PROGRESS REPORT TO JULY 31ST, 1979

EXPLORATION LICENCE NOS. 1181, [illegible], 1700, 1701

RUM JUNGLE PROJECT

NORTHERN TERRITORY

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Project Geologist
August, 1979.

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GENERAL

Exploration Licence Nos. 1181 (23.53 km^2) and 1219 (49.28 km^2) were granted to International Mining Corporation N.L. (I.M.C.) on 28th July, 1977. Licence Nos. 1700 (9.99 km^2) and 1701 (9.99 km^2) were granted to I.M.C. on 27th July, 1978 and 16th June, 1978 respectively. (Fig. 1)

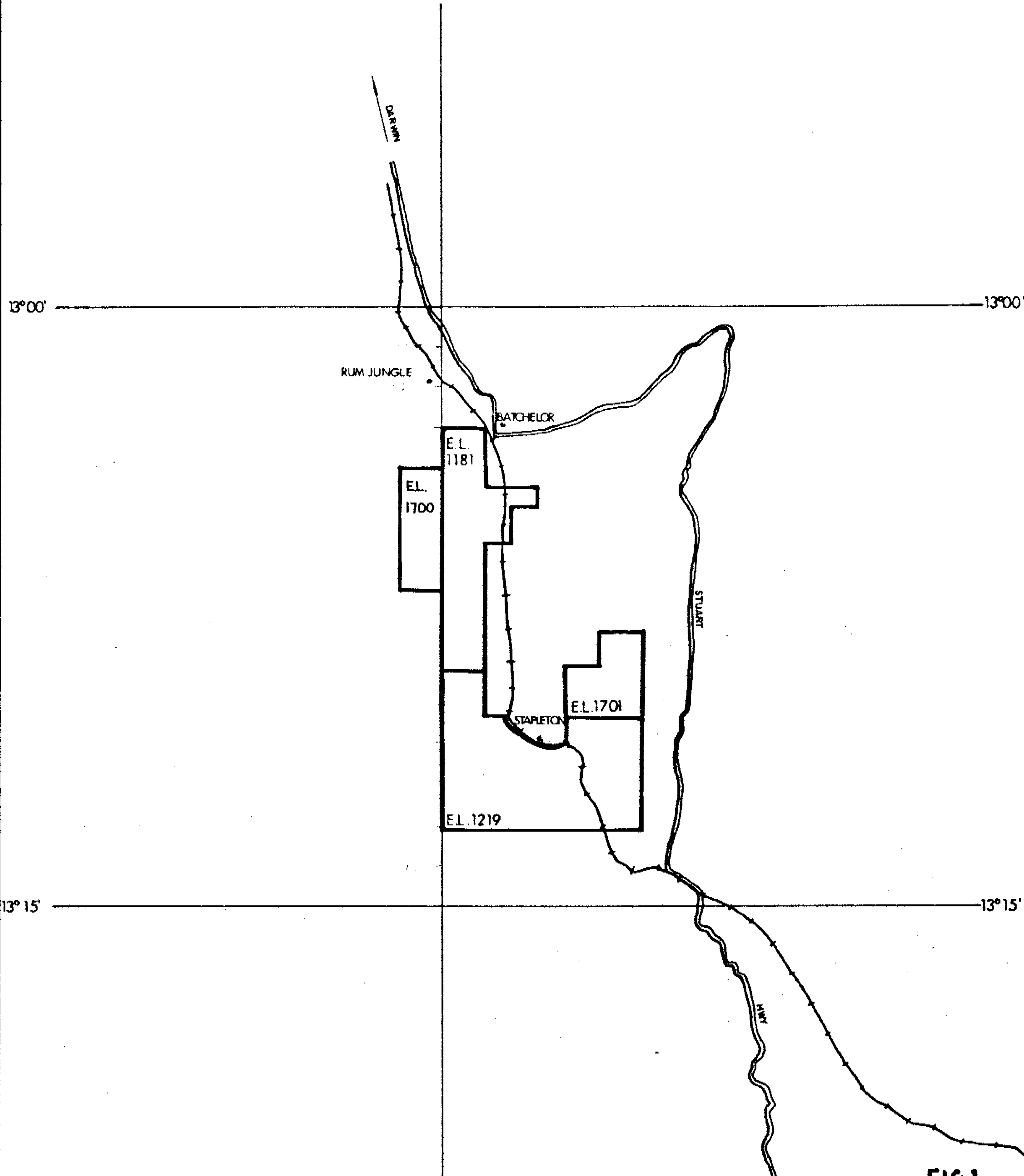
The licence areas are contiguous, and are located on the eastern side of the Waterhouse Complex in the Rum Jungle area, between the towns of Batchelor and Adelaide River, Northern Territory.

