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Record No. 1969 / 121

Comstock and Cape Horn areas, Queenstown, Tasmania- Drilling results, Bore logging, and Geophysical reinterpretation

by

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ILLUSTRATIONS

SUMMARY

Three holes drilled in the Comstock area, Queenstown, Tasmania, to test electromagnetic and induced polarisation anomalies revealed no significant mineralisation. Logging and laboratory tests on core samples, undertaken to investigate further the cause of the anomalies, led to the conclusion that the anomalies are probably due to carbonaceous material in the limestone encountered in the holes.

Drilling of similar geophysical anomalies in the Cape Horn area proved a substantial body of sulphide mineralisation, which satisfactorily accounted for the geophysical results.

Comparison of the drilling and geophysical results from the two areas suggests that the electromagnetic and induced polarisation methods are effective in exploration for sulphide mineralisation in the Mount Lyell field in areas free from carbonaceous material.

1. INTRODUCTION

In 1964-1965, the Bureau of Mineral Resources (BMR) carried out a geophysical survey in the Comstock valley near Queenstown, Tasmania, (Plate 1) to assist the search for copper-bearing sulphide mineralisation. As a result of that survey four drilling targets were recommended as a preliminary test of anomalies indicated by the electromagnetic (Turam) and induced polarisation methods (Williams, 1966).

Three holes were subsequently drilled by the Mount Lyell Mining and Railway Company to investigate the geophysical targets, but no significant mineralisation was encountered. All holes intersected several hundred feet of Gordon Limestone and not the Lyell Schist in which the sulphide mineralisation in the Mount Lyell field normally occurs.

Because the cause of the geophysical anomalies was not immediately apparent, BMR undertook to carry out further investigations, including logging and laboratory tests on core samples, with the aim of establishing the cause of the anomalies. The Company was able to keep one hole open for logging and provided core samples from the three holes. J.P. Williams (geophysicist) and N.A. Ashmore (geophysical assistant) visited Queenstown from 1 to 19 March 1968 to conduct the investigation.

At the same time, drilling was in progress to test geophysical anomalies indicated by BMR's 1966 survey of the Cape Horn area. The results of this drilling are discussed briefly in this Record as they provide a useful comparison with the results in the Comstock area.

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2. DRILLING RESULTS, COMSTOCK AREA

The geological information on the Comstock area available at the time of the geophysical survey was summarised by Williams (1966). However, the geology was not known in detail because of lack of outcrop. The geological sections along the traverses where drilling targets were recommended could only be inferred, and these sections were presented solely to illustrate the possible structure of the area.

Three holes - C49, C51 and C54 - were drilled in 1967 to test geophysical targets 1, 2, and 3 on Traverses 5600E, 4800E and 3200E respectively. It was expected that these holes would intersect the Lyell Schist near its contact with the conglomerate, i.e. in the environment known to be favourable for mineralisation in the Mount Lyell field. However, the drilling showed that the geological sections differ substantially from what had been inferred and that the schist/conglomerate contact does not occur in the expected position.

The geological sections revised on the basis of the drilling are shown in Plate 3. Details of the holes are given in Appendix 1. Hole C49 intersected glacial overburden, limestone, and then conglomerate. C51 and C54 intersected overburden and then continued in limestone to total depth. None of the holes intersected the schist that had been expected.

The limestone intersected in the holes is generally grey and fine- to medium-grained. Locally there are fossiliferous horizons, calcarenites, and calcite veins. A very small amount of pyrite is present, normally associated with slickensides and possibly a solution product. The limestone also contains dark bands, apparently composed of carbonaceous matter of organic origin.

The limestone is cavernous and the holes had to be cased for considerable lengths, e.g. 600 feet in C54. The holes also encountered large quantities of water. C51 and C49 made water at the surface, in the latter case 18,000 gallons per hour, and in C54 water came to within 46 feet of the surface.

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3. GEOPHYSICAL INVESTIGATION OF THE COMSTOCK DRILLING RESULTS

The hole selected for investigation was C54 which was planned to investigate the geophysical target on Traverse 3200E (Plate 3). In actual fact this hole did not investigate the recommended target, but passed about 200 feet above it. However, C51 on Traverse 4800E, which was closer to the recommended target, and C49 on Traverse 5600E, which passed under the recommended target, also encountered limestone. Thus it is assumed that limestone is also present near the target zone on 3200E. Hence a geophysical investigation of C54 should provide sufficient information to suggest the source of the anomalies on this traverse.

