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CAPTAINS FLAT GEOPHYSICAL SURVEY, NEW SOUTH WALES 1971

by

R.A. Almond

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SUMMARY

A metalliferous geophysical survey was carried out at Captains Flat, New South Wales, between 18 January and 10 March 1971. A gravity survey was carried out over the Molonglo Fault, and several geophysical methods were used in a survey over known surface mineralization in the Copper Dam area. Isolated VLF test traverses were made in two more areas. The gravity results over the Molonglo Fault were inconclusive, but fair IP and strong electromagnetic anomalies were found in the Copper Dam area, and two drill holes have been recommended.

1. INTRODUCTION

Captains Flat is 50 kilometres southeast of Canberra, in the western part of the Great Dividing Range. Access is by sealed road from Queanbeyan. The railway branch line from Bungendore has been inoperative since the mine closed in 1962.

When in operation under Lake George Mines Pty Ltd between 1937 and 1962, the mine at Captains Flat produced about 16,000 tonnes of sulphide ore per month, containing 5.7% lead, 9.9% zinc, 0.6% copper, 1.4 oz silver, and 1.0 dwt gold. The main workings were in the Elliots orebody, which is terminated at its northern end by the Molonglo Fault. Vanderbilt, a small worked-out orebody about 700 m east of Elliots, is also terminated to the north by this fault.

The present survey was planned in co-operation with the Electrolytic Zinc Company of Australasia (E.Z.), which had been carrying out detailed geological mapping in the Captains Flat area. It was proposed that a gravity survey should be conducted over the Molonglo Fault in order to obtain quantitative information about its throw, and that some electromagnetic traverses should be carried out to the north of the fault in order to help define the boundary of some rhyolite tuffs. A further objective was to take advantage of the survey to conduct various instrument comparisons and tests over anomalies and to familiarize members of the party with these instruments.

The survey started on 18 January 1971 and finished on 10 March. Personnel consisted of R. Almond (party leader), J. Williams (technical officer) and D.O. O'Neill (vacation student). D. O'Neill left the party on 18 February and was replaced by I. Hone (geophysicist).

The main areas surveyed were Elliots, Vanderbilt, and Copper Dam, with isolated traverses in Baldwins and Gourlay Hickey areas (see Plate 1).

Other geophysical surveys carried out in the Captains Flat area are those of Conaghan & Foskett (1949), Gibbons (1962), and Sedmik (1965).

2. GEOLOGY

Captains Flat lies ten kilometres from the southern end of a thirty kilometre long north-south synclinorium. The synclinorium is about 2.5 km wide and forms the valley of the Molonglo River. It is a horst-graben structure, the graben being bounded to the west by the Narongo Fault and to the east by the Ballallaba Fault. The horsts to the east and west of the graben consist of tightly folded Ordovician greywacke and shale intruded by granite which have been eroded into a very rugged relief. The graben consists mainly of interbedded Silurian shale and volcanics with very steep dips and north-south strike. The hole synclinorium plunges to the north at about 20° and has been much broken up by series of faults trending north along the axis of the synclinorium and others trending northwest across it.

The main Captains Flat orebodies, Keatings and Elliots, were situated in the overturned western limb of the synclinorium in Silurian shale, siltstone, and volcanics. The small Vanderbilt orebody was situated in the Vanderbilt Anticline, about 700 m east of the main workings. The orebodies had formed in near-vertical shear zones, and the ore-bearing zones seem to plunge to the north at the same angle as the synclinorium. Elliots, the northernmost worked orebody, and the Vanderbilt orebody, have been cut off at their northern ends by the northwest-trending Molonglo Fault. This fault is thought to have a large downthrow to the north, suggesting that any northern continuation of the orebodies should occur at some greater depth than the previous workings. Drilling by Lake George Mines prior to 1962 failed to locate the northern continuation of Elliots orebody; hence the desirability of obtaining more quantitative information about the throw of the fault by gravimetric means. Little effort has been made to find the northern extension of Vanderbilt owing to the small size of the known orebody. Further details about the Captains Flat orebodies are given by Conolly (1953) and Oldershaw (1965).

Information about the geology of the Copper Dam area was supplied by Mr L. Davies, the geologist in charge of E.Z.'s Captains Flat mapping program. The area consists of dacitic tuff ash-flows with a strong vertical cleavage and no contacts. The dip is very vague but is probably somewhere between 30° either side of vertical. Pyrite occurs in small quantities, at least near the surface, and traces of magnetite are present in some of the samples from the area.

3. DESCRIPTION OF GEOPHYSICAL METHODS USED

Gravity

The gravity method of prospecting can be used only where there is a density contrast in the geological structure to be investigated. Readings must be corrected for instrument drift, elevation, terrain, and latitude.

In order to obtain information about the throw of a fault by gravimetric means, the vertical movement must have brought beds of different densities into contact. The gravity profile over such a contact is typically step-shaped, and the throw of the fault can be obtained from the height of the step in the gravity profile if the densities of the rocks involved are known.

The instrument used was a Sharpe gravity metre (No. 145) with a calibration factor of 0.10658 milligals per scale division. Readings were estimated to be accurate to 0.02 milligals.

Electromagnetic

VLF. Very powerful radio stations transmitting in the very low frequency (VLF) range are located at various points around the world. The purpose of these stations is to communicate with submerged submarines. In the VLF method of geophysical prospecting, the primary field consists of the signal transmitted by one of the VLF stations. The station chosen depends on the anticipated strike of the conductor and on the position of the station relative to the prospecting area. The VLF receiver measures the vertical in-phase and quadrature components of the secondary field due to the conductor, as percentages of the primary field. If the field is undisturbed there is no vertical component and so both the in-phase and quadrature readings are zero.

The instrument used was a Geonics 'Ronka' Type EM16 VLF receiver.

Turam. In the Turam system used at Captains Flat the primary field is produced by an alternating current passed through a long straight cable grounded at both ends. The receiver consists of two coils a fixed distance apart connected to an amplifier-compensator unit. The compensator balances the two amplified signals in intensity and phase. The ratio of the field intensities at the two coils and the phase difference between them is read at each station, and the observed ratio values are reduced to allow for the decrease in primary field strength with increasing distance from the cable.

The equipment used for the survey consisted of an A.B.E.M. Turam 2S set and generator in conjunction with a J.L.O. petrol engine Type L-75.

Magnetic

The magnetic method is used to measure local variations in the vertical component of the Earth's magnetic field. Such variations may be caused by magnetic minerals. Observations must be corrected for instrument drift and diurnal variation of the magnetic field.

The instrument used was an A.B.E.M. torsion magnetometer with a calibration factor of 11.3 gammas per scale division.

Self-potential

In the S-P method naturally occurring earth potentials are measured. These can be caused by the oxidation of buried minerals. A high-impedance millivoltmeter is used to measure the ground potential between two non-polarizeable electrodes.

The instrument used was a Sharpe 'Austral' S-P meter.

Induced polarization

The IP effect is exhibited by rocks in which the ionic conduction paths are blocked by metallic minerals. An electrochemical force must be overcome if a current is to be passed through such a rock. This electrochemical force is due to polarization at the metal/solution interfaces and an overvoltage is required for passage of the current. If the applied current is switched off, the overvoltage decays in a finite time. Because the overvoltage is also built up over a finite time, it is found that rock impedances decrease with increasing frequency.

The IP work at Captains Flat was done in the frequency domain. The apparent resistivity of the ground was measured at two frequencies, the percentage change being the frequency effect. A dipole-dipole electrode configuration was used. The results are presented in the form of pseudo-sections of apparent resistivity, frequency effect, and metal factor. These pseudo-sections should not be considered as true cross-sections of the Earth's electrical properties along the traverse.

The equipment used was a McPhar IP transmitter and receiver in conjunction with a portable J.L.O. motor/generator unit.

4. WORK DONE AND RESULTS OBTAINED

The areas in which geophysical work was carried out were Elliots and Vanderbilt, Copper Dam, Baldwins, and Gourlay Hickey. The area to the north of Elliots, where it was hoped to trace the boundary of the rhyolite tuffs by electromagnetic means, was not surveyed. This was because the single VLF test traverse carried out showed that the disturbing effect of nearby fences and power lines was large.

Elliots and Vanderbilt area

The work in this area consisted of four gravity traverses, the surveying and pegging of which was arranged by E.Z. The traverses had a bearing of approximately 45° magnetic and were labelled from northwest to the southeast as A, B, C, and D. Traverses A, B, and C were 915 m (3000 ft) long, with stations from 1500SW to 1500NE. They were approximately 61 m (200 ft) apart. These traverses were related to the E.Z. grid by making station AOO coincident with Station 1123N, 998E, of the E.Z. grid. Traverse D was 580 m (1900 ft) long, with stations from 400SW to 1500NE. Station DOO was coincident with peg 1110.5N, 1016.5E of the E.Z. grid. The station spacing on each of the four traverses was 15 m (50 ft).

