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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/20

SKINNERS POUND RECONNAISSANCE GROUND MAGNETIC SURVEY, DAVENPORT RANGE, NT 1960

by

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SUMMARY

The results of a brief ground magnetic survey over a large aeromagnetic anomaly in the Davenport Range are described. The anomaly is due to a large mass of basic rock of moderate magnetic susceptibility. The results indicate that the relation between anomalies observed in ground magnetic surveys and aeromagnetic surveys over the same area is not a simple one, and further study is desirable to investigate the matter.

1. INTRODUCTION

The regional geology of the Davenport Range has been described by Smith, Stewart, and Smith (1960). The area consists mainly of sedimentary rocks, but includes also considerable amounts of intrusive rocks, both acid and basic. During 1956, an aerial magnetometer survey over the area was made by the Bureau of Mineral Resources, the results of which were published on Plan G281-4 at a scale of four miles to an inch. This showed a considerable number of anomalies, mainly long and narrow, with generally a north-westerly strike, although a few anomalies strike north-easterly. A very strong anomaly of considerable extent occurs in the area known as Skinners Pound, about 16 miles north of Murray Downs Homestead (Plate 2).

Comparison of the aeromagnetic and geological maps shows that the magnetic anomalies are in general associated with outcrops of basic rocks. These outcrops are not all similar in appearance. Some are mapped as possible flows, and appear as narrow bodies of considerable length; in some cases these bodies are associated with long and narrow magnetic anomalies. In some areas, however, the basic rocks crop out as large masses of roughly elliptical shape; the magnetic anomalies associated with such outcrops also tend to be long and narrow, with a general north-westerly strike, and appear to be associated with portions only of the outcrops. The large anomaly at Skinners Pound shows this tendency. The aeromagnetic anomaly appears as if it could well be due to several narrow strongly-magnetic bodies with a north-westerly strike. In order to check this point, opportunity was taken of the presence of a Bureau geophysical party in the area to run ground magnetic traverses over the anomaly. The work was confined to two long traverses, using a vertical-force magnetic variometer. The work was done by geopyysicists J. Daly and D.L. Rowston in August 1960.

2. TECHNICAL DETAILS

The positions of the traverses were chosen with reference to the aeromagnetic map. The traverses were laid out to cross the anomaly at suitable points, and the positions transferred to an air-photo mosaic. The traverses were then located on the ground, using the mosaic. Surveying was done by compass and pacing. Stations were spaced at 200-ft intervals along the traverses. The positions of the traverses are shown on Plate 1.

3. RESULTS AND INTERPRETATION

The results are shown as profiles of vertical magnetic intensity on Plate 2.

The results are of interest in two connexions, which will be discussed separately:

(a) the cause of the anomaly, and

(b) the relation between the results of ground and aerial surveys.

Traverse A was chosen so as to cross the strongest anomaly shown by the aeromagnetic survey. From the shape of the magnetic profile, it appears that it would be unsafe to draw detailed inferences from a single profile. However, the results show no evidence of the presence of a small number of discrete zones of strongly magnetic rock, as would appear possible from the results of the airborne survey. The anomalybappears to be due to the outcropping basic rocks in general being magnetic, although the degree of magnetisation changes notably over short distances. Whether the more-magnetic zones occur at random in the basic rock, or have a regular aspect, could only be determined by a detailed survey covering an area of some width. From the shape of the magnetic profile at the ends, it appears that the magnetic rock has a moderate extension in depth, and possibly a steep northerly dip. A separate anomaly occurs at about 2000S. This is due to a body, the nature of which is uncertain, at considerable depth.

Traverse B shows an anomaly due to a body at considerable depth, but the anomaly is much narrower than the main magnetic zone along Traverse A.

With regard to the relation between the results of airborne and ground measurements, the question is not a simple one. For the purpose of discussion it may be assumed that the amplitude (in gammas) of the anomaly due to a simple source, as measured by a total-force instrument, is of the same order as that due to the same source, as measured by a vertical-force instrument, at the same distance. The difference in the intensity of anomalies observed in ground and airborne surveys arises from the fact that the detector used in an airborne survey is considerably farther from the source of the anomaly than that used in a ground survey. This may influence the intensity of the anomaly in two opposite ways:

(a) the anomaly recorded by a detector on the ground will be greater than that recorded by an airborne detector, because the detector on the ground is closer to the source,

(b) if the source is of large dimensions, the anomaly recorded by the airborne detector will be enhanced relative to that observed on the ground, because the airborne detector 'sees' a larger area of the source.

