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BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

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MAGNETIC SURVEY OF THE "SEVEN-MILE" AND ADJACENT IRON ORE DEPOSITS, NEAR NOWA NOWA, EAST GIPPSLAND

by

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CONTENTS

ILLUSTRATIONS

APPENDIX 1

ABSTRACT

A ground magnetometer survey was made, at the request of the Victorian Department of Mines, over an area about 7,000 feet by 2,000 feet around the "Seven Mile" iron ore outcrop to the north of Nowa Nowa along the road to Buchan. The observations were made in September and October, 1955 to determine the significance of an anomaly recorded during an airborne magnetometer survey in 1951 which appeared to be associated with the "Seven Mile" iron ore outcrop.

Three separate anomalies were recorded in the ground survey, showing that the iron bodies in the area are disconnected and do not form one large, continuous body. The "Seven Mile" outcrop is shown to be part of a small deposit either at shallow depth or at the surface. Two of the anomalies indicate larger magnetic bodies at depths of about 100 feet and 400 feet respectively, and recommendations are made for test drilling to determine their mineral composition and possible economic value.

Further airborne magnetometer surveys are recommended, followed by detailed ground surveys if additional significant airborne magnetic anomalies are recorded.

1. INTRODUCTION

The iron ore deposits near Nowa Nowa, East Gippsland crop out sporadically over a length of about 10 miles along a line striking north-north-east towards Buchan from a point about one mile north-west of Nowa Nowa Township (Plate 1). Some prospecting work had been done on the outcrops, but no real attempt had been made to prove the extent of the iron ore deposits, either laterally or in depth.

An airborne magnetometer survey made by the Bureau in 1951 (McCarthy, 1952) over portion of the Gippsland Basin, included the area near Nowa Nowa. This survey revealed a pronounced anomaly caused by a magnetic body, but because of the wide spacing of the traverses, the possible extent of the body could not be indicated. As this anomaly was close to known iron-ore outcrops it seemed likely that it was caused by magnetic iron ore.

Reconnaissance geological investigations of the Nowa Nowa Area have been made by the Victorian Department of Mines and the latest of these by A.H. Bartlett (private communication, 1955), resulted in a request being made to the Bureau of Mineral Resources by the Department of Mines for a geophysical survey over certain selected areas.

After discussions between officers of the Department of Mines and the Bureau, it was decided that the Bureau would carry out a more detailed, low-level airborne magnetometer survey over an area about 15 miles long by 10 miles wide, and a ground magnetometer survey near the "Seven Mile" outcrop, near which a strong airborne magnetometer anomaly was found during the 1951 survey. Unfortunately, the detailed airborne survey could not be made in 1955 and was scheduled for, and made in, May, 1956.

The present report describes the ground magnetometer survey which was made near the "Seven Mile" deposit, about seven miles from Nowa Nowa on the Buchan Road (Plate 1). The objects of this survey were to determine the extent of the iron-ore deposits and to locate any anomaly corresponding to that obtained by the airborne survey and to determine its extent and other features.

The ground magnetometer survey was made in September and October, 1955, by O. Keunecke (party leader) and L.V. Skattebol, geophysicists of the Bureau. Surveying and pegging of traverses were done by geologist A.H. Bartlett of the Victorian Department of Mines, and his assistant. Twenty-one traverses, of total length 42,000 feet, were surveyed with a magnetometer over an area measuring approximately 7,000 feet by 2,000 feet.

2. GEOLOGY

The geology and mineralisation of the Nowa Nowa area have been described by Cochrane and Samson (1950), Howitt (1925), Whitelaw (1920) and others. Ordovician sediments (sandstones, slates and cherts) have been overlain by acid volcanics of Devonian age, and iron and manganese mineralisation is associated with the volcanics along zones approximately parallel to the bedding of the sediments.

Cochrane and Samson (1950) state that the sediments which form the base of the area are mainly north-north-east trending and steeply east-dipping Ordovician slates, cherts and sandstones. Their geological sketch map shows that the sediments

outcrop over a tract averaging about a mile in width and extending between Mt. Nowa Nowa and Mt. Tara. The strata are much disturbed, altered and sheared and contain small gold deposits associated with minor faults.

During the Devonian period, igneous activity resulted in the eruption of acid and intermediate lavas and ashes. The acid lava is a rhyodacite which was referred to as "Snowy River Porphyries" before Cochrane and Samson made their studies. Metamorphosed acid igneous rocks have been recorded about six miles southwest of Mt. Nowa Nowa and described as porphyroids. The intermediate lavas and ashes include augite, andesite, andesite ash and trachyte of which large outcrops are found mainly near Mt. Nowa Nowa.

Plate 3 shows the distribution of Ordovician sediments, rhyodacite and andesite, as mapped by A.H. Bartlett along the geophysical traverses.

Iron and manganese mineralisation occur in the area (Whitelaw, 1920 and Howitt, 1925). The mineralisation occurs apparently along zones of weakness more or less parallel to the general trend of the sedimentary strata. Some small lenses of iron ore in andesite are revealed in small cuts to the south-west of Mt. Nowa Nowa, including a solid body of iron ore about 8 feet thick.

The "Seven-Mile" outcrop, about 7 miles north-north-east of Nowa Nowa, is the most important in the area. The iron ore occurs in rhyodacite and is about 100 feet wide (Whitelaw, 1920); it consists of hematite, magnetite and a little limonite.

In the "Iron Mask" outcrop, south of Buchan, the ore is a more manganiferous one (hematite, limonite, and manganese dioxide) with barite. The outcrop is about 1000 feet long, and averages 30 feet wide. A shaft was sunk to 50 feet in earlier days but, although ore of good grade was cut (it is found on the dump), the development work was not extensive enough to prove the extent and value of the deposit.

North of Buchan is the Oxide Mine, in which the ore is a ferruginous manganese ore with up to 40 per cent Mn; this ore has been mined to a small extent.

The disposition and mineral content of the various outcrops suggest that the manganese content of the iron ore increases towards the north. Little is reported, however, about the type and origin of the deposits. Cochrane and Samson (1950) state briefly that the occurrences appear to have resulted from replacement by hydro-thermal solutions and that their extent in depth is unknown.

