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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS.

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RECORDS

1958, No.39



MAGNETIC SURVEY

of the

SAVAGE RIVER IRON-ORE DEPOSITS,

North-Western Tasmania

by

O. KEUNECKE

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ABSTRACT.

During an airborne magnetometer survey made by the Bureau of Mineral Resources over parts of north-western Tasmania, several well-defined magnetic anomalies were located. The most pronounced of these is centred on the Savage River, about 23 miles west of Waratah, and coincides with the Savage River (formerly Rio Tinto) iron ore deposits. The present report describes a ground magnetic survey which was made by the Bureau on the Savagē River deposit to delineate the anomaly more accurately and to ascertain the areal extent of the deposits.

The survey was made over an area about 2 miles in length from north to south and 2,000 to 3,000 feet in width, and revealed intense magnetic anomalies (up to 80,000 gammas), striking approximately north, over the whole area. The magnetic contours form two major anomalies, the northern of which indicates a large lenticular ore body about 2,600 ft. long, 200 to 400 ft. wide. To the north of this anomaly are some smaller anomalies, extending to the northernmost traverse surveyed. The southern major anomaly extends from north of the Savage River, and is still very pronounced on the southernmost traverse surveyed. It indicates a large magnetic ore body, at least 5,000 ft. long, up to 500 ft. wide. The magnetic susceptibility of these bodies is such that the bodies must consist mainly of magnetite.

Three drilling sites are recommended to test each of the major ore bodies and recommendations are made for further ground magnetic surveys both within and beyond the limits of the present survey, including the investigation of another airborne anomaly about 6 miles further south.

1. INTRODUCTION.

An airborne magnetometer survey carried out by the Bureau of Mineral Resources over parts of north-western Tasmania in 1956 revealed some very pronounced anomalies in the Savage River - Rio Tinto district (see Plate 1).

The anomalies strike north to north-north-east and coincide in places with iron ore outcrops in what is known as the Long Plain Iron Ore Field. These outcrops occur intermittently in an area 25 miles long and half-a-mile wide, and contain magnetite, with minor admixtures of sulphides in several places.

The most pronounced and extensive airborne anomaly is on the Savage River, and coincides with the Rio Tinto iron ore deposits. These are referred to in this report as the Savage River iron ore deposits, as recently proposed by the Department of Mines, Tasmania (Hughes, 1957) to avoid confusion with the Rio Tinto Exploration Company, which is operating in this area.

The Savage River deposits occur in very rough, heavily timbered country on both sides of the Savage River, about 2 miles west of the Waratah-Corinna Highway (Plate 1). They are best reached by proceeding along a track which branches off the Highway at a trig. station 21 miles from Waratah.

A certain amount of exploration work was performed in the early days, in order to test the sulphide bearing portions of the deposits for gold.

These sulphide bodies were found to be of no economic interest.

Alluvial gold and osmiridium have been mined intermittently on both banks of the river (Reid, 1921). The importance of the magnetite outcrops as sources of iron ore was realised first by Twelvetrees and Reid (1919), who estimated the ore reserves to be about 20 million tons. Woolnough (1939) considered the deposits to be too small and too contaminated by sulphur to be of any economic value. Recent interest in the iron deposits resulted in aerial magnetometer surveys being carried out by the Bureau of Mineral Resources over parts of Tasmania in 1956. At the request of the Department of Mines, Tasmania, the airborne magnetometer surveys were followed early in 1957, by ground magnetometer surveys over those portions of the area which appeared from the airborne results to be of most interest.

The ground magnetic survey in the Savage River District was carried out by O. Keunecke (party leader) and L.V. Skattebol, geophysicists of the Bureau, and forms the subject of this report.

J. Sleep of the Survey Section, Department of the Interior, Canberra, carried out the topographic survey of the traverse lines, and the Department of Mines provided bush cutters and camping facilities.

The surveyed area lies on both sides of the Savage River, and is about 2 miles in length from north to south and 2,000 to 3,000 feet in width. The area forms part of a broad peneplain, 1100 to 1300 feet above sea level and dissected by the drainage system of the Savage River, Halls Creek and Webster Creek, which form steep-sided, heavily timbered gorges up to 800 feet deep.

Seventeen traverses, totalling 27,000 feet in length and directed approximately east-west, were cleared and pegged with observation points about 50 feet apart. Magnetic observations were carried out also along a north-trending track more than 15,000 feet in length.

2. GEOLOGY.

(a) General Geology.

The geology of the area and the iron deposits is comprehensively described by Twelvetrees and Reid (1919). Later, Woolnough (1939), briefly reported on the deposits. More recently, Hughes (1957), carried out geological work in connection with the geophysical survey. During this work, he took rock and ore samples for petrographic investigations, and prepared a geological map of the surveyed area using the geophysical grid as a base.

The authors quoted above agree that the main rock formation in the area consists of metamorphosed basic igneous rocks which are intrusive into sedimentary rocks of Pre-Cambrian to Cambrian age. At the contact with the basic rocks, the sediments are quartz seticite schists. Along the track to the Highway and on the Highway itself, phyllites and slates are interbedded with quartz veins and bunches. To the writer the phyllites and slates appear to have a striking lithological similarity to the Dundas series near Zeehan.

Twelvetrees (1908), described the sedimentary rocks as "sericitic, graphitic and quartz schists" and classed them as of Pre-Cambrian age. Hughes (1957), agrees with this classification and Spry and Ford (1957), assign the same age to the quartzites, phyllites and slates near Corinna.

It is clear that insufficient correlation work has been done to define their definite geological age and it is possible that both Cambrian and Pre-Cambrian periods are represented.

The sediments have a northerly strike and dip steeply to the east. Their structural position within the surveyed area has not been determined, but further south the quartzites form a broad south-plunging anticline whose axis is approximately parallel to the coast (Spry and Ford, 1957).

The basic igneous rocks consist mainly of amphibolites. The amphibolites contain apatite and epidote, and are highly metamorphosed and decomposed so that at places talc schists and serpentine were formed. Hughes (1957), believes that the basic intrusion occurred during the Cambrian age.

During the Devonian period the rocks in the area were intensively folded, altered and intruded by widespread igneous rocks and mineralised. The intrusions included gabbro and granite which crop out 3 to 5 miles away (Twelvetrees and Reid, 1919). The extensive mineralisation which accompanied the intrusions included silica and sulphides.

Recent petrographic examinations revealed their complicated history, as the basic rocks show alterations from amphibolites to carbonates and also replacement of carbonate by quartz (Hughes, 1957).

Basalt boulders, basaltic remnants and traces of sandy beds which occur near the river in the northern part of the surveyed area are of Tertiary age. Hughes believes that the present erosion cycle has almost reached the base of the basalt.

(b) The Iron Ore Deposits.

The amphibolites contain large outcrops of iron minerals (mainly magnetite) with minor amounts of sulphides. The outcrops occur on the tops of the ridges. The sulphides consist of pyrite and chalcopyrite with traces of gold and silver. These outcrops have been investigated on several occasions, but owing to the extremely difficult nature of the country, firm geological conclusions have not been reached.

The first exploration work done was the driving of adits from creek level, to test the possibility of the presence of sulphide deposits carrying gold. No information is available on the results of this work, beyond the fact that some of the workings intersected considerable widths of iron ore, indicating that iron minerals may persist over a vertical range of at least 800 feet. The outcrops were tested by means of trenches. Twelvetrees and Reid (1919) examined the area as a source of iron ore. They assayed 17 surface samples, which contained 63 to 69% iron, and small amounts of silica and sulphur. Their conclusion was that the sulphides are confined to discrete bands adjacent to the main iron deposits, and that the iron deposit consists of large lenses striking north, containing reserves of 20 million tons of high grade ore to a vertical depth of 300 feet.

The area was again examined by Woolnough (1939). His opinion is very different to that of Twelvetrees and Reid. He considers that previous trenches were in detrital material, that the ore occurs as "numerous, rather small, isolated lenses, arranged en echelon along a broad zone of crushed and mineralised formation", and that ore at depth is likely to be pyritic, pyrite having been removed from surface material by oxidation. He concludes that the estimate of reserves by Twelvetrees and Reid is optimistic, both as regards quantity and quality.

The most recent investigation by Hughes (1957) has led to conclusions generally agreeing with those of Twelvetreets and Reid. Hughes believes that sulphide content is likely to be local and unimportant as regards the deposit as a whole, and that reserves down to Creek level may be of the order of hundreds of millions of tons.

Twelvetreets and Reid (1919) and Hughes (1957) believe that the ore bodies were formed as a magmatic segregation at the time of the intrusion of the basic rocks, probably during the Cambrian orogeny. Although this is a possibility, it should be mentioned here that most commercially valuable deposits of magnetite which are formed by magmatic segregation occur in syenite porphyries.

Metamorphic deposits similar to those at the Savage River are known as SKARN deposits; they are of pyrometasomatic origin (Lindgren, 1932).

3. APPLICABILITY AND DESCRIPTION OF THE MAGNETIC METHOD

As much literature exists about magnetic prospecting methods only those details are discussed which apply especially to the Savage River survey.

In the airborne magnetometer survey made in 1956, the highest values of total magnetic intensity (18,000 gammas) were recorded in the Savage River area. These very high values were recorded from an altitude between 500 and 1000 feet and indicated the presence of material with abnormally high magnetic susceptibility. In the ground survey, it was necessary to use a relatively insensitive type of magnetometer. A dip needle - "SHARPE" Model M1 magnetometer - was used over most of the area. This instrument has a range of more than 70,000 gammas. Although the accuracy is much less than that of magnetic balances of the Schmidt type, the errors involved are negligible in comparison with anomalies as large as those encountered at the Savage River.

