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RECORD No. 1961-138

SAVAGE RIVER MAGNETIC SURVEY, TASMANIA 1960

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by

E. C. E. SEDMIK

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ABSTRACT

This Record describes a detailed ground magnetic survey made by the Bureau of Mineral Resources over part of the area of the Savage River iron deposits. The purpose of the survey was to delineate more accurately the magnetic anomalies revealed by the previous surveys and hence to assist the Tasmanian Department of Mines in selecting drilling sites.

The magnetic survey area was about 1½ miles long and about 2000 feet wide. Some large anomalies were discovered north of Traverse A, and several smaller anomalies south of Traverse A.

These anomalies indicate that the iron deposits are formed of several bodies arranged *en echelon* which extend beyond the southern boundary of the surveyed area. The areal extent of the individual lenses appears to decrease southward.

The detailed survey resulted in a better-defined outline of the boundaries of the individual lenses. The results were somewhat disappointing as the lenses seem to be smaller than was suggested by the first reconnaissance survey (in 1957) but it is likely that some of the lenses increase in size with depth.

A self-potential survey made as a test over three traverses showed some S-P. anomalies which coincide with the magnetic anomalies and are probably caused by the pyrite which accompanies the magnetite. There are also some clearly-defined S-P. anomalies outside the surface mineralisation. These anomalies originate probably from separate sulphide veins.

Several drilling sites are recommended for testing the area south of the Savage River.

1. INTRODUCTION

Iron deposits have been known to exist in the Savage River district since the seventies of the last century. Between 1895 and 1898, extensive driving was done by Rio Tinto Company N.L.* while exploring for gold and sulphides. Further exploration of the deposits was done in 1926 by Hoskins Iron and Steel Company, which reported that the mineralisation was of a sulphide nature and did not extend to any depth.

In 1956, an airborne magnetometer survey conducted by the Bureau of Mineral Resources revealed a very pronounced anomaly whose position coincided with the previously known Rio Tinto deposits in the Savage River district. In 1957 a ground magnetic survey, covering an area about 2 miles in length by 2000 to 3000 feet in width (Plate 1), revealed two very intense magnetic anomalies (up to 80,000 gammas), one south and the other north of the Savage River (Keunecke, 1958). As a result of these two geophysical surveys, the Tasmanian Department of Mines started a diamond-drilling campaign to test the value of the deposits. Seven holes were drilled, and these proved a considerable tonnage of iron ore; this is mainly magnetite accompanied by some pyrite.

The southern area of the Savage River deposits is now accessible for 4-wheel-drive vehicles by an all-weather road, about 8 miles in length, which branches off the main Waratah-Corinna road at the 21-mile peg.

In 1959 the Tasmanian Department of Mines requested that the area covered by the 1957 survey should be resurveyed in more detail, with extensions north and south until the limits of the magnetically anomalous area were reached.

The Bureau of Mineral Resources agreed to do the survey as requested but, owing to difficulties in finding the necessary labour for clearing traverse lines and to difficulties in establishing a suitable base camp north of the Savage River, only the area south of Savage River could be surveyed during the season. The survey was made between January and March 1960, by the author and E.N. Eadie (geophysicists of the Bureau of Mineral Resources) and a field assistant. Cutting and surveying of the traverses were done by employees of the Tasmanian Department of Mines, often under very difficult conditions owing to the thick timber and rugged nature of the countryside.

2. GEOLOGY

The iron deposits and the geology of the area have been described by Twelvetrees and Reid (1919), Woolnough (1939) and more recently by Hughes (1958). While the views of these authors are very much in agreement over the general geology of the area, they differ considerably over the origin, extent, quality, and economic importance

* An old company no longer existent, and not to be confused with Rio Tinto Mining Co. of Australia Pty Ltd.

of the deposits. They agree that the main rock formations occurring near the deposits (amphibolite, chlorite schist, talc schist, quartz schist, dolomite, and quartzite) represent alteration products of an intrusion of basic material into rocks of Precambrian age. This intrusion probably occurred in the Cambrian period.

The Precambrian rocks into which the basic rocks have intruded are quartz schist, quartz-sericite schist, phyllite, and slate. These show a northerly strike, and dip steeply to the east. Twelvetrees (1908) named these rocks "Long Plain Schists" and Spray and Ford (1957) named them the "Corinna Beds".

The Savage River deposits occur as a series of lenses extending in a northerly direction over a distance exceeding 3 miles. They consist mainly of magnetite and are regarded as a magnetic segregation at the time of intrusion by basic rocks.

Twelvetrees and Reid (1919) were the first to examine the area as a possible source of iron ore. They assayed several surface samples which showed iron content as high as 69 per cent and small amounts of silica and sulphur. Their conclusion was that the sulphides were confined to discrete bands adjacent to the main iron bodies; this conclusion was based on the observation that most of the early exploration work, which was a search for sulphide deposits containing gold, was done in some discrete bands adjacent to the main iron deposits.

