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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1954, No. 4

GEOPHYSICAL SURVEY AT TALLAWANG MAGNETITE DEPOSIT, GULGONG, N.S.W.

by

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SUMMARY.

Geophysical surveys of the magnetite deposits of Australian Magnetite Pty. Ltd. at Culgong were made by the Bureau in 1952 and 1953, and revealed that the Tallawang deposit was the most important one. The present report gives the results of a detailed magnetic survey which was made over this deposit in August, 1953.

Results show that three concentrations of very strongly magnetic material exist within the Tallawang deposit. The southern concentration is unlikely to contain considerable reserves beyond those in sight. The central concentration has been partly worked and could yield reserves of ore from the west wall of the quarry. The northern concentration, which has not been worked, could yield limited reserves. It is shown that the deposit, as a whole, pitches northwards. Some exploratory drilling is recommended on each of the three concentrations.

1. INTRODUCTION.

The Tallawang magnetite deposit, situated about 12 miles north-west of Gulgong (see Plate 1), has been a source of high-grade iron ore, and was worked until 1927 by Messrs. Hoskins Iron and Steel Ltd., Lithgow, who recovered from the deposit more than 500,000 tons of ore. The quarry remained idle until 1951, when it was re-opened as a source of high-grade magnetite for the heavy media treatment process of coal-cleaning plants. The company operating the quarry, Australian Magnetite Pty. Ltd., applied to the Bureau for a geophysical survey to be made with the object of locating any additional rich deposits which may exist in the Gulgong-Tallawang district.

In August 1952, a preliminary magnetic survey was made over a lease held by the company in the Parish of Puggoon. Results of that survey are contained in a report by Horvath (1952) and his recommendations led to a second survey, which was made in April 1953 over the Puggoon, Tallawang South and Tallawang deposits (Tate, 1953). The smaller deposits at Puggoon and Tallawang South were shown to be relatively unimportant compared with that at Tallawang, and attention was re-directed to the latter deposit. The present report describes a detailed magnetic survey made over the Tallawang deposit in August 1953, with the object of locating the best concentration of magnetite within the deposit.

The field party consisted of K. H. Tate (party leader), M. J. O'Connor and one field assistant. Surveying work, involving the pegging of a grid system, was undertaken by the Property and Survey Branch, Department of the Interior, Sydney, surveyor N. Rochfort being in charge of this work. The geophysical survey occupied just over one week, during which time 20 traverses were surveyed.

2. GEOLOGY.

The geology of the Tallawang area is described in an earlier report (Tate, 1953) and reference should be made to that description. The geology in the immediate vicinity of the Tallawang quarry is shown on Plate 2. Of particular interest are the deposits of good quality ore which are being mined in the lower walls and floor of the quarry and which are shown on Plate 2.

3. SELECTION AND APPLICABILITY OF GEOPHYSICAL METHOD.

The work reported by Tate (1953) made it clear that the Tallawang deposit was the most important in the area. Because of the presence of strongly magnetic material, the magnetic method of survey is the most suitable. It was expected that the presence of ultrabasic rocks would also cause appreciable magnetic effects. However, it was considered that observations at closely spaced intervals would provide data which would allow conclusions to be drawn about the shape of the ore body, and also give an indication of the presence of any near-surface concentrations of magnetite which would be useful to the operating company. To do this, measurements had to be made within the quarry of variations in the vertical component of the earth's magnetic field. They were in excess of 50,000 gammas, i.e. of the order of the earth's field intensity itself. Only the most strongly magnetic material can cause anomalies of such magnitude.

4. MAGNETIC SURVEY.

(a) Field Work.

The lay-out of the traverses is shown on Plate 1. A base line 1,000 feet in length at a true bearing of 90° was laid about 100 feet south of the southern end of the quarry. This base line served as Traverse 00 and 19 other traverses were laid parallel to, and north of, Traverse 00, the northernmost one being Traverse 1100N. The traverses were mostly 50 feet apart and about 1,000 feet long, but intermediate ones of much shorter length were also surveyed where results warranted such additional measurements. Observation points were pegged at 100-foot intervals along each traverse.

