URANERZ (AUSTRALIA) PTY. LTD.

FINAL REPORT ON EXPLORATION OF

EL's 846, 847, 864, 865 AND 866,

HERMANNSBURG AREA, NORTHERN TERRITORY

BY

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CONTENTS

CONTENTS (CONT'D)

LIST OF TABLES

CONTENTS (CONT'D)

LIST OF FIGURES AND MAPS

LIST OF FIGURES AND MAPS (CONT'D)

S U M M A R Y

The exploratory work carried out on this group of Exploration Licences during the period of tenure from 7th June, 1973 to 6th June, 1975 was mainly of a regional nature and formed part of major exploration programme undertaken by Uranerz (Australia) Pty. Ltd. in the search for uranium in the general Alice Springs area.

The field work was carried out in several stages involving an initial fixed-wing aerial reconnaissance with a spectrometer, more detailed carborne and helicopter spectrometer surveys along pre-planned traverses and a stream sediment sampling survey by vehicle and helicopter. Geological information and other data obtained from these surveys have been recorded on the series of maps accompanying this report.

In areas to the west of Hermannsburg Mission which approximate half the total area, geological mapping is based on observations made during the carborne and aerial surveys. The remainder of the area to the east of Hermannsburg Mission was examined in more detail with geological mapping and radiometric surveying by scintillometer on selected ground traverses across the area.

One of the objectives in this ground traversing was to define the limits of the Undandita sandstone member of the Brewer Conglomerate which had been shown by earlier exploratory work in areas held by the Company further to the east to be the host rock for uranium mineralization. In particular, the aim was to delineate a zone within the Undandita member which, on the evidence of deep drilling in these areas to the east, was the principal locus for the occurrence of uranium.

This work was successful in delineating the zone in the eastern part of the area, but it was found that in proceeding westwards it became increasingly diffuse and more difficult to define as Hermannsburg Mission was approached; moreover, the zone of interest became increasingly obscured by a mantle of younger sediments and alluvium. From the knowledge of the main

controls in the localisation of uranium which had been obtained by deep drilling, this loss of distinctive characteristics of the zone towards the west indicated that the prospects for the occurrence of uranium progressively diminished in that direction; furthermore, the prospects for the discovery of uranium were not enhanced by the increasing amount of cover in the same direction.

From an evaluation of all of the data which had been obtained up to this stage, it was evident that the potential for the discovery of substantial deposits of uranium within this group of EL's could not be rated highly; also, as no distinctly anomalous situations had been revealed by the radiometric work and no specific targets had been defined in the ground investigations, further detailed exploratory work did not appear to be warranted. About this time the Company was informed of the creation of Special Purpose Lease No. 159 which embraced the whole of EL's 864 and 865 and a major portion of EL's 847 and 866. In the light of the evaluation and the creation of the special lease, the decision was made not to seek renewal of the exploration licences after the due expiry date.

STATEMENT OF EXPENDITURE

The costs of exploration in these areas has not been apportioned to individual EL's as they were investigated mainly as a group, in an integrated project. Total expenditure on these areas was $61,487.21.

INTRODUCTION

In mid 1972, following a detailed study of available literature and published geological maps, a regional aerial reconnaissance of Central Australia was carried out by the Company using a fixed-wing aircraft and a helicopter with ground support vehicles.

One of the areas selected for preliminary investigation was that occupied by the Devonian to Lower Carboniferous Brewer Conglomerate at the northern margin of the Amadeus Basin in the Northern Territory. As this formation was composed of continental mollasse-type sediments located marginally to Precambrian basement, the geological environment was considered to be favourable for the occurrence of uranium, the mineralization having a possible source in, and being derived by weathering and leaching of, the Precambrian basement rocks.

On completion of the aerial reconnaissance applications were lodged for a number of exploration licences covering a large area in the vicinity of Hermannsburg Mission to the west of Alice Springs, including an area within the Haasts Bluff Aboriginal Reserve. The application for the latter area was subsequently refused.

Following some amendments of the boundaries, to conform with the requirements of the Mining Ordinance, EL's 846, 847, 864, 865 and 866 were granted on 7th June, 1973, initially for a period of one year. Renewals of the licences for a further 12 months extended the period of tenure until 6th June, 1975.

The bulk of the field work was carried out between early June 1973 and the end of July 1974, after which all of the data were assembled and an evaluation made.

In October, 1974 the Company was formally advised that, in accordance with recommendations made in the Woodward Report on Aboriginal Land Rights, Special Purpose Lease No. 159 had been created in the Hermannsburg area.

In view of this development and the lack of encouragement from the work which had been done, it was decided not to undertake any further exploratory work in these areas nor to apply for renewals of the exploration licences when due.

GENERAL INFORMATION

LOCATION

The area covered by the exploration licences is within latitudes 23°40'S to 24°00'S and longitudes 132°00'E to 133°20'E. The five EL's form a contiguous group, the eastern boundary of which is about 60km west of Alice Springs and the western about 167km. Hermannsburg Mission is located more or less centrally between these limits. The configuration of the EL's within the group and their relationship to S.P.L. 159 is shown on Map 1.

COMMUNICATIONS AND ACCESS

The road to Hermannsburg, west from Alice Springs, is sealed for 48km to just beyond Jay Creek Settlement. The remaining 100km is frequently graded and generally easily passable except in wet weather, which was a frequent occurrence in 1973 and 1974.

Beyond Hermannsburg the road to Gosses Bluff is not of the same standard as that from Jay Creek, but quite negotiable in dry weather. Beyond Gosses Bluff it branches north to Haasts Bluff Settlement and south to Areyonga Settlement. Due west of Gosses Bluff there is only a track which would require 4 wheel drive vehicles.

West of Jay Creek a road runs within the MacDonnell Ranges to Glen Helen Tourist Camp and Haasts Bluff Settlement. This is unsealed but good going in dry weather.

The Hermannsburg road runs more or less along the south side of the tenement area. Access to the outcrop areas requires 4 wheel drive, along fences, occasional seismic lines and up creeks. South of the MacDonnell Ranges the relatively flat areas are quite easy going but traversing along straight lines is frequently difficult due to thick scrub. The ranges themselves are just about negotiable with a vehicle such as a Haflinger if time is plentiful and risks are taken. For ready access to much of the area a helciopter is required.

Hermannsburg Mission has an airstrip suitable for all light aircraft in dry weather. One small strip exists near Gosses Dam.

Adequate requirements for field work are four wheel drive vehicles and helicopter.

TOPOGRAPHY

Main relief in the area is formed by the E-W trending MacDonnell Ranges rising to about 1000m above sea level and about 300m above the Missionary Plain on the south. Highest peak in these ranges is Mt. Hermannsburg.

Mt. Giles in the Chewingo Range is 1305m and Brinkley Bluff 1225m above sea level.

The area is traversed by the Finke River and its tributaries, Umbarta Creek, Rudells Creek, Ellery Creek and Hugh River. Drainage is generally to the south.

The ranges are almost exclusively covered with spinifex, though scrubby eucalypts grow quite thickly on some slopes. Spindly eucalypts and acacias cover the adjoining plain, while large white gums and casuarinas grow along the creeks.

WATER RESOURCES

Surface water is collected in a number of earth dams on the Missionary Plain and in wetter years occurs in pools in the Finke and Hugh Rivers and in Ellery Creek. These streams flowed frequently in 1973 and 1974. Earth dams have been made in areas where supplies of underground water cannot be found.

Ground water is available in aquifers of Precambrian to Quaternary age. The Mereenie Sandstone of Ordovician to Devonian age is the aquifer which supplies Alice Springs.

Hermannsburg is supplied by water from Kaporilja Spring and by a well west of the mission. A mile south of the mission is a government bore. Gosses Bluff has a bore and a mile west of Undandita Native Settlement is a well on Undandita Creek. The only three other bores known in the area are Junction Bore, Eastern Dam and Gosses Dam bores.

Large reserves of water are available within the MacDonnell Range aquifers.

MAGNETIC DEVIATION

The deviation for the Hermannsburg Sheet is about 4°40'E, with a mean change of about 0°01'E per annum.

PREVIOUS SURVEYS AND ACTIVITIES

TOPOGRAPHIC MAPPING

The Hermannsburg Sheet, SF 53-13, at 1:250,000 scale was compiled in 1959 from 1950 aerial photography supplemented by 1958 spot photography and ground examination. The sheet was printed in 1969 with overprints added at that date.

GEOLOGICAL MAPPING

The geological map of the Hermannsburg Sheet, SF 53-13, at 1:250,000 scale, first edition 1968, was compiled in 1964 by D. J. Forman, E. N. Milligan, T. Quinlan and N. L. Kruger of the Bureau of Mineral Resources (BMR).

GEOPHYSICAL SURVEYS

An aerial magnetic and radiometric survey of the Amadeus Basin was conducted by the BMR in 1965. The survey was at a height of 800 feet above ground along lines spaced either 2 miles or 4 miles apart. The radioactivity was measured by scintillometer but the readings (unlike the magnetic data) were not corrected for variations in topography.

The combined magnetic and radiometric data were published on Hermannsburg Sheet F 53/B1-79 at 1:250,000 scale, in 1969.

Several seismic lines have been cut in the area, some parallel to the strike, others across it. These lines are shown in the 1969 overprint edition of the Hermannsburg topographic map. Some of the lines were put in by the BMR in 1962, others by private companies. Details of the BMR seismic survey were not published but were recorded by Moss (1964).

EXPLORATION AND MINING

The only known mineral occurrence in the vicinity of the tenements is a minor copper showing in the Waterhouse Range known as the Owen Springs Prospect. This copper occurs as malachite and cuprite in the Goyder Formation of Cambrian age and is thought to be syngenetic. The prospect was drilled extensively in 1953-54 with disappointing results.

The main exploration activity in this northern portion of the Amadeus Basin, until now, has been in the search for oil, by companies such as Magellan Petroleum and Exoil (N.T.) Pty. Ltd. The former company currently holds Oil Permits 175 and 178 over the area.

Numerous exploration companies are active in mineral search in the general Alice Springs area at the present time.

GENERAL GEOLOGY

The group of tenements cover portion of the northern margin of the Amadeus Basin which is a major E-W trending geologic feature situated between the Precambrian Arunta Block in the north and the Precambrian Musgrove Block in the south. The span of the Basin is roughly from Alice Springs in the north to Kulgera in the south.

The sediments on the northern margin of the Basin consist of a sequence of Proterozoic and Palaeozoic formations resting unconformably on Archean or Early Proterozoic crystalline granitic and strongly metamorphosed rocks known as the Arunta Complex.

This basement complex comprises gneiss, schistose gneiss, granulite, schist, amphibolite, metaquartzite and granite, all intruded by dykes of pegmatite and dolerite.

