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BAUXITE ON TAMBORINE MOUNTAIN, QUEENSLAND.

by

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SUMMARY

Laterite on Tamborine Mountain in south-eastern Queensland is derived from basalt which is probably of early Tertiary age. In places the laterite contains sufficient alumina to constitute bauxite of commercial grade. These bodies of bauxite have been partly tested by groups of shafts and bores. Most of this work was carried out by a Melbourne company, Messrs. Sulphates Limited, during 1941, and disclosed reserves of bauxite in three separate bodies (B, C and E listed hereunder).

Additional reserves (Area F), inferred from natural exposures and quarry faces, exist to the south of Area E and may total about 900,000 tons.

Most of the bauxite in Areas E and F, however occurs within North Tamborine village and small improved holdings, or is held under mining lease.

The proved and inferred reserves are :-

TABLE I.

Area shown on Plan	Locality	Long Tons.	SiO_2 %	Al_2O_3 %	Fe_2O_3 %
B	Por. 85a	288,000	6.8	35.3	27.3
C	Por. 85a	144,000	7.6	41.2	19.3
E	Subdivisions 9.10 & 11 of 82	41,000	4.4	39.6	23.0
F	Por. 82 and Subdivisions	900,000	4	41	22

Further outcrops of bauxite indicate that testing by pit sinking to the east of Areas B and C would reveal increased resources which are not likely to exceed a further 800,000 tons and may be much less. Of this very conjectural total the greater part lies in unimproved grazing land in Portions 82, 112, and 85a at about ¾ mile west of North Tamborine.

The bauxite does not occur at the highest points on the relatively flat surface of Mount Tamborine but is found at intermediate levels. It is believed to have formed on a surface of gentle relief contemporaneously with slow erosion which brought about a continued fall of the water-table level.

INTRODUCTION

Tamborine Mountain lies about 35 miles south-south-east from Brisbane; the distance by road from the Capital to North Tamborine village is 45 miles.

The mountain is an outlier of the Lamington Plateau and rises steeply from the coastal plain to a plateau surface with a maximum height above sea-level slightly in excess of 1800 feet. The plateau surface, formed by basalt and andesite flows, has been dissected to a depth of about 100 feet by Cedar and Sandy Creeks. Before the stream channels were cut the surface must have been nearly level as all higher points of the present land surface have a common elevation at a little above 1800 feet.

The plateau surface is very roughly rectangular in shape, with a maximum length from north to south of 5 miles, but the Guanaba Gorge, a deep embayment in the eastern flank, has nearly divided the mountain in two.

Laterite occurs in the north-western portion of the mountain and in general occupies the more elevated areas.

At present, small quantities of bauxite which are produced from a quarry on the mountain are delivered by motor truck to rail at

Tamborine village, approximately 7 miles by road from the quarry and at 1590 feet lower elevation.

The bauxite deposits have been known for many years and have been exploited as a source of road metal and more recently for the manufacture of aluminium sulphate.

The occurrences have been described briefly by Ball (1940) Curteis (1942) and Connah (1950). Mr. W.S. Curteis conducted testing operations by shaft-sinking on behalf of Messrs. Sulphates Limited. The results of this work have been made available to the writer by the Company and have been used herein.

During June 1950 the writer accompanied Mr. T.H. Connah to Tamborine Mountain during a very short visit, and again examined the area in November.

GEOLOGY

Tamborine Mountain is composed of volcanic rocks, mainly lavas, with a total thickness of 700 to 800 feet. Along the western side of the mountain the volcanics overlie Bundamba sandstone of Upper Triassic age, but on the northern and eastern flanks the lavas rest on Palaeozoic schists.

The volcanic rocks, which have been described by H.C. Richards (1916), attain a maximum thickness of 5000 feet at Lamington Plateau, and have been poured out during three periods separated by lulls in the volcanic activity. Accordingly the resulting lavas and tuffs fall into three groups or divisions which display characteristic petrological differences. At Tamborine the lower division which consists of basaltic members, is about 100 feet thick, the middle division, largely composed of trachytes and rhyolites, is of similar thickness, and the upper division, 400 to 500 feet thick is represented by basalt and porphyritic andesite.

Richards (pp. 125 & 131) considers that the vulcanicity which resulted in the wide distribution of these volcanic rocks in south-eastern Queensland probably began in the Lower Cainozoic and concluded in the Upper Cainozoic. He correlates the upper division of basalts and andesites with the Newer Volcanics of Victoria and with the Pliocene basalt of Inverell.