Woolnough, who examined the area 20 years later, considered Twelvetrees and Reid's opinion optimistic, both as regards quantity and quality.

Hughes (1958) investigated the Savage River deposits in connexion with the geophysical survey, and the following notes are extracted from his report:

> 'The iron oxide was formed as a magnetic segregation at the time of the intrusion of the basic rocks - that is, during the Cambrian orogeny.
>
> It therefore formed in a series of concentrations or pockets in the rock itself and the boundaries between the iron and amphibolite cannot be deduced from any structural evidence, except that in conformity with the planes of schistosity these boundaries have a steep dip to the east.
>
> During the Devonian period shearing occurred in both the iron ore and the amphibolite and along these passageways hydrothermal solutions of pyrite and quartz with a small percentage of other metallic minerals were introduced. Thus, the pyrite content of the iron is local and should not increase with depth. A sample taken over 70 feet in an adit showed 1.5 per cent iron pyrite.
>
> At the surface the iron has been oxidised, hardened and purified of its sulphur content. An assay shows very high iron content, no sulphur and a greater proportion of hematite and limonite to magnetite, than at depth.
>
> The reserves of ore appear much larger than was previously thought and must be of the order of hundreds of millions of tons. It does not appear that the area covered by talus from outcrop iron is large compared with the area actually underlain by the iron itself.'

These views agree in general with those of Twelvetrees and Reid. They are being confirmed also by the results of the diamond-drilling being done by the Department of Mines.

3. MAGNETIC METHOD

The magnetic method used in the survey consisted of measuring the variations in the vertical component of the Earth's magnetic field. From the previous surveys it was known that unusually high magnetic readings could be expected. Measuring of anomalies of up to 100,000 gammas in the vertical field presents some problems as the range of an ordinary Schmidt-type balance is only about 25,000 gammas.

During the 1957 survey a Sharpe Model M1 magnetometer, which is a rather insensitive instrument of dip-needle type, had been used over most of the area. Additional more accurate readings had been taken with an Askania magnetic balance in some parts of the area where anomalies were small.

During the 1960 survey an A.B.E.M. magnetometer was used. This is a new type of instrument, in which a small magnetic needle, suspended at the centre of a thin horizontal wire, is deflected from its horizontal reference position by the vertical component of the Earth's magnetic field. The needle is brought back to its horizontal position by a magnetic field acting in opposition to the Earth's field and produced by two built-in adjustable compensating magnets. A sensitive-range micrometer drum moves the smaller compensating magnet and is graduated from 0 to 2000 scale divisions, while a range selector with 20 positions moves the larger compensating magnet. Range and scale division can easily be converted into gammas by a formula given by the makers. This instrument need not be oriented, is compensated for temperature variations, and is designed to read magnetic anomalies from minus 150,000 gammas to plus 150,000 gammas. In practice, however, the maximum anomaly that could be read during the survey was plus 115,000 gammas, because the original zero setting of the instrument cannot be changed.

4. FIELD WORK AND RESULTS

A total of 28 traverses were read with the A.B.E.M. magnetometer during the survey. These traverses included A, B, B8, C, and C12 of the 1957 survey, which were repeated in order to have the whole area surveyed with the same instrument. The survey extended over an area about 1½ miles in length from north to south, and the length of traverses ranged from 1500 to 2800 ft. Distance between observation points along traverses was 25 ft throughout the whole area; this close spacing was necessary because the magnetic readings change very rapidly from place to place. Because of the rough nature of the country most of the traverses were cut only far enough to cover the magnetically disturbed areas.

Most of the traverses north of Traverse A started from the old packing track, known as "Specimen Reef Track", but some intermediate traverses started from the new road, suitable only for 4-wheel-drive vehicles, which connected the drillers' hut with the Waratah-Corinna road. All traverses south of Traverse A had a common baseline (about 4700 feet long) which started from 1895W on Traverse A (Plate 5). Since completion of the survey, discrepancies have been noted in the plan of the traverses shown on Plate 5. It appears that there were inaccuracies in the surveying and this plan must be regarded as provisional. It will be necessary to check the surveying of the whole grid before any new additional traverses are laid out.

The observed values were computed in conventional manner but diurnal variation was neglected; however, readings at a base station were taken at the beginning and end of the day's work. The observed magnetic anomalies were extremely great and even exceeded plus 115,000 gammas (range of the instrument) at a few points. The results of the detailed ground magnetic work are presented in the form of individual profiles on Plates 2, 3, and 4, and as magnetic contours on Plate 5.

The individual profiles show very large gradients, suggesting that the magnetic bodies are very close to the surface or even outcropping. In drawing the contour map, most of the irregularities in the profiles were taken into account, but a few smoothings were made.

The average width of the main anomalous zone was about 600 feet (Plate 5). On the four traverses south of Magnetite Creek the anomalous zone is narrower, and the profiles are smoother. No iron outcrops could be seen on the surface over this area but a distinct anomaly with a maximum intensity of 40,500 gammas was observed on Traverse 4500S. Thus the southern end of the anomalous area was not reached during the present survey. Difficulties in finding the necessary labour for cutting and pegging of new traverses prevented a further continuation of the survey to the south.