No systematic investigation of the question has been made, although with suitable simplification, the problem would be amenable to mathematical treatment. However, if H is defined as the height of the aircraft above the ground and D the depth of the source of the anomaly below the ground surface, the following conclusions follow from the elementary discussion above:

(1) if D is large, so that the ratio $(H + D)/D$ is not much greater than unity, the airborne and ground anomalies will be of about the same amplitude,

(2) if D is very small (i.e. the source of the anomaly is almost outcropping) and the area of the source is small, the amplitude of the ground anomaly will be much greater than that of the airborne anomaly,

(3) if D is very small, and the area of the source is large, the amplitudes of the airborne and ground anomalies will be more nearly equal than in case (2).

Surveys made by the Bureau have provided information that would enable these conclusions to be checked to some extent. This information has not been studied systematically. Detailed conclusions could not be based on aeromagnetic contour maps, as the scale of such maps frequently necessitates some smoothing of the data. However, it is known, for instance, that the amplitude of the ground anomaly obtained over the Savage River (Tasmania) iron ore deposits is up to five times as great as that of the airborne anomaly. This anomaly is due to an outcropping body about 200 ft wide. At Skinners Pound where the anomaly arises from an outcropping source about 15,000 ft wide, the ratio of the amplitude of the ground anomaly on Traverse A to that of the airborne anomaly is not much different from unity. Along Traverse B, on which the anomaly arises from a deep-seated source, the ratio of amplitudes is also not far from unity. Study of the information available on this matter might provide results of importance in connexion with the interpretation of the results of aeromagnetic surveys.

4. LABORATORY TESTS OF SAMPLES

Measurements of magnetic susceptibility have been made on samples of the basic rocks, with the following results:

0.102×10^{-3} c.g.s. units

0.164×10^{-3} " "

0.157×10^{-3} " "

0.069×10^{-3} " "

The results are not of great significance as regards the magnetic anomalies. The samples were taken at random from outcropping rock, without regard to magnetic survey results. Also, in view of the variation of magnetic intensity along Traverse A, it appears that a large number of samples would have to be tested to obtain a result that could be applied to the bulk of the rock with any large degree of probability. However, the measured susceptibilities are surprisingly low, considering the intensity of the anomalies observed.

It is possible that oxidation processes have reduced the susceptibility of the outcropping rock, and that the anomalies are mainly due to material in the primary zone. There appears to be no economic incentive to test the rock at depth; therefore it is unlikely that samples from the primary zone will become available for testing. However, mineragraphic examination of the outcropping rock does not suggest that the unweathered material is likely to be strongly magnetic.