A base station was set up in an area where the earth's magnetic field was relatively undisturbed. A Watts Vertical Force Variometer (No. 68630) was calibrated at the base station and adjusted to a sensitivity of 45.9 gammas per scale division. Readings were taken at all pegged observation points and also at numerous intermediate points in the areas where large anomalies occur. Because of the great magnitude of the anomalies, diurnal and temperature effects were ignored, but the base station was occupied at the beginning and end of each day's work, in order to check instrument behaviour. Stations at which the variometer could not be balanced using auxiliary magnets were re-occupied using as an additional balancing field that due to a current flowing in a Helmholtz coil arrangement. This technique allowed the measurement of variations in the vertical field at all but one per cent. of stations in spite of the very high readings, which exceeded 25,000 gammas at many observation points.

(b) Results.

The results are presented on Plate 3 in the form of vertical magnetic force profiles along each traverse. From these profiles a magnetic contour map has been drawn (Plate 4) with contours at intervals of 5,000 gammas. This map shows the extent of the magnetic effects, and the anomaly is clearly of the first class (Jakosky, 1950, p. 211). The interpretation of the map must be made with caution, however, as some of the observation points were within the open cut at very short distances from the outcropping body. Unfortunately, observations could not be made at some points because of their inaccessibility.

5. INTERPRETATION OF RESULTS.

The magnetic anomaly (Plate 4) is an elongated north-striking positive anomaly, extending from Traverse 200N to Traverse 900N; it agrees generally in position with the quarry. The sharp termination of the anomaly on these two traverses shows clearly that the ore body is confined within these limits and little ore can be expected in the extension of the quarry. Additional ore reserves can be expected only in depth or in the side walls.

The interpretation of the results can be taken only as an approximation for assessment of the shape of the deposit. The ideal bodies used in the calculation of theoretical magnetic profiles, such as uniform sheets or a vertical cylinder, are only convenient starting points to attack the problem mathematically. It should be noted that the fitting of observed and calculated ..

profiles (Plate 5) is not good, and, furthermore, the observed profiles are not complete. Nevertheless, the interpretation given below should be a useful guide to further prospecting.

The magnetic anomaly can be considered to be the cumulative effect of three geological factors, namely:-

(i) The iron ore of average grade, containing much magnetite.

(ii) The massive magnetite bodies, which are concentrations of high grade magnetite within the larger iron ore body, having no sharp boundary to define their extent and shape.

(iii) The ultrabasic igneous rocks of average magnetic susceptibility.

The ore of average grade will be magnetised by induction in the earth's field, but will also possess remanent magnetism; the former effect probably predominates. The high-grade concentrations of magnetite possess strong remanent magnetism and will be magnetised, also, by induction in the earth's magnetic field. The pyroxenites and amphibolites will be magnetised principally by induction in the earth's magnetic field. The direction of remanent magnetism may differ appreciably from the direction of the induced magnetism and it is not possible to resolve these factors by geophysical interpretation.

By concentrating on the zones of steep magnetic gradient within the anomaly, three major bodies of very strongly magnetised material can be recognised. These zones are marked A, B and C on Plate 4 and the corresponding major bodies will be referred to as the southern, central and northern concentrations.

<u>Zone A</u>.

In the immediate vicinity of the known mass of magnetite being worked in August 1953, the magnetic gradient is extremely steep, being of the order of 2,000 gammas per foot. There is a well-defined positive anomaly with a vertical field much greater than 25,000 gammas, side-by-side with a negative anomaly of similar magnitude. The negative anomaly terminates abruptly in the south at a line joining 160N/90E to 240N/200E. In the north the effects begin to diminish about 25 feet north of the haulage way. The anomalies are distorted because readings in the quarry were taken, on the average, about 100 feet below those outside the rim of the quarry. This tends to change the relative magnitudes of the positive and negative anomalies and would particularly accentuate the negative anomaly. The results make it plain, however, that a cross-section of this magnetic body can be assumed that will correspond to a magnetic doublet with a north-seeking pole in its upper portion and a south-seeking pole below. The south-seeking pole is sufficiently close to the surface to have a very large effect on the magnetic field measured. Plate 5, Fig. 1, shows, in a simplified form, such a magnetic doublet which corresponds to Section A, Plate 4. The actual magnetic body, however, would be more extensive than the supposed doublet and its outline may be irregular. Its upper surface would be shallower than the assumed upper pole and its lower surface deeper than the assumed lower pole. Further, the theoretical treatment which follows takes no account of the finite thickness of the magnetic body. East dip has been assumed, because of the relative positions of the positive and negative values of the anomaly, and in accordance with the geological structure. Plate 5 shows the observed profile and a corresponding calculated profile. The two curves are similar in shape, but show better agreement on the left than on the right-hand side of the profile. The right-hand positive peak can be explained by the fact that if stations could have been occupied at the original ground level the curve would have shown a broader positive anomaly, with a smaller negative centre on its right flank. It is probable that the body terminates in depth not far below the present floor of the quarry. If, as predicted, the body terminates at fairly shallow depth, and taking into account the fact that the upper portion of the body has been quarried, then the apparent dip will be less than the true dip. The direction of strike of the body is about 340° true. The truncation of contours which occurs near station 250N/100E (Plate 4) is caused by the massive magnetite ore near the quarry wall.

