COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1966/92

DAVENPORT RANGE DETAILED AEROMAGNETIC SURVEY,

NORTHERN TERRITORY 1965

by

B.A. DOCKERY and W.A. FINNEY

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1966/92

DAVENPORT RANGE DETAILED AEROMAGNETIC SURVEY,

NORTHERN TERRITORY 1965

by

B.A. DOCKERY and W.A. FINNEY

CONTENTS

ILLUSTRATIONS

Note. This Record supersedes Record No. 1965/238

SUMMARY

A detailed aeromagnetic survey was made over two areas in the Davenport Range; one adjacent to Whistleduck Creek and the other in Skinners Pound. Each survey area consists of a block of meta-basalt surrounded by sediments of the Hatches Creek Group. Minor copper mineralisation has been discovered in the amygdaloidal part of the meta-basalt in the Whistleduck Creek area. Minor copper and lead mineralisation occurs in the meta-basalt in Skinners Pound.

The aim of the survey was to obtain greater resolution of the magnetic anomalies previously detected over the meta-basalt, with a view to delineating structure. The results of the survey show that the boundaries of the meta-basalt blocks coincide with the boundaries apparent on the aerial photographs, while the structural trend within the meta-basalt blocks is similar to that of the surrounding sediments.

1. INTRODUCTION

Detailed aeromagnetic surveys of two areas in the Davenport Range, Northern Territory, were made between mid-August and early November 1965. These areas, known respectively as Whistleduck Creek and Skinners Pound, lie 75 and 90 miles south-south-east of Tennant Creek (Plate 1).

The Whistleduck Creek area was completed with 87 square miles of detailed aeromagnetic coverage, but owing to adverse surveying conditions only one flight covering 16 square miles was flown in the Skinners Pound area.

Each area contains a block of basic lava flows surrounded by sandstone of the Lower Proterozoic Hatches Creek Group. In 1964, copper mineralisation was discovered in the amygdaloidal meta-basalt that forms part of the lava flows at Whistleduck Creek, and copper and lead mineralisation was discovered in the amygdaloidal meta-basalt at Skinners Pound.

The Davenport Range was surveyed in 1956 by the Bureau of Mineral Resources (BMR) as part of a regional aeromagnetic survey involving the 1:250,000 map areas of Bonney Well, Barrow Creek, and Elkedra. This survey was carried out at a height of 500 feet above ground level along flight lines spaced one mile apart. The results were published in the form of a map of total magnetic intensity contours (Bureau of Mineral Resources Map No. G281-4).

The Geological Branch of the BMR requested the detailed aeromagnetic survey in order to obtain greater resolution of the magnetic anomalies previously recorded by the regional survey, and to locate any structural features within the basic blocks that might have a bearing on concentration of mineralisation.

2. GEOLOGY

The geology of the Davenport and Murchison Ranges has been described by Smith, Stewart, and Smith (1961). Most of the geological information given hereunder and shown in Plates 2, 3, and 4 was derived from this work.

The areas selected for surveying lie within the Davenport Range, which consists basically of sediments of the Davenport Geosyncline. This Geosyncline developed during the Lower Proterozoic era, and the Hatches Creek Group of sediments was laid down. These sediments were uplifted and intruded by granites towards the close of the Lower Proterozoic, and there has been no subsequent major tectonic movement in the area.

The Hatches Creek Group is a thick conformable sequence of dominantly arenaceous rocks, which constitute most of the Davenport and Murchison Ranges. The rocks of the Group are mainly thin- to medium-bedded, medium- to coarse-grained, silty silicified quartz sandstone. The arenites, which include some beds and lenses of pebble conglomerate up to 200 feet thick, crop out in long, sub-parallel ridges. In valleys between the ridges, shale, siltstone, soft greywacke, and extrusive volcanic rocks crop out. The shale, siltstone, and greywacke are poorly exposed, and complete sections of rocks of these lithologies are seldom seen. The thickness of the Hatches Creek Group, about 10 miles east of the Skinners Pound area, has been estimated to be 25,000 feet.