This group of rocks is overlain unconformably by the Heavitree Quartzite which is the basal member of the sequence of sediments in this part of the Amadeus Basin and which forms the prominent E-W trending rdiges of the MacDonnell Range. The complete stratigraphic succession in this part of the Basin is shown in Table 1 which is taken from Quinlan and Forman (1968).

The principal structural elements of the area are the MacDonnell Range Monocline in the north, the Waterhouse Range Anticline in the south and the intervening broad Missionary Syncline. These features which are broadly outlined by the pattern of distribution of the Mereenie Sandstone (Pzm) and the Brewer Conglomerate (Pzb) are shown on Figure 1 on the following page.

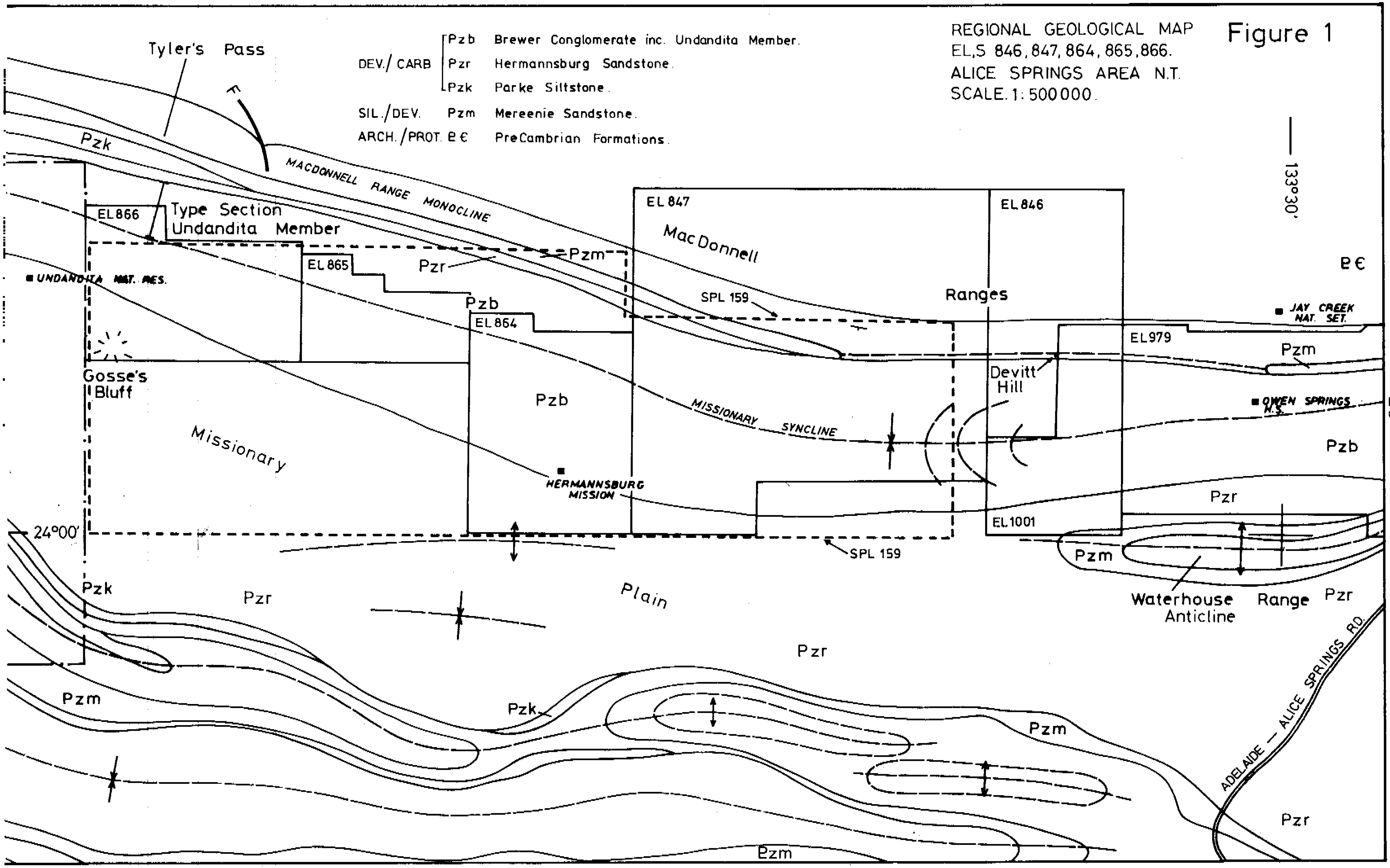
Most of the area covered by the tenements is underlain by the Brewer Conglomerate which is the uppermost formation of the Pertnjara Group, of Devonian to Lower Carboniferous age.

The Brewer Conglomerate, which in this general locality is confined to the Missionary Syncline, has been subdivided into a lower massive conglomerate unit and an upper conglomeratic sandstone unit, referred to as the Undandita Member.

The Undandita Member was the particular target of uranium search in the area as the exploratory work carried out by the Company in EL 845 further to the east has shown that this rock unit is the host for uranium mineralization.

Extensive areas within the group of tenements are occupied by fluviatile and lacustrine sediments of Tertiary age which were deposited both prior to and following a period of laterisation. These younger sediments conceal large portions of the Brewer Conglomerate and Undandita Member in the western parts of the Missionary Syncline.

The widespread soil and alluvium cover throughout the area is thought to be mainly of Quaternary age.


REGIONAL GEOLOGICAL MAP
EL,S 846, 847, 864, 865, 866.
ALICE SPRINGS AREA N.T.
SCALE. 1: 500 000.
Figure 1
DEV./ CARB
Pzb Brewer Conglomerate inc. Undandita Member.
Pzr Hermannsburg Sandstone.
Pzk Parke Siltstone.
SIL./DEV. Pzm Mereenie Sandstone.
ARCH./PROT. Pꞓ PreCambrian Formations.
Tyler's Pass
MACDONNELL RANGE MONOCLINE
Type Section Undandita Member
EL 866
EL 865
EL 864
EL 847
EL 846
EL 979
EL 1001
MacDonnell Ranges
SPL 159
UNDANDITA NAT. RES.
Gosse's Bluff
Missionary Plain
MISSIONARY SYNCLINE
HERMANNSBURG MISSION
Devitt Hill
JAY CREEK NAT. SET.
OWEN SPRINGS H.S.
Waterhouse Range
Waterhouse Anticline
ADELAIDE — ALICE SPRINGS RD.
133°30'
24°00'
Pzk
Pzr
Pzb
Pzm
Pꞓ

SUMMARY OF STRATIGRAPHY

Table 1

Age	*Group*	*Rock Unit*	*Lithology*	*Thickness (feet)*	*Stratigraphic relationship*
Quaternary		(Qa)	Alluvium.	1-250	
Quaternary		(Qs)	Aeolian sand.	1-50	
Quaternary		(Qt)	Travertine, kunkar.	1-100	
					UNCONFORMITY
Tertiary		(Tc)	Conglomerate.		
					UNCONFORMITY
Tertiary		(Tl)	Chalcedonic limestone.	1-20	
					UNCONFORMITY
Tertiary		(Ta)	Laterite.	50-200	
Tertiary		(Ts)	Sandstone, sandy siltstone, lignite.	1-200	
					UNCONFORMITY
Upper Permian		(P)	Brown and grey sandy clay.	100	
					UNCONFORMITY
Devonian to Carboniferous	Pertnjara Group	Brewer Conglomerate (Pzb)	Grey calcareous conglomerate and sandstone.	10,000 vertical thickness. 21,500 foreset thickness.	
Devonian to Carboniferous	Pertnjara Group	Hermannsburg Sandstone (Pzr)	Red-brown fine to medium silty sandstone, with scattered limestone and dolomite pebbles, current-bedded.	0-2000	? Conformable on Mereenie Sandstone in west. Unconformable on Larapinta and Pertaoorrta Groups in east.
Devonian to Carboniferous	Pertnjara Group	Parke Siltstone (Pzk)	Red-brown siltstone, some calcareous lenses.	0-800	
					UNCONFORMITY
Ordovician to Devonian		Mereenie Sandstone (Pzm)	Brown fine quartz sandstone, very thickly current-bedded.	0-2000	
					UNCONFORMITY
Cambrian to Ordovician	Larapinta Group (C-Ol)	Undifferentiated (C-Ol)	Fossiliferous sandstone, siltstone, shale, dolomite, limestone.		
Cambrian to Ordovician	Larapinta Group (C-Ol)	Carmichael Sandstone (Oc)	Red-brown sandstone, silty sandstone, siltstone.	0-200	
Cambrian to Ordovician	Larapinta Group (C-Ol)	Stokes Siltstone (Ot)	Dark red and purple siltstone, shale with thin limestone beds.	0-2000	
Cambrian to Ordovician	Larapinta Group (C-Ol)	Stairway Sandstone (Os)	Pale brown fine and medium silty quartz sandstone; quartz sandstone.	0-1500	
Cambrian to Ordovician	Larapinta Group (C-Ol)	Horn Valley Siltstone (Oh)	Siltstone with thin fossiliferous limestone beds, and some thin sandstone beds.	0-1400	
Cambrian to Ordovician	Larapinta Group (C-Ol)	Pacoota Sandstone (C-Op)	Pale brown fine and medium quartz sandstone; kaolinitic and silty quartz sandstone; micaceous siltstone.	0-2700	

Table 1 (cont'd)

Age	*Rock Unit*	*Lithology*	*Thickness (feet)*	*Stratigraphic relationship*
CAMBRIAN PERTAOORRTA GROUP (Cp)	Undifferentiated (Cp)	Sandstone, siltstone, shale, limestone.		
	Goyder Formation (Cg)	Pale brown fine to medium kaolinitic quartz sandstone commonly micaceous: limestone; siltstone; minor limestones.	1600	
	Jay Creek Limestone (Cj)	Blue-grey, yellow-brown dolomitic limestone and limestone; minor interbeds of shale.	175–1000	
	Hugh River Shale (Cl)	Grey or black shale; thin interbeds of limestone, silty sandstone, siltstone.		
				DISCONFORMITY
	Arumbera Sandstone (Ca)	Red-brown medium very silty sandstone; purple-red micaceous siltstone	800–2800	
	Petermann Sandstone (Ce)	Red-brown sandstone.	About 640	
	Deception Formation (Cd)	Red-brown siltstone; with minor fine silty sandstone.	About 600	A conformable sequence in the Gardiner Range, laterally equivalent to Pertayoorrta units at Ellery Creek.
	Illara Sandstone (Ci)	Red-brown sandstone with minor siltstone.	250–650	
	Tempe Formation (Ct)	Siltstone, fossiliferous limestone and sandstone; glauconitic.	About 760	
	Eninta Sandstone (Cn)	Red-brown sandstone and siltstone. Some conglomerate beds.	300–1200	Unconformably overlies Pertatataka Formation in Gardiner Range.
PROTEROZOIC	Pertatataka Formation (Pup)	Red, green siltstone; shale; thin limestone and sandstone beds.	2200–4000	
	Areyonga Formation (Pua)	Pale brown, white, medium calcareous quartz sandstone; green tillitic siltstone; conglomerate.	0–1300	Disconformably overlies Bitter Springs Formation. Tillitic siltstone and conglomerate may or may not be present.
				DISCONFORMITY
	Bitter Springs Formation (Pub)	Dark grey dolomitic and cherty limestone; siltstone; evaporites.	2500	Conformably overlies the Heavitree Quartzite.
	Heavitree Quartzite (Puh)	White, pale brown, purple, medium and coarse quartzite and silicified silty quartz sandstone; silicified sandstone; siltstone.	500	
				UNCONFORMITY
PRECAMBRIAN	Arunta Complex (pCa)	Gneiss, schist, amphibolite, quartzite, granite, dolerite, pegmatite.		
	(pCg)	Granite		
	(pCq)	Metaquartzite, quartz sericite schist.		