In addition to the abovementioned vertical-force magnetic survey, a few traverses were read with the horizontal magnetometer but the results of this work were considered to be of no special significance and the horizontal readings were discontinued.

The self-potential method of prospecting was used over Traverses A, B, and B8. The S-P. results and the corresponding vertical magnetic profiles are presented on Plate 6. This shows that large S-P. anomalies were measured, and their locations agree fairly well with the magnetic anomalies. However, in addition to the S-P. anomalies corresponding to the magnetic anomaly, two well-defined negative S-P. anomalies were observed, at 775W on Traverse A and 200W on Traverse B, which have no connexion with any magnetic anomaly; these may be caused by a sulphide body without magnetite.

5. INTERPRETATION OF RESULTS

Many of the magnetic vertical-force profiles (Plates 2 to 4) show very sharp gradients which are violently disturbed over the area of maximum anomaly; this indicates that the magnetic bodies come close to the surface. Abrupt changes in magnetic intensities from values as high as plus 100,000 gammas to values as low as minus 30,000 gammas indicate that the bodies have a high magnetite content.

To give an approximate idea of the magnetic susceptibilities of near-surface vertical bodies, Rössiger and Puzicha (1932) use a formula -

$$K = (\Delta Z) / 2\pi Z$$

where K = susceptibility in c.g.s. units,

Z = vertical component of the Earth's magnetic field,

ΔZ = maximum amplitude of the anomaly.

For a maximum amplitude of 60,000 gammas and Z also = 60,000,

$$K = 1/(2\pi) = 0.159 \text{ c.g.s. units.}$$

This is a remarkably high susceptibility, which could be produced only by a body rich in magnetite.

Many of the profiles show a relatively smooth rise up to the commencement of the anomaly on the eastern side, but not on the western side. This indicates that the bodies dip steeply to the east and persist at least to moderate depth.

The contour map (Plate 5) shows that an anomalous zone of width ranging up to 900 feet extends from the most northerly traverse (CX) to Traverse 3000S. This anomalous zone contains several "highs" and "lows", showing that the distribution of magnetic material is not homogeneous. It suggests that several lenses of magnetite ore arranged _en echelon_ are separated by relatively barren zones.

South of Traverse 3000S (near Magnetite Creek) a well-defined anomaly was found in an area where no iron outcrops are visible. This indicates that the iron continues southwards underneath the soil cover.

The magnetic profiles and the magnetic contour map show that the anomalies are caused by bodies of various types. For instance on Traverse A (Plate 3) a very strong anomaly is found at 1325W. Its maximum is even beyond the range of the instrument. The profile shows it to be quite narrow with a very sharp gradient. Such an anomaly is caused by a narrow band of magnetite which comes right to the surface. It has probably no appreciable extent in depth because the adjacent readings return practically to normal. In spite of the high maximum, this particular anomaly is of little economic importance because it indicates only a narrow band of magnetite close to the surface. Similar anomalies are seen on Traverses B08 at 325E, and B80 at 275E.

The sharp anomalies on Traverse 500S at 450W and on Traverse 750S at 400W are similar but the adjacent readings do not return to normal. Especially on 750S it can be seen how the profile east of the sharp rise assumes a more gentle slope; the sharp rise is thus superimposed upon a much wider anomaly arising from a magnetic body at somewhat greater depth. West of the sharp rise the profile returns to a normal value within 100 ft; east of the sharp rise normal values are reached only at about 400 east.

The other main type of anomaly is that in which the high values persist over a larger area. An example of this type can be seen on Traverse C between 650W and 900W. Here the gradients are less steep and the average values between these points vary around 50,000 gammas but remain mostly over 40,000 gammas. The profile of the anomaly indicates that the near-surface effects are much less pronounced and that the anomaly is due mainly to a magnetite body at depth. This has been confirmed by drill-holes 5 and 6. The steeper drill-hole 5 intersected a much greater thickness of iron ore than drill-hole 6.

The magnetic contours show that most of the iron mineralisation in the 1960 survey area lies between Traverses C7 and B08. South of Traverse B08 the iron is in smaller lenses. A relatively narrow anomalous zone can be traced from 1300W on Traverse B to 75W on Traverse 2000S. The most interesting portion of this narrow zone lies between Traverses 1500S and 1750S.

West of this zone is a series of short but wide lenses of which the most important ones are:-

(a) At 250W on Traverse 250S

(b) Between 450W on Traverse 500S and 400W on Traverse 750S

(c) Between 300W on Traverse 2250S and 250W on Traverse 2750S.

The last is probably the most important of this group.

A strong anomaly situated between 250E on Traverse 2000S and 200E on Traverse 2500S is probably caused by a relatively narrow band of magnetite close to the surface. The area between Traverses 3000S and 4000S is rather barren of anomalies, but on the southernmost Traverse 4500S a new magnetic anomaly appears which would be worth following farther south.