During 1977, I.M.C. carried out literature research and evaluation, and commissioned a preliminary appraisal of the area by consultant geologist J. Baird of John Baird and Associates Pty. Ltd. Mr. Baird carried out a brief reconnaissance of the area, and recommended a low level airborne radiometric survey.

In 1978, I.M.C. commissioned Geometrics International to conduct a fixed wing airborne magnetic and gamma ray spectrometer survey of approximately 550 line kilometres covering the entire Project area. The survey, with traverse lines in a general east-west direction and spaced 200 metres apart, was scheduled for July, 1978, but due to unforeseen problems, was delayed until the end of October. Preliminary data processing and map compilation took a further month, and as a result the planned field programme for 1978 was postponed until 1979.

During the third quarter of 1978, Marathon Petroleum Australia Ltd. took ov as operator for the Project, under the terms of a Joint Venture Agreement with I.M.C., which is in the final stages of completion before being submitted to the Department of Mines and Energy for Ministerial approval.

Early in 1978, consultant geophysicists from Hunting Geology and Geophysics Pty. Ltd. undertook a detailed interpretation of the airborne geophysical data; a report was prepared, which recommended ground investigations in selected parts of the licence areas.



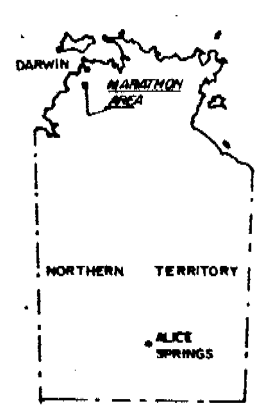


FIG 1.

MARATHON PETROLEUM AUSTRALIA, LTD.

BRISBANE AUSTRALIA

NORTHERN TERRITORY

EXPLORATION LICENSE No's 1700, 1701, 1219, 1181

RUM JUNGLE PROJECT

LOCATION MAP

SCALE

5 0 5 10Km

1 250,000

Drawn b K.J.C. Date 18-6-78

In May 1979, Marathon completed a thorough evaluation of previous work on the Project area (open-file company reports, B.M.R. records, etc.) and in June 1979, commenced a field programme based on the results of the geophysical interpretation, and evaluation of previous work.

Initial field work indicated that the existing 1:100,000 scale geological map (Rum Jungle Sheet) was not sufficiently detailed for the planned exploration programme. Accordingly a photogeological interpretation, with particular emphasis on the structural features of the Project area, was prepared by Hunting Geology and Geophysics, which resulted in a significant improvement in the structural detail for the geology of the Project area.

To the end of July, the field programme has been based on follow-up of airborne geophysical anomalies and reconnaissance surveys employing ground spectrometer and radon emanometer surveys, geological check mapping, soil and rock geochemical sampling, orientation ground radiometric and radon detection surveys over known mineralization, and grid surveying.

A Track Etch radon detection survey is currently under way on E.L. Nos. 1181, 1219, and 1700; the cups are scheduled for recovery in early September, and after data processing, the results are expected to be available by the end of September. Other gridding and Track Etch surveying over other parts of E.L. 1219 and E.L. 1701 is scheduled to follow.

A detailed E.M. Resistivity survey by Murdoch Geophysics Pty. Ltd. has been commissioned. It is scheduled for commencement on September 3rd, 1979, and is aimed at more accurately delineating the contact between the Coomalie Dolomite and the Masson Formation (formerly Golden Dyke Fm.) over a north south distance of more than 17 km. The Bureau of Mineral Resources have made available results of resistivity surveys and logs of stratigraphic drill holes within the Licence areas; this data will assist in planning, calibration and evaluation of the new E.M. Resistivity surveys.

A 1500 metre percussion drilling programme is scheduled for commencement in mid October, 1979. A number of drilling companies have submitted quotes, and the contract is expected to be let by late August. The drilling, aimed at testing one or a combination of airborne and ground radiometric anomalies, radon (Track Etch) anomalies, and geological targets, will comprise approximately 25 holes to a minimum depth of 50 metres, but with the capability of drilling to 120 metres if warranted.