ECONOMIC GEOLOGY

No materials of economic value other than building stone and water have been produced in the area, but it has been established that it has a very high potential for the production of natural gas and some oil.

Natural gas was found in the Larapinta Group in the two holes drilled by petroleum companies. Drill stem testing in Palm Valley No. 1 Well of four intervals within the Stairways Sandstone, Horn Valley Siltstone and Pacoota Sandstone yielded a total of 14 million cubic feet of natural gas per day (Magellan Petroleum, 1965).

The discovery of uranium by the Company to the south of Alice Springs indicates that the general area shows potential for economic uranium occurrence.

INVESTIGATIONS AND RESULTS

RADIOMETRIC SPECTROMETER SURVEYS

Fixed-Wing Survey

The initial airborne radiometric survey of the tenement area was carried out in a Cessna 206 aircraft fitted with a Scintrex GAM-2 4-channel differential spectrometer with a 4 x 5 inch (101.6 x 127mm) Na I sensor.

Pre-planned flight paths were marked on the Hermannsburg geological sheet and navigation was controlled by a geologist who also recorded geological data and anomaly locations. Another geologist operated the instrument and recorded on the chart, the time anomalies were detected, this information being transmitted to the navigator for registering on the geological map.

In this survey, the aircraft speed was 70 to 80 knots depending on weather conditions, height flown being 20 to 60 metres above ground level. Flight lines over the Arunta Complex covered the basement at about 500m and 1200 metres from the contact with the Heavitree Quartzite and the quartzites of the Chewing Range. South of the Heavitree Quartzite, flight lines were N-S at intervals of 1½ to 2 kilometres throughout the tenement area. Total distance flown during the survey was about 1500km, area covered being about 3100 sq. km.

Results of this survey are shown on Map 5.

Helicopter Survey

A more detailed spectrometer survey was carried out with a Bell 47J 2A helicopter when it was found that carborne traversing was time-consuming and not fully effective, owing to difficulty of access. This programme involved close N-S grid flying at a speed of 55 to 60 knots and a height of 20 to 50 metres on lines spaced about 500m apart, with zig-zag coverage of low-intensity anomalies recorded in the fixed-wing survey. Where anomalies were found to repeat, landings were made and the area inspected on the ground with SRAT scintillometers. Total distance flown was about 3000km and area covered approximately 3100 sq. km.

Results are recorded on Maps 6 and 7.

Carborne Survey

On completion of the fixed-wing radiometric survey, an attempt was made to carry out more detailed spectrometer traversing of the Brewer Conglomerate and Tertiary sediments south of the MacDonnell Ranges, with the instrument set up in a Haflinger LKV 540 4-wheel drive vehicle. This ground survey was abandoned in favour of helicopter coverage when difficulties were encountered in traversing the numerous, deeply incised stream channels and the thick scrub-covered country in between.

The work ceased after completing about 400km of N-S traverses in EL 846. (See Map 8).

Results of the aerial and carborne surveys may be summarized as follows:

From the radiometric data recorded on the uranium channel in the spectrometer surveys, background (B.G.) values were established for the various types of sedimentary formations traversed. These values are shown in Table 2.

The chart records were then re-evaluated to establish anomalous situations and this resulted in 103 low-intensity airborne anomalies (up to 2 x B.G.) being identified with certain sedimentary formations (see Table 3). Many of these anomalies which were inaccessible or which would be difficult to reach in ground follow-up work were reflown by helicopter. Only three of these, anomalies No. 30, 31 and 58, repeated convincingly. Some of the anomalies relating to certain formations not considered prospective, or which were located over Quaternary alluvium and Tertiary conglomerates, were not follow up on the ground.

Table 4 records the anomalies which were detected in the carborne survey and it will be noted that some did not repeat when immediately re-surveyed. Table 5 gives the uranium and thorium values of grab samples taken from four anomaly locations. All values are extremely low and show an excess of thorium over uranium.

In general, the results of the airborne and carborne surveys could not be regarded as very encouraging and this was substantiated by the follow-up work carried out both from the air and on the ground. This work failed to reveal any situations which warranted further detailed investigations, but it was noted that in much of the area mapped as Brewer Conglomerate, the outcrop consisted mainly of gritty sandstone to arkosic siltstone with occasional laminae of mudstone, material which represented an ideal host for uranium mineralization. Moreover, it was evident from the follow-up work that the majority of the carborne and many of the airborne anomalies occurred over creek beds or alluvium and this suggested that a stream sediment sampling programme could assist in defining areas in which to carry out more detailed uranium search.

STREAM SEDIMENT SURVEY

In the subsequent stream sediment survey, 138 samples were taken by helicopter and 10 by vehicle, radiometric readings being recorded at each locality.

The stream sediments were generally found to be very coarse, the bulk of the material being boulders, pebbles and sand. Silt and clay fractions were very rare, which is not unexpected considering the nature of the source rocks, the arid climatic conditions and the rather high relief. Thus, the stream sediment samples consisted mostly of fine sand and occasional silt.

Assay values of samples taken in the survey were all low, ranging up to 5ppm U_3O_8 and no obvious trends emerge from these results. (See Maps 9 and 10).

Radiometric readings at all sample locations were also low, ranging from 30 to 50cps on a SRAT scintillometer.

BACKGROUND VALUES OF U CHANNEL, GAM-2 SURVEYS Table 2

		Backgrounds in cps.		
Formation	Symbol	Fixed-wing	Helicopter	Carborne
Quaternary, alluvium	Qa	5-6	5	8-10
sand	Qs	6	5	
Tertiary Conglomerate	Tc	7	6	9-12
Brewer Conglomerate	Pzb	4-9	5-6	9
Hermannsburg Sandstone	Pzr	5	4	-
Mereenie Sandstone	Pzm	4	4	-
Stokes Siltstone	Ot	6	6	-
Stairway Sandstone	Os	6	6	-
Horn Valley Siltstone	Oh	6	6	-
Pacoota Sandstone	Є-Op	6	6	-
Goyder Formation	Єg	6	5	-
Jay Creek Sandstone	Єj	5	5	-
Hugh River Shale	Єh	5	-	-
Arumbera Sandstone	Єa	5	-	-
Pertatataka Formation	Pup	5	-	-
Areyonga Formation	Pua	6	-	-
Bitter Springs Formation	Pub	5	-	-
Heavitree Quartzite	Puh	5	-	-
Arunta Complex	pЄa	5-9	7-9	9-12

ANOMALIES RECORDED IN AIRBORNE SURVEYS Table 3

(See Maps 5, 6 and 7).

Anomalies 1 to 59 by fixed-wing ; 60 to 103 by helicopter

No.	Formation	Symbol	Remarks
1	Arunta Complex	p€a	granite, sample G128.
2	" "	p€a	" " "
3	" "	p€a	granite in col, doubtfully re-located by helicopter check.
4	" "	p€a	granite, not repeated.
5	" "	p€a	granite, relocated by helicopter
6	" "	p€a	" " " "
7	" "	p€a	granite, not repeated.
8	" "	p€a	granite, not followed up.
9	Brewer Congl.	Pzb	kick not repeated.
10	" "	Pzb	not repeated, by helicopter or carborne.
11	" "	Pzb	" " " " "
12	" "	Pzb	not followed up.
13	" "	Pzb	" " "
14	" "	Pzb	doubtfully relocated by helicopter
15	" "	Pzb	convincingly repeated by heli-copter, edge of Ellery Creek.
16	Tertiary Congl.	Tc	possibly repeated by kick 91, helicopter-borne.
17	Brewer Congl.	Pzb	not repeated.
18	Tertiary Congl.	Tc	" "
19	Quaternary alluvium	Qa	not followed up.
20	"	Qa	" " "
21	Tertiary Congl.	Tc	" " "
22	" "	Tc	" " "
23	" "	Tc	not convincingly repeated.
24	" "	Tc	tentatively repeated.
25	" "	Tc	" "
26	" "	Tc	not followed up.
27	" "	Tc	tentatively repeated.
28	Brewer Congl.	Pzb	close to Anom. 90, but neither were repeated on check survey.
29	Contact, Brewer Congl. on Hermannsburg Sst.	Pzb/ Pzr	not checked (off EL).
30	Tertiary Congl.	Tc	repeated convincingly, sample G159.
31	Quaternary alluvium	Qa	repeated convincingly, flood plain.
32	Brewer Congl.	Pzb	not checked.
33	Quaternary alluvium	Qa	" "
34	Brewer Congl.	Pzb	not repeated.
35	Quaternary alluvium	Qa	" "
36	Brewer Congl.	Pzb	tentatively repeated.
37	" "	Pzb	not repeated.
38	Tertiary Congl.		not followed up.

Table 3 (cont'd)

No.	Formation	Symbol	Remarks
39	Brewer Congl.	Pzb	not followed up.
40	" "	Pzb	" " "
41	" "	Pzb	not repeated.
42	Quaternary alluvium	Qa	" "
43	Brewer Congl.	Pzb	" "
44	" "	Pzb	tentatively repeated.
45	Quaternary alluvium	Qa	not followed up.
46	Tertiary Congl.	Tc	not followed up.
47	" "	Tc	not followed up
48	Brewer Congl.	Pzb	not repeated.
49	Stokes Siltstone	Ot	repeated.
50	Brewer Congl.	Pzb	"
51	Quaternary alluvium	Qa	not followed up.
52	Brewer Congl.	Pzb	not repeated.
53	Hermannsburg Sst.	Pzr	" "
54	Tertiary Congl.	Tc	not followed up.
55	Quaternary alluvium	Qa	" " "
56	"	Qa	" " "
57	Brewer Congl.	Pzb	not repeated.
58	Tertiary Congl.	Tc	repeated, sample G158.
59	" "	Tc	not repeated.
60	Jay Creek Limestone	Єj	repeated.
61	Brewer Congl.	Pzb	"
62	" "	Pzb	not repeated.
63	Goyder Formation	Єg	" "
64	Brewer Congl.	Pzb	tentatively repeated.
65	Pacoota Sst.	Є-Op	not repeated.
66	Goyder Formation	Єg	" "
67	Brewer Congl.	Pzb	tentatively repeated.
68	" "	Pzb	not repeated.
69	" "	Pzb	" "
70	Horn Valley Siltstone	Oh	" "
71	"	Oh	repeated.
72	"	Oh	not repeated.
73	Brewer Congl.	Pzb	" "
74	" "	Pzb	" "
75	" "	Pzb	" "
76	Quaternary alluvium	Qa	" "
77	Tertiary Congl.	Tc	tentatively repeated.
78	Brewer Congl.	Pzb	not repeated.
79	" "	Pzb	" "
80	" "	Pzb	" "
81	" "	Pzb	" "
82	Tertiary Congl.	Tc	tentatively repeated.