Readings were initially reduced to an arbitrary datum 61 m (200 ft) below the level of B.M.42. (B.M. 42 is near the southwestern end of traverse B). Stations AOO and D200N were tied in accurately to B.M. 42, and drift corrections were found by re-occupations of these three stations. The results were subsequently adjusted to the datum used by Sedmik in 1960 (Sedmik, 1965). Thus the results from the two surveys are directly comparable.

Elevation corrections were made using a density of 2.65 g/cm^3, which was indicated by the earlier work of Sedmik (1965). Both higher and lower values were later tried, but 2.65 proved the most suitable.

Because of the very rugged country, it was necessary to apply terrain corrections to the results. These were only approximate as the only topographical contouring available was that of the Captains Flat sheet of the 1:50,000 map series. Two methods were used for computing terrain corrections. The first was a mechanical gravity integrator built by the Bureau of Mineral Resources (Olbrich, 1966). The integrator is used to calculate the gravity effect of two-dimensional bodies; i.e. bodies of uniform cross-section in one direction, and infinite in this direction. Computations of terrain effects using this technique were made where contours were almost straight and parallel over a distance of several hundred metres on either side of the traverse, and where the traverse was almost at right angles to the contours. Thus simplified terrain effects could be computed directly from the elevation profile of the traverse. This method of computing terrain effects is rapid, and is considered to have given fairly reliable results on the parts of traverses A and B southwest of Station 250NE. The second method of computing terrain corrections was that of Hammer Zones (Hammer, 1939). Only Zones B to F were used, as terrain effects were considered to be due to local topography. This method is very tedious, and has been used for only a few selected points on each traverse.

No terrain effects were computed for Traverse C, as the southern half of the line was close to a large slag heap for which no contours were available. The results for this traverse have not been presented.

The gravity results for traverses A, B, and D are shown in Plates 2, 3, and 4. The plates show profiles of Bouguer anomaly, and the profiles after terrain corrections have been applied by the two methods described. In addition, Plate 4 shows a simplified geological cross-section along the Vanderbilt Anticline.

Copper Dam area

General. Geophysical work in the Copper Dam area was carried out over a grid previously pegged by E.Z. The grid consisted of twenty traverses, each 183 m (600 ft) long, with stations from 1045E to 1051E. Traverses were 30 m (100 ft) apart from 1079N to 1098N.

VLF, Turam, magnetic, IP, S-P, and gravity methods were used in the area. No anomalies were obtained with the S-P or gravity methods and consequently no results are presented for these methods. The other results of the survey in the Copper Dam area are shown in Plates 5 to 12.

The primary cable was placed 61 m (200 ft) from the eastern ends of the traverses and extended 122 m (400 ft) beyond the end traverses. The operating frequencies used were 220 Hz and 660 Hz. Coil separation was 30 m (100 ft) and readings were taken at 7.6 m (25 ft) intervals.

The Turam ratio results for the two frequencies were essentially identical, and only contours and some profiles for 660 Hz are shown (Plates 5, 9, and 10). The Turam reduced ratio contours in Plate 5 show two large anomalies, A and B, centred on traverses 1087N and 1083N, and two smaller anomalies, C and D, on Traverse 1079N at the southern end of the area. The small anomaly E between Traverses 1097N and 1098N is thought to be due to the effect of groundwater, as this part of the area is on spongy ground near the bottom of a very steep-sided gully. Plates 9 and 10 show profiles of reduced ratio and phase difference for traverses 1083N and 1087N, as well as the VLF profiles for the traverses. Plate 13 shows graphs of the Turam vertical-field components for these traverses, and the deduced positions of the current concentrations.

VLF. Two VLF stations were utilized for the survey: NWC (North West Cape, 22.3 kHz) and NDT (Japan, 17.4 kHz). The Japanese station NDT had only been in operation since 1970, and readings were taken using both stations in order to obtain a comparison between them. As NDT is situated almost due north of the area, the field is ideally oriented for the detection of conductors aligned along the north-south strike of the Captains Flat synclinorium. This is in contrast to NWC, which is unfavourably situated in relation to the strike. Readings were taken at 15 m (50 ft) intervals, along traverses.

The VLF results are shown in Plates 6, 7, 9, and 10. Plate 6 shows the contours of the in-phase component for NDT after a simple filtering process (Fraser, 1969). All the anomalies A to E present in the Turam contours are present in these contours. Plate 7 shows the same contours for NWC. Only anomalies A and E are present. Plates 9 and 10 show profiles of the in-phase and quarddrature components for both stations for Traverses 1083N and 1087N, in comparison with the Turam profiles for these traverses.

The fact that anomaly E is much stronger in the VLF contours than in the Turam contours is further evidence that it is due to the effect of near-surface groundwater.

The signal from NDT was always much weaker than that from NWC and on occasions was almost undetectable. However, readings using NDT were possible most of the time and were quite accurate despite the fact that they were usually tedious to make, owing partly to the weak signal and partly to the fact that the null position was often very broad. A comparison of the VLF contours of Plates 6 and 7 shows that conductors with strikes such that they cannot be detected with NWC are clearly defined with NDT. Furthermore, if the Turam contours of Plate 5 are compared with the VLF (NDT) contours of Plate 6, it can be seen that despite the difficulty of reading with NDT the VLF results give almost exactly the same picture of anomalies as does the Turam.

Magnetic. Readings of vertical magnetic field were made at 7.6 m (25 ft) intervals, except in areas of little variation where the spacing was increased to 15 m (50 ft). All readings were referred to station 1047.5E on traverse 1087N as base for the area. The signs of the observations have been reversed, so that anomalies are in general positive peaks as in the Northern Hemisphere.

The results of the magnetic survey are shown in contour form in Plate 8. The main feature is the very sharply defined ridge trending north from traverse 1079N to 1093N. This widens into anomaly M1 with a peak of 800 gammas at traverse 1085N. There are three more localized anomalies: M2, M3, and M4. Anomalies M2 and M3 on traverses 1090N and 1080N have peaks of 500 gammas and 400 gammas respectively.

Anomaly M4 on traverse 1097N is a very sharply defined negative anomaly of -600 gammas, and is situated exactly between the magnelectromagnetic anomalies C and D.

Induced polarization. Traverses 1083N and 1087N were surveyed with IP using a dipole-dipole electrode configureation. The six transmitting electrodes consisted of sheets of aluminium foil buried in the ground at 30 m (100 ft) intervals to form five 30 m (100 ft) transmitting dipoles, and the receiving dipole consisted of two porous pots, also separated by 30 m (100 ft). The frequencies used were 0.3 and 5.0 Hz.

The IP results from traverses 1083N and 1087N are shown in Plates 11 and 12 respectively.

Gravity. Gravity observations were made over Anomaly B on traverse 1083N. As no gravity anomaly was obtained, no results are presented. The readings were not tied in to the gravity results obtained in the Elliots and Vanderbilt areas.

Self-potential. The whole Copper Dam area was surveyed with S-P, but no anomalies were obtained and the results are not presented.

Baldwins and Gourlay Hickey areas

In the Baldwins area, two 183 m (600 ft) traverses, 933N and 934N, laid by E.Z. over known surface mineralization about three kilometres south of Captains Flat, were surveyed with VLF and IP methods.

For each traverse, both VLF stations gave a strong cross-over of the in-phase component over the zone of mineralization. The IP results were inconclusive owing to instrumental faults.

Traverse 1000N in the Gourlay Hickey area was surveyed with VLF from station 973E to 999E. This traverse had been surveyed in 1968 with VLF (Haigh, 1970) and was surveyed again in order to check on the repeatability of the method over a period of several years. The NWC station was used in both cases. The 1971 results obtained were almost identical to those of the previous survey, so verifying the repeatability of the method.

As the purpose of the VLF work in the Baldwin and Gourlay Hickey areas was essentially to check the response of the VLF equipment, and as the IP work was unreliable, the results from these areas are not presented.

5. INTERPRETATION AND RECOMMENDATIONS

Elliots and Vanderbilt areas

The gravity profiles along traverses A and B (Plates 2 and 3) do not show the type of anomaly which would be expected above a fault, where beds of different densities come into contact. The fact that the profiles are flat over the fault would indicate one of three possibilities:

(a) The throw of the fault is too small to be detectable by gravimetric work.

(b) There is a density contrast across the fault, but it is at a depth too great to have been detected.

(c) There is no density contrast across the fault at any depth.

Possibility (a) is likely in the light of the present geological thinking of E.Z. (L. Davies, pers. comm.). However, Lake George Mines was thought to have had geological evidence that the fault had a large throw, and if this is the case then (b) is the most probable explanation. As the formations have near vertical dips, the vertical movement of the two blocks of the fault will not have brought different formations into contact to any appreciable extent, except at the base of the synclinorium. This is at a depth of more than 3000 m. The step in the gravity profile at the surface due to a density contrast at such a depth would be so broad as to be undetectable on a 1000 m traverse.

It is thought that no useful purpose would be served in extending the traverses at either end in order to see whether the step has been spread out over more than 1000 m. Even if this were the case, the very rugged relief and lack of accurate corrections would make any quantitative conclusions very tentative. Also, it may be that there is no density contrast even at the basement, which, as alternative (c) listed above, is certainly a possibility to be considered.

