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# Astrolabe Area Geophysical Survey Papua, 1970

*by*

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## CONTENTS



## ILLUSTRATIONS

## SUMMARY

The Bureau of Mineral Resources made geophysical surveys in 1970 at the Laloki and Mount Diamond mines in Astrolabe Mineral Field, Papua, to test mining geophysical exploration methods in the local environment.

Electromagnetic methods (Turam and VLF) were used at Laloki, and anomalies were obtained over known near-surface mineralization. In addition, electromagnetic (Turam and VLF) and induced polarization methods were used at Mount Diamond where anomalies were obtained over the mineralization. In general the survey showed that electromagnetic and induced polarization methods were detecting near-surface conductors.

## INTRODUCTION

The Bureau of Mineral Resources (BMR) made geophysical surveys in 1970 in areas in eastern Papua to test mining geophysical exploration methods in the local environment. The surveys started in July in the Ormond River area and in August and early September surveys were made at the Laloki and Mount Diamond mines in the Astrolabe Mineral Field. This report deals with the surveys in the Astrolabe Mineral Field. The localities are shown in Plate 1. The field work was done by P.J. Gillespie and P.C. Pollard (Geophysicists) under the supervision of J. Gardener. Field hands were kindly provided by the Department of Lands, Surveys and Mines, Port Moresby.

In 1949 and 1950 BMR made geophysical surveys at all the major copper mines and prospects in the Astrolabe Mineral Field (Tate, 1951). Methods used were magnetic, self-potential, plus brief tests at the Laloki mine using equipotential-line, and potential-drop-ratio methods. Localized self-potential anomalies were found in some of the areas. The gabbro in the area was found to be weakly magnetic, as were most of the orebodies, and in general it was difficult to separate anomalies associated with orebodies from those due to gabbro. In the 1970 survey, Turam and VLF electromagnetic methods and induced polarization were used.

In 1967, Compagnie Generale de Geophysique, under contract to BMR made an aeromagnetic survey of an area in eastern Papua which included the Astrolabe Mineral Field (Compagnie Generale de Geophysique, 1969). No significant anomalies were found on any of the mines or prospects in the Astrolabe Mineral Field.

The T.P.N.G. Administration and Enterprise Exploration Pty. Ltd. diamond-drilled the Laloki mine between 1959 and 1961. This drilling outlined the orebody (Davies, 1961). A re-assessment of the Laloki and Mount Diamond mines was made in 1968-1969 (Cheeseman, 1969); this included further diamond-drilling at Laloki and three holes at Mount Diamond.

## GEOLOGY

The geology and mineralization of the Astrolabe Mineral Field are described by Yates and de Ferranti (1967). All important copper mineralization in the field occurs in shale and siltstone of the Port Moresby Beds. In most cases the orebodies are in sediments close to the contact with Sadowa Gabbro, and generally in areas where roof pendants are abundant.

The Port Moresby Beds are Eocene, and, in the Astrolabe Mineral Field, consist of folded sediments and are underlain by Sadowa Gabbro. This gabbro is Oligocene and intrudes the Port Moresby Beds. Generally the Port Moresby Beds show little metamorphism at their contact with the Sadowa Gabbro.

Copper orebodies throughout the field are approximately lenticular. The strike and dip of the lodes are about the same as the surrounding sediments.

At the Laloki mine, the lode grades laterally from massive sulphides up to 6 m thick into pyritic pug and then to weakly pyritic shale. In the mine workings the orebody has an overall dip of about $45^{\circ}$ to the north and northwest. To the north, the western part of the lode flattens and then rises so that the probable dip near the northern margin is about $15^{\circ}$ to the south.

At the Mount Diamond mine, a massive sulphide zone is located on an anticlinal fold with the mineralization stopping abruptly on the north-dipping limb, but tailing off into a zone of sulphide stringers within a pyritic argillaceous zone on the south-dipping limb. The main orebody is about 9m thick and about 27m long.

## METHODS

Electromagnetic (Turam and VLF) and induced polarization (IP) methods were used.

