COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF SUPPLY AND SHIPPING.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

REPORT No. 1949/46
(Geol. Ser. No. 29)

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

by

H.J. Ward
Geologist

CANBERRA, A.C.T. 7th July, 1949.

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

by

H. J. Ward,
Geologist, Bureau of Mineral Resources.

CONTENTS.

CONTENTS (Contd.)

APPENDIX.

MAP.

I. INTRODUCTION

A. GENERAL.

In January 1949 a brief examination was made of the area bounded by the Port Moresby-Rouna Road, the Rigo Road and the coastline between Port Moresby and Bogora Inlet, with the object of determining whether supplies of water and raw materials for the manufacture of cement were available. Possible quarry sites were chosen and specimens of the likely raw clay minerals, of the limestone at Boatless Inlet, of reef limestone and limestone from the Main Road (or "Nine Mile") Quarry collected. Fourteen of these specimens are being analysed for silica, alumina, lime, iron, magnesia, carbondioxide and water and total alkalies and as the suitability of the various raw materials examined depends largely on their chemical composition, this report must be regarded as only a preliminary one until these results are received.

"Geological Notes on the Supply of Raw Materials for Cement Manufacture in the Port Moresby Area" by L. C. Noakes (1949) and the Military Map of New Guinea, Port Moresby Sheet, 1 mile to 1 inch series were used during the inspection.

B. ACCESS.

The area is traversed by bush tracks suitable only for jeep transport and impassable in wet weather. The best road is the Port Moresby-Rouna Road which is graded and which can carry motor vehicles whose maximum capacity is three tons. The Rigo Road is not suitable for motor vehicles other than jeeps and is impassable in wet weather.

No port facilities are available at Bogoro Inlet. The jetty, which was last used when the Dubana Copper Mines were in production (about 1920), is beyond repair and only a few decayed piles remain.

C. WATER SUPPLY.

The Laloki River is probably the most convenient source of water. The cost of pumping water through a pipeline to a plant at Bogora Inlet would have to be considered against the cost of drilling for water in the vicinity of the Inlet. Records of bores put down by the Army during World War II were not available. The best localities at Bogoro Inlet where sufficient water might be obtained are thought to be areas marked (A) and (B) on the accompanying map. Both areas are low lying and surrounded by steep hills from which the run-off is rapid. They are covered by alluvium, which overlies beds of shattered argillite and thin beds of limestone. A stream flows southwards through area (A); area (B) is covered by grass and is swampy in wet weather. The average elevation of areas (A) and (B) is less than 50 feet above sea level so that supplies of ground water may be expected at less than 50 feet below the surface.

D. FUEL.

Supplies of coal are not available locally and consequently would have to be imported.

E. RAW MATERIALS USED IN THE MANUFACTURE OF CEMENT

In the manufacture of cement it is generally necessary to use two or more kinds of raw materials - the usual practice is to use a calcareous rock (limestone) to supply the necessary lime (CaO) and argillaceous material (shale and clay) for the alumina (Al_2O_3) and silica (S_1O_2). The raw mix should contain about 75 per cent ~~lime~~ calcium carbonate, about 20 per cent silica, alumina and iron oxide and not more than 5 per cent of impurities such as magnesia (MgO) and alkalies. The silica should approximately equal the combined alumina and iron oxide. Undesirable impurities are chert, flint and sand.

The following table (Miller 1937) lists the various source rocks from which the necessary mineral constituents for the manufacture of cement can be obtained.

Source of Lime (CaO)	Source of Alumina (Al_2O_3)	Source of Silica (S_1O_2)	Source of Iron (Fe)
Limestones	Clay	Clay	Ferruginous Limestones and Marls
Calcareous Marls	Shale	Shale	Clay Shale
Fossil Shell Marls	Slate	Slate	Slate
Recent Shells	Ash from coal used as fuel	Ash from coal used as fuel	Argillaceous limestones
Alkali Waste	Argillaceous Limestones	Argillaceous Limestones	Iron Ores
Blast Furnace Slag	Blast Furnace Slag	Blast Furnace Slag	Blast Furnace Slag.
	Granite	Sands	
	Andesite	Sandstones	
		Granite	
		Andesite	

If necessary flotation processes (Miller 1937) can be used to improve the quality of limestone by removing silica, alumina, and ferric oxide.