An added complication occurs in the case of traverse D (Plate 4) for which the gravity profile is also featureless across the fault. Surface rock samples indicate densities for the volcanics and shales on either side of the fault of about 2.6 and 2.4 g/cm^3 respectively. If this density contrast of 0.2 g/cm^3 were to persist to a depth greater than 30 m it would certainly produce a noticeable step in the Bouguer anomaly profile, even if the terrain-corrected profile were not detailed enough to show it. Thus it must be assumed that either the densities of the surface rock samples are not representative of those of the rocks beneath the surface, or that the volcanics occur northeast of the fault at a depth of less than 30 m (i.e. distance d in Plate 4 is less than 30 m). It is considered very likely that the surface rock samples do not give densities representative of the deeper rocks, as in previous gravity surveys in the area (Sedmik, 1965) such density measurements have proved unreliable when used for the reduction of gravity data. The cause of the large rise in the gravity profile toward the northeastern end of the traverse is not known, and little can be said about it without further information.

Thus no positive conclusion may be made about the throw of the Molonglo Fault on the basis of the data available.

Copper Dam area

Electromagnetic anomalies. The electromagnetic anomalies are presented in Plates 5, 6, 7, 9, and 10. Plates 5 and 6 display the enechelon arrangement of anomalies A, B, and C, and this arrangement may continue out of the area, south of anomaly C. Anomaly D is smaller than the other anomalies, and is probably the result of a minor branch of the conductor that forms the main chain of anomalies. The low Turam phase values indicate that the anomalies are caused by very strong conductors. The Turam and VLF profiles across anomalies A and B (Plates 9 and 10) indicate that the depths to the tops of the conductors are about 30 m and 27 m respectively. These compare with 25 m and 17 m for the depths calculated from the curves of the Turam vertical field components shown in Plate 13.

The electromagnetic results indicate that anomalies A, B, and C are the result of an enechelon arrangement of very strong conductors trending about 5° west of north and at a depth between 20 m and 30 m.

Magnetic anomalies. The magnetic anomalies (Plate 8) bear no apparent relation to the geology of the area, and there is no obvious reason why they flank the electromagnetic anomalies. They are probably caused by traces of magnetite which are known to be present in the rocks. However, the distribution of magnetite in the area has not been accurately mapped, so no correlation between the magnetic anomalies and the presence of magnetite can be attempted. No conclusions have been drawn from the magnetic results.

IP. Plate 12 shows the IP results for traverses 1087N, over the centre of electromagnetic Anomaly A. The metal factor results show high values distributed in the form of a wide inverted V, the shape typical of IP anomalies over near-vertical dyke-like conductors. This shape is reflected in the distribution of the anomalously low values of the apparent resistivity, and, though less pronounced, of the higher than background values of frequency effect. The shape of the anomaly indicates a near-surface, near-vertical thin conductor in the vicinity of station 1048.5E. The fact that the anomaly fades out with depth directly below this station suggests that the conductor is of limited depth extent.

The IP results for traverse 1083N, over electromagnetic Anomaly B, are shown in Plate 11. The shape of the anomaly again indicates a near-surface conductor, though the typical inverted V shape is not pronounced. The conductor is possibly wider and weaker than that of Anomaly A, a possibility also suggested by the real and imaginary current concentrations calculated from Turam results (Plate 13). It also is positioned near station 1048.5E.

The metal factor anomalies for both traverses have both apparent-resistivity and frequency-effect components. This would suggest that the conductors are massive rather than disseminated, and electronic rather than electrolytic. Thus the anomalies are likely to be the result of some form of mineralization and not of mineralized groundwater.

Recommendations

The electromagnetic and IP results in the Copper Dam area strongly suggest the presence of an enechelon arrangement of very strong conductors extending from traverse 1090N southwards out of the area. The old mine workings marked in Plates 5, 6, and 7 on the flank of Anomaly A is known to have met only pyrite mineralization. However, as pyrite is commonly found in the outer zones of more economic mineralization, it is recommended that Anomalies A and B be investigated by drilling. For Anomaly A, the hole should start at station 1047.25E on traverse 1087.5N with an angle of depression of 45° to the east, and it should not need to be much longer than 50 m in order to intersect the conductor. The hole to investigate Anomaly B should start at station 1049E on traverse 1083N and have an angle of depression of 45° to the west. It also should not need to be longer than 50 m. The two holes have been positioned to intersect the conductors from different sides, so that if the dip of the conductors is such that one hole will not make an intersection within a reasonable distance, the other one should. Plate 13 shows both the holes in relation to the Turam current elements for the two traverses. Plates 5 and 6 show the positions of the holes relative to the anomalies.

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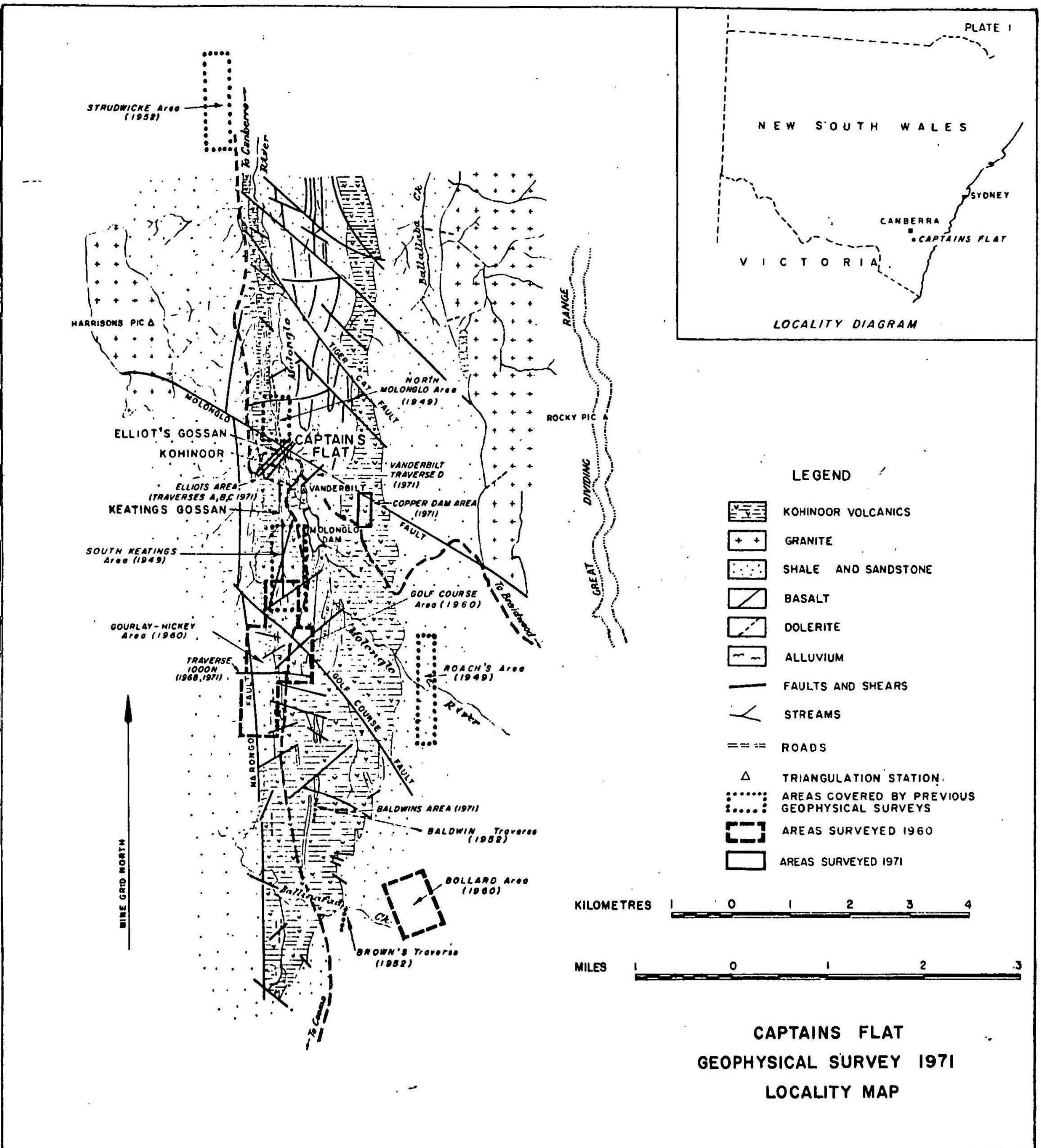


CAPTAINS FLAT
GEOPHYSICAL SURVEY 1971
LOCALITY MAP

BASED ON 155/B1-21 To Accompany Record No. 1971/136 Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics 155/B7-74