Expenditure on the Project for the 12 months ended July 31st, 1979, has totalled approximately $50,000, with planned expenditure for the remainder of 1979 of $40,000. Anticipated expenditure for 1980 is $100,000.

WORK COMPLETED

1. Airborne Geophysics Survey

An airborne geophysics survey covering the entire Project area, comprising E.L. Nos. 1181, 1219, 1700 and 1701 was undertaken by Geometrics International on October 25th, 28th and 29th, 1978.

Traverse flight lines totalling 550 kilometres were flown in a general east-west direction and spaced 200 metres apart. Tie-lines were flown in a north-south direction and spaced approximately 3 kilometres apart. Mean terrain clearance was 80 metres, and flying speed, 105 knots. Navigation and flight path recovery were by visual techniques, based on 1:25,000 scale photomaps.

Instrumentation comprised a Geometrics proton magnetometer Model G-803, with a sensitivity of 0.25 nT, a differential gamma ray spectrometer Model GR-800 providing 256 channels of radiometric data in digital form and utilizing a detector of 2000 cubic inches of extruded slab polycin sodium iodide crystal. A temperature controller, Model GR-900, directly interfaced between the spectrometer and detector, maintained spectrum stabilization. Terrain clearance was measured by a Honeywell YG7600 recording radar altimeter, and Flight path recovery provided by a Hulcher 35 mm tracking camera with wide angle lens and continuous strip. A Geometrics' recording Base Station Magnetometer, Model G806 was used as a diurnal monitor and ran continuously during survey periods.

Navigation was facilitated by an integrated navigation system comprising a Decca Radar Dappler - Type 72 and a Sperry C-9 Gyro Stabilized Compass.

All data were collected in both digital and analog format, at a constant time base of 0.8 second. Data recording was by Exploranium MARS-6 multi-channel analog recorder, recording magnetometer, radar altimeter, total count, K-40, Bi-214, Th.208, automatically corrected for Compton Scatter; and by a Geometrics' Digital Acquisition System, Model G.714, recording magnetometer, camera fiducal number, manually inserted information (survey area, flight line number and line direction), radar altimeter (by analog to digital conversion), and uncorrected gamma ray spectrometer data.

Synchronization of all data gathered was controlled by sequential imposition of fiducal or event marks on all records simultaneously.

Calibration of the spectrometer was performed prior to and at the completion of each data collection flight by using hand samples of uranium, thorium and potassium equivalents with the equipment set at a one second interval. A background check was made prior to each data collection sortie by flying a test line at a barometric altitude of 850 metres over an area of low radioactivity. In addition a calibration test line was flown before and after each data collection sortie to check the repeatability of the total radiation counts.

Compilation of the data was performed by Geometrics at its Sunnyvale facility, California. Field tapes were edited and the total magnetic field corrected for the observed diurnal variations; the gamma ray data were corrected for altitude, background and Compton Scatter, and location data was derived from the digitized flight path recovery. Profile and tie lines were adjusted to minimize intersectional errors, the data interpolated to a grid and machine plotted.

The survey data was presented as:

(i) a photo mosaic base map showing flight path and identified fiducals (1:25,000 scale)

(ii) analog profiles.

(iii) computer generated mini plots showing profiles of potassium 40, uranium, thorium, total count, uranium/thorium ratio and magnetics.

(iv) computer generated map at 1:25,000 scale showing contours of residual magnetic intensity (I.G.R.F. removed).

(v) a located data tape showing observed data, location co-ordinates for each data sample point together with appropriate header information; format is nine track, 800 B.P.I. N.R.Z.I., with all data recorded as EBCDIC characters. X and Y values are approximations of UTM values expressed in meters using the Australian national spheroid.

All of the above data have been made available to geophysicists of the Bureau of Mineral Resources who are involved in a study of the relationship between the radio element concentration of bedrock and surface material in the Rum Jungle area. The high quality survey data will provide a valuable guide to the distribution of radio elements at the surface and will assist the B.M.R. in planning a programme of auger drilling.

The digital data tape is currently being processed to produce a map showing total count radiometric contours. Development of a computer programme to produce stereo-pair contour maps of the data is well advanced; interpretation of the data could be greatly enhanced with the aid of visual stereo techniques.

2. Geophysical Interpretation

A detailed interpretation of the airborne spectrometric and magnetic data was undertaken on behalf of Marathon by Hunting Geology and Geophysics (Australia) Pty. Limited.

The main conclusions resulting from the interpretation are set out below:

1. The survey area is marked by high to very high count-rates in the three narrow spectrometer channels. Zonation of this activity has enabled the definition of three geological units as being highly radioactive: the Waterhouse Complex (R1), the Burrell Creek Formation (R2), and part of the Crater Formation (R3).
2. A total of twelve anomalous uranium channel zones have been interpreted, one within the Waterhouse Complex, one in the Crater Formation, two in the Coomalie Dolomite, four in the Golden Dyke Formation and four in the Burrell Creek Formation. These zones are variously associated with the boundaries of the above units, with amphibolites and banded ironstones, and with laterite cover. Of the twelve zones, four have been assigned highest priority, five moderate priority and three lowest priority.
3. The possible effects of cultural interference in the form of mine tailings, roads, rock crushing plants, drill sites, the railway and housing have been noted where appropriate and require testing during ground checking of anomalies.
4. Major structural directions, predominantly north-west and north-east have been interpreted from magnetic data over the area. The data reflects the occurrence of narrow magnetic horizons around the Waterhouse Complex, and sedimentary ironstones or amphibolites within the Proterozoic sequence.

Recommendations were:

1. Routine geophysical ground follow-up of the interpreted radiometric anomalies including magnetic surveying, particularly in the vicinity of sedimentary ironstones and amphibolites, and hand-held spectrometer surveying. In areas of very high radiometric backgrounds a discriminating spectrometer and long sampling intervals are called for.

2. In view of the probable correlation of uranium mineralization with structural features, a photogeological study of the survey area may provide valuable information.

A copy of the report is attached. (Appendix 1)

3. Photogeological Interpretation

Following the recommendation of the geophysical interpretation, and initial field reconnaissance which confirmed the strong correlation of uranium mineralization with structural features, a photogeological interpretation was commissioned. The interpretation was carried out during June 1979, by Hunting Geology and Geophysics, using National Mapping 1:25,000 scale colour air photographs. The objectives of the study were to define as much structure as possible, and to determine any new information on stratigraphy and relationships that was easily obtainable. The 1:100,000 scale B.M.R. 'Geology of Rum Jungle' sheet was used as a starting point for the study.

The following controls of uranium mineralization in the Rum Jungle area became evident during this brief study.

(i) Uranium mineralization is associated with sediments of the Masson Formation (formerly Golden Dyke Fm) and Hematite Quartz Breccia (H.Q.B) as well as accompanying schists; examples are the Dysons, Whites and Rum Jungle Creek South deposits.

(ii) The uranium deposits are situated within N.E. - trending fracture/fault zones; examples are Dysons, Whites and Rum Jungle Creek South.

(iii) Uranium association with N.N.W. - faulting (Dysons and Whites) and N.W. trending faults as seen at Rum Jungle Creek South.

(iv) The Rum Jungle Creek South deposit is associated with semi-circular and radial fracture patterns.

As well as providing considerably more structural detail, the study of the fracture zones of special interest, and in a number of small but significant changes to the distribution of some stratigraphic units.

The results of the study are subject, of course, to appropriate field checking. A copy of the Photogeological Worksheet and the Structural and Stratigraphic Interpretation sheet are attached. (Appendix 2)

4. Field Programme

Following a thorough review and evaluation of previous work (open-file company reports and B.M.R. reports etc.) the field programme commenced in early June, 1979. The work is being carried out by two geologists under the supervision of a senior project geologist.

The programme began with a brief orientation examination of the regional geology and visits to the Rum Jungle, South Alligator Valley and Alligator Rivers areas (as a participant of the I.U.S. on the Pine Creek Geosyncline Field excursion). Work to the end of July has concentrated on orientation radiometric and radon detection surveys over known uranium mineralization; follow-up investigation of airborne radiometric anomalies; reconnaissance scintillometer radon detection surveys, rock and soil geochemical sampling, and grid surveying. (Appendix 3)

Equipment employed in the work comprises a Geometrics portable gamma ray scintillometer Model G.R.-101 which utilizes a 3.8 x 3.8 cm crystal detector, and a Geometrics portable gamma ray spectrometer Model G.R.-310 utilizing a 103 cm^3 crystal detector, with internal calibration and variable counting time up to 1000 seconds. In addition some preliminary test work has been carried out using an E.D.A. portable radon detector, Model R.D.-200; the detector is used to determine radon and thoron in soil gas based on the measurement of alpha particle emissions from the decay of isotopic radon in its gas phase. A needle bar is driven 30 cm. into the ground and then withdrawn slowly. Immediately the probe is inserted and soil gas is pumped manually into the counting cell. The sequential one minute counts are initiated and recorded, then can later be reduced to determine the Radon-222 and the Thoron present at the sample site.

Results to Date

Reconnaissance radon gas and spectrometer readings have been taken on nearly all access roads and tracks in the Project area, on 250 m. or 500 m. spacing. Results are tabulated in Table 1 and are plotted as a frequency - histogram in Figs. 2 and 3. Rock samples with 4-channel spectrometer readings have been taken from within airborne radiometric anomalies and zones of higher radiation levels found on the ground. Results are tabulated in Table 2. The G.R.101 scintillometer is being carried on all grid survey lines, and anomalies located are being checked by spectrometer.

Orientation radon gas and spectrometer surveys were carried out over the Rum Jungle Creek South and Waterhouse No. 2 Prospect areas. Results are presented in Figs. 4 and 5. The Rum Jungle Creek South mineralization has an associated radon anomaly over 1 km wide, and at Waterhouse No. 2, the anomaly is about 350 metres wide.

Anomaly follow-up investigations to the end of July have only been partially completed, but results have been encouraging. A strong, localized surface anomaly up to 10 times background has been located in sandstone (Depot Creek?) near the probable contact between Coomalie Dolomite and Masson Fm, near the western margin of E.L. 1219. Significantly, the anomaly is located within a north-east trending fracture zone (photointerpretation - zone M1).

In the east of E.L.1219, ground radiometrics have confirmed an airborne anomaly in rocks of the Burrel Creek Formation (Sample locations R.J.R.1 - 7, Table 2); total counts range up to 75 c.p.s., with a high uranium component.

North of Eva Valley homestead on E.L. 1181, a series of high radon values in soil gas (G.72, 73, 74, 103, Table 1) were found near the contact between Crater Formation and Coomalie Dolomite. East of this contact, near the Coomalie - Masson Fm. contact, possible Depot Creek sandstone remnants have been located; at least one radon anomaly (G.39) is located nearby, but no significant radiometric gamma ray activity has been noted. This area has been assigned a high priority in the continuing exploration programme.

Radiometric anomalies in the northern part of E.L. 1181 appear to be associated with heavy lateritic cover, but the association with the Coomalie Dolomite - Masson Fm. contact and a north east trending fracture zone (photointerpretation - Zone M.2) indicate the area to be worthy of detailed investigation.

Several strong radon anomalies have been located over rocks of the Waterhouse Complex in the southern portion of E.L. 1700, near an area of radiometric anomalies. Radon values up to 8 times background occur at locations G.63-68 (Table 1). The anomalies are possibly associated with thorium, but further detailed investigations are needed to adequately explain the anomalies.

In E.L. 1701, an airborne radiometric anomaly has been confirmed by ground radiometrics (locations R.J.R. 8, 9, 10, Table 2); total counts up to 85 c.p.s. have been recorded, but appear to have a large thorium content. High radon has been found in soil gas samples at locations G.79 and G.81 (Table 1). Detailed investigations in this area are continuing.

5. WORK IN PROGRESS

Much of the Project area has extensive soil cover which renders surface radiometric techniques ineffective. In view of the encouraging results achieved with the E.D.A. radon detector in both orientation surveys over known mineralization and in reconnaissance surveys within the Project area, a Track Etch radon detection survey has been commenced.

The Track Etch technique detects radon gas using dielectric detectors which record alpha particle emission from the gas. The detectors are placed in inverted cups which are buried in shallow holes on a grid over the area to be explored. The cups are left in the ground for a period of three to four weeks. This period of time is necessary to integrate the signal and eliminate the large fluctuations in radon signal strength which occur with time. Integrated radon values, corrected to a standard exposure time of 30 days, are conveniently expressed as a number of alpha tracks per square millimeter, T, of the solid state detector. In areas of appreciable thorium concentration, such as the Crater Formation and Waterhouse Complex, thoron (radon-220) may cause severe interference in detecting the radon-222 that may be coming from deeper uranium mineralization. In such areas, special Track Etch thoron filters are used; they comprise plastic membranes which act as diffusion barriers, and prevent the passage of the short lived thoron, but still allow the passage of longer lived radon-222 into the cup essentially undiminished.

Based on the E.D.A. radon detector orientation surveys it was considered that a survey grid of 250 metre sample spacing in east west lines 500 metres apart would be appropriate. During July, the survey grid lines were established over the whole of E.L. Nos. 1181 and 1700, and the Track Etch cups (with Thoron filters) are scheduled to be in place by mid August. The cups will be retrieved around mid September and air freighted to Terradex Corporation in California for processing and interpretation of the data; - results should be available during the first week in October.

Gridding and emplacement of the Track Etch cups on the same grid spacing is scheduled for the western third of E.L. 1219 and for a 2 kilometre wide strip down the eastern margin of E.L. 1219 and 1701; it is hoped to have these results by mid October.

In addition to emplacing the Track Etch cups at each locality, surface radiometric activity is being recorded by a gamma ray spectrometer, and soil geochemical samples are being taken which will be analysed for uranium, thorium and base metals.

Details of the Track Etch programme are shown in Fig. 6.

Detailed Track Etch surveys on closely spaced grids may be carried out over anomalous areas defined by the initial survey if required later in 1979.

6. WORK PLANNED FOR THE BALANCE OF 1979.

(i) Geophysics

In the search for uranium mineralization in the Rum Jungle area the association with the contact between the Coomalie Dolomite and shaly rocks of the Masson Fm. appears to be of prime importance (Needham et.al. 1979). The Bureau of Mineral Resources has carried out a number of widely spaced resistivity surveys and stratigraphic drilling along profiles within the Project area. These surveys were able to delineate and investigate the nature of the contact; the interim results have been made available to Marathon, and will significantly increase the effectiveness of new geophysics in the area.

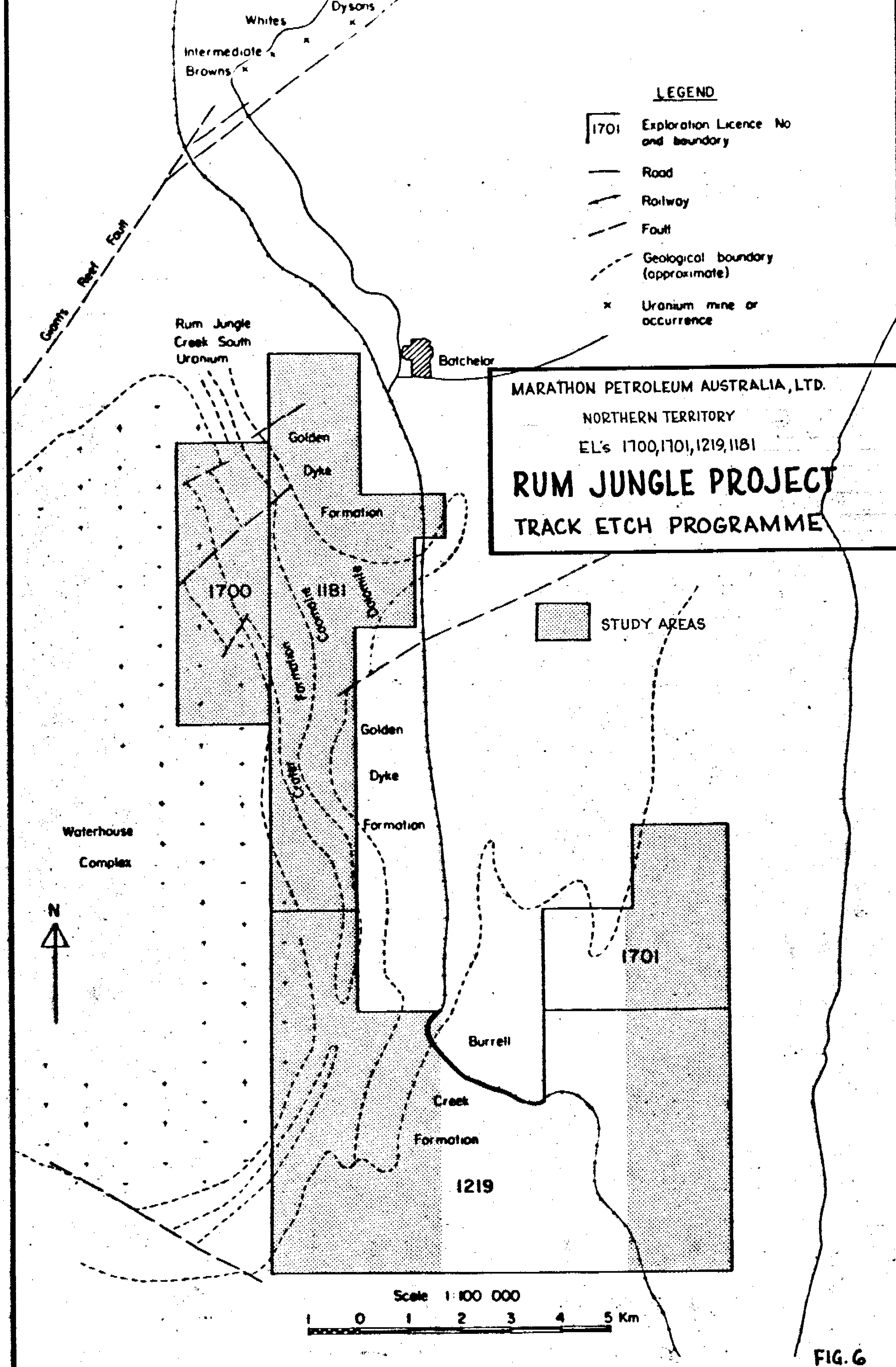
A detailed E.M. Resistivity survey by Murdoch Geophysics Australia Pty. Ltd. has been commissioned by Marathon. It is scheduled for commencement on September 3, 1979, and is aimed at more accurately delineating the contact between the Coomalie Dolomite and the Masson Fm. over the entire length of E.L. Nos. 1181 and 1219, a distance of more than 17 km. The B.M.R. resistivity profiles and stratigraphic drill hole information will be used in planning, calibration and evaluation of the new E.M. Resistivity survey. The work will be carried out using a new system, the first of its type in Australia, which reads conductivity (and hence resistivity) direct. The survey will comprise initially, east-west traverse lines (utilizing existing Track Etch grid lines) perpendicular to the strike of the rocks, on lines one kilometre apart using conventional resistivity; if comparable results can be obtained on those lines with the E.M. Resistivity Unit, in-fill work between those lines will be carried out using the E.M. Resistivity. The anticipated progress of the survey is of the order of 2 - 2½ line kilometres per day using resistivity, and probably in the order of 5 - 8 kilometres per day using E.M. Resistivity. The survey is scheduled for completion by mid-September.

(ii) Drilling

A 1500 - 2000 metre percussion drilling programme is scheduled for commencement in mid-October, 1979. A number of drilling companies have submitted quotes, and the contract is expected to be let by late August. The drilling, aimed at testing one or a combination of, airborne and ground radiometric anomalies, radon (Track Etch) anomalies, and geological targets, will comprise approximately 25 holes to a minimum depth of 50 metres, but with the capability of drilling to 120 metres if warranted. The holes will be wireline logged, and geochemically sampled. Cost of the drilling is anticipated to be approximately $30,000.

(iii) Reconnaissance

A continuing programme of geological reconnaissance mapping, ground radiometrics, and soil and rock sampling is planned in conjunction with the Track Etch, Resistivity and Drilling programmes. This work is scheduled to continue until the onset of the wet season, when detailed evaluation of the 1979 results and planning for the 1980 exploration programme will be commenced.

