COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF SUPPLY AND SHIPPING.

MINERAL RESOURCES SURVEY.

REPORT No. 1944/29.

Plans Nos. 998-1002.

REPORT ON

GEOPHYSICAL SURVEY OF KING ISLAND SCHEELITE MINE.

- By -

L.A.RICHARDSON.
Geophysicist.

CANBERRA. 22ND NOVEMBER, 1944.

1220. By Authority: L. F. JOHNSTON, Commonwealth Government Printer, Canberra.

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I. INTRODUCTION.

King Island Scheelite Mine is located on the east coast of King Island and is sixteen miles by road from Currie, the principal port on the island. The open cut method of mining is employed and the mine is an important producer of scheelite. There is scope for greatly increased production from the open cut area alone and with a view towards assessing the full possibilities of the area as a whole, geological and geophysical surveys were started concurrently by the Mineral Resources Survey Branch in June, 1942. The geophysical field work was conducted between 19th June and 10th July, 1942.

During the preliminary stages, the geophysical work was conducted by J. M. Rayner, Chief Geophysicist, Mineral Resources Survey, assisted by the writer. Upon the former's return to Canberra, field operations were continued by the writer. The magnetic method was used, employing a Watts Vertical Force Variometer.

II. GEOLOGY AND NATURE OF THE PROBLEM.

The geological survey referred to above was carried out by P. B. Nye, Assistant Director, Mineral Resources Survey, and Q. J. Henderson, Geologist, Tasmanian Mines Department. The immed- results of this survey were available in the field for the guidance of the geophysical survey and the interpretation of the results. Since the time of the field survey, geological investigations have continued and an extensive diamond drilling campaign has been completed. As a result of these investigations and the drilling, the geological knowledge of the area is considerable and provides a satisfactory basis for the correlation of the geophysical results with the geological structure.

The geology of the area is now described in a report by P. B. Nye and C. L. Knight (1943), which should be studied for a complete understanding of the geophysical problem. For the purpose of this report, Messrs. Nye and Knight have kindly prepared the following brief description of the geology of the area. The cross-section along the No. 2 line of drill holes given on plate 5 will serve to illustrate this description.

The rocks in the vicinity of the King Island Scheelite Mine belong to the Grassy series of hornfelses and are intruded on the southern side by granite, and overlain by Recent deposits of sand, etc., ranging up to 100 feet thick. The rocks of the Grassy series are folded and faulted.

To the north of the No. 3 fault, the rocks are muscovite-quartzites and spotted muscovite-quartzites. The general strike is 20 to 30 degrees and the dip at 30 to 40 degrees to the east.

South of the No. 3 fault, the rocks include many types of hornfelses. The general strike is 270 to 285 degrees, but at the eastern end of the workings, the strike is 40 degrees, the dips being to the south or southeast at 70 to 40 degrees.

A section across the mineralised zone from south to north, that is, from the hangingwall to the footwall side, is as follows:-

Actinolite-hornfels - at least 60 feet thick.

Pyroxene-garnet-hornfels - average thickness 37 feet.

Top orebody - average thickness 30 feet - mainly garnet-hornfels.

Marker beds - average thickness 13 feet - biotite-quartzite and spotted calcite-hornfels.

Bottom orebody - thickness from 48 to 110 feet - garnet-hornfels, garnet-pyroxene-hornfels; pyroxene-garnet hornfels, calcite-hornfels, etc.

Transition zone - thickness ranges from a few to 35 feet - alternating garnet-bearing hornfels and footwall hornfels.

Footwall rocks - at least 150 feet thick - thin-banded footwall hornfels.

Major faults traversing and displacing the rocks of the mineralised zone include Nos. 2, 5 and 7. The No. 8 fault is a low angle overthrust which has truncated the upper section of the mineralised zone on the northern side of the workings and brought the biotite-actinolite-hornfels (forming the overburden) above the mineralised zone.

The principal metallic mineral in the mineralised zone is scheelite. Sulphides, chiefly pyrite and pyrrhotite, are present in very small amounts.

Magnetite, hematite, ilmenite and probably titanhematite occur in the hangingwall actinolite-hornfels; iron ore in the biotite-actinolite-hornfels in the overburden; ilmenite in the biotite-quartzite and the calcite-actinolite-hornfels of the mineralised zone; and iron ore in the calcite-actinolite-hornfels of the mineralised zone.

The main aim of the geophysical survey was to trace the course of the rocks of the mineralised zone and adjacent beds along their strike to the west of the open cut. Preliminary tests in the office showed that the garnet ore was slightly magnetic and it seemed possible that small magnetic anomalies might be produced by these beds. It was decided to apply only the geomagnetic method in the first instance. The field survey revealed that the garnet beds had no pronounced magnetic effects, but that magnetic anomalies were obtained from rocks now known to be actinolite-hornfelses. The significance of such anomalies in the light of existing geological knowledge of the area is described in this report.

The presence of magnetic material in the form of galvanized iron buildings, scrap iron dumps, compressed air pipes, truck lines, etc., caused much local disturbance and made it impossible in certain parts to measure the true intensity variations due to the rocks.