The writer is not able to agree that the upper basalts of Tamborine Mountain are as young as suggested by Richards, and believes that they should be correlated with the lateritized basalts of Inverell which disconformably underlie volcanics of probable Lower Pliocene age. If the writer's contention is correct it becomes apparent that the three periods of vulcanicity represented at Tamborine Mountain all occurred in early Cainozoic time and probably were restricted to the Oligocene and Eocene epochs.

This view gains further support from the enormous erosion which has taken place since the last of the Tamborine volcanics was extruded, and presumably since the formation of the laterite. The Canungra and Coomera valleys of which the former has reached a fair degree of maturity, have been cut to levels about 1500 feet below the plateau surface.

The laterite forms a superficial cover over the volcanics, and at the one place where a complete section can be studied, passes to massive basalt from which it has been derived. Textures derived from the parent rock may be traced in the laterite up to the nodular and pisolitic zones.

Although it is probable that the lavas finally attained a virtually horizontal plane surface, it is noteworthy that the laterite does not occupy only the highest points on the plateau but may be found at elevations ranging from a maximum which slightly exceeds 1800 feet to about 1700 feet near Geissmann's quarry and West's Road. As mentioned below the bauxitic portions of the laterite are more restricted in their occurrence and bauxite has not been found associated with that laterite which occurs in the areas of highest elevation.

From these observations it appears that lateritization continued for some time contemporaneously with slow erosion and that as the water-table was lowered the lateritic process continued at slightly lower levels.

Changed conditions brought a halt to laterite formation with the result that much of the laterite was stripped by continuing erosion to expose the underlying parent basalt.

The bauxite, that is the more aluminous variety of the laterite, does not occur, as far as present exploration shows, at the highest points but rather at intermediate levels as indicated below -

Bauxite Area	Approx. Elevation at Surface
B	1800 - 1750 feet
C	1775 - 1750 "
E	1750 "
F	1770 - 1725 "
H	1750 "

Immature ferruginous laterite occurs at elevations both above and below that of the bauxite. Apparently the retreat of the water table was halted at an intermediate stage permitting continuation of the lateritic process to an advanced stage while the immature laterite previously formed remained unaltered out of reach of fluctuations of the water table and stabilized by oxidizing conditions.

Further retreat of the water table permitted attack on the basalt down slope from the bauxite with the formation of massive ferruginous immature laterite directly overlying basalt. Lowering of the water table continued too quickly for this process to reach completion.

DESCRIPTION OF THE BAUXITE

There is no good natural exposure of the bauxite but a very complete section is revealed in Mr. B.R. Geissmann's quarry in Portion 82 on the western outskirts of North Tamborine village.

At its greatest depth the quarry face measures 27 feet from natural surface to floor.

A measured section, with chemical determinations reported by the Geological Survey of Queensland, is given below -

Section - Geissmann's Quarry

Depth From	Feet to		Soda-soluble SiO_2 %	Soda-soluble Al_2O_3 %	Total Al_2O_3 % (Average)	Total Fe_2O_3 %
0	2	Soil	-	-	-	-
2	4	Soil with ferruginous pisolites	-	-	-	-
4	8	Loose pisolites				
8	10	Coarse ferruginous nodules	-	24	28	-
10	21	Yellow and red nodular bauxite (1)	0.1 to 0.3	30 to 49	40	20 to 33
21	27	Yellow and red Hard earthy bauxite	1.8	42	43	20

(1) Nodular bauxite - Average soda-soluble Al_2O_3 = 37%.

The coarse ferruginous nodules are rounded and commonly measure 2 to 4 inches in diameter. Externally they may be stained with a greenish tinge which is more common in the pisolitic zone above, but internally they are uniformly dull brown and texture-less and do not show concentric banding indicative of concretionary growth. With increase in iron content of the nodule the fractured surface shows the resinous lustre of limonite.

The nodular bauxite consists of irregular rounded masses of hard bauxite up to several inches across set in a loose earthy matrix. Near the top of this zone the nodules consist of dense dull brown cliachite containing blebs of white mineral, presumably gibbsite. These nodules contain cavities and tubes lined with small pisolites, and are plainly related to the ferruginous nodules occurring immediately above.

Most of the bauxite nodules, however, have a finely granular texture internally and a poorly shown concentric banded structure developed about a central core which may be very friable and more ferruginous than the outer layers.

The lowest zone is composed of hard earthy bauxite divided by numerous horizontal partings which give the rock a false appearance of stratification. Closer examination shows that the bauxite has developed by concentric or onion-skin alteration initiated from joint planes. The banding is oval in section with the longer axis lying horizontally, and the closely stratified appearance of the rock as a whole is due to the accentuation of the horizontal portions of the partings between concentric shells. The earthy bauxite is markedly granular in texture and contains recognisable plagioclase phenocrysts replaced by gibbsite and round blebs of gibbsite (?) replacing glass in the parent basalt.

A patch of blue-grey clay occurs near the base of the earthy bauxite zone. This clay is a peculiar mixture of small pisolites, fragments of kaolinized basalt, and grains of waxy gibbsite or halloysite in a matrix of bluish clay. **(See Appendix)**

This clay is believed to be secondary in origin and developed along an underground drainage channel or sink-hole which can be traced upwards to the surface on a sloping course to the south. Along the line of this channel the nodular zones have been destroyed and replaced by loose earth and pisolites.

The underlying basalt is exposed at one place in the quarry floor. It is a very dark grey medium-grained rock containing phenocrysts of glassy plagioclase and round blebs of black glass.

RESERVES OF BAUXITE

The accompanying plan shows areas on Tamborine in which laterite whether bauxitic or not, is known to occur. The boundaries of these areas as shown are only approximate but serve as a guide in attempts to assess the maximum possible reserves.

Prospecting operations, carried out chiefly by Sulphates Limited during 1941, have defined certain areas of bauxite so that it is possible to state proved reserves with confidence, but the places tested total only a small proportion of the areas known to be occupied by laterite and in part by bauxite.

The areas shown on the plan by the letters A to J are discussed here.

Area A. At the western extremity of the plateau 7 shafts were sunk by Sulphates Limited and revealed siliceous laterite averaging 6 feet in thickness. The best result was obtained from one of these shafts which was sunk to a depth of 32 feet and revealed 12 feet of laterite containing 28 per cent total alumina. The work at this locality indicated a total of 38,000 tons containing 16.9% SiO_2, 23.3% Al_2O_3, and 27.8% Fe_2O_3.

Area B. This area of about 8 acres occupies the north-western margin of a much larger area of laterite, which has been very incompletely tested on account of the thick lantana scrub. Messrs. Sulphates Limited have estimated that Area B contains 288,000 tons of low-grade bauxite containing 6.8% SiO_2 and 35.3% Al_2O_3.

Area C. A small patch of bauxite of similar grade to the above and occurring within the same large area of laterite was tested by a group of shafts sunk within an area of 3 acres. Reserves have been estimated at 144,000 tons containing 7.6% SiO_2 and 41.2% Al_2O_3.

Possible reserves of bauxite contained within the larger area of laterite which encloses A and C cannot be estimated. Bauxite has been observed outside the two small areas tested and significantly lies on or below the 1800 ft. contour. The highest ground within the laterite area has been tested by a few bores which did not disclose bauxite.

Bauxite may occur over an area of about 30 acres between the 1800' and 1750' contours along the eastern and north-eastern margin of the laterite body, and if so would be equivalent to 70,000 tons per vertical foot of thickness.

Area D. It is improbable that any significant quantity of bauxite occurs in this small area in which laterite outcrops for a distance of 1000 feet along the track to the Beacon. Two shafts disclosed low grade material only. **(See Appendix)**

Area E. This area is part of the large area of bauxite and laterite which lies to the west of North Tamborine village and in part underlies the village. Area E is nearly separated from the main body by Sandy Creek which has cut its channel through the bauxite and into the underlying basalt.

Twelve shafts in an area of 3½ acres showed bauxite of fair quality ranging in thickness from 3 to 21 feet.

Reserves have been estimated at 41,000 tons containing 4.4% SiO_2, and 39.6% Al_2O_3.

Area F. Extending south from Sandy Creek this area includes Geissmann's quarry. Little prospecting has been done, but it is known that the bauxite in the quarry is at least 16 feet thick and that it continues to south of Yulong Road.

Mr. W.S. Curteis has estimated the bauxite in Area F at 115,000 tons, but further exposure in the quarry since his inspection and additional field evidence suggest that this estimate is very conservative and it is believed that the total volume of bauxite is not less than 900,000 tons.

The grade of ore in the quarry shows a considerable range vertically and it is certain that similar variations would be encountered elsewhere. In the absence of sampling shafts south of the quarry it must be assumed that the average grade of ore would be similar to that obtained from the quarry and in Area E.

Geissmann's quarry. Average grade of ore excluding ferruginous pisolitic material is approximately -

Total			Soda-soluble	
SiO_2 %	Al_2O_3 %	Fe_2O_3 %	SiO_2 %	Al_2O_3 %
4	41	22	0.7	39

Area G. Scattered bauxite detritus occurs south of Area F. No solid outcrop of bauxite or laterite was seen at this locality and it is not possible to make any estimation of the possible value of this area without boring or shaftsinking. However the prospects are not considered to be good.

