by tuffs. In several localities the decomposition products consisting of a red clay with angular argillite, chert etc. fragments have moved down the valley slopes to form terrace-like accumulations. During the war and since huge quantities of this material, obtained from many "quarries" have been used for surfacing of local roads. Sample No.851377 is clay washed from one of these quarries on the Kapa Kapa Road near the Tatuna Causeway. The suspended clays remained suspended for 36 hours and precipitation was finally effected by the addition of a solution of common salt.

(ii) Approximately 4.1 miles from the Rector Mine along the old Hilo Road.

There is here a considerable accumulation of soft clay like material derived from decomposition of tuffs. It is in part transported and carries the nodular concretionary calcareous bodies characteristic of materials derived from the decomposition of tuffs. A brownish grey clay was washed from this material and

this constitutes semple 001400. The gritty residuum is rich in magnetite grains and also contains other mineral grains, presumably Zircon and other resistant minerals which have not as yet been determined.

IV. CONCLUSIONS :

1. The only limestones in the Port Moresby Area that are sufficiently free from objectionable impurities to be useful for cement manufacture occur in a Pink foliated limestone formation of Cretaceous age.

2. These limestones vary in clay content, and some samples examined suggest that it may be possible to obtain a mix containing sufficient or nearly sufficient alumina and Iron from this formation itself.

3. The most favourably situated occurrences of this formation are near the Waigani Road. Here ample water supplies are close at hand and road access presents no problems. Very large amounts of raw materials are readily available.

4. In the event that additional aluminous material is required, clays washed from decomposed argillites are suggested. Clays from decomposed tuffs may be highly aluminous.

5. Iron oxide is thought to be present in sufficient amount in the shaly limestones, also in residual clays. If not, the gossanous material from the various Laloki Mines is available. Haematite is also available from near Rigo.

6. Fuel for calcining must be imported.

The above conclusions are reached from field work and rough chemical and microscopic methods carried out with the limited apparatus now available to the writer. They may be confirmed or discounted by quantitative chemical analysis. In the event that this gives favourable results, detailed mapping of the selected sites should be undertaken.