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COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1956, No. 125

GEOPHYSICAL SURVEY AT THE CONRAD MINE, HOWELL, N.S.W.

by

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ABSTRACT.

This report describes the geophysical surveys made during 1952 and 1953 at the Conrad Mine, near Howell, N.S.W., on leases owned by Mines Exploration Pty. Ltd. The methods of survey used were self-potential and electromagnetic ones, but brief tests were made with magnetic and radiometric methods.

Only the self-potential survey gave anomalies. In addition to the strong anomaly above the line of lode between the Conrad and Moore shafts, two other well-defined anomalies were observed on the line of lode. These are worthy of investigation by trenching and/or shaft sinking.

1. INTRODUCTION.

The Conrad Mine is in the Parish of Mayo, County of Hardinge, N.S.W., about 18 miles south of Inverell. The mine is best reached by travelling about 14 miles from Inverell along the Bundarra road and then turning right along a minor road to the former town of Howell. Inverell, about 400 miles north of Sydney, is the nearest commercial centre and rail head (Plate 1). The mine is about one mile south-west of Howell.

Mines Exploration Pty. Ltd., has been developing part of the Conrad lode, with a view to the production of silver-lead-zinc concentrates from the Conrad Mine. The company applied to the Bureau of Mineral Resources for a geophysical survey to be made to examine the southern extension of the line of lode. The Bureau agreed to carry out the survey, and work was started in June, 1952, with K.H. Tate as party leader and A.F. Alle as assistant. Unfortunately, the survey was interrupted in August, 1952, because of commitments in other areas, and was not re-commenced until August, 1953, with K.H. Tate again as party leader, and M.J. O'Connor as assistant.

The Conrad lode was discovered in 1890 but no mining of any consequence was done until 1897, when the property was purchased by John Howell. Active mining operations ceased in 1912, but small parcels of hand-picked ore, carrying silver and lead, have been won since then from the old workings by parties of miners. The Conrad Mine and the nearby King Conrad Mine failed in the first stage, not for lack of ore, but because of metallurgical treatment problems. The present plans of the company involve the introduction of flotation methods, and the geophysical survey, together with geological investigations being carried out, was intended to assist in locating possible additional ore reserves in the area.

2. GEOLOGY.

The regional geology of the New England district has been described by Andrews (1903), and references to the Howell area are also made by Andrews (1904). At Howell, the New England plateau occurs and is part of the Stannifer peneplain. The plateau is dissected by the Gwydir river, whose tributary, Borah Creek, rises near the Conrad Mine. The creek has, in fact, followed the softer lode material in its course.

Cotton (1910) has described the ore deposits in some detail. In the area surveyed, the country rock is granite, of which two types are recognised. Firstly, a hornblende-biotite granite, known as the "Tingha" granite, and secondly a coarse-grained white granite, known as "acid" granite. The lode occupies a fissure in granite and can be traced for two miles. The known ore deposits lie in a tongue of "acid" granite, but the lode crosses into "Tingha" granite towards its south-eastern end. North-west of the area surveyed, the lode is joined by a similar lode, known as the King Conrad lode.

The ore occurs as shoots about 2 feet wide, with nearly vertical dip and a steep southerly pitch. The shoots worked have been persistent in depth. Ore minerals consist of galena, sphalerite, pyrite, arsenopyrite, chalcopyrite and stannite, in a quartz gangue. In the Conrad Mine, the lode fissure contains a well-defined clay gouge.

The course of the lode is indicated by the workings shown on Plate 1. The lode has been prospected south-east of the Conrad Mine over a length of more than 6,000 feet. There are other workings on the line of lode to the south-east and north-west of the area shown on Plate 1.

South-east of traverse 3400 S.E. the country is fairly flat, and in parts, a sandy drift covers the granite. South-east of 6000 S.E. the country is rough, and bare outcrops of granite occur.

In the hilly areas very little soil is present, and there are outcrops of granite up to an acre in extent.

3. THE PROBLEM.

As the lode outcrop is visible at the surface for a length of more than two miles, the problem is the determination of ore shoots in a lode whose position is known. The ore minerals are sulphides, including galena, and it may be expected that the ore will have, in general, fairly high electrical conductivity. For this reason, electrical methods were considered as being most likely to give results and the self-potential and electro-magnetic techniques were therefore used.

The ore does not appear to have any other physical properties sufficiently well marked to enable its detection by geophysical methods.

It must be remembered, however, that problems of this type are generally among the most difficult encountered in geophysical surveys. Difficulties may arise from various causes, of which the following may be mentioned as applying particularly to the present survey.