Tests with the Sharpe magnetometer indicated that in areas where the variations in magnetic intensity are comparatively small, this instrument is not sufficiently accurate. An Askania magnetometer, GF6 type (No. 541479) was therefore used in addition to the Sharpe magnetometer, in order to obtain more accurate coverage of those features of the area where anomalies are small.

Rossiger and Puzicha (1932) have suggested that the results of field surveys may be used to obtain a figure for the susceptibility of an outcropping magnetic formation, by means of the formula $K = \frac{\Delta Z}{2\pi Z}$, where K = susceptibility (in cgs units), Z = vertical component of earth's field, Z = amplitude of smoothed anomaly in vertical component. This formula assumes polarisation by induction only, which is not in general the case in the weathered zone, so that it can only be relied upon to give an order of magnitude. Substituting the appropriate values, a value of $K = 200 \times 10^{-3}$ is obtained, which is 200 to 400 times the usual susceptibility of basalt, and is generally only observed on material rich in magnetite.

4. FIELD WORK AND RESULTS.

The southern limit of the surveyed area is where "Johnson's Track" from the Waratah-Corinna Highway joins the north-trending "Bullock Head Track" (see Plate 2). The first traverse (A) starts at A0, about 500 feet further along Bullock Head Track; traverse B starts at B0 on the track, and similarly for the other main traverses.

As the survey progressed, it became necessary to add additional traverses: these were named B8, C12, etc., and started from the corresponding survey points on the track.

The observed magnetic variations were extremely high; they reached 80,000 gammas on the track between traverses E and F and are stronger than the earth's normal vertical magnetic field which, as stated earlier, is about 60,000 gammas in northern Tasmania. Cook (1950) has shown that an anomaly of this magnitude can be caused only by magnetite ore of high quality.

The only undisturbed areas are along parts of the track and at the ends of the longest traverses where normal sediments are reached. The area to the north of the northernmost traverse is weakly disturbed, as shown by readings taken for a further 900 feet along the track. The survey was not continued further north as it was assumed that the magnetic variations observed were not caused by iron ore, but by basalt, which is known to occur there.

An extremely disturbed area extends over a distance of 12,000 feet between traverses A and G; it consists of several anomalies of various extent and magnitude. The additional traverses (B8, C12, etc.) were necessary to delineate the individual anomalies. Because of the rough country, these traverses were extended only far enough to cover the magnetically disturbed area.

The results are shown as selected profiles on Plate 3 (Sheets 1 and 2) and as contours on Plate 4.

Plate 4 indicates that the whole area surveyed is magnetically disturbed. The zone of anomalies strikes about 90° east of north and varies considerably in width. Two main anomalies, one to the north of traverse D22 and the other to the south of traverse D12, are connected by a narrow band of weaker disturbances about 2000 feet in length. Near traverse D16 the zone widens to another small lenticular anomaly about 1000 feet in length.

The southern limit of the northern anomaly is between traverses D22 and D27, and the anomaly might extend almost as far north as traverse G. The anomaly indicates the presence of a lenticular body about 2,300 feet in length, about 200 feet in width. The body has a high magnetic susceptibility which can be satisfactorily explained only by assuming that it contains a high proportion of magnetite.

Though the main part of this anomaly ends near traverse F, the contour map (Plate 4) reveals additional lenticular anomalies arranged en echelon between traverses F, and G. The contours in this part of the area are extrapolated. Additional traverses F7, F13 and F20 (see Plate 4) were planned but were not cleared in time to be surveyed. No exploration work should be done in this part of the area before these traverses are surveyed and the contours between traverses F and G more accurately determined.

The southern anomaly originates from a very large magnetic body about 5,000 feet long, up to 500 feet wide. The northern limit of this body is just north of traverse D and the body continues across the Savage River. The southern limit of the body was not reached during the present survey, as the magnetic anomaly is still pronounced on the southernmost traverse (A). The anomaly does not show a well-defined wide maximum there, but consists of several narrower maxima extending finger-like towards the south. The southern anomaly indicates a very extensive body, bigger than the northern one.

5. INTERPRETATION OF RESULTS.

Plate 3 (Sheets 1 and 2) shows selected profiles over the bodies. Profiles over each of the main anomalies show the following features.

- (1) The profiles rise very steeply to the central maxima. However, over the area of maximum anomaly profiles are violently disturbed. This indicates that the tops of the magnetic bodies are very close to the surface, possibly outcropping.
- (2) Each profile shows a smooth rise up to the commencement of the anomaly on the eastern side. This is not present on the western side. This indicates that the bodies dip steeply to the east and persist to moderate depths at least.

In places, additional weaker maxima appear beside the main anomalies, thus indicating the presence of separate smaller bodies. Because of the proximity of the bodies to each other their dip is not clearly indicated in the profiles.

The profiles over the southern anomaly indicate that the body is up to 500 feet in width. The mineralisation is not homogeneous over the whole width: presumably several zones of magnetite ore are separated by relatively barren zones.

Profiles along traverses over the northern body are very similar to those over the southern body. The profiles indicate :-

1. A steep easterly dip of the body.
2. The body crops out or is at shallow depth.
3. The body has a width of about 200 feet.
4. The presence of additional small lenses west of the main body.

The small body between the two main ones is also at shallow depth and has a steep easterly dip, but its width is smaller as indicated by profile D16. Barometric levels taken during the survey show that the surface is nearly 400 feet below that of the two main bodies (Plate 2).

Calculation of actual depth extent are risky even when anomalies are smooth and of regular shape, and are particularly so in such cases as this. However, rough calculations based on restricted smooth features of the anomalies suggest a possible depth extent of 800 to 1000 feet at least. This estimate is supported by the width and smoothness of the airborne anomaly and by the fact that considerable widths of iron ore have been reported in old workings at creek level.

There can be no doubt that the highly magnetic material is magnetite. Comparison of the Savage River anomalies with results of surveys over known ore bodies quoted in the literature indicate strongly that the bodies causing the anomalies must consist almost entirely of magnetite. The assays of surface samples support these conclusions. The geophysical results indicate that the two main ore bodies each extend over a length of several thousand feet; moreover, the southern body continues beyond the southern limit of the geophysical survey. The bodies have a maximum width of about 500 feet and an average width of 300 feet; their depth extension may be of the order of 800 to 1000 feet. These dimensions indicate the high economic potential of the deposit and point to the possible presence of large reserves of high-grade magnetite ore. Testing by diamond drilling is necessary to determine the grade and extent of the magnetic bodies.

Magnetic anomalies of such intensity and extension are rarely found. Their investigation by mining exploration is therefore strongly recommended.

6. CONCLUSIONS AND RECOMMENDATIONS

The survey disclosed two large magnetic bodies and several smaller ones. The northern deposit is about 2300 feet in length and continues for another 2000 feet towards the north in the form of additional smaller bodies arranged en echelon.

The southern ore body is at least 5000 feet in length and may continue south beyond the surveyed area.

Drilling of both bodies is recommended, as it appears very likely that they consist of high-grade iron ore. The recommendations given here are limited to 6 drill holes. These holes should suffice to enable an assessment to be made of the economic value of the ore deposit. Sites for additional drill holes to prove the full extent of the deposit can be selected from the illustrations accompanying this report. It is suggested that the northern body be drilled before the southern one, because the latter appears to have a more complicated shape.

NORTHERN ORE BODY.

The northern body can best be tested by 3 drill holes sited as shown on Plates 2 and 4 and drilled as

shown on Plate 5.

As it is assumed that the body dips steeply to the east, it is recommended that the holes be drilled from the east at an angle of depression of about 45° in order to drill through the full width of the body at fairly shallow depth. It is suggested, however, that Drill hole No. 1 be extended to about 1100 feet to investigate a magnetic anomaly which lies to the west of the main one and is more pronounced on traverse E0 than on the neighbouring traverses. All recommended drill holes are situated relatively close to the foot track which crosses the area from south to north. The recommended holes should be drilled in the following order :

D.H.1

Position: Traverse E0, 200 east.
 Direction: North-west, in direction of traverse.
 Angle of depression: 45°
 Length of hole: 1000 feet.

D.H.2.

Position: Traverse E5, 150 east.
 Direction: 288° (true)
 Angle of depression: 45°
 Length of hole : 600 feet

D.H.3.

Position: Traverse D27, 200 east
 Direction: North-west, in direction of traverse
 Angle of depression: 45°
 Length of hole : 400 feet.

SOUTHERN ORE BODY.

Three drill holes are also recommended to investigate the southern body, but as the composition and shape of this body appear to be more complicated, these holes are recommended only to enable a first assessment to be made of the quantity and quality of the ore reserves.

D.H.4.

Position: 100 feet south of traverse B8,
 350 west.
 Direction: Parallel to traverse B8, towards the west.
 Angle of depression: 45°
 Length of hole: 1100 feet.

D.H.5.

Position: Traverse C, 500 west
 Direction: West, in direction of traverse
 Angle of depression: 45°
 Length of hole: 600 feet.

D.H.6.

Position: Traverse C32, zero (on foot track)
 Direction: West, in direction of traverse
 Angle of depression: 45°
 Length of hole: 500 feet.

In addition to the recommended drilling campaign, the following ground magnetic work is recommended :-

1. Northern part of area.

- (a) Three additional traverses between traverses F and G, as shown on Plate 2, at F7, F13, and F20. Results from these traverses will provide more accurate delineation of the contours.
- (b) Several traverses north of, and parallel to, traverse G, about 1000 feet apart. Such traverses to be extended to the north until magnetically undisturbed ground is reached.

2. Southern part of area.

- (a) A base line traverse should be read towards the south on a bearing of about 90° magnetic: it should start at 1900 W on traverse A and be continued until the end of the anomalous area is reached.
- (b) Several traverses parallel to, and south of, traverse A.