III. MAGNETIC PROPERTIES OF THE ROCKS.

During the course of the drilling campaign at King Island, specimens of drill cores representing the various types of hornfelses were made available, and an investigation of their magnetic properties was undertaken by the writer. The results of these investigations are summarised below:-

a. Hangingwall Actinolite-Hornfels. This rock exhibits magnetic susceptibility of a high order and is the most magnetic of the rocks concerned. Susceptibility values ranging from .004 to .018 appear to be typical. A few samples showed much lower values. Permanent magnetisation is pronounced is most samples, but is usually of minor intensity compared to the magnetisation due to induction in the earth's magnetic field.

b. Biotite-Hornfels. The susceptibility of this rock appears to be variable, but it is usually much lower than that of the actinolite-hornfels.

c. Pyroxene Rock. All samples of this rock available for tests showed magnetic susceptibility of the order .0001 and no pronounced anomaly can be expected from this material.

d. Garnet Rock. No satisfactory drill core specimens of typical garnet rock were available for tests and determinations on this material are incomplete. However, all available evidence suggests an average susceptibility of .0005 or less.

e. Calcite-Hornfels. This rock, which occurs within the ore zone and in drill hole No. 48 (in the hangingwall rocks) shows varying susceptibility. The rock from the ore zone has very low susceptibility, while that from drill hole No. 48 shows susceptibility of the order of .002 and permanent magnetisation is appreciable.

f. Geological Marker Beds. These beds form a band up to about 13 feet in width within the ore zone and include biotite-quartzite and spotted calcite-hornfels. The susceptibility of the biotite-quartzite is variable and ranges up to the relatively high figure of 0.008, but spotted calcite-hornfels appears to be much lower. Permanent magnetisation is appreciable in the biotite-quartzite.

g. Footwall Actinolite-Hornfels. The susceptibility is fairly consistently below .0001 and this rock is probably the least magnetic of those concerned.

The variations in the susceptibility of the rocks is due principally to the varying magnetite and ilmenite content.

Data given above re magnetic properties of the rocks, serves as a guide to interpretation of the geomagnetic survey results. However, the number of specimens tested to date is not sufficient for a complete analysis of the conditions.

IV. CALCULATION OF MAGNETIC ANOMALIES.

Before considering the survey results it is proposed to describe methods in use for the calculation of magnetic anomalies due to bodies of comparable size and susceptibility with those at King Island scheelite mine.

Hallimond (1933), Gulatee (1938) and earlier workers have listed expressions to give the magnetic anomalies due to wide dykes of infinite length by considering the dyke to be a body of uniformly magnetised material (magnetised by induction in the earth's magnetic field) bounded by plane surfaces. The effect of each surface is calculated for the point of observation and the total magnetic anomaly is obtained as a sum of a number of terms each representing the anomaly due to one of the surfaces. If the body is given infinite depth, the effect of the bottom surface is negligible. Gulatee also gives expressions for calculating anomalies due to spheres, cylinders, faults, inclined slabs, etc.

The expressions used by Hallimond are of much practical importance and his work is, therefore, reproduced here in a general form suitable for southern hemisphere conditions.

Consider a subsurface body with a magnetic east-west strike and extending to infinity in both directions. A north-south cross-section of such a body is shown in text figure 1.

Let F = Total force of earth's magnetic field directed upwards.

i = Magnetic inclination.

ϕ = Dip of anomaly body.

B = Angle between magnetic meridian and the direction of traverse which is normal to the strike of the anomaly body.

dZ = Vertical component of anomaly.

dH = Horizontal " " "

K = Susceptibility of material comprising anomaly body.

I_t = Intensity of magnetisation on top and bottom of anomaly body = KF Sin i.

I_s = Intensity of magnetisation on sides of anomaly body = KF Sin (i - ϕ) Cos B.

The position of the point P relative to the body is determined by the distances r and the directions θ, as indicated in the figure 1.

The angles θ_1, θ_2, θ_3 and θ_4 are measured in radians. The anomaly at the point P is determined for each face separately as below.