Turam is a conventional fixed-transmitter, moving-receiver, horizontal-loop, electromagnetic method. The primary field was produced using a straight grounded cable. The frequency used was 660 Hz.

The VLF method uses a VLF radio transmitting station; readings are made with a portable receiver. The transmitting station used was North-West Cape (NWC) in Western Australia, which transmits on a frequency of 22.3 kHz.

Frequency domain readings were made in the IP survey. Conventional dipole-dipole geometry was used with 100-ft dipoles and frequencies of 0.3 and 5 Hz.

## 4. RESULTS

### Laloki mine

One traverse across the mineralization at the Laloki mine was surveyed using Turam and VLF electromagnetic methods. This traverse was selected for ease of access with its position shown in Plate 2. The traverse was pegged at 50-ft intervals.

The Turam and VLF results are shown in Plate 2 with a geological section based on that of Davies (1961). The Turam readings were made every 50 ft, while staff separation was 100 ft, and the primary field was produced using a straight grounded cable at 500 W. The VLF readings were were made every 50 ft.

Diamond-drilling (Davies, 1961) showed that the traverse surveyed is underlain by the main lode at about 200 ft (Plate 2). This lode is about 20 ft thick and dips at about 15° to the south on the section shown. A massive sulphide lode about 10 ft thick was intersected in hole SC3 at shallow depth (30 ft). This lode was not intersected in the air-shaft 30 ft north of SC3, and its attitude is not known. Thus two thin flat-lying sulphide zones underlie the traverse, one at a depth of about 30 ft with limited extent, and one at a depth of about 200 ft.

A Turam anomaly is centred about 80E and another about 280E, separated by a break at about 150E. The anomaly centred at about 80E is over the sulphide zone intersected at 30 ft in hole SC3. The break at 150E may be associated with the eastern edge of this zone. The lithology of the sediments (the Port Moresby Beds) is predominantly fine-grained shale and lutite while the sulphide mineralization is generally associated with a fissile black shale (Davies, 1961, p. 4). Thus the country rock probably contains near-surface weak conductors due to shale or lutite and these are probably the cause of the Turam anomalies centred about 280E, and east of 500E.

The VLF profile can be resolved into two anomalies, one at about 80E and one about 560E. The anomaly at 80E is probably caused mainly by the near-surface sulphide zone, and the anomaly at 560E by near-surface shale. No VLF anomaly was found at the Turam anomaly at 280E. It appears that neither method used detected the sulphide zone at about 200 ft (60 m) depth.

No geochemical survey has been made over the Turam and VLF anomalies east of 500E. A brief survey would be warranted if the sediments have a reasonable thickness here.

### Mount Diamond mine

One traverse at Mount Diamond was surveyed using Turam, VLF, and IP methods. The 1949-1950 geophysical survey (Tate, 1951) located magnetic and self-potential anomalies at Mount Diamond. Diamond-drilling results and geological mapping have indicated mineralization in the position shown in Plate 3, which is based on the cross-section of Cheeseman (1969). The traverse surveyed was selected because it crosses the magnetic and self-potential anomalies and the mineralization. The traverse was pegged at 50-ft intervals (slope distances).

The topography shown in Plate 3 is taken from Tate (1951, plate 21). To compare the geophysical results with the geological section, the results have been plotted using horizontal distances between stations.

The Turam primary field cable was laid along 25N. The Turam results show an anomaly centred at about 400N over the mineralized zone.

The VLF anomaly at about 400N is over the mineralized zone and is superimposed on a topographic effect due to the slope, which has produced a progressive increase in the in-phase readings northwards. A VLF anomaly, not fully covered by the traverse, occurs at about 50N; its source may be a near-surface shale.

The IP results show resistivity lows and frequency effects associated with the mineralization. The resistivity and frequency effect anomalies appear to be displaced down-slope from the mineralization; which is only a topographic effect.

The magnetic and self-potential anomalies are over the mineralization (Tate, 1951). The drilling found no source for the magnetic anomaly, although magnetite is known to be associated with sulphides in some of the mines in the Astrolabe Mineral Field (Yates & de Ferranti, 1967, p. 42) and the magnetic anomalies are likely to be caused by magnetite. The self-potential anomaly is apparently caused by the sulphide zone.

