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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1970/95

Tests of the V.L.F. Electromagnetic Prospecting Method in the Queenstown and Zeehan Districts, Tasmania 1969

by

J.E. Haigh

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ILLUSTRATIONS

SUMMARY

In February and March 1969 testing of the v.l.f. electromagnetic prospecting method using Ronka EM16 equipment was carried out in the Queenstown-Zeehan region of Tasmania.

The tests were conducted over selected traverses previously surveyed by various geophysical methods. Although many anomalous zones were located by the v.l.f. method, the profiles in general did not conform to the idealized shape expected from discrete conductors.

No conclusive demonstration of the depth penetration of the method was obtained.

Tests of a prototype field strength meter were carried out, and the results indicate that measurement of the relative field strength along a traverse may be of help in determining the significance of some v.l.f. anomalies.

1. INTRODUCTION

Preliminary evaluation of the RONKA EM16 prospecting equipment by the Bureau of Mineral Resources, Geology & Geophysics (BMR) was carried out in the Captains Flat area in 1968 (Haigh, 1970). The results indicated that further tests were warranted, and during February and March 1969 tests were conducted in the Queenstown-Zeehan region of Tasmania. Areas previously covered with other electromagnetic methods were read, and in general the traverses used during the early surveys were relocated. In the Queenstown area, a large proportion of the original traverse pegs were relocated, even for surveys as early as 1957 (Great Lyell and Glen Lyell grids), but in these earlier grids all trace of traverse numbering had disappeared. In the Great Lyell area, two trig points were used to re-establish peg numbers. However, in the Glen Lyell area no reference points were available, except for two mine adits, so old and new peg numbers may not agree.

In the Montana and Oceana areas no previous traverses could be located, and new traverses were laid out using a tape and compass.

Traverses were also read in the Cuni-Genet's Winze area, the Razorback area, and the Comet and Comet South areas.

The willing co-operation of the following companies is gratefully acknowledged: The Electrolytic Zinc Company, Geophoto Resources Consultants, and the Mount Lyell Mining & Railway Company.

2. PREVIOUS GEOPHYSICAL SURVEYS

Extensive geophysical surveys have been made in the Queenstown area (Plate 1). The earliest electromagnetic work was the equipotential surveys by Blazey (1933-35) and Douglas (1935-38). Further investigations of significance to the current tests were made, using the Turam method, by Rowston (1957, 1959), Webb (1958), and Williams (1965, 1966, 1967).

In the Zeehan area, electromagnetic (Slingram) investigations made in 1954 in the Oonah-Queen Hill and Montana areas are reported by Daly (1965). Further work in the Oonah-Queen Hill area using the Turam method is reported by Gardener (1964) and Williams (1965).

In 1952-53, traverses were surveyed in the Cuni Area of the North Dundas field (Keunecke, 1953).

Prior to and during the current survey, Geophoto Resources Consultants conducted a magnetic and self-potential survey in the Comet area, and read several traverses with the EM16.

In addition, a considerable amount of induced polarization surveying has been done in most of the areas referred to above.

3. GEOPHYSICAL METHODS

The theory and general practice in the use of the RONKA EM16 has been treated in a previous report (Haigh, 1970).

As the form of most of the anomalies previously detected differed considerably from the 'classical' profiles it was thought desirable to compare the EM16 anomalies with the variations in the field strength. A prototype field strength meter tuned to the frequency of the North West Cape Station NWC was constructed and tested at both Queenstown and Zeehan. A hand-held detector allows the field strength in any direction to be measured and usually the maximum field strength was recorded. The field strength measurements in general were not successful because of random variations in the readings, but the work in the Montana area was a notable exception.

4. DISCUSSION OF RESULTS

Queenstown area

A resume of the general geology which bears on the geophysical surveys carried out in the area is given by Williams (1966).

For the purpose of the current interpretations, it is only necessary to recognize that the mineralization in the Mount Lyell area is almost entirely confined to the Mount Read Volcanics (Cambrian) on and near the contact with the Owen Conglomerate (Ordovician). The contact usually dips steeply and there is a good conductivity contrast between the conductive schists and the poorly conductive conglomerate.

The contact extends from the Glen Lyell area through the Corridor and Cape Horn areas (Plate 1) and was formerly thought to extend eastward along the Comstock Valley. However, recent drilling on Comstock traverses 4800E and 5600E (abbreviated to 48E and 56E in Plate 1) has shown that the structure in this part of the valley is synclinal, with the Gordon Limestone (Upper Ordovician) directly overlying the basal Owen Conglomerate (K.O. Reid, pers. comm.).

Plates 4 to 8 show comparisons of the v.l.f. profiles with other geophysical and geological data in the Cape Horn area. Here the v.l.f. field azimuth is approximately 45° to the traverse direction. There is a reasonable correlation between 'cross-overs' on the v.l.f. profiles and Turam results although some features in the v.l.f. profiles are difficult to explain. On Traverse 3000S (Plate 8) there is a considerable outcrop of sulphide mineralization, and where this occurs a general irregularity of profile exists but anomalies can still be recognized. The effects of topography on v.l.f. readings in mountainous regions has been discussed by Whittles (1969). It seems likely that the v.l.f. profiles in Plates 4, 5, and 6 are influenced by the topography, as the slope of the ground is very steep in the anomalous areas. However, the slope, provided it is constant, should only raise or lower the general level of the profile. The behaviour of the v.l.f. profile at the northern end of Traverse 4000W (Plate 5) is due largely to the abrupt change of slope there.

Traverses 5800W to 2600W were all read with the EM16 equipment, and Plates 4 and 5 are representative of the results obtained. Readings with the field strength meter were attempted on Traverse 5600W but the results were unreliable.

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In the Comstock area, several holes were drilled on the basis of induced polarization (IP) and Turam anomalies (Williams, 1966). On Traverses 3200E, 4800E, and 5600E (Plates 11-13), the anomalies were found to be due to carbonaceous limestone. There is no v.l.f. anomaly associated with the Turam anomalies on these traverses, except for a slight in-phase anomaly at 300S on Traverse 5600E. At 50N on Traverse 800E (plate 10) a diamond-drill hole was recommended to test a Turam anomaly. This hole was omitted when other holes encountered limestone. However, the Turam anomaly is of a different form from the ones that were drilled, and is also accompanied by a v.l.f. anomaly (at about 0). This suggests a different type of source at that point, and it should be tested by drilling as recommended previously.

On Traverse 1200W (Plate 9) Turam and IP anomalies are associated with the Tasman orebody (Williams, 1965). There is also an in-phase anomaly at 300S on the v.l.f. profile. Of interest is an anomaly at 700N on this traverse. No Turam results are available for comparison. The IP sections show a possible anomalous zone to the north of 1000N but no feature corresponding to the v.l.f. anomaly at 700N.

In the Glen Lyell and Great Lyell areas the traverse direction was almost perpendicular to the field azimuth, and with this unfavourable orientation no interpretation of the profiles was attempted. In both areas outcropping schist would also be likely to interfere with the response from near-surface conductors.

ANn attempt was made to evaluate the effect of steep topography, and a traverse was read over one of the spurs of Mount Owen just below the television station. The slopes down sides of the spur averaged 35° to the north and 40° to the south, but only a small effect was seen on the v.l.f. profiles (Plate 14). This test was in an area of almost non-conducting ground rocks and in more conductive areas the topographic effect would be expected to be much greater (resistivities measured in the Owen Conglomerate, using IP equipment, typically range from 3000 ohm-metres upward). The cross-over near peg 0 is caused by the abrupt change in topography. Likewise the in-phase and quadrature values measured at the foot of Mount Owen tend to approach zero values in accordance with the theory of terrain effects developed by Whittles (1969).

Zeehan area

A detailed description of the Zeehan mining field has been given by Blissett (1962). The geology of the field is complicated by extensive faulting, but most of the economic mineralization (mainly galena with a variable silver content) seems to have occurred as fissure lodes in the Oonah Quartzite.

The locations of the survey areas are shown in Plates 2 and 3. In the Montana area (Plate 2) in 1954, electromagnetic surveys using the Slingram method located several anomalous areas which were shown by shallow trenching to be due to outcropping bands of carbonaceous shale. In Plate 15 the v.l.f. profiles over one such band show a very strong anomaly which closely resembles the response normally expected over such a body. Field strength measurements over the body also show a very strong response; the maximum in the field strength corresponds to the cross-over points in the EM16 profiles. It should be noted that the field strength meter was not calibrated and the profile in Plate 15 refers only to instrument dial units.

No anomalies were located over the Montana Mine itself or over the Oceana Mine, which was tested with a north-south traverse centred near the headframe.

Plate 16 shows the comparison between v.l.f. and other geophysical results along Traverse 00 in the Oonah area. The strong response in all methods at about 600W corresponds to an outcropping lode which contains abundant sulphide mineraliszation. At 1500E there is a weak anomalous zone in the v.l.f. profiles; the Turam results, although incomplete, also indicate an anomalous zone. The area is a large swamp which has been partly drained, and it is difficult to determine whether the anomalies are due to surface effects or to a conductive zone beneath the swamp.

The anomaly in the in-phase v.l.f. 16 profile at about 2100E does not correspond to any known ore-body and is not supported by the Turam results. Here the traverse crosses the northern end of Queen Hill, and the anomaly could possibly be a topographic effect although it would appear to be too strong to be totally ascribed to this source.

In this area the traversse azimuth is again unfavourable for v.l.f. operations, the angle between the traverse and the field azimuths being about 50°.

Cuni area

Keunecke (1953) has reported surveys using electromagnetic (compensator), self-potential, (S-P) and magnetic methods in the Cuni area. Although not reported by Gardener (1964), surveys using IP, S-P, and magnetic methods were carried out by him in the Nickel Reward and Genet's Winze area at the time of the Oonah-Queen Hill survey.

Traverses in the above areas (Plate 3) were re-occupied using the EM16 equipment but no siginificant anomalies were located.

Razorback area

Longron and Horvath (1962) report surveys using electromagnetic (Turam), S-P, and magnetic methods. Traverse 2200W of the Razorback grid (Plate 3) was read with the EM16 equipment but the traverse orientation was unsuitable and no significant anomalies were located.

Comet area

Several traverses were read in the leases of Geophoto Resources Consultants in the Comet and South Comet areas but because the company is still engaged in work in this area, the location of the traverses is not shown in Plate 3. In general the traverses were poorly orientated with respect to the primary field, and topographical effects would appear to be high. It is apparent on the traverse shown in Plate 17, that the conductive zones at a depth of 500 feet have not affected the profile. However, it seems probable that the v.l.f. method has detected the shallow body that crops out at about 13.5W. This has been confirmed by a subsequent v.l.f. survey by Langron and Gillespie (1970).

5. CONCLUSIONS

Tests of the Ronka EM16 v.l.f. prospecting equipment in western Tasmania have shown good agreement with previous electromagnetic results. The method is limited by the fact that only one v.l.f. radio station is available and in many areas the direction of the field is poorly oriented with respect to the strike of the country rock. As yet no conclusive tests of depth penetration of the method have been demonstrated and this remains a pressing need in future tests.

Initial tests with a prototype field strength meter have shown that it may be useful in assisting interpretation of the EM16 results. However, for satisfactory field strength measurements it would appear desirable to use a second instrument for drift control, or two instruments to obtain differential readings.