The strongest part of the anomaly is within the lip of the quarry, as shown on Plate 4. This indicates that additional ore reserves exist in the western wall, but the prospects of any considerable reserves being found in the eastern wall are not great.

Zone B.

This zone of steep magnetic gradient is virtually an extension of Zone A, but because it has different strike and shape, it is more convenient to describe it separately. The positive anomaly is broader, and the negative anomaly smaller, than in Zone A. A typical section across the zone is shown as Section B on Plate 5, Fig. 2, together with a calculated curve, assuming a similar arrangement of poles to that in Zone A. Study of Plate 5 indicates that the anomaly is probably caused by an east-dipping body, extending from Traverse 350N to about Traverse 500N. The strike of the main part is similar to that of the body in Zone A, but north of Traverse 450N it swings through about 65°, to a bearing of 45° true.

The bodies intersected by sections A and B are similar in character but are separated by a narrow zone of weakly magnetic material.

Taking into account the batter of the west wall of the open cut at Section B, it is probable that the major part of the ore body is not exposed, except where shown on Plate 2. A depth estimate for Section B shows the depth to the upper pole to be about 50 feet. A large portion of the body would therefore be above economical quarrying depth.

Immediately to the north of Zone B the whole anomaly narrows and a trough occurs which corresponds approximately in position to an acid dyke of quartz porphyry (see Plate 4). It is possible that the point 550N/100E may be near a fault.

Zone C.

This zone of steep magnetic gradient is centred at about 700N/100E. The anomaly here is of different form from that in Zones A and B. It is much less elongated, and the direction of strike is difficult to assess, but is considered to be north-west. The form of the anomaly indicates that it is caused by a body dipping steeply to the east. The upper surface of the body is below the floor of the quarry and the lower surface is at relatively great depth. The shape and size of the anomaly can be accounted for by a cylindrical pipe-like body of relatively small diameter, with its upper pole at a depth of about 100 feet and its lower pole at great depth. It can be assumed that the deposit is much deeper here than it is further south, thus indicating a northerly pitch of the deposit as a whole.

At the southern end the quarry will soon have reached the lower surface of the mineralisation, but at the northern end it has hardly reached the upper surface.

6. CONCLUSIONS AND RECOMMENDATIONS.

The Tallawang iron ore deposit is a continuous irregular-shaped mass of iron ore, containing three major concentrations of massive magnetite. The southern concentration, which was being mined at the time of the geophysical survey, is the shallowest, and is a wide, east-dipping body which is probably terminated in depth not far below the present quarry floor. The central concentration also dips to the east and is of limited depth, with its top probably less than 50 feet below ground level and its upper portion likely to be mainly within the western wall of the quarry. The northern concentration is likely to be a steeply-dipping, roughly cylindrical mass of greater depth extent, with its upper pole at about 100 feet depth.

For purposes of future quarrying operations, the central concentration of the deposit is most likely to yield useful reserves, assuming that it is desired not to mine the southern concentration below the existing quarry floor.

The southern concentration could be tested by a short vertical drill hole about 50 feet in length if it is desired to verify the conclusion that it is not persistent in depth. This hole should be located near 250N/175E.

The central concentration could be prospected by cleaning out the quarry for 200 feet, north of the haulage way, cross-cutting into the west wall between Traverses 350N and 500N at various depths between bench levels 70 and 25 (see Plates 4 and 5), and also testing its depth extent by a vertical drill hole at 450N/100E.

The northern concentration of magnetite could be prospected by a vertical drill hole at 705N/120E, to a depth of at least 100 feet.

7. REFERENCES.

Horvath, S., 1952 - Preliminary report on magnetite deposit, Gulgong, N.S.W.; Bur. Min. Res. Geol. & Geophys., Record 1952, No. 86.