3. APPLICABILITY AND DESCRIPTION OF METHOD.

Local variations in the strength of the earth's magnetic field are caused by the presence of rocks of higher magnetic susceptibility than that of the surroundings. The higher susceptibility is almost always due to the presence of ferromagnetic minerals such as magnetite, pyrrhotite, or ilmenite, occurring either as massive bodies, or as disseminations through larger bodies of non-magnetic rocks. Such disseminations are rare in

unaltered sedimentary rocks, but occur commonly in igneous rocks. Other iron minerals, such as hematite and limonite, are of common occurrence, but are very weakly magnetic.

The only magnetic material so far observed in the Nowa Nowa district is magnetite, which forms a considerable percentage of the iron ore, and occurs in small quantities in certain of the igneous rocks. Field tests of hand specimens indicate that the magnetite ore from the dumps at the "Seven Mile" outcrop is strongly magnetic, and that the igneous rocks are weakly magnetic, the strength of the magnetism being greatest in rocks showing the highest visible content of iron minerals.

Susceptibility test on core samples from drill holes put down by the Department of Mines to test magnetic anomalies disclosed by the present survey (see Appendix 1) show the following ranges of susceptibility:-

Andesite, from 0.01×10^{-3} c.g.s. units to 0.8×10^{-3} c.g.s. units.

Possible ore, containing hematite, magnetite, and pyrite, 25×10^{-3} c.g.s. units to 100×10^{-3} c.g.s. units.

So far as is known, this material has not yet been assayed to determine its iron content. However, the tests indicate that an ore body of the type likely to be encountered in this area should be readily detected by magnetic methods.

Airborne magnetometer surveys record variations in the total intensity of the earth's magnetic field, whereas ground magnetic surveys (which use magnetic field balances) record variations in the vertical or horizontal component only. Measurements of the vertical component can be made more quickly and are usually sufficient. In the present survey, the value of the vertical component was recorded at each observation point; values of the horizontal component were recorded only over the "Seven Mile" outcrop.

An Askania magnetometer, Type GF6 (No.521633), was used to measure both the vertical component (Z) and the horizontal component (H). The vertical magnet system was adjusted to a sensitivity of 30 gammas per scale division and the horizontal magnet system to a sensitivity of 20 gammas per scale division. The physical unit of the intensity of the earth's magnetic field is the gauss, but for practical purposes variations in magnetic intensity are usually expressed in gammas (1 gamma = 10^{-5} gauss).

4. FIELD WORK AND RESULTS

The traverses were laid perpendicular to a base line which was orientated in the direction of magnetic north (see Plate 3). Observation points were mainly 25 feet or 50 feet apart along the traverses, but where necessary, as for example over the "Seven Mile" outcrop, the separation was reduced to 12½ feet. The position and lengths of the traverses were not determined before the survey, but were arranged in accordance with the results obtained as the survey progressed.

As the observed variations in the magnetic intensity were so large, it was considered unnecessary to make any corrections for diurnal variation. The observed values have been reduced with reference to an arbitrary base station at which the magnetic intensity was measured at the beginning and end of each day's observations.

The results of the measurements of the vertical magnetic component are shown as profiles along selected traverses on Plate 2 and as contours for the whole area on Plate 3. On the latter, the contour interval used is 200 gammas, but where the gradients are very steep a contour interval of 1,000 gammas is used.

Plate 3 shows three areas of magnetic anomalies, referred to later as The First, Second, and Third anomalies. The First and strongest of these coincides with the "Seven-Mile" outcrop, where values range from +25,000 gammas to -2,000 gammas. The rapid alternation between positive and negative values is shown very clearly on the profile along Traverse 39N (Plate 2). The maximum length of this anomaly is about 600 feet.

The Second anomaly is about half-a-mile south of the "Seven Mile" outcrop, and is a much broader and longer anomaly, about 2,500 feet in length with a maximum value of more than 4,000 gammas at 200E on Traverse 12N.

The Third anomaly is about 2,000 feet long, and lies about half-a-mile to the south-west of the Second anomaly. The contours form a rather complicated pattern, somewhat similar to, but not as complex as, that of the first anomaly. An elongated maximum on the western side has two centres with maxima of more than 10,000 gammas and 12,000 gammas respectively, whilst on the eastern side there is a maximum of just over 3,000 gammas. The 10,000-gamma and 3,000-gamma centres are separated by a minimum with a value of less than 800 gammas.

Traverse 30S was laid across the minimum of the airborne anomaly but showed only low magnetic values, with no pronounced anomaly.

5. INTERPRETATION OF RESULTS

First anomaly.

The zone of rapidly alternating positive and negative magnetic anomalies across the "Seven Mile" outcrop coincides closely with the outcrop of iron ore. The extent of the anomalous area in the direction of strike is from traverse 34N to traverse 42N, and the width is about 500 feet. The sudden decrease from extreme values to normal values, on either side of the anomalous area on traverse 39N, indicates that the deposit is shallow and does not extend to great depth. The grade of the ore cannot be judged by the strength of the anomalies, because high-grade ore containing mainly hematite may cause weaker anomalies than lower-grade ore containing mainly magnetite.

Second anomaly.

The shape and strength of the Second anomaly (centred on Traverse 12N) indicate that it is caused by strongly magnetic material at a greater depth. The shape of the anomaly indicates a pipe-like body, elongated in a north-south direction and having a steep north-north-westerly dip. Approximate theoretical calculations (see Plate 4, profile A-A') give the following results:-

Depth to upper part of body, about 375 feet.

Depth to assumed pole, about 500 feet.

These depth calculations assume one magnetic pole only, and should therefore be taken only as first approximations.

Alternative calculations, based on the assumption that the body is polarized by induction in the earth's field, and that its effective susceptibility is of the order of 0.1 c.g.s. units, indicate that the body may extend from 350 feet to 950 feet vertical depth.