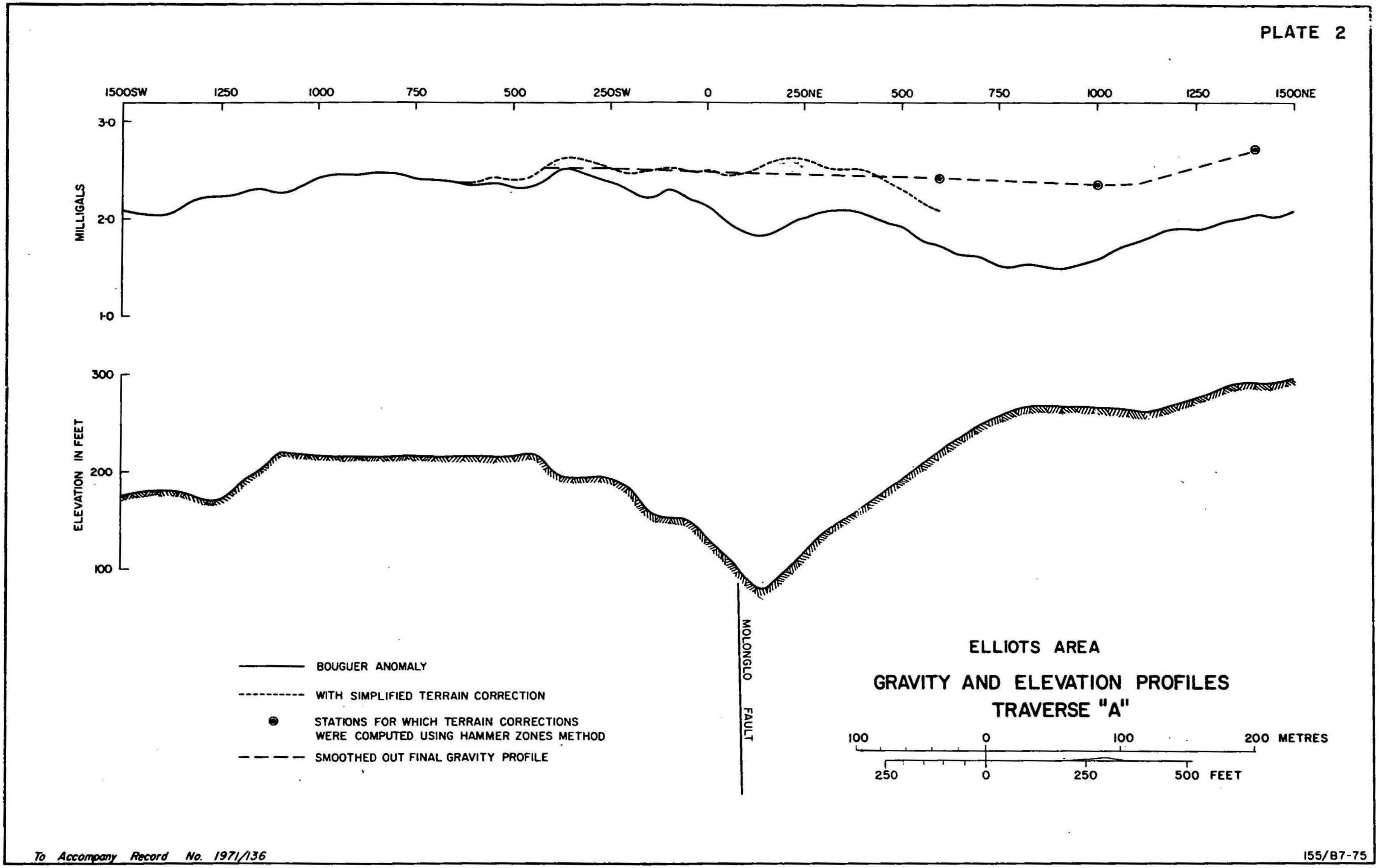
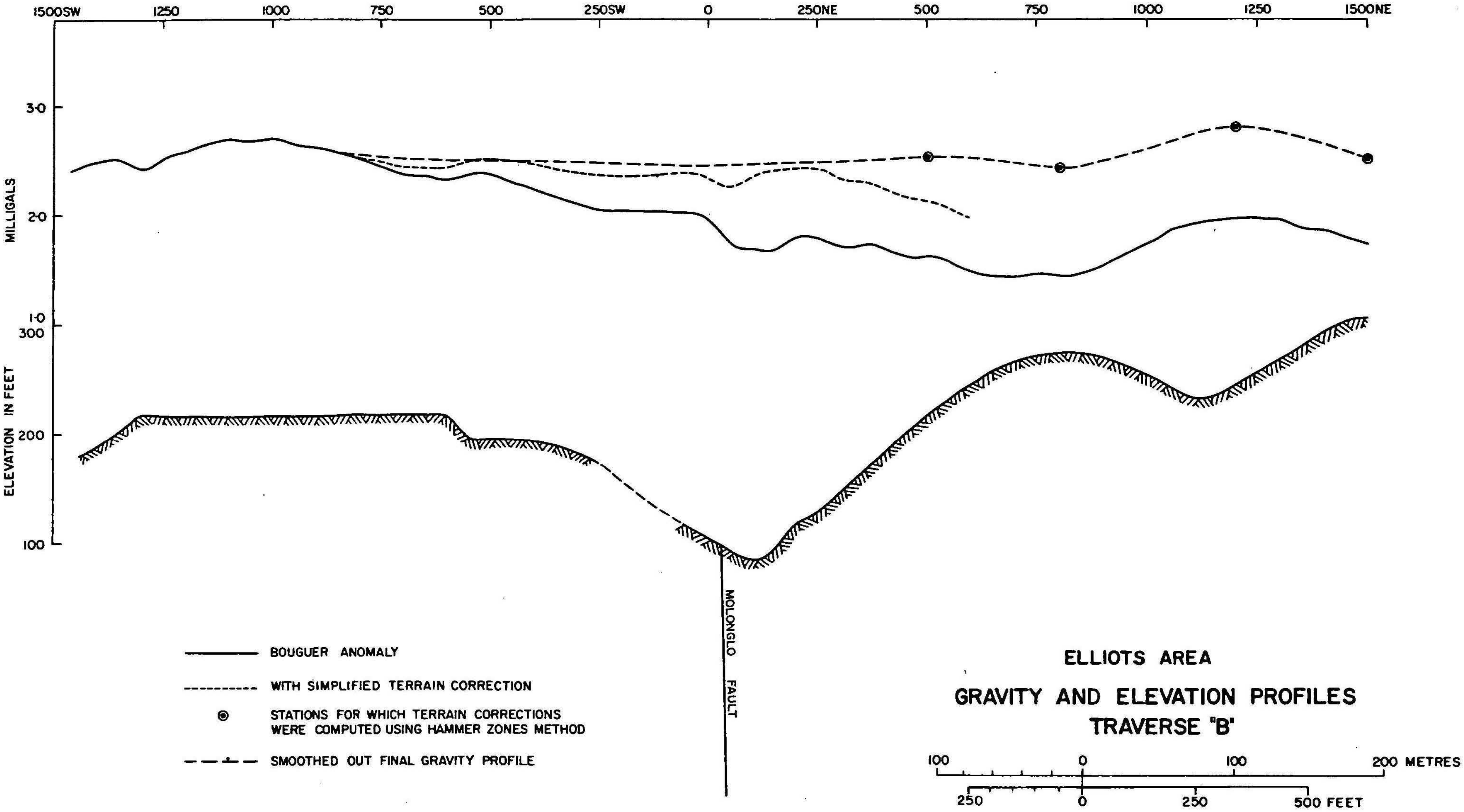


PLATE 2
1500SW
1250
1000
750
500
250SW
0
250NE
500
750
1000
1250
1500NE
MILLIGALS
3·0
2·0
1·0
ELEVATION IN FEET
300
200
100
MOLONGLO FAULT
BOUGUER ANOMALY
WITH SIMPLIFIED TERRAIN CORRECTION
STATIONS FOR WHICH TERRAIN CORRECTIONS WERE COMPUTED USING HAMMER ZONES METHOD
SMOOTHED OUT FINAL GRAVITY PROFILE
ELLIOTS AREA
GRAVITY AND ELEVATION PROFILES
TRAVERSE "A"
100
0
100
200 METRES
250
0
250
500 FEET
To Accompany Record No. 1971/136
155/B7-75