Acid and intermediate extrusive rocks occur within the Hatches Creek Group. Usually they can be traced over distances of tens of miles and commonly maintain a fairly uniform thickness over a large distance. Possible basic flows are reported by Smith et al (1961), but whether they are extrusive rocks that are members of the Group or sills that intrude the Group is not resolved.

The Group has been intruded by basic igneous rocks, by quartz-feldspar porphyry and other acid and intermediate igneous rocks, and by granite. The basic intrusive rocks and the quartz-feldspar porphyry occur over a large area. Small outcrops of granite are found in several localities. All the sediments intruded by granite are stratigraphically low in the Hatches Creek Group.

The Group has been folded into numerous basins and domes and into synclines and anticlines. In most of the area the fold axes trend north-west, and many of them have a short sigmoidal section.

Metamorphism of the Hatches Creek Group is generally of low order; commonly only surface silicification is apparent. In places dynamic metamorphism has converted sandstone to dense quartzite, and shale has been changed to slate or mica schist. The intrusion of basic rocks has caused local severe metamorphism of the Group.

In the Whistleduck Creek area, Smith et al (1961) mapped a large block as basic intrusive gabbros and differentiates (Plate 2). Recent work, however, has shown that this block consists of basaltic lava flows with some interbedded quartzites. Individual flows exhibit an amygdaloidal and vesicular structure towards the top, and some of the amygdules consist of copper minerals.

Pontifex (personal communication) described a sample from the area as a porphyritic and amygdaloidal oligoclase meta-basalt whose alteration is probably deuteric. He identified the main minerals as plagioclase, actinolite, epidote, and calcite with minor chlorite and quartz, and expressed the opinion that after consolidation of the rock a number of deuteric minerals derived from the basalt became localised in vesicles by late magmatic processes. These minerals are epidote, calcite, haematite, chrysocolla, covellite, chalcocite, bornite, and chalcopyrite. Basalt commonly contains 0.02 to 0.04% (and up to 0.2%) inherent copper, mainly in the form of chalcopyrite, cornite, and chalcocite. In this case, copper minerals have possibly been concentrated in the tops of the flows to give rock samples that assay up to 2% copper, but more generally 0.2% copper. If this is so, large deep-seated copper orebodies are unlikely to be found within the block.

In the Skinners Pound area, Smith et al (1961) mapped a large block as basic intrusive gabbros and differentiates (Plate 4). Recent investigations by Yeaman (personal communication) showed that the basic block consists of rocks of the same type (and possibly the same origin) as the meta-basalt flows in the Whistleduck Creek area. Occasionally concentrations of chalcopyrite and galena occur in the amygdaloidal and vesicular parts of the flows, but this mineralisation does not appear to be of economic significance.

3. RESULTS

In this interpretation, it is assumed that the magnetic susceptibility of the Hatches Creek Group of sediments is uniformly low in contrast with the susceptibility of the basic rocks. The basic rocks detected by the survey have been assumed to be meta-basalt and give rise to the anomalous areas in Plates 2 and 4. The trends apparent from a study of the contour map and the magnetic profiles are assumed to represent the direction of bedding of the various meta-basalt lava flows (Plate 3). Estimates of the depth to sources were made for a number of anomalies. These estimates indicated near-surface sources and provided justification for relating the magnetic trends to the surface features apparent on the aerial photographs.

Whistleduck Creek area

In the western part of this area separate beds of meta-basalt were distinguished (Plate 3) and a study of the relevant aerial photographs shows that these beds are represented by valleys contained by steep-sided

ridges, possibly of quartzite. Owing to the difficult terrain, few of these beds have been mapped. Apparently the Hatches Creek Group contains a sequence of extrusive basic igneous rocks recorded by Smith et al (1961) as possible basic flows.

The main basic block is roughly triangular in shape. One vertex of the triangle is in the north-west corner of the survey area. Here the beds have a south-east strike and the trends fan out in east to south-east directions towards the centre of the area. Another vertex of the triangle is in the north-east corner of the survey area, where the meta-basalt beds strike slightly south of west. From here the trends change to south-west towards the central south of the area. In the centre there is no definite pattern in the contours and it seems likely that the meta-basalt beds are not continuous across the area but have been subject to a considerable amount of folding and faulting.