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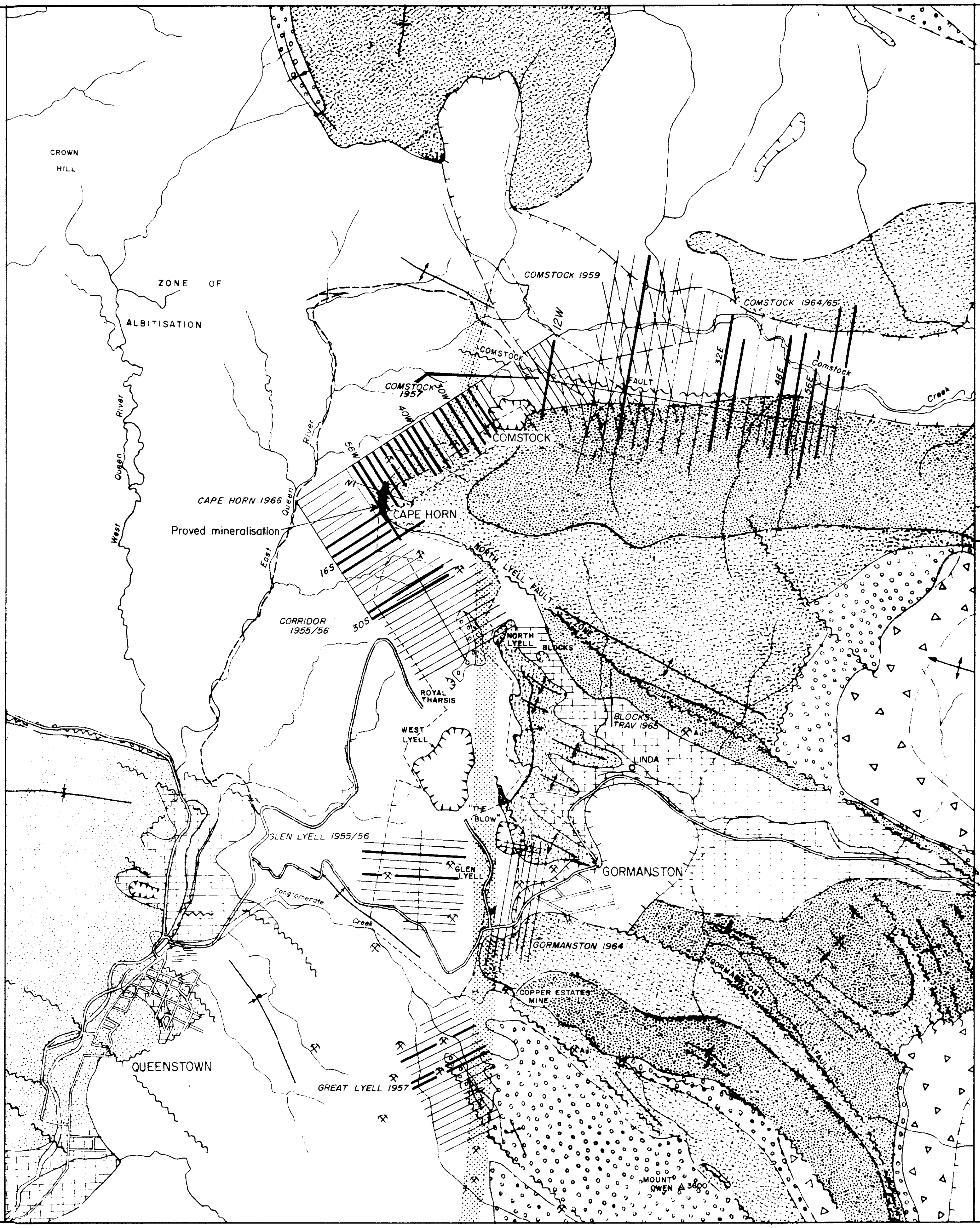
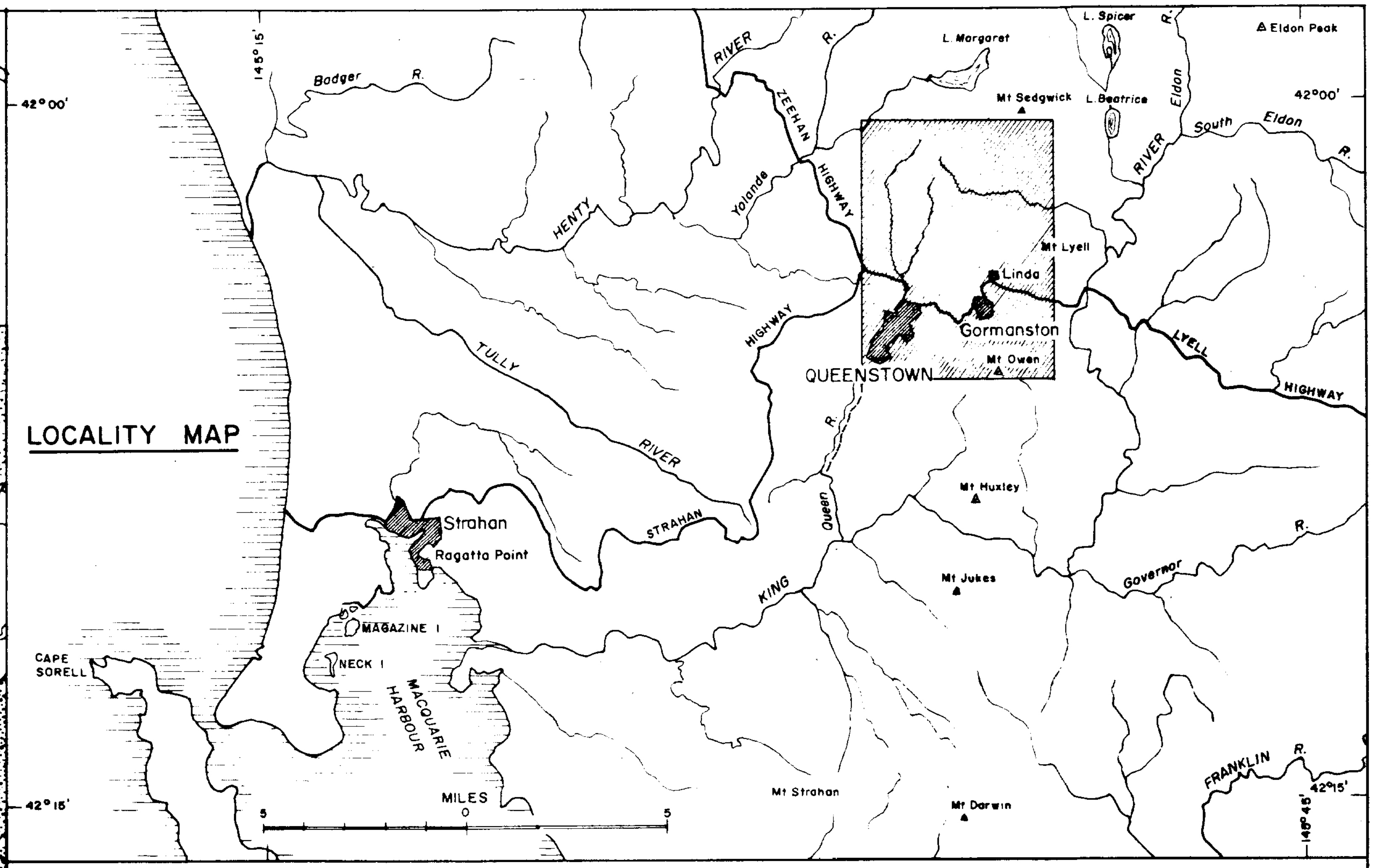
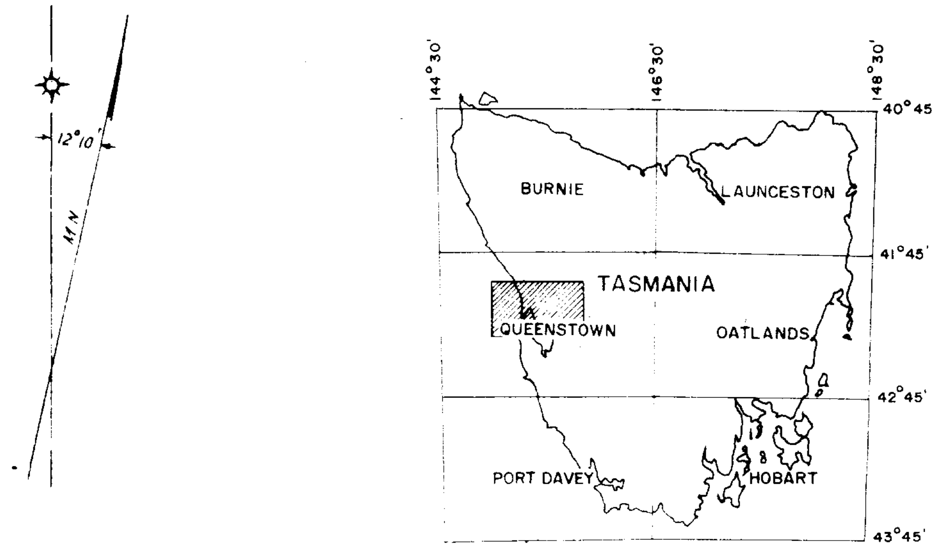
LEGEND