Table 3 (cont'd)

No.	Formation	Symbol	Remarks
83	Quaternary alluvium.	Qa	not repeated.
84	Brewer Congl.	Pzb	repeated.
85	Stokes Siltstone	Ot	not repeated.
86	" "	Ot	" "
87	Brewer Congl.	Pzb	" "
88	" "	Pzb	tentatively repeated.
89	Quaternary alluvium	Qa	not followed up.
90	Brewer Congl.	Pzb	not repeated.
91	Tertiary Congl.	Tc	repeat of Anomaly 15.
92	" "	Tc	not followed up.
93	Brewer Congl.	Pzb	" " "
94	" "	Pzb	" " "
95	" "	Pzb	" " "
96	Tertiary Congl.	Tc	" " "
97	Quaternary alluvium	Qa	" " "
98	Brewer Congl.	Pzb	not repeated.
99	" "	Pzb	not followed up.
100	" "	Pzb	not repeated.
101	Goyder Formation	Єg	not followed up.
102	Mereenie Sst.	Pzm	" " "
103	Brewer Congl.	Pzb	not repeated.

ANOMALIES RECORDED IN CARBORNE SURVEY

Table 4

(See Map 8)

No.	Formation	Symbol	Remarks
1	Quaternary alluvium	Qa	definite, but not convincingly repeated.
2	"	Qa	repeated.
3	"	Qa	high background, close to Tc.
4	"	Qa	" " " " "
5	Tertiary Congl.	Tc	edge of Tc outcrop.
6	Brewer Congl.	Pzb	side of creek.
7	" "	Pzb	not convincingly repeated.
8	" "	Pzb	" " "
9	" "	Pzb	top of outcrop.
10	" "	Pzb	valley.
11	" "	Pzb	sequence of kicks in valley.
12	Quaternary alluvium	Qa	flood plain.
13	"	Qa	" "
14	Tertiary Congl.	Tc	" "
15	" "	Tc	close sequence of kicks.
16	" "	Tc	" " " "
17	" "	Tc	" " " "
18	Quaternary alluvium	Qa	edge of Tc.
19	"	Qa	" " "
20	Tertiary Congl.	Tc	
21	" "	Tc	
22	Quaternary alluvium	Qa	flood plain.
23	"	Qa	" "
24	"	Qa	" "
25	Brewer Congl.	Pzb	rubble and sub-outcrop.
26	" "	Pzb	" " " "
27	" "	Pzb	" " " "
28	Quaternary alluvium	Qa	edge of flood plain
29	Tertiary Congl.	Tc	edge of flood plain, good kick.
30	Quaternary alluvium	Qa	" " " " " "
31	"	Qa	edge of flood plain.
32	Tertiary Congl.	Tc	" " " "
33	Quaternary alluvium	Qa	creek course in Tc.
34	"	Qa	" " " "
35	Brewer Congl.	Pzb	" " " Pzb.
36	" "	Pzb	" " " "
37	Quaternary alluvium	Qa	sample G129.
38	"	Qa	creek side, large kick.
39	"	Qa	" " " "
40	"	Qa	" " " "
41	Tertiary Congl.	Tc	creek.

Table 4 (cont'd)

No.	Formation	Symbol	Remarks
42	Quaternary alluvium	Qa	edge of Tc.
43	Arunta Complex	p€a	widely fluctuating background, granitic rocks.
44	" "	p€a	sample G118, granite.
45	" "	p€a	basement.
46	" "	p€a	"
47	" "	p€a	"
48	" "	p€a	basement, in vicinity of airborne anomaly.
49	" "	p€a	basement, in vicinity of airborne anomaly, boosted by Th.
50	" "	p€a	basement, boosted by Th.

ASSAY RESULTS OF GRAB SAMPLES

Table 5

Analysts : Labtech, Midland, W.A.

BLD = Below level of detection, i.e. <10 ppm by x-ray fluorescence method.

Sample No.	ppm U_3O_8	ppm Th	Anomaly No.
G128	BLD	20	Airborne, 1
G129	BLD	20	Carborne, 37
G158	10	20	Airborne, 58
G159	BLD	40	Airborne, 30

GEOLOGICAL MAPPING

In the earlier stages of investigations, geological information was compiled from observations made during the airborne and carborne spectrometer surveys and during the follow-up work on the ground. This information has been incorporated in Maps 6, 7 and 8 which include results of later, more detailed mapping.

For this more detailed mapping programme the Company engaged the services of Dr. B. G. Jones of the University of Wollongong who had gained an extensive knowledge of the general area from previous field work carried out for a Ph.D thesis. In this programme, Dr. Jones was assisted by various Company personnel.

The mapping formed part of a broader programme which included coverage of adjoining areas held by the Company on the east of this group of tenements. The mapping was carried out on a series of traverses across the Missionary Plain between the MacDonnell and Waterhouse Ranges, extending from the vicinity of the Stuart Highway on the east to Ellery Creek on the west. Most of the outcrop encountered was in stream channels and exposure improved towards the west. Results of this mapping are presented in Map 4 and the main subdivisions which have been recognized within the Brewer Conglomerate are also incorporated in the earlier mapping shown on Maps 6 and 7.

General Stratigraphy

In the area between Ellery Creek and Pine Gap the pre-Pertnjara succession starts with the Proterozoic (Adelaidean) Heavitree Quartzite unconformably overlying the Archaean Arunta Complex. Near the base of the Heavitree Quartzite is a readily recognizable sequence of coarse-grained arkosic sandstone with a black iron-rich matrix. The Heavitree Quartzite is conformably overlain by the Loves Creek Member of the Bitter Springs Formation which comprises limestone, dolomite, chert and pinkish siltstone. The limestones and dolomites are stromatolitic in part. Lying disconformably above the Bitter Springs Formation is the sandstone, pebble conglomerate and tillite of the Areyonga Formation. This is followed conformably by the Proterozoic Pertatataka Formation which, in this area, consists mainly of greenish siltstone with minor glauconitic sandstone and limestone near the top of the formation. It is overlain by the characteristic dark red-brown sandstone and siltstone of the ?Proterozoic to Cambrian Arumbera Sandstone (Pertaoorrta Group). The Cambrian Pertaoorrta Group continues with the limestone, dolomite and minor chert of the Chandler Limestone, the greenish grey siltstones of the Hugh River Shale, the algal and oolitic limestone and dolomite of the Jay Creek Limestone, and the sandstone, siltstone, limestone and dolomite of the Goyder Formation. The Goyder Formation is conformably overlain by the clean white quartzites and pipe-rock of the Cambrian Ordovician Pacoota Sandstone, Larapinta Group. The overlying predominantly grey siltstones and limestones of the Horn Valley Siltstone and the brown and white sandstones of the Stairway Sandstone are present in the western MacDonnell Ranges but are absent over most of Waterhouse Anticline. The Larapinta Group is in part conformably and in part unconformably overlain by the well-sorted, white to red-brown, quartz-rich Mereenie Sandstone of ?Silurian to Devonian age. The Mereenie Sandstone is in turn overlain partly conformably and partly unconformably by the Pertnjara Group. Along most of the northern margin of the Missionary Syncline east of Ellery Creek the Brewer Conglomerate lies unconformably on the Mereenie Sandstone, the Larapinta Group, and the Goyder Formation and Jay Creek Limestone of the Pertaoorrta Group.

In ascending stratigraphic order the formations in the Pertnjara Group are the Parke Siltstone, the Hermannsburg Sandstone and the Brewer Conglomerate. Clasts from all the pre-Pertnjara units can be recognized in the Brewer Conglomerate and the influx of certain distinctive clasts, especially the Areyonga Formation, the Bitter Springs Formation, the Heavitree Quartzite and the Arunta metamorphics, form useful marker horizons.

Structure

The most important structures in the Ellery Creek to Pine Gap area are the east-west MacDonnell Ranges Monocline, the Missionary Syncline and the Waterhouse Anticline.

The MacDonnell Ranges Monocline forms the northern margin of the area studied and has produced a steeply south dipping sequence ranging from the Proterozoic Heavitree Quartzite to the Upper Devonian to Lower Carboniferous Pertnjara Group inclusive. Dips vary from 50° to 80° south and the strike of all units is generally east-west.

Dips decrease fairly rapidly to the south of the MacDonnell Ranges to reach the centre of the surface expression of the Missionary Syncline at about the latitude of Owen Springs homestead. From the plunge and outcrop distribution this syncline appears to have a maximum thickness in the area south of Pine Gap and Twelve Mile Bore. However, seismic evidence indicates that the present surface expression of the syncline does not accurately reflect the subsurface structure owing to the presence of unconformities within the Pertnjara Group. The greatest thickness (about 3300m) of Pertnjara sediments in this part of the Missionary Syncline is in the Owen Springs area and the seismic data indicate that the deepest part of the synclinal trough has migrated northwards and eastwards during the deposition of the Pertnjara Group.

The Waterhouse Anticline extends for approximately 50km east-west and 15km north-south. The east-plunging eastern nose and the west-plunging western nose both continue as subsurface ridges well beyond the surface expression of the anticline. The northern flank of the anticline dips at about 50° north while the dip on the southern flank is slightly shallower. The anticline may have had a slight topographic expression during the deposition of the upper part of the Larapinta Group since these units thin over the structure and were at least partly eroded prior to the deposition of the Mereenie Sandstone.

The anticline also acted as a local source area during the deposition of the Hermannsburg Sandstone. Hence it has almost certainly been a periodically growing structure between mid-Ordovician and lower Carboniferous times. Thrust faults have been recognized seismically on the eastern and western extensions of the anticline and, while not actually recorded on the northern and southern flanks either seismically or in the surface geology, they are inferred to continue along the length of the anticline. Thus the Waterhouse Anticline is possibly a diapiric structure thrust up along a south-dipping northern thrust fault and a north-dipping southern thrust fault with the Bitter Springs Formation acting as a decollement surface.