F. DEFINITIONS

(i) Limestone. is a sedimentary rock, normally white grey, black or buff in colour, composed chiefly of calcium carbonate ($CaCO_3$).

(ii) Shale is a fine grained laminated sedimentary rock in which the constituent particles are predominatly of the clay ~~or~~ grade and consist mainly of silicates of alumina.

(iii) Argillite is a firmly consolidated massive shale in which the lamination is less clearly defined.

II. GENERAL GEOLOGY

The geology of the area has been described by Montgomery (1930) and summarised by Noakes (1949) as follows.

"The oldest rocks in the area are the Lower Port Moresby beds of Cretaceous age which consist of folded marl, chert and limestones. Stratigraphically above these beds lie the Upper Port Moresby beds which range from Eocene to Lower Miocene and consist mainly of marl, argillite (claystone), chert, tuff, grit and a wide variety of limestones. All of these beds are folded along axes trending northwest and in many places the dips are steep with minor folds and buckles. The limestones have been affected to varying degrees by silicification in some places due to small bodies of serpentine, gabbro and granophyre which intrude the sediments".

The depth to which weathering has affected these rocks ranges up to 50 feet. In the case of argillites it is much less, probably about 10 feet to 20 feet, and thus weathered argillite will only be available to a shallow depth below which the rock would be more resistant and would require more crushing.

III. DEPOSITS OF RAW MATERIAL EXAMINED.

A. GENERAL.

The choice of a site for the erection of a cement manufacturing plant is governed ~~namely~~ mainly by accessibility, raw materials and water supply. In the Port Moresby-Bootless district Bogoro Inlet is accessible by sea and probably has satisfactory water supply and Erima about 11 miles by road from Port Moresby can be reached by the main Rouna road and has an excellent water supply. The distribution of raw materials in each of these two areas was therefore investigated.

B. BOGORO INLET.

In the vicinity of Bogoro Inlet the sedimentary beds consist of argillite and limestone which strike from N60°W to N25°W and dip from 60°NE to vertical.

(i) Argillite. In many places the argillite contains large concretionary boulders of chert and veins of secondary quartz. A conservative estimate is that this free silica (viz., chert and secondary quartz veins) would be about 10 per cent of the whole. It may be possible to remove the boulders of chert by screening and so reduce the percentage of silica.

On the eastern side of the Inlet the beds of argillite and limestone strike N60°W and dip from 60°NE to vertical. The best quarry site (No. 1) would be about 0.8 mile on a true bearing of 55 degrees from the old jetty. The outcrops were covered with long grass and no concretionary boulders of chert were seen. Specimens* Nos. 66, 58, 67, 56, 65, 62, 64 were collected from this locality.

Another possible quarry site (No. 2) for argillite is 1½ miles on a true bearing of 26 degrees from the old jetty. Specimen No. 79* was collected here.

* Sent for analysis.

(ii) Limestone. On the eastern side of the Inlet, white to grey limestone interbedded with argillite and up to 15 feet wide, outcrop at a distance of three-quarters of a mile in a north-easterly direction from the old jetty. A specimen (No. 82) from one of these limestone outcrops was collected for analysis. No large deposits of white limestone were seen in the vicinity of Bogoro Inlet.

In 1913, J. F. Carne collected samples of limestone on an old mule track from Bogoro Inlet to Dubuna Mine, about 1¼ miles west of the old Inlet road and about 1 mile northeast of the Inlet. This limestone contained about 82 per cent of calcium carbonate and about 11 per cent of silica. The limestone bed from which this specimen was collected was found. It is about 30 feet wide and is underlain by gritty limestones and calcareous grits. The old mule track and the locality from which the specimen was collected are marked on the map.