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 read with he Ronka EM16







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

V.L.F. TESTS, TASMANIA, 1969
QUEENSTOWN AREA
LOCALITY AND REGIONAL GEOLOGICAL MAP

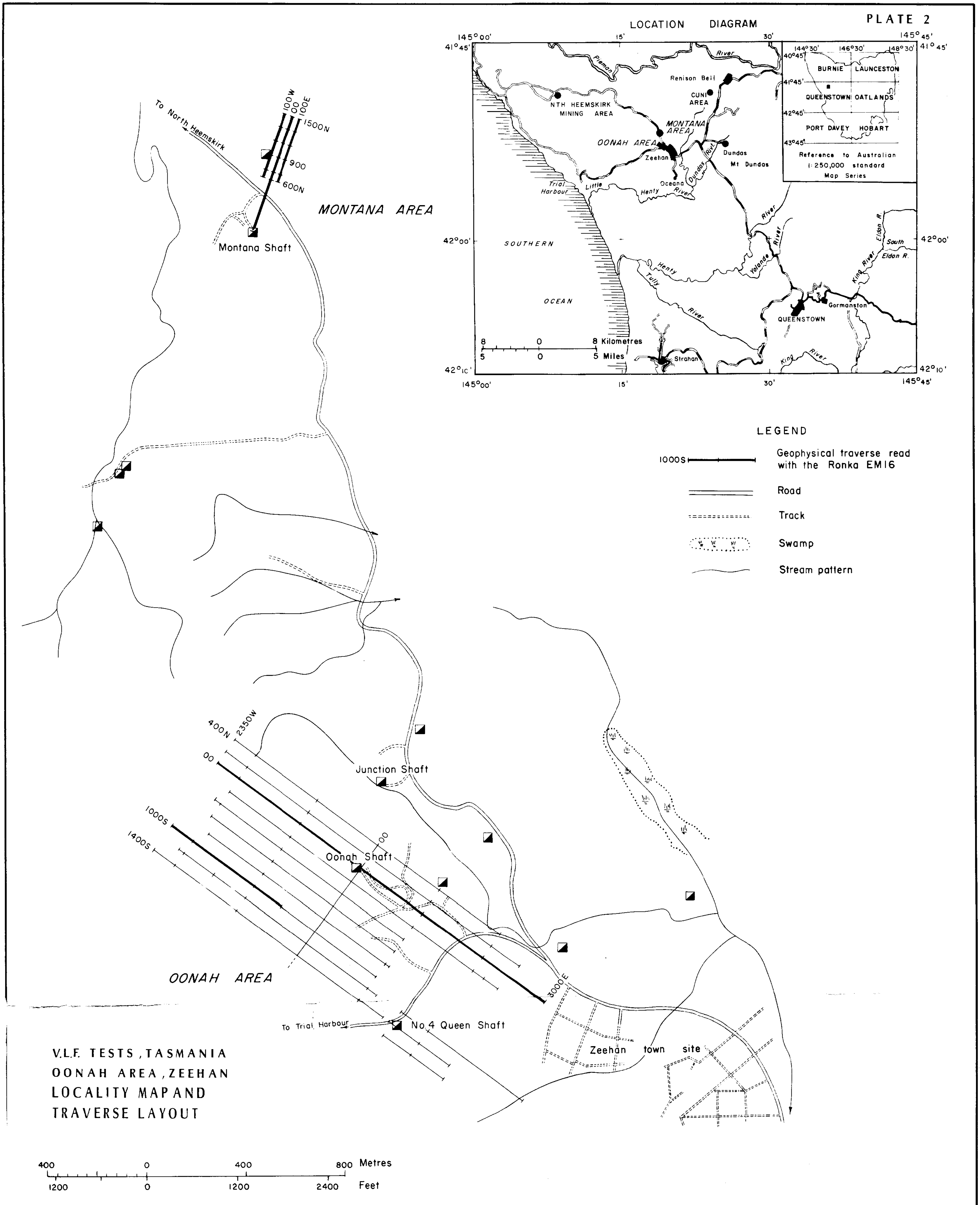
0 1 2 MILES
0 1 2 3 KILOMETRES

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

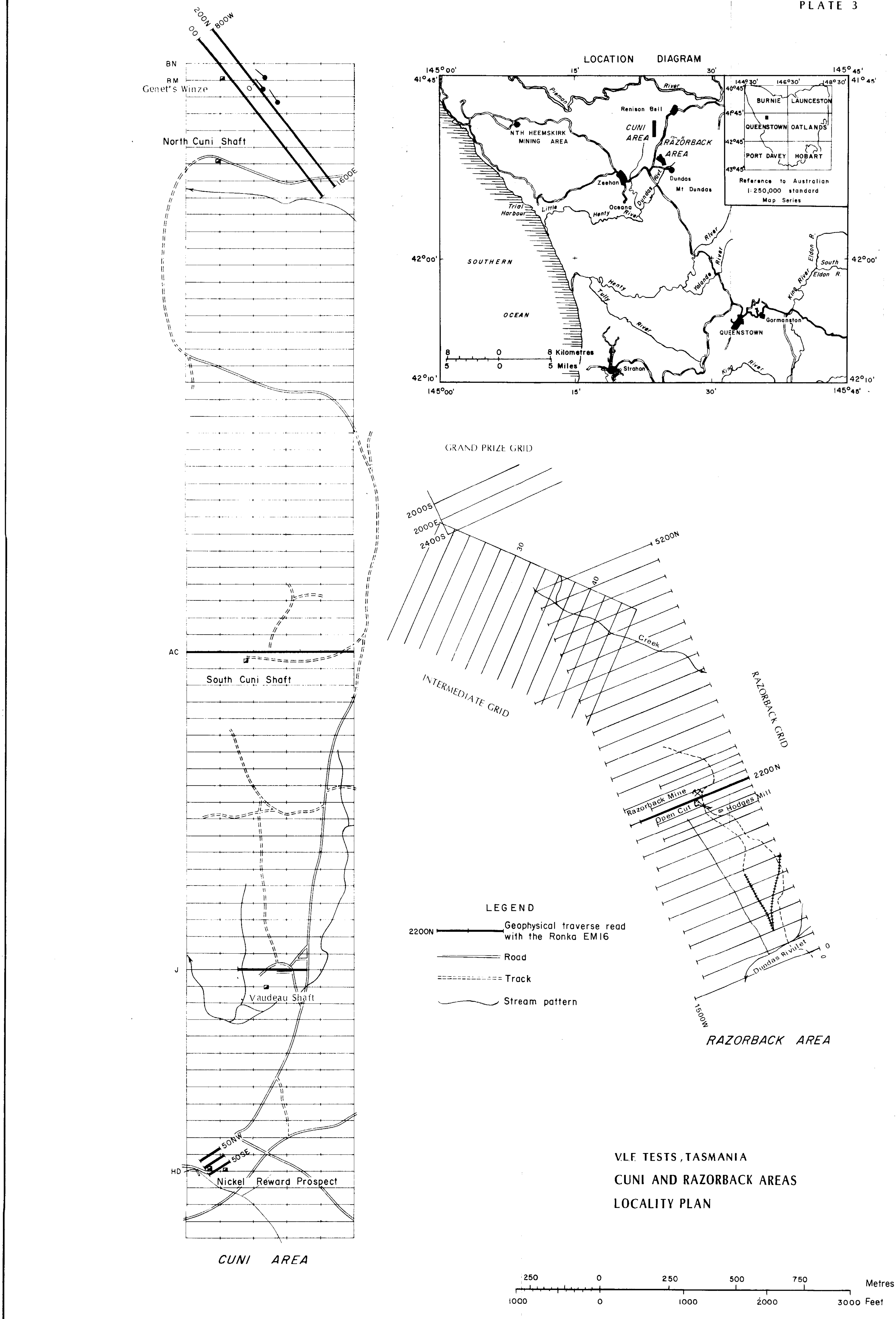
TO ACCOMPANY RECORD No. 1970/95

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. K55/B7-218

(BASED ON K55/B7-129)