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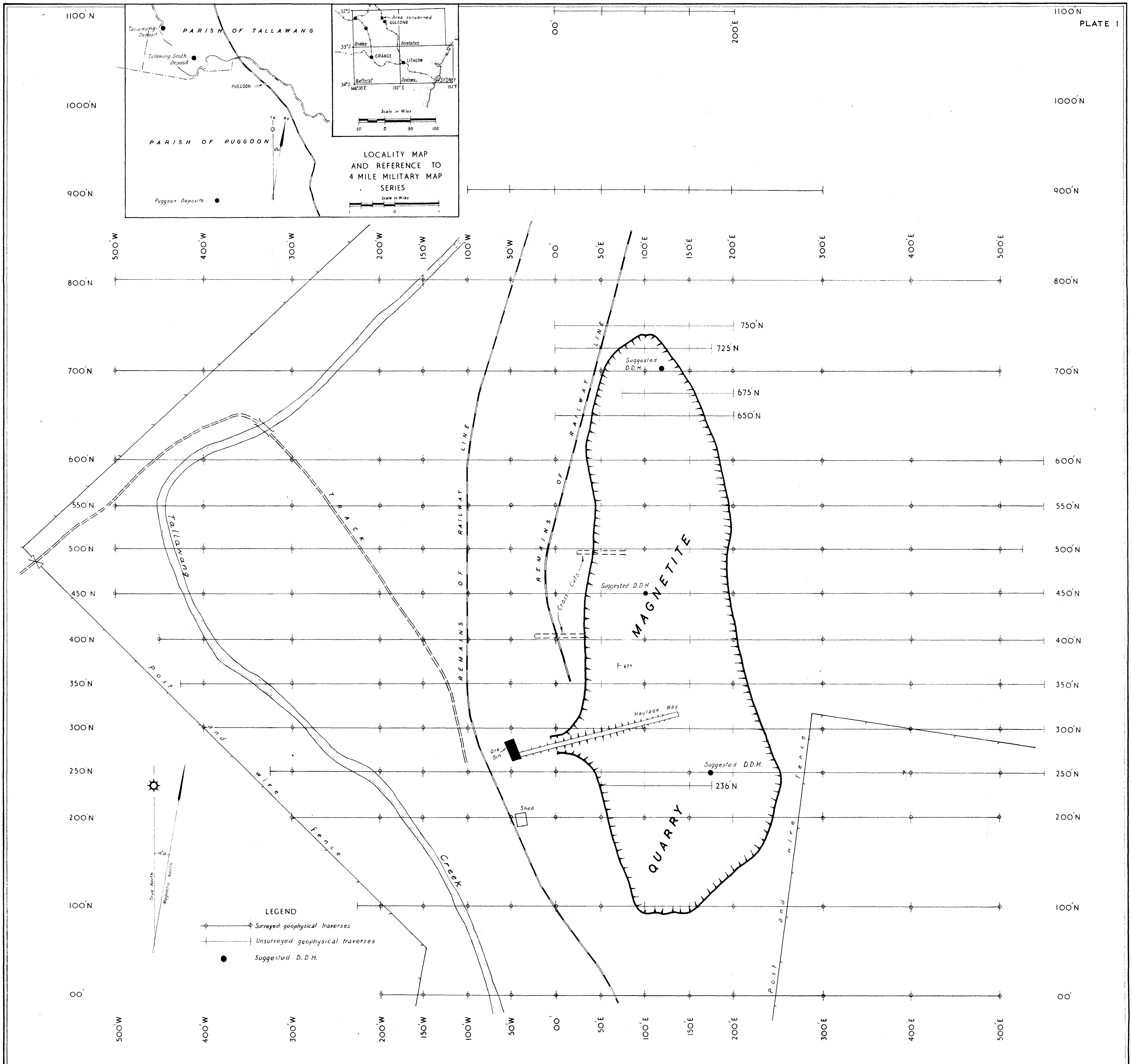

SCALE IN FEET

50 0 50 100 150 200 250

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GEOPHYSICAL SURVEY AT TALLAWANG MAGNETITE DEPOSIT,
GULGONG, N.S.W.