Electric logging

C54 was logged using a Widco Porta logger, model PLA-PRG-10A. Radiometric, single-point resistance, and self-potential logs were obtained. For the purposes of this Record the methods are adequately described by Dobrin (1960). The hole was logged radiometrically while the hole was cased, but the casing had to be withdrawn for the electric logging. Although the casing was withdrawn in sections, some cave-ins occurred and only those portions shown in Plate 2 were logged.

The radiometric (gamma-ray) log generally shows a background of 0.012 to 0.020 milliRontgens per hour (mR/h) in the overburden with an increase to about 0.036 mR/h between 120 and 183 feet, where a grey brown clay was intersected. There are several small zones of extremely low radiation count - centred at 248, 392, 510, 573, and 615 feet. The first two coincide with high single-point resistance values. The last two are in a portion of the hole not logged by other methods. All these zones probably correspond to cavities in the limestone. There are three small zones at 280, 325, and 370 feet with anomalies about one and a half times local background count. These coincide with resistance highs and dark grey fine-grained limestone. However, not all limestone of this type produced such effects, and there seems to be no way of recognising changes in lithology from the reaiometric results obtained in this hole.

The S-P results do not appear significant and the low at 840 feet does not coincide with anything unusual on the geological log.

Although the resistance log is incomplete (Plate 2) it has some interesting features. The resistances below 660 feet are much higher than those above 460 feet. There is a zone of lower resistance between 400 and 460 feet. There are other smaller zones of low resistance between 400 feet and the top of the limestone. The resistance in the overburden is only slightly higher.

The IP survey results (Plate 3) show a zone of low resistivity adjacent to higher resistivities. The resistivity low appears to be due to the averaged effect of the low resistance zones indicated by the log between 250 and 460 feet. The 'shallow' IP

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results (i.e. the n = 2 values) indicate that the overburden has a slightly higher resistivity. There is no evidence in the IP survey results of the high resistances recorded in the limestone below 660 feet. However, with the dipole spacings used in the survey, the theoretical depth penetration would be insufficient to admit detection of resistivity changes at this depth. The higher resistances below 600 feet are presumably due to a lower carbon content in the limestone. The fact that no pyrite was reported below 700 feet also points to a change in the composition of the limestone.

Laboratory investigations

Sections of the drill cores were selected for IP measurements in the laboratory. These measurements were made by passing a d.c. signal into the core, then switching off the current after 10 seconds, and observing the overvoltage decay curve on an oscilloscope. The results are expressed in millivolts one second after power-off divided by the total impressed voltage expressed in volts, i.e. millivolts per volt. These measurements are summarised in Appendix 2. Typical readings are shown in Plate 2. For a description of the instrumentation see Haigh and Smith (in prep.).

While making these measurements the author noted that the dark carbonaceous bands gave strong IP effects. The measured IP effects were plotted against resistance taken from the single-point resistance log (Plate 2). Although there are not many results available for this plot, the results show an obvious correlation between high IP effects and low resistances. The high IP effects showed no obvious correlation with the small amounts of pyrite visible in some cores. Since small amounts of pyrite are present between 250 and 700 feet they may contribute to the general low resistivity values and even the IP effects, but it appears that the high IP effects are due mainly to carbonaceous matter. Thus the low-resistance zones in the electric log may indicate carbonaceous zones in the limestone. However, this does not exclude the possibility of IP effects and low resistivity zones being associated with larger amounts of pyrite.

Turam anomalies arise from the presence of good electrical conductors in a medium of low electrical conductivity. The resistivity log suggests that such a condition exists at Comstock owing to the carbonaceous zones in the limestone. In addition, the holes intersected cavities containing saline water, which would also act as conductors.

A sample of water was collected from each hole, and although the total dissolved solids did not exceed 237 p.p.m., resistivities as low as 23 ohm-metres were measured; for C54 the value was 29 ohm-metres. Thus although the evidence is not conclusive, it appears that the Turam anomalies could be explained by water-filled cavities and/or low-resistivity zones in the limestone.