The inferred faults in Plate 3 were derived from a study of the aerial photographs and the magnetic trends. The position of faults in the central region could not be proposed as the contour pattern is too complex for the magnetic trends to be recognised.

In the north-east corner of the survey area the east-striking meta-basalt beds have been displaced south-west by a fault over a horizontal distance of one mile.

The trends derived from the magnetic contour map reflect the structure in the surrounding sediments that is apparent from a study of the aerial photographs. Other than confirming this apparent structure, the aeromagnetic survey has added little to the geological knowledge of the area. None of the magnetic results can be associated directly with mineralisation. If the copper minerals have been remobilised after the period of folding of the Hatches Creek Group, then the highly folded and faulted central region of the survey area might be the best place to search for mineralisation. If no such remobilisation has taken place, prospecting should be directed to finding a concentration of ore in the amygdaloidal parts of the lava flows. The position of the amygdaloidal parts of the lava flows could not be determined from the results of this survey.

In the north-west of the survey area, outcropping quartz-feldspar porphyry gives rise to a random pattern of magnetic anomalies. This pattern is not apparent on the contour map as the amplitudes of the anomalies are less than the contour interval. Such a pattern is normal over an area of intrusive igneous rock. A study of the magnetic profiles suggests that there might be a concentration of magnetic minerals along the fault planes in this region.

Skinners Pound area

The results of the single survey flight (Plate 4) made to test the value of the survey method in this area indicate that a survey of the whole of Skinners Pound would yield a result similar to that obtained for the Whistleduck Creek area. The magnetic contour map indicates that the boundary of the meta-basalt block is the same as that apparent on the aerial photographs, althouth this boundary is somewhat different from the boundary between the gabbro and the Hatches Creek Group that is shown on the geological map. The trends of the magnetic anomalies over the anomalous meta-basalt area reflect the trends apparent on the aerial photographs and these in turn reflect the structure apparent in the surrounding sediments.

4. CONCLUSION

The survey succeeded in determining the magnetic pattern over the survey areas with greater resolution that was achieved in the reconnaissance survey, but it has added little to the geological knowledge of the areas. On the geological evidence there is little reason to believe that economic concentrations of ore are present, but if such concentrations are present the survey results do not suggest a means whereby they might be located.

In view of the above, surveying of the remainder of Skinners Pound is not recommended.

5. REFERENCE

SMITH, K. G., STEWART, J. R., and SMITH, J. W. 1961 The regional geology of the Davenport and Murchison Ranges, Northern Territory. Bur.Min.Resour.Aust.Report No. 58.

APPENDIX

Operational details

Survey specifications

Detector altitude	:	250 feet above ground level
Line spacing	:	One-fifth of a mile between adjacent flight lines
Line direction	:	East-West
Recorder sensitivity	:	1st recorder - 100 gammas f.s.d. 2nd recorder - 10,000 gammas f.s.d. for first three flights. 1st recorder - 1000 gammas f.s.d. for remaining flights
Diurnal correction	:	Applied correction rounded off to nearest multiple of five gammas
Area surveyed	:	Whistleduck Creek area - 87 square miles Skinners Pound area - 16 square miles
Flight line miles	:	Whistleduck Creek area - 494 Skinners Pound area - 94

Equipment

Aircraft	:	Cessna 180
Magnetometer	:	BMR proton precession, type MNS1
Recorders	:	1 x Mosely Autograph 1 x DeVar
Camera	:	Modified Vinten frame, 35-mm, 186° field of view
Radio altimeter	:	AN/APN-1

Method

For the Whistleduck Creek area, correction for diurnal variation was determined by flying a baseline at the beginning and end of each survey flight. The standard baseline level for the survey was the level of the baseline obtained on the first survey flight. The diurnal correction was applied on the assumption that the diurnal magnetic field varied in a linear manner during any one survey flight.

For the Skinners Pound area, no correction for diurnal variation was determined. It was assumed that the magnitude of the diurnal variation during a single survey flight would be too small to affect the resulting contour map.

The airborne magnetometer records accepted as survey data showed a noise envelope of 15 to 40 gammas.