The weak narrow Turam anomaly at 650N has associated high IP frequency effects, and may be caused by a small sulphide zone.

## 5. CONCLUSIONS

At the Laloki mines, Turam and VLF electromagnetic anomalies were found. One of the anomalies is related at least in part, to near-surface sulphides. Other anomalies are probably related to near-surface shale. The main sulphide zone is about 200 ft (60 m) below the traverse surveyed and was not detected.

At Mount Diamond, Turam, VLF, and IP anomalies were found over the known mineralization. In addition, magnetic and self-potential anomalies were found over the mineralization in the 1949-1950 survey (Tate, 1951). The mineralized zone comes within 50 ft (15 m) of the surface.

In general, the 1970 survey showed that near-surface conductors were detected in the areas surveyed.

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TATE, K.H., 1951 - Final report of the geophysical survey of the Astrolabe Mineral Field, Papua. Ibid. 1951/29 (unpubl.).

YATES, K.R., and DE FERRANTI, R.Z., 1967 - Geology and mineral deposits Port Moresby/Kemp Welch area, Papua. Bur. Miner. Resour. Aust. Rep. 105.

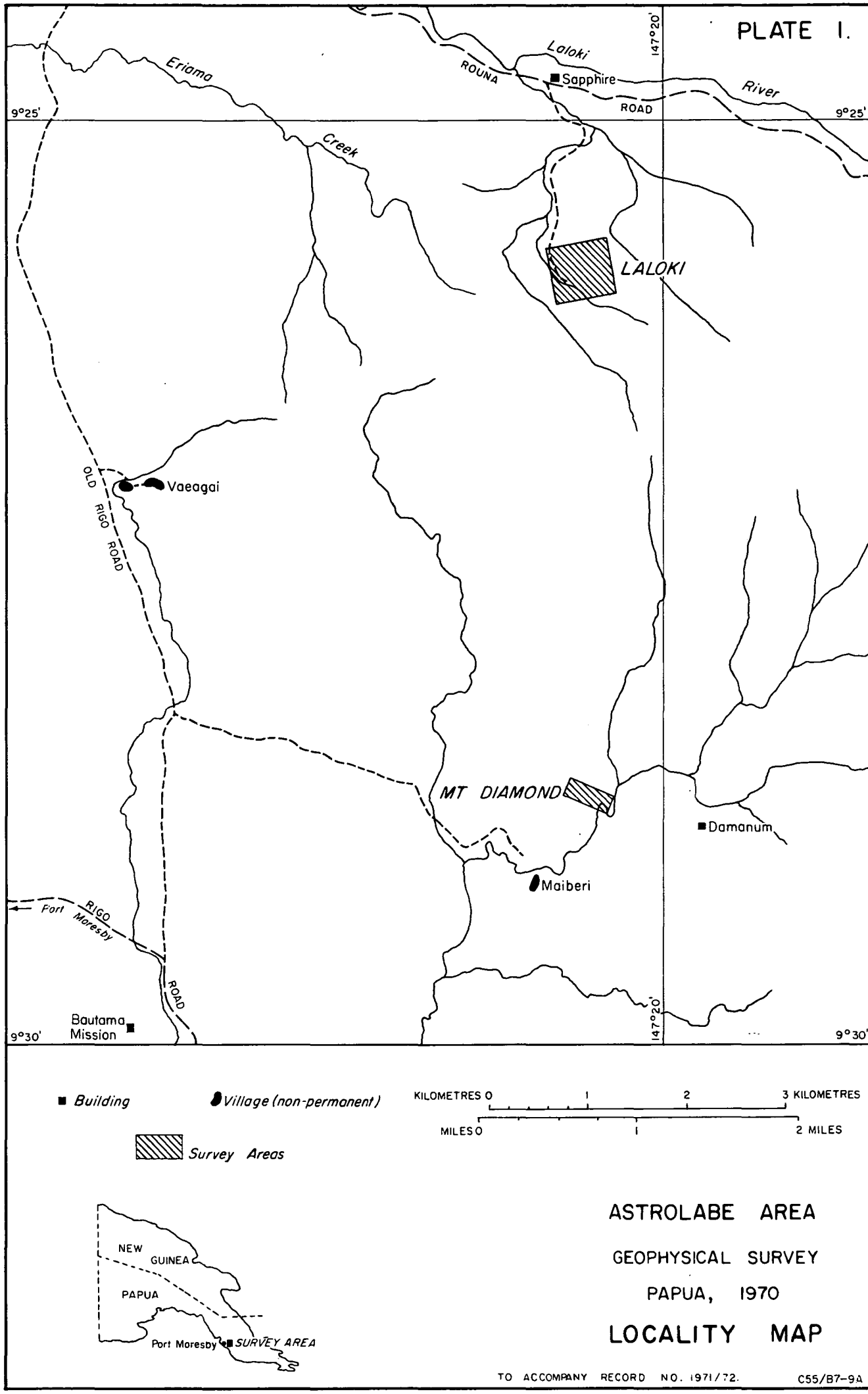
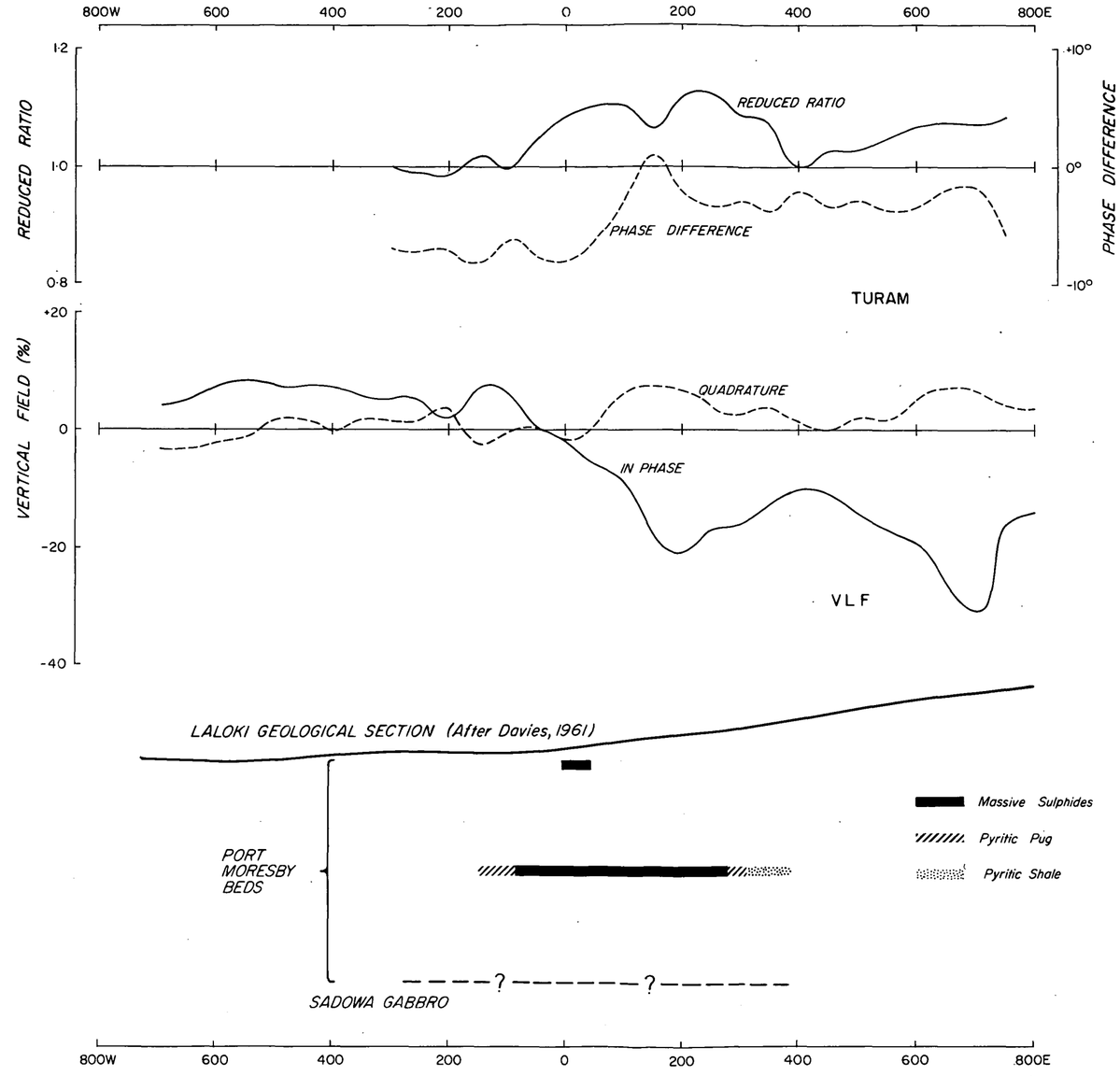
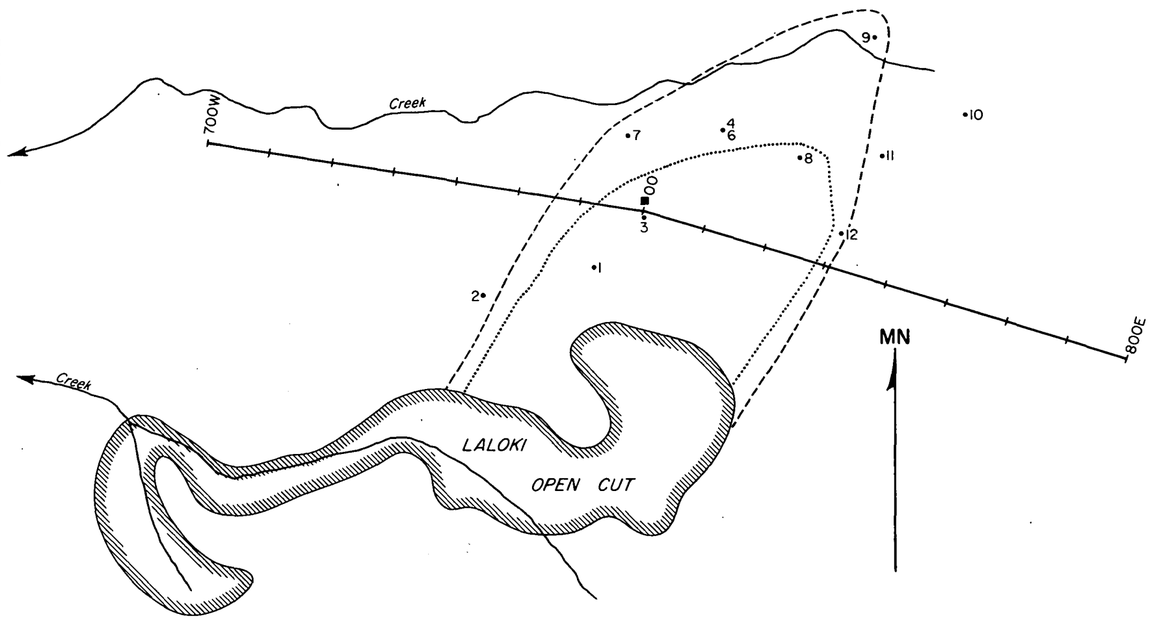