LOCALITY MAP AND GEOPHYSICAL TRAVERSES

After Department of Interior, N.S.W. Negative No. 5507

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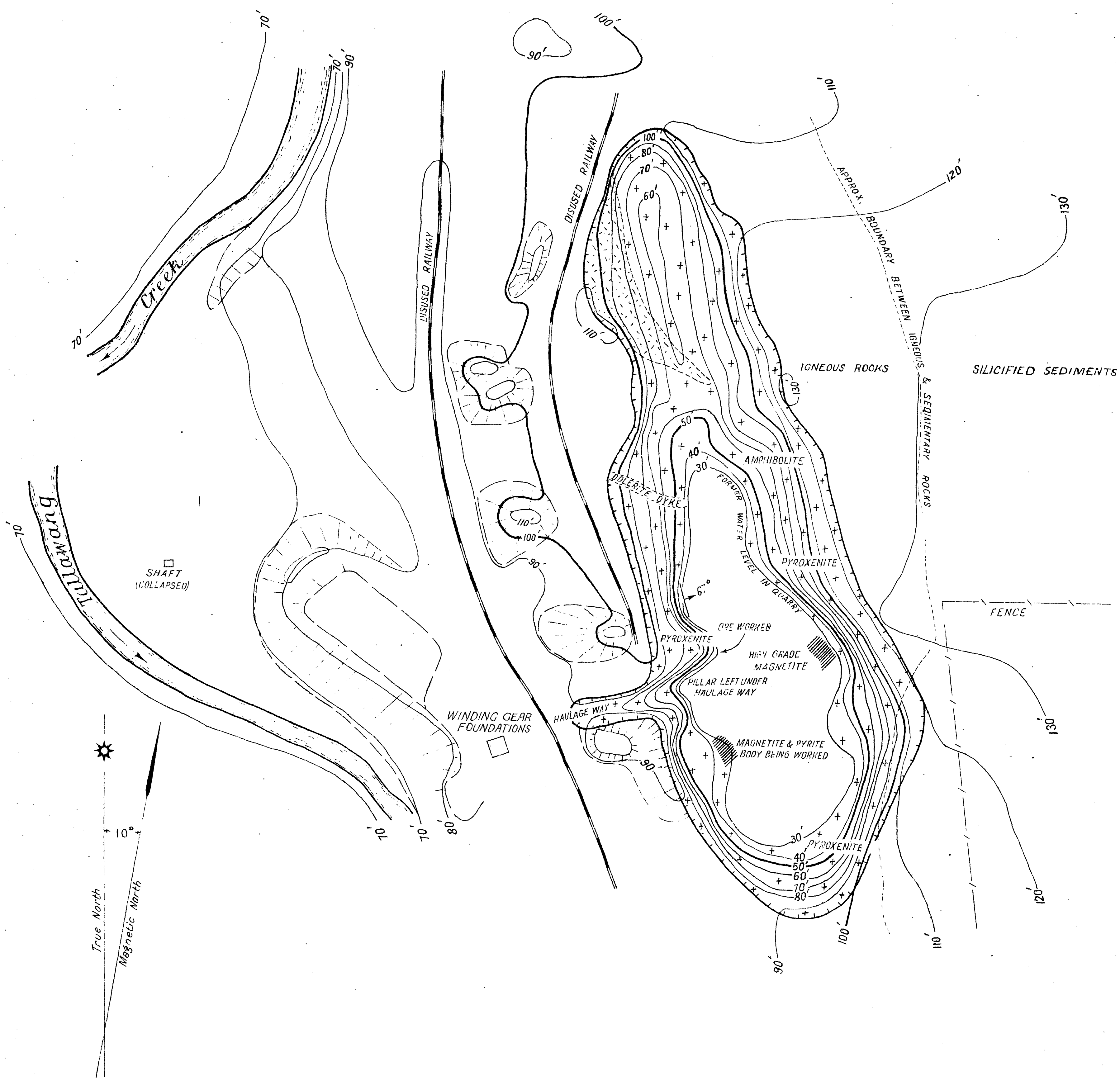
PLATE 2



LEGEND

- LEVEL CONTOURS IN FEET (90′, 100′)
- OLD RAILWAY BED
- FENCE
- SHAFT
- DUMP
- ACID PORPHYRY
- AMPHIBOLITE AND PYROXENITE

GEOPHYSICAL SURVEY AT TALLAWANG
MAGNETITE DEPOSIT, GULGONG, N. S. W.