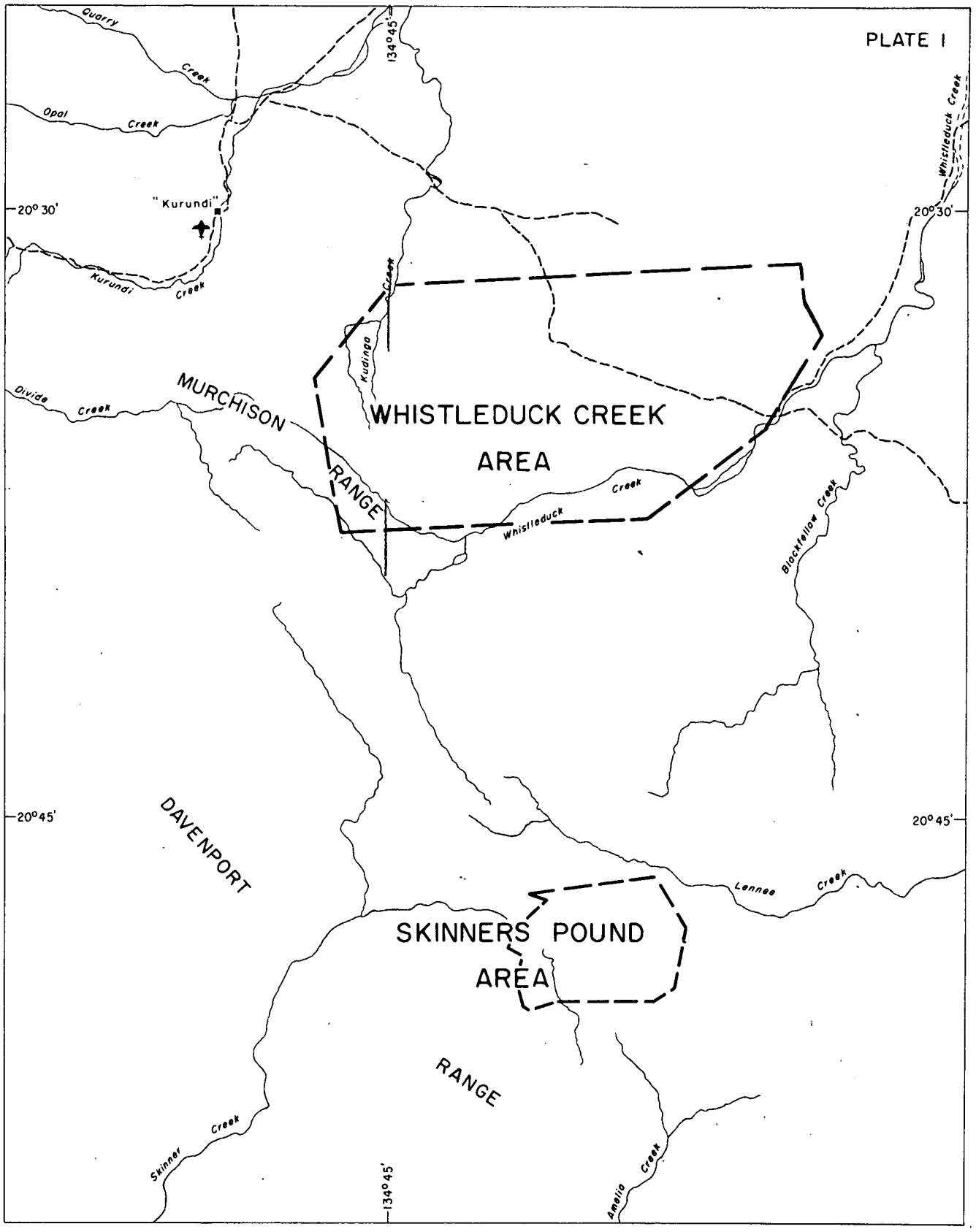
The basis of the interpretation was that the large amplitude anomalies occurred over meta-basalt lava flows. No measurements of remanent magnetisation were made and it was assumed that the anomalies were due to induction by the Earth's field.