The general geological picture and the shape and strength of the anomaly suggest that the anomaly is caused by material of similar composition to that in the "Seven Mile" outcrop. Whether or not the material is of sufficient extent and grade to be of economic value can be determined only by drilling.

Third anomaly.

The configuration of the Third anomaly leads to the suggestion that the two maxima to the west are caused by separate magnetic bodies at fairly shallow depth and the eastern maximum by a magnetic body at greater depth. The shape and value of the contours indicate a fairly steep easterly dip in all three bodies. Approximate theoretical calculations (see Plate 4) give the following information.

(i) Profile B-B', for the deeper-seated body:-

Depth to upper part of body, about 410 feet.
Depth to assumed pole, about 550 feet.

(ii) Profile C-C', for northern portion of anomaly:-

Depth to upper part of body, about 60 feet.
Depth to assumed pole, about 80 feet.

(iii) Profile D-D', for southern portion of anomaly:-

Depth to upper part of body, about 130 feet.
Depth to assumed pole, about 200 feet.

The extremely rapid decrease in magnetic intensity on the western side of the anomaly indicates that the body may have a sharp footwall boundary. The sudden decrease in magnetic intensity towards the south is also worthy of note; this indicates an abrupt termination of the body in this direction such as may possibly be caused by a fault near the creek coinciding with approximately the zero magnetic contour. Two small outcrops of iron ore occur between the two maxima on the western side of this anomaly.

6. TESTING

Subsequent to the magnetic survey, three vertical drill holes were put down by the Department of Mines to test certain of the anomalies observed. The sites of these drill holes were selected by the Department of Mines on its own responsibility, based on a preliminary plot of results furnished to officers of the Department in the field. They are not the sites recommended by the Bureau. At least two of them are in positions which, from a consideration of the magnetic data, could not be expected to intersect the magnetic iron ore, which is considered to be the likely sources of the anomalies. The approximate positions of the holes, as indicated by Mr. Bartlett of the Department of Mines, are shown on Plate 3.

Core samples from the drill holes as at 30th April, 1956, were supplied by Mr. Bartlett, and 20 samples were selected for determination of magnetic susceptibility. Nine samples were tested from Drill Hole No. 1, ten from Drill

Hole No. 2, and one from Drill Hole No. 3. Susceptibility determinations were made in the geophysical laboratories of the Bureau. The results are shown in Appendix 1.

The following comments are offered on the results:-

Drill Hole No. 1.

This hole penetrated rhyodacite and andesite of low susceptibility to a depth of 112 feet. At this depth it entered magnetic material of relatively high susceptibility, which persisted to 135 feet, the lowest depth reached at the date of sampling.

Drill Hole No. 2.

This hole passed through unaltered and altered andesite to a depth of 188 feet. Although the samples show some variation in susceptibility, no material of susceptibility high enough to account for the magnetic anomaly was encountered to this depth. It is considered that this hole has been located to the footwall side of the magnetic body and it is unlikely that magnetic material will be encountered in the hole at greater depth.

Drill Hole No. 3.

This hole had reached a depth of 66 feet at the date of sampling. It was still in the weathered zone, and core recovery was poor. No material containing visible iron minerals was encountered, and it is considered that this hole has been located between the two separate magnetic bodies which correspond to the two maxima on the western side of the Third anomaly.

It is understood that all drill holes are being continued.

7. CONCLUSIONS AND RECOMMENDATIONS.

The survey disclosed three well-defined anomalies, and the results show that the iron bodies in the Nowa Nowa area exist, not as one large continuous body, but as several disconnected bodies.

The strike of the magnetic anomalies is almost the same as that of the Ordovician sediments.

The first of the anomalies, over the "Seven Mile" outcrop, arises from a magnetic body either at shallow depth or at the surface; the extent and grade of ore could be tested by trenching or shallow drilling.

The Second anomaly is more extensive, and arises from a magnetic body at greater depth. If it is considered desirable to test its composition this could be done most effectively by means of an angle drill hole located as follows:-

Collar of hole: 1380N, 140W

Bearing: 123° (true); 112° (magnetic)

Depression: 45°

This hole should intersect the body at about 400 feet vertical depth. If a vertical hole is required it should be located at 1240N, 220E; it should encounter the body at a depth not greater than 400 feet.

The Third anomaly appears to arise from three separate magnetic bodies, each of which dips to the east. Two of the bodies appear to lie within 100 feet of the surface, and the third is at rather greater depth. It is recommended that this anomaly be tested by diamond drill holes along C-C' and D-D' (see Plate 3). The following sites are suggested:

(i) D.D.H.1 should be sited on C-C', about 150 feet east of the northern centre of the anomaly. At an angle of depression of 45° and bearing 270° magnetic, this hole should intersect the deposit between 100 and 150 feet vertical depth.

(ii) D.D.H.2 should be sited on D-D', 200 to 250 feet east of the southern centre of the anomaly. At an angle of depression of 55° and bearing 270° magnetic, this hole should intersect the deposit between 200 and 250 feet vertical depth.

The drilling sites and the inclinations of the recommended drill holes take into account the positions and probable widths and dips of the magnetic bodies as indicated by the magnetic results. They should not be altered without full consideration being given to the theoretical aspects of the magnetic results. These recommendations were passed on verbally to Mr. Bartlett of the Department of Mines.

It is recommended that the magnetic survey be extended to other parts of the area in an attempt to locate anomalies that are caused by bodies at shallow depth. In particular, any likely anomalies shown up by the airborne survey in May should be followed by detailed ground magnetic surveys.

8. REFERENCES

Cochrane, G.W. and Samson, H.R., 1950 - The geology of the Nowa Nowa-South Buchan Area, Victoria, Proc.Roy.Soc. Vic., 60 (New series), 93-122.

Howitt, A.M., 1925 - Iron ore at Nowa Nowa. Rec.Geol.Surv. Vic., 4 (4), 416-422.

Whitelaw, O.A.L., 1920 - Iron ore at Nowa Nowa and Mount Tara, Rec.Geol.Surv.Vic., 4(2), 162-164.