The self-potential method was used only on three traverses (A, B, and B8) as a trial. While three profiles are not sufficient for a detailed interpretation they show good agreement with the magnetic anomalies (Plate 6). The cause of the S-P. anomalies is probably mainly the pyrite content of the mineral bodies, which from assay information available appears to be up to about 4 per cent. The pyrite, which is mainly coarse-grained, can easily be removed by magnetic concentration to reduce the sulphur content to about 0.07 per cent and is therefore not detrimental.

The S-P. profiles also show pronounced negative anomalies isolated from the magnetic anomalies and so point to the existence of separate bands of sulphide at 775W on Traverse A and 200W on Traverse B.

6. CONCLUSIONS

The survey outlined several strong magnetic anomalies of various lateral extents, suggesting that the iron deposit is composed of several bodies arranged <u>en echelon</u>. The anomalous area is at least 7500 feet in length and may continue farther south beyond the surveyed area.

Magnetic anomalies of such intensity and extent are only rarely found. They can be produced only by magnetite deposits that are both large and close to the surface. It is recommended that the current diamond-drilling campaign should be continued in order to determine more accurately the grade and extent of the magnetic bodies.

The following drill sites are recommended on and south of Traverse A :-

DS1	Position:	Traverse A, 1200W
	Direction:	West, in direction of traverse
	Angle of depression:	45°
	Length of hole:	1150 feet.

Two shorter holes (DDH8 and DDH9) at about 1600W on Traverse A were planned by the Department of Mines. DDH8 could be drilled instead of DS1 but it would have the disadvantage of going through the main zone closer to the surface than DS1. DDH9 would not penetrate magnetite bodies of worth-while dimensions, and its drilling is not recommended.

DS2	Position:	Traverse 750S, 175E
	Direction:	West, in direction of traverse
	Angle of depression:	45°
	Length of hole:	900 feet
DS3	Position:	Traverse 1500S, 0 (i.e. at baseline).
	Direction:	West, in direction of traverse
	Angle of depression:	45°
	Length of hole:	800 feet
DS4	Position:	Traverse 2500S, 50W
	Direction:	West, in direction of traverse
	Angle of depression:	45°
	Length of hole:	650 feet
DS5	Position:	Traverse 2250S, 150E
	Direction:	East, in direction of traverse
	Angle of depression:	45°
	Length of hole:	300 feet

It is also recommended that the adit near 400W on Traverse 250S be extended for several hundred feet into the magnetite lens, which it has scarcely penetrated.

The following drill sites are also recommended between Traverses A and C12 in the area where drill-holes DDH3 to DDH7 have already been drilled:-

DS6	Position:	Traverse B80, 200W
	Direction:	Towards site of DDH3
	Angle of depression:	45°
	Length of hole:	1400 feet
DS7	Position:	Traverse C3, 100W
	Direction:	West, in direction of traverse
	Angle of depression:	45°
	Length of hole:	950 feet

It is also recommended that the tunnel at 500E on Traverse B80 be extended to 200W. This tunnel has only passed through the vicinity of a narrow magnetic anomaly and has not yet reached the body causing the main anomaly. It would reach this body in about 50 feet and should then continue for most of its length in the mineral body.

The geophysical investigation of the Savage River area was continued in 1961. The results of the drilling, which have only been mentioned briefly in this report, together with a comparison of the drilling and magnetic data, will be treated more fully in the report on the 1961 surveys.

The results of the S-P. test traverses show that the search for sulphides could be continued by an extension of the S-P. survey, particularly in the northern part of the 1957 survey area which was not included in the 1960 survey. Pyrite recovered from the iron and other sulphides (which may contain other metals) could be by-products of an iron-ore industry.

7. REFERENCES

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8. RECONNAISSANCE SURVEY AT ROCKY RIVER

A reconnaissance survey was requested by the Tasmanian Department of Mines in the Rocky River area where strong magnetic anomalies were also recorded during the Bureau's 1956 airborne magnetometer survey.

The Rocky River iron deposits are situated about 10 miles south of the Savage River deposits, near the junction of the Whyte and Rocky Rivers (Plate 1). They can be reached by a track three miles long which starts from the 34-mile peg of the Waratah-Corinna Road. The country is very rugged and fairly heavily timbered.

The only exploration work worth mentioning in this area was done about the beginning of this century when several small magnetite bodies were encountered while searching for copper- and gold-bearing iron ore. A brief description of these workings has been given by Twelvetrees and Reid (1919).

