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Record 1972/96

PRESURVEY REPORT ON ALCOOTA REGIONAL AND ARLTUNGA DETAILED AIRBORNE GEOPHYSICAL SURVEYS, N.T. 1972

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B.W. Wyatt

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SUMMARY

During 1972 it is proposed to carry out magnetic and radiometric surveys of the ALCOOTA 1:250 000 map area and selected parts of the Arltunga Nappe Complex. This record outlines the objectives of the surveys and summarizes the geology and previous geophysical work in the areas to be covered.

1. ALCOOTA 1:250 000 SHEET

Introduction

The ALCOOTA 1:250 000 Sheet is bounded by latitudes 22°00'S and 23°00'S and longitudes 133°30'E and 135°00'E and covers an area of about 17 000 square kilometres.

The major part of the sheet area is occupied by sand plain, fixed sand hills, and plains of alluvial soil. The western half of the sheet slopes gently to the north between about 650 m and 500 m above sea level. The eastern half is made up mainly of the Sandover-Bundey Basin which falls from about 600 m to 450 m in the north-east. Isolated hills and ranges are up to 200 m above the level of the plains.

A proton magnetometer and 4-channel gamma-ray spectrometer will be flown by Aero Commander aircraft VH-BMR at an altitude of approximately 150 m above ground level along north-south lines at 1.5 km spacing. The purpose of the survey is to provide systematic geophysical data covering the ALCOOTA area to supplement the existing geological knowledge and possibly assist mineral exploration.

The present summary of geology is taken mainly from published and unpublished papers of the Bureau of Mineral Resources and from personal communications with R.D. Shaw of BMR.

Stratigraphy

The metamorphosed Arunta Complex comprises the greater part of the outcrop in the sheet area. 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. The stratigraphy is summarized in Table 1.

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 by a major metamorphic and igneous event which probably took place about 1700 to 1900 m.y. ago.

The Arunta Complex is strongly magnetic and provides a well-defined magnetic basement. It is mostly shallow in the ALCOOTA sheet except for the northeast corner, where aeromagnetic work (Wells, Milsom & Tipper, 1966; American Overseas Petroleum, 1966) indicates a depth of about 1500 m.

Proterozoic

Much of the Arunta Block has been intruded by granites. The largest 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.

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.

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 is thought to correlate with the Heavitree Quartzite of the Amadeus Basin. The Trever Member consists of thinly bedded sandstone and siltstone.

Adelaidean to Cambrian

The central Mount Stuart Beds crop out in the northwest and central north of the ALCOOTA sheet. 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.

TABLE 1. STRATIGRAPHY - ALCOOTA SHEET

Age	Rock Unit	Symbol	Max. Thickness (ft)	Stratigraphic Relationship	Structure
Quaternary	Undifferentiated	Qa, Qs, Qr			
Tertiary	Waite Formation	Tw	550+	Unconformable	Flat
	Undifferentiated	Cz			
Devonian	Dulcie Sandstone	Dud	1500+	Unconformable	Low & steep N-E dips
Upper Cambrian to Lower Ordovician	Tomahawk Beds	ϵ-Ot	400+	Unconformable	Low & steep N-E dips
Adelaidean to Cambrian	Central Mt Stuart Beds	Pus	1000+	Unconformable on Archaean	Low S-E dips
Adelaidean	Vaughan Springs Quartzite	Puv		Unconformable on Archean	
	Treuer Member	Put			
Proterozoic	Grant Bluff Formation	Pm	200	Unconformable	M. to steep N.E. dips
	Undifferentiated	Pb, Pg			
	Woodgreen Granite	Pgw			
	Mt Swan Granite	Pgs			
	Mt Ida Orthogneiss	Pgi			
	Crooked Hole Ck. Orthogneiss	Pgm			
Archean to L. Proterozoic	Undifferentiated	pϵg			Intensely folded
	Queenie Flat Orthogneiss	pϵgf			
	Utopia Quartzite	pϵu			
	Ledan Peak Schists	pϵ1			
		pϵ14	acid and intermediate meta-volcanics and gneiss		
		pϵ13	gneiss, minor amphibolite		
		pϵ12	orthogneiss		
		pϵ11	gneiss		
		pϵ8	gneiss		
		pϵ7	quartzite, gneiss		
		pϵ6	gneiss		
		pϵ5	gneiss and mafic granulite		
		pϵ4	gneiss and mafic granulite		

(Table 1. Stratigraphy - Alcoota Sheet - Continued)

Age	Rock Unit	Symbol	Max. Thickness (ft)	Stratigraphic Relationship	Structure
	Harts Range Group	pℰ3	gneiss and amphibolite		
		pℰ2	felsic gneiss		
		pℰ1	gneiss		
	Brady Gneiss	pℰb	felsic gneiss		
	Reynolds Range Area	pℰr	felsic granulite, rare mafic granulite		
		pℰrs	schist and quartzite		
		pℰrd	mafic granulite		

Devonian

The Dulcie Sandstone forms the core of the asymmetrical Dulcie Syndline and has measured thicknesses of 630 m and 460 m in the neighbouring HUCKITTA and BARROW CREEK sheets respectively. The formation is composed of cross-bedded quartz sandstone with some beds of siltstone and pebble conglomerate.

Tertiary

Much of the Arunta Block is covered by remnants of a lateritic terrain and unconformably overlain by flat-lying Tertiary sediments. The thickness of these lacustrine and fluviatile sediments is 130 m near the Harts Range Police Station and at least 194 m in the central west of the sheet area.

Quaternary

Alluvium, sand, and red earth soil cover large areas on the ALCOOTA sheet.

Metamorphism

An orogeny antedated the deposition of the Proterozoic Grant Bluff Formation 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 are thought to have affected the rocks in the area.

The rocks of highest metamorphic grade (granulite facies) crop out in two broad bands trending roughly ENE and WNW and meeting near Bushy Park homestead in the southwestern corner of the sheet area. The metamorphic grade decreases through amphibolite and greenschist facies farther away from these more highly altered belts.

A comparison of aeromagnetic contour maps of adjacent sheets with metamorphic maps compiled by D.J. Forman of BMR shows generally good correlation between disturbed magnetic zones and highly metamorphosed zones. Trend-lines and lineaments are mostly oriented between ENE and ESE.

Mineralization (After R.D. Shaw)

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

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

Previous geophysical work

BMR has flown a regional aeromagnetic survey east of the ALCOOTA sheet (Wells et al., 1966) and a regional airborne magnetic and radiometric survey to the south (Young & Shelley, 1966). A detailed aeromagnetic survey has been made in the Strangways Range immediately south of the ALCOOTA sheet (Tipper, 1969).

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

The previous aeromagnetic surveys indicate that the Arunta Block forms a well defined magnetic basement and that its depth in the Dulcie Syncline to the northeast is about 1500 metres.

The regional gravity survey (Lonsdale & Flavelle, 1963) has outlined the Lake Caroline Gravity Ridge, which trends southeast from the centre of the ALCOOTA sheet, and a gravity 'low' extending west from the ALCOOTA sheet. There are no major trends in the Georgina Basin to the northeast.

Radiometric surveys of Authorities to Prospect have been carried out by Central Pacific and Kratos Uranium over parts of the ALCOOTA sheet.

2. ARLTUNGA NAPPE COMPLEX

A detailed magnetometer and gamma-ray spectrometer survey will be flown over parts of the Arltunga Nappe Complex in the ALICE SPRINGS Sheet (Fig. 1). The survey has been requested by the Geological Branch of BMR to aid in the detailed mapping of the structure, and its specific purposes are:

1. To determine the northward extent of the synclinal core beneath the White Range Nappe.
2. To determine the dip of the basement-cover contact in the central area 4 km south-southwest of the Arltunga Mission.
3. To determine the nature and position of the boundary between rocks retrogressively metamorphosed to greenschist facies and the 'granulites' east of Claraville.

The following summary of geology is taken from Forman (1971). The Arltunga Nappe Complex trends east along the northeastern margin of the Amadeus Basin. The nappes formed in a stratigraphic sequence consisting of the crystalline Precambrian Arunta Complex overlain unconformably by Upper Proterzoic Heavitree Quartzite and carbonate rocks of the Bitter Springs Formation. The uppermost and largest nappe was transported at least 24 km to the south and developed by a combination of recumbent folding and overthrusting. The lower nappes were formed by overthrusting alone. The nappes have their roots to the north in a belt of crystalline rocks of the Arunta

Complex that were originally in the amphibolite facies. These are now retrograded to greenschist facies and are flanked to the north by amphibolite and granulite facies rocks and to the south by amphibolite facies rocks. The Arunta Complex was deformed and metamorphosed during the Arunta Orogeny before the Heavitree Quartzite was deposited. Later retrograde metamorphism accompanies nappe formation during the Alice Springs Orogeny. The degree of metamorphism of basement and cover rocks in the nappes varies according to their structural position; little metamorphism is apparent in the front of the White Range Nappe, but metamorphism to greenschist facies is typical deeper in the nappes.

Bouguer anomaly values increase strongly in the 10 km northward from the root zone. The nappes apparently developed near the surface of the crust in a strongly deformed zone that dips northward through the crust into the mantle. At the same time a large part of the Upper Proterozoic and Palaeozoic sedimentary rocks was detached from the nappes and travelled southward into the Amadeus Basin on a major thrust surface (Forman, 1971).

Metallic deposits (Au, Ag, Cu, Pb) in the deformed zone in front of the nappes show strong structural control.

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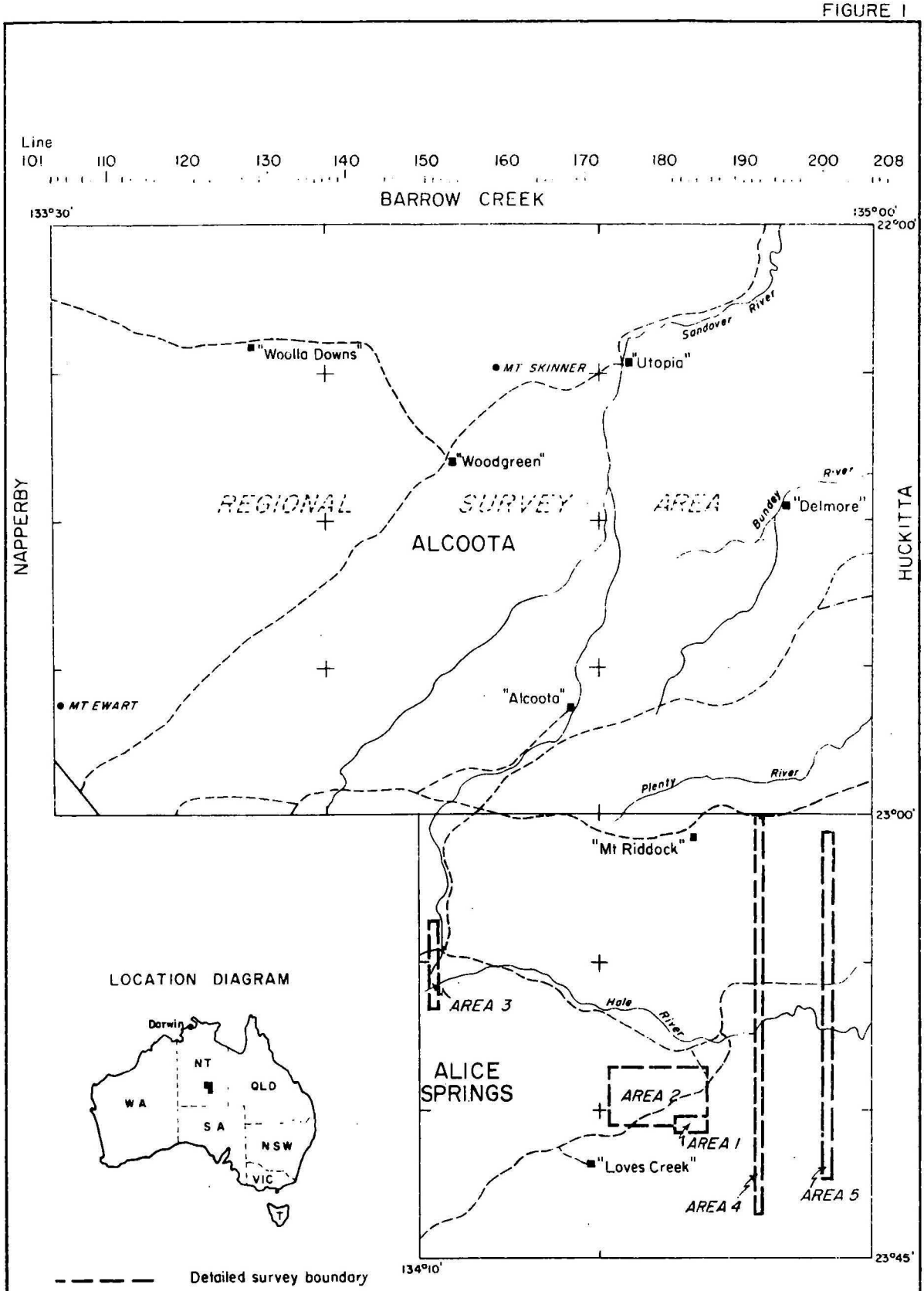
FIGURE 1



AIRBORNE SURVEY, ALCOOTA, NT 1972

LOCALITY MAP

20 0 20 40 60 KILOMETRES

10 0 10 20 30 MILES

To accompany Record No. 1972/96

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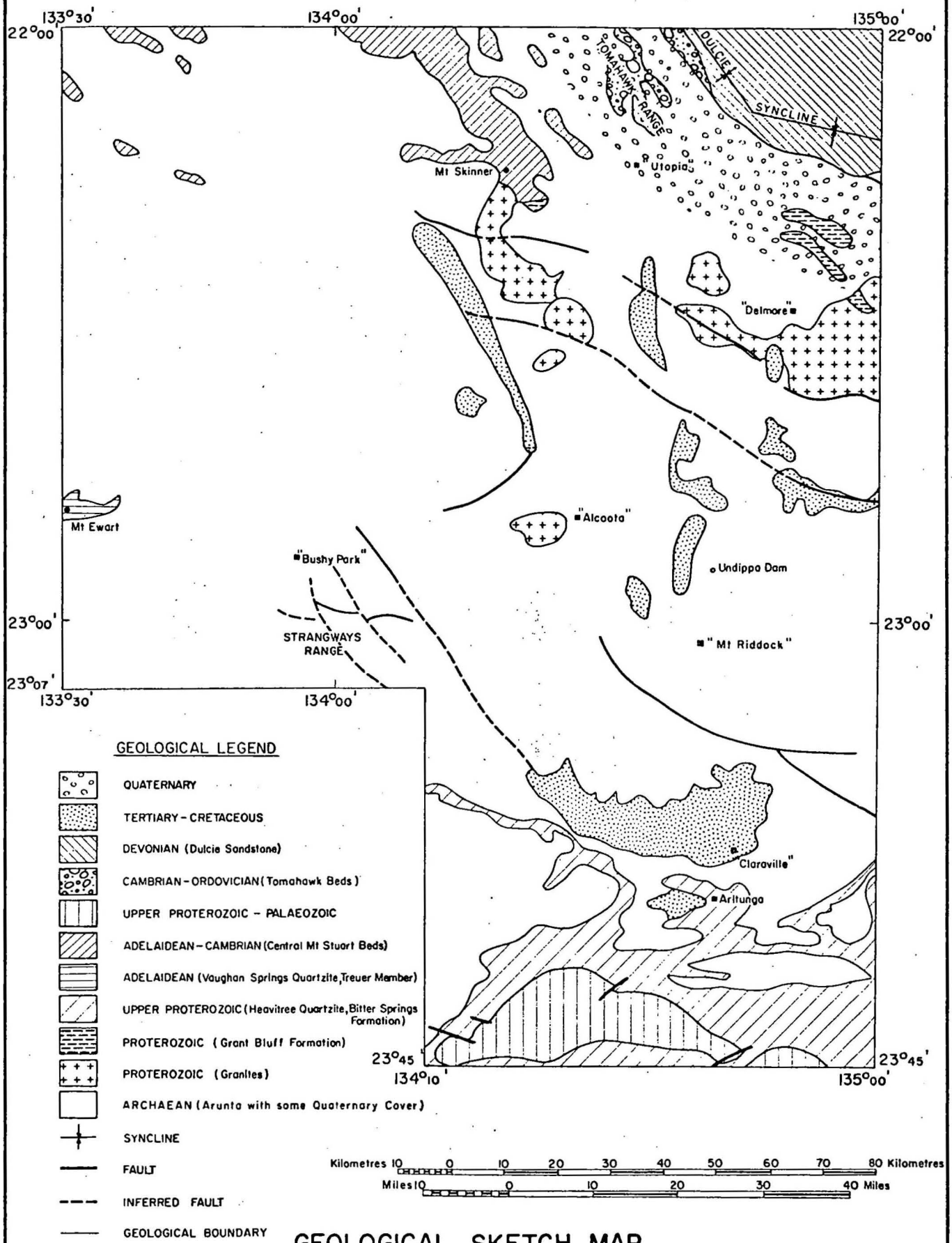
FIGURE 2



GEOLOGICAL SKETCH MAP

ALCOOTA SHEET AND ARLTUNGA NAPPE COMPLEX

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