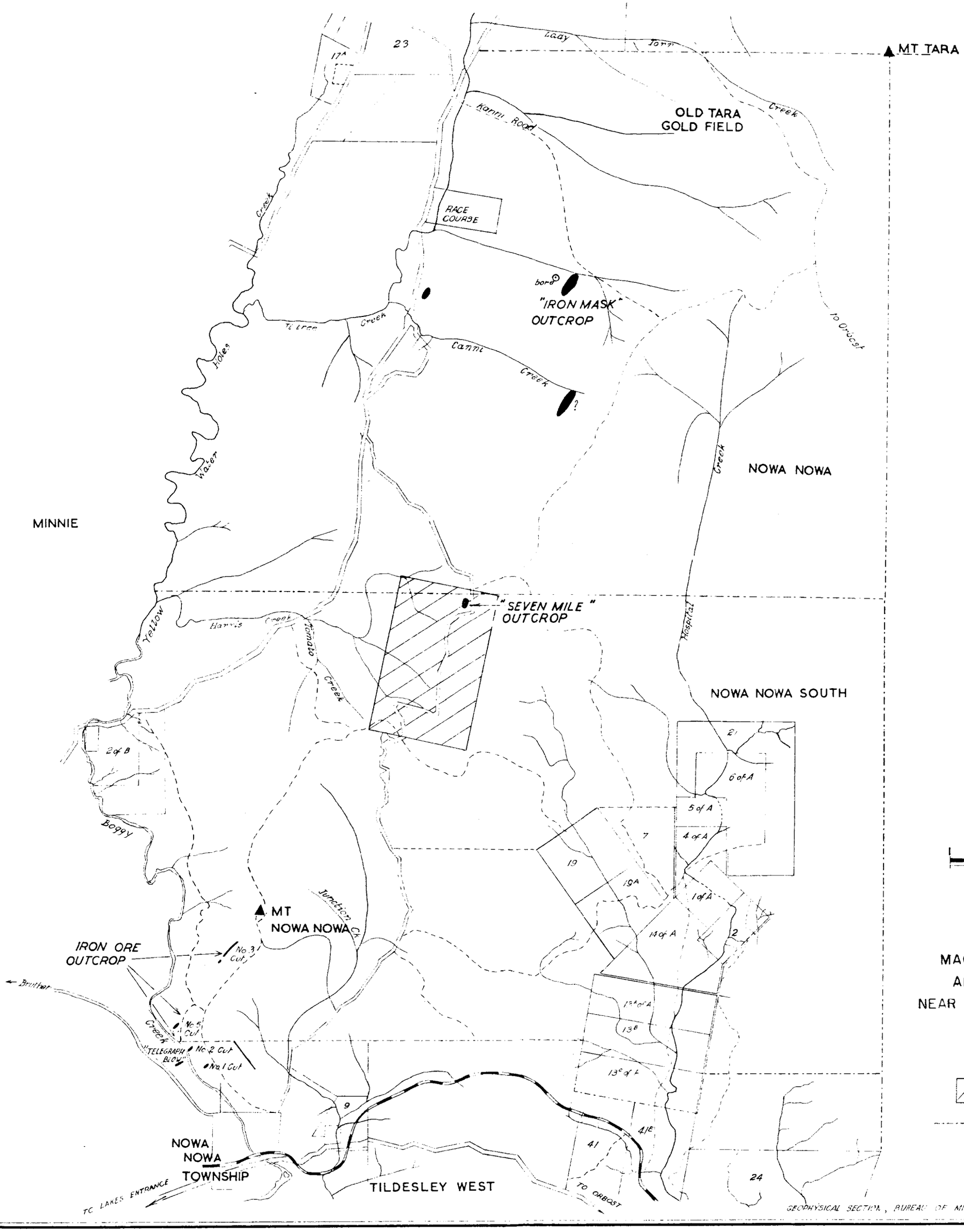
Appendix 1.

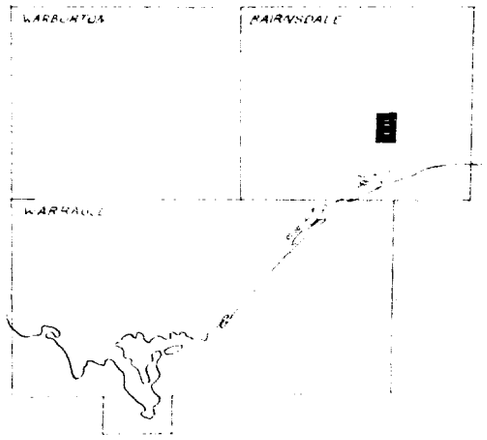
MAGNETIC SUSCEPTIBILITY OF CORE SAMPLES FROM DRILL HOLES AT NOWA NOWA.

Drill Hole No. 1

Sample No.	Depth Feet	Description	Susceptibility (c.g.s.units x10^{-3})
1	101	Andesite	0.022
2	102	"	0.079
3	107	Limonite	0.10
4	112	Hematite, Magnetite, Pyrite	37.5
5	117	Mudstone	0.01
6	123	Magnetite, Hematite, Pyrite	95
7	126	Magnetite, Hematite, Mudstone	106
8	129	Magnetite, Hematite, Mudstone	104
9	135	Hematite, Magnetite Bottom of hole	25
		Drill Hole No. 2.	
10	61	Andesite	0.01
11	64	"	0.144
12	74	"	0.192
13	85	Andesite with some Mudstone	0.056
14	102	Andesite	0.336
15	122	Altered Andesite	0.770
16	132	" "	0.288
17	161	" "	0.280
18	175	Altered Andesite with Hematite vein	0.530
19	188	Altered Andesite Bottom of hole	0.144
		Drill Hole No. 3.	
20	66	Weathered Andesite Bottom of hole	0.120