A large outcrop of pink limestone, about 150 feet wide and over a mile long is situated west of the Seventh Day Adventist Mission and north of Bogoro Inlet. The pink limestone, in which are some narrow bands of white limestone, strikes from N20°W to N50°W and dips 60°S.W. The pink coloration is possibly due to the presence of iron but so long as the proportion does not exceed 5 per cent this limestone may be suitable for use as a raw material for the manufacture of cement. Two individual specimens (Nos. 60 and 76)* were collected.

Another source of limestone is the reef limestone which may be obtained by dredging in the waters off the coastline of the Inlet. Specimen No. 78 from Bogoro Inlet has been sent to be analysed.

(iii) Ironstone. The necessity for mining ironstone depends on the composition of the shales and limestones to be used. If they contain sufficient iron oxide (up to 5%) it is unnecessary to add ironstone to the charge. It is possible that the pink limestone may contain sufficient iron oxide.

Gossanous outcrops of limonite are reported from the copper mines of the Astrolabe Mineral Field (Fisher 1941). The nearest locality from which iron oxide could be obtained is the old "Hector" Mine which is situated near the junction of the Port Moresby-Rouna Road with the Rigo Road, about 3 miles west of Sapphire Creek.

C. ERIAMA.

In the vicinity of Eriama the limestone and argillite beds strike from N20°W to N10°E and dip approximately 70 degrees to the east.

(i) Argillite. No suitable outcrops of argillite were seen but it is possible that suitable argillite might be found adjacent to the limestone outcrop about 11 miles by road, or 8.9 miles on a true bearing of 55 degrees, from the Port Moresby Post Office. Outcrops were poor but no chert or quartz rubble was observed.

(ii) Limestone. A white to grey and in places light chocolate coloured limestone forms a prominent series of outcrops between the Port Moresby-Rouna Road and Eriama, between the road and the Pumping Station, and at the Main Road (or "Nine Mile") Quarry. The presence of wollastonoite, tremolite, garnet and diopside, due to contact metamorphism by a basic igneous (gabbro) intrusion, may render some the the outcrops of this limestone unsuitable for use.

* Sent for analysis.

One of these outcrops of limestone, situated about 11 miles by road from Port Moresby, is adjacent to the Port Moresby -Rouna Road. The outcrop, which is about 2,000 feet long and about 70 feet wide, strikes N10°E and dips 70°W. At the southern end of the outcrop is a discordant intrusion of gabbro. About half a mile to the east of this outcrop of limestone another bed of limestone outcrops over a length of half a mile and a mile to the east of this outcrop of limestone another bed of limestone outcrops over a length of half a mile and a maximum width of 50 feet.

Specimens Nos. 71*, 72*, 73 and 75* were collected from these two localities which are marked on the accompanying map.

Specimen No. 74 was collected from a small limestone quarry about half a mile on a true bearing of 206 degrees from the Pumping Station on the Laloki River.

(iii) Ironstone. Ironstone will have to be transported if the shales and limestone do not contain sufficient iron oxide.

The nearest source of ironstone is the old "Hector" mine mentioned above. This is about 2 miles farther east along the Rouna road from Erima.

(IV) CONCLUSIONS.

Until the results of the chemical analysis of the specimens collected are received it cannot be decided whether any of the deposits of raw materials examined are actually suitable for use in the manufacture of cement. In any case more detailed geological work will have to be carried out. If the results are satisfactory, geological surveys should be made of the possible quarry sites shown on the accompanying map in order to show the distribution in detail of beds of different composition, to determine their continuity both along the strike and in depth, and to map the relationships of the basic igneous intrusion where present to the limestone outcrops. If some or all of the raw materials sampled prove to be unsuitable, particularly if only the shale or argillite is not satisfactory it may be possible by further search, preferably with a team of natives, to sink pits in areas where outcrops are scarce, to locate more satisfactory material.

If Bogoro Inlet were selected as the site for a cement manufacturing plant roads would have to be constructed and a water supply developed. Limestone outcrops, other than pink limestone, are not of sufficient width but as they are interbedded with argillite it may be possible to quarry both the limestone and argillite together.

If the water supply at Bogoro Inlet proves unsatisfactory an alternative plant site would be adjacent to the Laloki River, about a mile northwest of Erima. Transport facilities, water supply and large quantities of limestone (if analyses prove them to be satisfactory) are readily available, but further work will be necessary to prove adequate supplies of argillaceous material.