Pertnjara Group

Four units of the Pertnjara Group can be recognized in the Ellery Creek to Pine Gap area - the lower Hermannsburg Sandstone, Ljiltera Member, Brewer Conglomerate and Undandita Member.

(a) Lower Hermannsburg Sandstone

On the northern flank of the Waterhouse Anticline the basal 170 to 200m of the Pertnjara Group consists of white and grey, fine to medium grained, non-pebbly, quartz-rich Hermannsburg Sandstone which weathers to a red-brown colour. Current directions in this unit indicate a northeasterly flow direction initiated by a local uplifted source area within the Waterhouse Anticline.

(b) Ljiltera Member

The lower Hermannsburg Sandstone in the Waterhouse Anticline is overlain by a band, 10 to 150+m thick, of pebbly sublitharenite which can be termed the Ljiltera Member of the Hermannsburg Sandstone. This unit forms the steep flanks of the Waterhouse Anticline. At the east end of the anticline in Orange Creek an unconformity is clearly visible between the lower

Hermannsburg Sandstone and the Ljiltera Member. On the north side of Orange Creek the unconformity becomes very distinct towards the nose of the anticline. In places the Ljiltera Member shows an angular disparity of 70° to 90° with the lower Hermannsburg Sandstone and it cuts right through this unit to lie unconformably on the Mereenie Sandstone. In Orange Creek and further south there is only a very slight disconformity between the lower Hermannsburg Sandstone and the Ljiltera Member which can be distinguished by the influx of coarse pebbly sandstones. The clasts in the Ljilter Member are mainly well rounded and vary in size from 5 to 15cm. They consist almost entirely of white sandstone and quartzite derived from the Mereenie and Pacoota Sandstones. The clasts usually occur towards the base of cross-bedded sets or within flat-bedded sets. The sandstones consist predominantly of quartz and kaolinitic clays and are generally white to grey, weathering to brown on the surface. Current directions within this unit also indicate derivation from the Waterhouse Anticline. Thus the deposition of the pebbly Ljiltera Member, at least partly unconformable on the lower Hermannsburg Sandstone, is probably the result of renewed uplift of the core of the Waterhouse Anticline to expose both Mereenie and Pacoota sediments to erosion.

In the Ellery Creek area the Ljiltera Member is the basal unit of the Pertnjara Group and lies disconformably on the Mereenie Sandstone. East of Ellery Creek the Ljiltera Member transgresses the eroded lower Mereenie Sandstone and unconformably overlies the Stairway Sandstone. In this same area the Ljiltera Member itself lenses out laterally eastwards into the massive Brewer Conglomerate.

In the Ellery Creek area the Ljiltera Member consists of subequal proportions of pebbly sandstone and conglomerate lenses. The clasts commonly vary in size from granules to 20cm cobbles but in some horizons clasts are up to 35cm and one isolated boulder of Mereenie Sandstone was recorded with a size of

100x60x30cm. The average size of the clasts increases upwards through the Ljiltera Member. Most of the clasts are subrounded to rounded and mainly consist of Larapinta and Pertaoorrta Group sandstones, shales and limestones. In several horizons at Ellery Creek reworked Ordovician nautiloids occur in the conglomerate lenses. Scoured erosion surfaces are common between the sedimentary units and the sediments are mainly flat-bedded or low angle trough cross-bedded. The detailed sections at Ellery Creel can be subdivided into cyclic sequences varying in thickness from 50cm to more than 4.5m. Each cycle starts with an erosive phase and the structures within the cycles indicate decreasing flow velocities during the deposition of the cycle. There is also an upwards decrease in average grain size within the cycle. In the lower Ljiltera Member the cycles usually start with upper flow regime flat bed deposits or lower flow regime dune cross-stratified beds containing some pebbles and mudclasts. Towards the top of the cycles the thickness of the cross-bedded sets decreases and they may be overlain by ripple-bedded or lower flow regime flat-bedded fine grained sandstones with rare occurrences of red-brown siltstone. Higher in the Ljiltera Member the cycles usually start with a massive conglomerate bed overlain by flat-bedded medium to coarse grained pebbly sandstones and a few with low angle cross-beds. These features all indicate higher average flow velocities. The thickness of the cycles suggests that flow depths were usually less than 5m. Current bedding indicates a flow direction from north to south which links up with a major east flowing drainage system. The environment of deposition was probably a fluviatile braided stream system occurring at or near the base of a series of alluvial fans situated north of the present basin margin.

(c) Brewer Conglomerate

The Brewer Conglomerate conformably and transitionally overlies and interdigitates with the Ljiltera Member in the Ellery Creek area. However, from about 6km east of Ellery Creek to Pine Gap the Brewer Conglomerate lies unconformably on the Larapinta and Pertaoorrta Groups with maximum downcutting in the area immediately west of where the Hugh River cuts through the MacDonnell Ranges. The basal contact of the Brewer Conglomerate is usually not exposed but can be picked to within 5 to 50m. At one section 16km west of Hugh River the contact with the Jay Creek Limestone is exposed and shows up to 20m of local relief on the unconformity surface. East of Hugh River the contact with the Pacoota Sandstone appears to have very little local relief and the two units seem to be almost conformable.

Between Ellery Creek and Hugh River the basal unit of the Brewer Conglomerate is usually a poorly sorted massive pebble and cobble conglomerate. The clasts mainly consist of Larapinta and Pertaoorrta sediments. They vary from subangular to rounded and are usually less than 12cm in diameter. The clasts are set in a coarse to very coarse grained lithic matrix with abundant calcite cement. The maximum clast size in the massive conglomerate units usually increased to between 35cm and 1m in the interval 100 to 500m above the base of the conglomerate. At about this same level Proterozoic clasts appear in the conglomerate in moderate numbers e.g. Areyonga and Bitter Springs Formations. The maximum clast size then decreases upwards through the remainder of the Brewer Conglomerate and is about 10 to 15cm in most of the Undandita Member. Occasional sandstone stringers in the massive conglomerate are flat-bedded. Clast imbrication occurs in some areas. Bedding can sometimes be recognized in the massive conglomerate on the basis of erosion surfaces and alternations of clast sizes and sorting e.g. an influx of larger rounded clasts. Current directions are mainly southwards and the conglomerate probably accumulated as a series of alluvial fans. It is probable that deposition occurred in the periodic floods following each rainfall as a result of the rapid run-off caused by a virtual lack of land flora in well drained upland areas.

The main changes in colour and composition of the Brewer Conglomerate near the base of the sequence depend on the relative proportion of white sandstone clasts (Pzm, Os & Є-Op), red sandstone clasts (Pzp, Pzm & Єa), red and pink siltstone clasts (Єa & Pub), green siltstone clasts (Pup) and grey to tan limestone clasts (Єj & Pub). The abundance of a particular clast type usually increases fairly rapidly, as does clast size, after the first noted occurrence e.g. the start of the Heavitree Quartzite zone is denoted by the presence of rare small pebbles, and about 50 to 100m stratigraphically higher the Heavitree Quartzite is represented by more abundant large pebbles and cobbles. The relative abundance of the various clasts depends on the amount and depth of headward erosion of the stream system in the source area. Higher in the Brewer Conglomerate the clast types are much more heterogeneous owing to the greater diversity of rocks exposed in the source area.

The subdivision of the massive conglomerate into Types A, C and D is dependent entirely on the presence of particular distinctive clast lithologies. All the conglomerate beneath the first recognizable Heavitree Quartzite clasts (coarse grained arkosic sandstone with a black iron-rich matrix) is grouped into Type A. The interval containing Heavitree Quartzite clasts but no Arunta metamorphic clasts is termed Type C, and the interval containing both Arunta and Heavitree Quartzite clasts is termed Type D. The upper limit of the Type D unit is taken at the first major influx of sandy sediments above which the massive conglomerate occurs only as lenses.

A distinctive and predominantly sandstone unit (Type B) is situated at or near the base of the Brewer Conglomerate in the area between Hugh River and Pine Gap. This unit in part rests directly on the Pacoota Sandstone and in part is separated from the latter by Type A conglomerate lenses up to several hundred metres thick. The Type B unit is similar in many respects to the Ljiltera Member. It consists of sandstones and minor siltstones interbedded in places with massive conglomerate lenses. Clast sizes are mainly less than 15cm. The clasts are rounded to subrounded and consist of Larapinta and Pertaoorrta sediments. Most of the sandstones are pale reddish brown to purplish immature litharenites. In some areas they may have small greenish grey reduction patches. One larger reduced zone was recorded about 13km east of Jay Creek where the sediments consist of pinkish grey sandstone interbedded with greenish grey shaley sandstone over a stratigraphic interval of about 15m. Structures in the Type B unit show that currents flowed to the south or southeast and the sediments were largely deposited under lower flow regime conditions in a braided stream fluviatile environment.

The boundaries of these four units (Types A to D) do not simply follow the basin margin but show a series of west facing flexures in the area between Ellery Creek and Pine Gap. Probably with more detailed work these flexures would be found to be interdigitations of the various units and may possibly also show local unconformities e.g. in the area 22km west of Hugh River where there are two alternations of Type C and D units. Unconformities within the Brewer Conglomerate are also recognizable in seismic data with the younger units of the Brewer Conglomerate unconformably overlapping the lower units in a northward direction.

The reason for these interdigitations and disconformities can probably be related to the phases of orogenic activity on the northern margin of the Amadeus Basin. At the start of the massive Brewer Conglomerate deposition the area of maximum source uplift lay to the west of Ellery Creek and extended westwards to about Stokes Pass. In this western area deposition of the conglomerate would have occurred as a series of laterally interdigitating piedmont alluvial fans extending southwards onto a broad sandy plain drained by braided stream systems. In the area between Ellery Creek and Pine Gap the Missionary Syncline was probably a shallow structure with its main development west of Owen Springs homestead. During this early stage the alluvial fans extended eastwards to a point approximately 17km east of Ellery Creek where the Type A conglomerate unit lenses out (see Map 4). As deposition continued the Type C and D conglomerate units overlapped the depositional edge of the Type A unit and pebbly sandstones with increasing numbers of silty horizons were deposited south-eastwards in the centre of the syncline.

After this stage the zone of uplift must have moved eastwards to the Hugh River area where a further fanglomerate sequence, again starting with a Type A conglomerate unit, was deposited as the result of erosion of Larapinta and Pertaoorrta sediments in the local source area. This fan was localized just west of the Hugh River and shows the typical southwards sequence of Type A, Tupe C and Type D conglomerate units. At the same time two smaller fans of Type A conglomerate accumulated further east as lenses indicating less intense or slightly more distant uplift of the source rocks. These latter fans gave way southwards to the pebbly Type B sandstones. During the uplift and folding of the source area the axis of the Missionary Syncline would have migrated northwards and the site of maximum deposition in the syncline would have migrated eastwards to lie between Owen Springs and Pine Gap. The centre of the syncline would have received detritus southwards from the adjacent alluvial fans as well as eastwards from the still active fans west of Ellery Creek. Thus the clasts in the southern part of the syncline include both locally derived sedimentary clasts and more distantly derived Arunta metamorphic clasts. These clasts are incorporated into a lithic sandstone forming the Undandita Member.