PLATE I





REFERENCE TO 4 MILE MILITARY MAP SERIES

SCALE IN MILES

1 0 1 2

MAGNETIC SURVEY OF THE "SEVEN MILE" AND ADJACENT IRON ORE DEPOSITS NEAR NOWA NOWA, EAST GIPPSLAND, VICTORIA

LOCALITY MAP

AREA INVESTIGATED

PARISH BOUNDARY

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G 223-2

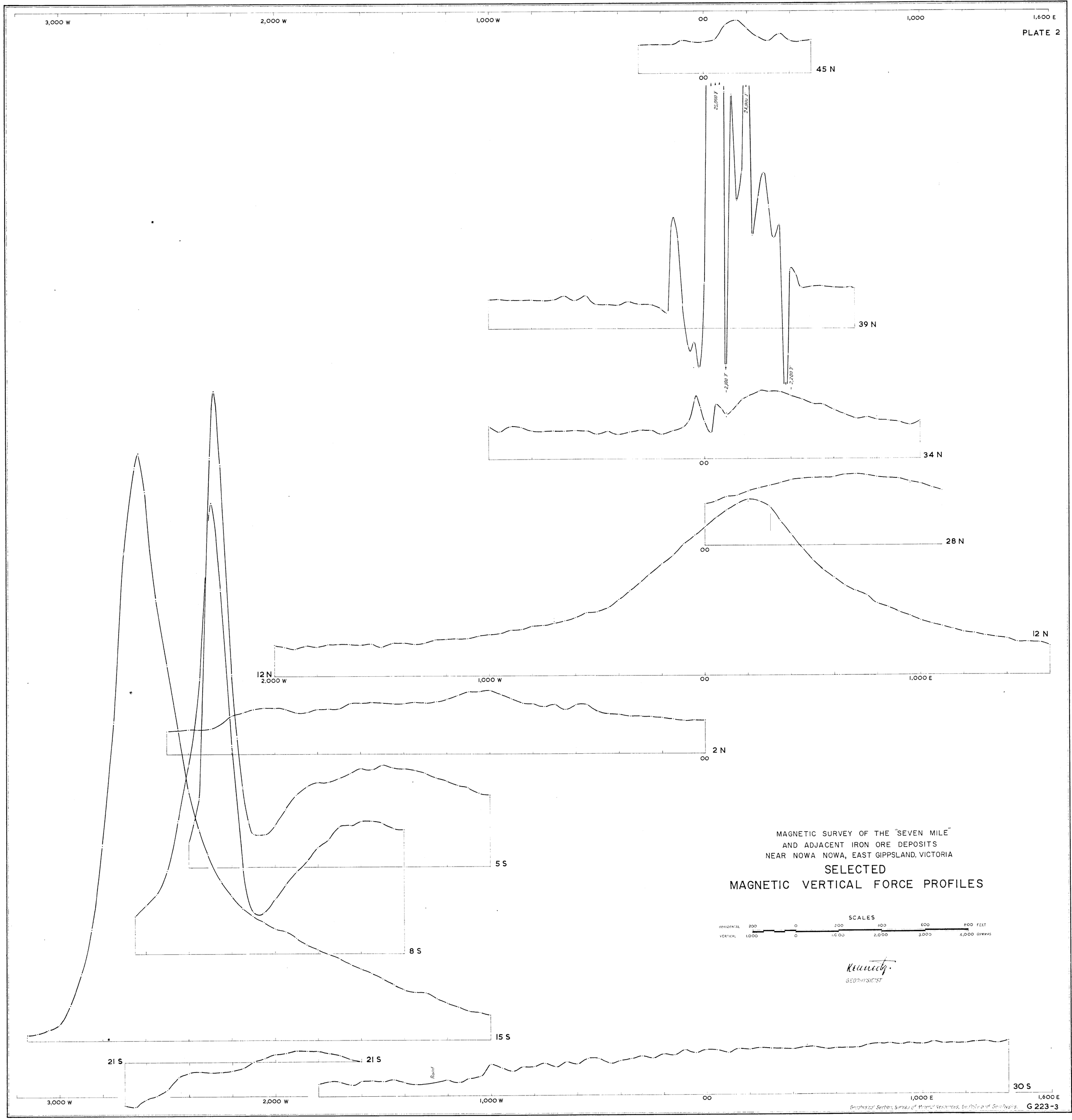
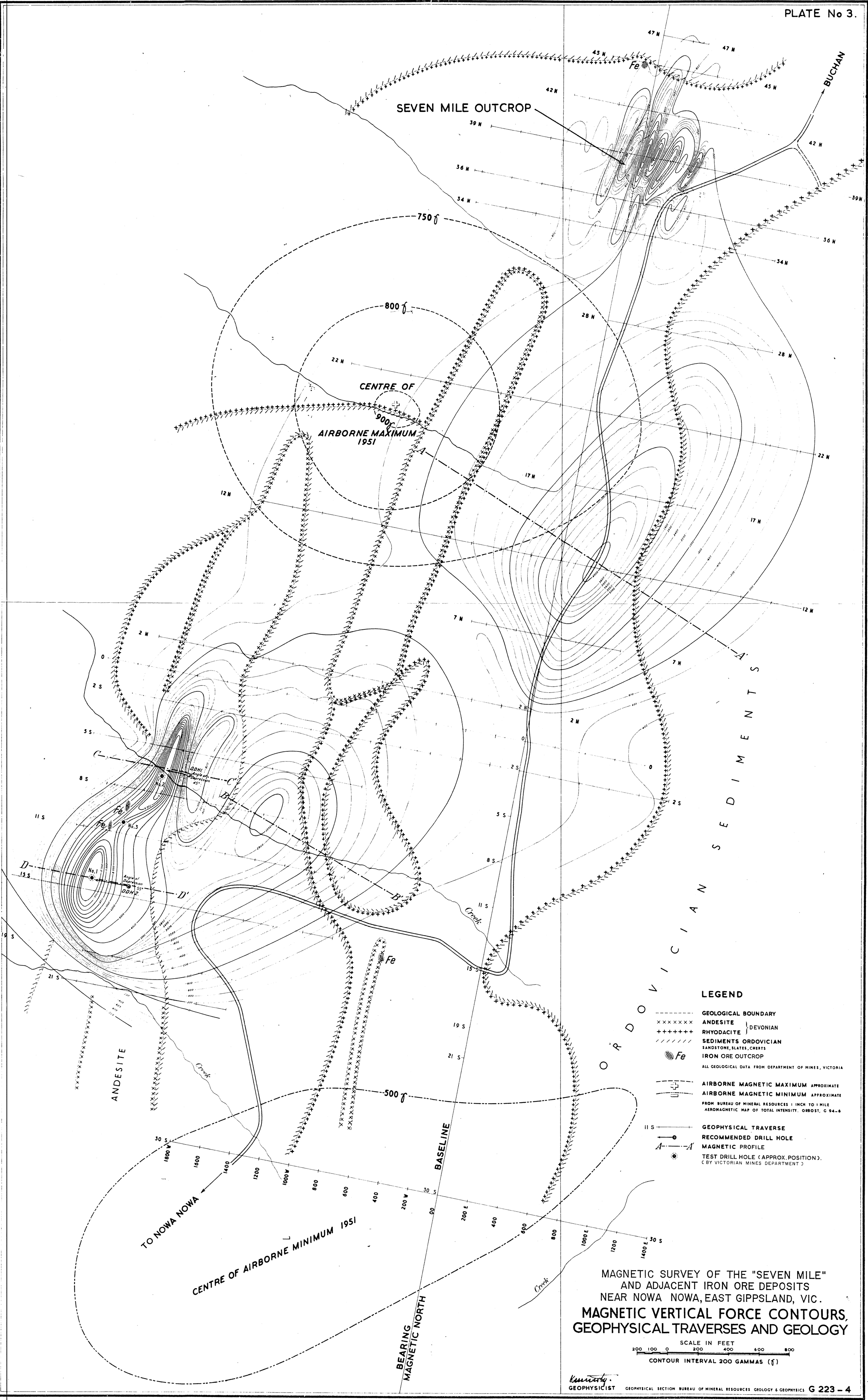
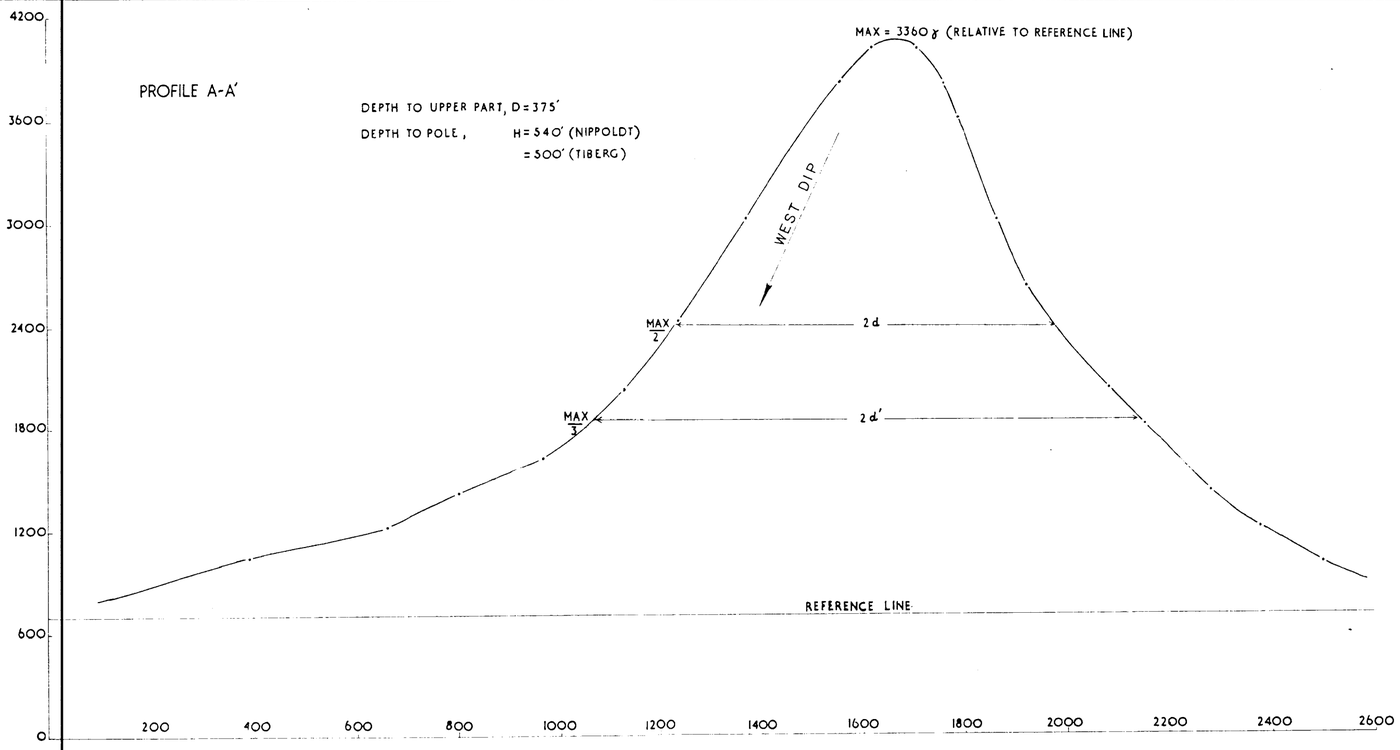
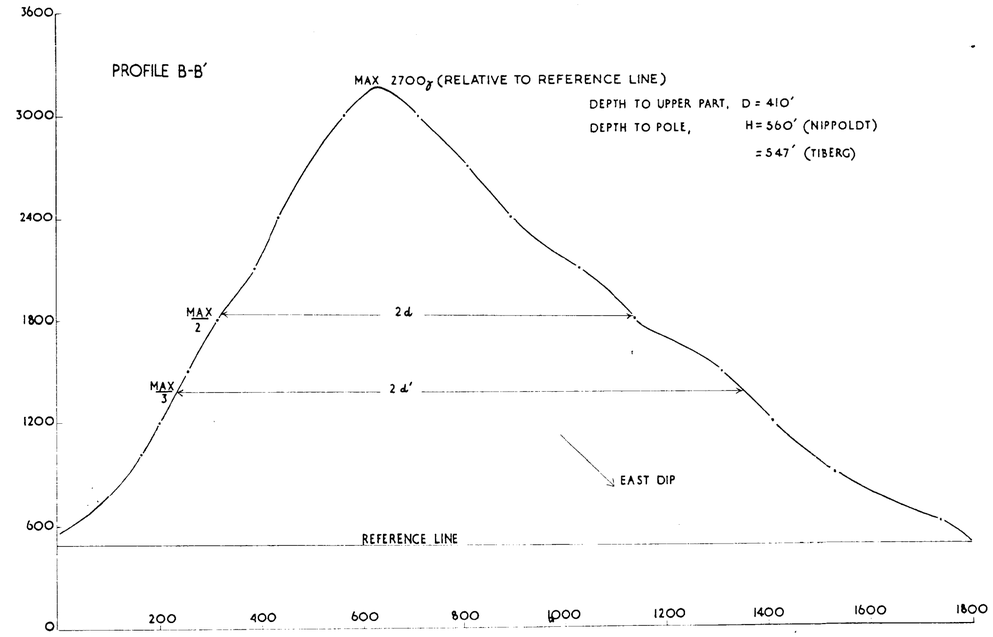