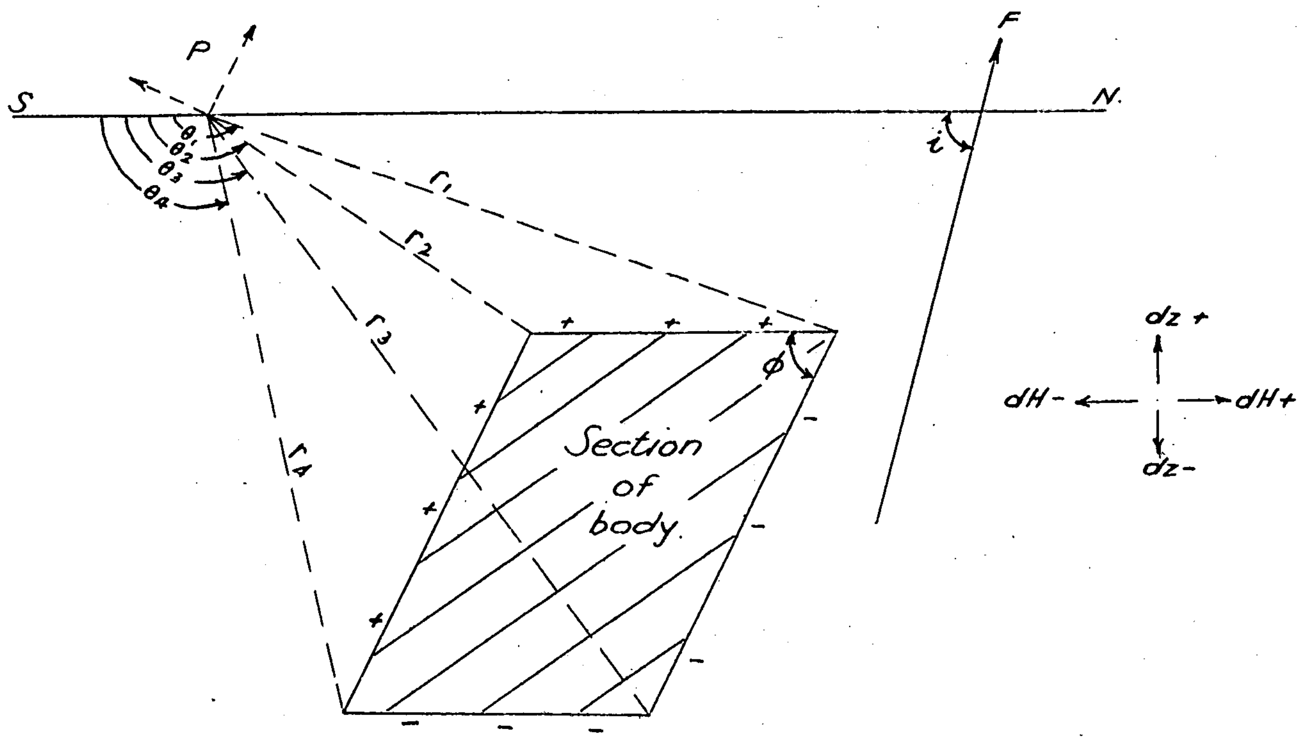

Fig. 1.

a. Top of anomaly body.

$$dz = 2I_t\,(\theta_1 - \theta_2) \qquad dH = -2I_t \log_e \frac{r_1}{r_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

b. Bottom of anomaly body.

$$dz = -2I_t\,(\theta_3 - \theta_4) \qquad dH = 2I_t \log_e \frac{r_3}{r_4} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

c. Southern side of anomaly body.

Anomaly component normal to the side = $2I_s(\theta_2 - \theta_4)$ in the direction shown by arrow.

Anomaly component parallel to the side = $2I_s \log_e \frac{r_4}{r_2}$ in the direction as shown by arrow.

Resolving in the vertical and horizontal directions for dZ and dH.

$$dZ = 2I_s\,(\theta_2 - \theta_4)\cos\phi + 2I_s \log_e \frac{r_4}{r_2} \sin\phi \quad \ldots\ldots\ldots\ldots \Big\}\ (3)$$

$$dH = -2I_s\,(\theta_2-\theta_4)\,\text{Sin}\,\phi + 2I_s\,\log_e \frac{r_4}{r_2}\,\text{Cos}\,\phi \quad (3)$$

d. Northern side of anomaly body.

$$\left.\begin{aligned} dZ &= -2I_s\,(\theta_1-\theta_3)\,\text{Cos}\,\phi - 2I_s\,\log_e \frac{r_3}{r_1}\,\text{Sin}\,\phi \\ dH &= 2I_s\,(\theta_1-\theta_3)\,\text{Sin}\,\phi - 2I_s\,\log_e \frac{r_3}{r_1}\,\text{Cos}\,\phi \end{aligned}\right\} \quad (4)$$

The total anomaly for the four sides becomes -

$$\left.\begin{aligned} dZ &= 2I_t(\theta_1-\theta_2-\theta_3+\theta_4)+2I_s\text{Cos}\,\phi\,(\theta_2-\theta_4-\theta_1+\theta_3)+2I_s\,\text{Sin}\,\phi\,\log_e\frac{r_4}{r_2}.\frac{r_1}{r_3} \\ dH &= 2I_t\log_e\frac{r_3}{r_4}.\frac{r_2}{r_1} - 2I_s\,\text{Sin}\,\phi\,(\theta_2-\theta_4-\theta_1+\theta_3)+2I_s\,\text{Cos}\,\phi\,\log_e\frac{r_4}{r_2}.\frac{r_1}{r_3} \end{aligned}\right\} \quad (5)$$

When the anomaly body extends to infinite depth, the effect of the bottom side is negligible since $r_3 = r_4$ and $\theta_3 = \theta_4$. The above expressions then become -

$$\left.\begin{aligned} dZ &= 2I_t\,(\theta_1-\theta_2) - 2I_s(\theta_1-\theta_2)\,\text{Cos}\,\phi + 2I_s\log_e\frac{r_1}{r_2}\,\text{Sin}\,\phi \\ dH &= 2I_t\,\log_e\frac{r_2}{r_1} + 2I_s\,(\theta_1-\theta_2)\,\text{Sin}\,\phi + 2I_s\,\log_e\frac{r_1}{r_2}\,\text{Cos}\,\phi \end{aligned}\right\} \quad (6)$$

When $\phi = i$, the intensity of magnetisation on the sides is zero and dZ and dH are left with the first term in each case.

When $\phi < i$, which is the case dealt with above, each term will have sign as shown above.

When $\phi > i$, the sign of the terms containing I_s will be reversed except when $\phi > 90$ degrees when the I_s terms containing Cos ϕ will be as above.

The above method may become laborious when the anomaly body has irregular shape and for these cases a polar chart is a useful aid. Polar charts for calculating magnetic anomalies due to two-dimensional bodies have been described by Happe (1935), Pirson (1940) and others. Pirson assumes a cylindrical distribution of elementary magnetic dipoles and derives an expression for the magnetic anomaly due to an infinite magnetic cylinder of elementary cross section. A polar chart is constructed for the evaluation of the expression and can be used for any cross sectional shape of anomaly body. As the expression for the anomaly components is similar to that giving gravity gradient anomalies for equivalent two dimensional cases, the polar chart may be used also for computing gravity gradient anomalies.

Pirson has extended his investigations to three-dimensional cases and describes how these may be handled with the aid of special polar charts and graphs. It is stated that by this means the anomaly due to basement ridges of finite length may be evaluated. Attention is drawn to the necessity of interchanging the position of Cos e and Sin e in Pirson's equations 13 and 14, as given in the above reference.

Figure 2 shows vertical and horizontal component profiles calculated by Hallimond's method for bodies of infinite depth extent and attitude and section as shown. Susceptibility is assumed to be .004, and the magnetic elements used are the figures for King Island, viz. F = .617 gauss, Inclination = 70°.

V. DESCRIPTION OF THE GEOMAGNETIC SURVEY RESULTS.

Plate 1 shows the traverses and all variometer stations, and for each station the reduced value of vertical force component relative to the value at the main base station, 0/0.

Plates 2 and 3 show magnetic profiles representing vertical force component variations along the traverse lines.

Plate 4 shows the magnetic survey results in the form of isodynamic lines representing lines of equal vertical force component.

It will be clearly observed on Plate 4 that anomalies in the vertical force component are present in the form of:-

a. Pronounced increased vertical force over certain areas forming what are referred to as the Southern and the Northern anomalies. (The latter includes the North-Eastern and North-Western anomalies).

b. Less pronounced, but definite, decreased vertical force occurring within the open cut and on the south side of the Northern anomalies referred to above.

c. Pronounced, but small, increased vertical force over narrow zones centred at 255E/50N, 255E/125N and 390E/00,

The increased vertical force anomalies which may be called 'positive' anomalies, are due to the presence of a rock formation exhibiting high magnetic susceptibility or intense permanent magnetisation, or both.

The decreased vertical force anomaly forming 'negative' anomaly, represents, in this case, an integral part of an adjoining positive anomaly and is thus not a separate feature.

The positive anomalies found on traverses 255E and 390E can be correlated in each case with the Marker beds (geological), the biotite quartzite of which, in some parts, has a relatively high susceptibility and permanent magnetisation. No similar anomaly is found on traverse 100E at the indicated position of the Marker beds (geological section line 2). Presumably the 25 feet of sand cover overlying the Marker beds at this place is sufficient to substantially reduce the anomaly at the surface due to this thin bed. It is apparent that because there are considerable thicknesses of sand, the geological Marker beds cannot be used as geophysical Marker beds also.

Plate 5 shows geological section line No. 2 as prepared by Messrs. P. B. Nye and C. L. Knight and also the profile of magnetic vertical force along that line taken from the map of isodynamic lines (Plate 4).

Using the methods outlined in the previous section, vertical force component anomalies have been calculated for bodies of such a shape that there is substantial agreement between the calculated and observed magnetic profiles. Such profiles for the Southern and the North-Eastern anomalies are shown on Plate 5. This work is intended as an illustration only of method and it is applicable in this case only in a qualitative way since the finite strike extent of the bodies and the irregularities in depth of sand cover over the bodies produce serious departures from the two-dimensional conditions for which the calculations are designed.

The body of assumed shape at the southern end of the section representing the bed of actinolite-hornfels and assumed to be responsible for the Southern anomaly, is drawn without regard for any effect of the southerly extension, at depth, of fault No. 8. It is possible that this fault has brought biotite-actinolite-hornfels, actinolite-hornfels or other hornfelses into the position represented by the upper southern corner of the shaded areas.

It should be noted that a stratigraphic width of 112 feet has been assumed, whereas the greatest width of actinolite-hornfels so far proved by drill holes on the southern side of the mineralised zone is 60 feet. This statement does not imply, however, that greater widths may not be eventually proved to exist. It should further be noted that no drill holes penetrate the position of this assumed body on line 2 and so it cannot be stated whether actinolite-hornfels is present or not. At least 50 feet of actinolite-hornfels have been proved by one drill hole on line 3 about 140 feet to the east, but in the corresponding place on line 1 about 140 feet to the west, 25 feet of biotite-hornfels have been proved. These drill holes have tested the rocks with a width of about 60 feet immediately above the pyroxene-garnet-hornfels - the rocks above the 60 feet width have not been tested and may include actinolite-hornfels.

The correlation between geological and geophysical data as illustrated on Plate 5 is an important guide in interpretation of the geophysical survey, but it does not tell the whole story because the correlation is not complete. In the case of the Northern anomaly on Section line No. 2, the area shown shaded is, generally speaking, acceptable from a geological point of view as a representation of the body of actinolite-hornfels assumed to be responsible for this anomaly. The Southern anomaly body shown shaded, on the other hand, can be correlated with known geology only in so far as the position of the northern edge of the body and its dip are concerned and even in these aspects the correlation is not exact. As explained above, on this Section line, as on most others, little is known about the maximum thickness of the hangingwall actinolite-hornfels (if present) or the identity of the adjacent rock on the south side of the hangingwall actinolite-hornfels. Consequently it is not known to what extent the Southern anomaly is due to the hangingwall actinolite-hornfels. Various possibilities exist depending largely on the nature of Fault No. 8 and its effect on the hangingwall actinolite-hornfels. It may be that the dip of this fault has steepened to the south-east and the area shown shaded may be occupied largely by unknown rocks with high susceptibilities, lying above Fault No. 8. Any anomaly due to biotite-actinolite-hornfels lying above Fault No. 8 is disregarded for the present because available field evidence and data concerning the magnetic properties of the rocks definitely known to exist on the area, shows that the biotite-actinolite-hornfels is commonly only slightly magnetic, whereas, the actinolite-hornfels is the only one which has sufficient magnetisation and sufficient thickness to account for the anomalies. It is expected that further light on this subject will be obtained later when laboratory investigations of drill core specimens are resumed, although it is desirable that information be obtained from parts to the south of the southern limit of drilling.