V.L.F. TESTS, TASMANIA
OONAH AREA, ZEEHAN
LOCALITY MAP AND
TRAVERSE LAYOUT

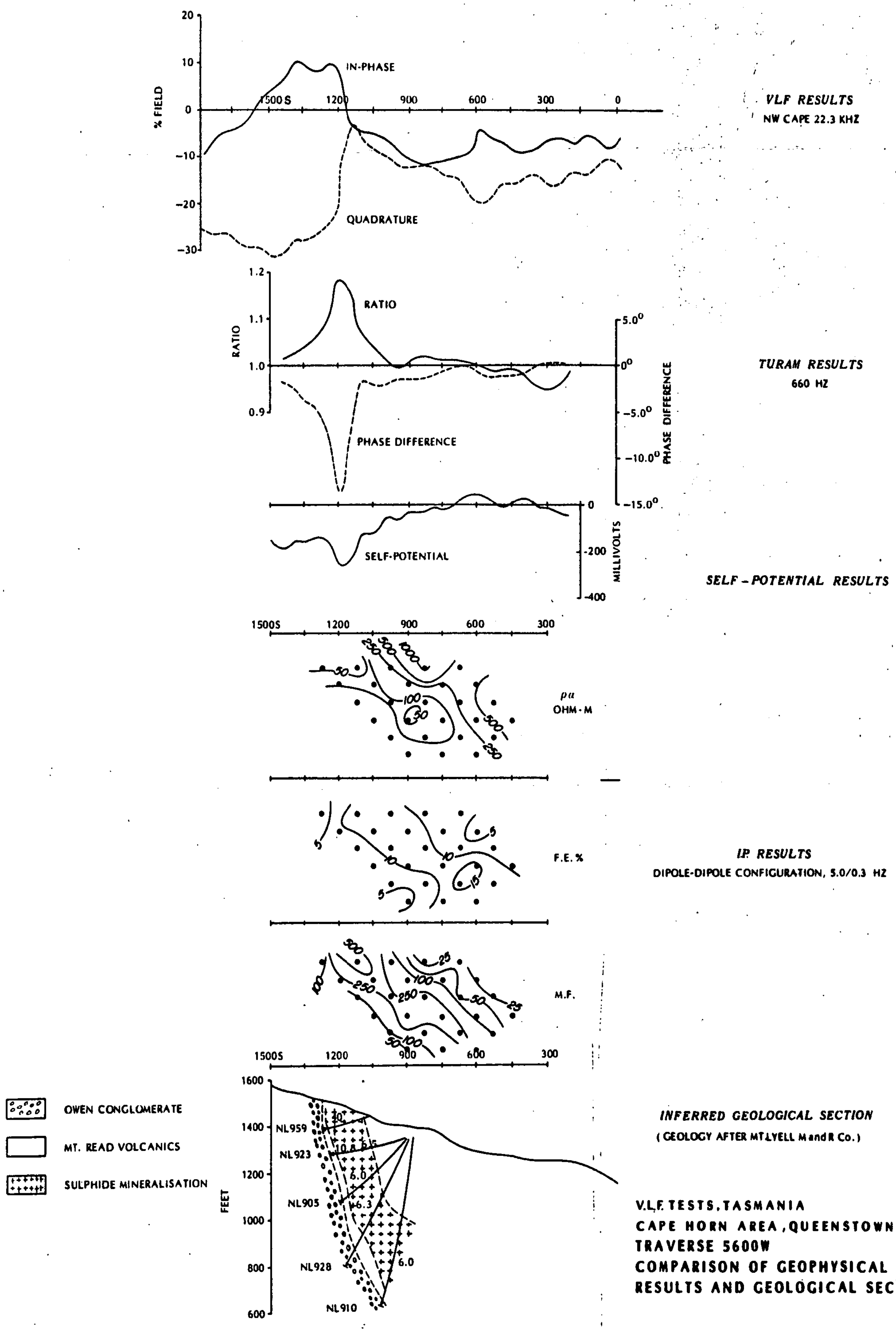


V.L.F. TESTS, TASMANIA

CUNI AND RAZORBACK AREAS

LOCALITY PLAN

PLATE 4

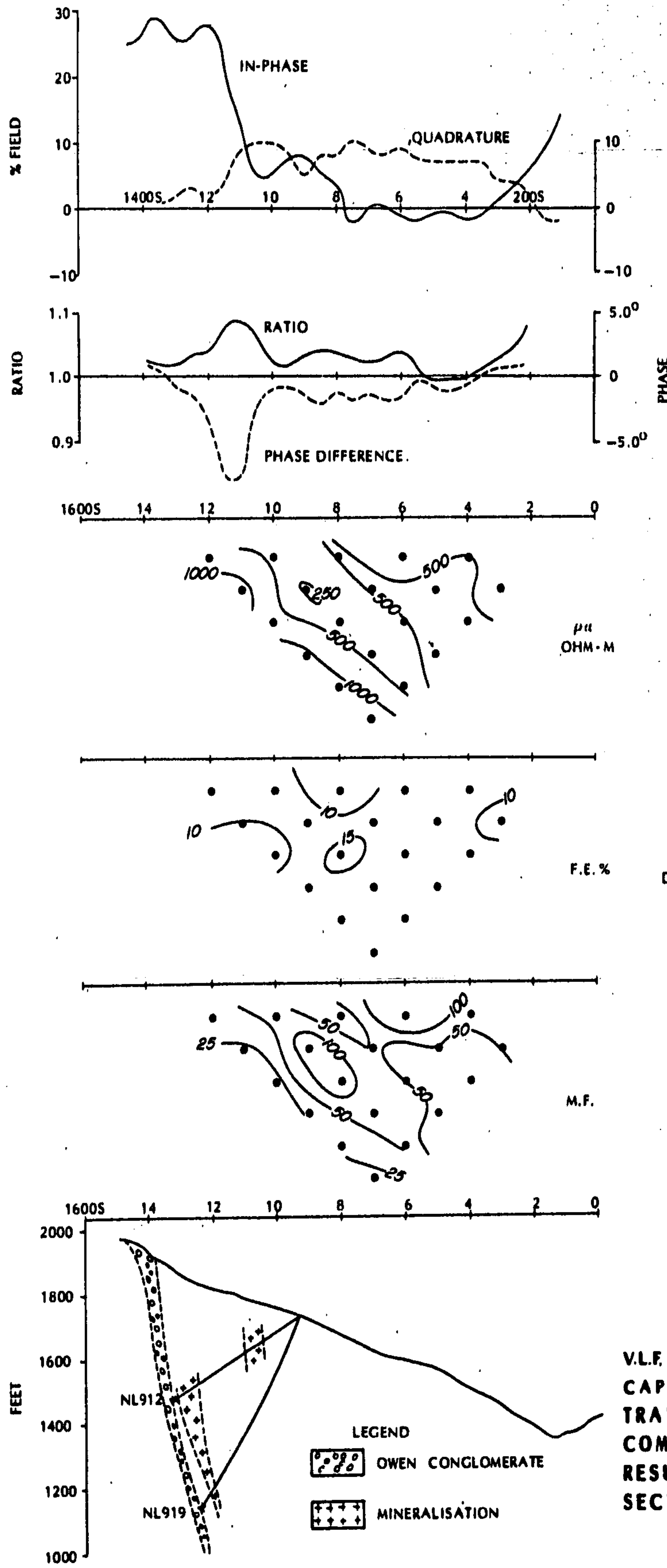


V.L.F. TESTS, TASMANIA
CAPE HORN AREA, QUEENSTOWN
TRAVERSE 5600W
COMPARISON OF GEOPHYSICAL RESULTS AND GEOLOGICAL SECTION

TO ACCOMPANY RECORD No. 1970/95

K55/B7-213

PLATE 5



V.L.F. RESULTS

NW CAPE 22.3 KHZ

TURAM RESULTS

660 HZ

I.P. RESULTS

DIPOLE-DIPOLE CONFIGURATION, 5.0/0.3 HZ

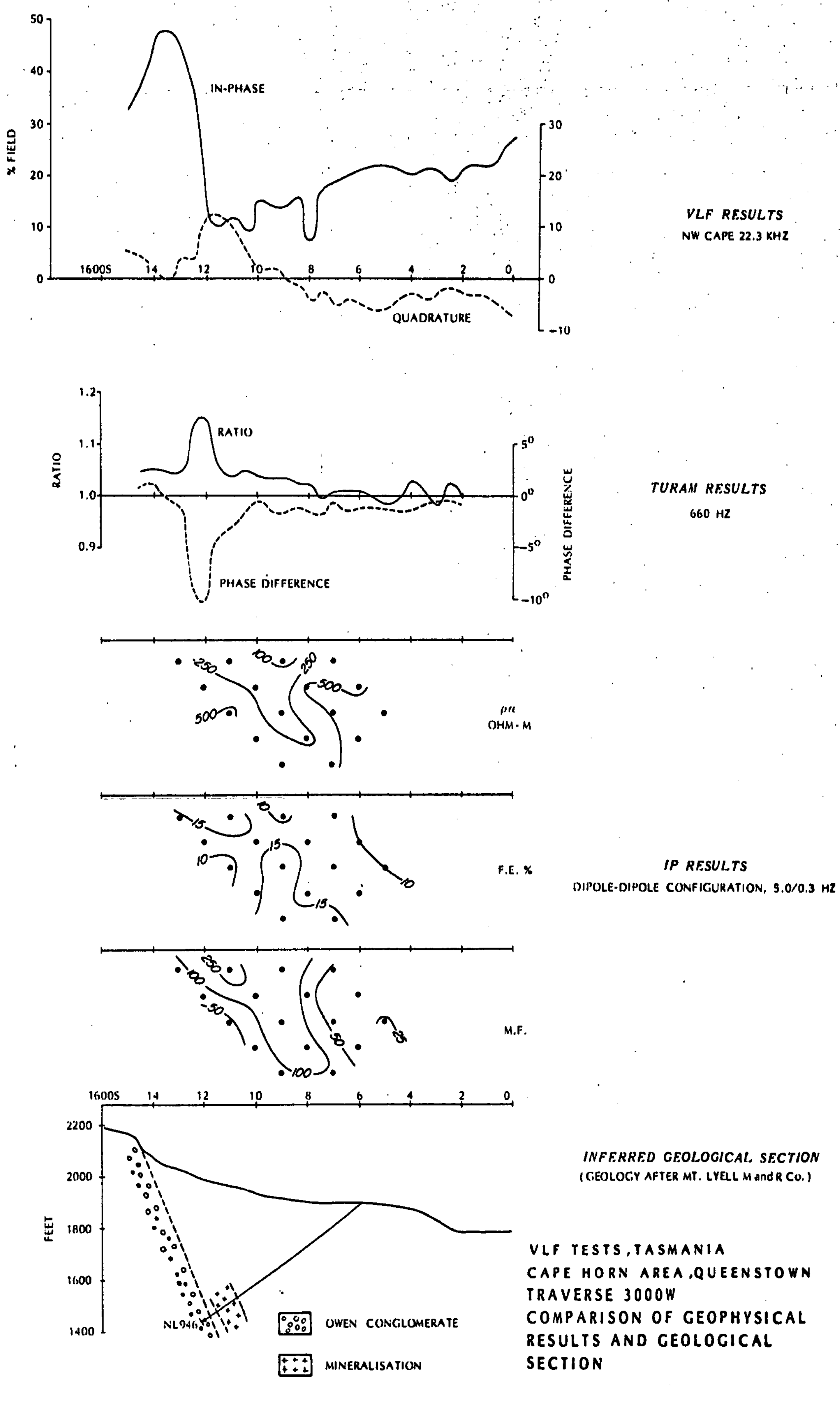
INFERRED GEOLOGICAL SECTION

V.L.F. TESTS, TASMANIA
CAPE HORN, AREA QUEENSTOWN
TRAVERSE 4000W
COMPARISON OF GEOPHYSICAL RESULTS AND GEOLOGICAL SECTION

