COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1965/114

GEOLOGICAL INVESTIGATION OF THE YANDERA COPPER PROSPECT MADANG DISTRICT - NEW GUINEA.

by

M. Plane

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SUMMARY

The Yandera Copper Prospect is located in the Bismarck Ranges of New Guinea, 57 miles south-west of Madang. The prospect area can be reached by graded walking track from Bundi, where there is a landing strip suitable for light aircraft.

The prospect is situated within the Bismarck Granodiorite where intermediate porphyry dykes have introduced disseminated gold and sulphide mineralization. Brecciated granodiorite, which has been brecciated by the later intrusives, is exposed over a limited area and contains disseminated secondary mineralization.

All known areas of mineralization were sampled and the relationship between the granodiorite and the later intrusive rocks was determined.

The mineralization associated with the porphyry dykes is low grade, the average grade for the two areas sampled being 0.153% copper. In the brecciated area the grade of mineralization is generally higher, and selected samples assayed as high as 10% copper.

GENERAL INFORMATION

LOCATION:

Yandera Copper Prospect is situated in the Bismarck Ranges between Yandera and Gogumbagu villages in the Madang Central sub-district of New Guinea. The prospect is six miles west of Bundi Patrol Post at approximately 5° 45' south latitude and 145° 9' east longitude. (Plate 4). The prospect area ranges from 5,200 feet to 6,600 feet above sea level.

ACCESS:

Bundi, 4,100 feet above sea level, is 52 miles south-west of Madang. There is a Catholic Mission as well as an Administration Patrol Post at Bundi; the airstrip is suitable for aircraft up to DeHaviland "Otter" type.

An easy walking track leads from Bundi to Yandera and Gogumbagu villages, and provides good access to the prospect. I walked to Gogumbagu via Bundikara, Korinogobu, Karisokera and Yandera, all of which have Government rest houses. The outward journey took two days but the return journey, with only light loads, took one day.

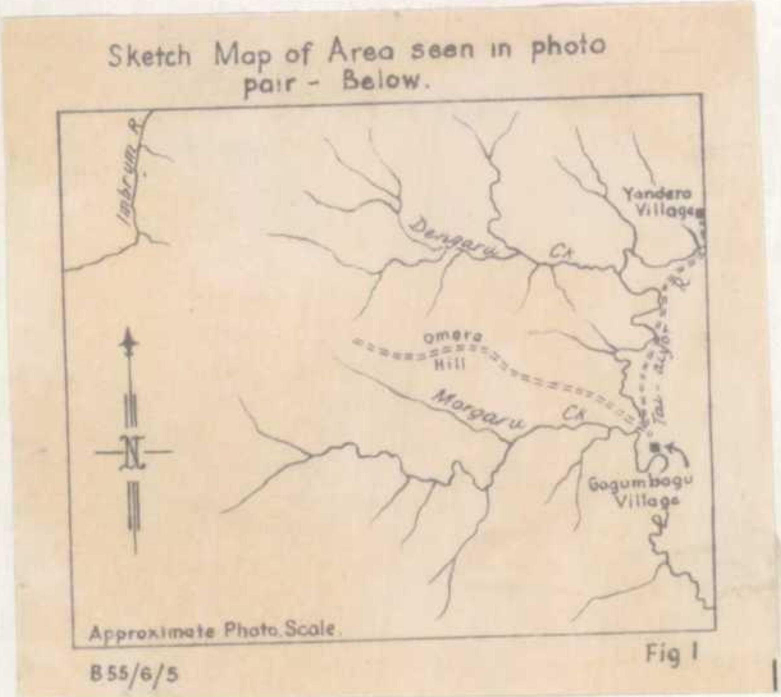
TOPOGRAPHY:

The prospect has marked relief and lies on the north-western flank of Mount Wilhelm (15,400 feet), which slopes steeply to the Ramu Valley. The rivers are deeply incised (Figures 1 and 2), swift flowing, and are choked by large boulders. Waterfalls and narrow gorges make stream-traverses in the prospect area difficult and hazardous. Omora Hill, which forms the divide between Dengaru and Morgaru Creeks is more than 1200 feet above the Tai-aiyor River level. (see Plate 3.)

CLIMATE AND VEGETATION:

The area lies in "tierre templada" zone of Koppen (1931) in which rain falls throughout the year. No accurate meteorological records are available, but annual rainfall ranging up to 200 inches has been reported. The days are warm to cool, but most nights are cold, and the area is usually cloud-covered in the early mornings and afternoons; light rain often falls during these bleak overcast periods.

1. (a)



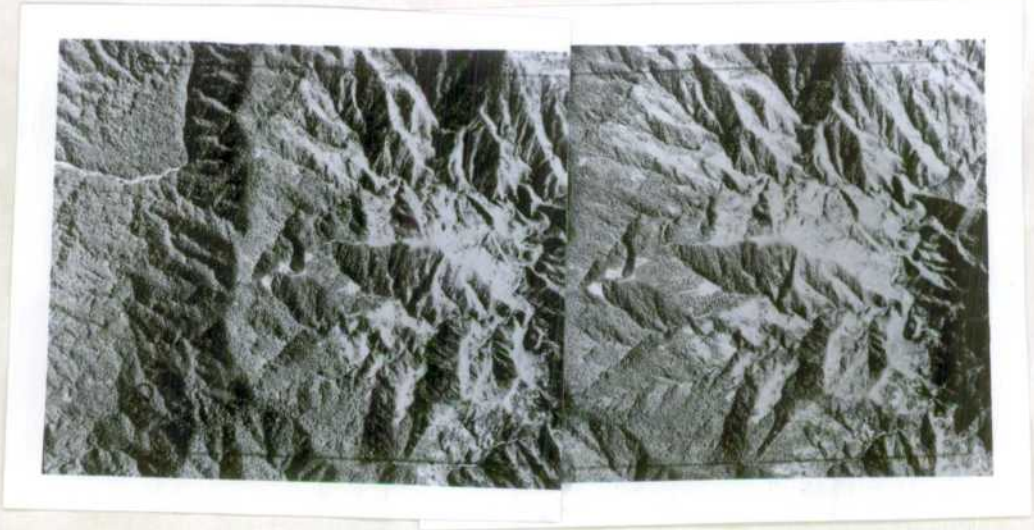


FIGURE 2: Stereo-pair of airphotos
of the prospect range at Yandera.