PLATE 3



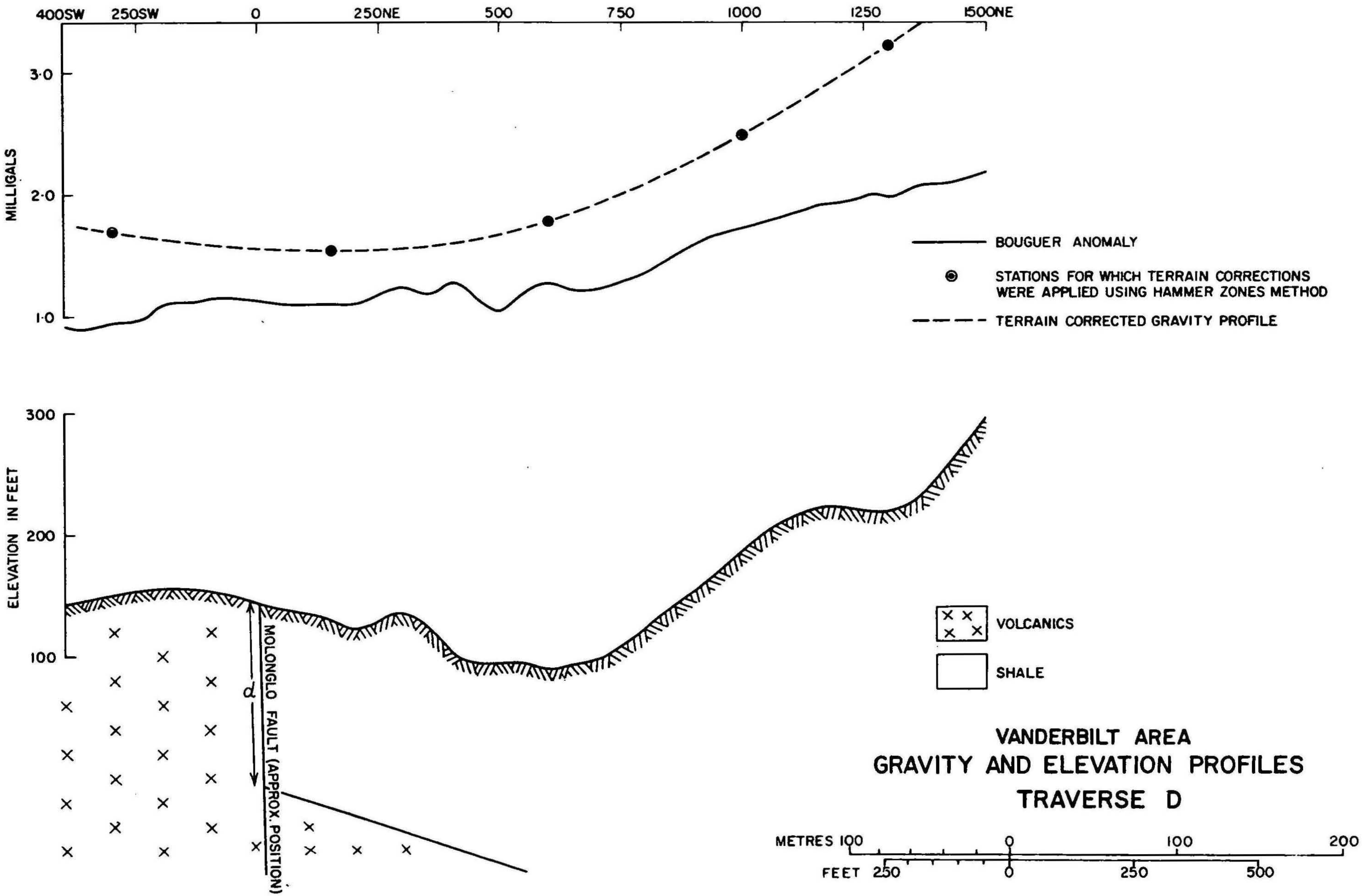
ELLIOTS AREA

GRAVITY AND ELEVATION PROFILES TRAVERSE "B"