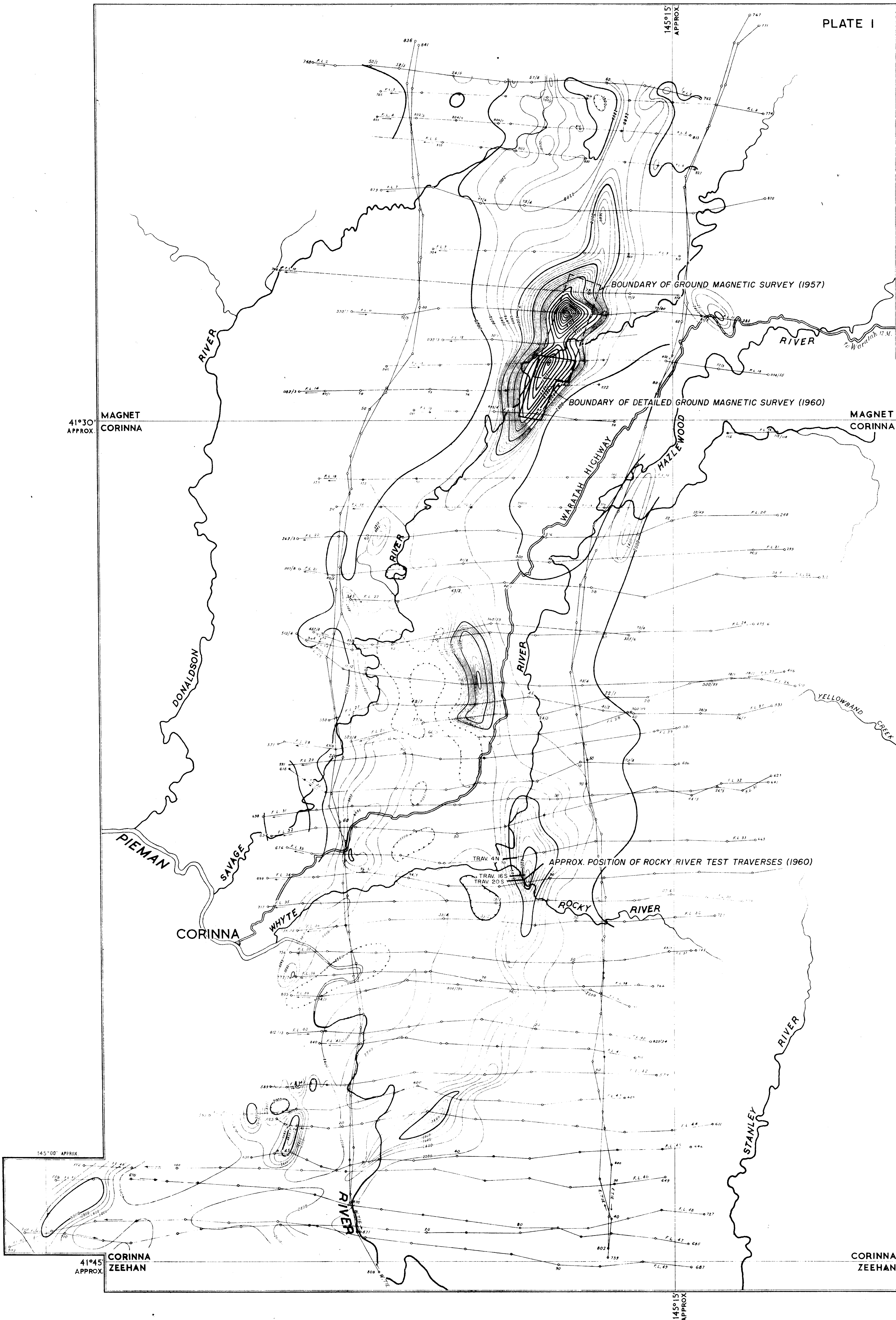
The geophysical work was done by E.N. Eadie. The whole survey lasted only three days during which three test traverses of 7300 feet total length were read with the A.B.E.M. magnetometer. Track cutting and topographical surveying were done by Rio Tinto Exploration Company of Australia for the Department of Mines.

Results of this survey are presented as vertical magnetic force profiles on Plate 7. Traverses 20S and 16S which were only 400 feet apart show a rather broad anomaly of appreciable intensity (over 10,000 gammas) suggesting a less strongly magnetic body than at Savage River. The apex of this anomaly coincides fairly well with the anomaly shown in the airborne map. The body dips to the east at not more than 30 to 45 degrees. The deposit consists probably of several mineralised layers of low magnetite content.

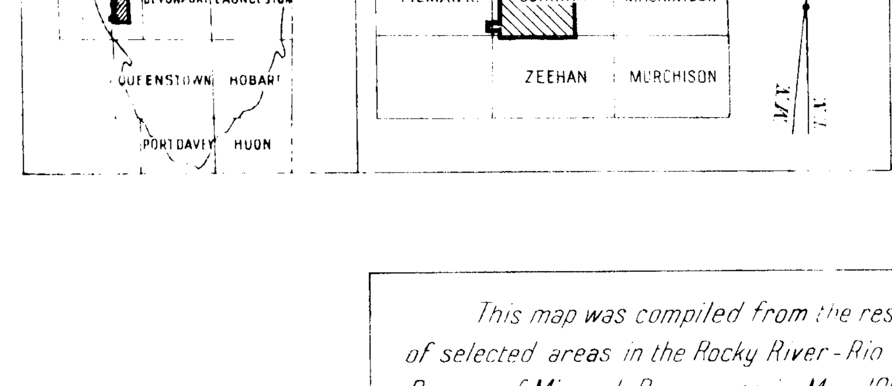
Traverse 4N failed to show an anomaly although it was laid out across a visible thin lens of magnetite.