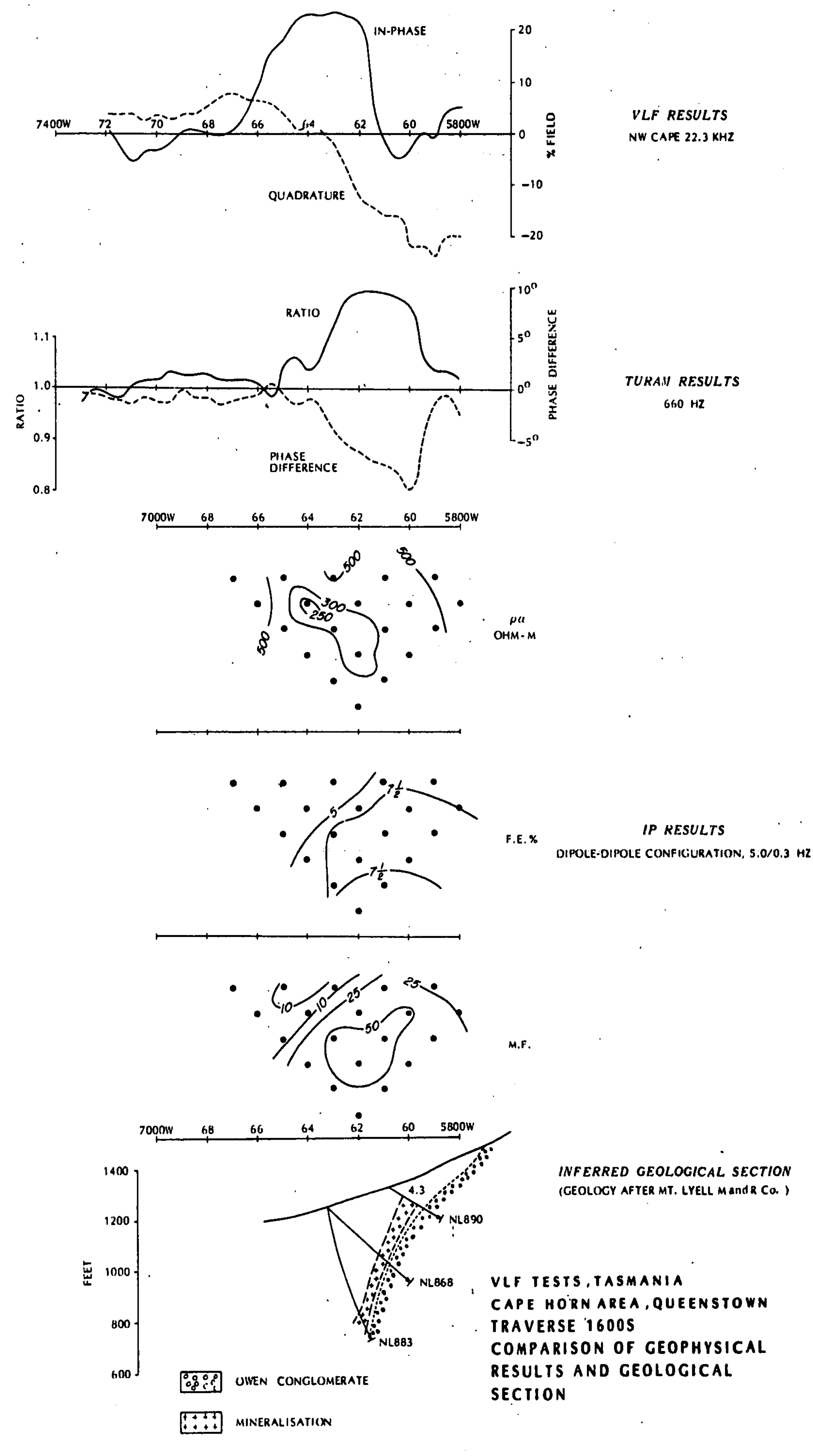
TO ACCOMPANY RECORD No. 1970/95

K55/B7-209

PLATE 6

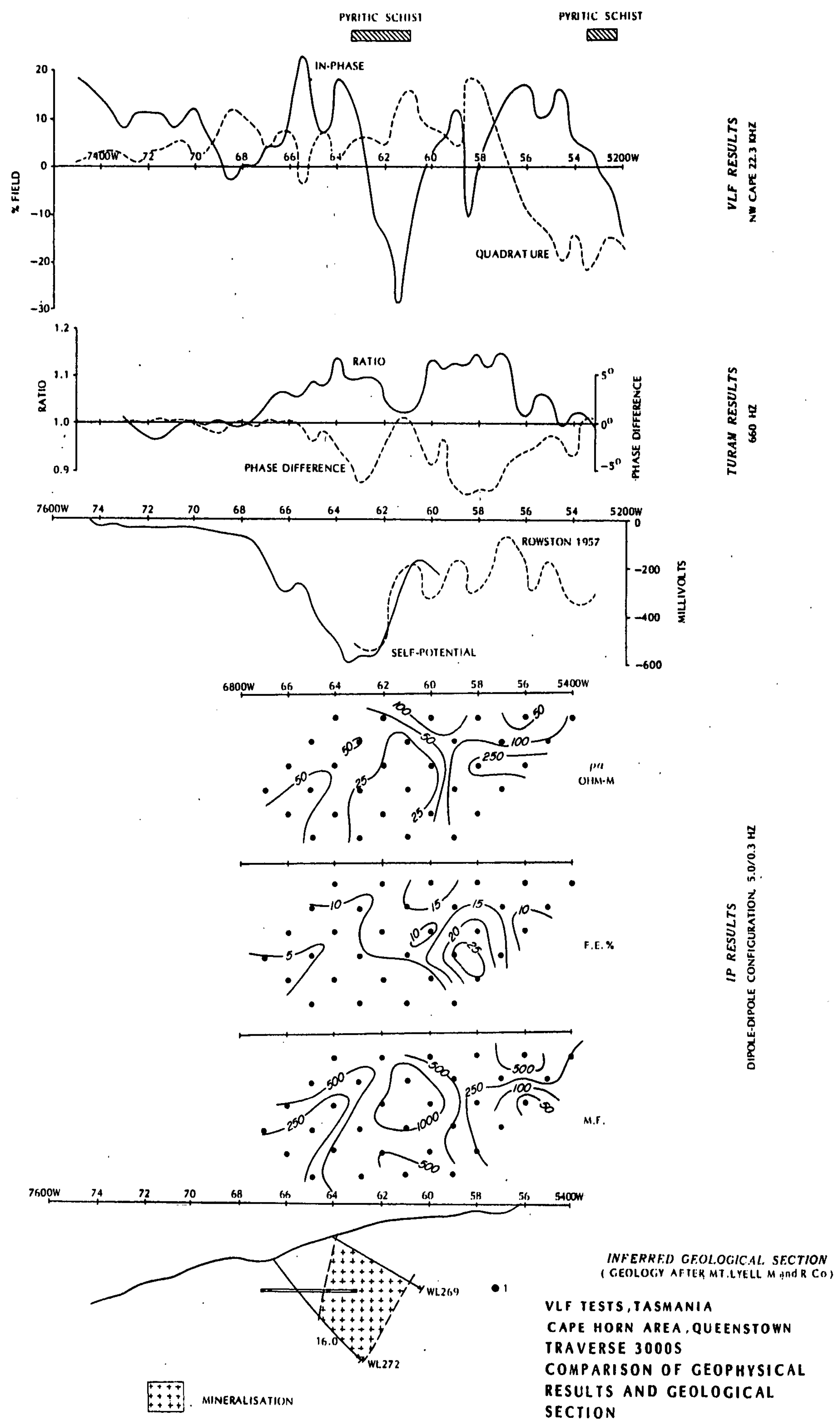


VLF TESTS, TASMANIA
CAPE HORN AREA, QUEENSTOWN
TRAVERSE 3000W
COMPARISON OF GEOPHYSICAL RESULTS AND GEOLOGICAL SECTION



VLF TESTS, TASMANIA
CAPE HORN AREA, QUEENSTOWN
TRAVERSE 1600S
COMPARISON OF GEOPHYSICAL RESULTS AND GEOLOGICAL SECTION

PLATE 8



INFERRED GEOLOGICAL SECTION
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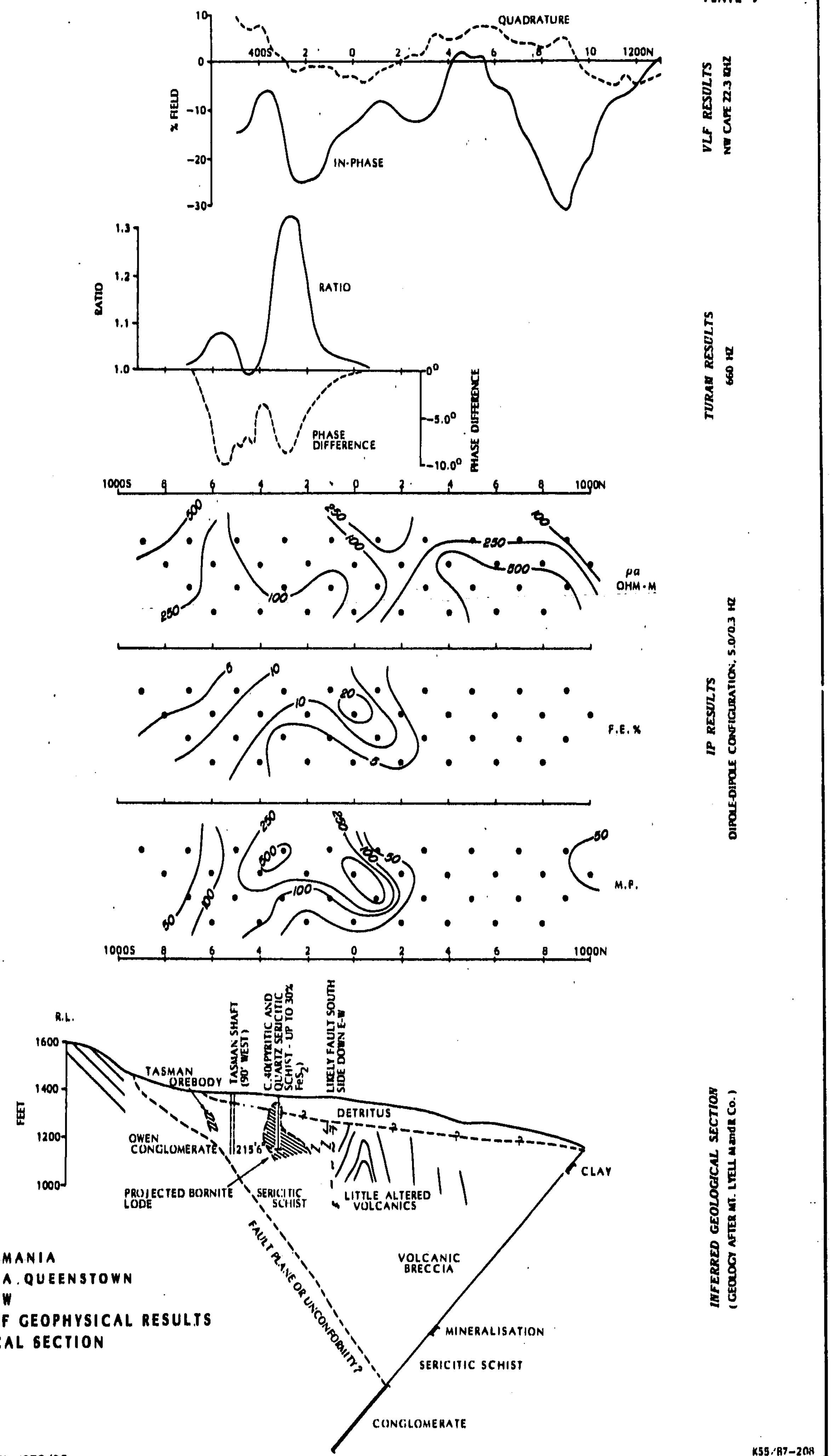
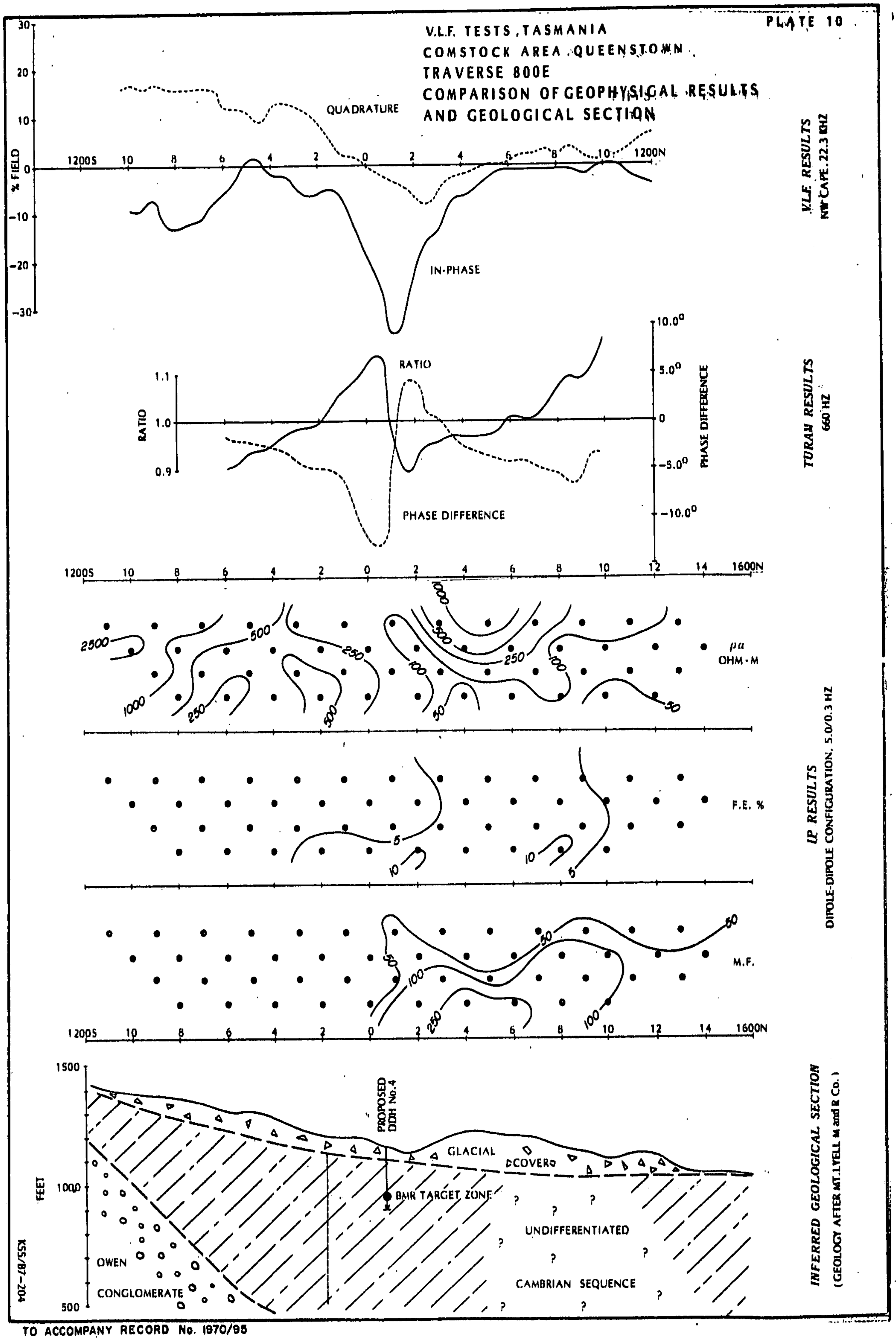
VLF TESTS, TASMANIA
CAPE HORN AREA, QUEENSTOWN
TRAVERSE 3000S
COMPARISON OF GEOPHYSICAL RESULTS AND GEOLOGICAL SECTION