Personnel

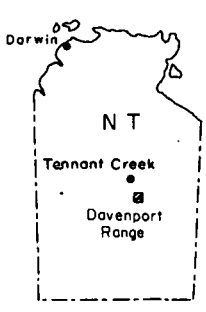
Personnel engaged in the survey were :

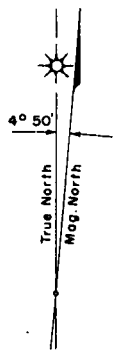
BMR	B. A. Dockery, W. A. Finney, A. Crowder, I. Heath J. Boyd, A. E. Busuttil.
T.A.A.	First Officer J. Lord.

PLATE 1



LOCATION DIAGRAM





LEGEND

- River or creek
- Road or track
- Homestead
- Aerodrome or landing ground
- Detailed survey area boundary

DETAILED AEROMAGNETIC SURVEY, DAVENPORT RANGE, NT 1965

LOCALITY MAP

MILES 5 0 5 10 15 MILES

KILOMETRES 5 0 5 10 15 20 KILOMETRES

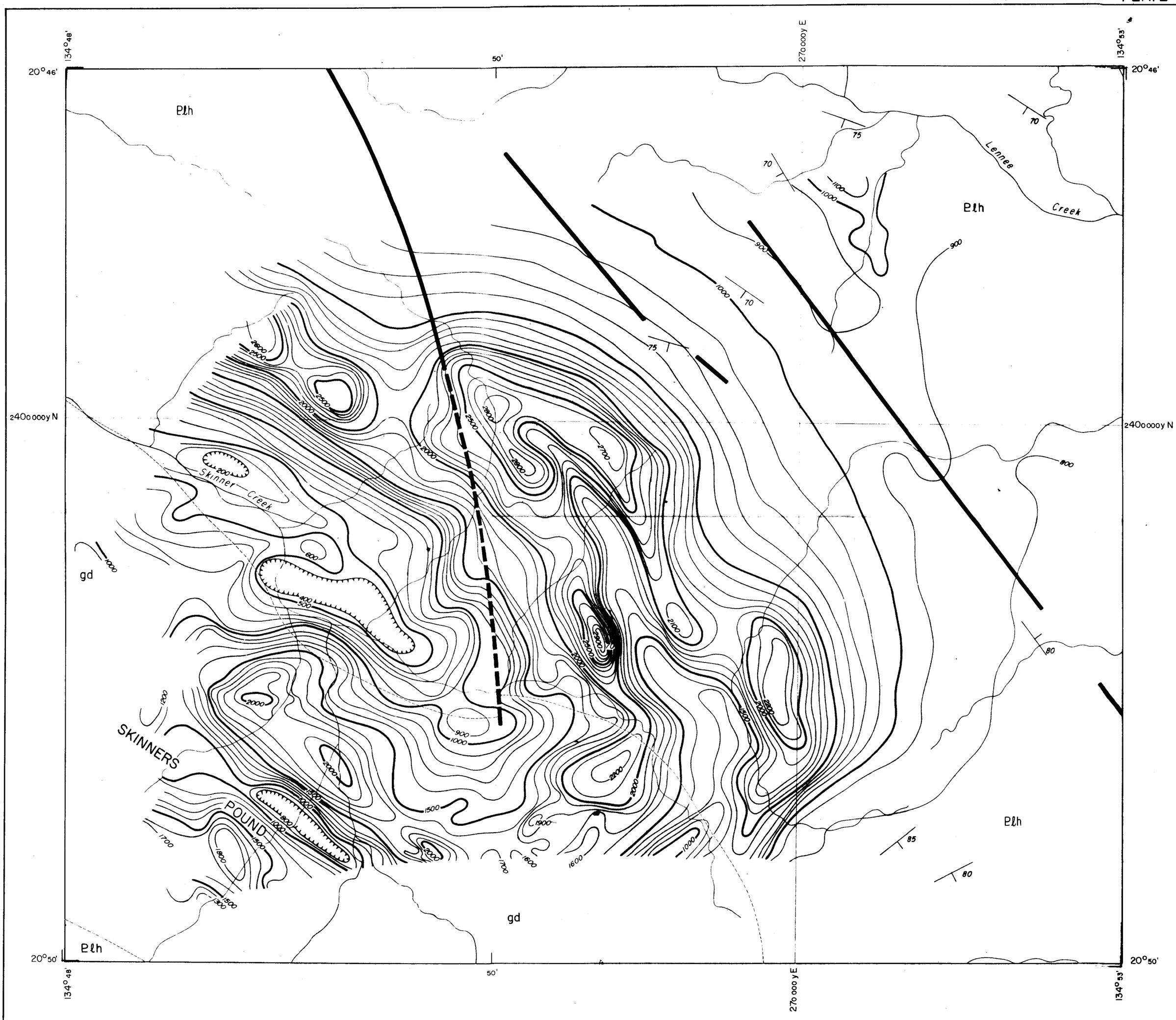
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. F53/BI - 45
TO ACCOMPANY RECORD No. 1966/92