(i) The lode occurs in a well-defined fissure, and the presence of a clay gouge indicates that there may have been movement along the walls of the fissure. Such fissures permit free circulation of ground water, with consequent high chemical activity. It is commonly found that zones of high conductivity not connected with mineralisation occur in such fissures. It cannot be assumed, therefore, that electrical indications of good conductors necessarily indicate the presence of mineralisation.

(ii) As mentioned later, it appears that water circulating through the filled stopes in the old workings is definitely acid and more conductive than that circulating in the unworked portions of the lode fissure. Therefore it cannot be expected that electrical indications obtained over the mined portion of the lode will be in any way respresentative of the anomalies to be expected over unworked ore shoots.

(iii) Although it is advantageous for the conductivity of the ore to be sharply distinguishable from that of the country rock, the resistivity of the granite and granitic soil in the area surveyed is so extremely high as to be a serious practical hindrance in carrying out surveys by electrical methods.

Although it was not expected that any other established geophysical techniques would be of use in prospecting the Conrad lode, brief tests were made using magnetic, radiometric and potential-ratio methods.

4. SELF-POTENTIAL SURVEY.

(a) Method.

A fixed rear-station was established and the surface potential at points on the grid was measured using a Cambridge pH-meter as a millivoltmeter. At many stations difficulty was experienced in taking reliable readings, because of poor ground-contact conditions. When it became evident that the self-potential method was the only suitable one for this particular investigation it became increasingly important to ensure that the greatest possible care was taken in making observations. Traverses 250 S.E. to 1200 S.E. were surveyed in 1952. In 1953, traverses 1200 S.E. to 5000 S.E. were surveyed using a different rear-station, which was tied-in to the 1952 rear-station. The survey of the area from 5000 S.E. to 6000 S.E. had to be abandoned because the conditions became so dry that it was impossible to obtain reliable readings even by watering observation points.

It was noted that at the deeper levels in the mine, the groundwater which passed through stoped areas was sufficiently acid to corrode tram-rails, but water from newly-broken ore was fresh. Acid water has a much high conductivity than fresh. It has been recorded that not much oxidised ore was found and that sulphides were found close to the surface. It would be expected therefore that anomalies would be larger over areas which had been extensively mined, than over any undisturbed ore bodies which may exist.

(b) <u>Results</u>.

The self-potential profiles (Plate 2) are very irregular and difficult to interpret. However, some definite self-potential anomalies occur which are much greater than the average variations in the profiles and these are shown in the form of contours on Plate 3. The contours show a complex pattern, which, over most of the area surveyed, has no obvious correlation with the line of lode. It is considered that any pattern which might be associated with the lode is overlain by a potential distribution which reflects essentially the distribution of flat outcrops of bare granite. In such circumstances, no overall interpretation can be offered with any confidence. The best that can be done is to select such anomalies as are apparently associated with the lode, and which could, from their shape, be caused by mineralised portions of it.

Between traverses 250 S.E. and 1100 S.E. there is a strong negative anomaly with a maximum amplitude of -100 millivolts whose axis corresponds to the line of lode. The known mineralisation between the Conrad and Moore shafts consists of a shoot of ore pitching steeply to the south and extending to at least 700 feet depth as exposed in the accessible workings. This shoot has been mined extensively at the upper levels and stopes have been filled. It is in this area that surface water penetrating the old workings becomes acid and it is certain that strong self-potential effects are produced. The anomaly may be related to the disposition of the filled stopes as well as to the amount of sulphide ore that may be present.

A negative anomaly of maximum amplitude about -80 millivolts is centred at 2400 S.E./1105 S.W. near Davis' Shaft, but it is not very extensive in the direction of the line of lode. The broad extent of the anomaly at right angles to the line of lode is probably a distortion of the self-potential contour lines caused by the wide expanse of bare rock near Davis' Shaft.

A small negative anomaly centred near 3300 S.E./1300 S.W. broadens out southwards from that point, and has a maximum amplitude of about -80 millivolts.

A strong negative anomaly of maximum amplitude about -80 millivolts occurs at 4500 S.E./1205 S.W. It is persistent along the line of lode from 4260 S.E. to about 4750 S.E. Anomalies on individual profiles in this area are well-defined because of uniform ground conditions. The area is relatively flat and covered by a thin sandy drift. No mine workings, other than a shallow prospecting pit, exist in the area and it is probable that any mineralisation which exists has been missed by earlier prospecting work.

Some smaller anomalies are centred at 2050 S.E./1390 S.W. and 1410 S.E./660 S.W. These anomalies are not encouraging because they are not situated on the well-defined line of lode.

5. ELECTROMAGNETIC SURVEY.

(a) Method.