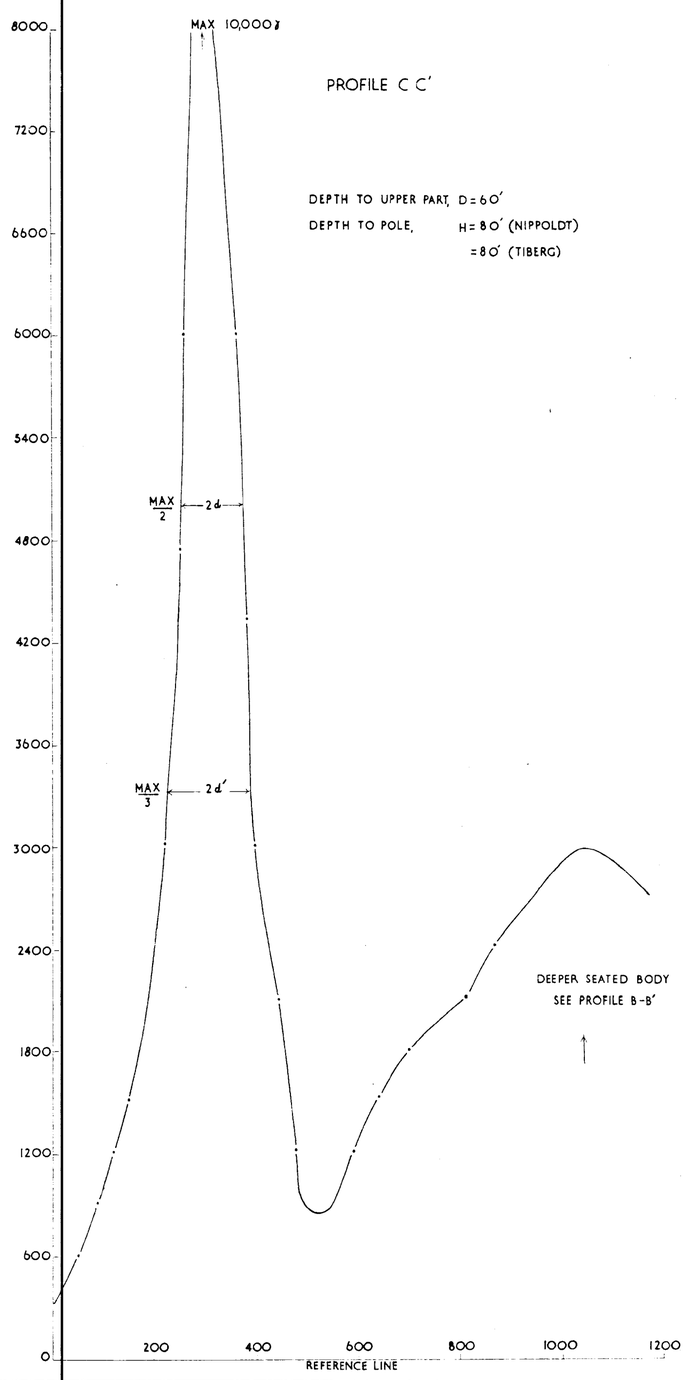
PLATE 2
3,000 W
2,000 W
1,000 W
00
1,000
1,600 E
45 N
25,000 γ
24,000 γ
39 N
-2,100 γ
-2,200 γ
34 N
28 N
12 N
2,000 W
1,000 W
1,000 E
2 N
5 S
8 S
15 S
21 S
Point
30 S
MAGNETIC SURVEY OF THE "SEVEN MILE"
AND ADJACENT IRON ORE DEPOSITS
NEAR NOWA NOWA, EAST GIPPSLAND, VICTORIA
SELECTED
MAGNETIC VERTICAL FORCE PROFILES
SCALES
HORIZONTAL 200 0 200 400 600 800 FEET
VERTICAL 1,000 0 1,000 2,000 3,000 4,000 GAMMAS
Kennedy.
GEOPHYSICIST
Geophysical Section, Bureau of Mineral Resources, Melbourne and Geophysics.
G 223-3