Two further periods of local uplift of the source area, one just east of Jay Creek and the other, a later one, in the area west of Pine Gap, each produced an asymmetrical lobe of massive conglomerate (one at Owen Springs homestead and the other 16km to the east). Each lobe shows the successive zoning of conglomerate types (i.e. A to C to D) and gives way in a south-eastward direction to the pebbly sandstones of the Undandita

Member. During the deposition of the easternmost lobe the area of greatest accumulation in the Missionary Syncline would have been southeast of Pine Gap in the approximate area shown by the present surface expression of the syncline.

(d) Undandita Member

The Undandita Member is a conglomeratic to pebbly lithic sandstone characterized by the presence of clasts of Arunta metamorphics. Such clasts usually comprise 20 to 50 percent of the total with numerous varieties being represented e.g. granite, gneiss, schist, amphibolite, pegmatite, vein quartz, etc. The Undandita sandstones are very lithic and often contain pinkish feldspars and abundant biotite. In places, especially in the greenish grey horizons, the sandstones may be cemented with calcite.

The southern boundary between the Ljiltera and Undandita (Type E) Members occurs just north of the present margin of the Waterhouse Anticline. The contact appears to be gradational with the sediments becoming much more lithic upwards. The basal Undandita Member in this area consists of red-brown to purplish grey feldspathic, micaceous, pebbly litharenite with a clay and calcite matrix. The included pebbles show a much wider range of lithologies than in the Ljiltera Member with common sandstone, quartzite and vein quartz clasts and a few limestone, Heavitree Quartzite and Arunta granite and gneiss clasts. This indicates a change from a local Waterhouse source area to one which also includes a northern Arunta source.

In the Ellery Creek to Pine Gap area the Undandita Member is coarsest and contains more abundant and larger clasts on the northern flank of the Missionary Syncline than on the southern flank. Maximum size of the clasts is usually in the range from 10 to 20cm and they are typically rounded. Occasional massive or flat-bedded conglomerate lenses occur in the northernmost areas near the transitional lateral contact with the alluvial fans of the Brewer Conglomerate. Most of the

Undandita Member in the central and southern parts of the syncline consists of medium to coarse grained litharenites with scattered rounded pebbles and cobbles usually less than 10cm in diameter. The sandstones are flat-bedded or trough cross-bedded in sets up to 1m thick, with only rare ripple cross-stratified or silty interbeds except near the top of the member. The sets can be grouped into cycles as in the Ljiltera Member and cycle thicknesses in the Undandita Member generally vary from 1 to 8m. Current directions indicated by cross-bedding are usually to the east and southeast but occasional divergent directions were noted e.g. local west flowing current directions in the lower Undandita Member at one locality near the Waterhouse Anticline. These probably only represent local variations in stream orientation. During the deposition of the Undandita Member the existence of an upstanding Waterhouse structure is questionable since there is no evidence above the Ljiltera Member of the influx of common locally derived clasts. Deposition of the Undandita Member in this area was mainly controlled by the subsidence of the Missionary Syncline.

The occurrence of siltstone interbeds is mainly limited to the upper parts of the Undandita Member. Siltstones form 15 to 20 percent of the sequence on the northern limb of the syncline 6 to 11km south of the Ljiltera Member-Brewer Conglomerate contact at Ellery Creek. Along the north-south traverse 4km west of Owen Springs homestead siltstone occurs with an irregular distribution on both limbs of the syncline. It forms between 0 and 60 percent of seismic hole cuttings. South of Pine Gap siltstone is again abundant in the centre of the syncline reaching a maximum of 90 percent of the cuttings in one hole (average 40-60% 4km on either side of the syncline axis). These siltstones are mainly red-brown and micaceous and they are known to be continuous along the axis of the syncline at least between Owen Springs and Pine Gap.

With the exception of the upper Undandita Member near the centre of the syncline, the lack of abundant siltstone interbeds and the average cycle thickness of 3.5m both tend to indicate that deposition occurred from a predominantly east to southeast flowing braided stream fluviatile system. The increase in abundance of siltstone in the upper Undandita Member may indicate that the relative relief between the source and depositional areas was decreasing, the rivers were flowing more slowly and possibly had more stable meandering coarses. Overbank floods after rains would have deposited silty beds especially in backwater areas between isolated alluvial fans. These siltstones were preserved owing to the river systems having a lower gradient and being more stable. At the same time plants were probably able to become established in the flooded depressions and would have given rise to the thin coaly stringers seen in the drill cores.

In this study the Undandita Member has been subdivided into three "stratigraphic" units on the basis of the predominant colour of the sediments - all other characteristics being essentially the same in the three units. The upper and lower units (Type E) consist mainly of pale red-brown to purplish grey sandstones and darker red-brown siltstones. The colour in the Type E units is fairly constant with only rare areas containing small greenish grey spots. The number and size of the spots increases towards the boundaries with the middle Type F greenish grey sandstone unit and the rocks in this transitional zone often have mottled colour distributions. The boundaries between the Type E and Type F units are fairly regular and straight although they are transitional in nature. The boundaries are not strictly stratigraphically controlled and cut across bedding in some places. The Type F unit mainly parallels the northern flank of the Waterhouse Anticline. Near the east end of the anticline the unit probably bends southeastwards to join up with a similar zone in the Ewaninga area. However, no evidence of the bend was actually found because of alluvial and aeolian sand cover. The colour in the Type F unit is predominantly greenish grey but frequent mottled zones are present especially in the west where, in places, up to 30 percent of the sequence is purplish grey.

Scintillation Readings

Table 6 sets out the average scintillation readings obtained at each sample location in the Pertnjara Group. The instrument used for all readings was a Saphymo-SRAT scintillometer.

Average sample location readings in the Hermannsburg Sandstone and Ljiltera Member varied from 30 to 60 counts per second with individual readings even at shallow depths not exceeding 70 counts per second. The overall averages for the units varied from 43 to 50 counts per second. These were the lowest reading recorded from the Pertnjara Group in the Ellery Creek to Pine Gap area and they represent background radiation.

Average readings for the massive Brewer Conglomerate outcrops (Types A, C & D) are also low (range 35-75 c/s; average 52 c/s). Individual readings did not exceed 85 counts per second at any outcrop locality. These readings likewise mainly represent background radiation.

The sandy unit (Type B) at or near the base of the Brewer Conglomerate between Hugh River and Pine Gap contains several significantly higher readings (range 45-95 c/s; average 64 c/s). In one area about 16km ENE of Owen Springs homestead, just above the contact with the Pacoota Sandstone, readings of up to 120 counts per second were recorded from a dark brown iron-rich siltstone with irregular greenish grey mottled patches. Approximately 12.6km ENE of Owen Springs homestead greenish grey shaley sandstone (average 95 c/s) is interbedded with pinkish grey lithic sandstone (average 70 c/s). These latter occurrences indicate at least some concentration of radioactive elements in this sandy unit particularly in zones where there are greenish grey reduced patches and lenses. It is doubtful if any of these patches in the Type B unit would be large enough to suggest possible economic concentrations of uranium.

SAPHYMO - SRAT SCINTILLATION READINGS

Table 6

UNIT & AREA	Counts/sec. - average for each sample site. Range	Average	Number of sample sites
Lower Hermannsburg Sandstone - Waterhouse Anticline	35-65	47	7
Ljiltera Member - Waterhouse Anticline	40-65	50	8
Ljiltera Member - Ellery Creek	30-50	43	5
Brewer Conglomerate			
Type A (conglomerate)	35-75	50	55
Type B (sandstone)	45-95	64	23
Type C (conglomerate)	37-65	53	29
Type D (conglomerate)	37-68	54	31
Undandita Member			
Type E (north of Type F)	50-80	59	40
Type F (greenish grey)	50-296	85	63
Type E (south of Type F)	35-80	57	21

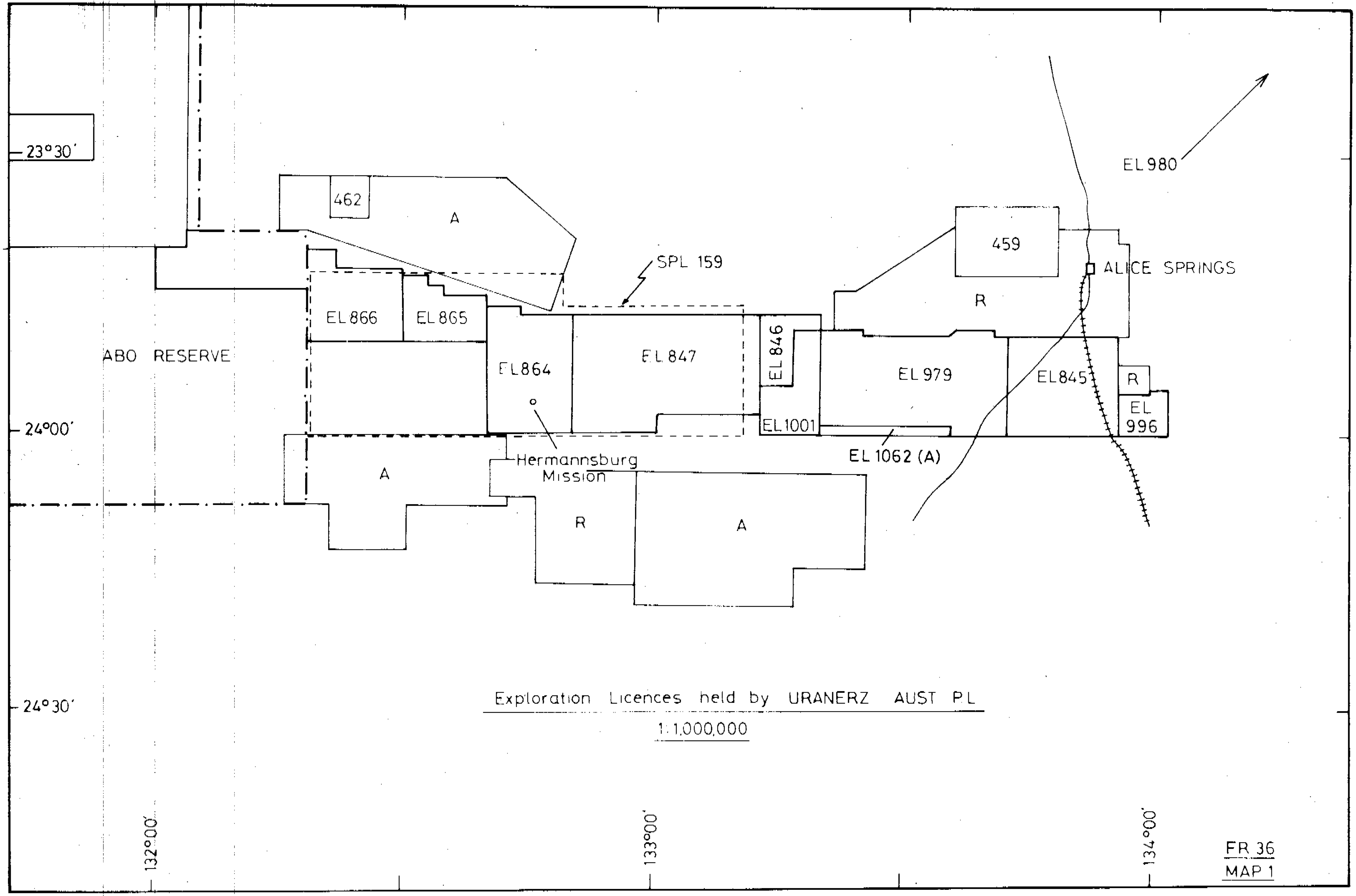
In the Undandita Member three "stratigraphic" units can be recognized both on the basis of colour and scintillation readings. The red-brown to purplish grey Type E units north and south of the greenish grey Type F unit are essentially the same and have average scintillation readings varying from 35 to 80 counts per second. Localities with readings of less than 50 counts per second usually consist of poorly exposed and very weathered Undandita Member associated with caliche deposits. In other parts of the area the caliche zone has an average background reading of 35 counts per second and hence the low readings given above are probably due to recent surface leaching of radioactive elements combined with carbonate deposition. Maximum individual readings in the Type E sediments are 95 to 110 counts per second and, as in the sandy Type B unit in the Brewer Conglomerate, these high readings are usually associated with mottled greenish grey reduction spots in the predominantly oxidized sediments.