The problem was attacked by using the horizontal loop method. A large rectangular loop of wire measuring 4000 feet by 2000 feet was laid out with one long side along 1500 S.W., i.e. about 500 feet from the line of lode. The electromagnetic field produced near the lode by the alternating current passed through the loop was measured with search coils at stations on a rectangular grid. The essence of the method is the measurement at the surface of the effects produced by induced currents in the buried conducting body. It was expected that the shoots of ore in the Conrad fissure would be good conductors.

A modification of the method is the use of a long cable (in effect, one side of the loop) with an earth return via point or line electrodes. This method was tested but was unsuccessful, because of the very high resistivity of the granite.

(b) Results.

Measurements were made along traverses 250S.E. to 2550S.E.. Small anomalies were observed near the line of lode in both real (in-phase) and imaginary (out-of-phase) components of the electromagnetic field. However, the anomalies are so limited in extent that no conclusions can be drawn about the depth at which the effects originate. Also, the prototype equipment used was not completely satisfactory. It is not desirable to use the electromagnetic results for interpretation, but the profiles of the imaginary component of the vertical field are shown on Plate 4 for reference purposes. The electromagnetic survey was made in the 1952 season and was not continued during the 1953 season.

6. MAGNETIC SURVEY.

Some observations were made with a vertical force magnetic variometer to measure differences in magnetic susceptibility between ore and country rock. The slight differences observed were not of sufficient magnitude to be of use for interpretation and must be attributed mainly to the irregular distribution of magnetite and other accessory minerals in the granite.

7. RADIOMETRIC SURVEY.

Tests were made on dumps at the Conrad Mine with an Austronic Ratemeter, Type PRM.200. No readings exceeding normal background count were observed. No tests of the underground workings were made.

8. CONCLUSIONS AND RECOMMENDATIONS.

It is commonly found that the results of self-potential surveys, unconfirmed by other methods, do not provide a very reliable basis for recommending extensive testing. The three most promising indications are:-

(i) An anomaly corresponding with the known mineralisation in the Conrad workings.

(ii) A minor anomaly centred at 3300 S.E./1300 S.W.

(iii) An anomaly of dimensions comparable with (i) above, centred at 4500 S.E./1205 S.W.

It is recommended that indications (ii) and (iii) be tested by trenching in the first instance. The following trenches are recommended:-

No. 1 4505 S.E./1240 S.W. to 4495 S.E./1180 S.W. (Approx. length 60 ft).

No. 2 3320 S.E./1320 S.W. to 3320 S.E./1280 S.W. (Approx. length 40 ft).

Any further testing would depend on the results of the trenching.

It appears that the self-potential method may give useful results in this area, provided confirmation can be obtained using other methods. If further work is contemplated, every effort should be made to find an electromagnetic method capable of overcoming local difficulties. It is possible that a much higher frequency than that used in this survey (500 cycles/sec.) would yield useful results. If a satisfactory electromagnetic technique can be developed it appears that surveys over larger areas would be warranted.

9. REFERENCES.

Andrews E.C., 1903 - The Tertiary History of New England, Rec. Geol. Surv. N.S.W. 7(3).

Andrews E.C., 1904 - New England Geology, Rec. Geol. Surv. N.S.W. 7(4).

Cotton L.A., 1910 - The ore-deposits of Borah Creek, Proc. Lin. Soc. N.S.W., 35(2), No. 138.