3. An airborne magnetic anomaly near the Waratah Highway, about 6 miles further south (Plate 1), should be investigated by ground magnetic survey. This anomaly is well-pronounced over a distance of two miles and strikes almost due north. This area might add considerably to the iron ore reserves in the Savage River area.

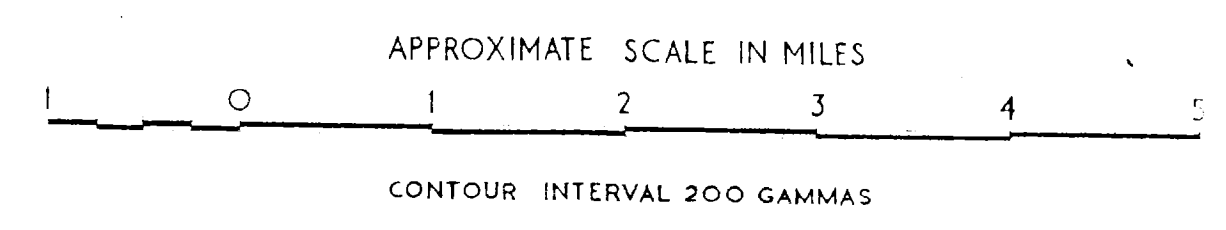
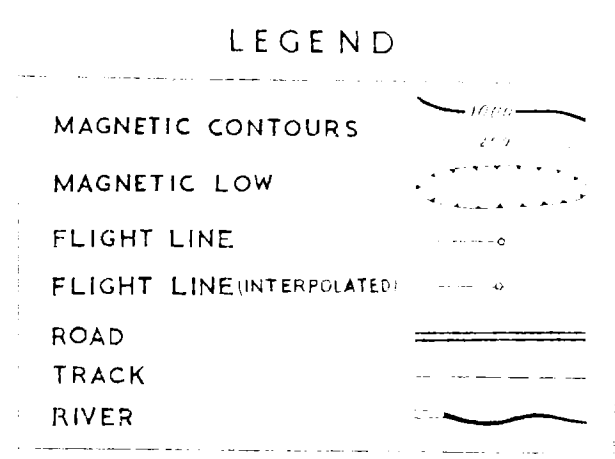
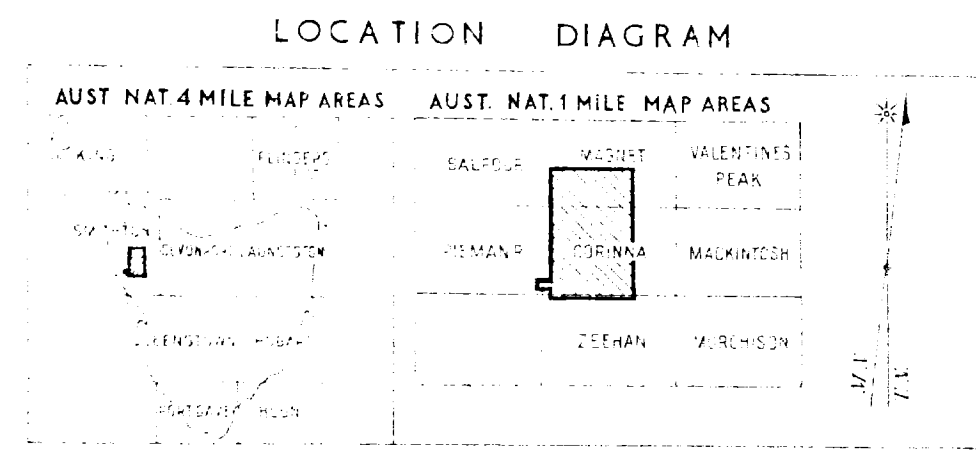
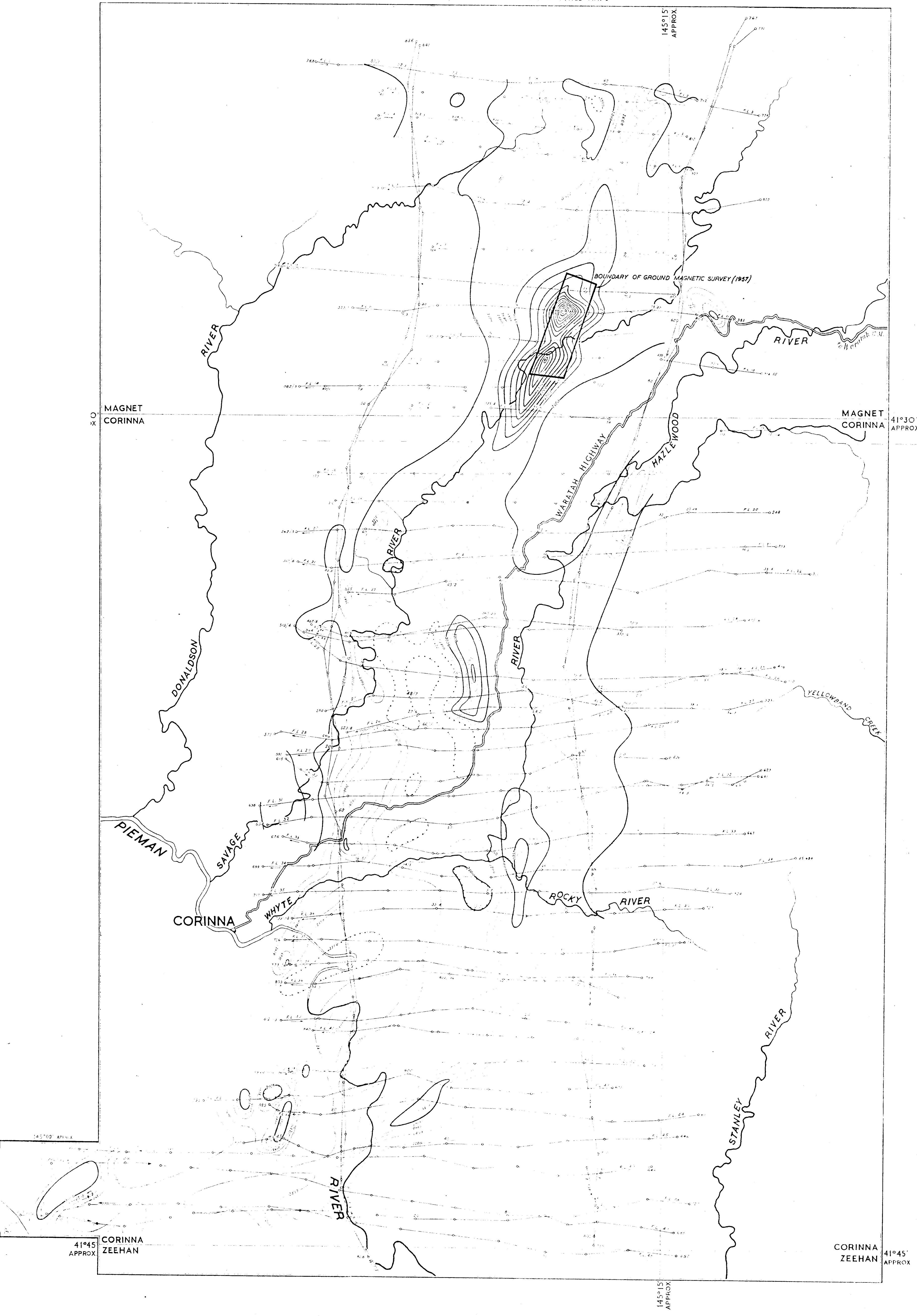
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TASMANIA
ROCKY RIVER - RIO TINTO DISTRICT
PARTS OF MAGNET, CORINNA AND ZEEHAN 1 MILE MAPS