The selection of the traverses for this reconnaissance survey does not seem to have been very fortunate and further geophysical work would have to be done before any conclusions could be made about the importance of the deposit.

PLATE I



LOCATION DIAGRAM



LEGEND

MAGNETIC CONTOURS
MAGNETIC "LOW"
FLIGHT LINE
FLIGHT LINE (INTERPOLATED)
ROAD
TRACK
RIVER

APPROXIMATE SCALE IN MILES

1 0 1 2 3 4 5

CONTOUR INTERVAL 200 GAMMAS

SAVAGE RIVER AREA, TASMANIA

AEROMAGNETIC MAP OF TOTAL INTENSITY

SHOWING AREA OF GROUND MAGNETIC SURVEYS 1957 AND 1960

EXPLANATION

This map was compiled from the results of an airborne magnetometer survey of selected areas in the Rocky River - Rio Tinto district, Tasmania, conducted by the Bureau of Mineral Resources in May, 1956. 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 mile 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 along lines spaced one half mile apart.

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

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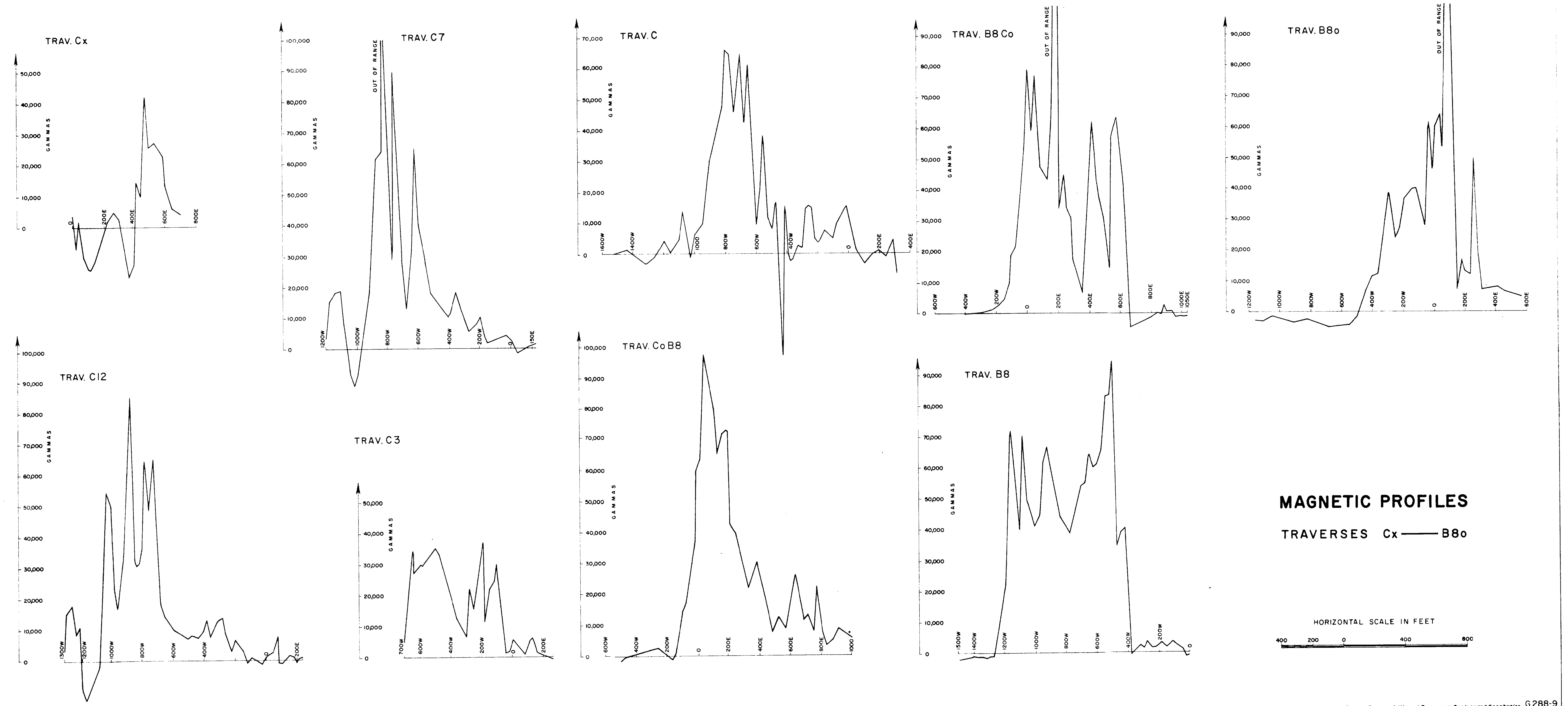

MAGNETIC PROFILES

TRAVERSES Cx —— B8o

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SAVAGE R., TAS.