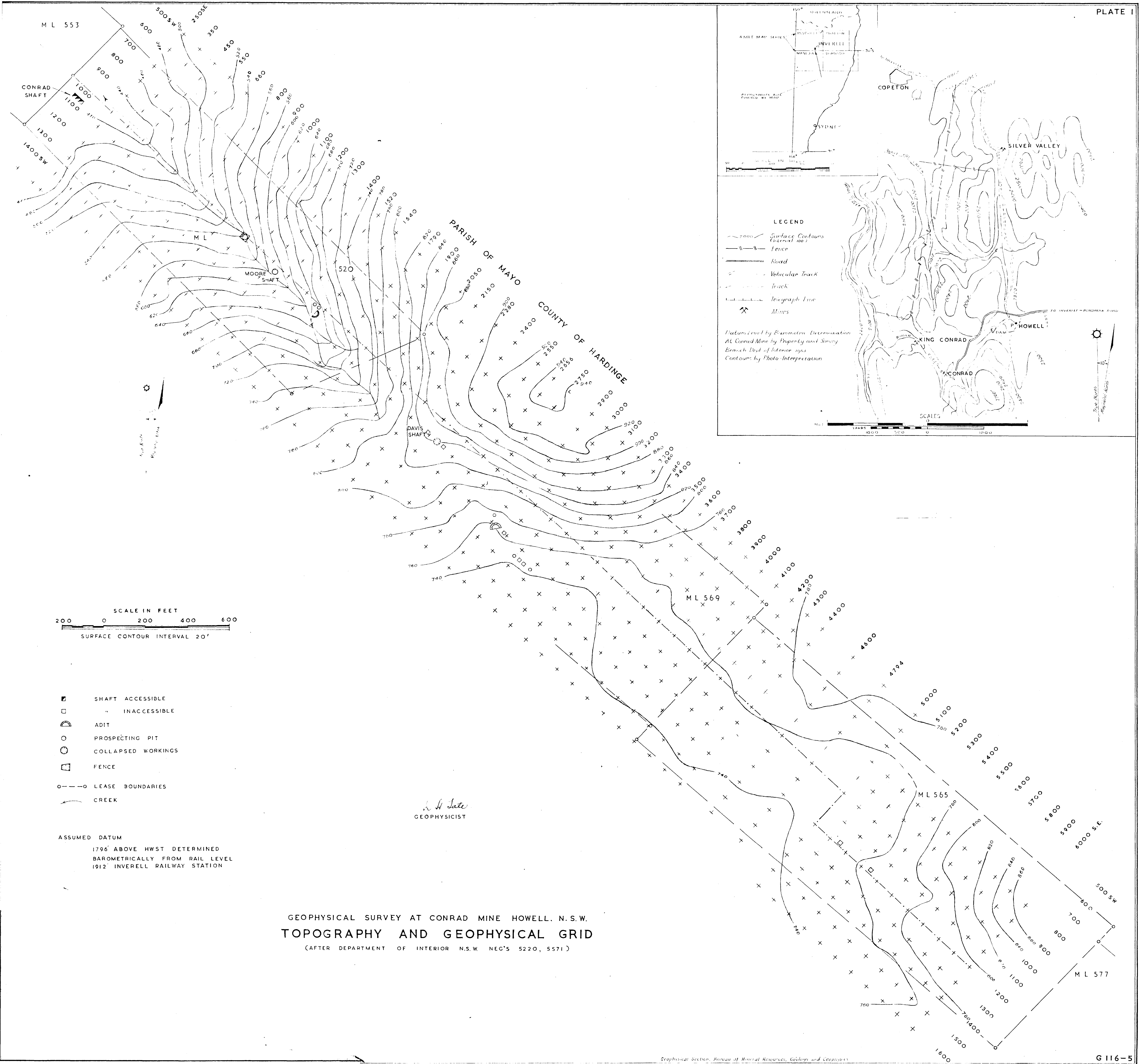
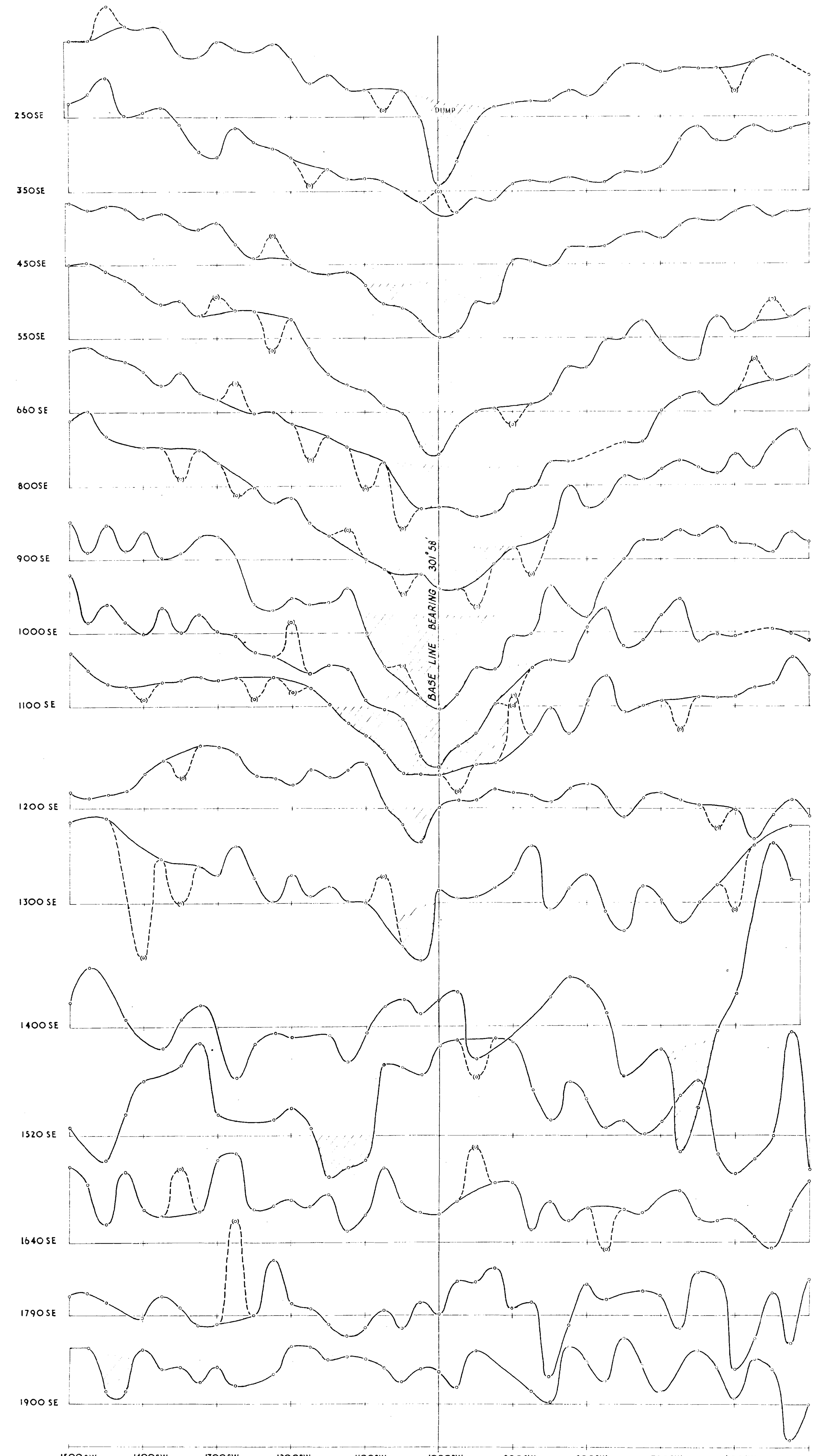