Primary rainforest and secondary grassland cover the area. The grasslands have resulted from the timber being cleared for subsistance agriculture and the subsequent repeated grassburning. Omora Hill is grass-covered with the exception of its forested south-western flank.

POPULATION AND INDUSTRY:

The area is fairly densely populated by Gende-speaking natives. Very little flat land is available for agriculture, but steep slopes and well drained soils produce good vegetables of many varieties; however no marketing facilities exist for the disposal of cash crops.

The natives do not mine or practise any other industry although gold mining was reported in the vicinity of Yandera during 1956-57 by MacMillan and Malone (1960). A high percentage of the young and able men are away from the district on contract labour. The Catholic Mission operated a boarding school which accommodates about 400 children, and a small sawmill which is situated at Batua, 3 miles from Bundi along the main tract to Yandera; all timber is utilized by the mission.

The Patrol Post at Bundi is a one-man station, and a nearby Administration hospital is staffed by a European Medical Assistant.

PREVIOUS INVESTIGATIONS:

In 1956 and 1957 regional mapping of this area was carried out by officers of the Bureau of Mineral Resources. In their report on the regional work McMillan and Malone (1960) drew attention to gold and copper mineralization in lower Dengaru Creek. Dow and Dekker (1964) visited this area in 1962 as part of a regional geological investigation of the Bismarck Mountains. Previous mapping by McMillan and Malone of certain parts of the Bundi Fault Trough (Plate 4) was revised. Mr. S. B. Barker of Wau became interested in the area early in 1962 and had samples collected by local natives.

Mr. H. A. Trestrail, Inspector of Mines at Wau, visited the area with Mr. Barker during July and August 1962; during this period Trestrail directed a program of transverse and lateral costeaning in conjunction with sampling. Two internal Mines Division reports describe the work carried out during this period.

FIELD METHOD:

A geological reconnaissance was made of the area, (see Plate 2) and random chip samples were taken of sulphide mineralized porphyries and granodiorite. The field observations were plotted directly onto vertical air-photographs of the Obulu series, and an uncontrolled map (Plate 2) was compiled from the air-photographs. Three areas of mineralization (Plates 5 & 6) were surveyed by chain and compass, and a barometer was used to obtain average uncorrected heights. The two areas in Morgaru Creek were sampled at close intervals, and mapped in detail.

REGIONAL GEOLOGY.

Liberal use has been made of the reports by McMillan and Malone (1960) and Dow and Dekker (1964). For detailed account of the regional geology the reader is referred to these reports.

The Yandera Prospect lies within the probably Mesozoic Bismarck Granodiorite. This batholith has been intruded by Pliocene intermediate porphyries. Bordering the Bismarck Granodiorite to the north is a mile-wide belt of biotite-andulusite schist, shale, altered volcanic rocks and marble, of the Palaeozoic or Mesozoic Goroka Formation.

To the north-east of the Goroka Formation is the NW-SE trending Bundi Fault Zone. The rocks of the Zone range in age from Upper Cretaceous to Miocene; they consist principally of siltstone and shale and greywacke called the Asai Beds, which have been locally metamorphosed to fine grained sericite schist and phyllite. Pebble conglomerate, recrystallized limestone and rare quartz sandstone beds are also found within this formation. Also exposed in the trough are, fault wedges of the Upper Cretaceous Kumbruf Volcanics, lenses of ultrabasic rocks of probable Miocene age, and many altered gabbro dykes.

Noakes (1939) was the first to map the granodiorite, which he called the Wilhelm Batholith: Rickwood (1955) changed the name to "Bismarck Granodiorite". The Bismarck Granodiorite is an elongated body thirty miles long by approximately eleven miles wide. Its long axis is aligned NW-SE; parallel to the regional structural trend.

The batholith has been sampled extensively by McMillan and Malone and by Dow and Dekker. Thin sections have shown the most common rock type to be a "light coloured hornblende-biotite granodiorite, which grades with decreasing quartz into hornblende-biotite tonalite". (MacMillan and Malone). Near Yandera the most common rock-type is a light grey granodiorite in which the most abundant minerals are plagioclase (40%), quartz (25%) alkali feldspar (20%), and chlorite (15%). (See Appendix II).

Late crystallization of residual solutions has produced aplite veins in fractures in the granodiorite; these light coloured rocks are exposed in the middle reaches of Dengaru Creek, where they cut through the granodiorite. These veins range from a few inches to one or two feet in thickness.

The age of the Bismarck Granodiorite has been in dispute. McMillan and Malone ((1960) correlated it with the pre-Permain Kubor Granodiorite but Dow and Dekker's field observations and tentative correlations indicated that it may be Upper Triassic. Strontium/Rubidium age determinations carried out on granodiorite samples from near Yandera give a minimum age of 380 million years, confirming the Upper Triassic dating.

The intermediate porphyries which intrude the Bismarck Granodiorite were recognised by McMillan and Malone as possibly separate intrusions; this has been confirmed by Dow and Dekker. The intermediate porphyries range in composition between micro-granodiorite, quartz-biotite andesite porphyry and microdiorite porphyry. The estimated composition of a microdiorite porphyry from near Gogambagu village is: plagioclase (60%), hornblende and biotite (5-10%), primary quartz (1%), secondary quartz (30%)

ECONOMIC GEOLOGY.

Microdiorite porphyry-dykes (Dow and Dekker's "intermediate porphyries") intrude the Bismarck Granodiorite along faults and zones of structural weakness in the prospect area. These porphyries have introduced gold and copper. Copper carbonate staining is exposed in the walls of the rather steep gorges which have, in places, been cut through the country rock by Morgaru and Dengaru Creeks. Disseminated sulphide mineralization is evident in almost all out-crops, but segregations of sulphides were only observed within the shear zone in Lower Morgaru Creek (Plate 5). In the stream sections examined the rocks are relatively fresh and hard with no metasomatic alteration of the granodiorite. Porphyry intrudes the granodiorite.