PLATE 2

Based on F53/B0-37 and F53/B0-45 Based on F53/B1-49


DETAILED AEROMAGNETIC SURVEY, DAVENPORT RANGE NT, 1965
WHISTLEDUCK CREEK AREA
GEOPHYSICAL INTERPRETATION
AND
GEOLOGY
MILES
2 MILES
KILOMETRES
3 KILOMETRES
LOCATION DIAGRAM
DARWIN
NT
Davenport
EXPLANATORY NOTES
GEOLOGY AFTER K.G. SMITH, J.R. STEWART AND J.W. SMITH, 1960.
True North
Magnetic North
4°50'
GEOLOGICAL LEGEND
CAINOZOIC
Qa
Alluvium, soil, sand
PRECAMBRIAN
q-f-p
Quartz-feldspar porphyry
bg
Basalt with basic intrusive gabbros
bf
Basic flow
Pℓh
Hatches Creek Group
TOPOGRAPHICAL LEGEND
River or creek
Road or track
LEGEND OF INTERPRETED GEOLOGY
Interpreted meta-basalt
Interpreted trend in bedding of meta-basalt
Interpreted fault
Geological boundary
Established fault - position accurate
Established fault - position approximate
Strike and dip of strata, with angle of dip
Strike and dip of strata with direction of dip
Trend lines
Quartz vein
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.
F53/B1-47
TO ACCOMPANY RECORD No. 1966/92
Whistleduck Creek
Tattaro W.H.
Battery W.H.
Ingudlbinguan W.H.
Blackfellow Creek
Kurinjee Creek

PLATE 4



Based on F53/BO-38 and 39 Based on F53/BI-50

GEOLOGICAL LEGEND

PRECAMBRIAN

gd — *Basic intrusive gabbros and differentiates*

Plh — Hatches Creek Group
Thin-bedded, cross-bedded, ripple-marked medium and coarse-grained sandstone and silicified sandstone, pebble conglomerate, greywacke, shale, siltstone. Acid and intermediate type extrusive rocks.

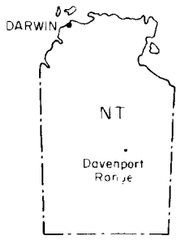
Geological boundary

Established fault - position accurate

Established fault - position approximate

Strike and dip of strata, with angle of dip

LOCATION DIAGRAM

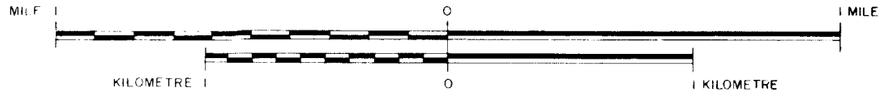


DETAILED AEROMAGNETIC SURVEY, DAVERNPORT RANGE NT, 1965
SKINNERS POUND AREA

TOTAL MAGNETIC INTENSITY CONTOURS

AND

GEOLOGY



MAGNETIC CONTOUR INTERVAL 100 GAMMAS

TOPOGRAPHICAL LEGEND

River or creek

GEOPHYSICAL LEGEND

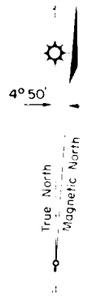
1500 / 1000 — *Magnetic contours*

Magnetic 'low'

EXPLANATORY NOTES

GEOLOGY AFTER K.G. SMITH, J.R. STEWART AND J.W. SMITH, 1960.

THE MAGNETIC DATA HAVE NOT BEEN CORRECTED FOR THE REGIONAL MAGNETIC GRADIENT.



Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics F53/BI-48

TO ACCOMPANY RECORD No 1966/92