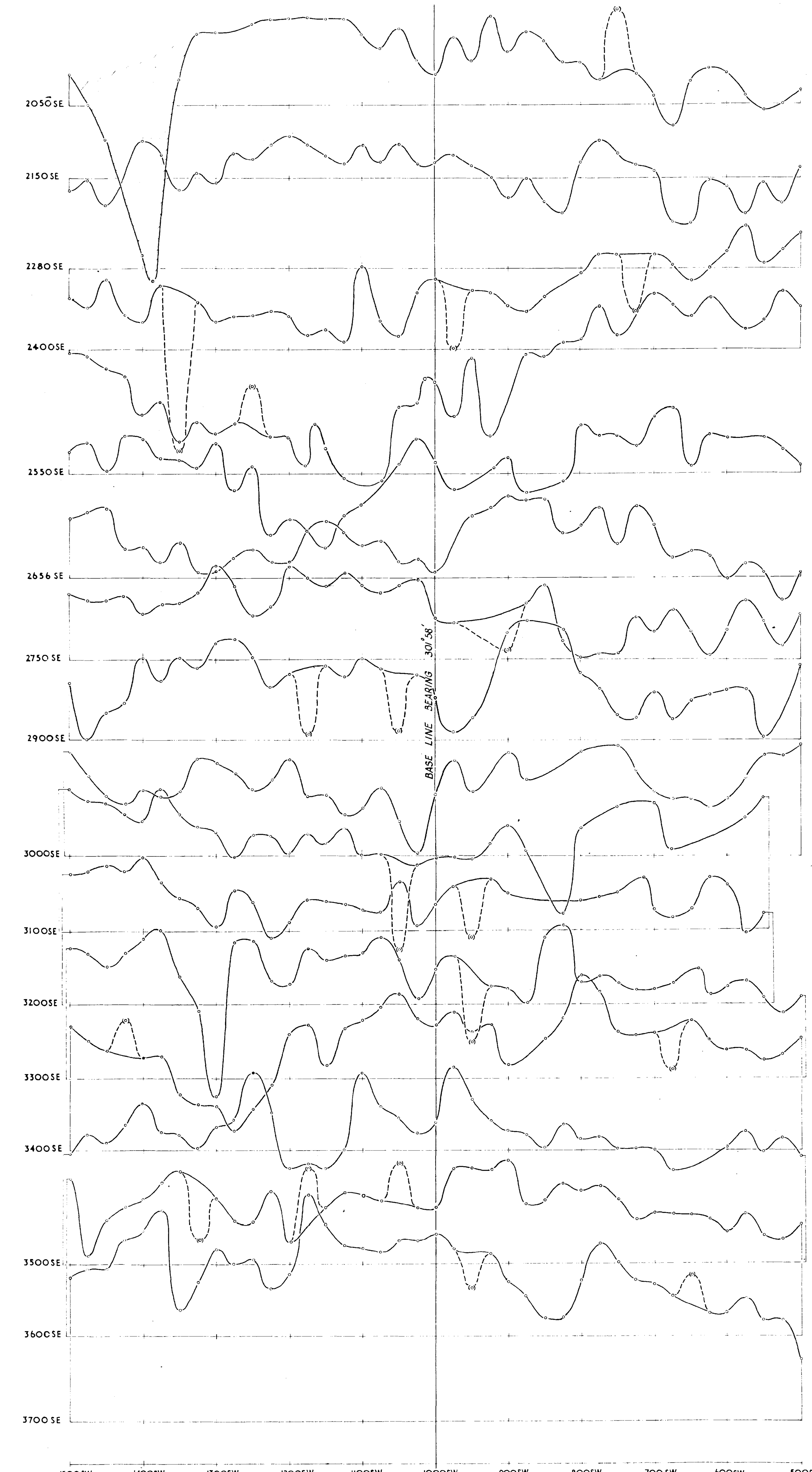
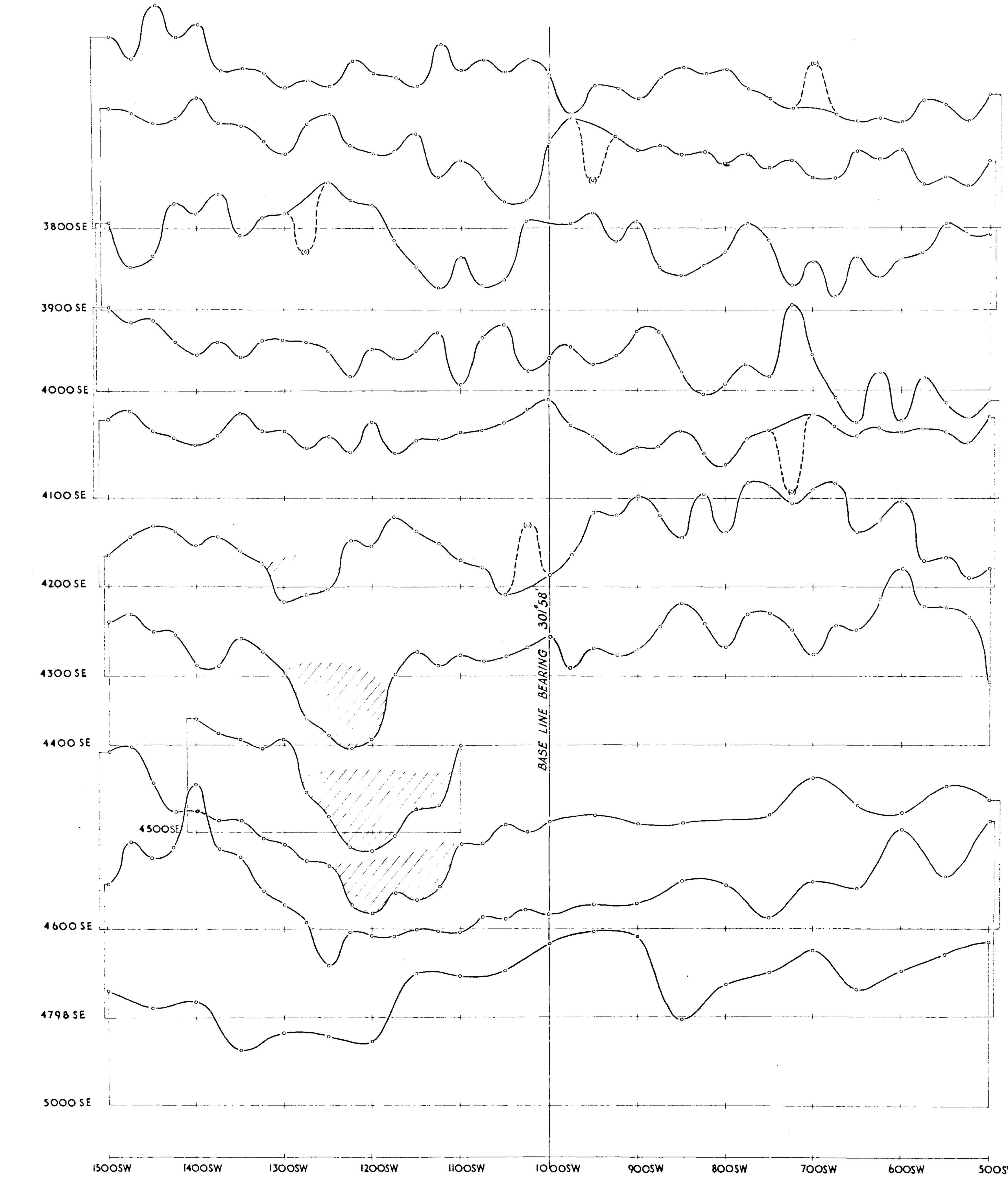