PLATE 3

MAGNETIC PROFILES

TRAVERSES Bo8 — 1250S

HORIZONTAL SCALE IN FEET

400 200 0 400 800

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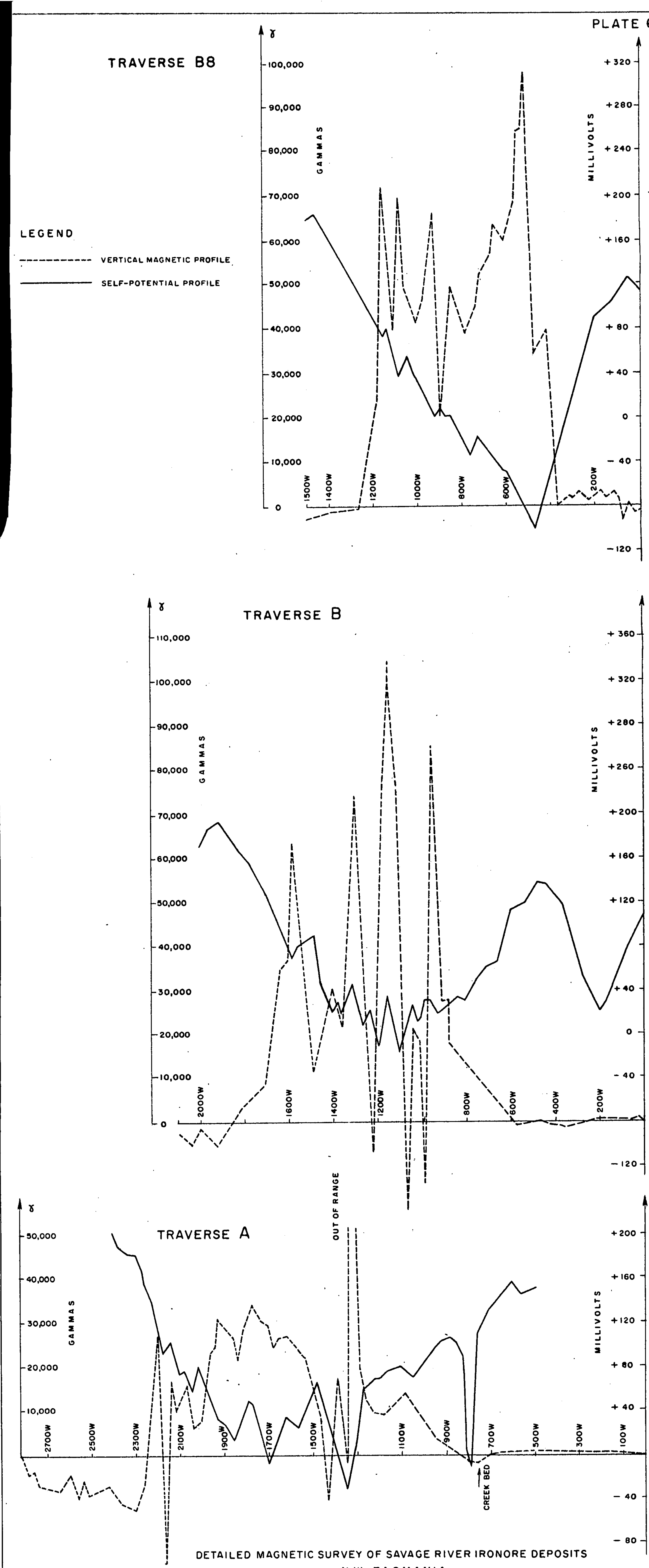
SAVAGE R., TAS.

SAVAGE R., TAS.

TO ACCOMPANY RECORD No 1961-138


PLATE 5
True North
Magnetic North
11°30'
SAVAGE RIVER
Webster Creek
Magnetite Creek
SOUTHERN BASE LINE
TO WARATAH - CORINNA ROAD
TRACK
SPECIMEN REEF TRACK
Comp
DDH 7
DDH 5-6
DDH 3
DDH 4
Proposed DDH 8-9
DS 1 45° 1150'
DS 2
DS 3 45° 800'
DS 4 45° 650'
DS 5 45° 300'
DS 6 45° 1400'
DS 7 45° 950'
TRAV. Cx
TRAV. C12
TRAV. C7
TRAV. C3
TRAV. C
TRAV. Co B8
TRAV. B8 Co
TRAV. B8
TRAV. B8o
TRAV. Bo8
TRAV. B
TRAV. AoBo
TRAV. A
TRAV. 250 S
TRAV. 500 S
TRAV. 750 S
TRAV. 1000 S
TRAV. 1250 S
TRAV. 1500 S
TRAV. 1750 S
TRAV. 2000 S
TRAV. 2250 S
TRAV. 2500 S
TRAV. 2750 S
TRAV. 3000 S
TRAV. 3500 S
TRAV. 4000 S
TRAV. 4500 S
LEGEND
RECOMMENDED DRILL HOLE
EXISTING DRILL HOLE
50,000γ AND OVER
40,000γ " "
30,000γ " "
CONTOUR INTERVAL 10,000γ
4-WHEEL-DRIVE ROAD
SCALE IN FEET
200 100 0 200 400 600 800 1000
SAVAGE RIVER N-W TASMANIA
1960 SURVEY
MAGNETIC VERTICAL FORCE CONTOURS
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
G 288-7
TO ACCOMPANY RECORD No. 1961-138