Dykes of porphyry, at relatively high temperature, were apparently injected into zones of structural weakness in the grano-diorite with little assimilation or gradation at the contacts. Inliers of granodiorite display no contact metamorphism. The porphyry was evidently subject to two sets of conditions during intrusion and these are reflected in the two types of mineralization found in the area.

1. Disseminated Sulphide in porphyry dykes.

The intrusive porphyry which gave rise to disseminated sulphides, is best seen in exposures in Upper and Lower Morgaru Creek; and in Dengaru Creek and the Tai-aiyor River, where porphyry dykes have intruded along NE-SW structural breaks and weaknesses in the granodiorite. Forces which continued to operate after the porphyry intrusions, have given rise to joint sets which cut across both granodiorite and porphyry intrusions.

The mineralization introduced by these porphyry dykes, which are up to 60 feet wide, is the disseminated sulphide type, consisting of copper and iron sulphides, and some gold, disseminated throughout the granodiorite and porphyry in the immediate vicinity of the contacts. Concentration of mineralization was found in some pre-porphyry shears, e.g., Lower Morgaru Creek (see Plate 5a) assayed up to 8 percent copper, but the values in the surrounding country rock, both granodiorite and porphyry, which was sampled over a length of 260 feet, are of a low order (average 0.125% Cu.). The shear zone (Plate 5a) ranges from 10 to 20 feet wide; it strikes 294°, and dips NE at 85°. The shear zone is exposed for a length of about 90 feet and the intensity of shearing is less at the southern end. No attempt was made to expose the shear zone on the north-eastern bank of Morgaru Creek because of steep topography and heavy bush.

In Upper Morgaru Creek (Plate 5b) spectacular carbonate staining drew my attention to further disseminated sulphide mineralization. Three hundred and ninety feet of the steep creek bed was exposed and in this area two porphyry dykes were found intruding the granodiorite. These dykes (Plate 5b), are respectively ten and forty feet wide. Disseminated chalcopyrite grains were found to be more common in these dyke rocks than in any others in the prospect area. Again no segregations of sulphides were found and systematic sampling of the country rock produced an overall average for this area of 0.141% copper. Upstream from sample locality 43 (Plate 5b) a large waterfall made further progress upstream impossible. However, access to the upstream portion of the creek was gained from a ridge which extends westwards from Omora Hill, and further samples were taken; these samples are of the same low-order as those downstream. (Plate 2, and refer to Table I).

2. Disseminated Sulphides in brecciated granodiorite.

Disseminated sulphide mineralization within brecciated granodiorite is exposed on Omora Hill about 1000 feet above the mineralization exposed in lower Morgaru Creek. At this level, at the time of intrusion, there was probably less confining pressure on the granodiorite and consequently the porphyry shattered and brecciated the country rock. The granodiorite breccia consists of angular blocks of granodiorite, up to 12 inches long, in a matrix of microdiorite porphyry; the microdiorite porphyry is highly altered (Appendix II, sample G 125). The primary copper mineral is chalcopyrite, but this has been altered and the minerals cuprite and malachite are dominant in most hand specimens from this area (Appendix II, sample G 108). Exposures on the rather narrow (100 feet wide) crest of this hill are sparse. Costeans cut by the Trestrail party have exposed brecciated granodiorite and porphyry over an area of approximately 250 feet long by 80 to 100 feet wide. These shallow (2 to 3 feet deep) trenches (Plate 6) have not been sampled systematically but random samples gave an indication of a higher overall grade, and selected samples from this area assayed up to 10% copper.

This type of mineralization with its brecciated upper margin, alteration and secondary enrichment can be likened to the "Porphyry Copper" type deposits and warrants further investigation.

McMillan and Malone (1960) reported calcareous veins in Dengaru Creek, these assayed 4 dwts. of gold per ton but were not assayed for copper. McMillan and Malone also reported alluvial gold mining in the vicinity of Yandera but this has now ceased. All samples from the current investigation were check-assayed for gold and silver. Silver was present in most samples and ranged up to 7.16 dwts. per ton. There were only trace amounts of gold.

Attention is drawn to a copper anomaly which was noted by Dow and Dekker (1964). They carried out a program of stream sediment sampling in conjunction with their regional mapping; the following is extracted from their report:

> "............ The most anomalous sample was taken 2 miles downstream from the Yandera Copper Prospect, and it contained 300 ppm copper. The stream has a steep gradient, and most of the sediment collected was silt size, so it is likely that the high copper value is due to detrital material transported from the mineralized area, and not to absorption of copper by clay.
>
> The anomaly is important, because it shows that copper mineralization can be detected by the method up to 2 miles downstream in an area of high rainfall and steep streams."

CONCLUSIONS AND RECOMMENDATIONS.

The preliminary investigation has shown that there is copper mineralization, in the form of disseminated sulphides, over a considerable area in the Yandera-Gogumbagu area. The leaching of primary sulphides, and the subsequent deposition of carbonates has created several areas of intense and spectacular green staining. The systematic sampling of the two areas of most intense disseminated sulphide mineralization produced results which average 0.153% copper. From the assay results and the general mineralization pattern it is concluded that the prospect (Plate 2) may not constitute a low-grade-high tonnage proposition.

The more confined area on Omora Hill, where the alteration of primary sulphides in a brecciated zone has given rise to an area of prominent green copper carbonates, remains of interest. The systematic evaluation of this hill remains to be done and the present indications are that this rather confined locality does contain mineralization of a higher grade than that exposed in Morgaru Creek. The mineralization pattern, with metasomatic alteration of the host granodiorite and secondary enrichment, is favoured for "porphyry copper" type mineralization. The lateral and vertical extent of this area of brecciated granodiorite is completely unknown and warrants investigation. Considerable prospecting and development work could be carried out on Omora Hill at low cost, and it is suggested that systematic geochemical sampling on a grid pattern over this area might serve to delineate anomalies which could then be investigated by pitting and costeaning, and finally, if preliminary indications warrant it, by a diamond drilling program.

REFERENCES.