PLATE I
ML 553
CONRAD SHAFT
MOORE SHAFT
DAVIS SHAFT
PARISH OF MAYO
COUNTY OF HARDINGE
ML 569
ML 565
ML 577
500 SW
250 SE
1400 SW
6000 S.E.
SCALE IN FEET
200 0 200 400 600
SURFACE CONTOUR INTERVAL 20'
SHAFT ACCESSIBLE
" INACCESSIBLE
ADIT
PROSPECTING PIT
COLLAPSED WORKINGS
FENCE
LEASE BOUNDARIES
CREEK
ASSUMED DATUM
1796' ABOVE HWST DETERMINED
BAROMETRICALLY FROM RAIL LEVEL
1912' INVERELL RAILWAY STATION
GEOPHYSICIST
GEOPHYSICAL SURVEY AT CONRAD MINE HOWELL. N.S.W.
TOPOGRAPHY AND GEOPHYSICAL GRID
(AFTER DEPARTMENT OF INTERIOR N.S.W. NEG'S 5220, 5571)
LEGEND
Surface Contours (Interval 100')
Fence
Road
Vehicular Track
Track
Telegraph Line
Mines
Datum Level by Barometric Determination
At Conrad Mine by Property and Survey
Branch Dept of Interior 1953
Contours by Photo Interpretation
COPETON
SILVER VALLEY
HOWELL
KING CONRAD
CONRAD
INVERELL
SYDNEY
SCALES
Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics
G116-5