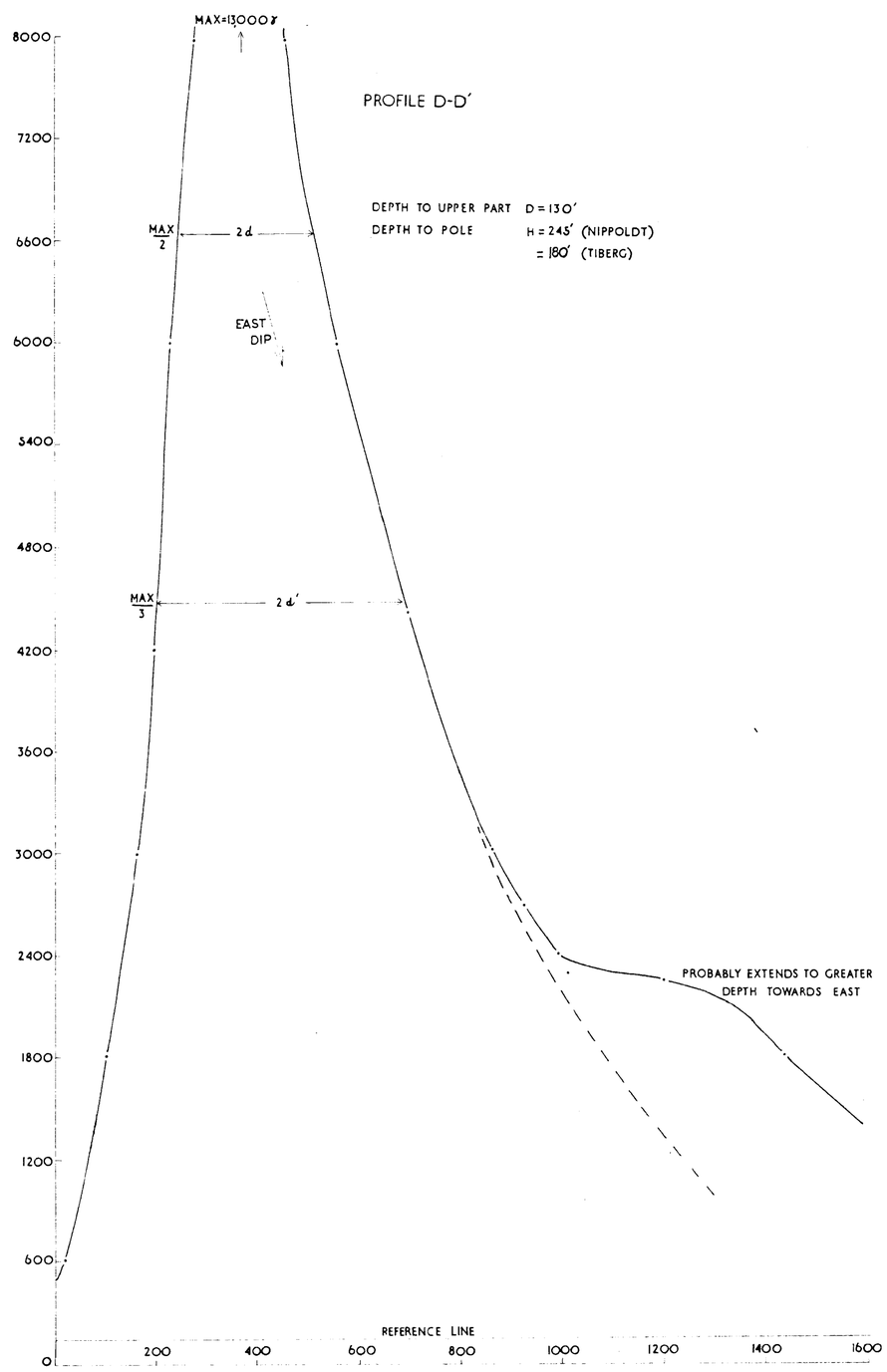
PLATE No 3.


SEVEN MILE OUTCROP
BUCHAN
750 γ
800 γ
900 γ
500 γ
CENTRE OF
AIRBORNE MAXIMUM
1951
CENTRE OF AIRBORNE MINIMUM 1951
TO NOWA NOWA
ANDESITE
ORDOVICIAN SEDIMENTS
BASELINE
BEARING
MAGNETIC NORTH
Creek
Fe
DDH1
DDH2
No.1
No.2
No.3
Angle of Depression 45°
Angle of Depression 55°
A
A'
B
B'
C
C'
D
D'
LEGEND
GEOLOGICAL BOUNDARY
ANDESITE
RHYODACITE
DEVONIAN
SEDIMENTS ORDOVICIAN
SANDSTONE, SLATES, CHERTS
IRON ORE OUTCROP
ALL GEOLOGICAL DATA FROM DEPARTMENT OF MINES, VICTORIA
AIRBORNE MAGNETIC MAXIMUM APPROXIMATE
AIRBORNE MAGNETIC MINIMUM APPROXIMATE
FROM BUREAU OF MINERAL RESOURCES 1 INCH TO 1 MILE
AEROMAGNETIC MAP OF TOTAL INTENSITY. ORBOST, G 94-6
GEOPHYSICAL TRAVERSE
RECOMMENDED DRILL HOLE
MAGNETIC PROFILE
TEST DRILL HOLE (APPROX. POSITION).
(BY VICTORIAN MINES DEPARTMENT)
MAGNETIC SURVEY OF THE "SEVEN MILE"
AND ADJACENT IRON ORE DEPOSITS
NEAR NOWA NOWA, EAST GIPPSLAND, VIC.
MAGNETIC VERTICAL FORCE CONTOURS,
GEOPHYSICAL TRAVERSES AND GEOLOGY
SCALE IN FEET
200 100 0 200 400 600 800
CONTOUR INTERVAL 200 GAMMAS (γ)
GEOPHYSICIST
GEOPHYSICAL SECTION BUREAU OF MINERAL RESOURCES GEOLOGY & GEOPHYSICS
G 223 – 4









FORMULAE USED

$2d$ = WIDTH OF ANOMALY AT $\frac{MAX}{2}$

$2d'$ = WIDTH OF ANOMALY AT $\frac{MAX}{3}$

DEPTH TO UPPER PART $D = d$ ..... (ROESSIGER AND PUZICHA, 1933)

DEPTH TO POLE $H = d'$ ..... (NIPPOLDT, 1930)

$= \frac{4d}{3}$ ..... (TIBERG, 1931)

MAGNETIC SURVEY OF THE "SEVEN MILE"
AND ADJACENT IRON ORE DEPOSITS
NEAR NOWA NOWA, EAST GIPPSLAND, VICTORIA

INTERPRETATION DIAGRAMS

SCALES

HORIZONTAL 200 0 200 400 600 800 FEET

VERTICAL 600 0 600 1200 1800 2400 GAMMAS

Kenneth Lee
GEOPHYSICIST

G 223·5

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS