DEPARTMENT OF MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1974/33

PRELIMINARY REPORT ON AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY OF ALCOOTA 1:250 000 SHEET AREA N.T. 1972

by

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SUMMARY

This Record describes the results of a regional airborne magnetic and radiometric survey of the ALCOOTA 1:250 000 Sheet area made during 1972. The magnetic data are presented as stacked profiles and the radiometric data as smoothed total-count values together with an indication of the source of the anomaly. Magnetically disturbed areas correlate with rocks of high metamorphic grade, and many of the magnetic lineaments are due to WNW-trending faults. Depth estimates indicate a maximum sediment thickness of about 2700 metres in the Dulcie Syncline and up to 300 metres of Tertiary sediments in the remainder of the sheet. Basement relief is fairly high in the northern part of the sheet. Thorium anomalies generally correlate with outcrops of laterite, granite, and orthogneiss. Potassium anomalies correlate with some granite and orthogneiss.

1. INTRODUCTION

In October and November 1972 a regional airborne magnetic and radiometric survey was made over the ALCOOTA* 1:250 000 Sheet area, which lies between latitudes 22°S and 23°S and longitudes 133°30'E and 135°E (Fig. 1). The aim of the survey was to complement geological mapping by the BMR. Equipment and operational details are listed in Appendix 1.

BMR has flown a regional aeromagnetic survey to the east of ALCOOTA (Wells, Milsom & Tipper, 1966), a regional airborne magnetic and radiometric survey to the south (Young & Shelley, 1966), and a detailed aeromagnetic survey in the Strangways Range immediately south of ALCOOTA (Tipper, 1966).

A regional aeromagnetic survey by Adastra Hunting Geophysics Pty Ltd for American Overseas Petroleum covered a small strip of the ALCOOTA Sheet and the area to the north and northeast (American Overseas Petroleum Ltd, 1966).

BMR has made a regional gravity coverage of ALCOOTA (Lonsdale & Flavelle, 1963).

Radiometric surveys of Authorities to Prospect within the ALCOOTA Sheet have been made by Central Pacific N.L. and Kratos Uranium N.L.

2. GEOLOGY

The northern half of the area was mapped by Milligan (1964). Other BMR geologists have been mapping in more detail since 1968, and the present summary of geology is taken mainly from published and unpublished BMR papers and from personal communications with R.D. Shaw of BMR. The geology is presented in Plate 1.

The major part of the sheet area is covered by sand plain, fixed sand hills, and plains of alluvial soil. The western half of the area slopes gently to the north from about 750 to 600 m above sea-level. The eastern half is made up mainly of the Sandover-Bundey Basin, which falls from about 650 m to 500 m above sea-level in the northeast. Isolated hills and ranges are up to 200 m above the general level. Physiography and land use are described in detail by Perry et al. (1962).

The greater part of the outcrop in the Sheet area consists of metamorphic rocks of the Arunta Complex. These rocks have been intruded by granites of Lower Proterozoic age and are unconformably overlain by Upper Proterozoic and Cambrian rocks in the north and northeast of the area. The Dulcie Syncline in the northeast is composed of Upper Cambrian to Lower Ordovician Tomahawk Beds and Devonian Dulcie Sandstone. Tertiary deposits occupy the positions of some old river valleys.

* Throughout this Record, the names of 1:250 000 Sheet areas are written in capitals to distinguish them from ordinary place names.

Archaean to Lower Proterozoic

The Arunta Block consists of sediments which have been strongly metamorphosed by deep-seated igneous activity and intruded by felsic and mafic igneous rocks. The rocks were strongly folded and intruded during a major metamorphic and igneous event which probably took place about 1700 to 1900 million years ago.

Proterozoic

Much of the Arunta Block has been intruded by granites. The largest intrusion is the Mount Swan Granite, which has a minimum age of 1460 ± 40 m.y. (Hurley, Fisher, Timpson & Fairbairn, 1961) and a probable age of 1700 to 1800 ± m.y.

Adelaidean

The Vaughan Springs Quartzite and Treuer Member crop out near Mount Ewart in the southwest of the Sheet, where they form the eastern tip of the Ngalia Trough. The Vaughan Springs Quartzite is composed of thickly bedded quartzite and conglomerate and probably correlates with the Heavitree Quartzite of the Amadeus Basin. The Treuer Member consists of thinly bedded sandstone and siltstone.

The Grant Bluff Formation crops out around the northeastern boundary of the Arunta Block and consists of quartz sandstone, arkose, siltstone, and black and green shales. It forms a steeply dipping, WNW-plunging syncline southeast of Mount Skinner, with dips up to 65° on the northern limb.

Adelaidean to Cambrian

The Central Mount Stuart Beds crop out in the northwest and central north of ALCOOTA and are unconformable on the Grant Bluff Formation. An elevated ridge northwest of Mount Skinner is composed of conglomerate, sandstone, siltstone, arkose, greywacke, and dolomite. These rocks dip gently to the southwest. The dip increases along strike to the southeast.

Upper Cambrian to Lower Ordovician

The Tomahawk Beds form the Tomahawk Range and isolated outcrops along the southern flank of the Dulcie Syncline. They are a sequence of richly fossiliferous sandstone, siltstone, and dolomite dipping gently to the northeast.

Devonian

The Dulcie Sandstone forms the core of the asymmetrical Dulcie Syncline and has measured thicknesses of 630 m and 460 m in the neighbouring HUCKITTA and BARROW CREEK Sheet areas respectively (Smith, 1963; Smith & Milligan, 1964). The formation is composed of cross-bedded quartz sandstone with some siltstone and pebble conglomerate.

Tertiary

Much of the Arunta Block is covered by remnants of a lateritic terrain and is also unconformably overlain by flat-lying Tertiary sediments. Drilling has indicated the thickness of these lacustrine and fluviatile sediments to be 130 m near the Harts Range Police Station and at least 194 m in the central west of ALCOOTA.

Quaternary

Alluvium, sand, and red earth soil cover large areas of ALCOOTA.

Metamorphism (Fig. 2)

An orogeny antedated the deposition of the Adelaidean rocks and caused deformation and moderate to high-grade metamorphism of the Arunta Complex. Subsequent orogenies, including the Alice Springs Orogeny, have retrogressively metamorphosed some of the rocks to the greenschist facies. Three orogenies probably affected the rocks in the area.

The rocks of highest metamorphic grade (granulite facies) crop out in a southeast elongated zone near Mount Lucy on the western edge of ALCOOTA and in an ENE-trending zone between Bushy Park homestead and Mount Swan. The metamorphic grade decreases through amphibolite and greenschist facies farther away from these more highly altered belts.

Mineralization (after R.D. Shaw)

Most of the mineral deposits in the area are pegmatitic, but some are associated with granite. The deposits are all small and most workings are now abandoned with the exception of the Delmore Downs wolfram mines and the Bundey River pegmatites.

Tungsten, tantalum, bismuth, and very minor thorium occur in the Delmore Downs region. Tungsten occurs 10 km east of Delmore Downs on a boundary between granite and metamorphic rocks. Tantalite and bismuth occur in pegmatites to the northwest of Delmore Downs, and minor thorium concentrations have been recorded in the Mount Swan Granite. Copper occurs in the Perenti deposits about 20 km ENE of Delmore Downs in the Mount Swan Granite. The copper is in quartz breccia with hematite, fluorite, and chlorite. Minor tantalite also occurs west of Utopia homestead.

Near Mount Skinner, copper occurs in 'grey beds' within the Central Mount Stuart Beds. The origin of these deposits is not known, but mineralization appears to be controlled by stratigraphy and basement depth.

Mica deposits occur near Undippa Dam in the southeast of the sheet and in the Harts and Strangways Ranges in the northern part of ALICE SPRINGS. These deposits contain muscovite, biotite, beryl, feldspar, minor garnet, and some monazite. Copper and base metals occur in small quantities in the Phlogopite mine in the Strangways Range, and in deposits at present under investigation in the ranges south of Mount Riddock.

3. MAGNETIC RESULTS AND INTERPRETATION

The magnetic data are shown in Plate 2 as stacked profiles with a north-south scale of 1:500,000. The east-west scale has been extended for clarity. The profile scale is approximately 250 gammas/cm and the data remain uncorrected for diurnal variations and the Earth's regional magnetic field.

The interpretation map (Plate 3) has been divided into zones of differing magnetic character, and magnetic trends have been plotted. Positioning errors may be as great as 1 km as the data at this stage have been referred to idealized flight-lines.

The majority of trends are WNW, parallel to the margin of the Dulcie Syncline and to the major fault direction.

Sixty-seven anomalies were hand digitized from the original charts and fitted to two-dimensional tabular models using a spectral analysis program by H.D. Hsu (BMR). Each anomaly was chosen as being a representative profile over a linear magnetic feature. In some cases, superimposed anomalies had to be removed by hand smoothing. Eleven of the interpretations were rejected because of poor fits between the observed and model anomaly spectra or because of noise due to superposition of other anomalies. The remaining 56 computed models are tabulated in Appendix 2 and their positions indicated in Plates 2 and 3.

Correlation between zones and geology

Zone A is highly disturbed, with anomalies of up to 2000 gammas in amplitude. The majority of trends are WNW and many can be correlated with faults. Rock types include the Mount Swan Granite Complex (Bgs), Mount Ida Granite (Bgi), Granite (Bg), Grant Bluff Formation (Bug), Ledan Schists (pЄl), Utopia Quartzite (pЄu), and units pЄg, pЄl0, pЄ5, pЄ8, pЄ, pЄgf, pЄh. The most magnetic of these appears to be mafic granulite and gneiss pЄ5. Depth estimates indicate about 250 m of Tertiary cover in the southwest of the zone. The source of anomaly 59 in the north is 550 m below ground level and therefore below the basement surface. As the anomaly has an amplitude of 500 gammas it is obviously caused by some basic rock underlying or intruding the granite (Bg) in this locality.

Zone B is also highly disturbed, with 2000 gamma anomalies. This zone correlates with the major fault striking WNW from Mount Ida.

Zones C and D have anomalies up to 1500 gammas in amplitude. Anomalies 40, 45, and 46 indicate 100 to 200 m of Tertiary cover over basement. Outcrop in these zones includes mafic granulite and amphibolite. The boundaries of zones C and D are not well defined.

Zone E continues south into the Strangways Range in ALICE SPRINGS. Anomalies are up to 4000 gammas in amplitude. A depth of 100 m is indicated by anomaly 2 at the western margin. Several anomalies between 5 and 10 km SSW of Mount Byrne may be due to mafic plugs.

The eastern part of zone E, the southern part of zone A, and zones C and D correlate with areas of granulite facies metamorphism and with positive Bouguer anomalies.

Zone F contains numerous anomalies of amplitude 100 to 500 gammas. Interpretation of these indicates that the thickness of Tertiary sediments ranges up to 300 m. Anomaly 25 (500 m depth) may represent the base of the Central Mount Stuart Beds for the reasons discussed under zone L. Anomaly 11 of amplitude 1100 gammas is interpreted as a highly magnetic intrusion within the basement, about 700 m below the surface. Most trends in this zone are WNW, parallel to surface lineaments.

Zone G is marginal to part of the Dulcie Syncline, and anomalies range up to a few hundred gammas in amplitude. Estimated depths to basement increase towards the northeast and indicate an irregular basement surface.

Zone H is magnetically quiet except for a few very continuous anomalies up to 400 gammas in amplitude, which form arcuate trends concave to the south. The anomalies are due to near-surface features which dip very steeply to the south. In the west of the zone they are covered by about 100 m of Tertiary sediments (anomalies 50,51). The arcuate magnetic trends are parallel to airphoto lineaments.

Zones H and I correlate with rocks of the Harts Range Group (pЄh) and with a positive Bouguer anomaly. The interpretation suggests that the Harts Range Group forms a synformal structure plunging steeply to the south.

Zone I is magnetically disturbed, with anomalies up to 1500 gammas in amplitude.

Zone J is magnetically quiet, with anomalies less than 100 gammas. Anomalies 7 and 15 are due to near-surface features under a thin veneer of Quaternary cover. The basement in this zone is composed of non-magnetic granite and gneiss. The

magnetic results show that the area of granulite metamorphism in zone K is not continuous with that in the eastern part of zone E. Zone J correlates with a negative Bouguer anomaly.

Zone K contains anomalies 1 and 9, of amplitude 1200 and 1800 gammas respectively. Anomaly 1 is due to a near-surface source whereas anomaly 9 is interpreted as having its source about 130 m below the surface. This zone correlates with an area of high-grade metamorphism and with a positive Bouguer anomaly.

Zone L contains outcrop of Central Mount Stuart Beds, granite and gneiss, and large areas of Tertiary and Quaternary cover. It is magnetically quiet, and there are only two anomalies of amplitude in excess of 150 gammas. The Central Mount Stuart Beds are non-magnetic and gently dipping, and have been deposited unconformably on an older surface. It is assumed that anomalies 17, 22, 29, 32, and 42 are due to more basic rocks contained within the older basement and that their respective interpreted depths of 75, 100, 1650, 400, and 300 m therefore represent the maximum local thicknesses of Central Mount Stuart Beds.

Zone M is magnetically quiet and may represent a considerable thickness of Central Mount Stuart Beds or granite.

Zone N contains several long-wavelength anomalies which give interpreted basement depths of up to 2700 m in the Dulcie Syncline. This depth compares reasonably with estimates by Wells, Milsom, & Tipper (1966) and American Overseas Petroleum (1966). The marked changes in magnetic character and the strong magnetic gradient which delineates the boundary of the basin suggest that it may be a faulted margin. Zone N correlates with a gravity low.

4. RADIOMETRIC RESULTS AND INTERPRETATION

The radiometric results are shown in Plate 4 at a scale of 1:250 000. This plate has been obtained by smoothing the Channel 1 profiles, removing background, dividing it into 50 count/s intervals, and plotting this information along flight-lines. Anomalies recorded on Channel 1 have been investigated by comparing count rates on the other three channels and showing the interpreted source or sources symbolically beside the flight line. No allowance has been made for altitude effects because of the generally low relief and unreliability of the radio altimeter.

Details of equipment, channel widths and settings, sensitivities, and time constants are given in Appendix 1.

Except for some Cainozoic laterites (Cz), all rock types younger than Proterozoic have low radioactivity (less than 100 count/s in total count). Some small anomalies recorded over the Tomahawk Range are probably topographic effects. Anomalies up to about 150 counts/s in total count over the northern part of the Sandover River are due to alluvium derived from granites to the south.

Isolated anomalies of up to 200 counts/s in total count in the western and northwest parts of the sheet correlate with outcrops of Proterozoic granite (Eg) and Archaean gneiss or granite (pЄg). These anomalies have contributions from both Channels 2 and 4 (K and Th).

A strip 20 km wide which trends south from Mount Skinner has Channel 1 values up to 350 counts/s. It contains numerous Channel 4 (Th) and some Channel 2 (K) anomalies, and correlates with outcrops of Proterozoic granites (Eg, Egw, Egm), Archaean units (pЄ6, pЄg, PЄ4), and some Cainozoic laterites (Cz).

An anomalous area in the central east of the sheet has Channel 1 anomalies up to 350 counts/s. This is due to outcrops of Proterozoic granite (Eg, Egs) and orthogneiss (Egi), Archaean units pЄ5, pЄ8, and some Cainozoic laterites (Cz).

Almost all anomalies recorded have a contribution from Channel 4 (Th). The anomalies over the Woodgreen, Mount Ida, the Eg, and Crooked Hole Creek granites also contain contributions from Channel 2(K).

A few very minor anomalies, of about 15 counts/s above background, were recorded on Channel 3 (U). Most of these can be correlated with outcrops of granite, schist, and gneiss (Eg, Egi, pЄ).

5. CONCLUSIONS AND RECOMMENDATIONS

There is good correlation between magnetically disturbed areas and those of high metamorphic grade. This is a feature common with the Sheet areas adjacent to ALCOOTA. There is a fair correlation between magnetically flat zones, negative Bouguer anomalies, and areas of large sediment thickness or non-magnetic granite and gneiss.

Most magnetic trends are oriented WNW parallel to mapped faults and to the axis of the Dulcie Syncline.

Depth estimates from magnetic anomalies indicate a maximum sedimentary thickness of 2700 m for the Dulcie Syncline within the survey area. The thickness of Tertiary cover varies but is generally less than 300 m. Calculations of depth to sources of magnetic anomalies in areas of Central Mount Stuart Beds outcrop suggest the possibility of rugged underlying basement relief.

It is intended that a review of the magnetic interpretation be made after magnetic contours are produced. This would allow better delineation and more accurate positioning of trends and zones, especially in anomalous areas.

Areas of higher radioactivity correlate generally with outcrops of laterite, granite, and orthogneiss. Line spacing would have to be reduced and detector size increased before rock boundaries could be delineated accurately or contour maps produced.

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APPENDIX 1: OPERATIONAL DETAILS

Personnel

BMR	B.W. Wyatt	Party leader
	R.J. Taylor	Geophysicist
	P.G. Wilkes	Geophysicist (part time).
	D. Souter	Draftsman
	J. Bloye	Draftsman
	T. Kimber	Draftsman (part time).
	P. Mendrinos	Technical Officer
	M. Johnson	Technical Assistant
	D. Park	Technical Assistant
TAA	First Officer L.A.T. Manning	Pilot

Equipment

Magnetometers: Airborne: Proton-precession MNS-2 with output to Moseley 7100 B recorder. Ground: Proton-precession MNS-1 with output to Esterline-Angus recorder.

Gamma-ray spectrometer: Detector - Two Harshaw 15 cm x 10 cm thallium activated NaI crystals optically coupled to photomultiplier.

Electronics - Hamner modules.

Stabilization - Cs^{137}, (Co^{57} used experimentally)

Recorders - Two Sppedomax Mark II, 3-channel.

Ancillary: Radio altimeter - Bonzer TRN70 with output to one of the Speedomax recorders.

Camera - Vinten 35-mm with fish-eye lens

Timer - BMR solid state.

Equipment settings

Magnetometer: Airborne sensitivity 1000 gammas f.s.d.

Ground station sensitivity 100 gammas f.s.d.

Spectrometer: Channel 1 window 0.84 - 3.0 MeV
Channel 2 window 1.3 - 1.6 MeV
Channel 3 window 1.6 - 1.9 MeV
Channel 4 window 2.4 - 2.8 Mev

Channel 1 sensitivity 500 counts/s f.s.d.
Channel 2 sensitivity 200 counts/s f.s.d.
Channel 3 sensitivity 100 counts/s f.s.d.
Channel 4 sensitivity 100 counts/s f.s.d.

Time constant 3 seconds (all channels)

Survey details

Flight altitude	150 m above ground level
Aircraft speed	200 km/h
Line orientation	north-south
Line spacing	1.5 km

APPENDIX 2: DEPTH ESTIMATES

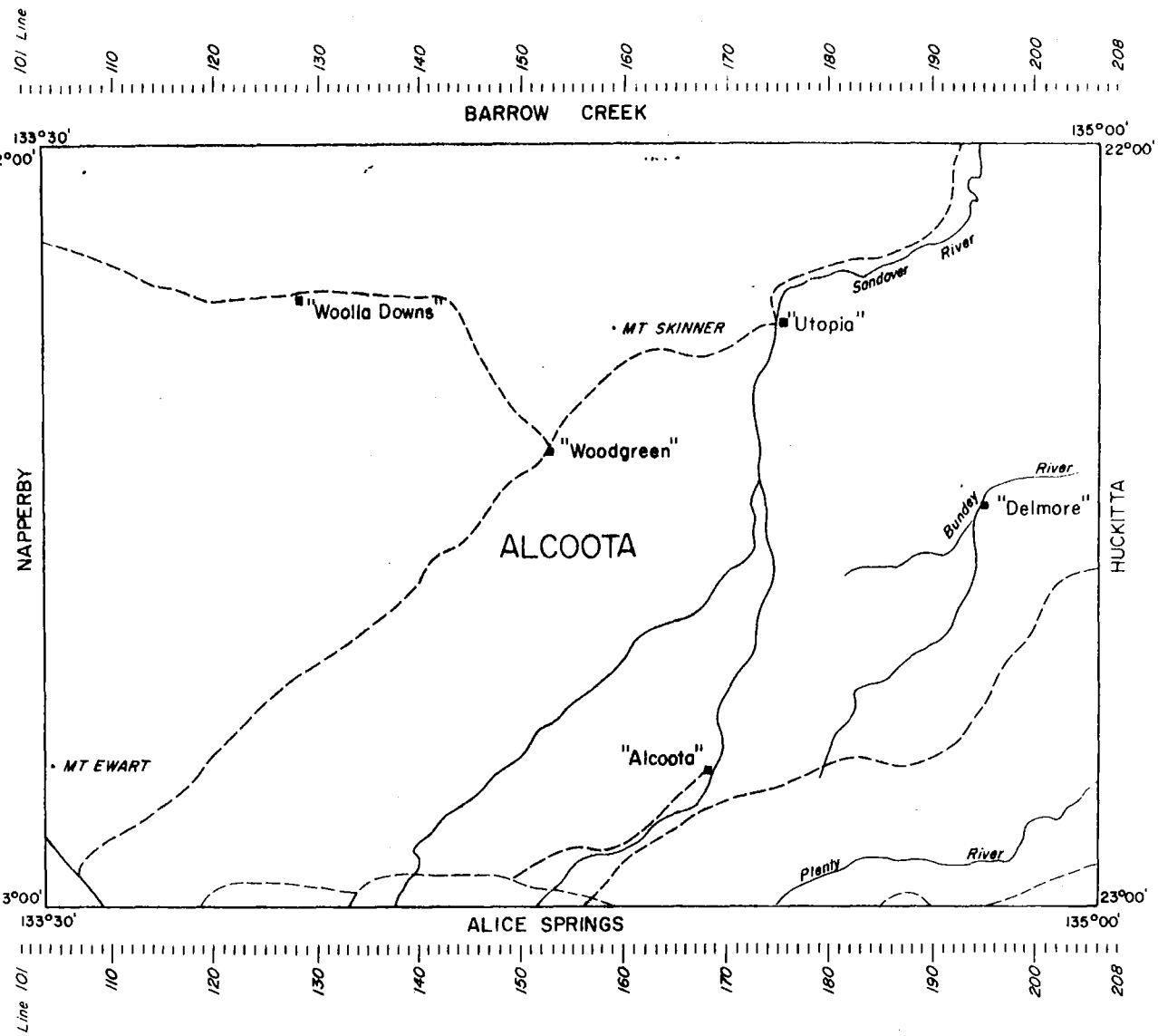
The depth estimates tabulated below are relative to the detector, which was normally 140 m above ground level but less over hills.

Anomaly	Line	Fiducial	Strike	Dip	Susceptibility $\times 10^{-4}$ cgs units	Width metres	Depth metres	Reliability
1	103N	1032	110°	40°S ± 25°	15	1000	150	fair
2	105N	1651	90°	90°N ± 15°	9	1150	250	fair
3	108S	616	125°	60°S ± 30°	4	350	125	good
4	108S	687	75°	*	30	1500	200	fair
5	108S	693	65°	60°S ± 35°	45	1400	175	good
7	109N	645	110°	60°N ± 25°	3	750	150	fair
8	111S	1350	90°	40°S ± 10°	7	950	250	poor
9	111S	1405	105°	60°S ± 10°	45	2100	275	good
11	113S	2074	95°	30°S ± 30°	65	5000	850	fair
14	122N	423	80°	80°S ± 25°	20	750	150	good
15	124N	902	60°	70°N ± 25°	3	750	125	good
16	124N	954	140°	70°N ± 35°	40	1100	250	good
17	126N	1794	105°	50°S ± 10°	9	700	225	fair
19	128S	2046	100°	30°S ± 25°	40	3000	450	good
21	129N	2438	90°	30°S ± 30°	10	1150	250	poor
22	132N	1225	90°	80°S ± 15°	9	850	225	good
23	142N	1558	90°	40°S ± 25°	20	1400	300	poor
25	142N	1684	90°	90°N ± 20°	20	2700	675	fair
26	145N	411	120°	50°S ± 20°	16	1100	225	good
28	149N	1005	80°	60°S ± 20°	30	1000	150	good
29	149N	1111	90°	40°S ± 30°	45	2500	1800	poor
30	151N	1560	45°	60°N ± 25°	30	600	250	fair
31	151N	1666	75°	*	25	400	175	fair
32	151N	1743	90°	80°S ± 40°	7	1300	550	poor
34	155N	449	90°	10°S ± 15°	10	700	250	good
35	156S	574	55°	20°S ± 15°	22	1000	75	good
36	158S	1263	125°	40°N ± 20°	45	900	375	good

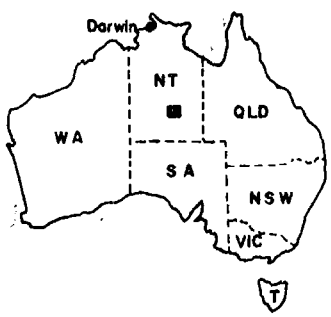
Anomaly	Line	Fiducial	Strike	Dip	Susceptibility $\times 10^{-4}$ cgs units	Width metres	Depth metres	Reliability of depth estimate
37	160S	1933	120°	10°S ± 10°	100	1100	575	good
39	160S	2065	90°	40°S ± 15°	5	500	125	fair
40	160S	2106	105°	*	10	500	225	poor
41	160S	2203	55°	60°N ± 30°	10	1200	175	good
42	163S	885	110°	30°S ± 20°	20	1900	450	good
43	163S	995	80°	*	30	700	300	fair
44	164N	1305	95°	30°S ± 15°	45	4350	875	fair
45	165S	1570	95°	10°N ± 30°	75	900	250	good
46	165S	1582	85°	10°S ± 45°	65	1000	475	fair
48	170N	397	75°	60°S ± 15°	9	650	200	good
49	170N	472	110°	50°S ± 25°	35	3000	1175	poor
50	174N	1576	70°	80°S ± 25°	40	600	225	poor
51	174N	1590	70°	80°S ± 30°	20	800	250	fair
52	177S	2675	70°	*	4	450	100	poor
53	178N	306	70°	*	5	400	100	fair
54	182S	1323	120°	40°S ± 40°	16	500	150	good
55	183N	609	95°	*	4	250	150	fair
56	184N	1114	85°	20°S ± 30°	30	1000	400	poor
57	185N	1519	90°	20°S ± 25°	7	1750	700	poor
58	187N	336	100°	90°S ± 20°	11	400	100	good
59	188S	693	100°	10°S ± 40°	20	1300	700	good
60	192S	1982	105°	40°S ± 10°	20	2600	1550	good
61	194S	2883	120°	50°S ± 15°	4	350	50	poor
62	194S	2904	120°	*	17	400	175	poor
63	196S	683	125°	40°S ± 15°	10	1200	300	good
64	196S	699	140°	70°S ± 25°	30	1500	175	good
65	196S	870	110°	*	20	650	175	fair
66	206N	579	80°	0°N ± 20°	15	5300	475	good
67	206N	662	90°	10°S ± 10°	30	7800	2850	good

* Dip not shown as error range exceeds ± 45°

FIGURE 1



LOCATION DIAGRAM

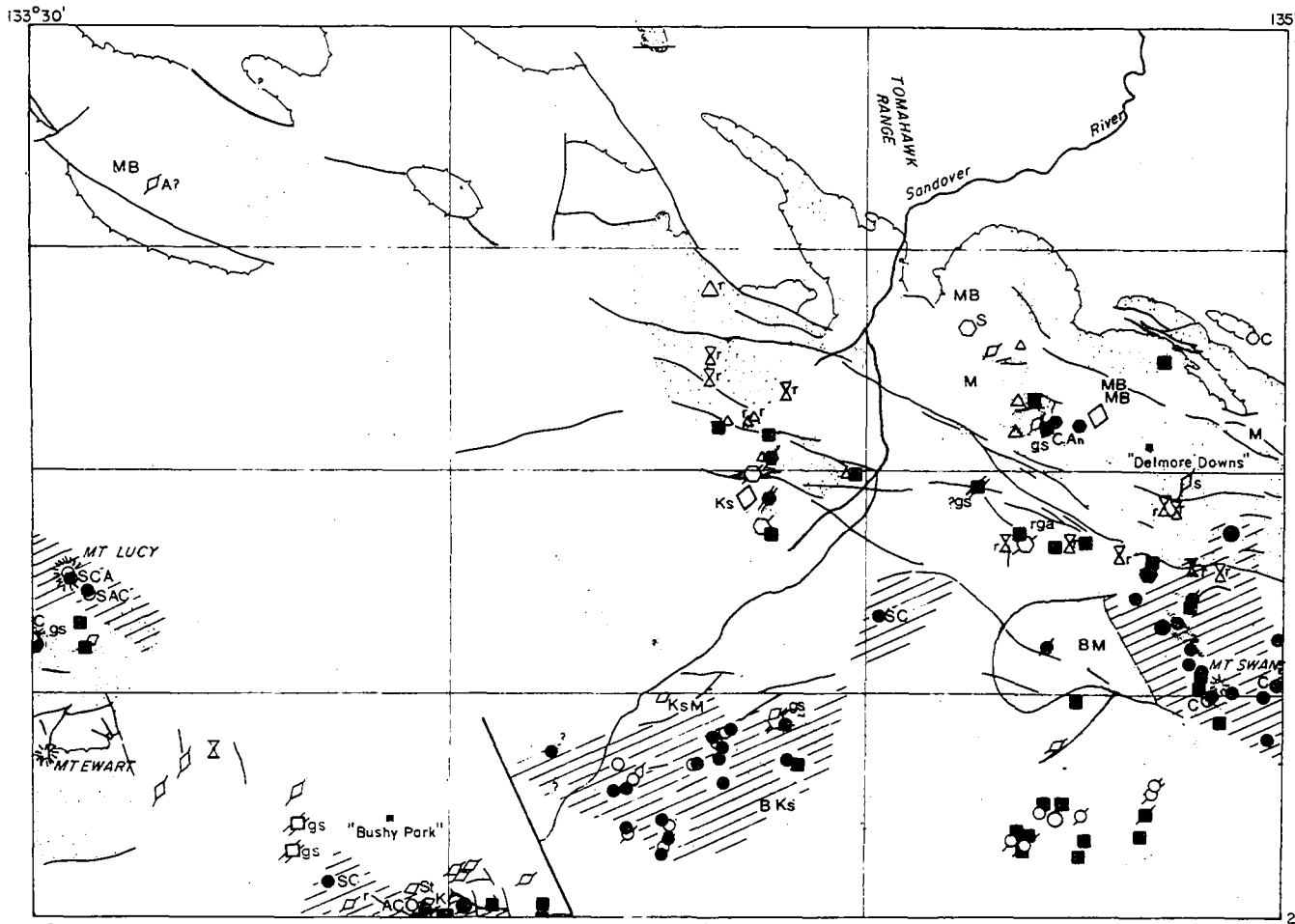


AIRBORNE SURVEY, ALCOOTA NT, 1972

LOCALITY MAP AND FLIGHT-LINE SYSTEM

METAMORPHIC FACIES

ALCOOTA SHEET AREA



BASED ON F53/A10/31

0 10 20 30 40 50 60 70 KILOMETRES

0 10 20 30 40 MILES

REFERENCE

GRANULITE FACIES ROCKS

GRANITE & ORTHOGNEISS

Unconformity, tap of 'v' towards younger rock

Fault

METAMORPHIC GRADE

GRANULITE

- Hypersthene ± Hornblende ± Garnet ± Sillimanite ± K-feldspar Clinopyroxene ± Biotite ± Cordierite ± Rutile
- Sillimanite ± K-feldspar ± Garnet ± Cordierite ± Andalusite ± Biotite ± Hornblende ± Epidote
- Hornblende ± Garnet ± Clinopyroxene ± Scapolite ± Biotite ± Epidote Plagioclase (?Labradorite) ± Rutile

AMPHIBOLITE

- Actinolite ± Hornblende ? ± Clinopyroxene ± Epidote ± Biotite ± K-feldspar ± Muscovite ± Calcite ± Quartz ± Plagioclase (? Andesine)
- Sillimanite ± Muscovite ± K-feldspar ± Garnet ± Hornblende ± Biotite ± Epidote
- Cordierite Anthophyllite-Quartz-Biotite ± Chlorite
- ± Staurolite ± Kyanite ± Garnet ± Chlorite ± Biotite ± Muscovite ± Epidote ± K-feldspar ± Quartz ± Plagioclase (including albite)
- Biotite + Muscovite superposed schistosity, in granulites

GREENSCHIST

- Chlorite ± Albite ± Sericite ± Epidote (in more than trace amounts)

grade of retrogression

Possible Classification

Slightly retrogressed ; gs – Greenschist

r Retrogressed

rga Relic granulite mineral or texture

C Cordierite
A Andalusite
K Kyanite
St Staurolite
Ks K-feldspar
B Biotite
M Muscovite
An Anthophyllite
S Sillimanite

From Shaw and Warren (in prep.)

FIGURE 2

F53/A10/1099

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

ALCOOTA

NORTHERN TERRITORY

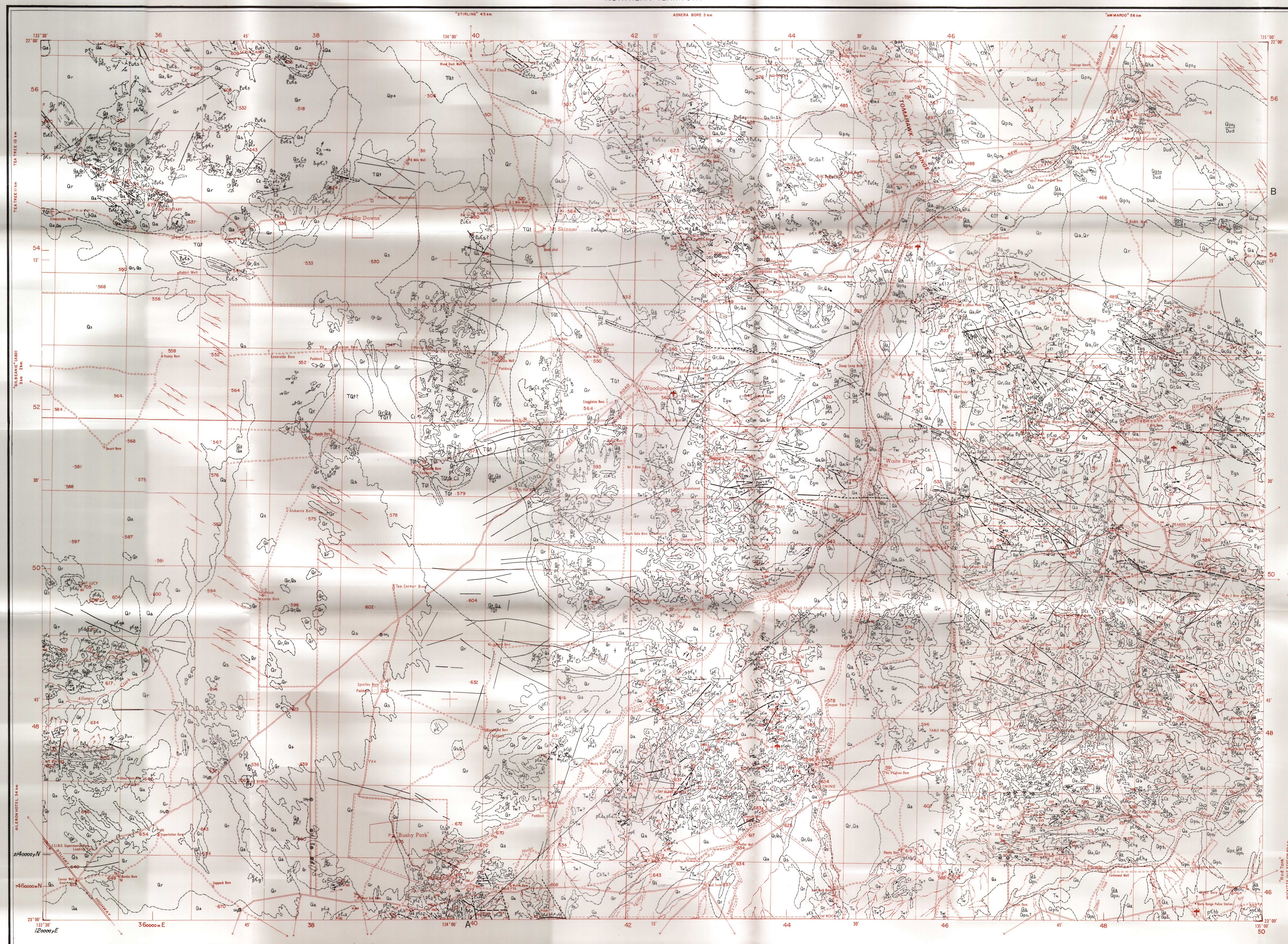
SHEET SF 53-10

Reference

- Geological boundary
- Anticline
- Syncline
- Syncline, concealed
- Overturned anticline
- Overturned syncline
- Plunge of minor anticline, unmeasured
- Fault

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, faults are shown by short dashes

- Shear-zone
- Strike and dip of strata
- Strike and dip of strata, unmeasured
- Dip < 15° } airphoto interpretation
- Dip 15°–45° } airphoto interpretation
- Dip > 45° } airphoto interpretation
- Trend line } airphoto interpretation
- Lineament } airphoto interpretation
- Strike and dip of foliation
- Strike and dip of foliation, unmeasured
- Vertical foliation
- Foliation with plunge of lineation
- ALIS Macrofossil locality with reference number
- Vertebrate fossil locality
- X27 Specimen locality with reference number
- KS3 Geological section with reference number
- Dyke, q - quartz, peg - pegmatite, do - dolerite
- mq Mylonized quartzite zone
- Drill hole, SH - Scout hole, PD - Percussion drill hole (Kennecott Corp), DD - Diamond drill hole (1-5 BMR, C-1,2 Centamin N.L.)
- Mine - minor
- Mine - abandoned
- •Cu Minor mineral occurence
- Cu Copper
- Fe Iron
- Mi Mica
- Ta Tantalum
- Th Thorium
- W Tungsten
- Bore
- Windpump
- Well
- Dam
- Waterhole
- Spring
- Swamp
- Dunes
- Highway
- Road
- Vehicle track
- Fence
- Landing ground
- "Alcoota" Homestead
- Building
- Yd Yard
- Astronomical station
- Trigonometrical station
- •610 Elevation in metres, approximate



Reference*

Era	Period	Unit	Symbol	Description
CAINOZOIC	QUATERNARY – HOLOCENE		Qha	Fine and coarse sands, some cobbles
			Qa	Alluvium, eluvium, colluvium, soil, scree
			Qr	Red clayey - soil and sand
			Qs	Aeolian sheet quartz sand
	QUATERNARY – PLEISTOCENE		Qps	Aeolian sand
			Qps_1	Aeolian dunes: red and light coloured quartz sand
			Qps_2	Aeolian sheet sand light coloured quartz sand
	TERTIARY	Alcoota Beds	TQt	Silty sandstone, travertinous limestone, chalcedony, quartzite sandstone pebble conglomerate, minor siltstone and mudstone in subsurface
		Alcoota Beds – Waite Formation	Tw	Chalcedonic limestone, sandstone, mudstone, minor sandy conglomerate
		Alcoota Beds	Ta	Green and grey pyritic mudstone, white mudstone and siltstone, red iron oxide stained and mottled siltstone and mudstone
			Cz	Deeply weathered (leached, mottled and ferruginous rocks,) in part kaolinitic and pisolitic, laterite, silcrete
PALAEOZOIC	DEVONIAN	Dulcie Sandstone	Dud	Crossbedded sandstone, minor pebble conglomerate and siltstone
	UPPER CAMBRIAN TO LOWER ORDOVICIAN	Tomahawk Beds	€Ot	Quartz sandstone, glauconite quartz sandstone, minor siltstone, dolomite, dolomitic sandstone and chert
PROTEROZOIC	ADELAIDEAN TO CAMBRIAN	Central Mount Stuart Beds	Pu€s	
			$Pu€s_3$	Red and white quartz and lithic sandstone and siltstone. Minor amounts of feldspathic sandstone and siltstone
			$Pu€s_2$	Red and chocolate quartz and lithic sandstone. Rare dolomite and arkose interbeds of grey sandstone and siltstone. Grey sandstone, dark grey and grey-green siltstone, cupriferous in part. Basal tillite, boulder beds and ferruginous pebbly sandstone
			$Pu€s_1$	Feldspathic quartzite, minor quartzite
	ADELAIDEAN	Grant Bluff Formation	Pug	White to grey quartz-feldspar sandstone, quartz sandstone, quartzite, minor granule and pebble conglomerate, rare white siltstone, probable shale and siltstone in subsurface
		Vaughan Springs Quartzite	Puv	Thick bedded quartzite, sandstone granule and pebble conglomerate, glauconite
		Treuer Member	Put	Thin bedded, fine grained sandstone, white, yellow and red siltstone, possible evaporites
			Pb	Mafic igneous rocks, metamophosed but generally unfoliated
			Pg	Granite
		Woodgreen Granite	Pgw	Porphyritic gneissic biotite granite
		Mount Ida Granite	Pgi	Gneissic biotite granite, rarely muscovite-bearing
		Mount Swan Granite	Pgs	Gneissic biotite granite with microcline phenocrysts, very rarely muscovite bearing
		Crooked Hole Creek Granite	Pgm	Gneissic biotite granite
		Copia Granite	Pgc	Gneissic biotite granite
PRECAMBRIAN		Allungra Granite	p€ga	Gneissic biotite granite with feldspar phenocrysts
		Queenie Flat Granite	p€gf	Porphyritic biotite gneissic granite
		Langford Orthogneiss	p€gl	Porphyroblastic muscovite-biotite orthogneiss
			p€g	Orthogneiss or granite
			p€p	Pegmatite
			p€d	Mafic granulite, amphibolite
		Utopia Quartzite	p€u (Fe)	Quartzite, grit. Ironstone lenses
		Ledan Schists	p€l	Muscovite-quartz schist, muscovite-biotite-quartz schist, tourmaline-quartzite, chert, boulder bed at base
		Mendip Metamorphics	p€m	Quartzite, biotite-feldspar gneiss, minor grit, para-amphibolite and calc-silicate rock
		Unnamed Metamorphic Rocks	$p€_{10}$	Calc-silicate gneiss, pelitic gneiss, possible acid to intermediate metavolcanics, cordierite-anthophyllite schistose gneiss
			$p€_9$	Leucocratic biotite gneiss with clots of muscovite, biotite-muscovite schist, amphibolite, minor calc-silicate rock
			$p€_8$	Biotite-quartz-feldspar gneiss, biotite schist, amphibolite
			$p€_7$	Quartz-biotite-feldspar gneiss, muscovite-biotite-quartz schist, garnet-biotite-quartz-feldspar gneiss
			$p€_6$	Garnet-biotite-feldspar gneiss, minor amphibolite, calc-silicate rock
			$p€_6a$	Muscovite-biotite gneiss
			$p€_6b$	Calc-silicate rock, quartzite, biotite feldspar gneiss
			$p€_6c$	Amphibolite
			$p€g_6$	Gneissic granite
			$p€_5$	Felsic gneiss, mafic granulite, biotite-garnet-potassium feldspar-quartz migmatite, minor calc-silicate rock, rare cordierite-bearing felsic granulites
			$p€_4$	Sillimanite-garnet-biotite-feldspar-quartz gneiss, garnet-potassium feldspar-quartz migmatite, mafic granulite, minor calcareous pelitic gneiss, calc-silicate rock and plutonic migmatite
			$p€d_4$	Mafic granulite and amphibolite
			$p€g_4$	Plutonic garnet-biotite-feldspar-quartz migmatite
			$p€_3$	Pelitic, semi pelitic, psammic and calc-silicate gneisses, amphibolite
			$p€d_3$	Meta gabbro and metadolerite
			$p€_2$	Schistose biotite-quartz-feldspar gneiss and muscovite biotite-quartz-feldspar gneiss, amphibolite, hornblende gneiss, kyanite-muscovite schist, quartz-biotite-staurolite-chlorite schist
			$p€_1$	Felsic granulite and gneiss, minor pelitic gneiss and mafic granulite (section only)
			$p€_1a$	Felsic gneissic granulite and gneiss, minor muscovite-microcline granitic gneiss, mafic granulite
			$p€_1b$	Hypersthene-felsic granulite, quartz-biotite-feldspar-gneiss, garnet-biotite-quartz-feldspar gneiss, minor schistose biotite gneiss and mafic granulite
			$p€_1c$	Felsic granulite, minor garnet-biotite gneiss and amphibolite
			$p€_1d$	Biotite-quartz-feldspar gneiss
			$p€_1e$	Garnet-biotite-quartz-feldspar gneiss, minor granitic gneiss
		Harts Range Group	p€h	Pelitic, semi-pelitic, calc-silicate and psammitic gneiss, leucocratic felsic gneiss, meta-quartzites, meta mafic gneiss
			$p€h_3$	Leucocratic biotite-quartz-feldspar gneiss
			$p€h_4$	Meta calc-silicates and flaggy quartzites
			$p€h_5$	Amphibolite, quartz-amphibolite
			$p€h_6$	Sillimanite-garnet-quartz-feldspar gneiss and biotite-garnet-quartz-feldspar gneiss, minor amphibolite
			$p€h_7$	Leucocratic biotite-quartz-potassium feldspar gneiss rarely garnetiferous, porphyroblastic
			$p€h_8$	Biotite quartzite, calcareous in parts, rarely garnetiferous
		Brady Gneiss	p€hb	Almandine-muscovite-biotite-plagioclase-quartz gneiss, sillimanite bearing in part
			p€	Gneiss, schist

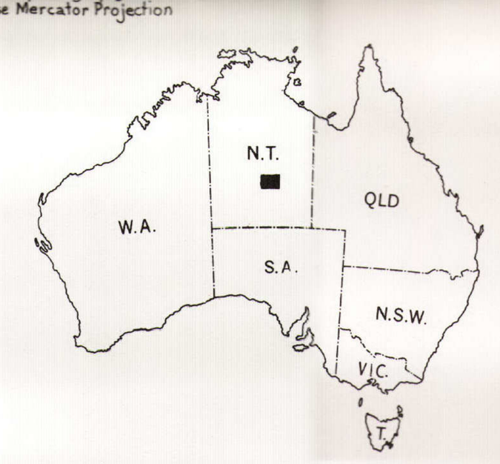
* Where two or more stratigraphic units cannot be distinguished from one another the units are listed in order of abundance, the dominant unit listed first eg. Qa, Qr, Qs (Qa with subordinate Qr and a lesser amount of Qs). Tw, Qa, Qr? / Tw (Tw with fewer outcrops of Qa and possible subsidiary Qr overlying Tw)

NOTE ON GRID COORDINATES

Brown lines with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 10,000 yard grid, Zone 5 (Australia Series). CLARKE 1858 SPHEROID. Transverse Mercator Projection

Brown numbered ticks (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 53 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of Minerals and Energy. Issued under the authority of the Hon. R.F.X. Connor, M.P., Minister for Minerals and Energy. Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50 000 Scale. Transverse Mercator Projection



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970

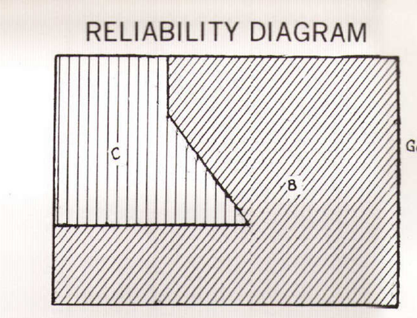
MOUNT SOLITAIRE SF 52-4	LANDER RIVER SF 53-1	BONNEY WELL SF 53-2	FREW RIVER SF 53-3	AVON DOWNS SF 53-4
MOUNT THEO SF 52-8	MOUNT PEAKE SF 53-5	BARROW CREEK SF 53-6	ELKEDRA SF 53-7	SANDOVER RIVER SF 53-8
MOUNT DOREEN SF 52-12	NAPPERBY SF 53-9	ALCOOTA SF 53-10	HUCKITTA SF 53-11	TOBERMORY SF 53-12
MOUNT LIEBIG SF 52-16	HERMANNSBURG SF 53-13	ALICE SPRINGS SF 53-14	ILLOGWA CREEK SF 53-15	HAY RIVER SF 53-16
LAKE AMADEUS SG 52-4	HENBURY SG 53-1	RODINGA SG 53-2	HALE RIVER SG 53-3	SIMPSON DESERT NORTH SG 53-4

Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

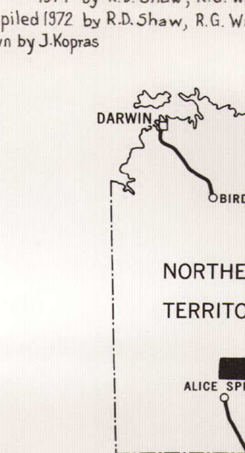
5 0 5 10 MILES

RELIABILITY DIAGRAM



Geology B Detailed reconnaissance: numerous traverses, and airphoto interpretation
C General reconnaissance: few traverses, mainly airphoto interpretation

Geology 1961 by K.G. Smith, E.N. Milligan
1968 by A.T. Wells, T.G. Evans, T.N. Nicholas, A.Y. Glikson
1969 by D.T. Grainger
1969 Photo interpretation by C.J. Simpson
1970 by R.D. Shaw, R.G. Warren, B.R. Senior, C.J. Simpson
1971 by R.D. Shaw, R.G. Warren
Compiled 1972 by R.D. Shaw, R.G. Warren, J. Kopras
Drawn by J. Kopras

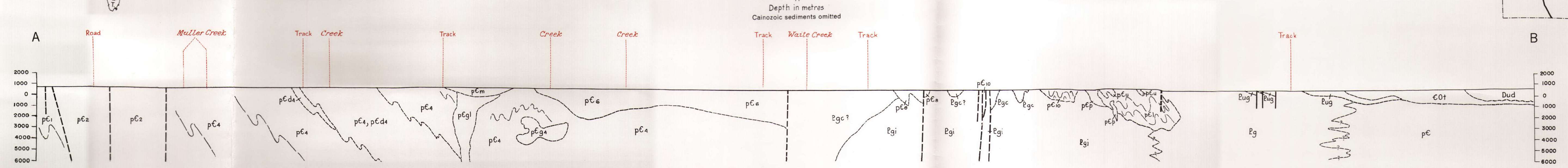


Section

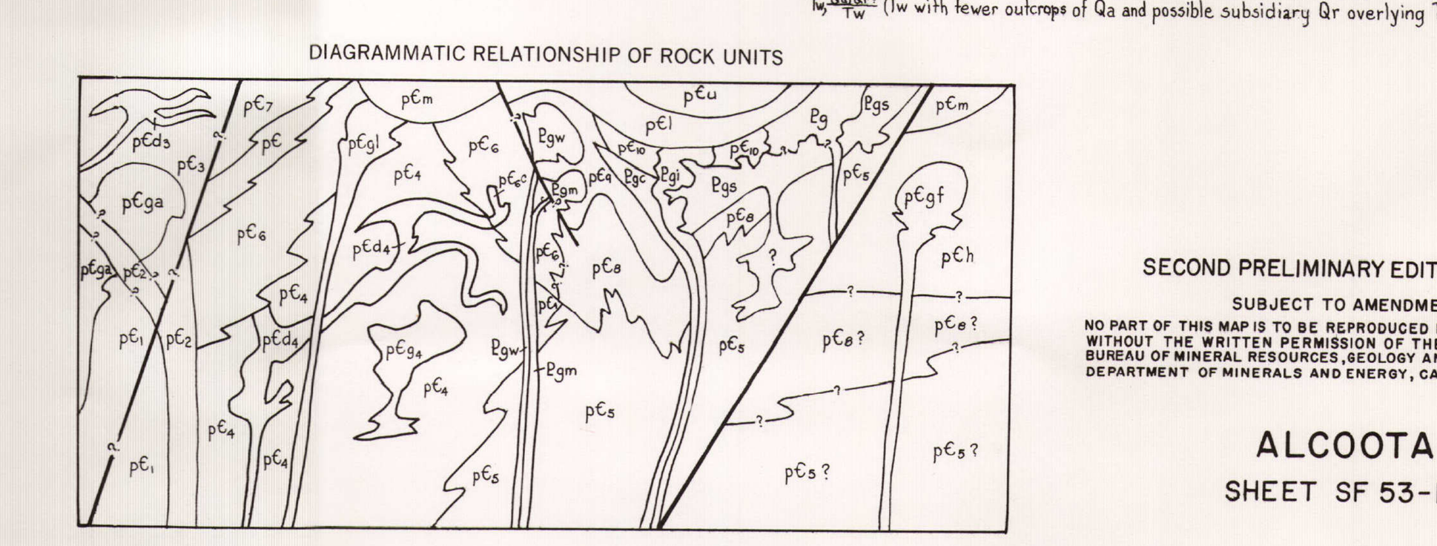
Scale: V/H = 1

Depth in metres

Cainozoic sediments omitted



DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



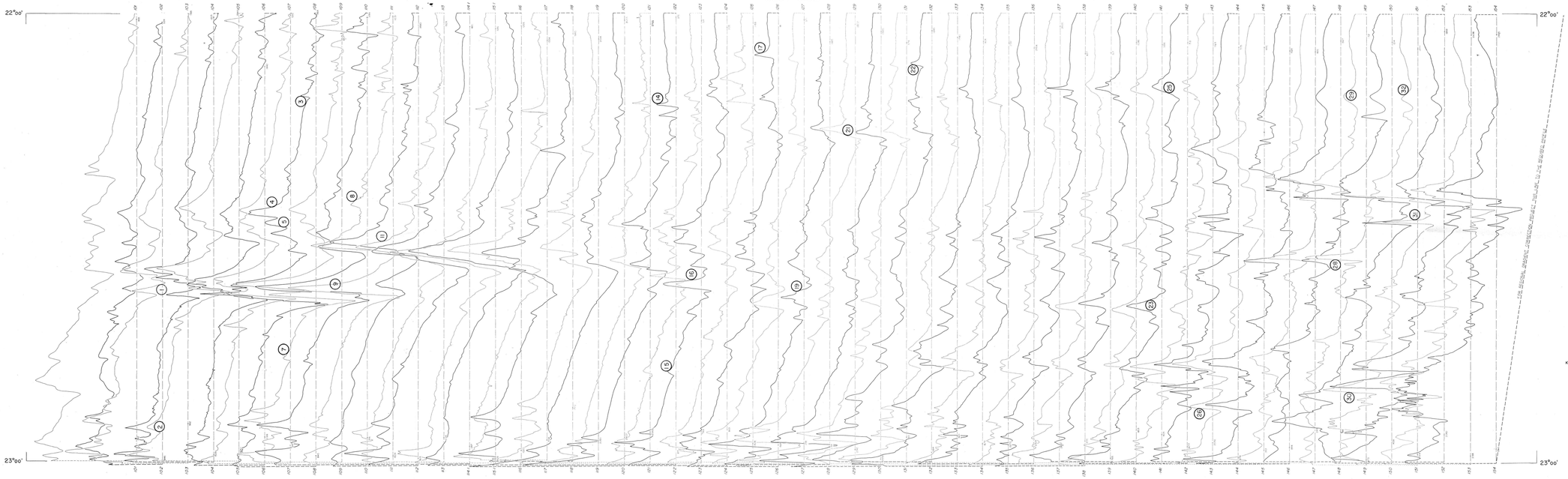
SECOND PRELIMINARY EDITION 1973

SUBJECT TO AMENDMENT

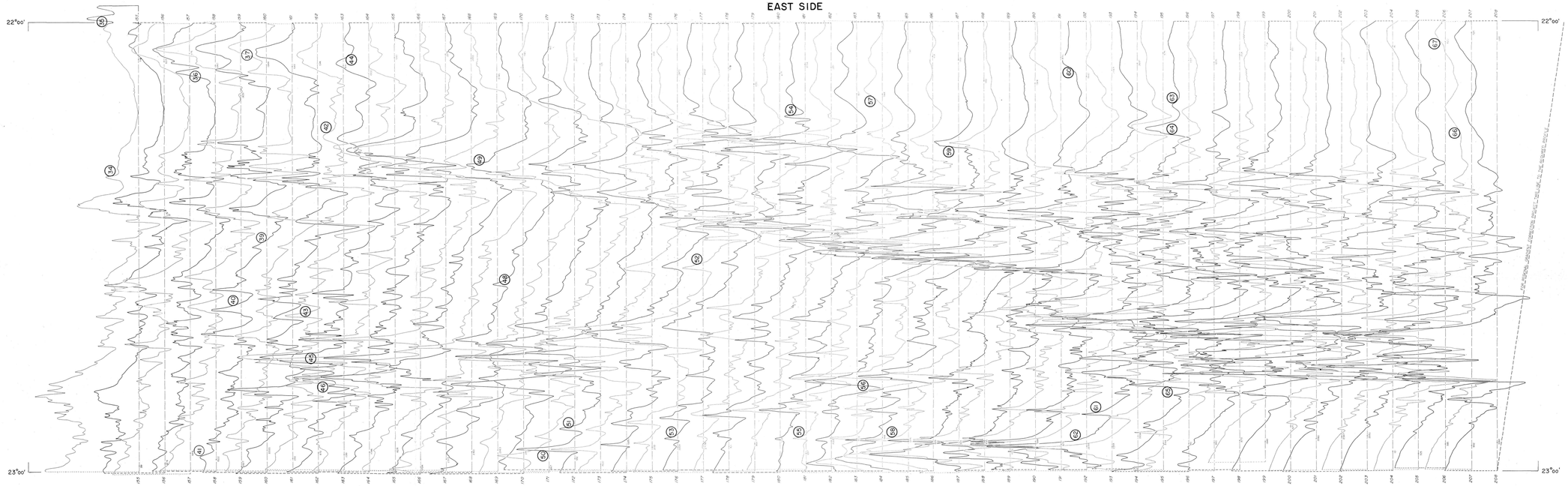
ALCOOTA

SHEET SF 53-10

WEST SIDE



EAST SIDE



AIRBORNE SURVEY, ALCOOTA NT, 1972

TOTAL MAGNETIC INTENSITY PROFILES

NORTH-SOUTH SCALE

KILOMETRES 10 0 10 20 30 40 50 KILOMETRES

MILES 5 0 10 20 30 MILES

REFERENCE TO 1:250000 MAP SERIES

MOUNT PEAKE	BARROW CREEK	ELKEDRA
NAPPERBY	ALCOOTA	HUCKITTA
HERMANNSBURG	ALICE SPRINGS	ILLOGWA CREEK

21°00' 24°00' 132°00' 136°30'

PROFILE SCALE (APPROX)

GAMMAS 800 600 400 200 0 200 GAMMAS

EXPLANATORY NOTES

The survey was flown at an average altitude of 150m above ground level and with a flight-line spacing of 1.5km.

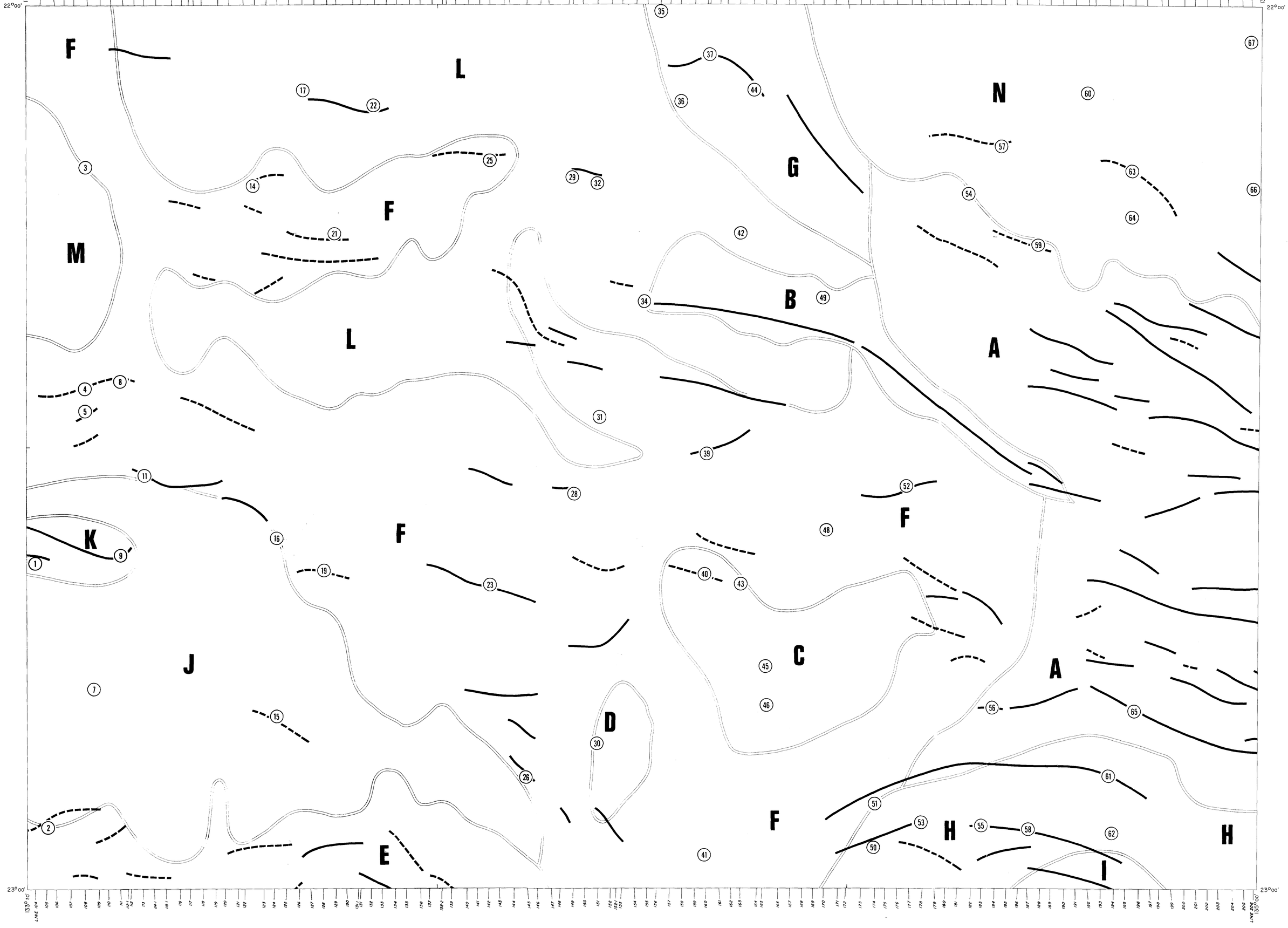
The regional gradient of total magnetic intensity has not been removed from the profiles. This amounts to 7.5γ/km southwards and can be removed graphically by reference to the graticule at the right hand side of the plate.

The probable error of positioning of the flight-lines is ± 150m.

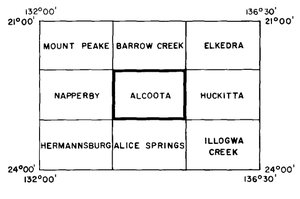
To accompany Record No 1974/33

F53/BI-129

PLATE 3



INDEX TO ADJOINING SHEETS



AIRBORNE SURVEY, ALCOOTA NT, 1972

MAGNETIC INTERPRETATION

SCALE 1:250 000

KILOMETRES 5 0 5 10 15 20 KILOMETRES

MILES 5 0 5 10 MILES

GEOPHYSICAL LEGEND

M — *Magnetic zone*

Magnetic trend — well defined

Magnetic trend — poorly defined

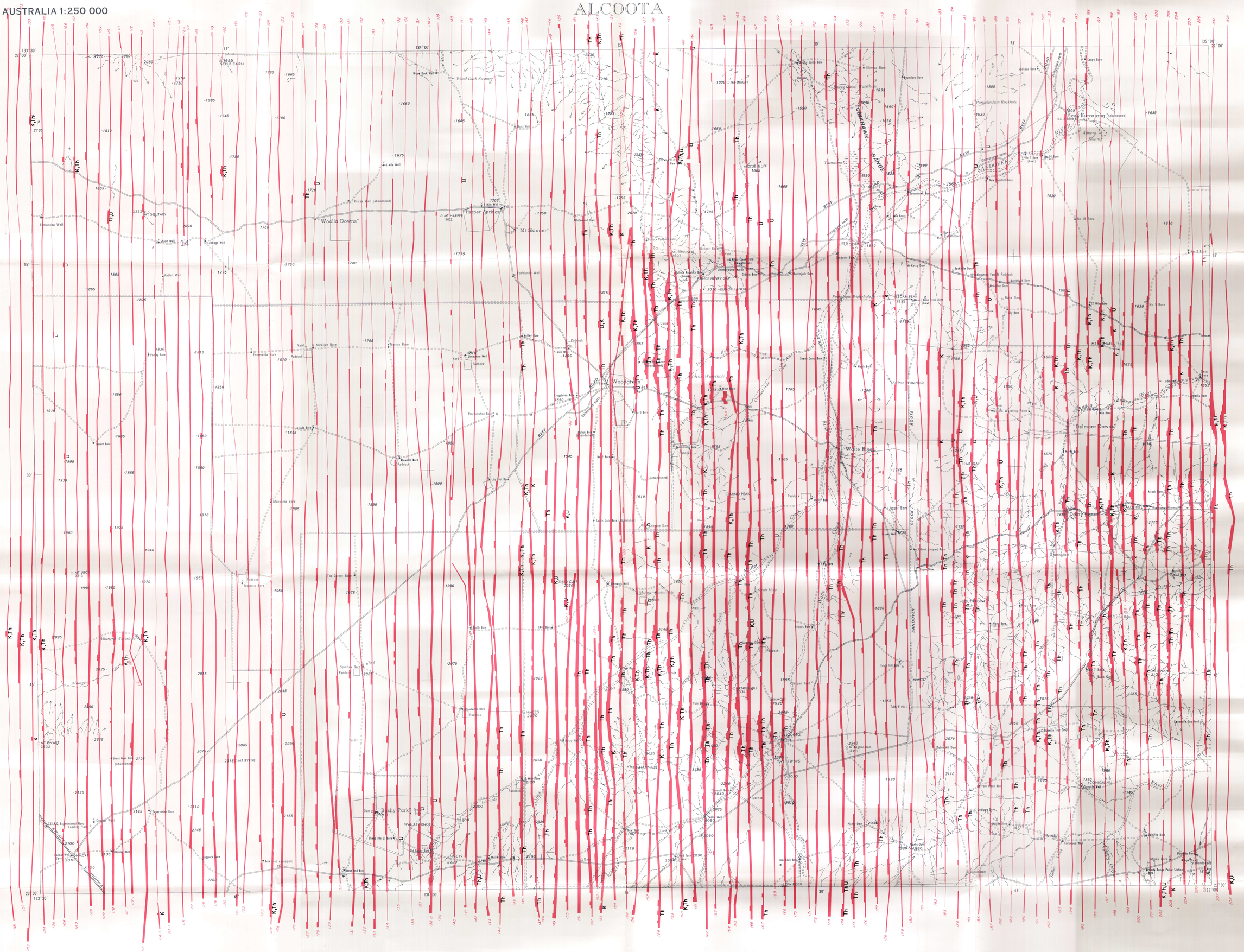
(37) — *Anomaly number (for text reference)*

To accompany Record No. 1974/33

F53/B1-134

AUSTRALIA 1:250 000

ALCOOTA



INDEX TO 1:250 000 MAP SERIES

132°00'		136°30'
21°00' MT PEAKE	BARROW CREEK	ELKEDRA
NAPPERBY	ALCOOTA	HUCKITTA
HERMANNSBURG	ALICE SPRINGS	ILLOGWA CREEK
24°00'		

The topographic base map was compiled and prepared by the Division of National Mapping, Department of Minerals and Energy.

Overlays F53/BI-131, 132 . F53/80-60
To Accompany Record No. 1974/33

TOPOGRAPHICAL LEGEND

- Road
- Track
- Fence
- Windpump
- Building
- Yard
- W/T — Wireless transceiver
- River or stream
- 750 750 — Spot elevation in feet
- Control points

AIRBORNE SURVEY, ALCOOTA NT, 1972

RADIOMETRIC RESULTS

KILOMETRES 5 0 5 10 15 20 KILOMETRES

MILES 5 0 5 10 MILES

GEOPHYSICAL LEGEND

250 — 300
300 — 350
250 — 300
200 — 250
150 — 200
100 — 150
50 — 100
0 — 50

Counts/s above background

143 — Flight-line number

K — Potassium source

U — Uranium source

Th — Thorium source

EXPLANATORY NOTES

The radiometric data were obtained using two 15cm x 10cm Na I crystals (3700cm³ volume) in an aircraft flying at 150m above ground level.

The Channel 1 (total count) profiles have been smoothed, divided into 50 counts/s intervals, and plotted along the actual flight lines.

The interpreted source or sources of anomalies are shown symbolically beside the anomalies.

F53/BI-133