Area H. Bauxite of good quality outcrops in the West's Road. This bauxite is reddish-brown in colour, very hard and nodular. Samples chipped from the outcrop have assayed over 50 per cent Al_2O_3. No accurate estimate of tonnage can be made, but under the most favourable circumstances the total possible reserves are not likely to exceed 120,000 tons.

Area J. Nodular bauxite overlies kaolinized basalt near the cliff top by the side of the western road at $1\frac{3}{4}$ miles south of North Tamborine. **(See Appendix)**

The deposit has a very limited extent and is not of commercial importance.

Bartel's Farm. The writer was told of bauxite on Bartel's property $2\frac{1}{2}$ miles south of North Tamborine at the head of Guaraba Gorge. No guide was available when the farm was visited but a search of the property revealed partly bauxitized basalt exposed in the scar of an old land-slide.

The foregoing information is summarized in Table 2.

TABLE 2.

TAMBORINE MOUNTAIN - SUMMARY OF BAUXITE RESERVES

Area	Reserves Tons Proved	Inferred	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	Remarks
A	-	-	16.9	23.3	27.8	No bauxite. 38,000 tons of siliceous laterite of composition indicated.
B	288,000	-	6.8	35.3	27.3	Surrounding body of laterite might contain 70,000 tons of bauxite per vertical foot, lying to the east of Areas B and C.
C	144,000	-	7.6	41.2	19.3	
D	-	-	-	-	-	Probably very small. Low grade laterite disclosed in two shafts.
E	41,000		4.4	39.6	23.0	
F	-	900,000	4	41	22	Soda-soluble SiO_2 about 0.7% " " Al_2O_3 " 39%
G	-	-	-	-	-	Probably small
H		not more than 120,000	-	-	-	Specimens from outcrop contain more than 50% Al_2O_3.
J	-	-	-	-	-	Probably very small.

CONCLUSION

Approximately three-quarters of the potentially largest body of bauxite on Tamborine Mountain (Area F) underlies closely subdivided and improved land in North Tamborine village and consequently is not available under the provisions of the Mining Act. Of the remainder of this area A.C.F. and Shirleys Fertilizers Ltd. of Brisbane have purchased 7 acres, containing about 200,000 tons of bauxite, especially for the purpose of mining bauxite for the manufacture of aluminium chemicals.

The small proved body of bauxite in Area E also occurs in improved land within the village and could not be mined except on the terms of the present owner.

Similar considerations apply to the deposit in West's Road (Area H.)

The important reserves which lie under unimproved land include Areas B and C and the unexplored extension of these areas, in all a possible total of the order of 1,000,000 tons.

The potentialities of the area can be determined only be shaft-sinking; a suggested layout for test-pits at intervals of 800 and 400 feet is marked on the plan.

ACKNOWLEDGMENTS

Much of the information contained in this report has been communicated by Messrs. Sulphates Limited and the Geological Survey of Queensland to whom the writer is indebted. Thanks are also due to Mr. B.R. Geissmann of North Tamborine for helpful discussion regarding the bauxite deposits of the area and their history.

REFERENCES.

Ball L.C.	1940	Bauxite at Tamborine North. Qd. Govt. Min. Jour. 41 (July) p. 184
Connah, T.A.	1950	Bauxite-Tamborine Mountain. Summary of Available information. Geol. Surv. of Qd. July 1950. (unpublished)
Curteis, W.S.	1942	Bauxite, Tamburine Mountain, Queensland. Report, Sulphates Pty. Ltd. (Unpublished)
Richards, H.C.	1916	The volcanic rocks of south-eastern Queensland. Proc. Roy. Soc. Qd. 27, No. 7 pp. 105 - 204.

CANBERRA.
24th November, 1950.