4. DRILLING RESULTS, CAPE HORN AREA

The drilling results at Cape Horn revealed sulphide mineralisation in the vicinity of the geophysical targets selected in 1966 (Williams, 1967). The results are summarised in Plate 4. BMR target No. 1 on Traverse 3000S is the only target so far untested.

Targets No. 2, 4, and 5 lie within the sulphide zone. Target No. 6 probably does also, but this can only be surmised as the drilling section supplied was for Traverse 2800W while the recommended target was on 3000W. Target No. 3 is outside the sulphide zone on Traverse 1600S but, as pointed out in the survey report (Williams 1967 pp. 9-10), the Turam results on this traverse were ambiguous as there appeared to be two possible interpretations:

(1) A conductor with current concentration at 6100W, depth 250 to 300 feet; or

(2) Conductors with current concentrations at 6050W and 6200W with depths between 150 and 200 feet.

This target, then, did not refer to a specific current concentration, but was positioned so that the recommended drill hole would investigate both possibilities. Drilling has revealed only one sulphide zone, so the first possibility would seem correct. However, this places the current concentration much deeper than one would expect from the results on Traverse 5600W. Considering the second possibility, the current concentration indicated at 6050W seems in good agreement with the drilling section, but there is no evidence of any mineralisation at 6200W where the other current concentration was predicted. There are definitely two anomalies on the next traverse, 1800S, and these appear almost to merge on Traverse 1600S. In this case the current concentration at 6200W may be an end effect due to the presence of a conductor south of 1600S.

Any further drilling in this area, especially near 1800S, may clarify the ambiguity of the interpretation of Traverse 1600S.

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5. CONCLUSIONS

Williams (1966) based the interpretation of the Comstock area largely on a comparison with the geophysical results obtained from a test traverse over the Tasman and Crown Lyell Extended mine. The interpretation of the Cape Horn area (Williams, 1967) was based partly on the results of this test traverse and partly on the results obtained in the Corridor area. The similarity of the geophysical anomalies at Cape Horn and Comstock suggested that the chances of encountering mineralisation in these two areas were equal. The drilling at Cape Horn shows that the interpretation applied to this area was justified. The drilling at Comstock shows that comparison of this area with the Tasman mine area was not justified because of the completely different geological situations. In the Comstock valley, limestone several hundred feet thick is present beneath 200 feet or more of glacial material. The Tasman mine is in schist near the contact with conglomerate, and the overburden is considerably thinner.

Because of the similarity of the geophysical anomalies at Cape Horn and Comstock, there is no way at present of distinguishing IP and electromagnetic anomalies due to sulphide mineralisation from anomalies due to carbonaceous matter in limestone. The three holes drilled at Comstock all investigated the large anomaly that extends through most of the surveyed area and is apparently related to the Gordon Limestone. The remaining recommended target on Traverse 800E at Comstock was planned to investigate a separate anomaly. Although the source of this anomaly may be related to limestone, the proximity of the anomaly to the Tasman mine suggests that it could be due to sulphide mineralisation. Testing of this anomaly is still recommended.

In other areas of Mount Lyell where there is no likelihood of encountering carbonaceous material, as at Cape Horn, it appears that combined electromagnetic and IP surveys can be a reliable guide to mineralisation.

6. REFERENCES

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HAIGH, J.E. and SMITH, M.J. - Laboratory measurements of physical properties of rocks. Bur. Min. Resour. Aust. Rec. (in prep.).

WILLIAMS, J.P., 1966 - Comstock area geophysical survey, Queenstown, Tasmania 1965. Ibid. 1966/103 (unpubl.).

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APPENDIX 1 - DETAILS OF DRILL HOLES

Hole No.	COLLAR Position		RL, ft	Bearing	Inclination	Length, ft
	BMR grid	Mt Lyell grid				
C54	200N/3200E	6719.6N/4068.5E	1102.50	174°34'	-51°20'	1131.5
C51	85N/4800E	6571.14N/5666.83E	1018.25	179°11'	-28°30'	801
C49	360N/5600E	6860.5N/6468.1E	967.48	179°11'	-39°30'	1460.5

APPENDIX 2 - IP MEASUREMENTS ON CORE SAMPLES

Hole	Depth (feet)	Average mV/V 1 sec. after cut-off	Single-point resistance (from log)	Remarks (limestone inferred)
C54	258	90	120	grey, black patches, pyrite specks
	282	30	340	dark grey, small black band
	306	80	90	dark grey
	351	180	60	grey, black bands, pyrite specks
	370	10	400	dark grey, pyrite specks
	405	48	120	grey with black patches
	440	278	120	dark grey, strong black band
	698	90	80	dark grey, pyrite specks
	849	20	400	light grey
C49	306	NIL	Not logged electrically	grey
	360	NIL	"	grey
	649	NIL	"	grey with calcite
	742	143	"	dark grey, pyrite specks
C51	298	37	"	dark grey, pyrite vein
	354	NIL	"	grey, pyrite specks
	420	NIL	"	light grey
	491	176	"	very dark grey

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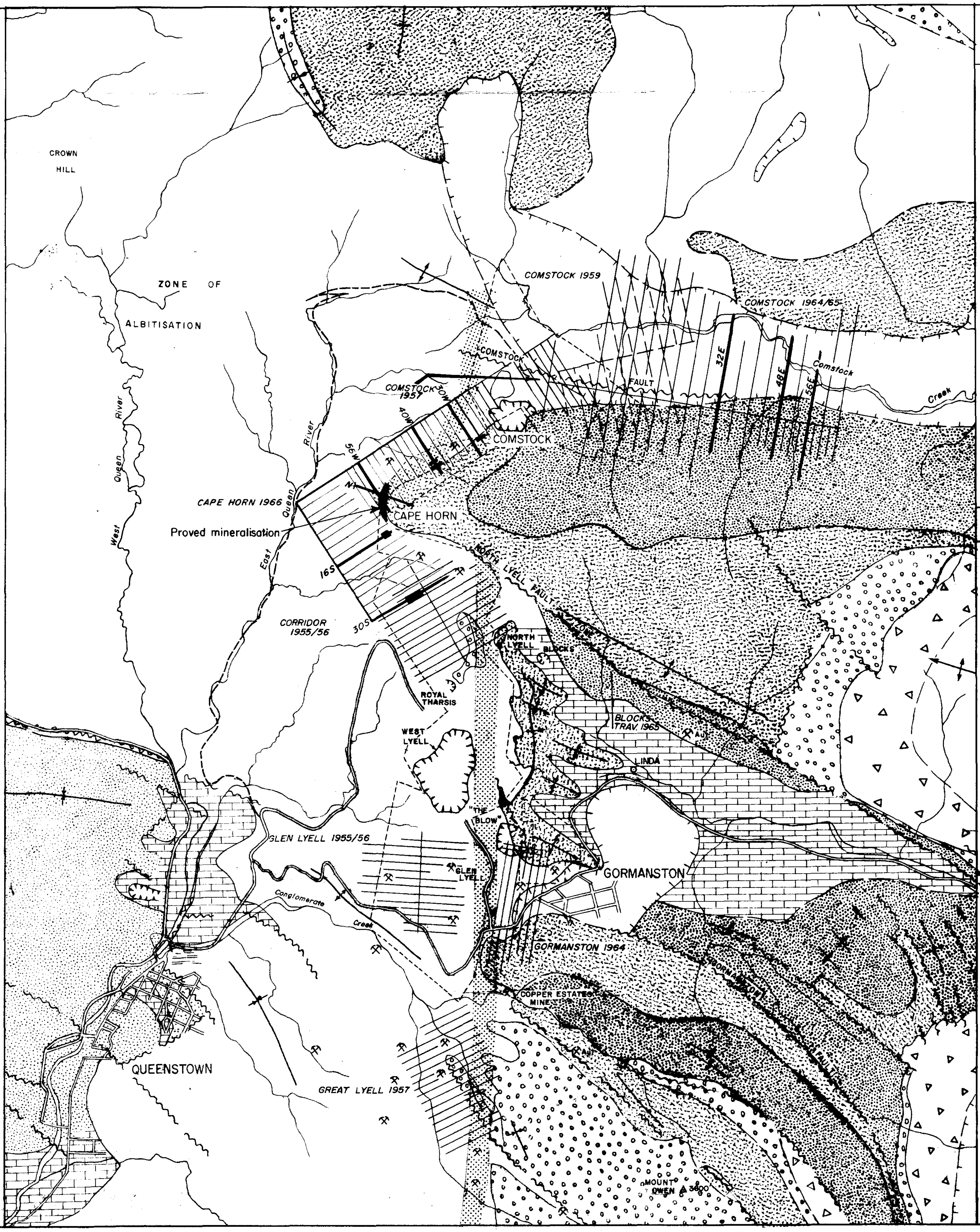
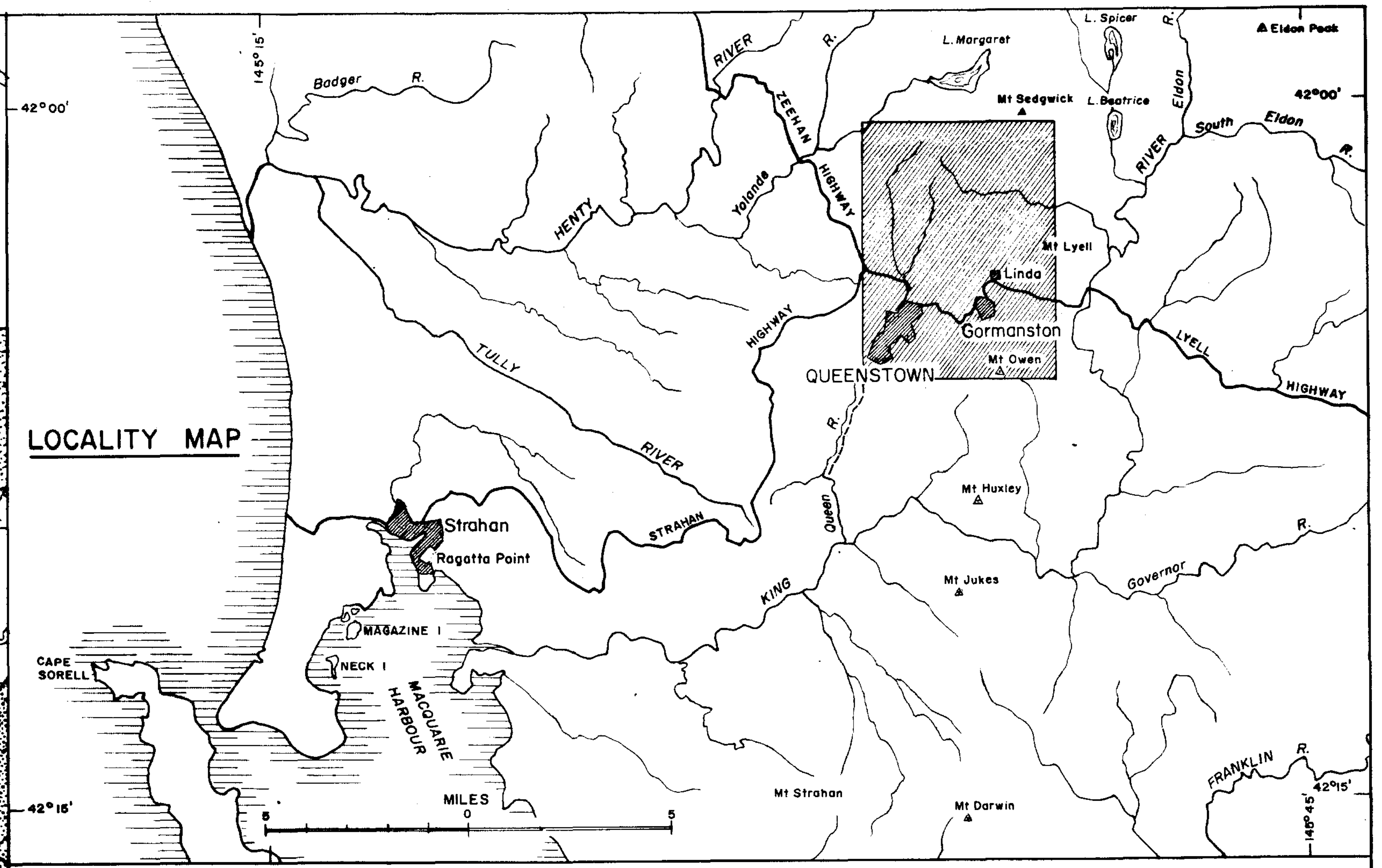
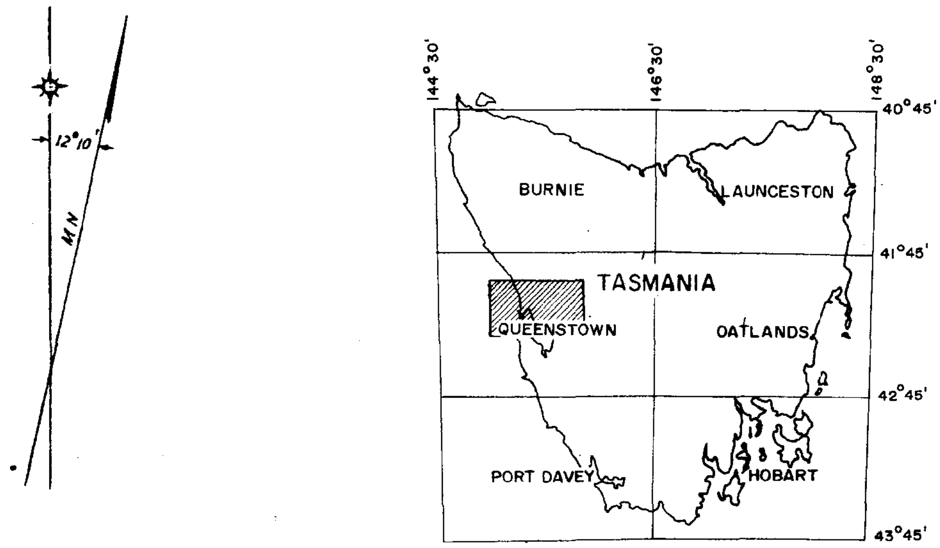
LEGEND