BATEMAN, A. M., 1950 ECONOMIC MINERAL DEPOSITS John Wiley & Sons, Inc.

DOW, D.B., & DEKKER, F.E. 1964 The Geology of the Bismarck Mountains, New Guinea. Bureau of Mineral Resources, Australia. Rep. No. 76.

KOPPEN, W. 1931 Grundiss der Klimakunde. Walter de Gryter Co. Berlin.

McMILLAN, N.J., & MALONE, E.J., 1960 The Geology of the Eastern Central Highlands of New Guinea. Bureau of Mineral Resources, Australia. Rep. No. 48.

NOAKES, L.C., 1939 Geological report on the Chimbu - Hagen Area, New Guinea. Bureau of Mineral Resources, Australia. Rec. 1955/25 (unpub.)

RICKWOOD, F. K., 1955 The Geology of the Western Highlands of New Guinea. J. Geological Society of Australia 2. Pages 63 - 82.

TABLE 1:_ ASSAY RESULTS.

Assay No.	Sample	Result Cu %
1796	BA 1	0.037
1797	BA 2	0.025
1798	BA 3	0.025
1799	BA 4	0.025
1800	BA 5	0.025
1801	BA 6	0.050
1802	BA 7	0.347
1803	BA 8	0.397
1804	BA 9	0.074
1805	BA 10	0.012
1806	BA 11	3.422
1807	BA 12	0.335
1808	BA 13	0.050
1809	BA 14	0.050
1810	BA 15	0.074
1811	BA 16	0.074
1812	BA 17	0.074
1813	BA 18	0.037
1814	BA 19	0.248
1815	BA 20	0.124
1816	BA 21	0.248
1817	BA 22	0.025
1818	BA 23	0.149
1819	BA 24	0.012
1820	BA 25	0.074
1821	BA 26	0.149
1822	BA 27	0.124
1823	BA 28	0.050
1824	BA 29	0.124
1825	BA 30	0.657
1826	BA 31	0.037
1827	BA 32	0.037
1828	BA 32	0.186
1829	BA 33	0.062
1830	BA 34	0.074
1831	BA 35	0.050
1832	BA 36	0.347
1833	BA 37	0.037
1834	BA 38	0.062
1835	BA 39	0.372
1836	BA 40	0.087
1837	BA 41	0.310
1838	BA 42	0.062
1839	BA 43	0.087
1840	BA 44	0.050
1841	BA 45	0.099
1842	BA 46	0.025
1843	BA 47	0.062
1844	BA 48	10.565
1845	BA 49	0.384
1846	BA 50	0.533
1847	BA 51	0.198
1848	BA 52	0.124
1849	BA 53	0.260
1850	BA 54	0.124
1851	BA 55	0.149
1852	BA 56	0.050
1853	BA 57	0.074
1854	BA 58	0.570
1855	BA 59	0.521

J.C.Wise.

PETROGRAPHY OF A SPECIMEN FROM THE BARKER'S CAMP AREA.
OBULU, T.P.N.G. by W.R. Morgan.

APPENDIX 1.

R.14498 Silicified biotite - hornblende microgranodiorite or microdiorite porphyry.

The hand specimen has a greyish-black, flinty groundmass that encloses tabular phenocrysts ranging up to about 5mm. across. A fine grained sulphide mineral is finely disseminated through the rock, and can also be seen associated with exceedingly thin veins of a white mineral.

In thin section (10294), the rock is seen to be seriate porphyritic, with grain-sizes ranging from 0.005 mm. in the groundmass to phenocrysts 5.0 mm. across. A faint flow-texture is present.

The phenocrysts consist of plagioclase and hornblende. Plagioclase is fresh, and shows oscillatory zoning; it has a composition of about An_{50} zoned to An_{25}. Hornblende forms pale olive-green prismatic crystals that are slightly chloritized.

The groundmass is composed of fine plagioclase laths, hornblende prisms, biotite flakes, and a few clear quartz grains; all these are enclosed in a mosiac of fine quartz grains crowded with inclusions of sericite and chlorite. This quartz and its inclusions appear to be secondary, and possibly result from devitrification and silicification of a glass. Accessory minerals present are euhedral sphene, acicular apatite, and octahedral black iron oxide.

A rough estimate of the percentages of minerals present is:- Plagioclase 60%, hornblende and biotite 5-10%, primary quartz less than 1%, secondary quartz 30%.

The thin veins cutting the rock are filled with hematite, chlorite, and sphene. The sulphide mineral noted in hand specimen was identified in polished section by W. M. B. Roberts as pyrite.

PETROGRAPHY AND MINERAGRAPHY OF SPECIMENS FROM THE YANDERA COPPER PROSPECT AREA, MADANG DISTRICT, NEW GUINEA. by D.E. Ayres.

APPENDIX II.

G.101 :

This is a coarse-grained igneous rock - a granodiorite. Plagioclase, quartz, alkali feldspar and chlorite are the most abundant minerals.

Plagioclase (40 per cent) occurs as euhedral, zoned crystals of sodic-oligoclase composition. Most grains are sericitised and partly replaced by crypto-crystalline silica which has penetrated along fractures and cleavage planes. Quartz (25 per cent) is present as anhedral grains interstitial to the plagioclase. Inclusions of quartz occur in both plagioclase and alkali-feldspar. Alkali feldspar (20 per cent) occurs as cloudy anhedral grains, often with inclusions of plagioclase and quartz. It is also cut by veinlets of cryptocrystalline silica. Myrmekitic intergrowths of alkali feldspar and plagioclase are common. Chlorite (15 per cent), pleochroic from colourless to pale green, occurs as coarse laths, as aggregates of many small laths or as veinlets replacing the feldspar. The anomalous birefringence indicated that the chlorite is probably the penninite variety. Most laths show distinct cleavages along which aggregates of minute opaques or epidote grains occur. This suggests that the chlorite has altered from a pre-existing ferro-magnesian mineral - probably biotite. Epidote is also present as coarse, anhedral grains replacing feldspar. Accessory minerals are opaques, apatite, and jarosite, which occurs in several fractures.

This rock has been fractured and fine-grained quartz, and also chlorite, have been introduced along the fractures. Alteration of the rock is shown by replacement of the minerals, mainly the plagioclase, by sericite, chlorite, crypto-crystalline silica and epidote.

G112: TS10722: PS7142

This rock appears to be a similar type to G101; however it has suffered intense fracturing which has caused granulation and recrystallisation of the coarse feldspar and quartz grains. Plagioclase grains are extremely cloudy and show indistinct twinning. A new generation of quartz occurs with chlorite and epidote along fractures through the rock. Chlorite is also present as aggregates of many small laths with inclusions or opaques and epidote.

Opaque minerals are present along fractures and often associated with chlorite, epidote and new quartz. Most abundant are chalcopyrite, which shows alteration to chalcocite and occasionally covellite, and magnetite. Trace amounts of Bornite which is rimmed by chalcocite, and gold, also occur. Gold is present as grains, up to 0.05 mm. in diameter, included in non-opaques or magnetite.

G125: TS10723:

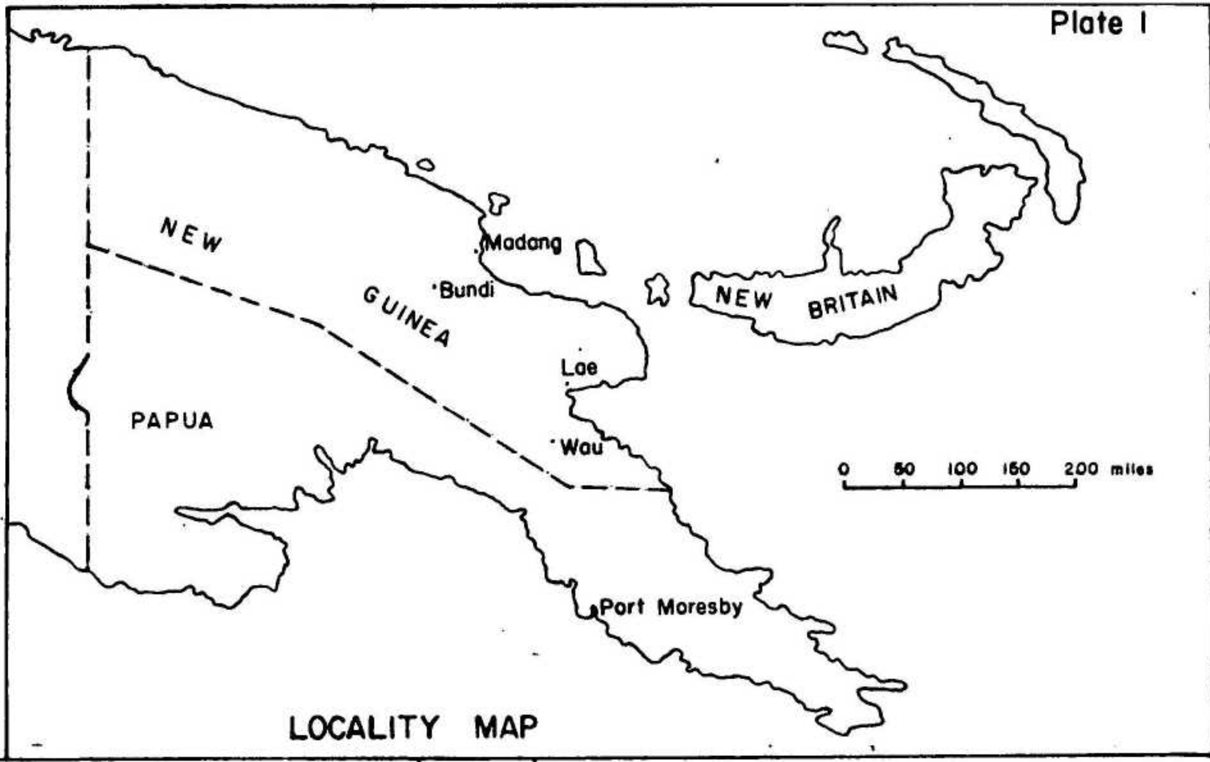
This is a highly altered, porphyritic micro-granodiorite. Euhedral phenocrysts of altered plagioclase and ferromagnesian minerals are set in a medium-grained groundmass of feldspar and quartz.

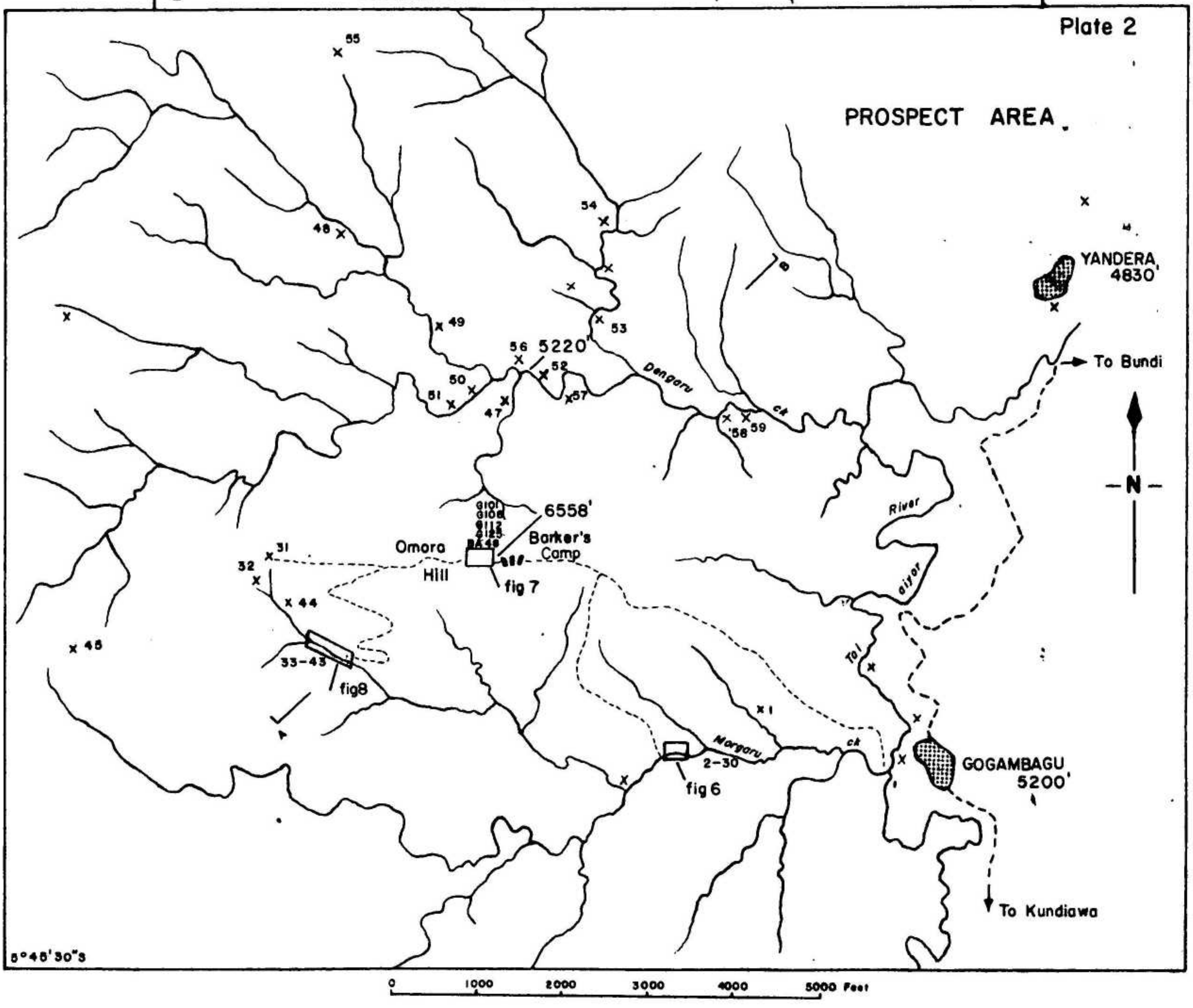
Plagioclase is the most abundant mineral and forms the majority of the phenocrysts. The composition is in the andesine range. All phenocrysts are partially replaced by bluish, crypto-crystalline silica around their boundaries, along zones in zoned crystals, and along cleavages and fractures. Sericitisation and alteration to epidote are common. Phenocrysts of alkali-feldspar were not observed, but staining tests indicate that it is present in the groundmass. Chlorite occurs as large aggregates of grains which appear to have replaced former ferromagnesian minerals. In several instances the shape of the pseudomorphs indicate that chlorite has replaced pyroxene. Anhedral epidote grains, aggregates of minute sphene grains and several apatite crystals are included in the chlorite. Chlorite also occurs in small veinlets through the rock. Accessory minerals are sphene, apatite and opaques. Opaque minerals are mostly euhedral martite grains and rarely grains of pyrite and gold.

G108: PS7171:

The predominant opaque mineral in this specimen is cuprite. Minor amounts of tenorite, chalcocite and copper and traces of covellite and chalcopyrite also occur. Malachite is the common transparent green copper mineral which can be seen in the hand specimen.

The primary copper mineral in the specimen was chalcopyrite. The other copper minerals have formed by alteration of the chalcopyrite. Occasionally boxwork structures of chalcocite after chalcopyrite can be observed. These boxworks are filled by a gangue mineral, probably quartz, which contains blebs of remnant chalcopyrite.





6558' *Uncorrected average barometric height*

× *Sample locality & number (if assayed)*

B *Section line (See fig3)*

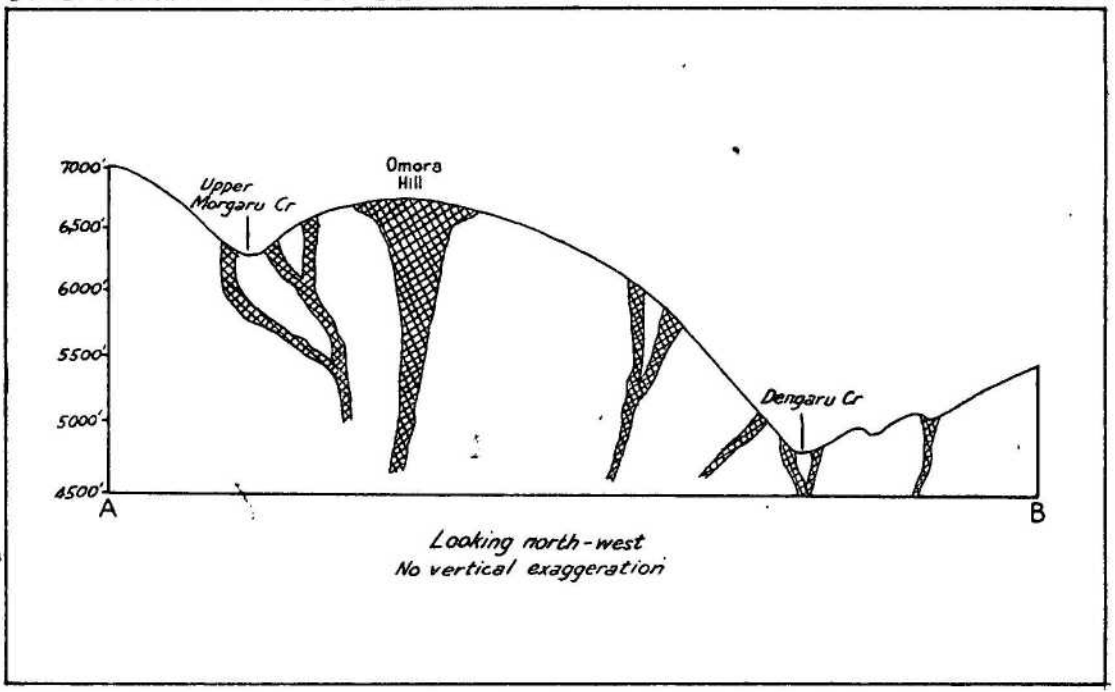
- - - *Easy walking track*

Native foot pad

Village

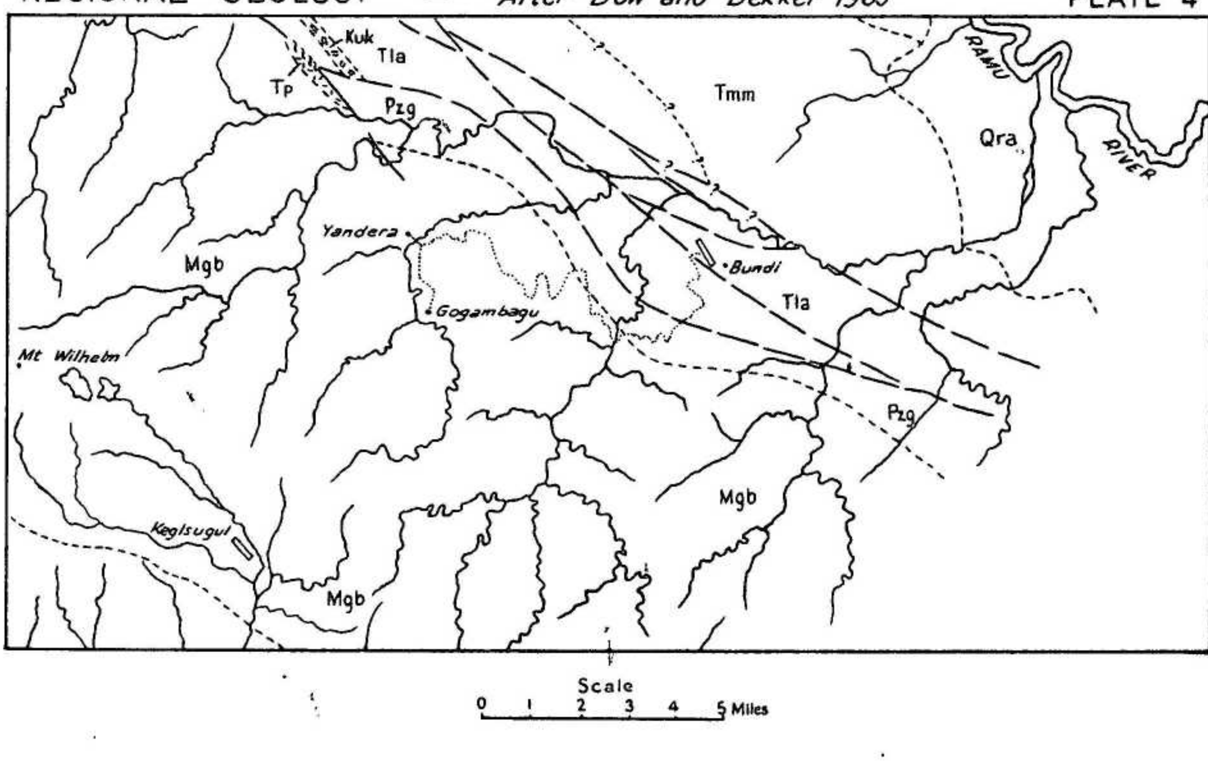
DIAGRAMMATIC CROSS-SECTION

PLATE 3

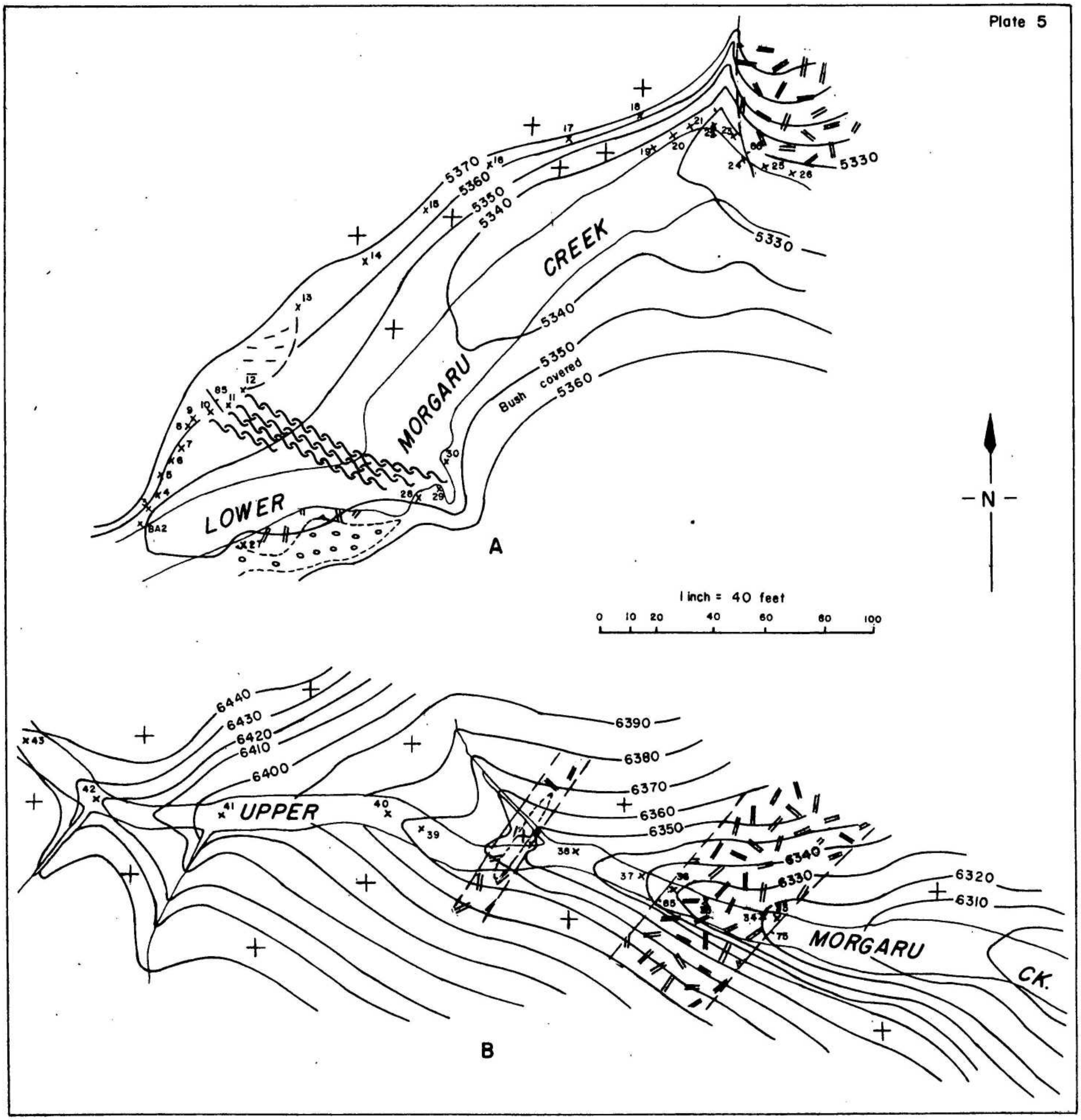


REGIONAL GEOLOGY — *After Dow and Dekker 1963*

PLATE 4



QUATERNARY			Qra	*Mudstone, siltstone, conglomerate, gravel*
TERTIARY	?Pliocene		Tp	*Porphyritic microdiorite*
	?Miocene	*Marum Basics*	Tmm	*Gabbro, dunite, peridotite, pyroxenite*
	Eocene - Miocene	*Asai Beds*	Tla	*Phyllite, shale, pebble conglomerate, calcarenite*
MESOZOIC	Cretaceous	*Kumbruf Volcanics*	Kuk	*Pillow lavas, agglomerate, tuffaceous greywacke, siltstone*
		Bismarck Granodiorite	Mgb	*Granodiorite*
PALAEOZOIC		*Goroka Formation*	Pzg	*Schist, marble, phyllite*



Quaternary — Alluvium

Tertiary — ? Pliocene Porphyry

Mesozoic — Bismarck Granodiorite

Strike & dip of schistosity

Fault

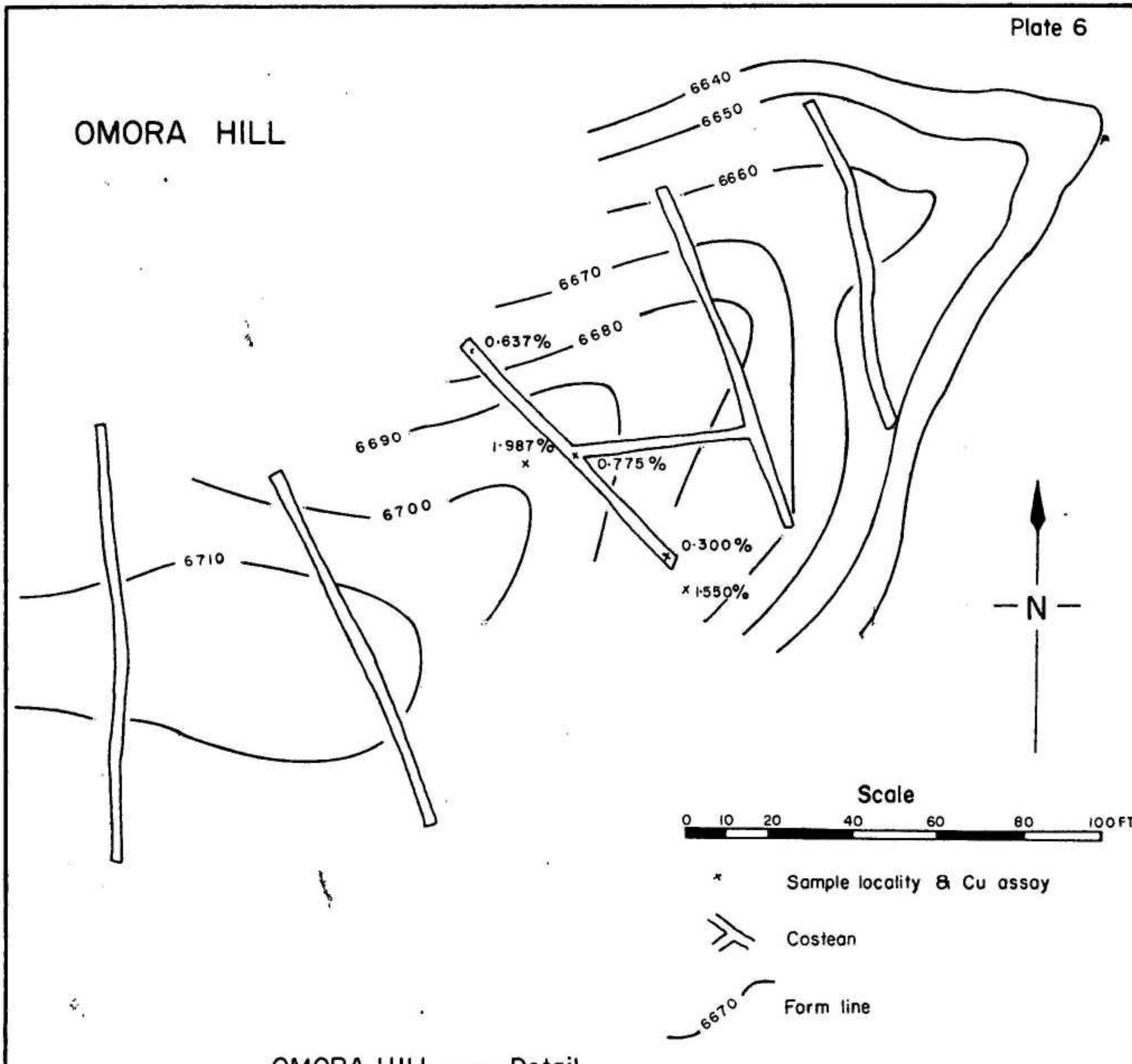
Shear zone

Sample locality BA 42 (assay number)

6330 Form line

Geological Boundary approx

MORGARU CREEK — Detail



OMORA HILL — Detail

Bureau of Mineral Resources, Geology Geophysics To accompany Record No 1965 / 114 B55/A5/18