GEOPHYSICAL SURVEY AT THE CONRAD MINE,
HOWELL, N.S.W.

SELF - POTENTIAL PROFILES

SCALES

HORIZONTAL 100 0 100 200 300 400 500 FEET
VERTICAL 50 0 50 100 150 200 250 MILLIVOLTS

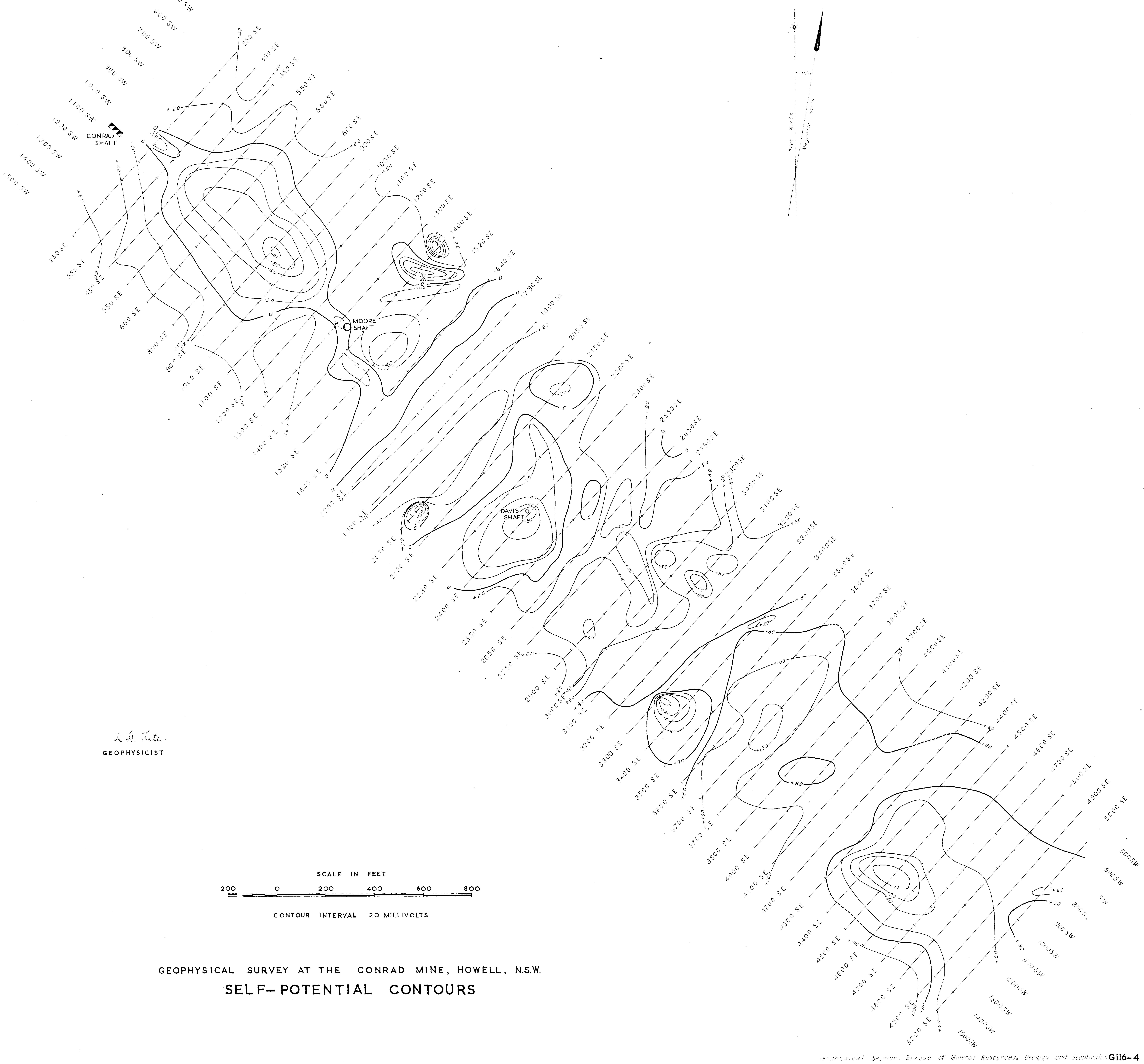
Note: Vertical spa[illegible] of profiles not to scale