To Accompany Record No. 1971/136

155/B7-76

PLATE 4

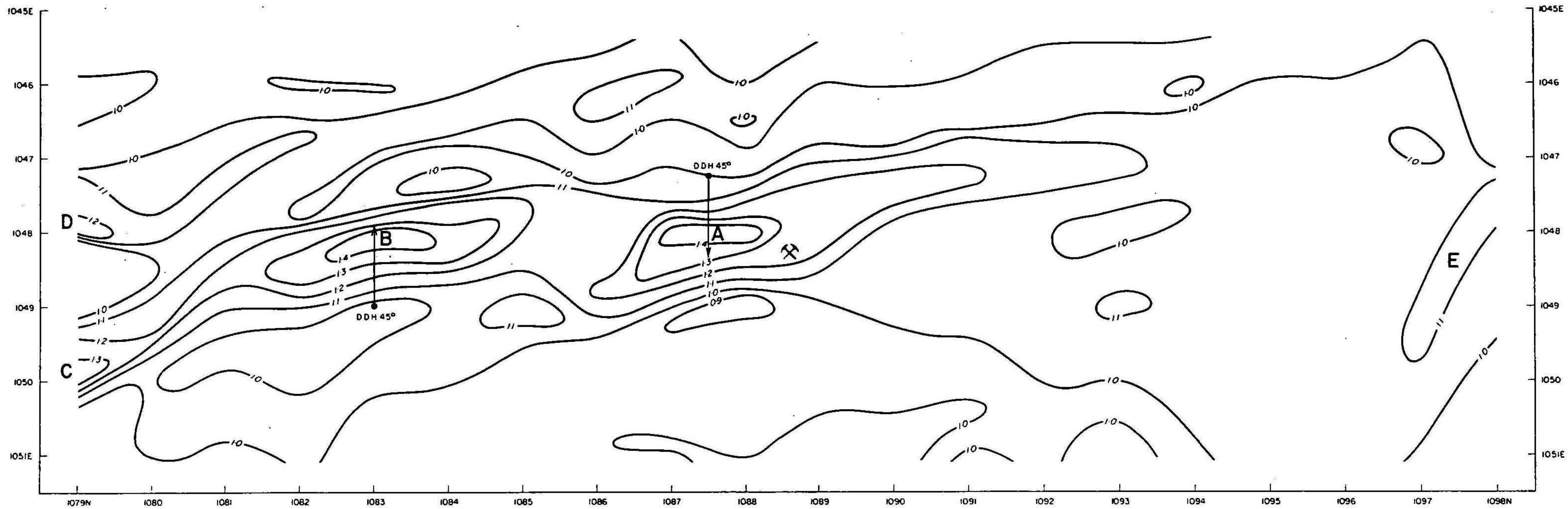


VANDERBILT AREA
GRAVITY AND ELEVATION PROFILES
TRAVERSE D

To Accompany Record No. 1971/136

155/B7-77

PLATE 5



COPPER DAM AREA

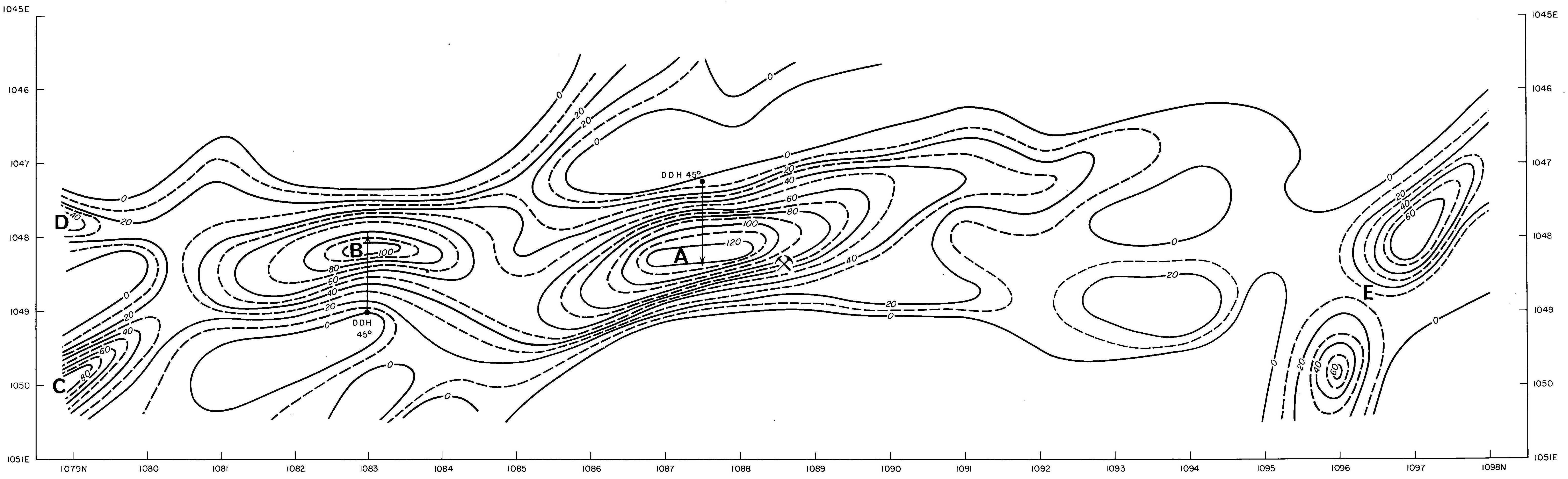
TURAM RATIO CONTOURS

25 0 25 50 75 METRES

50 0 50 100 150 200 FEET

CONTOUR INTERVAL 0·1

PLATE 6



COPPER DAM AREA

CONTOURS OF FILTERED VLF IN-PHASE COMPONENT,

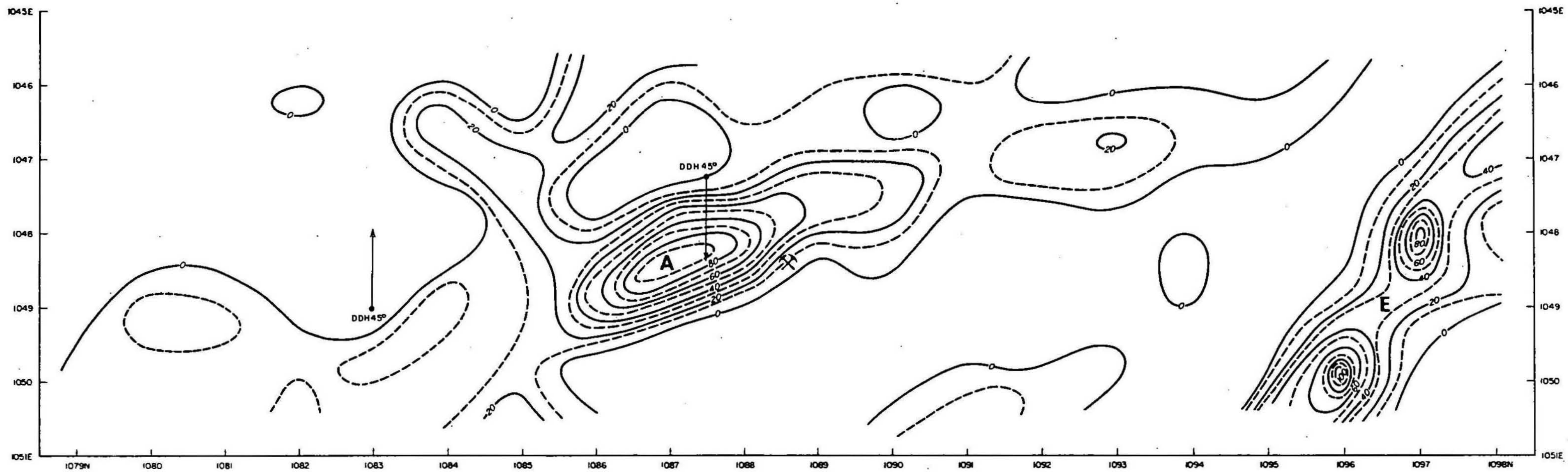
NDT (JAPAN)

25 0 25 50 75 METRES

50 0 50 100 150 200 FEET

CONTOUR INTERVAL 10

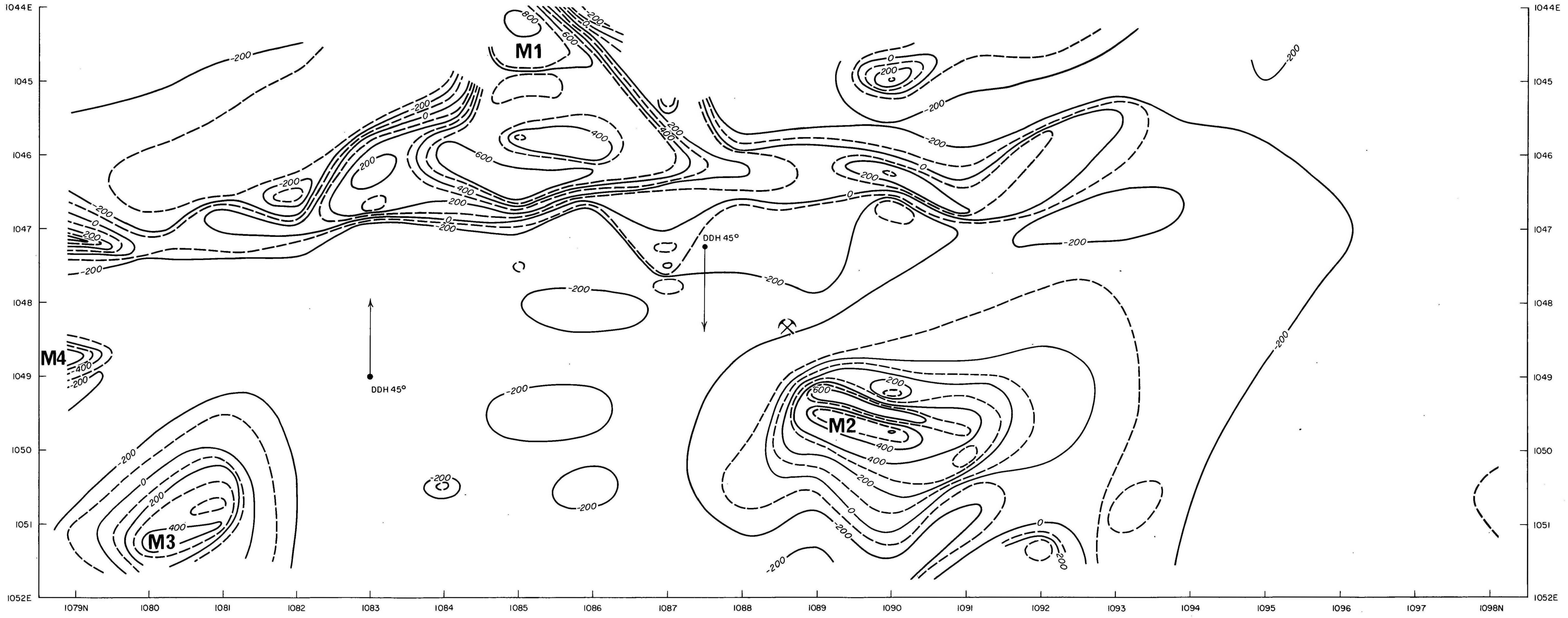
PLATE 7



COPPER DAM AREA
CONTOURS OF FILTERED VLF IN-PHASE COMPONENT,
NWC (NORTH WEST CAPE)