GEOLOGICAL MAP

AFTER DEPARTMENT OF MINES, N. S. W., 1939

SCALE IN FEET

100 0 100 200 300

CONTOUR INTERVAL 10 FEET

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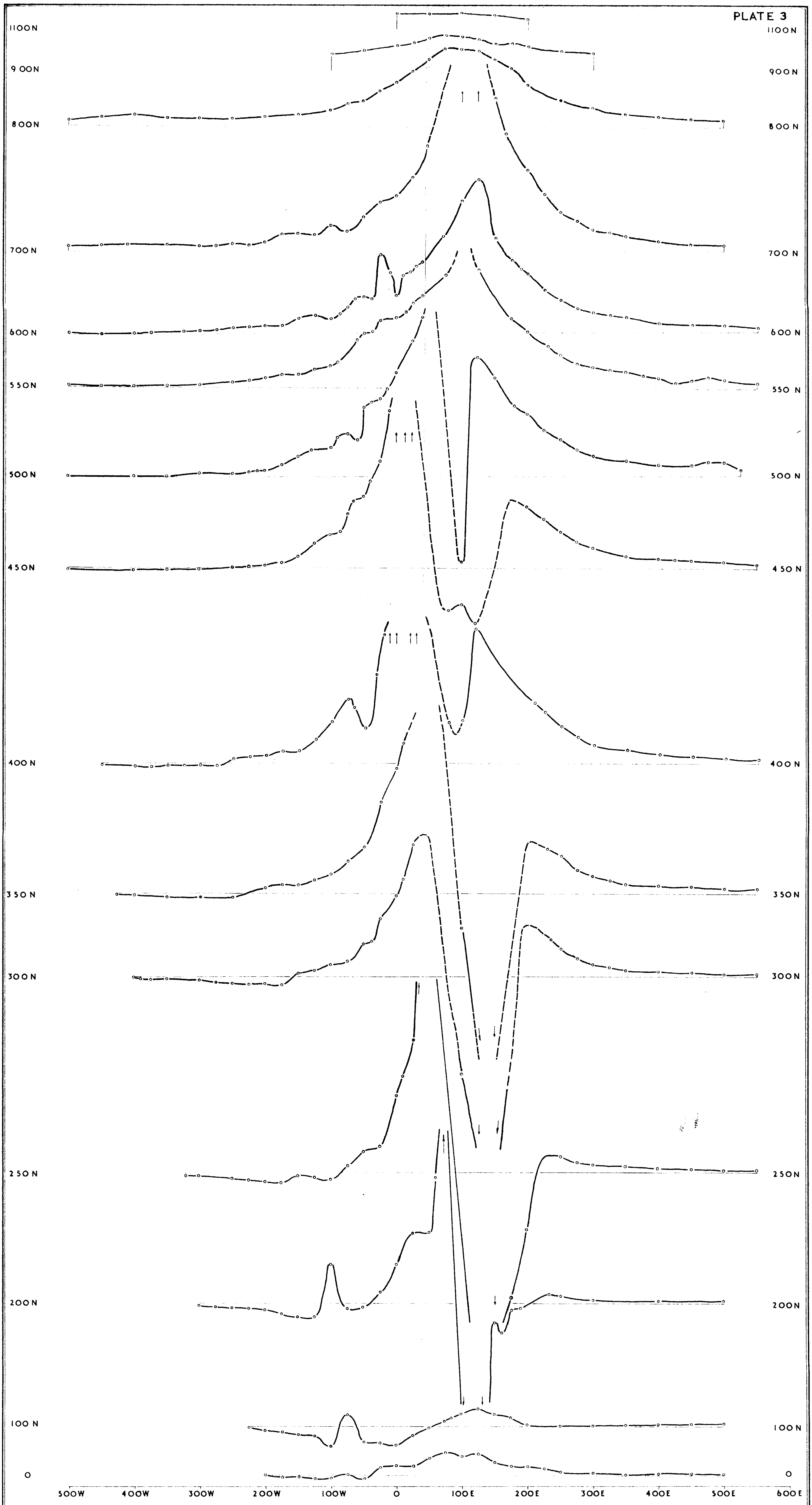
PLATE 3



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SCALES

HORIZONTAL 100 0 100 200 300 FEET

VERTICAL 10000 0 10000 20000 30000 GAMMAS

GEOPHYSICAL SURVEY

AT TALLAWANG MAGNETITE DEPOSIT, GULGONG, N.S.W.