VLF TESTS, TASMANIA
COMSTOCK AREA, QUEENSTOWN
TRAVERSE 1200W
COMPARISON OF GEOPHYSICAL RESULTS AND GEOLOGICAL SECTION

TO ACCOMPANY RECORD No 1970/95

K55/B7-208



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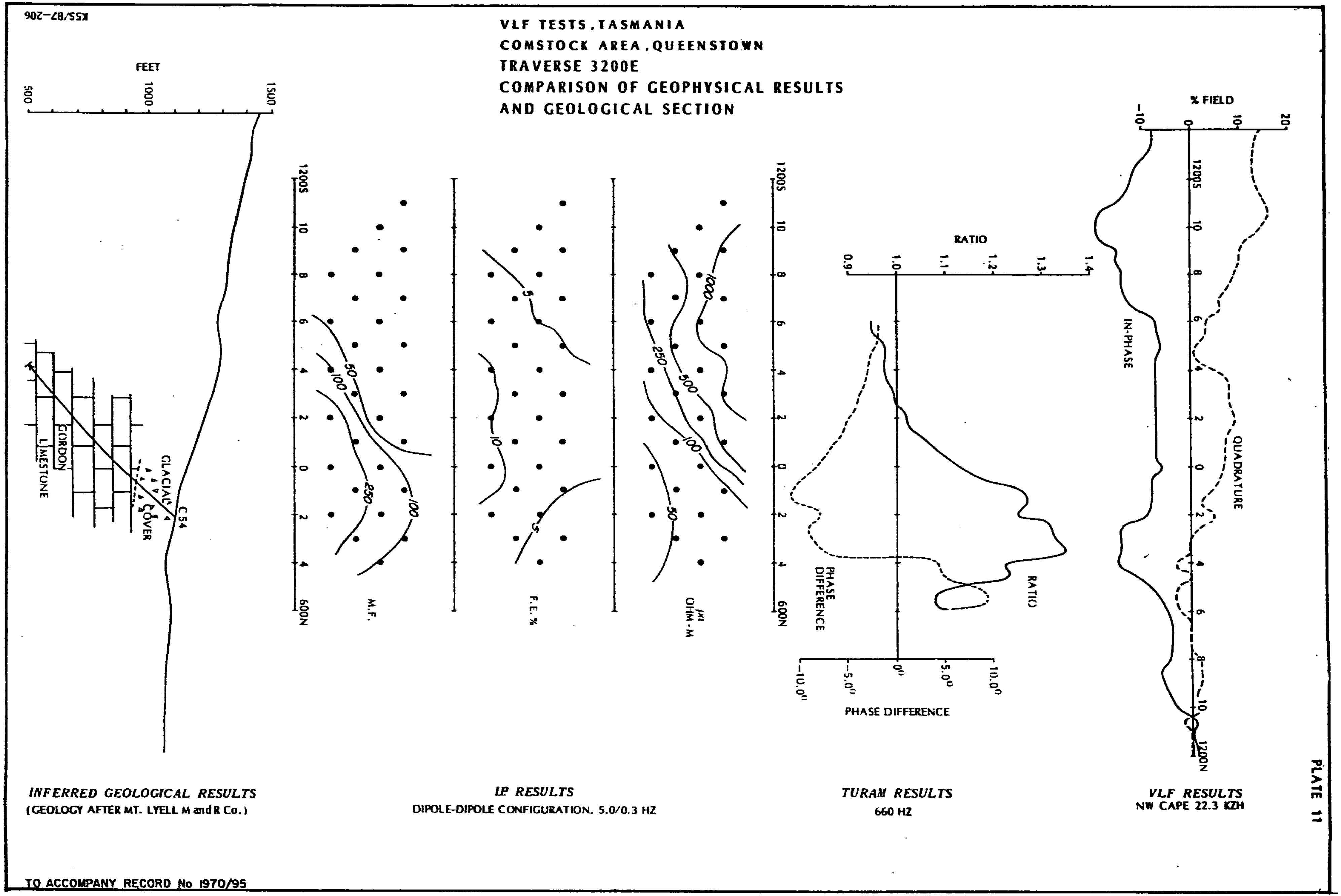
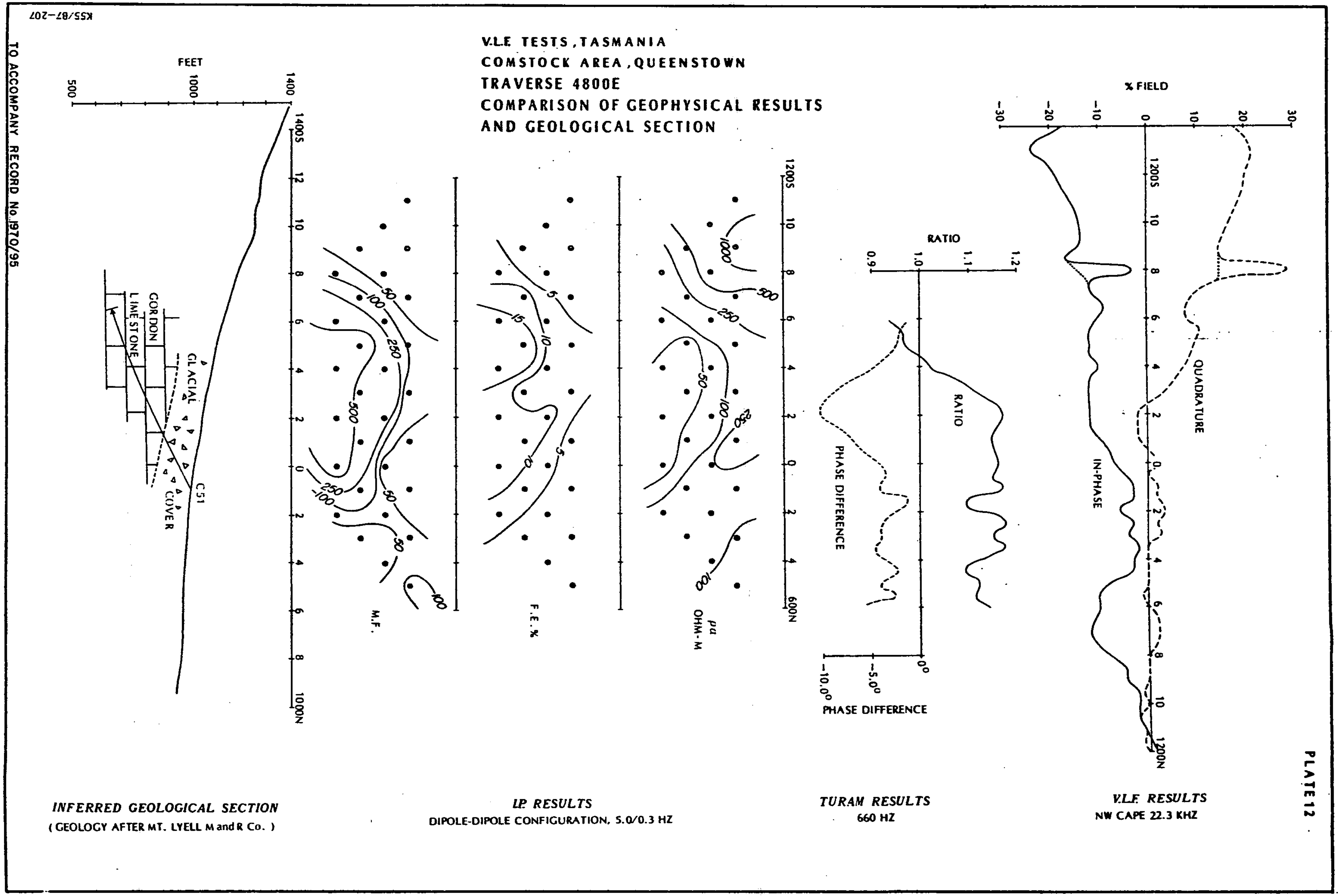


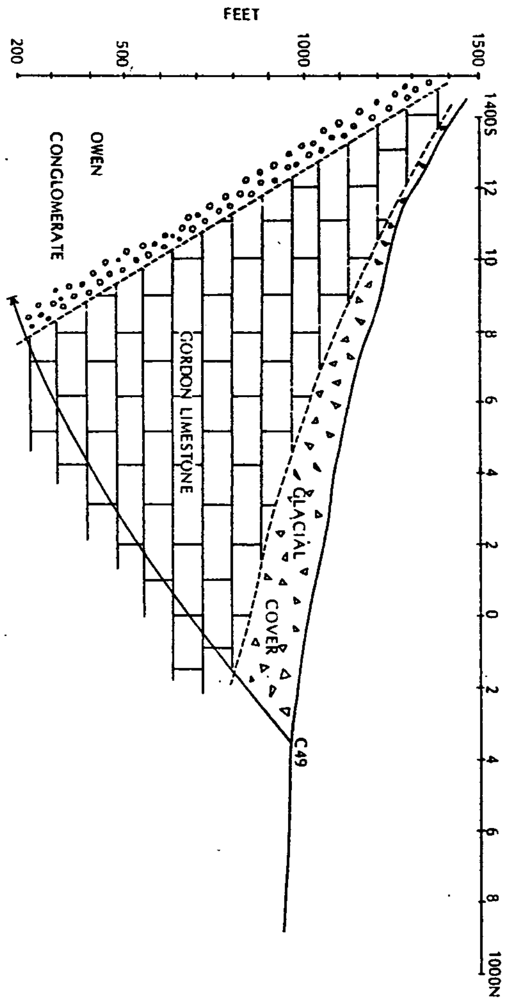
KSS/B7-206
VLF TESTS, TASMANIA
COMSTOCK AREA, QUEENSTOWN
TRAVERSE 3200E
COMPARISON OF GEOPHYSICAL RESULTS
AND GEOLOGICAL SECTION
FEET
500
1000
1500
GORDON
LIMESTONE
GLACIAL
COVER
C 54
1200S
600N
M.F.
F.E. %
OHM-M
RATIO
0.9
1.0
1.1
1.2
1.3
1.4
PHASE DIFFERENCE
-10.0°
-5.0°
0°
5.0°
10.0°
% FIELD
-10
0
10
20
IN-PHASE
QUADRATURE
INFERRED GEOLOGICAL RESULTS
(GEOLOGY AFTER MT. LYELL M and R Co.)
IP RESULTS
DIPOLE-DIPOLE CONFIGURATION, 5.0/0.3 HZ
TURAM RESULTS
660 HZ
VLF RESULTS
NW CAPE 22.3 KZH
PLATE 11
TO ACCOMPANY RECORD No 1970/95