25 0 25 50 75 METRES
50 0 50 100 150 200 FEET

CONTOUR INTERVAL 10



COPPER DAM AREA

CONTOURS OF VERTICAL COMPONENT OF MAGNETIC FIELD

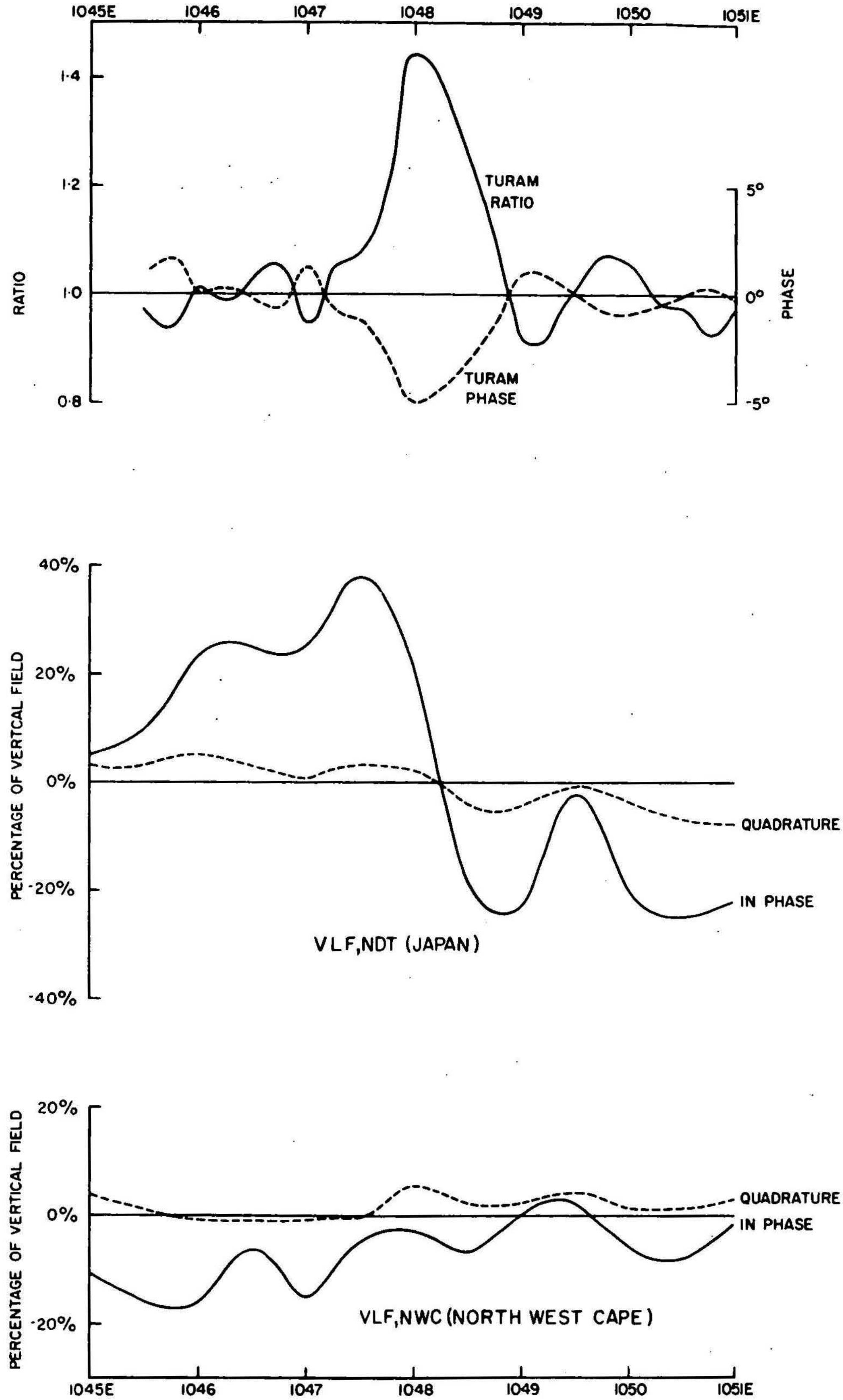
25 0 25 50 75 METRES

50 0 50 100 150 200 FEET

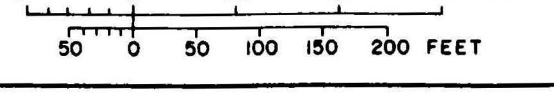
CONTOUR INTERVAL 100 GAMMAS

To Accompany Record 1971/136

155/B7-81

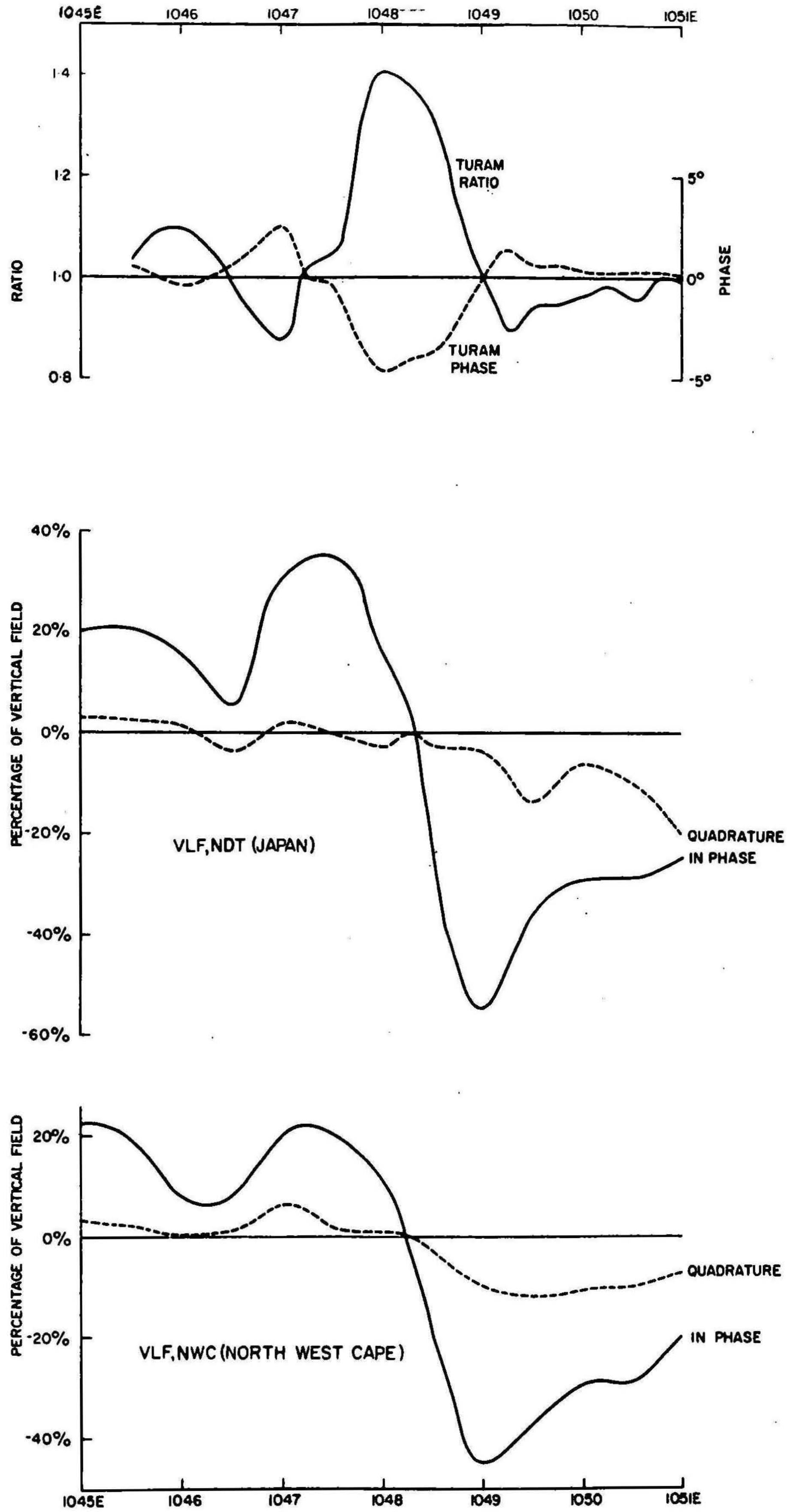


COPPER DAM AREA
TURAM AND VLF PROFILES
TRAVERSE 1083N ANOMALY "B"



To Accompany Record 1971/136

155/B7-82



COPPER DAM AREA
TURAM AND VLF PROFILES
TRAVERSE 1087N ANOMALY "A"

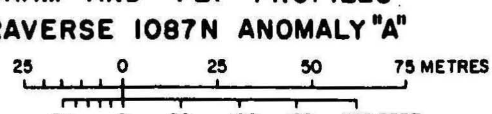
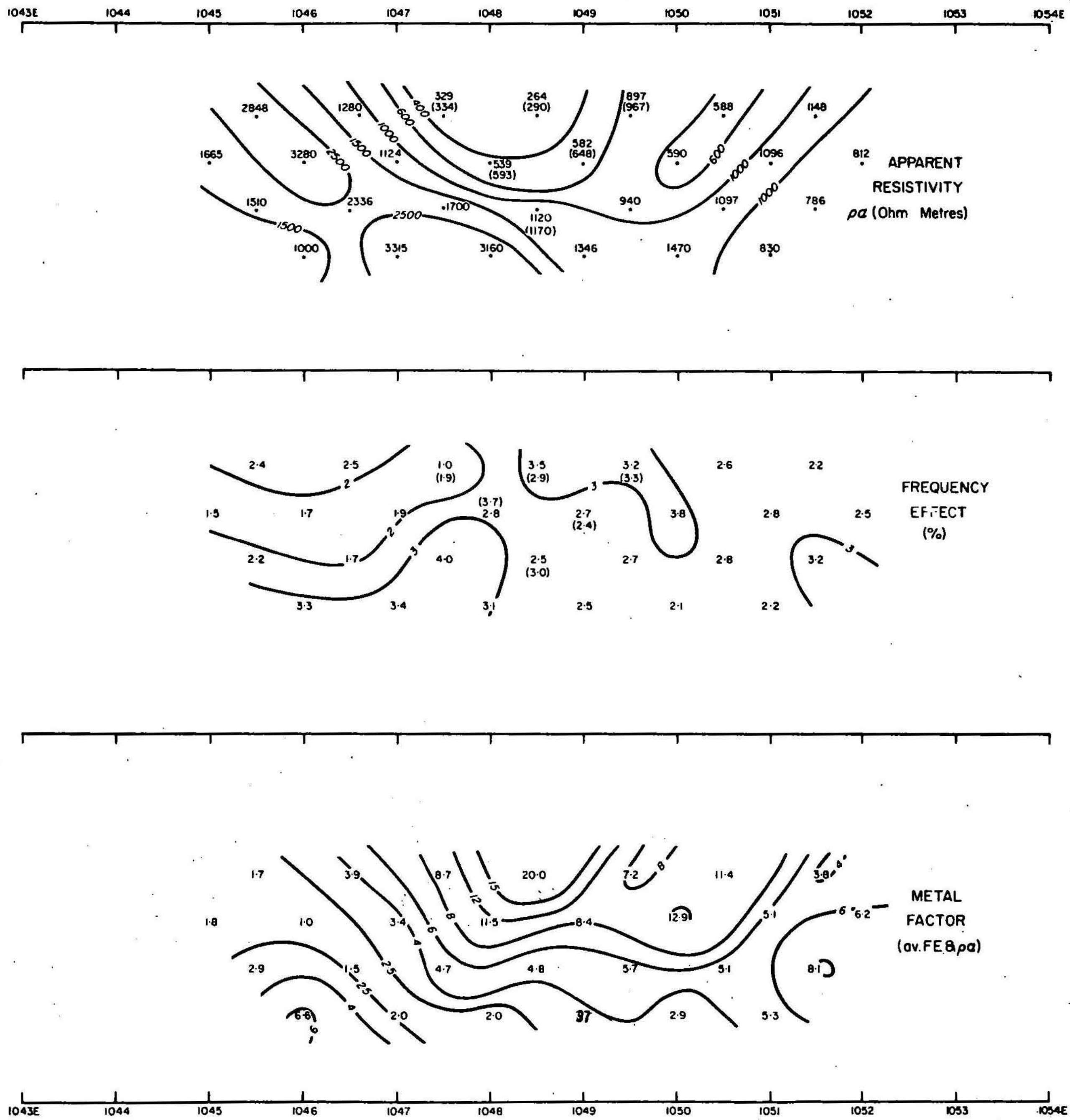