Self-potential anomaly probably due to mineralisation

Reading unreliable due high contact resistance

R. H. Tate
GEOPHYSICIST

PLATE 3



GEOPHYSICAL SURVEY AT THE CONRAD MINE, HOWELL, N.S.W.

SELF-POTENTIAL CONTOURS

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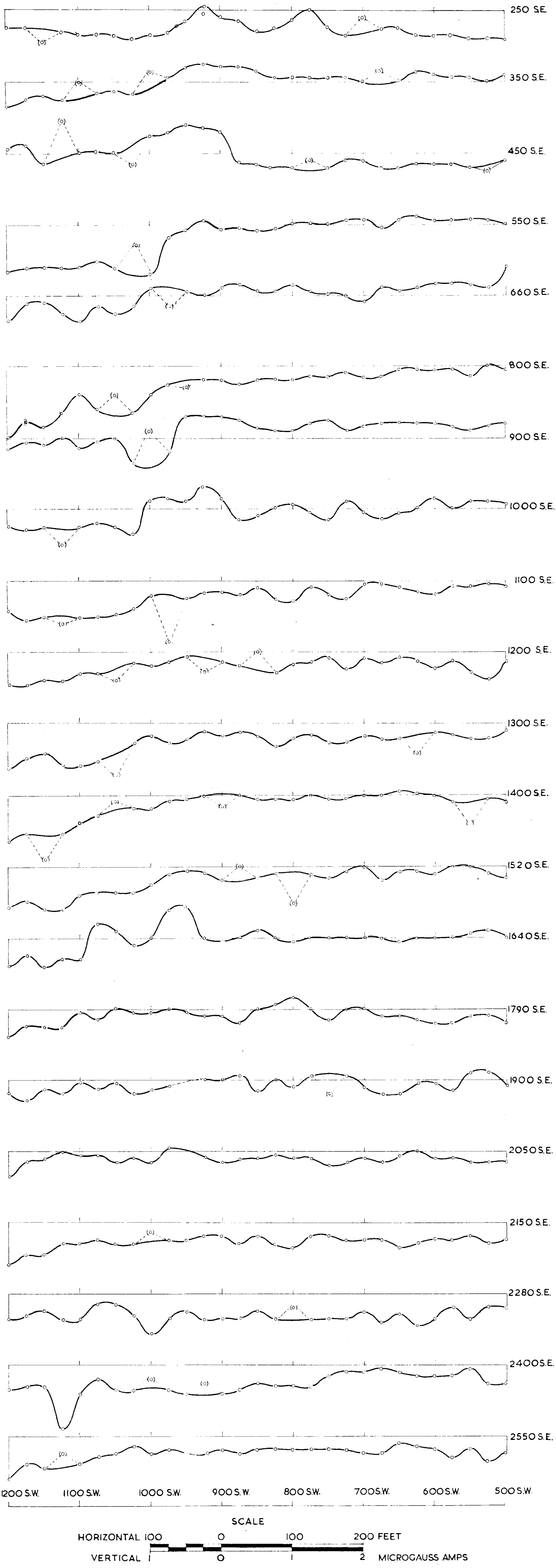

NOTE:
VERTICAL SPACING OF PROFILES NOT TO SCALE

(o) Reading considered unreliable

GEOPHYSICIST

GEOPHYSICAL SURVEY AT THE CONRAD MINE,
HOWELL, N.S.W.

PROFILES OF IMAGINARY COMPONENT OF VERTICAL ELECTROMAGNETIC FIELD

G116-2

GEOPHYSICAL SECTION BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS