BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

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THE SOURCE OF SOME MAGNETIC ANOMALIES IN THE BURRELL CREEK FORMATION, PINE CREEK GEOSYNCLINE, NORTHERN TERRITORY

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CONTENTS

FIGURES

SUMMARY

During November 1979, detailed ground magnetic traverses were carried out over rocks of the Burrell Creek Formation in the Pine Creek and Katherine areas, Northern Territory, in order to determine the source of magnetic anomalies detected during regional airborne magnetic surveying by the Bureau of Mineral Resources.

Shallow magnetic anomalies having similar characteristics to the regional airborne anomalies were detected over outcropping massive greywacke along the Edith River road south of Katherine. At Union Reefs, north of Pine Creek, similar anomalies were detected, but in this case the sources are at a depth of more than 40 m.

Interpretation of the ground magnetic data suggests that the sources of aeromagnetic anomalies detected within the Burrell Creek Formation are units of massive greywacke which are conformable with the generally non-magnetic metasedimentary sequence. If it is necessary to investigate the source of the anomalies further in the Union Reefs area, a site for a possible drillhole is recommended.

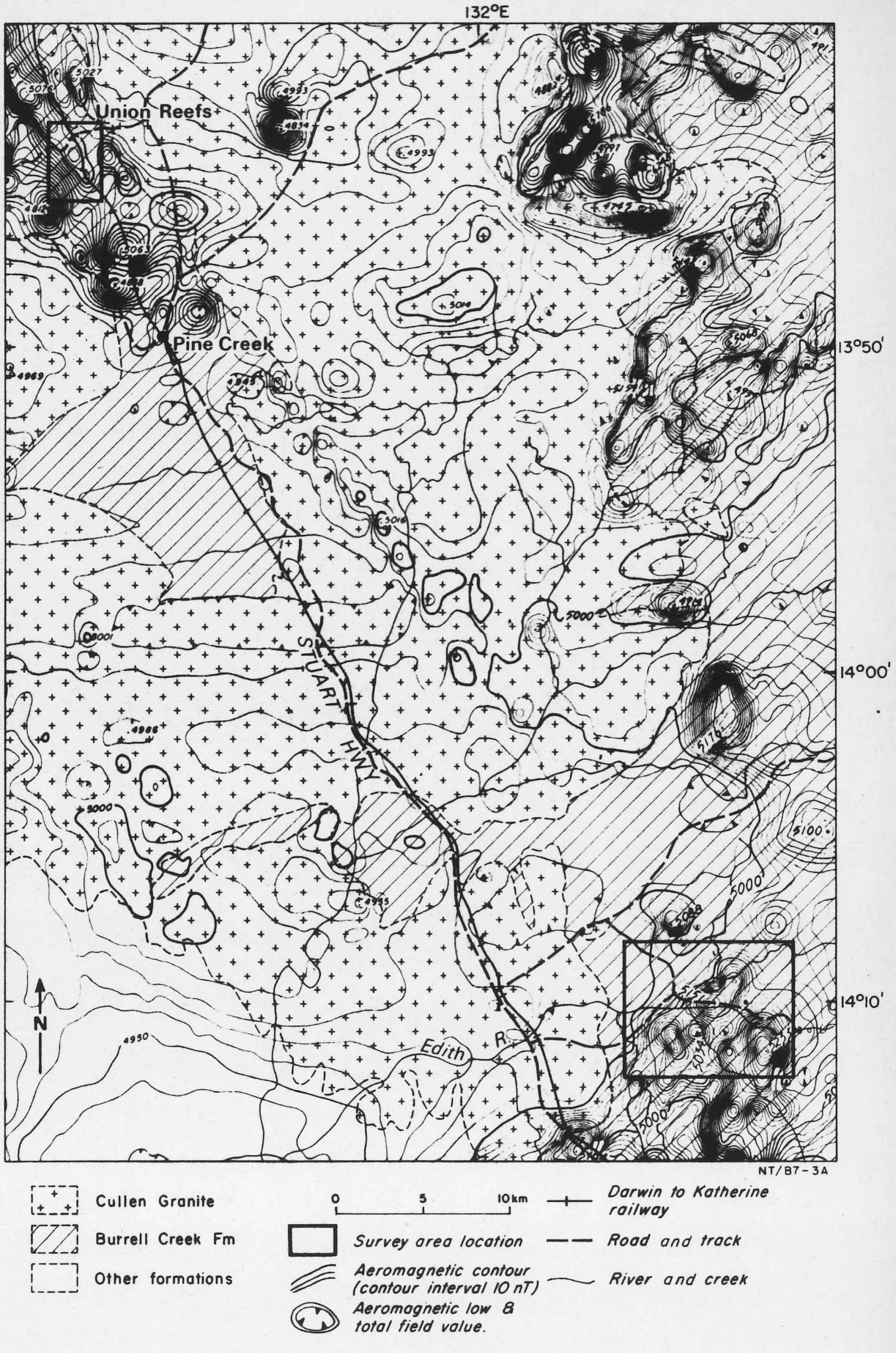

Fig. 1 Regional locality map; showing generalised geology, aeromagnetic contours and survey area

1. INTRODUCTION

During November 1979, detailed ground magnetic traverses were carried out in the Pine Creek and Katherine areas, Northern Territory (Fig. 1), in order to determine the source of magnetic anomalies detected during regional airborne magnetic surveying by the Bureau of Mineral Resources (BMR) in 1975. The anomalies were detected within the Burrell Creek Formation, which occurs in the upper part of the Lower Proterozoic succession of the Pine Creek Geosyncline, and which consists of a sequence of greywacke and conglomerate, made up largely of volcanic detritus, and other metasediments. The objective of the work was to establish the source of the anomalies which occur within an extensive geological formation which is elsewhere devoid of strong magnetic anomalies. The regional distribution, stratigraphy, and lithology of the Burrell Creek Formation have been described by Needham, Crick & Stuart-Smith (1980).

2. BACKGROUND GEOPHYSICS

The Burrell Creek Formation can be regarded on a regional scale as a non-magnetic unit, being associated with only weak anomalies compared with older Lower Proterozoic units of the Pine Creek Geosyncline (Tucker & others, 1980). In the Batchelor-Adelaide River area, extensive outcrop of the Burrell Creek Formation coincides with a very flat regional magnetic field, and anomaly amplitudes rarely exceed 20 nT.

In the Pine Creek-Katherine area, however, the Burrell Creek Formation is intruded by the early Carpentarian Cullen Granite, around which many small hydrothermal mineral deposits are clustered. The contact metamorphism appears to have generated magnetic sources in the Burrell Creek Formation as indicated by the regional aeromagnetic and geological data shown in Figure 1. However, although numerous anomalies with amplitudes up to 200 nT occur within the Burrell Creek rocks surrounding the granite, there are also areas - for example, immediately south of Pine Creek - where Burrell Creek Formation rocks with intrusions are associated with magnetic anomalies.

In order to establish the nature of the sources of the magnetic anomalies within the Burrell Creek Formation, the two areas outlined in Figure 1 were chosen for detailed ground magnetic traversing using a Geometrics G-816 proton-precession magnetometer. In the southern or Edith River area three traverses were made across a 150 nT northeast trending magnetic anomaly. In the northern area, near Union Reefs about 15 km northwest of Pine Creek, four traverses were made across a northwest trending airborne magnetic anomaly also of about 150 nT amplitude.

3. RESULTS AND INTERPRETATION

Edith River area

The location of the traverses, and the ground magnetometer results, are shown in Figure 2. The location of airborne magnetic anomalies and flight-lines are also indicated.

Traverse B was made along the main track from the Stuart Highway to the Edith Falls, with magnetometer stations at 25 m intervals, in order to locate precisely the airborne anomalies on the ground. The results along Traverse B as shown in Figure 2 reveal complex zones of high-frequency anomalies between 1500 W and 600 E. The magnetic lows between 900 W and 500 W and 00 and 600 E suggest either the effects of remanent magnetisation or geometric effects associated with bodies dipping to the northwest. The depth to the source of the observed high-amplitude, narrow peaks is clearly very shallow and narrow. The anomalies have a peak amplitude of 400 nT between 900 W and 1500 W, and an outcrop of medium-grained grey massive greywacke between 900 W and 1200 W coincides with the largest anomaly. A sample of the rock collected from 1000 W has a relatively high magnetic susceptibility of 0.019 SI units and a specific gravity of 2.74 t/m^3. Analysis of a thin polished section of this sample by G.R. Ewers of BMR (pers. comm.) indicates a magnetite content about 1%, with practically no pyrrhotite. Minor sulphides, including chalcopyrite, are also present. Modelling of the magnetic data shows that the positive anomaly observed between 900 W and 1100 W could be produced by

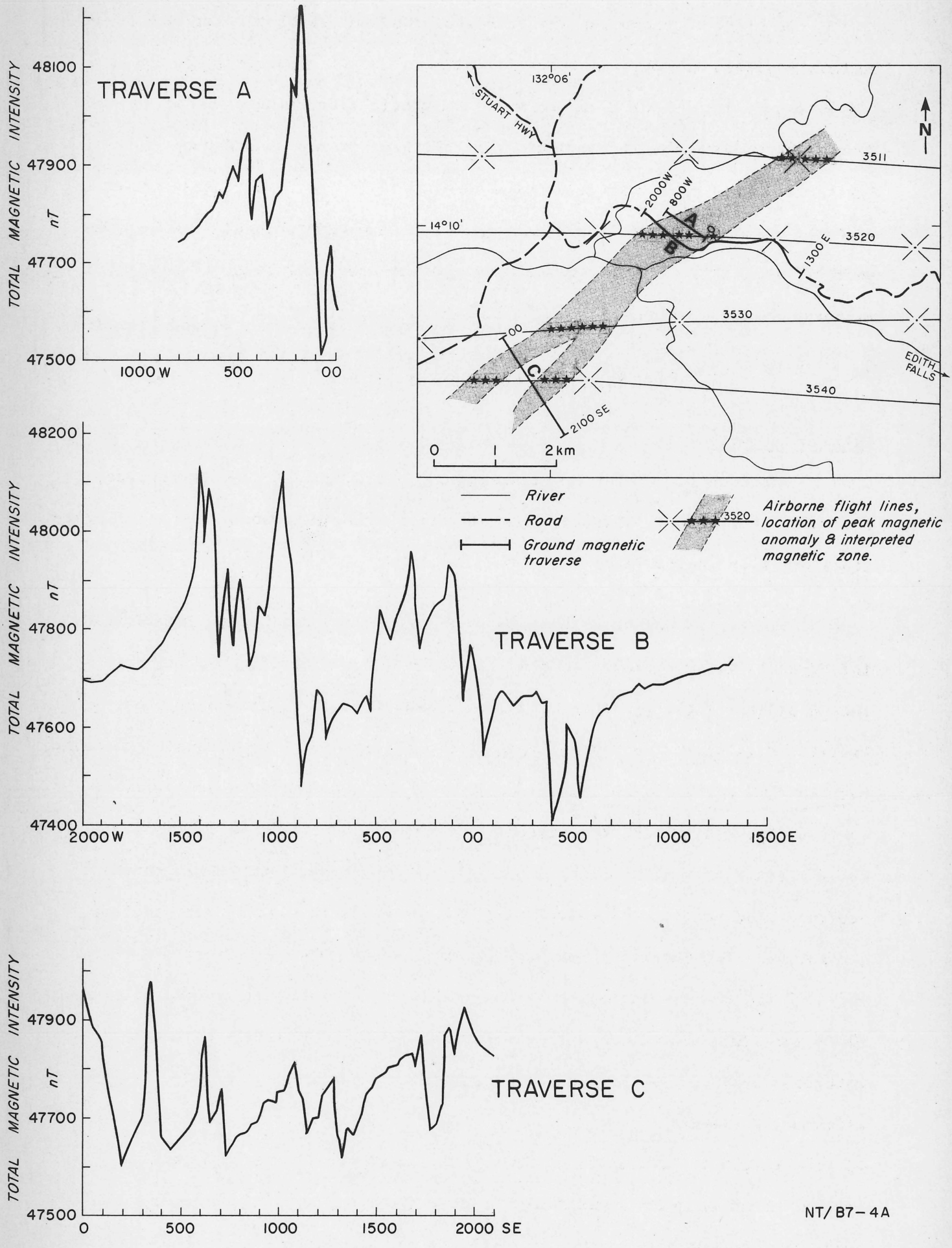

Fig. 2 Edith River area; location of traverses and magnetometer results

a dyke-like body of susceptibility similar to that measured in the sample, and with the following configuration:

Width	75 m
Depth to top	2 m (detector height)
Dip	70° south
Susceptibility	0.02 SI units

The strike continuity of these anomalies was investigated by a short traverse (A) 200 m to the northeast of, and parallel to, that part of Travers B from 700E to 1500E, and another traverse (C) 3 km to the southwest of Traverse B over an aeromagnetic anomaly thought to be related to that observed on Traverse B.

On Traverse A anomalies of a similar shape and amplitude to those on Traverse B were detected over a large outcrop of massive greywacke. Although it is not possible to identify individual features on Traverse B which extend to Traverse A, the source of the anomalies on each traverse is clearly similar and indicates a continuous magnetic unit striking at approximately 060°.

Along Traverse C, anomalies of somewhat lower amplitude (200 nT) but otherwise similar high frequency were detected across the entire traverse. However, the apparent bifurcation of the aeromagnetic anomaly was not observed. The depth to the source of the narrow anomalies is obviously shallow, and outcrops of laminated metasediments occur along most of the traverse. It is probable that massive grewyacke occurs at the northwestern end of the traverse.

It is clear from the results along Traverses A and B, and to a lesser extent Traverse C, that the magnetic anomalies in this area are due to a conformable sequence of magnetite-bearing massive greywacke. Such rocks are probably the source of most airborne magnetic anomalies observed in the Burrell Creek Formation in this area.

Union Reefs area

The location and ground magnetometer results for the four traverses (A to D) made to investigate the source of airborne magnetic anomalies in the Union Reefs area, are shown in Figure 3. The airborne survey flight-lines, and location and amplitude of the peak anomalies, are also shown.

It is immediately apparent that, probably as the result of positioning errors, the main anomalous zone detected by the airborne magnetometer on flight-line 2270 is displaced about 200 m to the east of the surface anomalies detected on Traverse A.

The shape and the amplitude of the ground anomaly along Traverse A (200 nT) compare closely with the airborne anomaly (150 nT) allowing for a decrease in amplitude with distance from source. The only indication of outcrop along Traverse A occurs at its western end, where extensive quartzite and purple shale float is found. Alluvium covers the remainder of the traverse.

Simple modelling of the ground magnetic data from Traverse A indicates that the anomaly could be produced by a dyke-like body with the following characteristics:

Width	150 m (centred on 500 W)
Depth to top	40 m
Dip	vertical
Susceptibility	0.02 SI units

This susceptibility was used as a control for the model, and was chosen to be similar to that of the massive greywacke cropping out in the Edith River area. The resultant body is a plausible solution taking into account other geological constraints in the area, but it should be noted that other models with a different susceptibility could also fit the data.

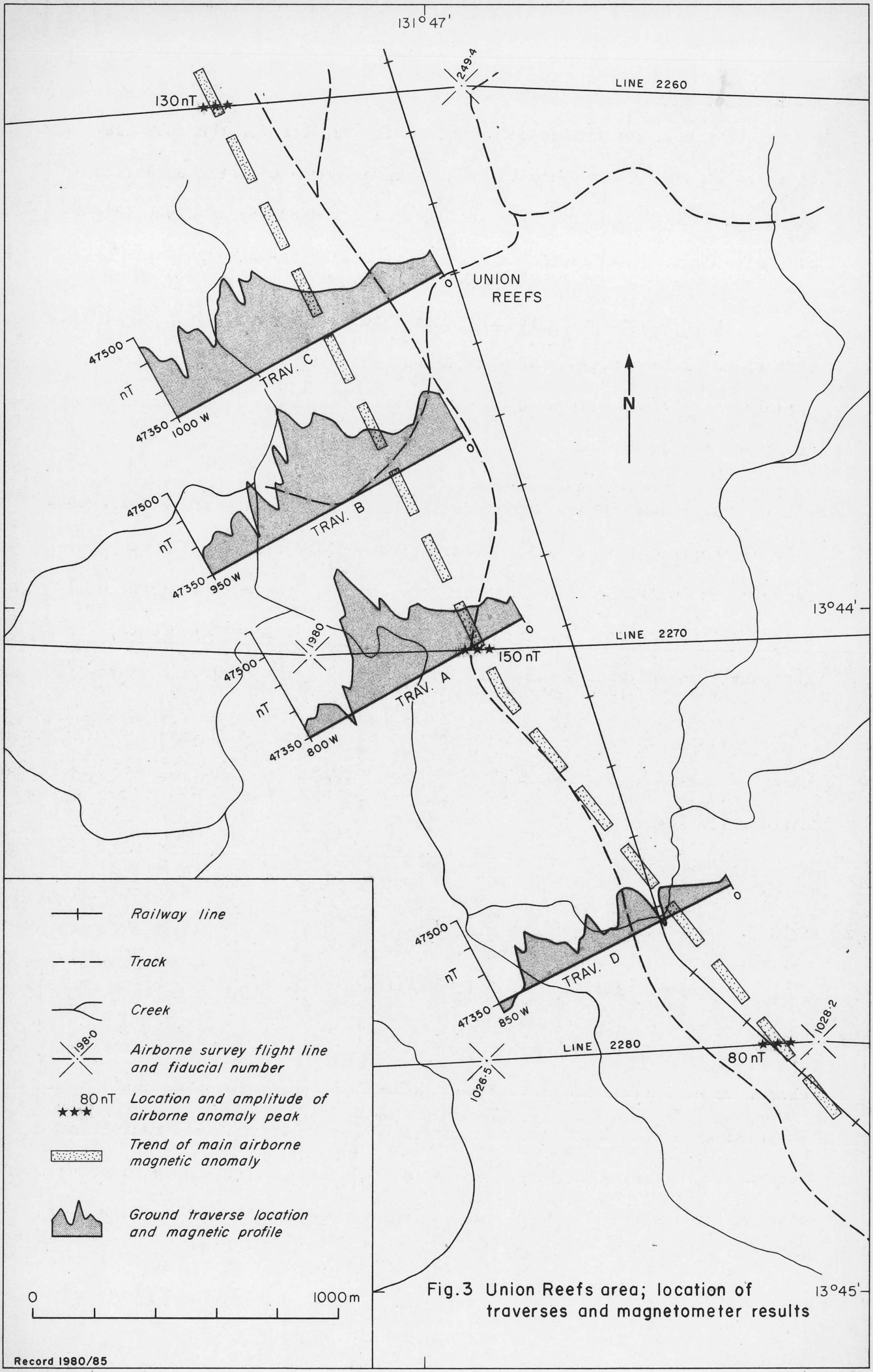

Fig.3 Union Reefs area; location of traverses and magnetometer results

Record 1980/85

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On Traverse B, 600 m to the north of Traverse A, a similar but weaker anomaly (150 nT) was detected. Outcrop occurs on this traverse between 150 W and 200 W (quartz and laminated shaly bands, vertical dip), at 450 W (steeply dipping brown ferruginous phyllite), between 750 W and 775 W (phyllite cropping out in creek), and at 950 W (quartzite and shaly bands). The magnetic susceptibility of all these rocks was investigated with a portable susceptibility meter and appears to be low and insufficient to produce the observed anomaly. It is probable that the source of the anomaly is similar to that interpreted as the source of the anomaly on Traverse A. However, on Traverse B the depth to the top of the body would be about 60 m.

The anomalies observed on Traverse C and D are not as distinctive as the centre traverses but are similar in form and suggest a greater depth to the source rocks. Outcrop occurs on Traverse C between 100 W and 450 W, but is non-magnetic phyllite and quartzite. In the magnetically anomalous zone between 500 W and 900 W virtually no outcrop occurs. Very little outcrop occurs on Travers D to the south, apart from minor quartzite and shale at the western and eastern ends of the traverse. Again only alluvium occurs within the magnetic zone between 300 W and 750 W.

From the analysis of the ground data it appears that the body (or bodies) causing the magnetic anomalies in the Union Reefs area does not crop out but is buried at depths greater than 40 m. The interpreted susceptibility and width of the source rock suggest that it could be greywacke similar to that found in the Edith River area.

4. CONCLUSIONS

The sources of aeromagnetic anomalies detected within the Burrell Creek Formation in the Pine Creek-Katherine areas of the Pine Creek Geosyncline are interpreted as being units of magnetite-bearing massive greywacke which are conformable with the generally non-magnetic metasedimentary sequence.

In the Edith River area, a 400 nT ground magnetic anomaly occurs directly over outcrop of magnetite-rich massive greywacke. Susceptibility measurements on surface samples of this outcrop give values of 0.019 SI units, which could readily account for the observed anomaly. In the Union Reefs area 15 km northwest of Pine Creek, a 200 nT ground magnetic anomaly occurs over alluvium between outcrops of non-magnetic metasediments. This anomaly could be produced by a body or bodies at a depth of 40 m or more, and having a magnetic susceptibility similar to the massive grewyacke in the Edith River area.

The source of the anomaly in the Union Reefs area should be tested by a drillhole sited near station 550 W on Traverse B. This site has easy access for a drill rig, and the depth to the source is interpreted as being about 60 m. A better drill site, but having poor access, would be on Traverse A at station 500 W, where the depth to the source would be about 40 m.

5. REFERENCES

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