If the actinolite-hornfels is responsible for the Southern anomaly, then some diagnostic value can be attached to the latter because the hangingwall actinolite-hornfels is one of the series of hornfelses and can be regarded as a strike feature. Consequently any anomaly due to this bed would serve as a geophysical marker indicative of structural features of the hornfelses including the mineralised zone. On the other hand, anomaly due to any rock above the No. 8 fault would not materially assist in determining structure of the hornfelses including the mineralised zone because it is not structurally conformable with same. The anomalies are described in detail below:-

<u>Southern Anomaly.</u> The Southern anomaly is the magnetic feature exhibiting increased intensity over an area to the south of the base line and extending from about 650 W to about 420 E and thence irregularly to the eastern limit of the survey. The feature is shown on Plate 4 by the yellow, brown and red colours over this area. The form of the isodynamic lines between traverses 120W and 372W is very uncertain due to local disturbance caused by galvanised iron buildings. For this reason the dynamic lines are shown broken in this part of the area.

Considering this anomaly as a whole and on the assumption that it is due to an inclined tabular bed of actinolite-hornfels, the following conclusions are apparent.

The anomaly terminates abruptly at its western end at about 625W indicating the termination of the actinolite-hornfels or of its magnetite content. The small area of increased vertical force centred at 560W/30N may be due to actinolite-hornfels and some support is given to this view by the results of drill hole No. 21 which shows 8 feet of "decomposed slate" overlying "pyroxene rock" and with only 10 feet of sand and gravel cover. Geological opinion is that the "decomposed slate" probably represents hornfels overlying pyroxene-garnet-hornfels and may possibly, therefore, be the hangingwall actinolite-hornfels. The possible existence of actinolite-hornfels so far north may be explained by faulting or absence of deep erosion affecting the actinolite-hornfels compared to parts further south (vide Geological Section line No. 5). If faulting is responsible, the ore zone may also be affected, but it seems unlikely that there will be any large displacement.

It can be concluded that the bed responsible for the Southern Anomaly terminates at about 625W or the bed loses its magnetite content at about that part. The significance of this in terms of structure affecting the ore zone, assuming that the Anomaly is due to the hangingwall actinolite-hornfels, can be summarised as below.

1. If the anomaly termination is due to faulting, it is likely that the ore zone would also be affected. Presumably, the displacement associated with any such faulting must be regarded as sufficient to have removed the western fault block outside the area of the survey or a considerable distance vertically.

2. If the anomaly termination is due to loss of magnetite content of the actinolite-hornfels, the feature would be of no structural significance and of no significance in terms of ore unless it could be established that the magnetite content of the actinolite-hornfels is due to the same mineralising agencies as the scheelite in the ore zone. In the light of present information, geological opinion does not consider that there is a relationship between the magnetite content of the actinolite-hornfels and the mineralisation.

The most intense part of the Southern anomaly is found on Traverse 328E. In this region not only is the anomaly most intense, but irregularity is found which is apparently not a feature of the anomaly elsewhere. The isodynamic lines on Plate 4 show this irregularity extending over an area between Traverses 180E and 390E. It is possible that even more anomaly-irregularity over this area might be revealed by a more detailed survey.

Referring to Plate 4, it is clear that from a geophysical point of view there is a marked change in subsurface conditions concerning the actinolite-hornfels bed along Geological Section Line No. 4 as compared with those on Line No. 2. The broad anomaly of 500 gammas is replaced by a much more narrow anomaly of 1000 gammas centred at about 328E/132S and a separate area of increased vertical force at the southern end of Line No. 4.

A factor which is probably largely responsible for the increased vertical force near Traverse 328E is the small thickness of sand cover overlying the actinolite-hornfels in that vicinity. It is possible that this factor also has a bearing on the anomaly irregularities above referred to, because the effects of any prominent inhomogeneities in magnetite content present in or near the top of the actinolite-hornfels would be most apparent in the survey results where the overburden thickness is small. An alternative explanation for the anomaly irregularity would be the presence of beds other than actinolite-hornfels introduced possibly as a result of faulting. In the light of our present knowledge no structural information can be deduced from the irregularities.

Referring again to Plate 4, a comparison of geophysical results along Geological Section Lines Nos. 4 and 7 indicates the termination of the actinolite-hornfels or of its magnetite content between these two lines, say at about 390E. The intensity of the anomaly would be reduced to the east of 390E due to increasing depth of sand cover, but the actual termination of the anomaly would not be caused by this factor alone.

If it is assumed that that part of the Southern anomaly situated to the southwest, south and southeast of the office building as shown on Plate 4, is due to the same actinolite-hornfels bed assumed to be responsible for the western part of the anomaly, the disposition of the anomaly near the office building indicates a southerly displacement of the actinolite-hornfels.

Of interest in connection with this possibility is the calcite-hornfels exhibiting appreciable susceptibility and pronounced permanent magnetisation found overlying actinolite-hornfels in Drill Hole No. 48. The extent to which this material instead of the actinolite-hornfels, has contributed towards the increased intensity under discussion, to the south and southeast of the office may be considerable.

It will be noticed on Plate 1 that few variometer readings were made near the office and to the south of it. This was due to the presence of magnetic material in the form of buildings and scrap iron dumps and difficult terrain due to steep dump sides. Consequently there is some uncertainty regarding the position of the isodynamic lines as shown in this vicinity. Where uncertain, the lines are shown broken. It is considered, however, that the uncertainty applies more to detail rather than to the general trend of the lines.

<u>Northern Anomalies.</u> Of the two Northern anomalies, the Northeastern one is produced by a lens-like body of actinolite-hornfels, the presence of which has been proved by drill holes 24, 26, 27 and 33. This actinolite-hornfels is distinct from the hangingwall actinolite-hornfels. In general, it would appear that the Northwestern anomaly is caused by a similar rock. However, there is no geological evidence as to the rocks causing this anomaly except that from the adjacent drill hole 19 in which hornfels was revealed.

Considering first the Northeastern anomaly where the southern limit of the actinolite-hornfels responsible for the anomaly is determined by Fault No. 2, it is apparent that the northwestern extension of No. 2 Fault from its known position in the open-cut can be approximately gauged by means of the geophysical results. This extension representing the near-surface position of the fault, is shown on Plate 4 and it agrees well with the position of No. 2 Fault shown on the Geological plan of the 150-foot level. Topography and dip of the fault presumably are responsible for the departure of these two positions at the western end.

The "Probable fault with down-throw to the north" (shown on the 150-foot level Geological Plan)apparently forms the northern boundary of the actinolite-hornfels and the lens-like shape of the western parts of the anomaly suggests that this fault and the No. 2 fault junction at about the position shown on Plate 4.

With regard to the Northwestern anomaly, it is probable that again the position of faulting on the southern side may be fixed by means of the geophysical survey, on the basis of curve-fitting similar to that for Section line 2 shown on Plate 3. It is suggested that the fault is that resulting from the junction of the "Probable fault" and the No. 2 fault and which continues westerly with the strike of the former. This fault would form the southern boundary of the actinolite-hornfels causing this anomaly. It is possible that a fault may be present on the northern side of this anomaly as in the case of the Northeastern one.

From the geological aspect the region containing these two anomalies is considered to be of little importance in connection with ore occurrence as they are caused by rocks which are partly, if not wholly, above the No. 8 fault, and the anomalies need not be further considered.

As mentioned earlier, the foregoing discussion of the Southern and Northern anomalies is based on the assumption that the actinolite-hornfels is primarily responsible for the anomalies. This assumption is supported by aspects of correlation between known geology and geophysical results and by laboratory tests completed to date on drill core specimens. However, Mr. P. B. Nye has recently pointed out other possibilities, some of which are mentioned on pages 6 and 7. These involve the assumption that the Southern anomaly may be largely or wholly due to rocks above the No. 8 fault (overburden rocks) and brought by No. 8 fault into a position normally occupied by the upper part of thg hangingwall actinolite-hornfels. If this is correct, the termination and irregularity of the anomaly at its western end might be due to erosion of the overburden rock, and the easterly termination, at about 390E, could be due to the termination of the overburden rock on No. 8 fault. If the overburden rock is responsible, the anomalies would have little structural significance as regards the ore zone because the overburden rock is above the No. 8 fault and the strikes above and below that fault need not necessarily be the same.

VI. SUMMARY AND CONCLUSIONS.

The geomagnetic survey completed to date at King Island Scheelite mine may now be regarded primarily as a test survey because recent intense exploration by diamond drilling has covered a large portion of the area surveyed. The geological determinations following the drilling and now presented in detail on plans and sections, provide a satisfactory basis for the determination of certain criteria which may be used in the interpretation of the geophysical results.

Some uncertainty, however, still exists on the southern side of the area regarding the distribution of actinolite-hornfels or other magnetic rocks which may have contributed towards the Southern Anomaly and the part played by Fault No. 8 in such distribution. Further light on the distribution of magnetic rocks may be obtained when additional laboratory work on drill core specimens is completed.

The principal features of the geomagnetic survey is the anomaly believed to be associated with the actinolite-hornfels, because that rock appears to be outstanding among the hornfelses as regards magnetic properties. The anomaly, if due to the actinolite-hornfels, represents an expression of geology which can be used to deduce the existence of certain broad geological relationships of importance. These are briefly outlined below.

1. The apparent ending of the hangingwall actinolite-hornfels or of its magnetite content at 625W which may or may not denote a similar ending of the ore zone.

2. The possible southerly displacement of the hangingwall actinolite-hornfels in the vicinity of the mine office building.

3. Faulting may be postulated to account for the western termination of the North-western anomaly. Elsewhere on these northern anomalies interpretation may be made to show good agreement with known geological structure.

The desirability of continuation of the geophysical survey to the west cannot be satisfactorily determined until the significance of results to date in terms of ore or geological structure is proved. Further diamond drilling suitably located on the area of the Southern anomaly and immediately to the west of it would probably supply such proof. It would be useful to extend the geophysical work southerly and westerly to embrace the granite contact.

If the extended survey showed that the granite contact could be detected geomagnetically, it would be useful to trace the contact where there are no exposures of bedrock and particularly to determine whether there is a northerly extension of the granite which could be responsible for the abrupt westerly termination of the Southern anomaly.

The survey should be extended to the west for 30 chains to include the ridge on which actinolite-hornfels is common and specimens of which exhibit strong magnetic properties.

It is desired to express appreciation for the co-operation and valued assistance of Messrs. P. B. Nye and C. L. Knight in connection with all geological aspects of the studies and to gratefully acknowledge the help provided by Messrs. J. M. Rayner and R. F. Thyer on the geophysical side.

CANBERRA, A.C.T.
22nd November, 1944.

L. A. RICHARDSON,
Geophysicist.

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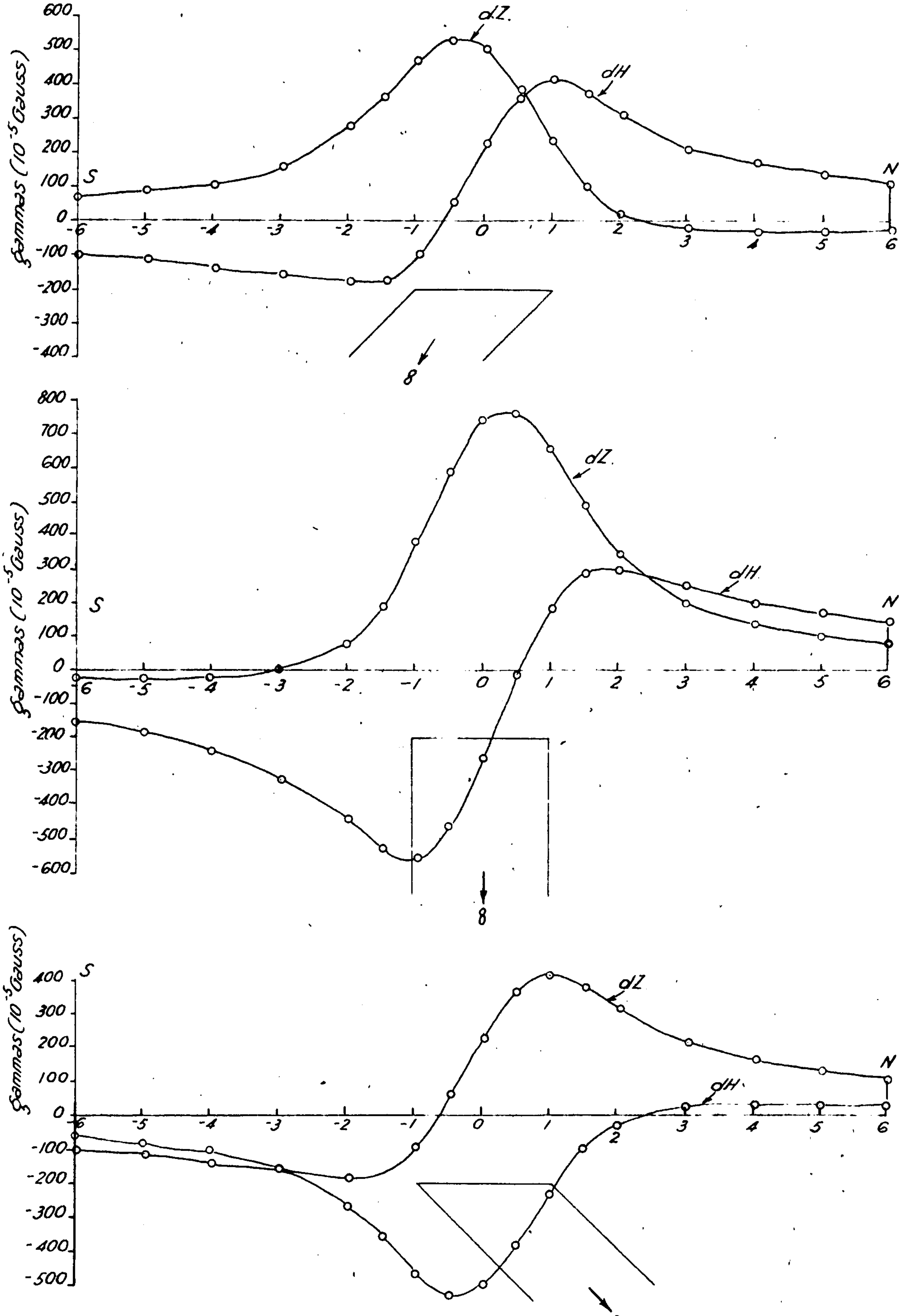
FIG. 2.



Profiles showing vertical (dZ.) & horizontal (dH.) anomalies along N.-S (magnetic) traverses, due to wide dyke-like bodies of infinite strike extent in E-W direction (magnetic), of dimensions & attitude as shown, of susceptibility ·004 c.g.s. units & situated in an inducing field of intensity 0·617 Gauss dipping to the south at 70°.

Plate 1
KING ISLAND SCHEELITE MINE
GEOPHYSICAL SURVEY
PLAN OF AREA SHOWING SURFACE FEATURES
POSITION OF VARIOMETER STATIONS AND
REDUCED VALUE OF MAGNETIC VERTICAL FORCE (in gammas)
RELATIVE TO THE VALUE AT THE BASE STATION 0/0.
SCALE 1 INCH = 100 FT.
M.N.
OPEN CUT
Tank
Fence
ROADWAY
BASE LINE 90° MAG
870W
700W
550W
370W
280W
180W
120W
60W
0/0
50E
100E
190E
255E
320E
390E
420E
496E
600E
690E
Fence approximately on southern boundary of 220P/M
220P/M
1198B/M
Peg found
998
Geophysicist
Mineral Resources Survey Branch
Dec. 1943


KING ISLAND SCHEELITE MINE
PROFILES SHOWING VARIATIONS IN THE VERTICAL COMPONENT OF THE EARTH'S MAGNETIC FIELD ALONG TRAVERSES AS SHOWN ON PLATE I.
Scales:- Hor. 1" = 100 feet
Vert. 1" = 200 gammas
Note - Smoothing of profiles for purpose of drawing isodynamic lines shown thus :-
800S
600S
400S
200S
0
200N
400N
600N
800N
Trav 1100 W
Trav 870 W
Trav 700 W
Trav 550 W
Trav 472 W
Trav 372 W
Trav 282 W
Trav 180 W
Trav 120 W
Trav 60 W
Trav 0
Geophysicist
Mineral Resources Survey Branch
Dec 1943
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KING ISLAND SCHEELITE MINE
PROFILES SHOWING VARIATIONS IN THE VERTICAL COMPONENT OF THE EARTH'S MAGNETIC FIELD ALONG TRAVERSES AS SHOWN ON PLATE I.

Scales:- Hor. 1" = 100 feet
Vert. 1" = 200 Gammas

Note:- Smoothing of profiles for purpose of drawing isodynamic lines shown thus:- ....

Geophysicist
Mineral Resources Survey Branch.
Dec. 1943.

Plate 4.

KING ISLAND SCHEELITE MINE
GEOPHYSICAL SURVEY

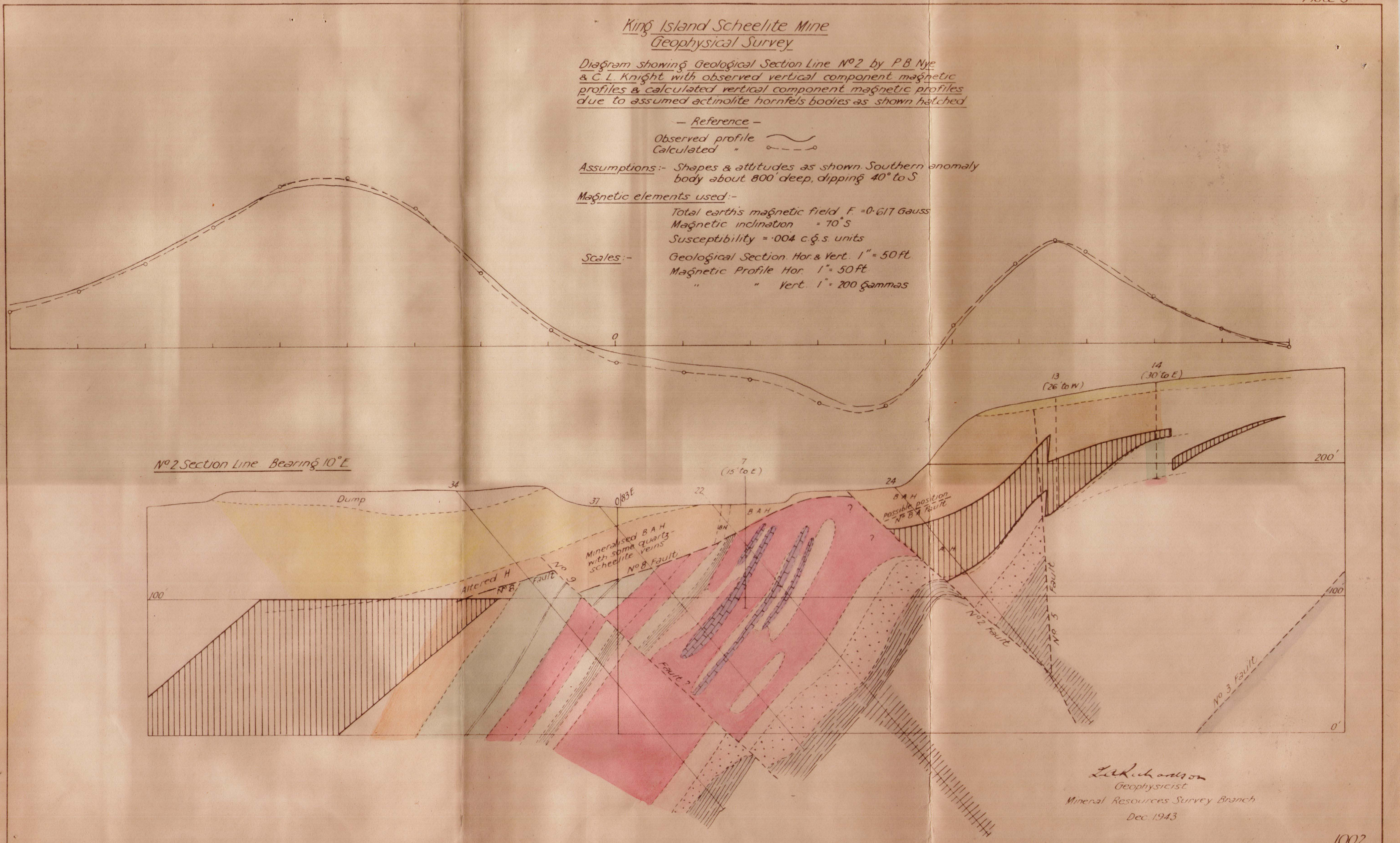
PLAN SHOWING MAGNETIC ISODYNAMIC LINES REPRESENTING LINES OF EQUAL VERTICAL FORCE COMPONENT

NOTES:- VALUES (IN GAMMAS) OF VERTICAL FORCE COMPONENT SHOWN BY THE LINES ARE RELATIVE TO THE VALUE AT THE MAIN BASE STATION AT 0/0.

FOR PARTICULARS OF GEOLOGICAL SECTIONS ALONG LINES AS SHOWN SEE GEOLOGICAL REPORT BY P. B. NYE & C. L. KNIGHT

L. A. Richardson
Geophysicist
Mineral Resources Survey Branch.
Dec. 1943.

1001


King Island Scheelite Mine
Geophysical Survey
Diagram showing Geological Section Line Nº 2 by P.B. Nye & C.L. Knight with observed vertical component magnetic profiles & calculated vertical component magnetic profiles due to assumed actinolite hornfels bodies as shown hatched
— Reference —
Observed profile
Calculated "
Assumptions:- Shapes & attitudes as shown. Southern anomaly body about 800' deep, dipping 40° to S.
Magnetic elements used:-
Total earth's magnetic field F. = 0·617 Gauss
Magnetic inclination = 70° S
Susceptibility = ·004 c.g.s. units
Scales:- Geological Section. Hor. & Vert. 1" = 50 ft
Magnetic Profile Hor. 1" = 50 ft
" " Vert. 1" = 200 gammas
0
13 (26° to W)
14 (30° to E)
Nº 2 Section Line Bearing 10° E
200'
7 (15° to E)
34
Dump
37
0/83E
22
24
B A H
Possible position Nº 8 A Fault
Mineralised B A H with some quartz-scheelite veins
Nº 8 Fault
Altered H
Nº 8 Fault
Nº 9
100'
100'
Nº 2 Fault
Nº 5 Fault
Fault ?
Nº 3 Fault
0'
Geophysicist
Mineral Resources Survey Branch
Dec. 1943