PLATE I.
Eriamo
Creek
Laloki
ROUNA
Sapphire
ROAD
River
147°20'
9°25'
LALOKI
Vaeagai
OLD RIGO ROAD
MT DIAMOND
Damanum
Maiberi
Port Moresby
RIGO ROAD
Bautama Mission
9°30'
Building
Village (non-permanent)
Survey Areas
KILOMETRES 0 1 2 3 KILOMETRES
MILES 0 1 2 MILES
NEW GUINEA
PAPUA
Port Moresby
SURVEY AREA
ASTROLABE AREA
GEOPHYSICAL SURVEY
PAPUA, 1970
LOCALITY MAP
TO ACCOMPANY RECORD NO. 1971/72.
C55/B7-9A

PLATE 2




After Davies (1961)

- Limit of Pyritic Pug
- Limit of massive Sulphides
- 7 Diamond Drill-hole SC7
- Airshaft
- 00 Traverse surveyed

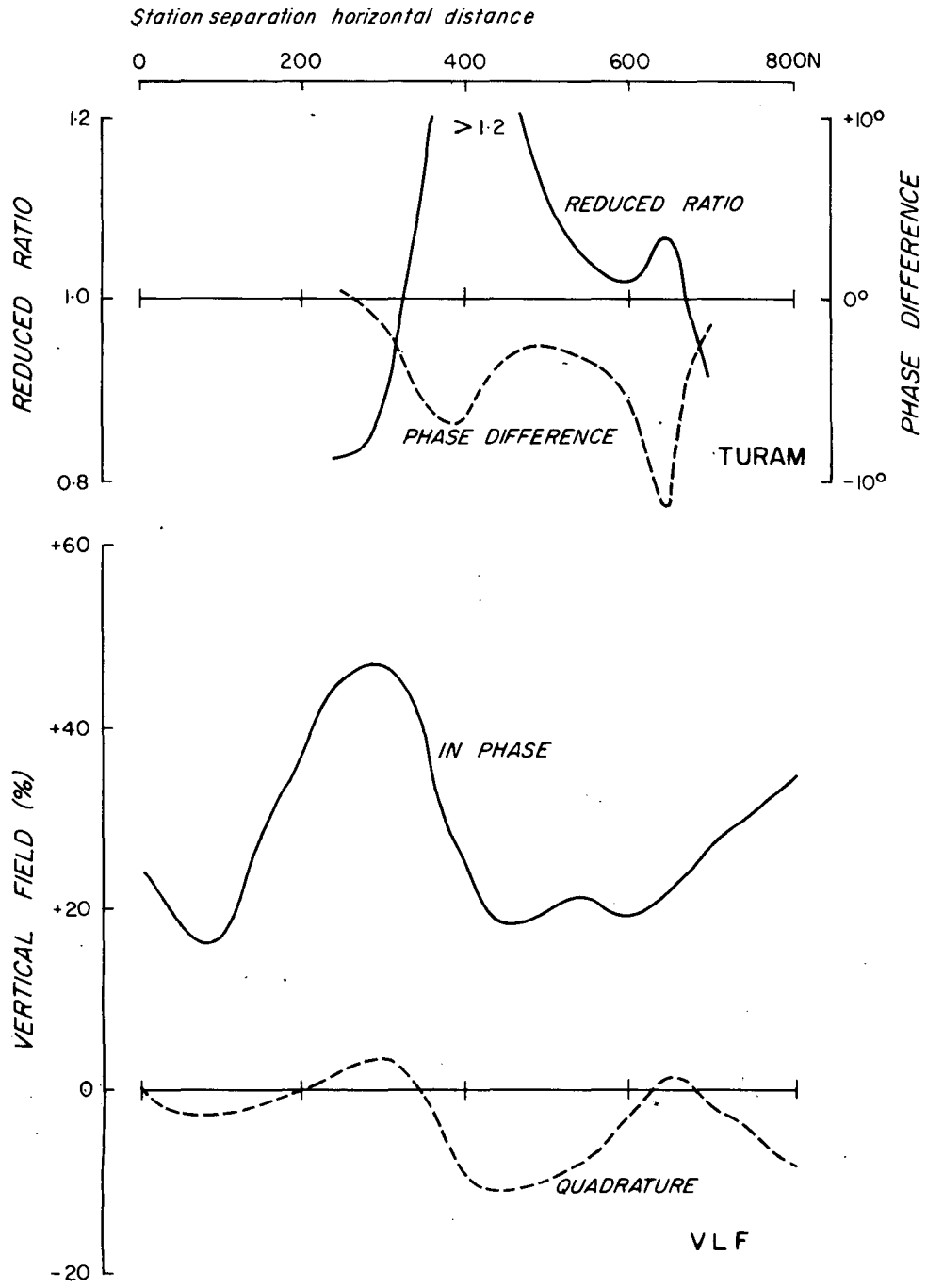
METRES 50 0 50 100 150 METRES

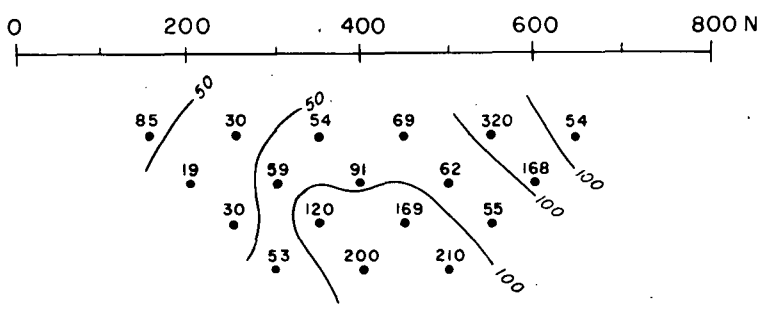
FEET 200 0 200 400 FEET

# GEOPHYSICAL RESULTS
## LALOKI AREA
## PAPUA

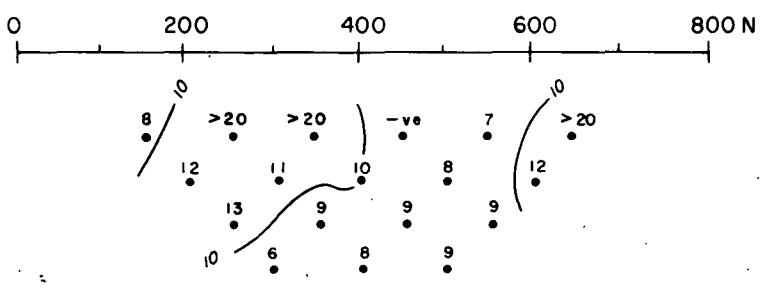
TO ACCOMPANY RECORD NO. 1971-72 C55/B7-10

PLATE 3

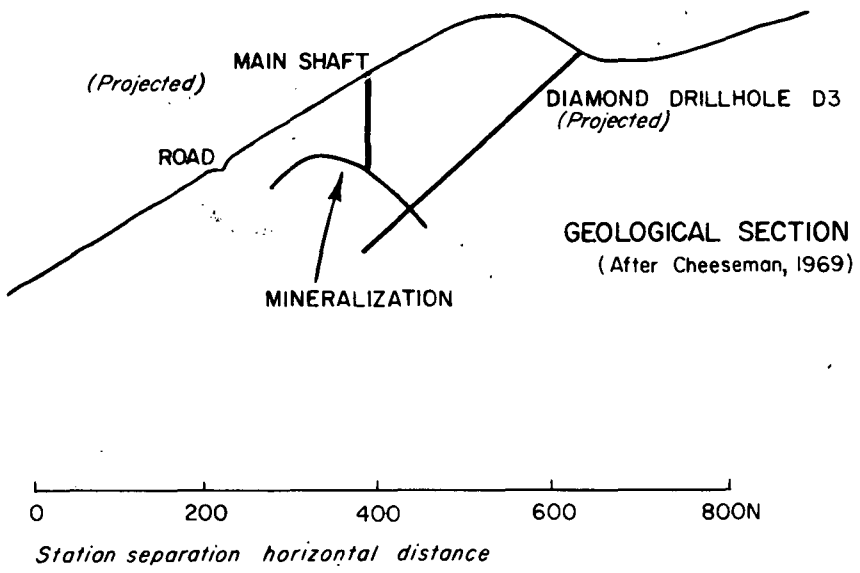


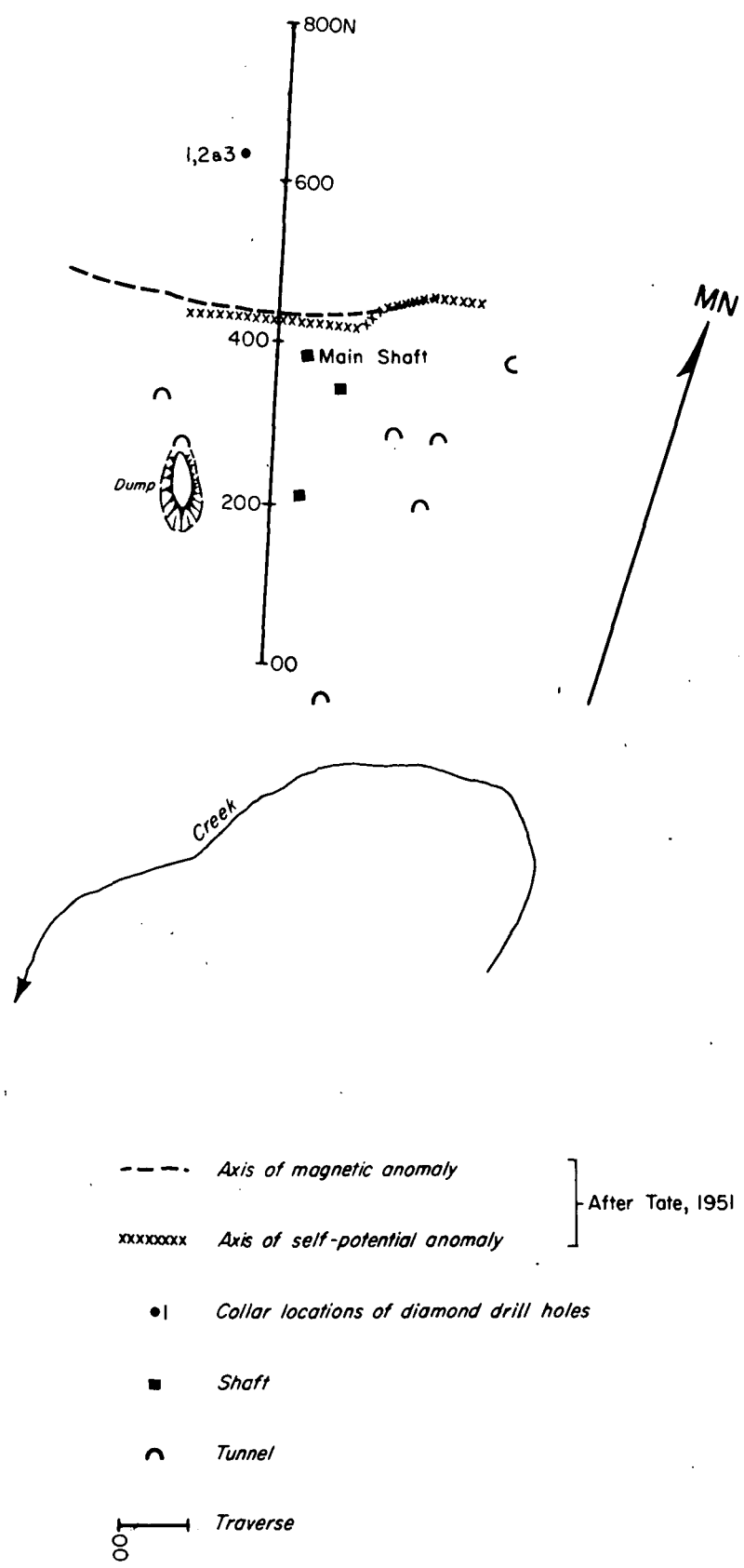

APPARENT RESISTIVITY
Ohm – metres




FREQUENCY EFFECT (%)




GEOLOGICAL SECTION
(After Cheeseman, 1969)




*Horizontal and vertical scales 1" = 200 ft*

*NOTE: Traverse was pegged using slope distances, but results plotted here are corrected to true horizontal distances.*

# GEOPHYSICAL RESULTS
# MOUNT DIAMOND AREA
# PAPUA

TO ACCOMPANY RECORD NO. 1971/72. C55/B7-11