V.L.F TESTS, TASMANIA
COMSTOCK AREA, QUEENSTOWN
TRAVERSE 4800E
COMPARISON OF GEOPHYSICAL RESULTS
AND GEOLOGICAL SECTION
K55/B7-207
TO ACCOMPANY RECORD No.1970/95
FEET
500
1000
1400
1400S
1000N
GORDON LIMESTONE
GLACIAL COVER
C51
M.F.
F.E.%
ρa OHM-M
1200S
600N
RATIO
0.9
1.0
1.1
1.2
PHASE DIFFERENCE
0°
-5.0°
-10.0°
% FIELD
-30
-20
-10
0
10
20
30
QUADRATURE
IN-PHASE
1200N
INFERRED GEOLOGICAL SECTION
(GEOLOGY AFTER MT. LYELL M and R Co.)
I.P. RESULTS
DIPOLE-DIPOLE CONFIGURATION, 5.0/0.3 HZ
TURAM RESULTS
660 HZ
V.L.F. RESULTS
NW CAPE 22.3 KHZ

PLATE 12

V.L.F. TESTS TASMANIA
COMSTOCK AREA, QUEENSTOWN
TRAVERSE 5600E
COMPARISON OF GEOPHYSICAL RESULTS
AND GEOLOGICAL SECTION



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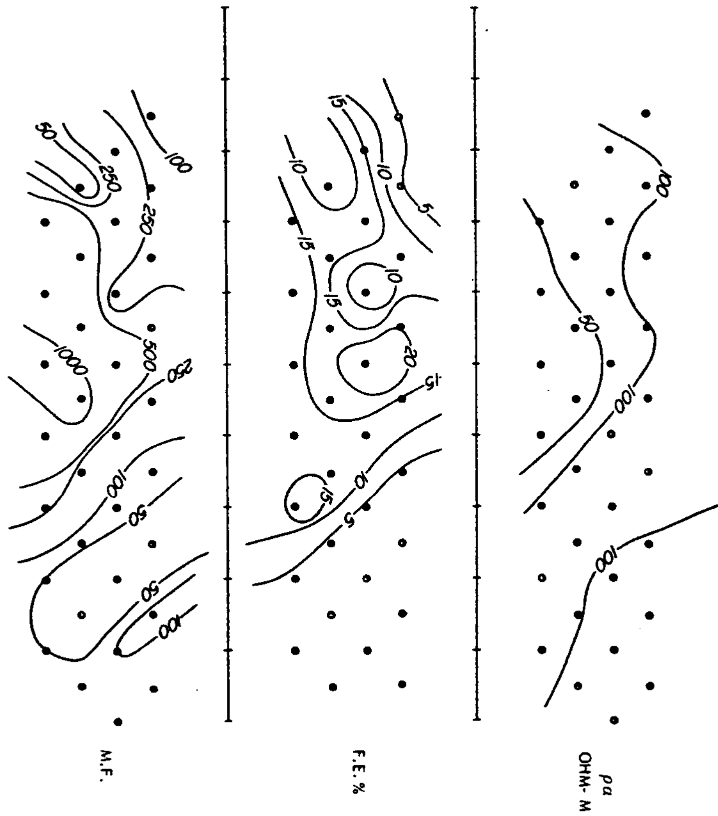
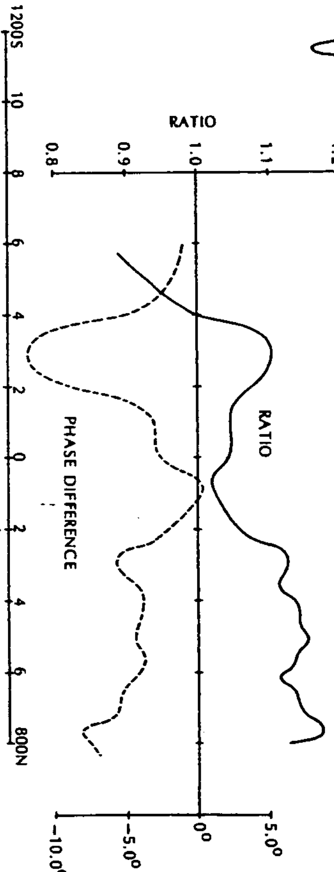
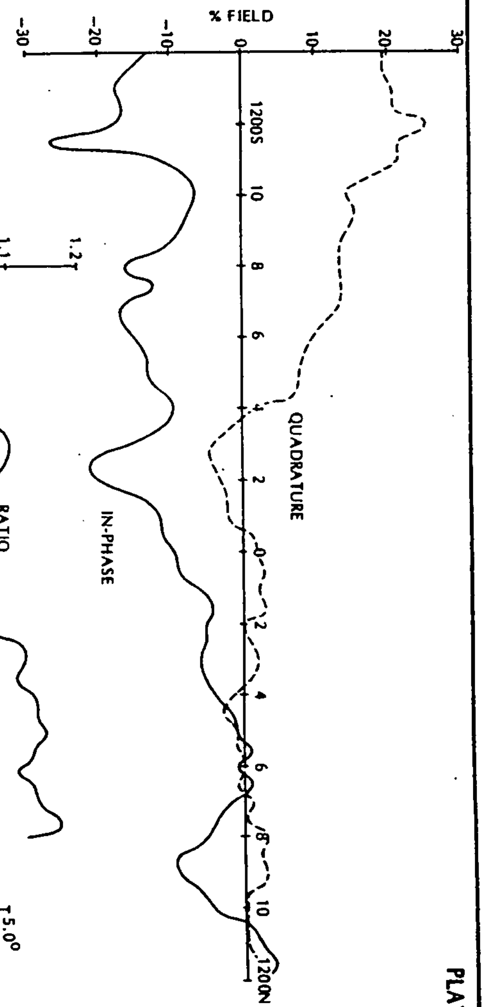


IP RESULTS
DIPOLE-DIPOLE CONFIGURATION, 5.0/0.3 HZ



TURAM RESULTS
660 HZ



V.L.F. RESULTS
NW CAPE, 22.3 KHZ

PLATE 13

TO ACCOMPANY RECORD No. 1970/95

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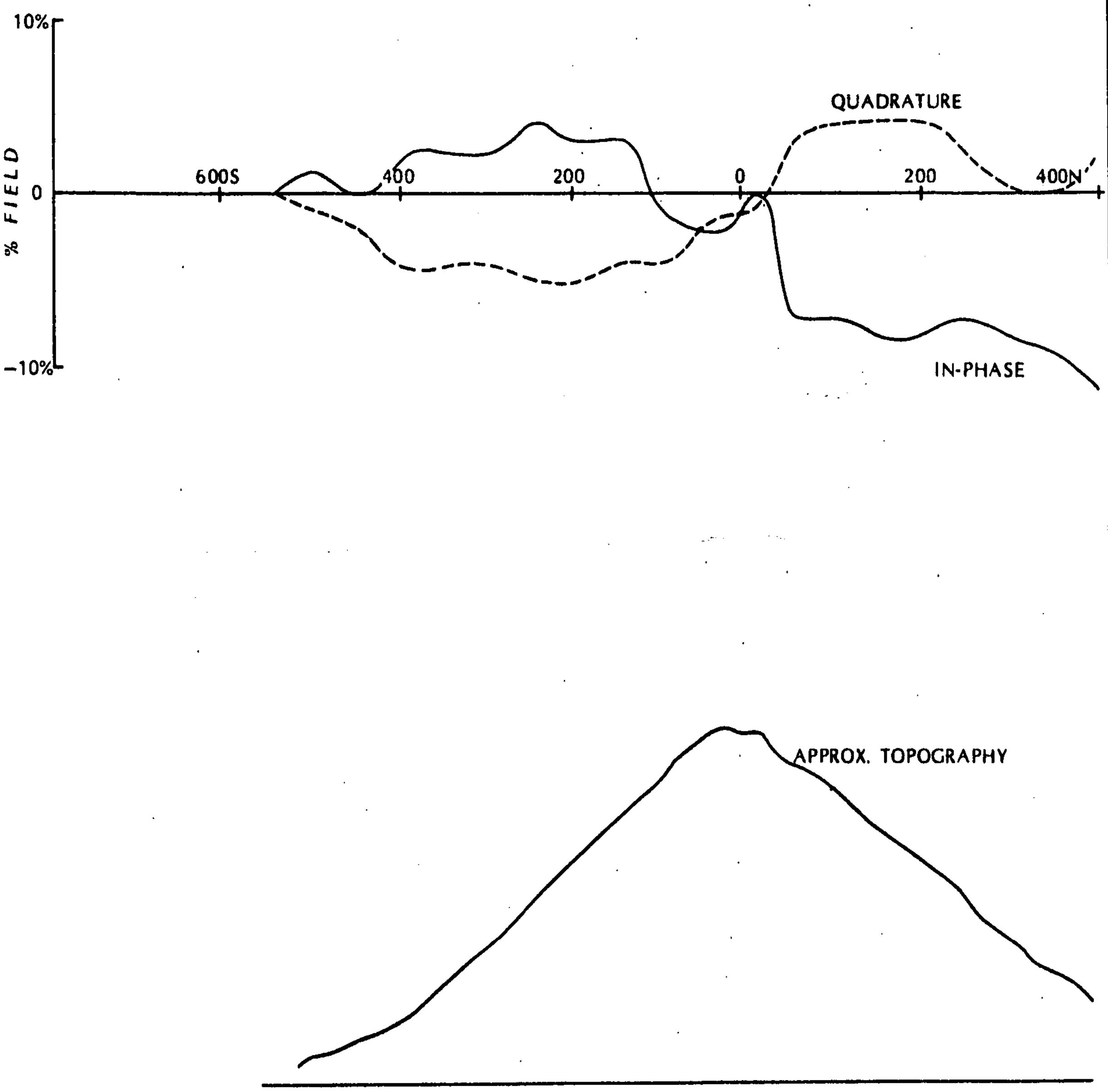
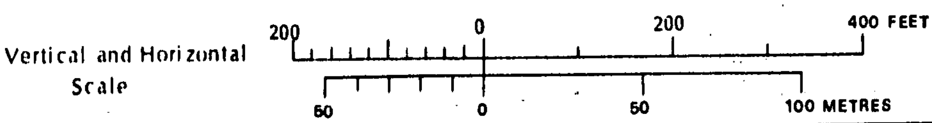