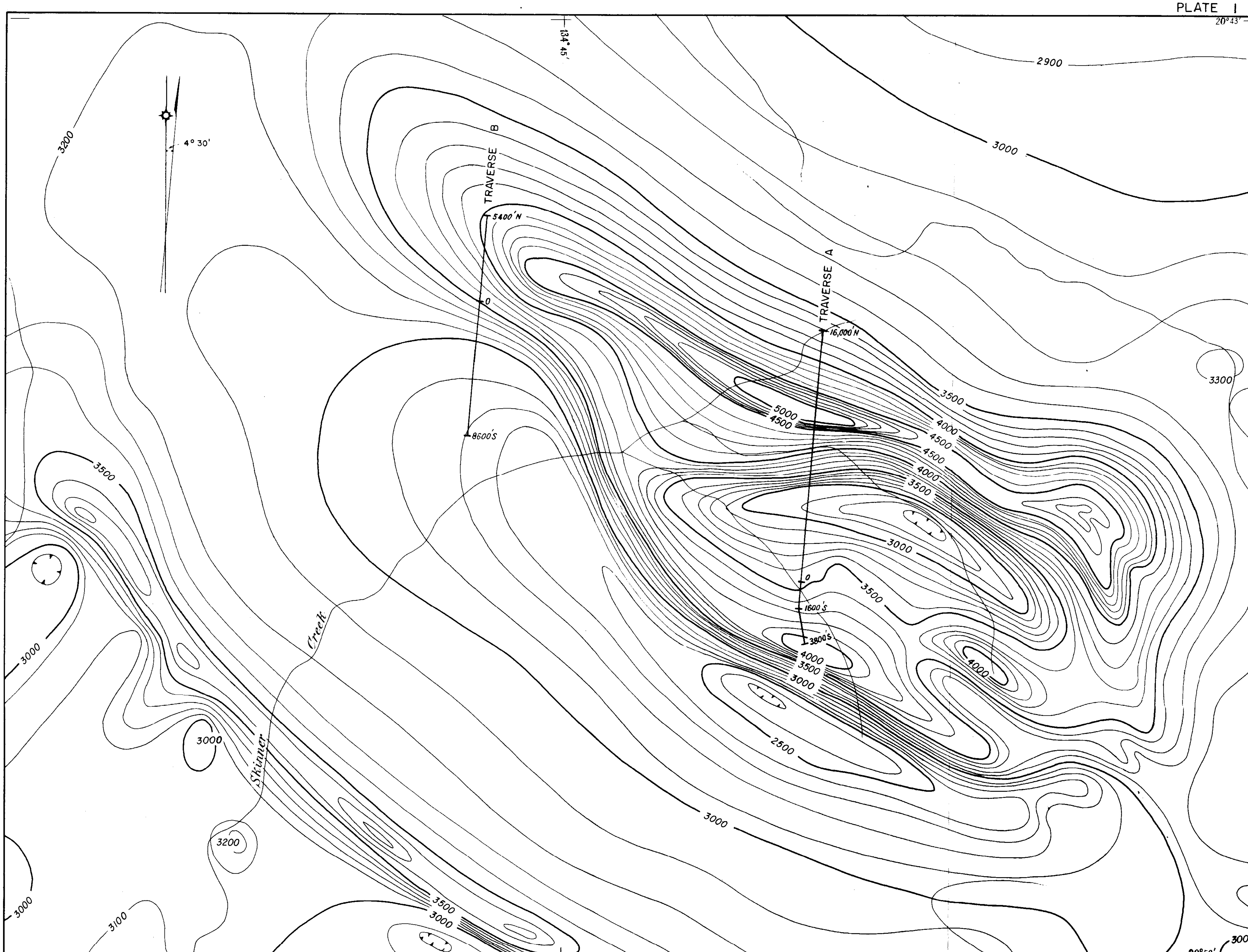
5. CONCLUSIONS

The evidence available is not sufficient to warrant detailed conclusions, but it suggests that the magnetic anomalies are mainly due to a large mass of basic rock, of moderate but non-uniform susceptibility. The samples tested in the laboratory are only weakly magnetic, and none appears to have a susceptibility high enough to be representative of the general mass of the rock.

Firm conclusions could only be reached on the basis of a much more extensive study, involving ground magnetic surveys and laboratory tests on samples. The ground magnetic surveys should be made by a party equipped to spend some weeks in the area, and should involve detailed surveys over an area of reasonable size. Some attention should also be paid to other well-marked aeromagnetic anomalies, such as the one near Kurundi and the one south of Hatches Creek. The detailed surveys should be followed by systematic sampling on a scale sufficient to allow of statistical treatment of the results of laboratory tests.

6. REFERENCE

SMITH, K.G., STEWART, J.R. and SMITH, J.W.	1960	Regional geology of the Davenport and Murchison Ranges, NT <u>Bur. Min. Resour. Aust. Rec. 1960/80 (unpubl.).</u>



SCALES

1	0	1	2	3 MILES
6000	0	6000	12,000	18,000 FEET

Note:

Bearing of traverses 0° (MAG) except for traverse A, 3800S – 1600S, bearing of this portion 345° (MAG)

DAVENPORT RANGE, NORTHERN TERRITORY

MAGNETIC SURVEY, SKINNERS POUND AREA

LOCATION OF TRAVERSES IN RELATION TO CONTOURS OF TOTAL MAGNETIC INTENSITY

After 4-mile Total Magnetic Intensity Map G281-4

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Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. F53/B7-6

PLATE 2

VERTICAL MAGNETIC FORCE PROFILES

SKINNERS POUND, DAVENPORT RANGE, N T 1960

SHOWING APPROXIMATE GEOLOGICAL BOUNDARIES

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