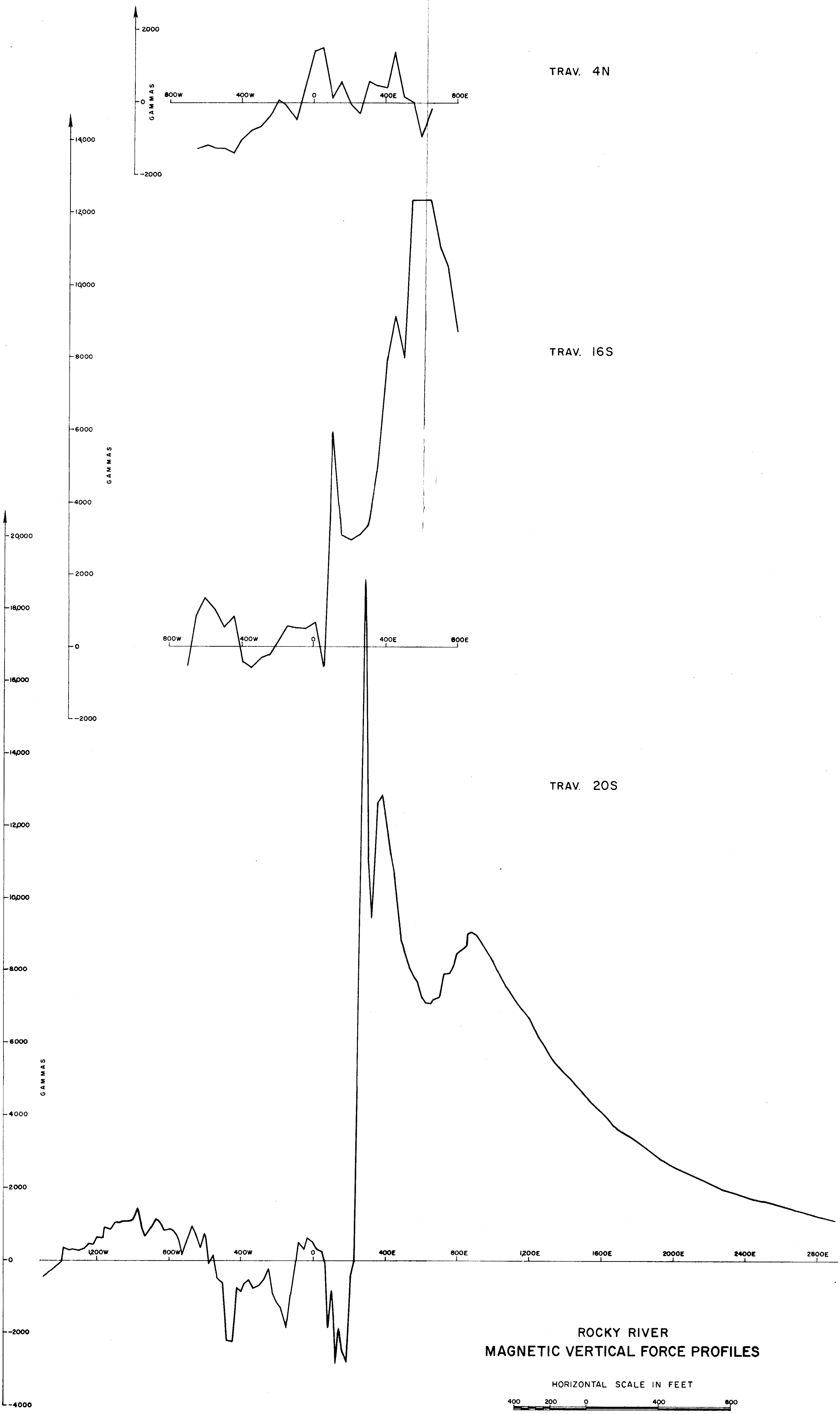
PLATE 6



DETAILED MAGNETIC SURVEY OF SAVAGE RIVER IRONORE DEPOSITS
N.W. TASMANIA

SELF-POTENTIAL PROFILES

PLATE 7



ROCKY RIVER
MAGNETIC VERTICAL FORCE PROFILES

HORIZONTAL SCALE IN FEET

400 200 0 400 800

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