PLATE I



AEROMAGNETIC MAP
OF TOTAL INTENSITY
SHOWING AREA OF GROUND MAGNETIC SURVEY

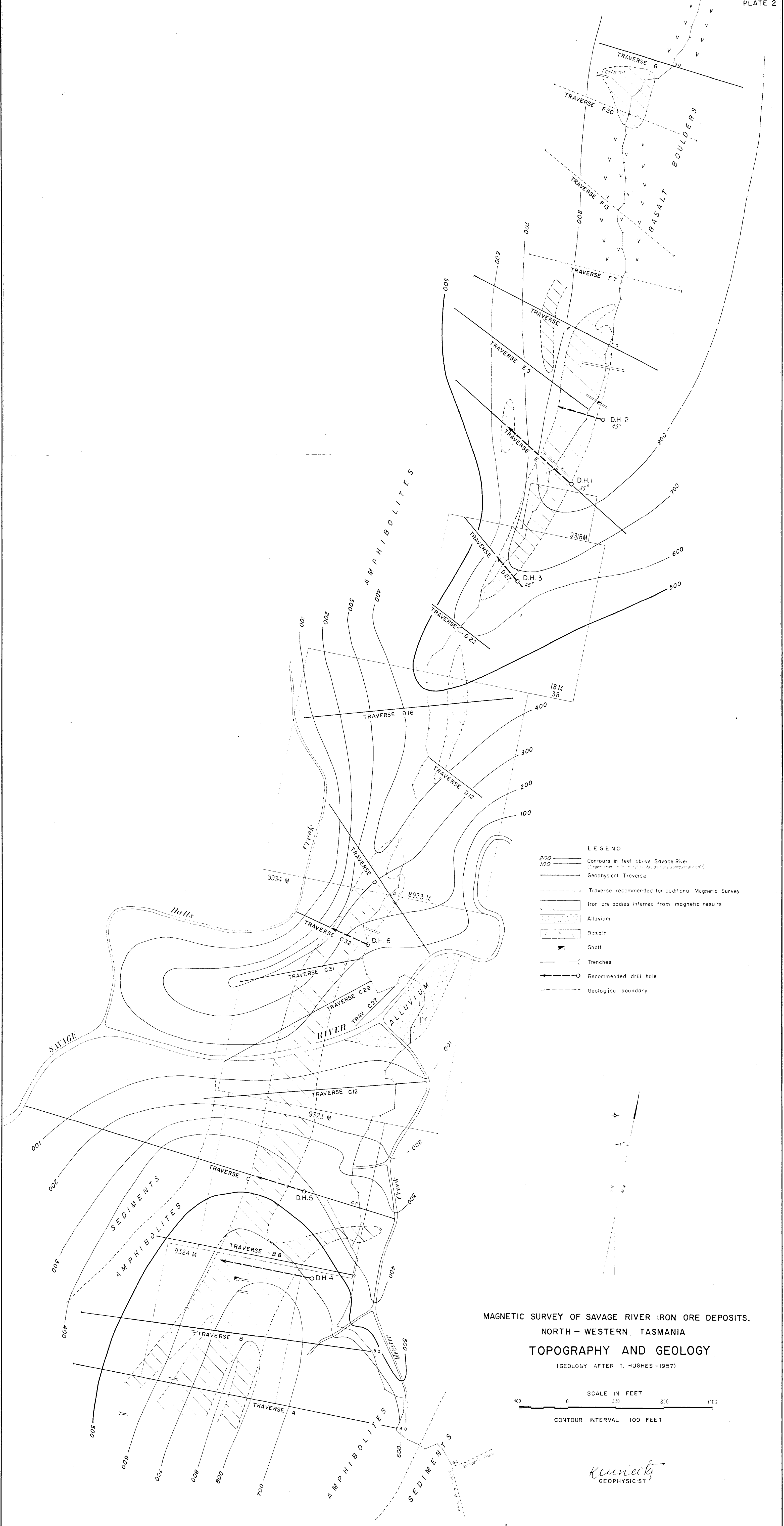
EXPLANATION

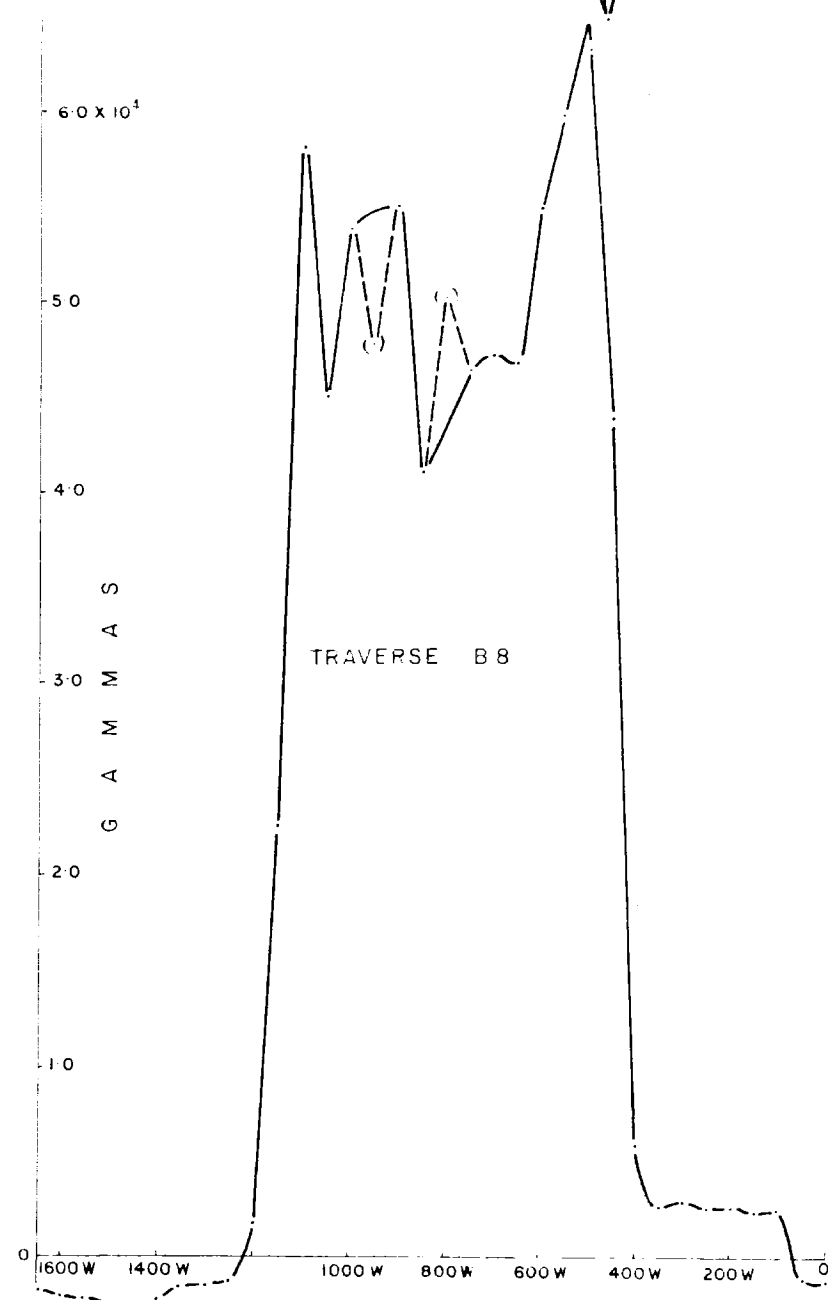
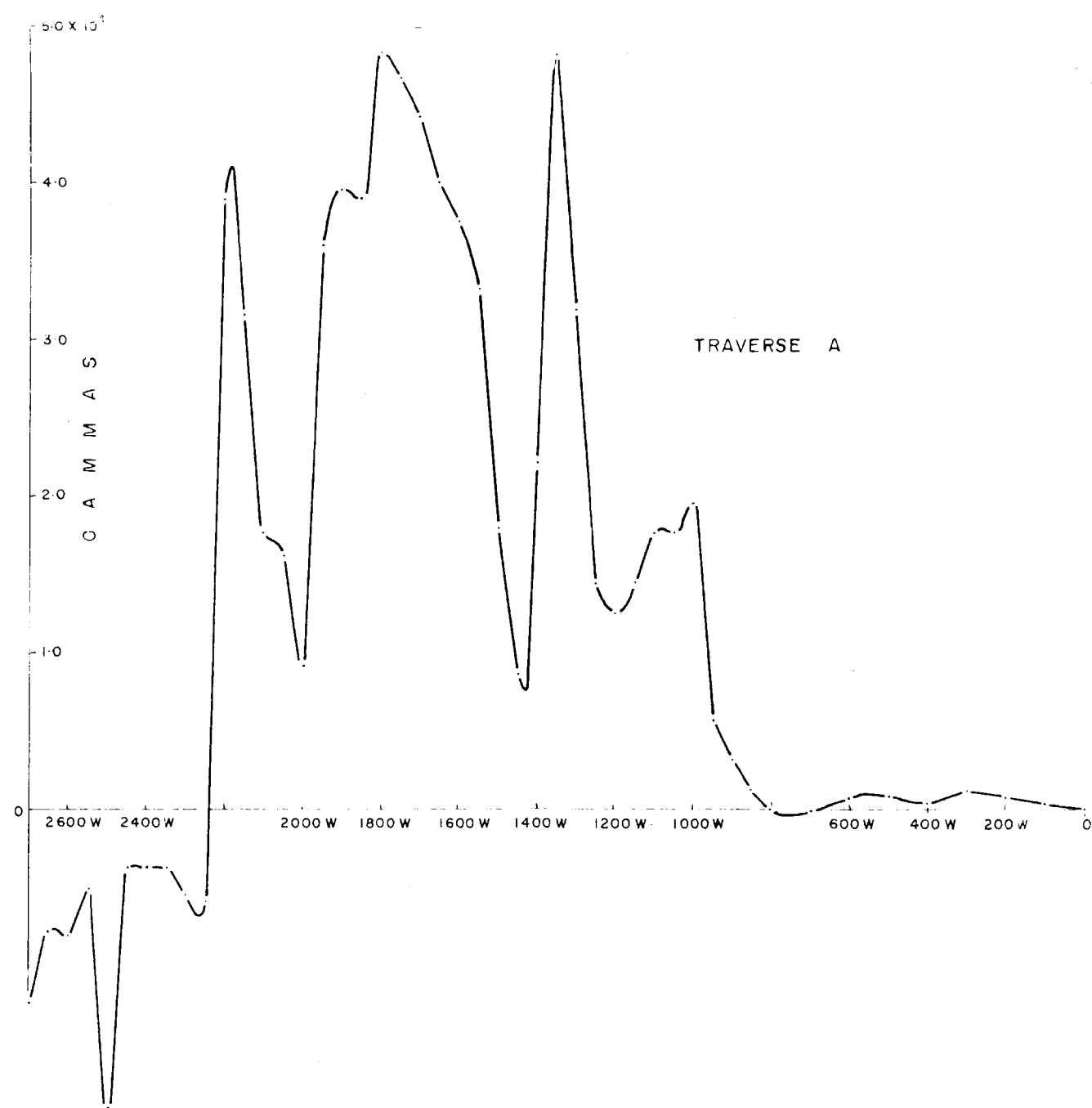
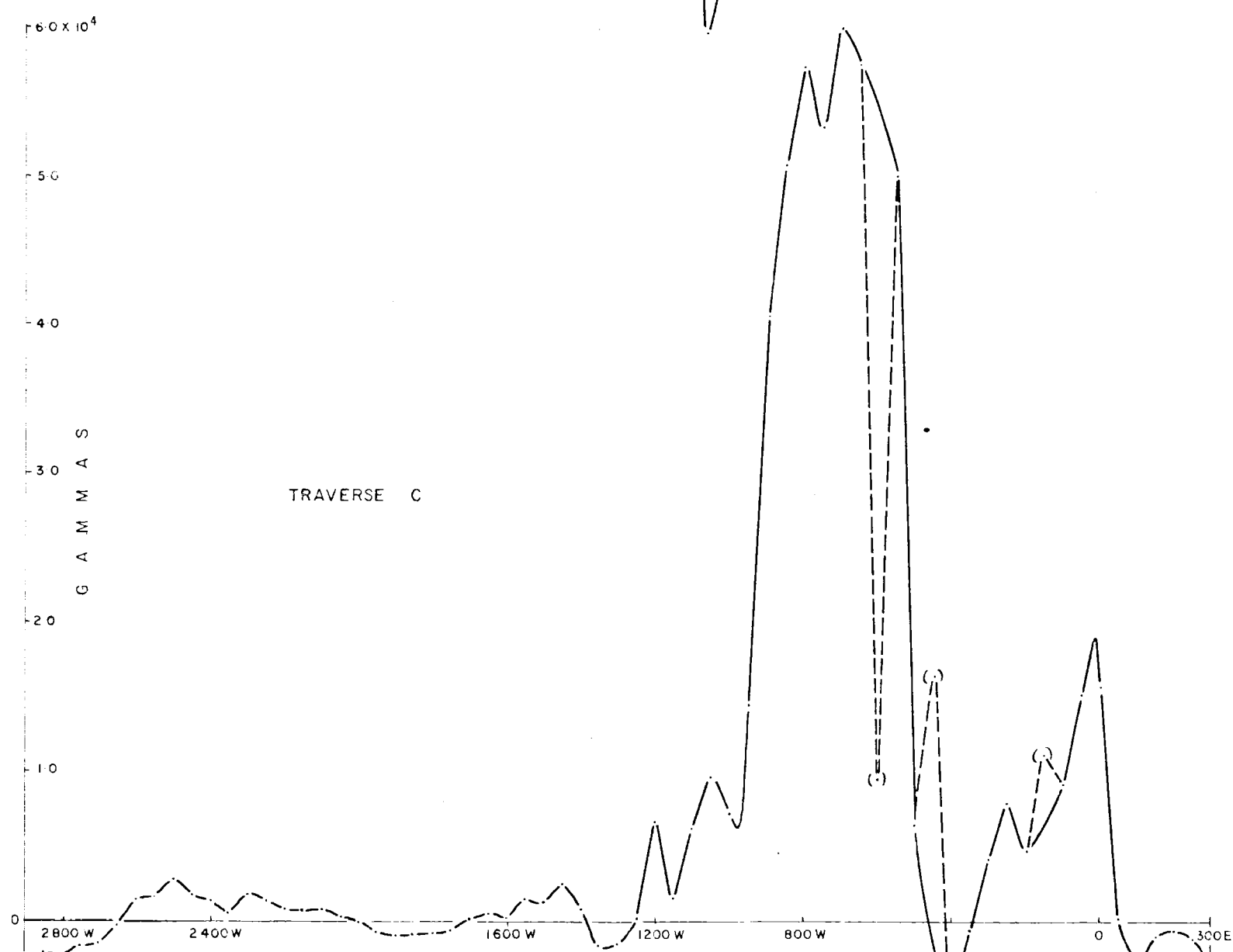
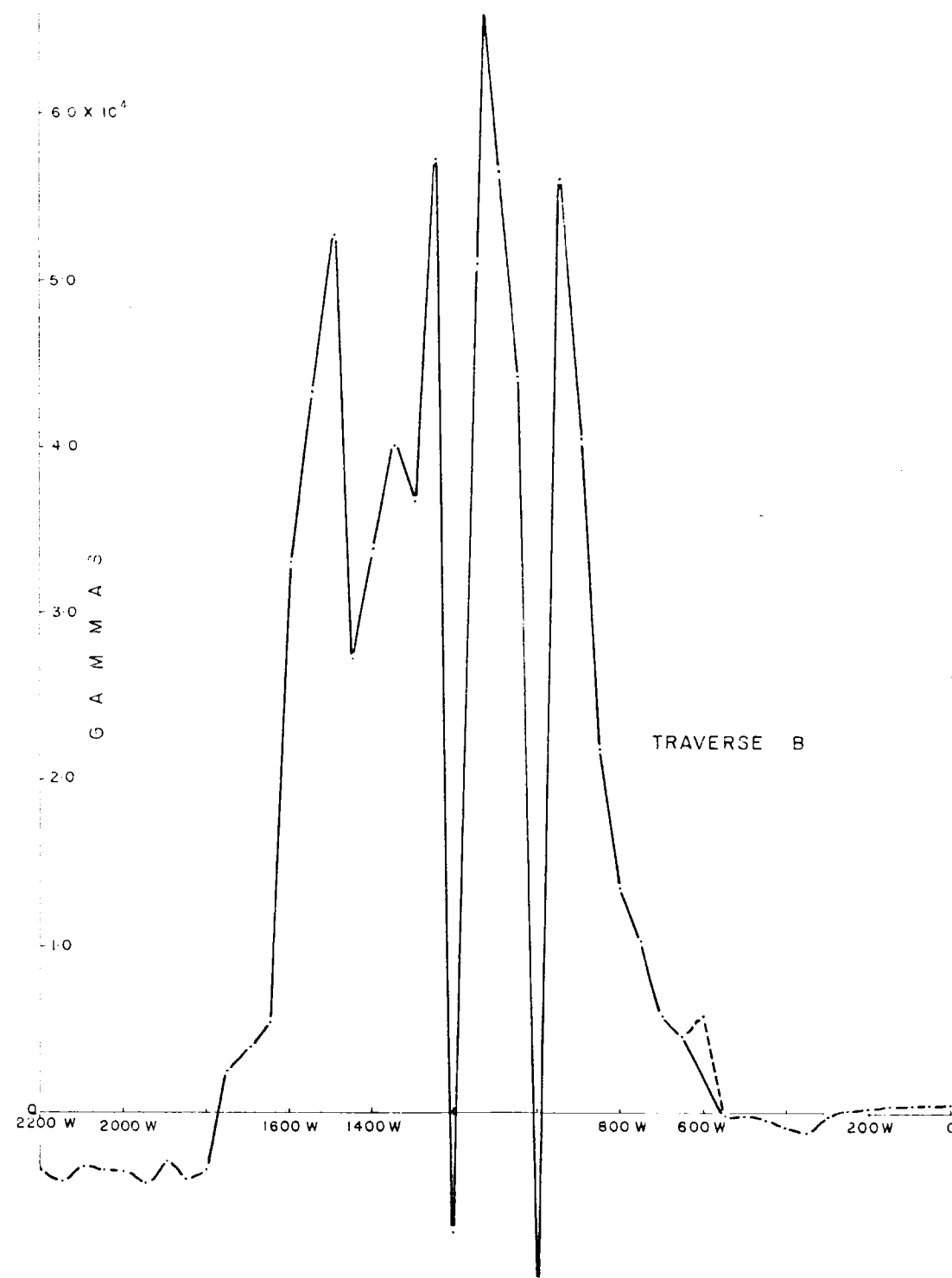
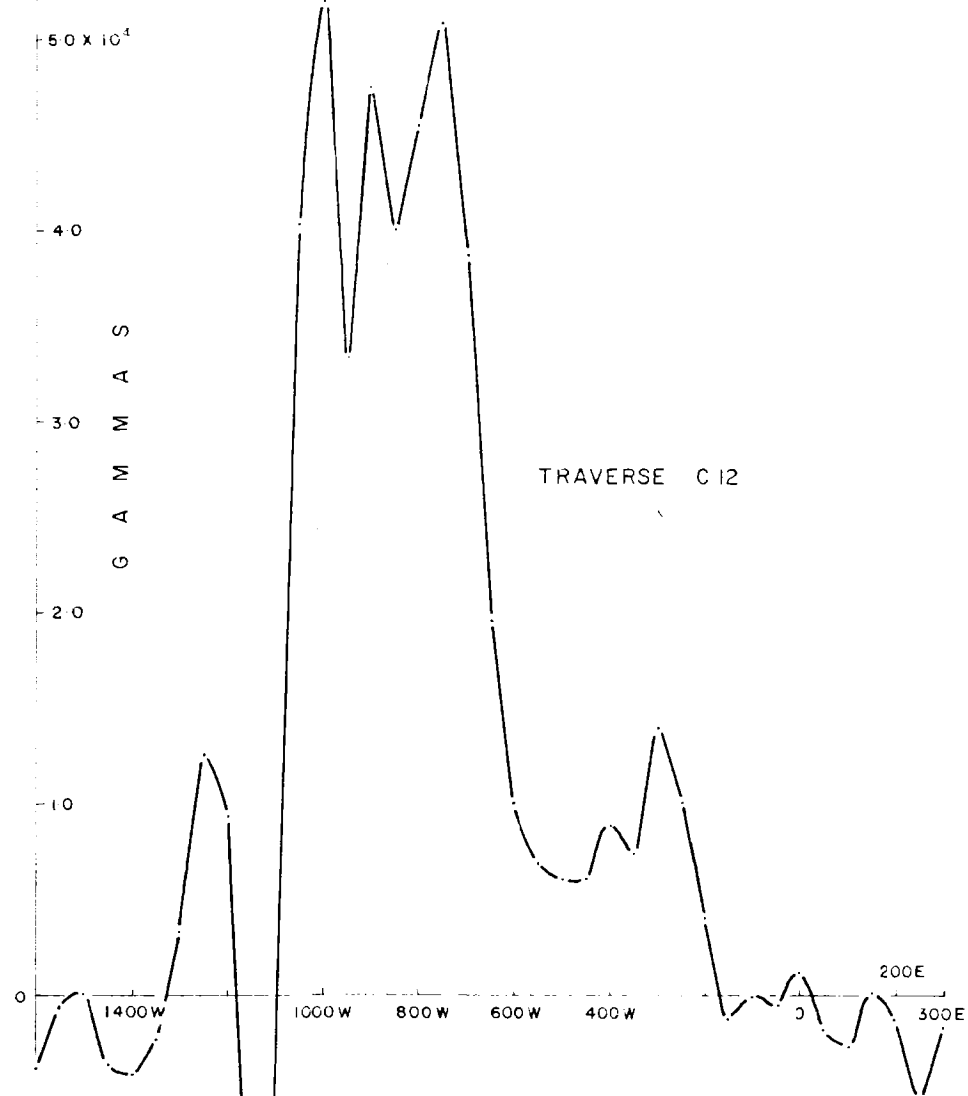
This map was compiled from the results of an aeromagnetic survey of selected areas in the Rocky River-Rio Tinto district, Tasmania, conducted by the Bureau of Mineral Resources in May 1955. The object of the survey was to delineate magnetic anomalies showing the extent and distribution of probable iron ore deposits.

The data remain uncorrected for regional gradient in total field intensity of 5.6 γ per m in a direction of S 19° W.

The total intensity was continuously recorded by an airborne magnetometer. The survey was made at an altitude of 500 feet above ground level and lines spaced one half mile apart.

Photo mural assemblies were used as a visual aid to navigation. The actual flight path of the aircraft was plotted from 35 mm continuous strip photographs of the ground taken during flight.



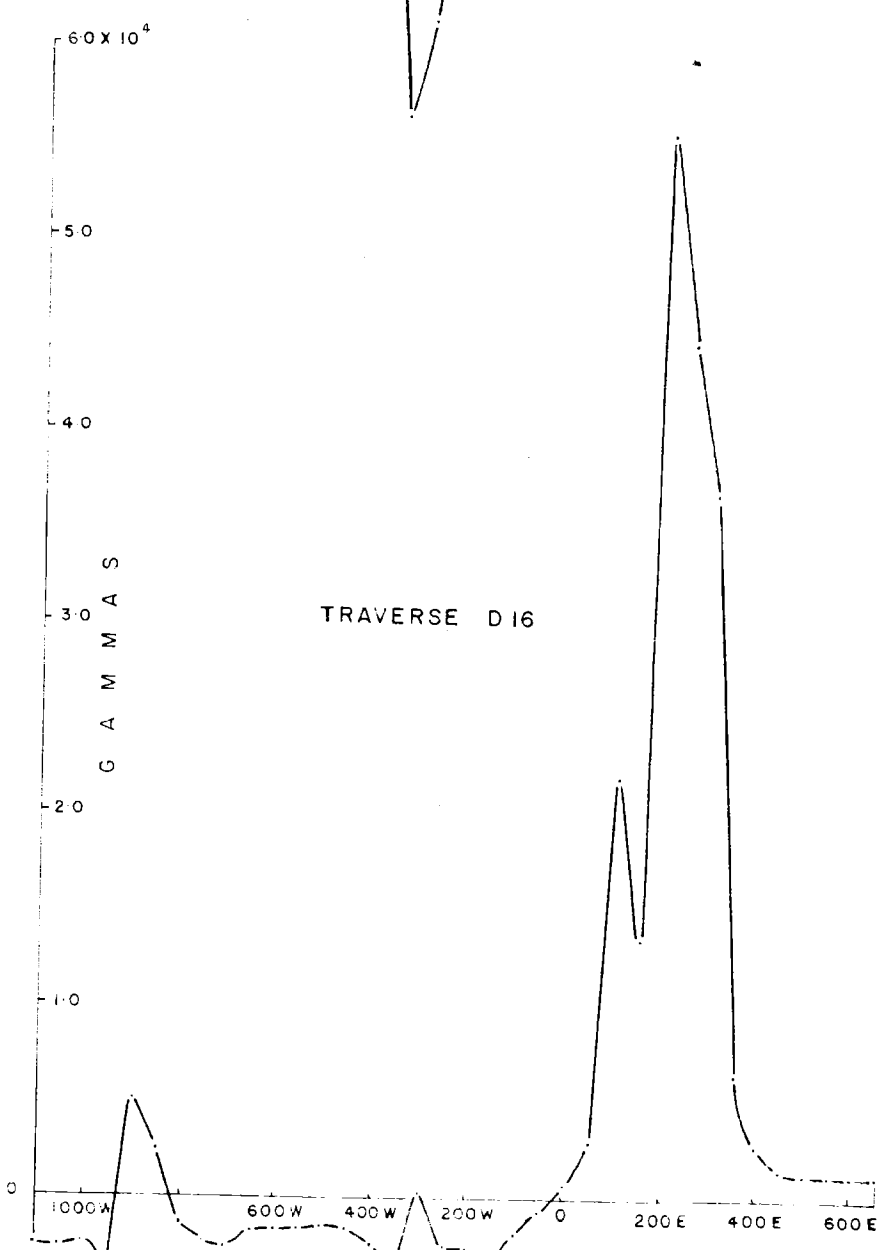
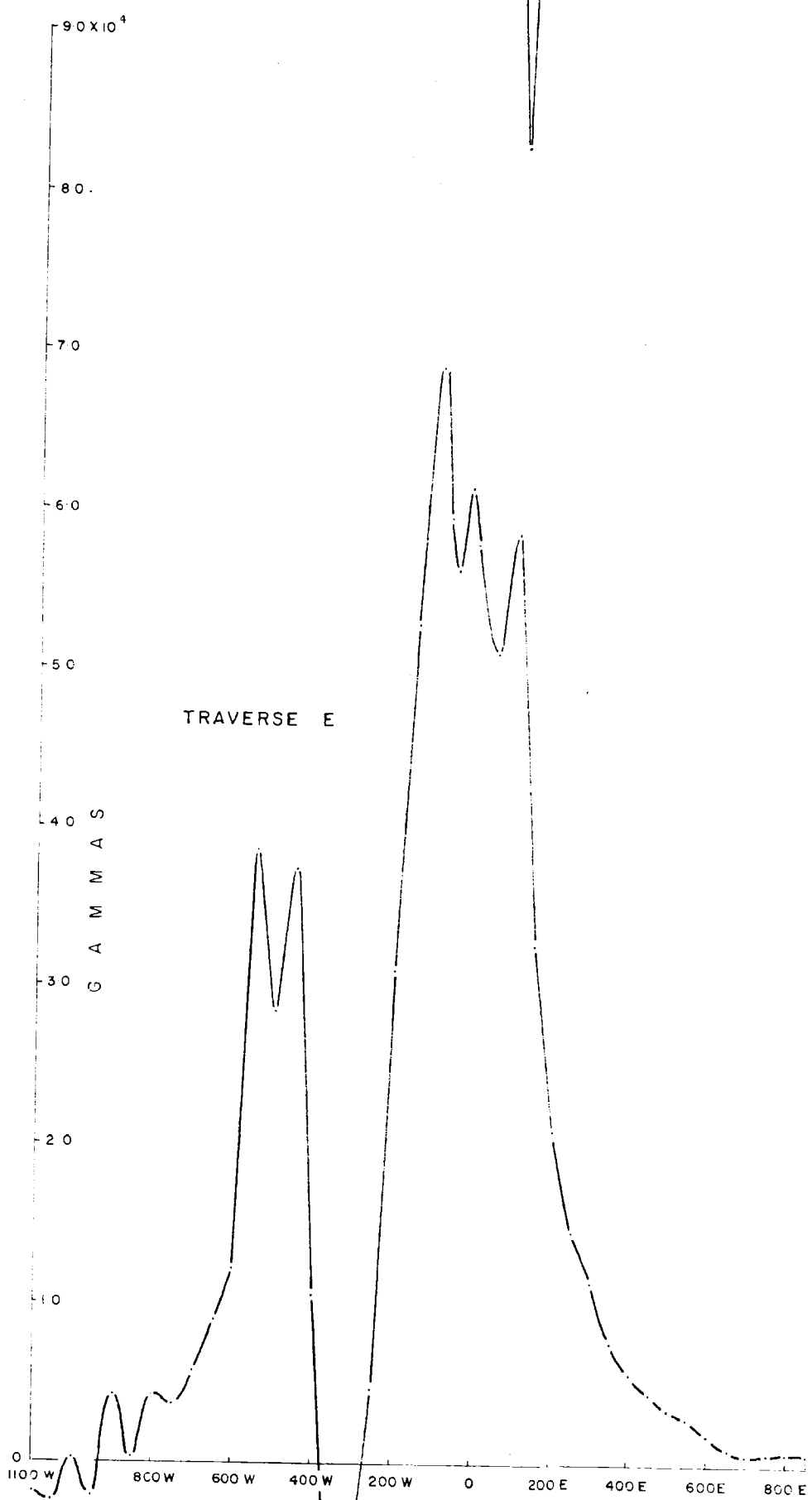
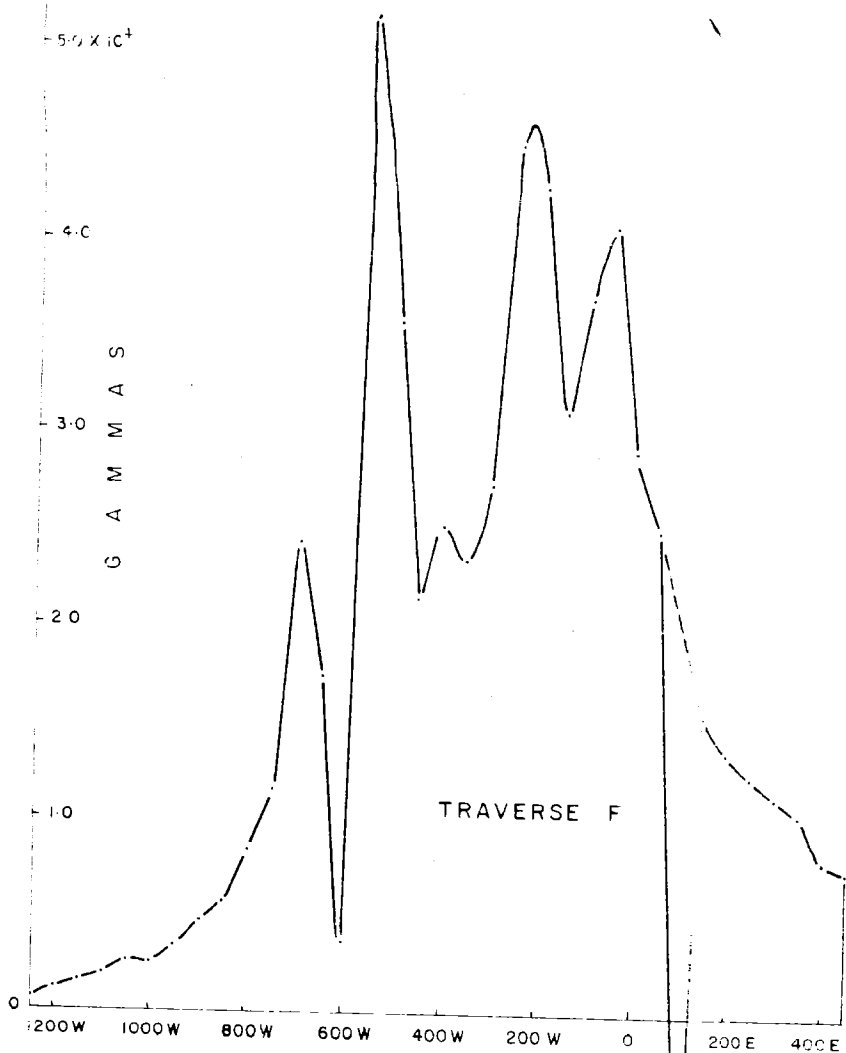


MAGNETIC SURVEY OF SAVAGE RIVER IRON ORE DEPOSITS,
NORTH - WESTERN TASMANIA

MAGNETIC VERTICAL FORCE PROFILES
(SOUTHERN BODY)

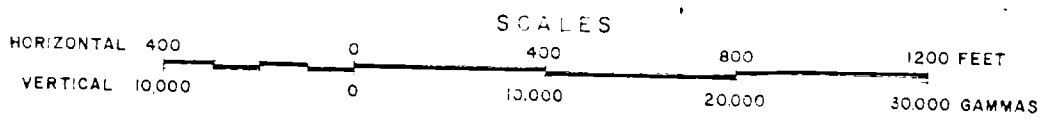
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GEOPHYSICIST

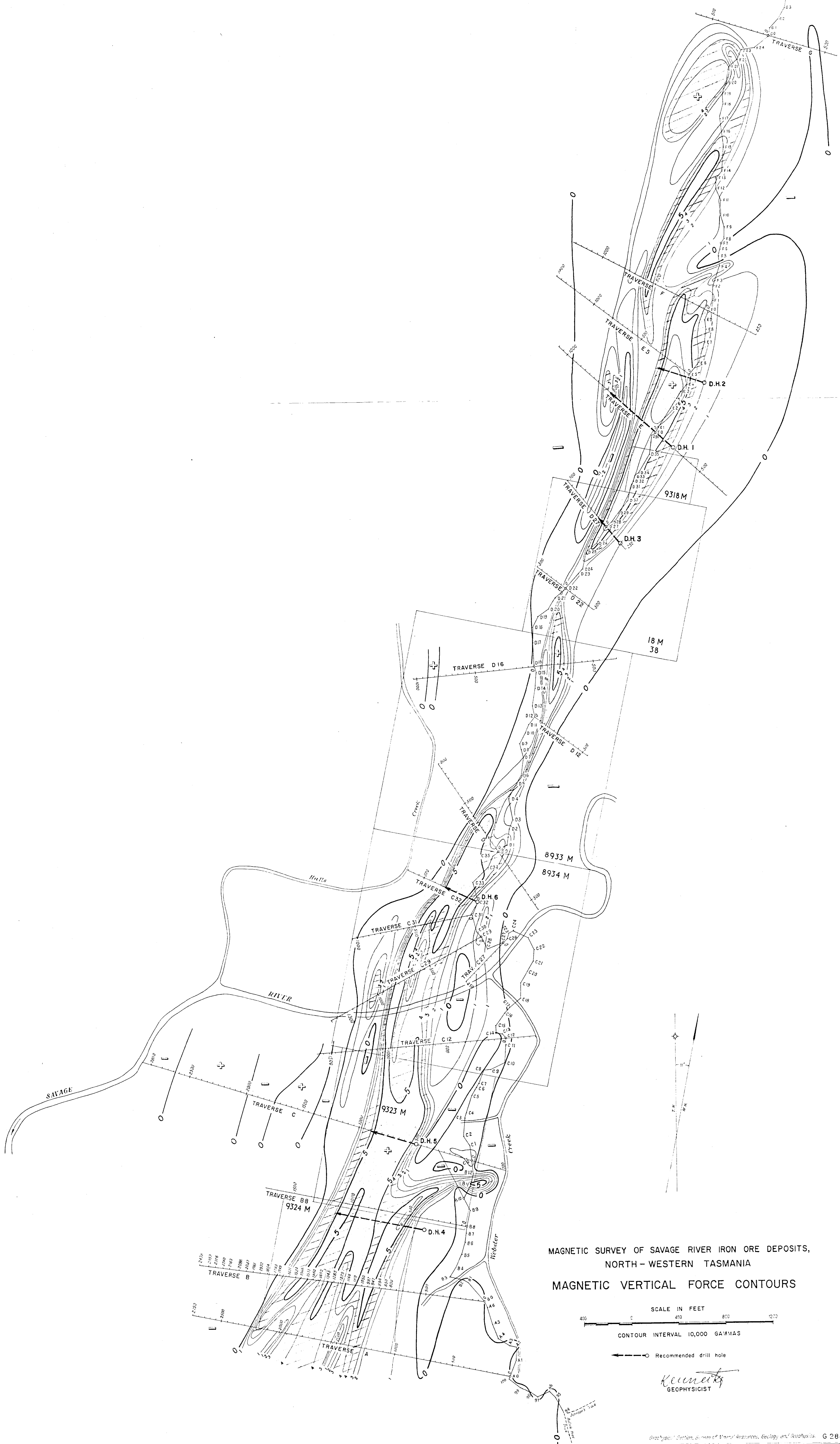


MAGNETIC SURVEY OF SAVAGE RIVER IRON ORE DEPOSITS,
NORTH-WESTERN TASMANIA

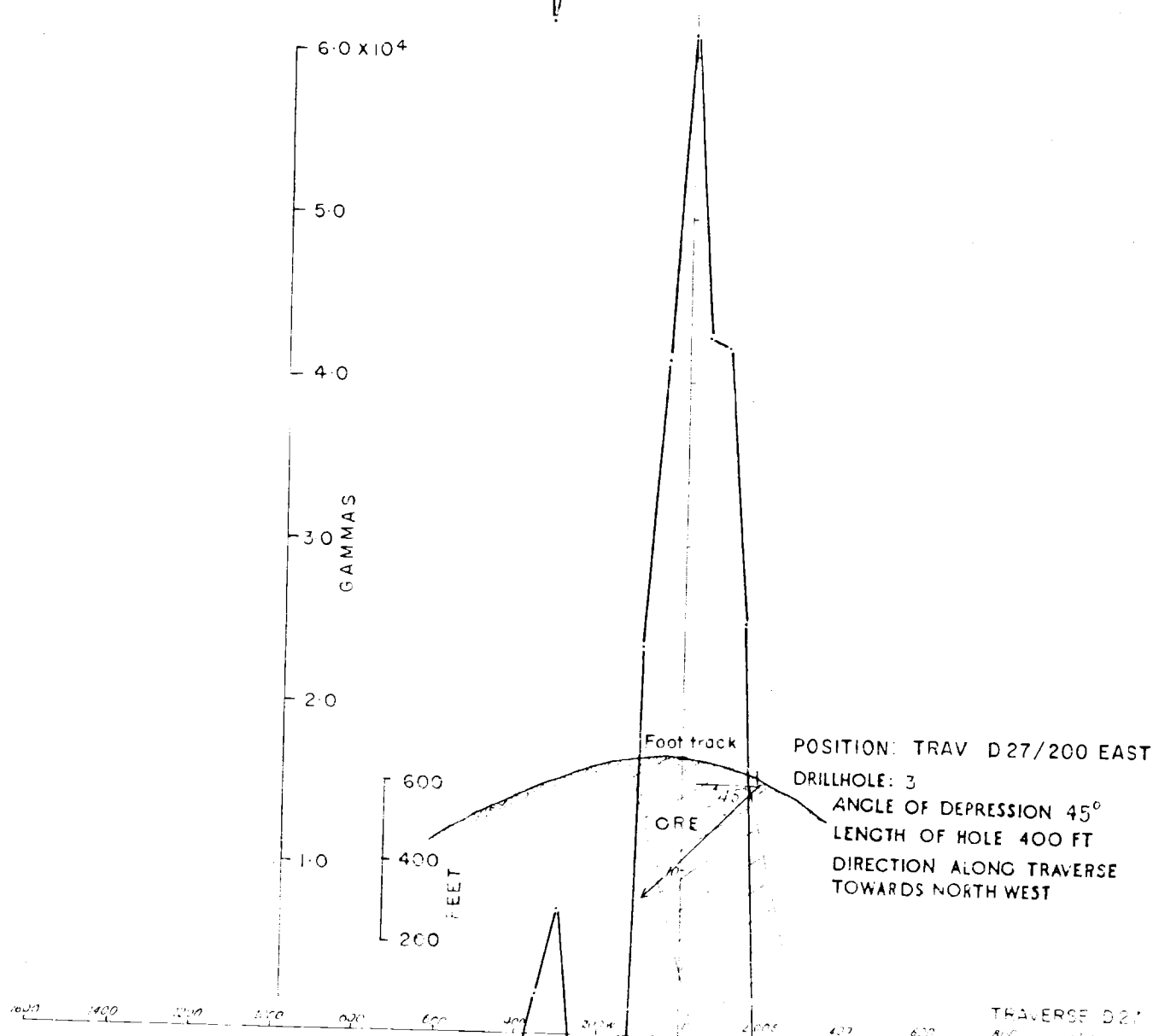
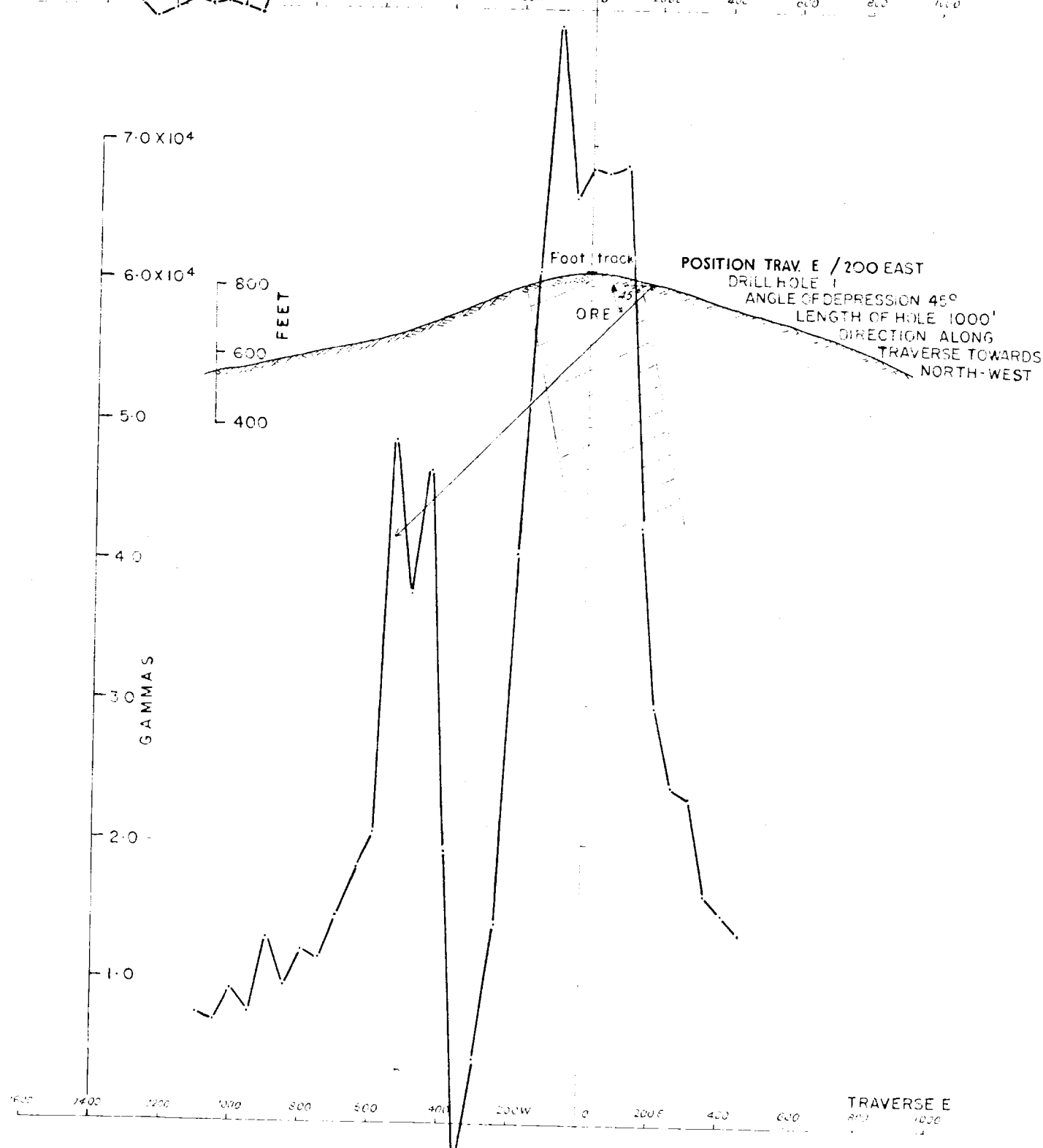
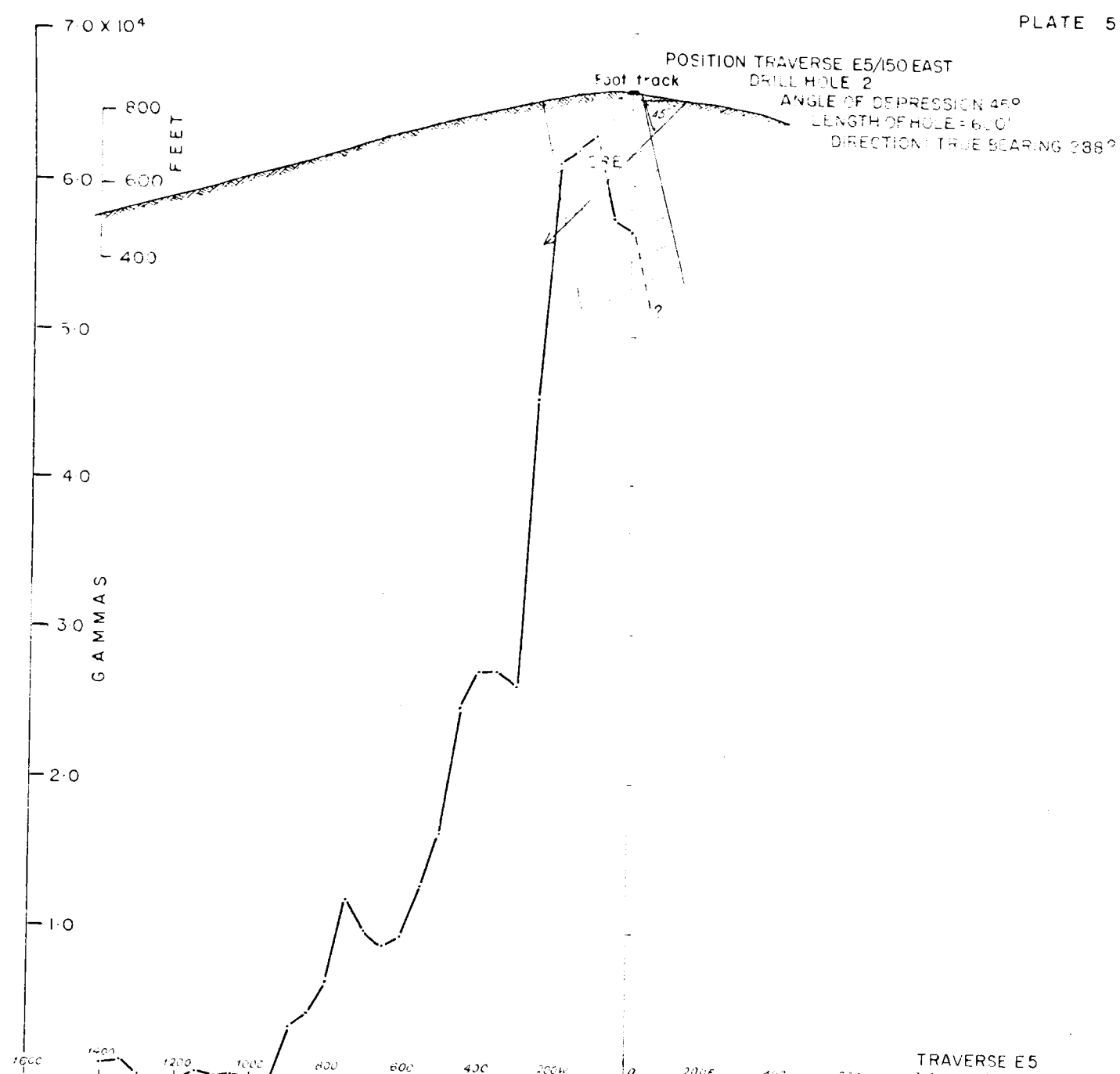
MAGNETIC VERTICAL FORCE PROFILES
(NORTHERN BODIES)



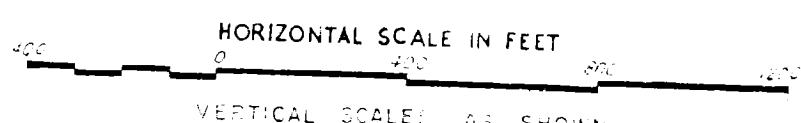
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GEOPHYSICIST



K. L. ...
 GEOPHYSICIST



VERTICAL SCALE: AS SHOWN

MAGNETIC SURVEY OF SAVAGE RIVER IRON ORE DEPOSITS, NORTH WESTERN TAIWAN, A.
 SECTIONS ALONG TRAVERSES D27, E, AND E5, SHOWING MAGNETIC VERTICAL
 FORCE PROFILES, SURFACE LEVELS, ESTIMATED POSITION OF NORTHERN ORE
 BODY, AND SITES RECOMMENDED FOR DRILL HOLES.