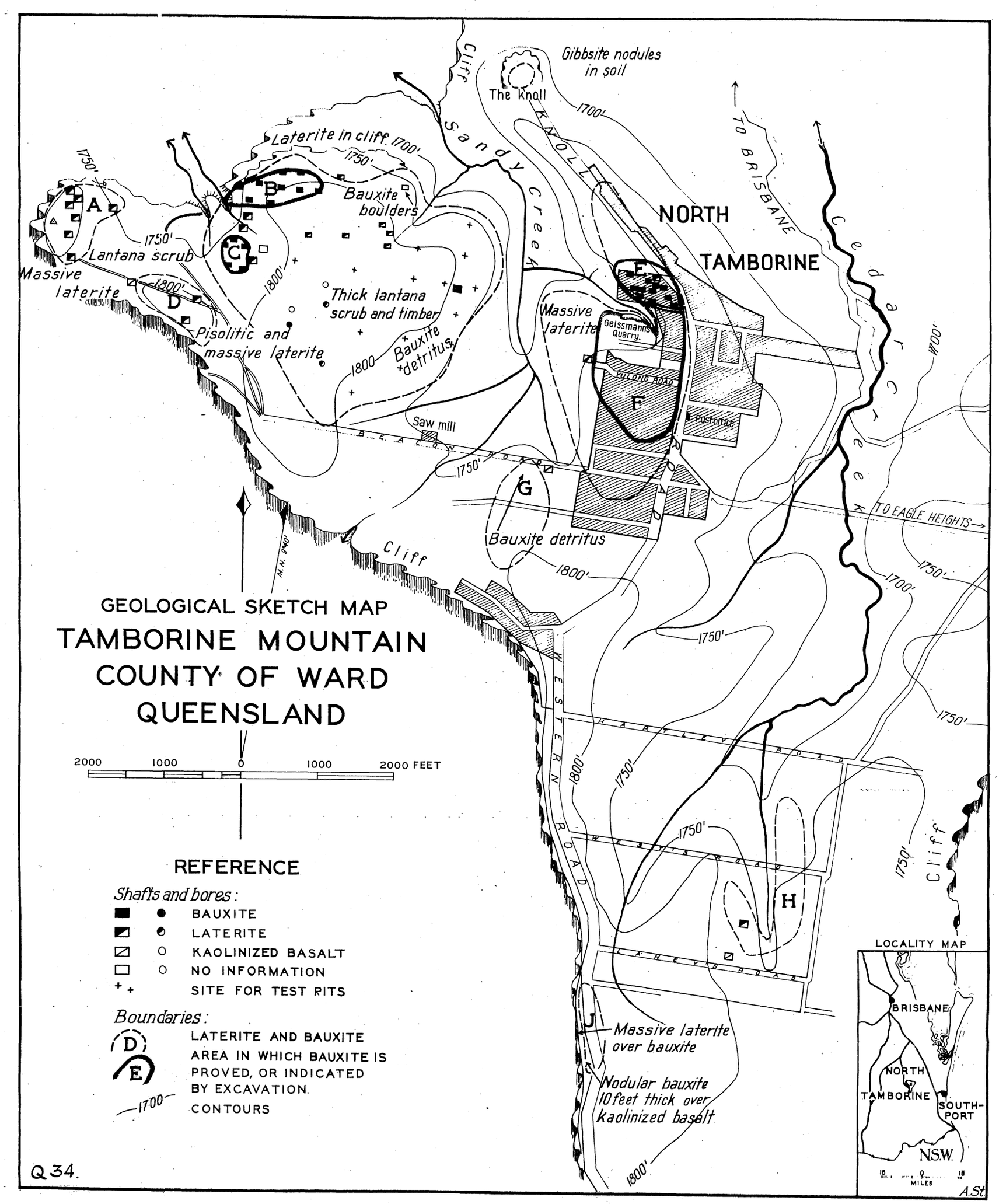
APPENDIX

The following analyses of specimens collected by the writer have been carried out by the Chief Chemist and Metallurgist at the Mines Department laboratory, Launceston through the courtesy of the Director of Mines, Tasmania.

No. / Area on Plan.	1 D	2 D	3 F	4 J
	%	%	%	%
Insoluble matter	11.0	2.3	16.4	2.8
Alumina, total	30.2	51.3	48.5	59.4
Alumina, soda-soluble (a)	24.7	51.2	39.0	59.3
Ferric oxide	32.9	13.9	4.7	4.5
Titania	6.9	3.8	5.7	2.8
Ignition loss	17.2	27.1	23.2	29.5

(a) Extracted for 3 hours with boiling 10% NaOH solution at atmospheric pressure.

1. Dark red, clayey ferruginous laterite.
2. Light brown granular and finely tubular bauxite with yellowish gibbsite replacing felspar phenocrysts.
3. Blue-grey clayey altered bauxite from Geissmann's quarry.
4. Gibbsite nodules from outcrop of nodular bauxite. Western road.



GEOLOGICAL SKETCH MAP
TAMBORINE MOUNTAIN
COUNTY OF WARD
QUEENSLAND

2000 1000 0 1000 2000 FEET

REFERENCE

Shafts and bores:

- BAUXITE
- LATERITE
- KAOLINIZED BASALT
- NO INFORMATION
- SITE FOR TEST PITS

Boundaries:

- (D) (E) LATERITE AND BAUXITE AREA IN WHICH BAUXITE IS PROVED, OR INDICATED BY EXCAVATION.
- —1700— CONTOURS

LOCALITY MAP

A.St.

Q 34.