VERTICAL MAGNETIC FORCE PROFILES

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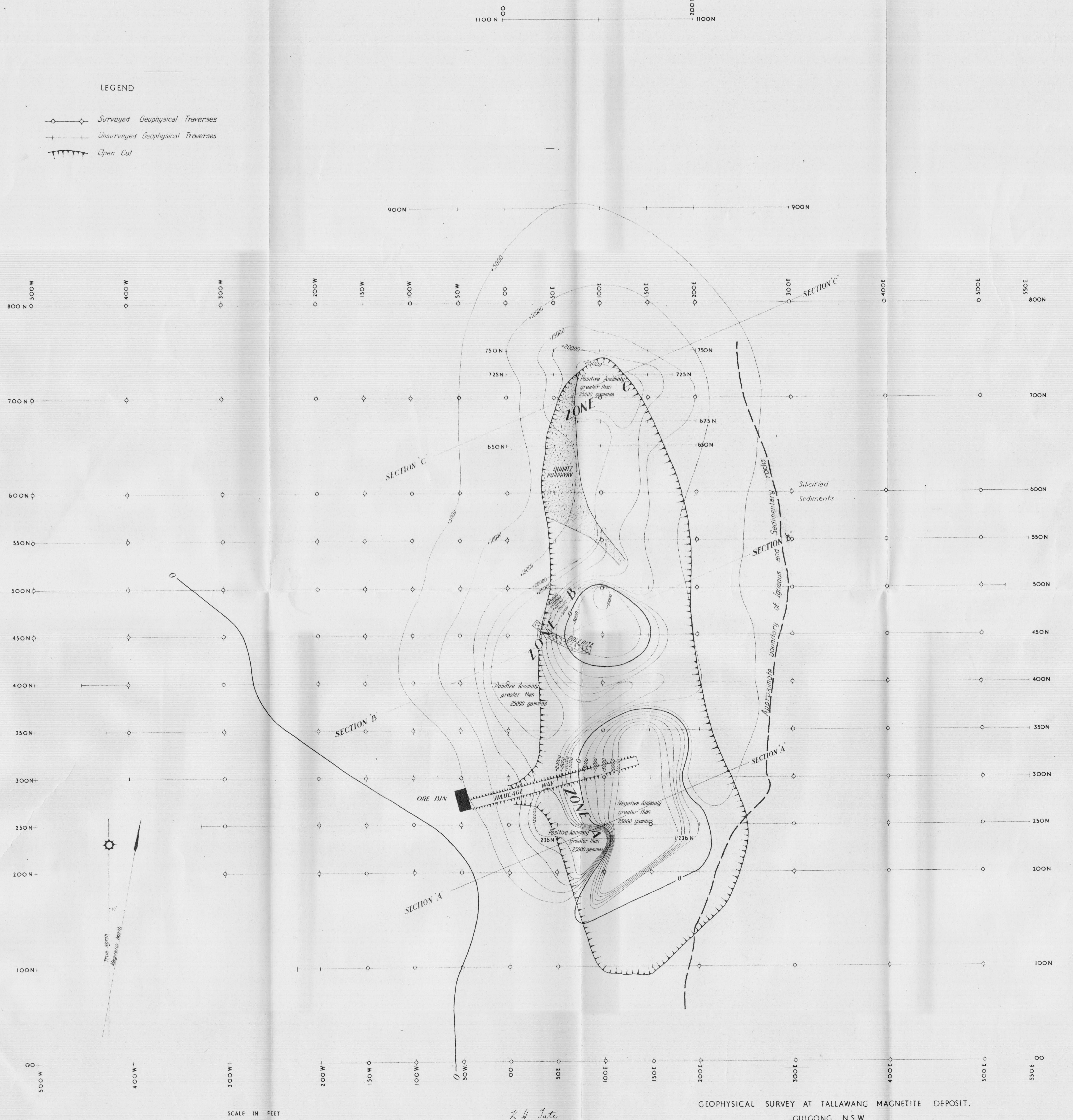
LEGEND

Surveyed Geophysical Traverses
Unsurveyed Geophysical Traverses
Open Cut



SCALE IN FEET

50 0 50 100 150 200 250

Contour interval 5000 gammas

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GEOPHYSICAL SURVEY AT TALLAWANG MAGNETITE DEPOSIT.
GULGONG, N.S.W.

VERTICAL MAGNETIC FORCE CONTOURS

GEOPHYSICIST

GEOPHYSICAL SURVEY AT TALLAWANG MAGNETITE DEPOSIT
GULGONG, N. S. W.

INTERPRETATION DIAGRAMS

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