Pleistocene Moraine	Pleistocene
Eldon Group	L. Devonian to Silurian
Gordon Limestone	Ordovician
Upper Owen Conglomerate	Ordovician
Middle Owen Conglomerate	Ordovician
Lower Owen Conglomerate	Ordovician
Jukes Conglomerate	Ordovician
Mount Read Volcanics (including Lyell Schists)	Cambrian

- Observed geological boundary
- Approximate " "
- Observed fault
- Approximate "
- Approximate position of Lyell Shear
- Syncline (with plunge)
- Anticline
- Mine for copper
- Au Unless marked gold
- Quarry
- Trigonometric station
- Main road
- Vehicular track
- River or creek
- Outline of geophysical survey areas prior to 1949
- BMR geophysical surveys 1949-1966
- Rio Tinto geophysical survey 1959
- 16S Traverses referred to in the text, showing sulphide mineralisation







REFERENCE TO AUSTRALIA STANDARD
1:250,000 MAP SERIES: QUEENSTOWN

QUEENSTOWN, TASMANIA, 1968
LOCALITY AND REGIONAL GEOLOGICAL MAP

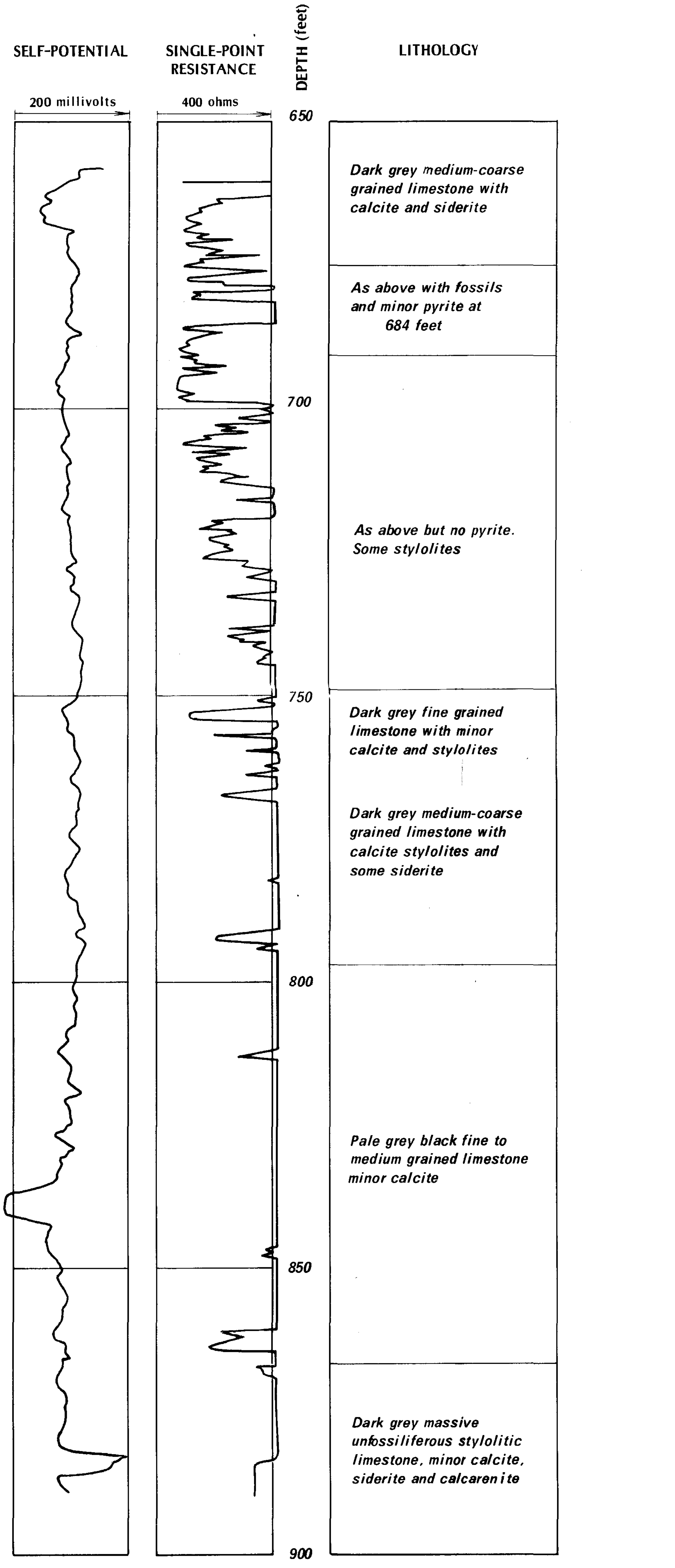
MILES
1 0 1 2

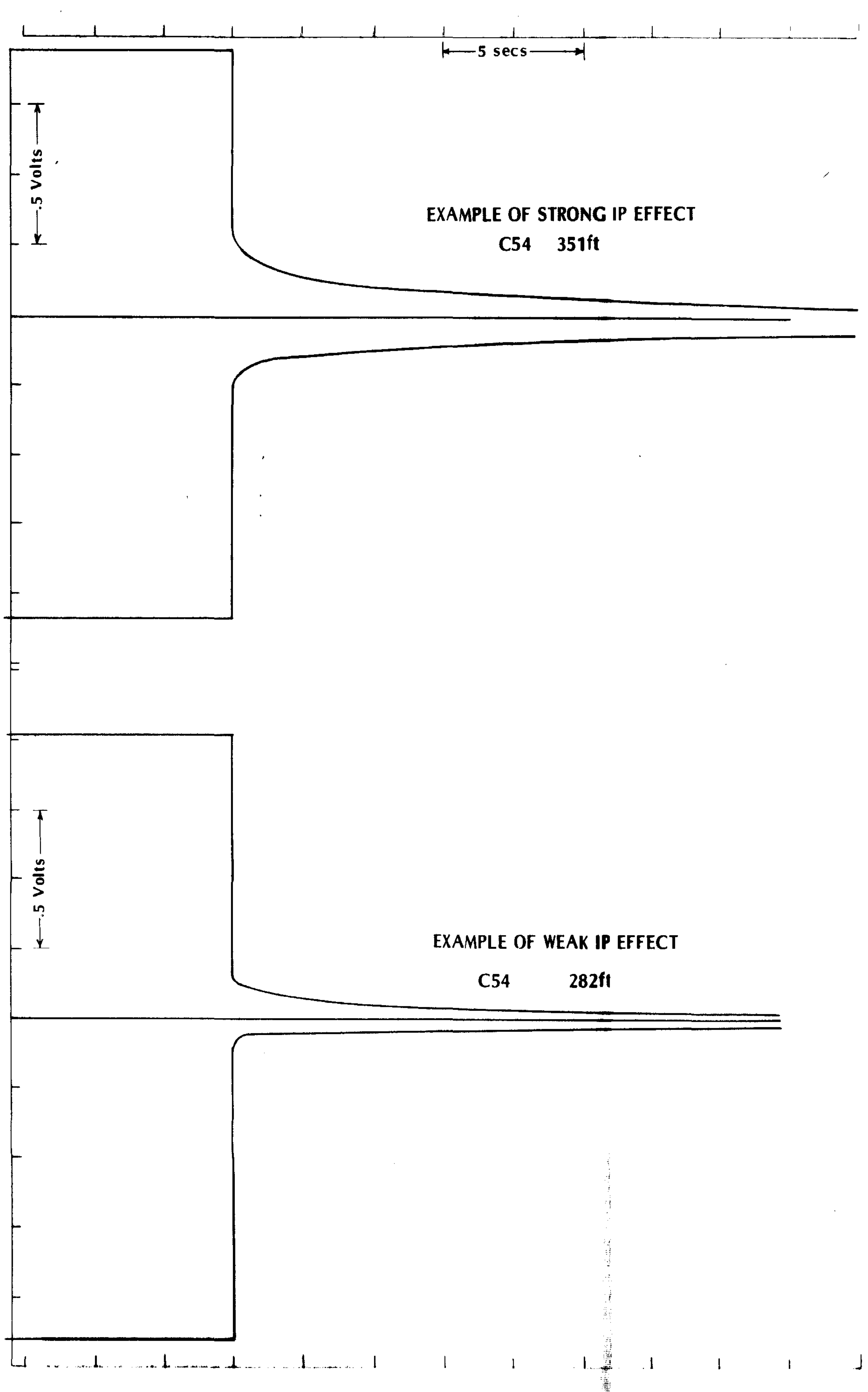
AFTER MT LYELL M. AND R. CO. LTD, QUEENSTOWN AREA GEOLOGICAL MAP

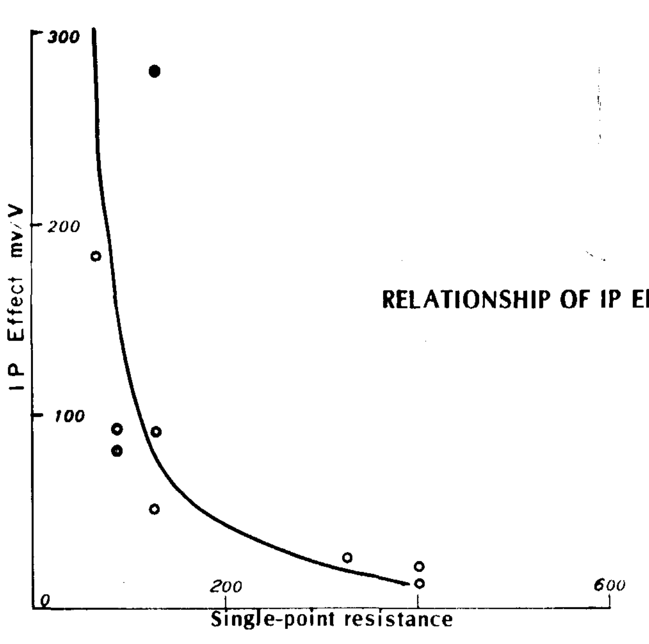
TO ACCOMPANY RECORD No. 1969/121

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. K55/B7-199

(BASED ON K55/B7-129)







RELATIONSHIP OF IP EFFECTS AND RESISTANCE

COMSTOCK AREA

GEOPHYSICAL AND GEOLOGICAL LOGS AND IP RESULTS OF DDH C5A

PLATE 2

K55/B7-196

TO ACCOMPANY RECORD No. 1969/121

PLATE 3

COMSTOCK AREA

GEOPHYSICAL PROFILES, GEOLOGICAL SECTIONS AND DRILLING RESULTS

TO ACCOMPANY RECORD No. 1969/121

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

K55/B7-197

CAPE HORN AREA

GEOPHYSICAL PROFILES, GEOLOGICAL SECTIONS AND DRILLING RESULTS

(Based on K55/B7-146)

TO ACCOMPANY RECORD No. 1969/121

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. K55/B7-198