PLATE 11



COPPER DAM AREA
TRAVERSE 1083 N
INDUCED POLARIZATION

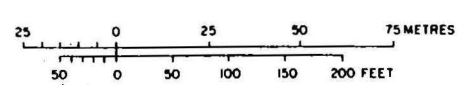
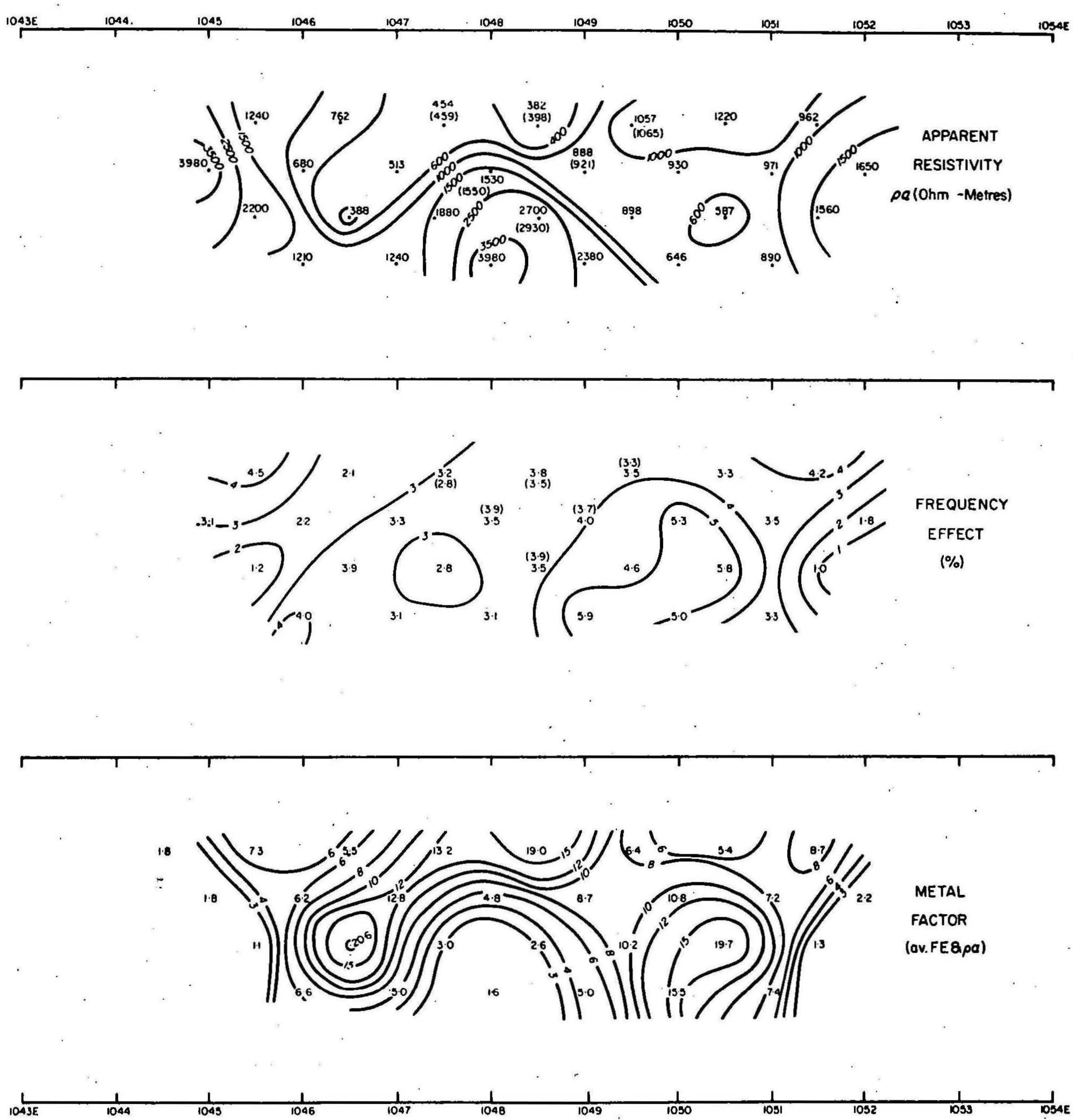


PLATE 12



COPPER DAM AREA
TRAVERSE 1087 N
INDUCED POLARIZATION

25 0 25 50 75 METRES
50 0 50 100 150 200 FEET

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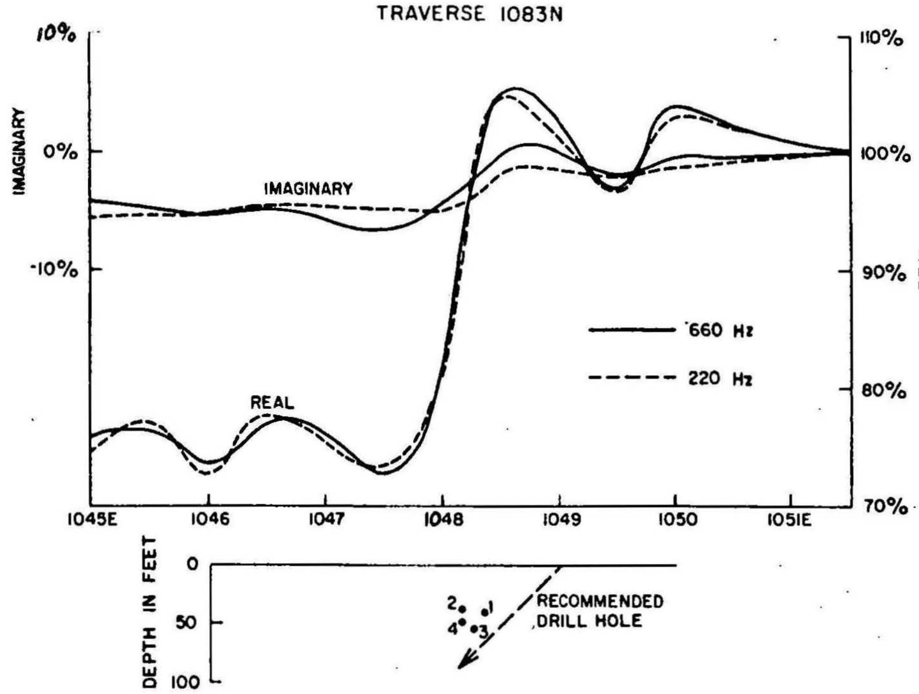
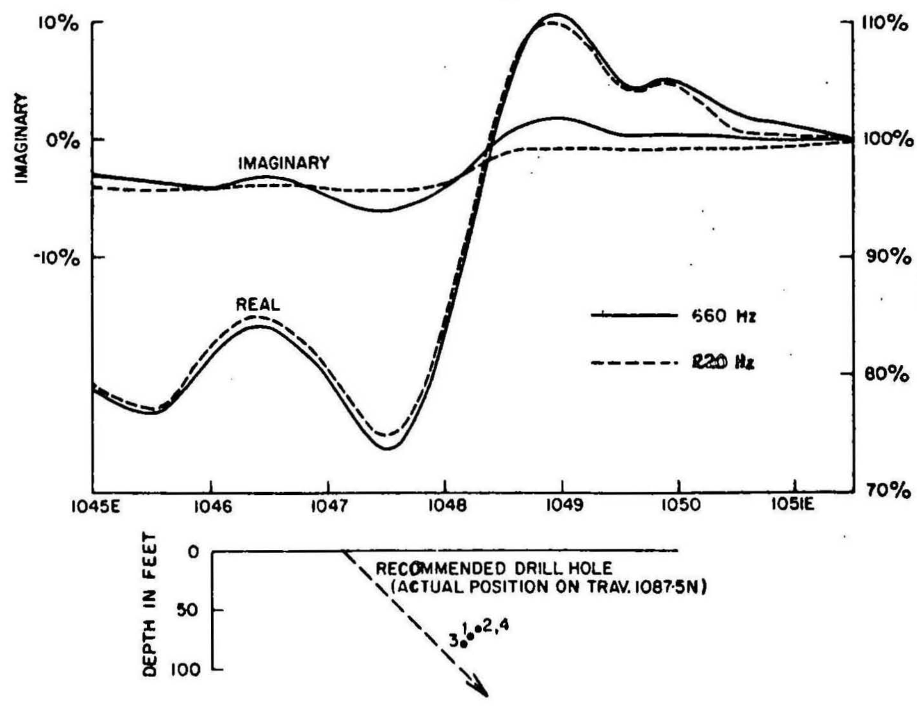
TRAVERSE 1083N



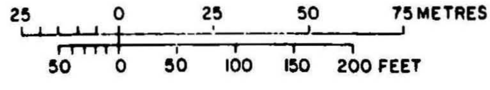
TRAVERSE 1087N



• DOTS SHOW POSITION AND DEPTH OF CURRENT CONCENTRATIONS AS DETERMINED FROM GRAPHS OF VERTICAL FIELD COMPONENTS

1: IMAGINARY, 220 Hz
2: REAL, 220 Hz
3: IMAGINARY, 660 Hz
4: REAL, 660 Hz

COPPER DAM AREA
TURAM VERTICAL FIELD COMPONENTS AND LOCATIONS OF CURRENT ELEMENTS
TRAVERSES 1083N AND 1087N



To Accompany Record 1971 /136

155/87-86