The Type F unit is characterized by a predominance of greenish grey sediments and has a significantly higher average scintillation reading of 85 counts per second. Individual readings at a locality in this unit showed a much wider range of values than in any of the other units and the readings increased significantly (average about 130 c/s) at shallow depths. However, only two localities had average readings of more than 150 counts per second. The first of these localities 170m ESE of Uranerz peg 1000N, 39000W, was disappointing. Readings of 180 to 270 counts per second were obtained in a small sandy creek showing no outcrops. The radioactive zone was concentrated within the sand at the top of the water table approximately 30cm below the surface. Below the water table the readings dropped back to 150 counts per second. The second and most important locality is situated about 9km south of Owen Springs homestead (See Map 4). This locality contains greenish grey medium grained lithic sandstones and a few greenish micaceous (biotitic) very fine grained sandstone and siltstone horizons interbedded with purplish grey medium grained lithic sandstone containing greenish grey mottled patches. The sandstones are cross-bedded in sets 20 to 50cm thick and contain isolated rounded pebbles of sandstone, quartzite and Arunta metamorphics. Individual surface readings vary from 130 to 350 counts per second and a maximum recorded reading of 400 counts per second was obtained at a depth of 5cm at one locality.

ASSESSMENT

Exploratory work carried out by the Company in areas to the east, principally on EL 845, has shown that the Type F zone is the portion of the Undandita Member which is of most interest in uranium search and offers the greatest potential for uranium occurrence. This tends to be supported by the geological observations made and scintillometer readings taken during ground traversing of the various subdivisions of the Brewer Conglomerate and the Undandita in areas further to the west. It is evident, however, that while the Type F zone is fairly continuous it becomes increasingly diffuse and more difficult to define in a westerly direction and particularly to the west of the eastern boundary of EL 847. While the limits of the zone in that area have been very broadly defined, there is evidence, within these limits, of a gradual transition towards Type E sediments which probably make up about 50% of the section, as interdigitating tongues and also as lenses which are more readily defined. Detailed definition of the boundaries between Type E and Type F zones from surface exposures is virtually impossible as outcrop of the Undandita Member is confined to stream channels; as indicated on Maps 5, 6 and 7, the Undandita in the interfluve areas is concealed by deposits of Tertiary sediments or by alluvium.

The gradual transition from Type F to Type E zone towards the west tends to suggest that the uranium potential of the prospective Zone F is diminishing in that direction; this,



23°30′
24°00′
24°30′
132°00′
133°00′
134°00′
ABO RESERVE
462
A
459
EL 980
ALICE SPRINGS
SPL 159
R
EL 866
EL 865
EL 864
EL 847
EL 846
EL 979
EL 845
R
EL 996
EL 1001
EL 1062 (A)
Hermannsburg Mission
A
R
A
Exploration Licences held by URANERZ AUST P.L
1:1,000,000
FR 36
MAP 1

URANERZ (AUSTRALIA) PTY. LTD.

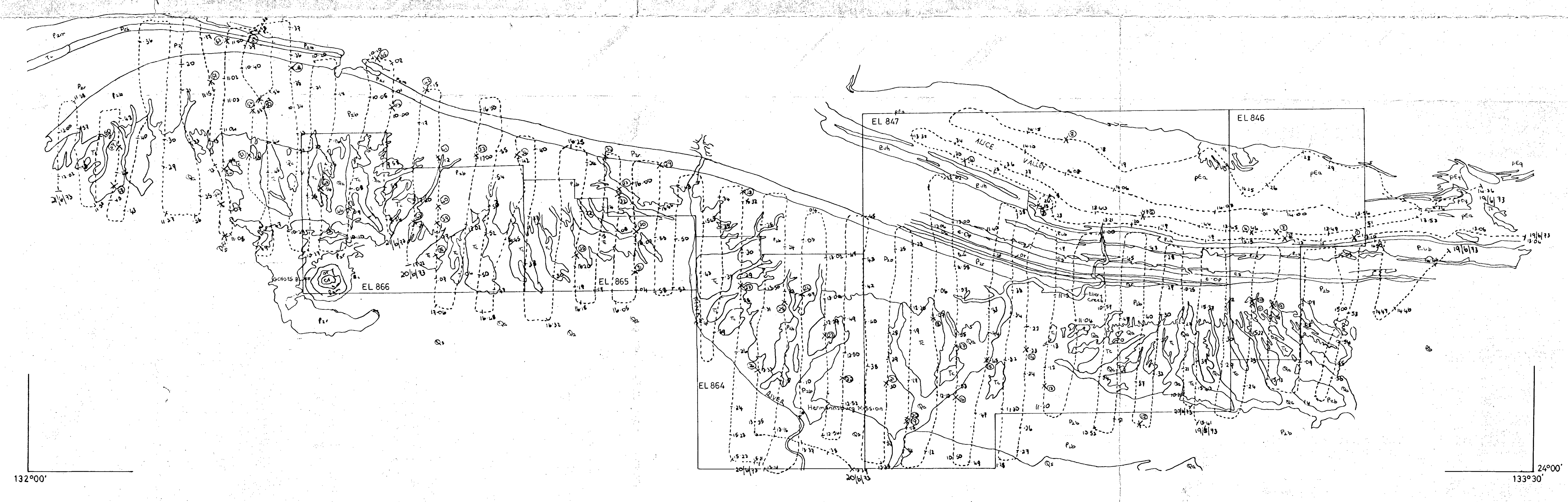
HERMANNSBURG
SHEET 1
GEOLOGY OF BREWER CONGLOMERATE AND UNDANDITA MEMBER

GEOLOGY: IL	DATE: APR 74	TENEMENT:	MAP No. 2
DRAWN: EA	DATE: MAY 74	NT-112-2c	REPORT No. FR 36
T.C: UAL. UEB	SCALE: 1:80 000		PROJECT No. 2c
P.C: UAL. UEB	REF:		


EL 847
EL 846
EL 864
8/147
9/161
9/088
9/074
10/034
10/045
Brewer
Conglomerate
Undandita
Member
Hermannsburg
Sandstone
HERMANNSBURG 2
800m 0 2 4km
1: 80 000
N
Inferred boundary
Undandita
Brewer
Hermannsburg
URANERZ (AUSTRALIA) PTY. LTD.
HERMANNSBURG
SHEET 2
GEOLOGY OF BREWER CONGLOMERATE
AND UNDANDITA MEMBER
GEOLOGY: IL
DATE: APR 74
TENEMENT:
MAP No 3
DRAWN: EA
DATE: MAY 74
NT - III - 2c
REPORT No. FR 36
T.C: UAL, UEB
SCALE: 1:80 000
PROJECT No 2c
P.C: UAL, UEB
REF:

GEOLOGY OF THE PERTNJARA GROUP IN THE ELLERY CREEK - PINE GAP AREA, MISSIONARY AND BREWER PLAINS, AMADEUS BASIN
SAMPLE SITE PRE 1974
SAMPLE SITE 1974
SAMPLE SITE 1974 (>200 counts/sec)
GEOLOGICAL BOUNDARY
BOUNDARY WITHIN BREWER CONGLOMERATE
ROAD OR TRACK
HOMESTEAD
DAM
Pzr HERMANNSBURG SANDSTONE
Pzr(L) LJILTERA MEMBER (sst. with congl. lenses)
A BREWER CONGLOMERATE (no Puh or pCa)
B (mainly sst., clasts as above)
C (with Puh, no pCa)
D (with Puh and pCa)
E UNDANDITA MEMBER (mainly red-brown)
F (mainly greenish-grey)
MACDONNELL RANGES
ELLERY CREEK
HUGH RIVER
JAY CREEK
OWEN SPRINGS
Pzr(L)
Pzr
EL846
EL847
EL979
EL1001
TO HERMANNSBURG
WATERHOUSE ANTICLINE
ORANGE CREEK
ADELAIDE ROAD
NORTH
0 2 4 km
1:80000
A
B
C
D
E
F
?
B.G. JONES AUGUST 1974
MAP 4
UAL PLAN Nº NT-119-2c

HERMANNSBURG



- - - AIRBORNE RADIOMETRIC TRAVERSES
- - X - - - ANOMALIES

5 0 10 km

1 : 250 000

URANERZ (AUSTRALIA) PTY. LTD.

HERMANNSBURG
PR. 2c. SHEET SF. 53. 13.

RADIOMETRIC AIRBORNE SURVEY

GEOLOGY: IL	DATE: JULY 73	TENEMENT:	MAP No. 5
DRAWN: IL	DATE: JULY 73	NT-1041-2c	REPORT No. 27
T.C: UAL, UEB	SCALE: 1: 250,000.		PROJECT No. 2c.
P.C: UAL, UEB	REF: SF 53. 13. GEOL & TOPO		


DAVENPORT CK.
GLEN HELEN CAMP
AREYONGA RD.
FINKE CK.
EL 866
EXOIL GOSSES BLUFF No 1
EL 865
TO HERMANNSBURG
2.15 0 6.5km
1 86 000 Approx
LEGEND
QUATERNARY Qa ALLUVIUM
TERTIARY Tc CONGLOMERATE
Pzb BREWER CONGLOMERATE
DEVONIAN TO CARBONIFEROUS Pzr HERMANNSBURG SANDSTONE
Pzk PARKE SILTSTONE
ORDOVICIAN TO DEVONIAN Pzm MEREENIE SANDSTONE
€ Ol UNDIFFERENTIATED
Oc CARMICHAEL SANDSTONE
CAMBRIAN TO ORDOVICIAN Ol STOKES SILTSTONE
Os STAIRWAY SANDSTONE
Oh HORN VALLEY SILTSTONE
€Op PACOOTA SANDSTONE
€g GOYDER FORMATION
€j JAY CREEK LIMESTONE
CAMBRIAN €h HUGH RIVER SHALE
€a ARUMBERA SANDSTONE
€e PETERMANN SANDSTONE
Eup PERTATATAKA FORMATION
Eua AREYONGA FORMATION
PROTEROZOIC Eub BITTER SPRINGS FORMATION
Euh HEAVITREE QUARTZITE
p€a ARUNTA COMPLEX
HELICOPTER FLIGHT LINES AND TIME
GEOLOGICAL BOUNDARY
ROAD
45 RADIOMETRIC ANOMALY
URANERZ (AUSTRALIA) PTY. LTD.
EWANINGA WESTERN EXTENSION
HELICOPTER RADIOMETRY AND GEOLOGY
GEOLOGY: JO J, IL
DATE: DEC 73
TENEMENT:
MAP No. 6
DRAWN: JO J EA
DATE: JAN 74
NT-1123-2c
REPORT No. MAY 74
T.C: UAL. UEB
SCALE: 1:86,000. Approximately
PROJECT No. 2c
P.C: UAL. UEB
REF:

LEGEND

QUATERNARY	Qa	ALLUVIUM
TERTIARY	Tc	CONGLOMERATE
	Pzb	BREWER CONGLOMERATE
DEVONIAN TO CARBONIFEROUS	Pzr	HERMANNSBURG SANDSTONE
	Pzk	PARKE SILTSTONE
ORDOVICIAN TO DEVONIAN	Pzm	MEREENIE SANDSTONE
	€ Ol	UNDIFFERENTIATED
	Oc	CARMICHAEL SANDSTONE
CAMBRIAN TO ORDOVICIAN	Ot	STOKES SILTSTONE
	Os	STAIRWAY SANDSTONE
	Oh	HORN VALLEY SILTSTONE
	€Op	PACOOTA SANDSTONE
	€g	GOYDER FORMATION
	€j	JAY CREEK LIMESTONE
CAMBRIAN	€h	HUGH RIVER SHALE
	€a	ARUMBERA SANDSTONE
	€e	PETERMANN SANDSTONE
	Pup	PERTATATAKA FORMATION
	Pua	AREYONGA FORMATION
PROTEROZOIC	Pub	BITTER SPRINGS FORMATION
	Puh	HEAVITREE QUARTZITE
	p€a	ARUNTA COMPLEX

21	HELICOPTER FLIGHT LINES AND TIME
-----	GEOLOGICAL BOUNDARY
——	ROAD
●45	RADIOMETRIC ANOMALY

2·15 0 6·5 km

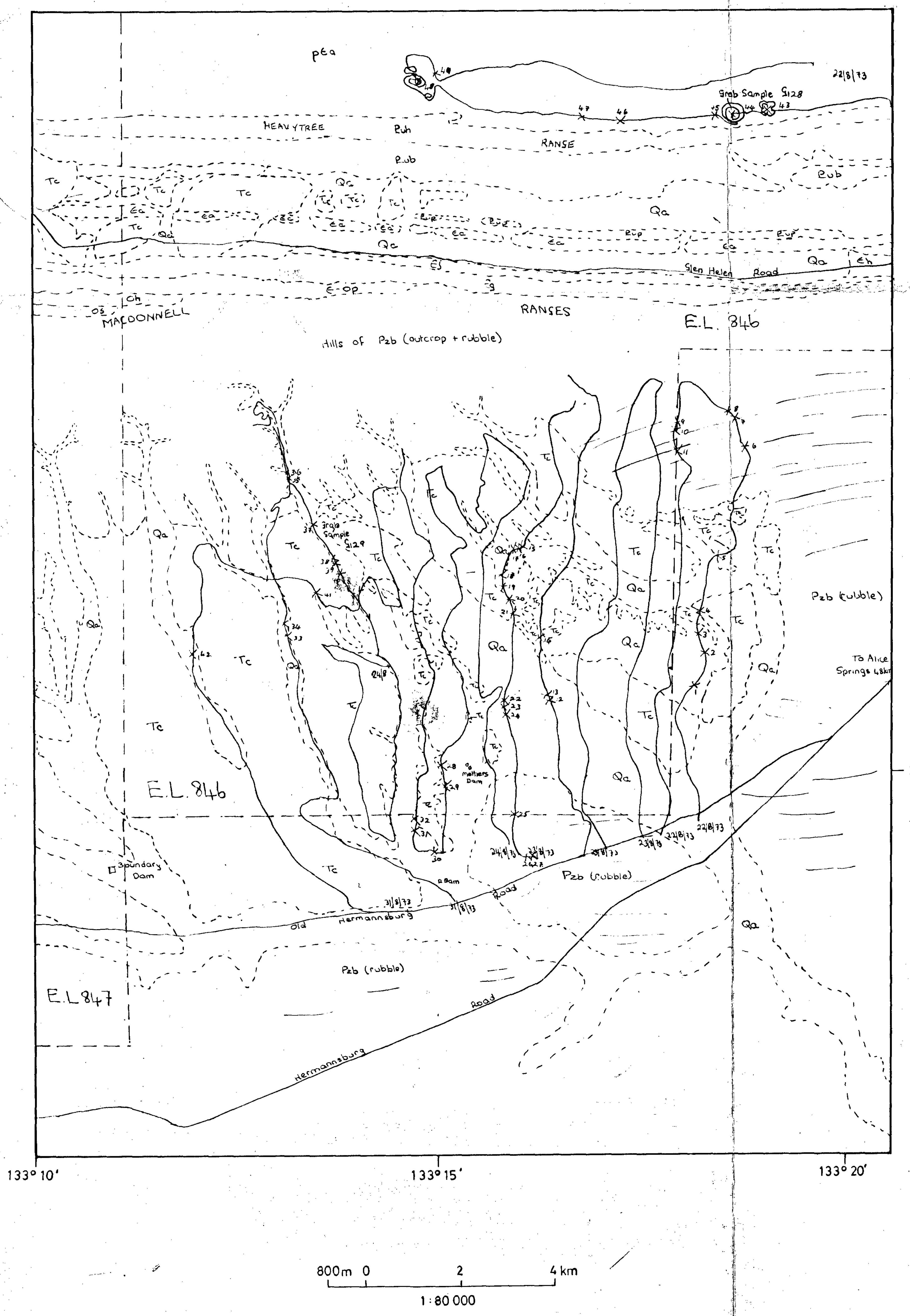
1 : 86 000 Approx.

URANERZ (AUSTRALIA) PTY. LTD.

EWANINGA WESTERN EXTENSION

HELICOPTER RADIOMETRY AND GEOLOGY

GEOLOGY: JO J, IL	DATE: DEC 73	TENEMENT:	MAP No. 7
DRAWN: JO J EA	DATE: JAN 74	NT-1124-2c	REPORT No. MAY 74
T.C: UAL, UEB	SCALE: 1: 86,000. Approximately		PROJECT No. 2c
P.C: UAL, UEB	REF:		



N

⁓	Carborne radiometric traverse
— —	EL boundary
( )	Formation boundary
///	Trend lines
x2	Anomalies
Qa	Alluvium
Tc	Tertiary conglomerate
Pzb	Brewer "
Os, Oh, Є-Op, Єg, Єj, Єa.	Cambrian & Ordovician seds.
Pup, Pub, Puh.	Proterozoic seds.
Pea	Arunta complex

URANERZ (AUSTRALIA) PTY. LTD.

EL 846

CARBORNE RADIOMETRIC SURVEY WESTERN EXTENSION OF BREWER CONGLOMERATE

GEOLOGY: RO PA	DATE: SEP 73	TENEMENT:	MAP No. 8
DRAWN: RO PA	DATE: " "	NT - 1073 - 2c	REPORT No. 27
T.C: UAL, UEB	SCALE: 1: 80,000.		PROJECT No. 2c.
P.C: UAL, UEB	REF: PHOTOS: HERMANSBURG RUN 9/076. RUN 10/048.		

URANERZ (AUSTRALIA) PTY. LTD.

HERMANNSBURG
SHEET 1

STREAM SEDIMENT SURVEY
SAMPLE DETAILS

GEOLOGY: IL	DATE: APR 74	TENEMENT:	MAP No. 9
DRAWN: EA	DATE: MAY 74	NT-2004-2c	REPORT No. FR 36
T.C. UAL UEB	SCALE: 1:80 000		PROJECT No. 2c
P.C. UAL UEB	REF:		

132°50' (132.83°)
133°12' (133.20)
23°40' (-23.6°)
23°58' (-23.96°)
24°00'
EL 846
EL 847
ELLERY
CREEK
JERIMAH
HERMANNSBURG MISSION
10/034
8/147
9/161
9/088
9/074
10/046
B S033
2 S035
2 S036
4 S034
2 S037
1 S038
2 S039
4 S040
1 S021
4 S020
3 S019
S022 2
1 S023
3 S016
2 S018
4 S017
2 S014
B S012
2 S015
2 S013
2 S011
1 S010
2 S009
2 S008
2 S007
2 S006
1 S005
2 S004
1 S003
1 S002
1 S001
2 S267
2 S266
B S138
1 S265
B S264
3 S137
B S135
S133
B S134
S136
1 S130
3 S129
B S131
S132 B
S061 2
S062 3
2 S043
4 S044
1 S045
2 S046
2 S251
1 S261
2 S262
B S263
1
HERMANNSBURG 2
800m 0 2 4km
1:80 000
N
URANERZ (AUSTRALIA) PTY. LTD.
HERMANNSBURG
SHEET 2
STREAM SEDIMENT SURVEY
SAMPLE DETAILS
GEOLOGY: IL
DRAWN: EA
T.C: UAL, UEB
P.C: UAL, UEB
DATE: APR 74
DATE: MAY 74
SCALE: 1:80 000
REF:
TENEMENT:
NT-2005-2c
MAP No. 10
REPORT No. FR 36
PROJECT No. 2c
S267 ● 2 Sample number with U_3O_8 result in ppm
● B Below detection