* Sent for analysis.

V. BIBLIOGRAPHY

Carne, J. F. 1913 : "Astrolabe Copperfield Central Division Papua". Bulletin of the Territory of Papua - No. 1.

Fisher, N.H., 1941 : "Geological Report on the Sapphire-Moresby King, Laloki and other mines, Astrolabe Mineral Field, Papua." (Unpublished)

Miller, B.L., 1937 : "Cement Materials" A.I.M.E. Seely W. Mudd Series "Industrial Minerals and Rocks".

Montgomery, J.N., 1930 : "Contribution to the Tertiary Geology of Papua". Oil Exploration work in Papua and New Guinea, 1920-1929, vol. 4.

Noakes, L.C., 1949 : "Geological Notes on the Supply of Raw Materials for Cement Manufacture in the Port Moresby Area". Bureau of Mineral Resources Report No. 1949/10 Geol. Ser. 5.

APPENDIX I.

LIST OF SPECIMENS COLLECTED IN PORT MORESBY AREA.

Note: The field number of each specimen collected is marked on the accompanying plan. The following list also shows the locality as plotted on the 1 mile to 1 inch Military Map of New Guinea, Port Moresby Sheet.

Field No.	Locality		Name
* 56	Bogoro Inlet Area; point	024327	Argillite
* 58	" " "	0233255	"
59	" " "	013319	Limestone
60	" " "	006345	Pink Limestone
62	" " "	0283285	Argillite
* 64	" " "	029329	"
* 65	" " "	027328	"
* 66	" " "	023324	"
67	" " "	023326	"
68	" " "	023319	"
69	" " "	014320	"
70	" " "	014319	"
* 71	Erisma Area	976433	Limestone
* 72	" "	983432	"
73	" "	976435	"
74	" "	981444	"
* 75	" "	979436	"
* 76	Bogoro Inlet Area	009338	Pink Limestone
* 77	" " "	002318	Argillite
* 78	" " "	002323	Coral
* 79	" " "	023342	Argillite
80	" " "	032342	Limestone (from Carne's locality)
81	" "	023319	Limestone
* 82	" " "	023323	"
83	" " "	032342	" (from Carne's locality)
* 84	Nine Mile Quarry	934427	"
85	" " "	934427	"
88		894337	Coral.

PORT MORESBY AREA

Tterritory of Papua

PROPOSED QUARRY SITES

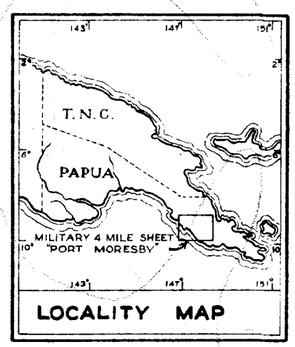
FOR THE EXTRACTION OF

RAW MATERIALS FOR CEMENT

MILES 1 ½ 0 1 2 3 MILES

Scale

Topography from Military one mile map, Port Moresby.



REFERENCE

- Roads, main
- other
- Tracks
- Limestone } Quarry sites
- Argillite } Quarry sites
- Old road metal quarries
- ⊙82 Specimens
- Watercourses
- Swamp
- Areas recommended for boring for water

Grid North / Magnetic North

BUREAU OF MINERAL RESOURCES
GEOLOGY & GEOPHYSICS. JUNE, '49

WAIGANI SWAMP
WAIGANI ROAD
ALOLA
GOLDIE R.
HIWICK
BERRY DROME
PUMPING STATION
RIVER
HECTOR MINE
Oro Ck
ROAD
ROUNA
ERIAMA
Eriama Ck
RIGO
WARDS DROME
JACKSON DROME
NEILL ROAD
PORT MORESBY
MORESBY
WALTER BAY
Paga Point
JOYCE BAY
Lands End
BOOTLESS INLET
BOGORO INLET
JETTY
TAURAMA ROAD
RIGO ROAD
A
B
C O R A L S E A
Pyramid Pt
P.N.G. 8C-4
J.A.B.