MOUNT OWEN AREA, QUEENSTOWN
TESTS OVER STEEP TOPOGRAPHY



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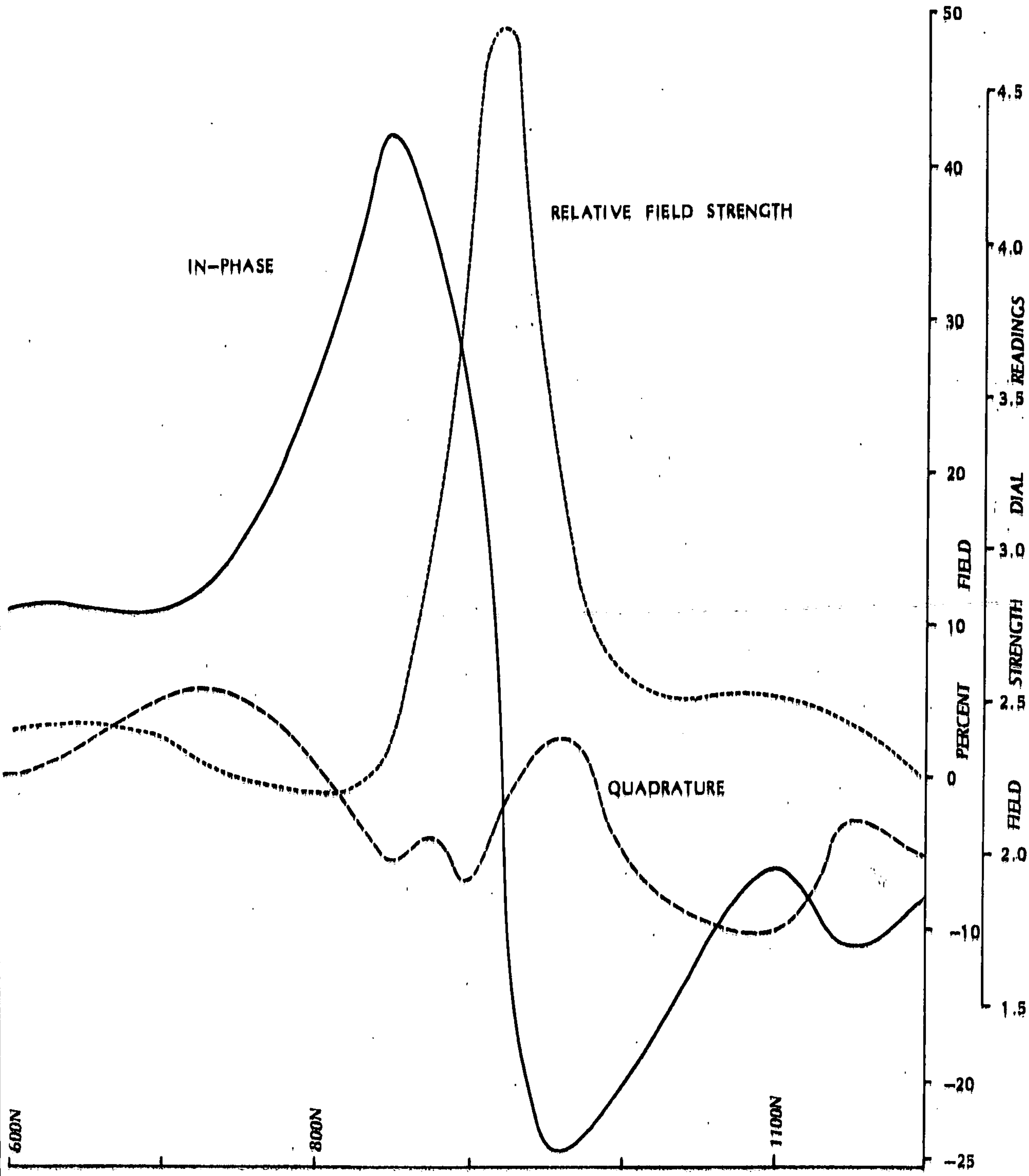
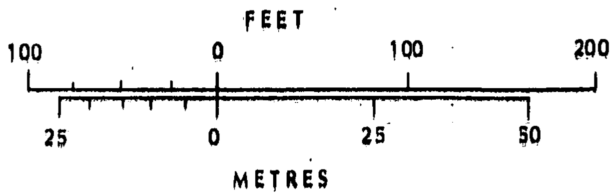


V.L.F TESTS, TASMANIA
MONTANA AREA, ZEEHAN

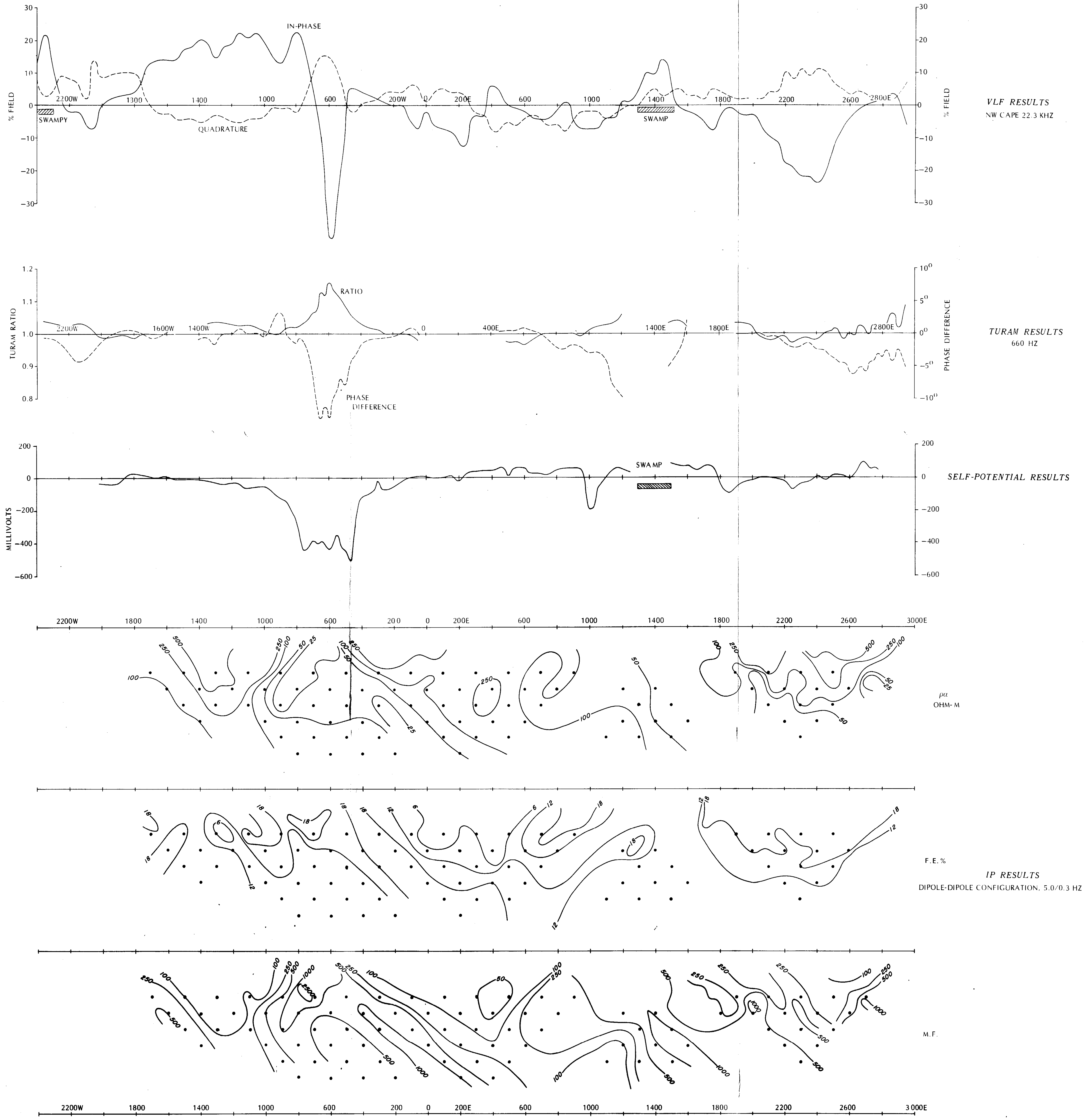
TRAVERSE 00

COMPARISON OF EM16
AND FIELD STRENGTH PROFILES

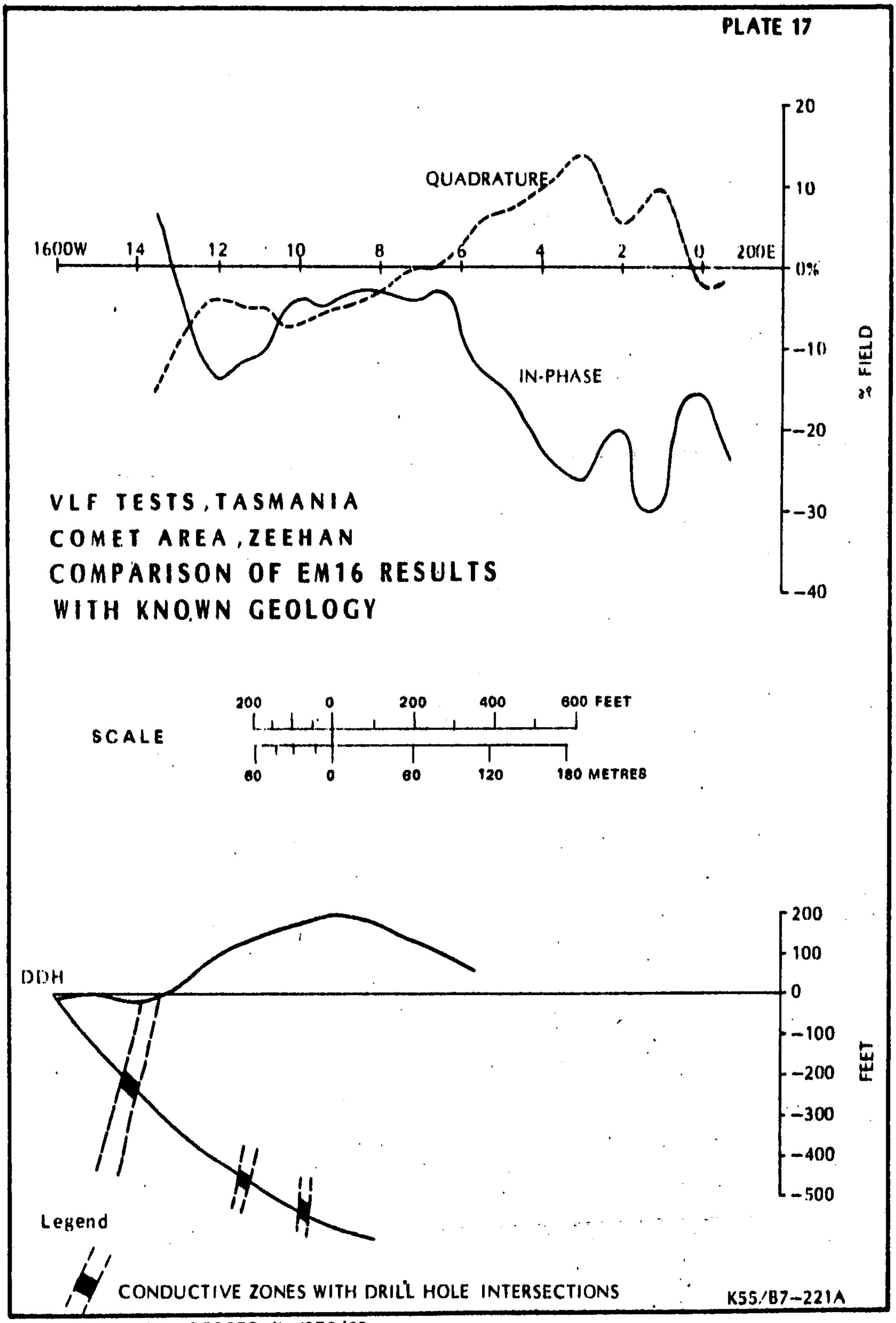


TO ACCOMPANY RECORD No.1970/86

K55/B7-216A



VLF TESTS, TASMANIA
OONAH AREA, ZEEHAN
TRAVERSE 00
COMPARISON OF EM16 RESULTS
WITH TURAM, S—P, AND I.P. DATA



TO ACCOMPANY RECORD No 1970/98