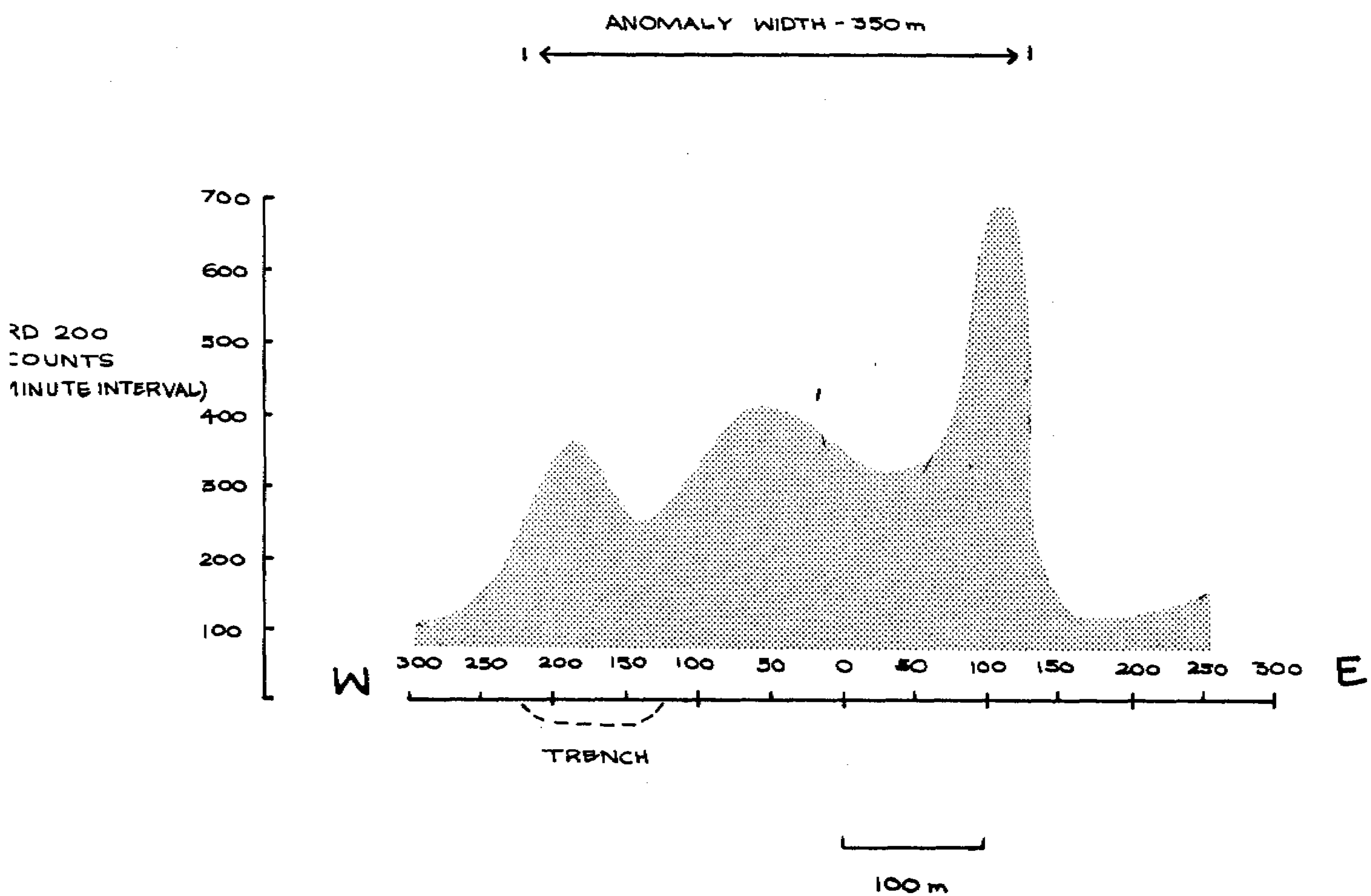


Dysons
Whites
Intermediate
Browns
LEGEND
1701 Exploration Licence No and boundary
Road
Railway
Fault
Geological boundary (approximate)
Uranium mine or occurrence
Giants Reef Fault
Rum Jungle Creek South Uranium
Batchelor
MARATHON PETROLEUM AUSTRALIA, LTD.
NORTHERN TERRITORY
EL's 1700,1701,1219,1181
RUM JUNGLE PROJECT
TRACK ETCH PROGRAMME
STUDY AREAS
Golden Dyke Formation
1700
1181
Coomalie Dolomite
Formation
Crater
Golden Dyke Formation
Waterhouse Complex
N
1701
Burrell Creek Formation
1219
Scale 1:100 000
1 0 1 2 3 4 5 Km

FIG. 6

RADON ANOMALY OVER WATERHOUSE #2 PROSPECT

Fig. 5



RADON ANOMALY OVER RUM JUNGLE CREEK SOUTH MINE

Fig. 4

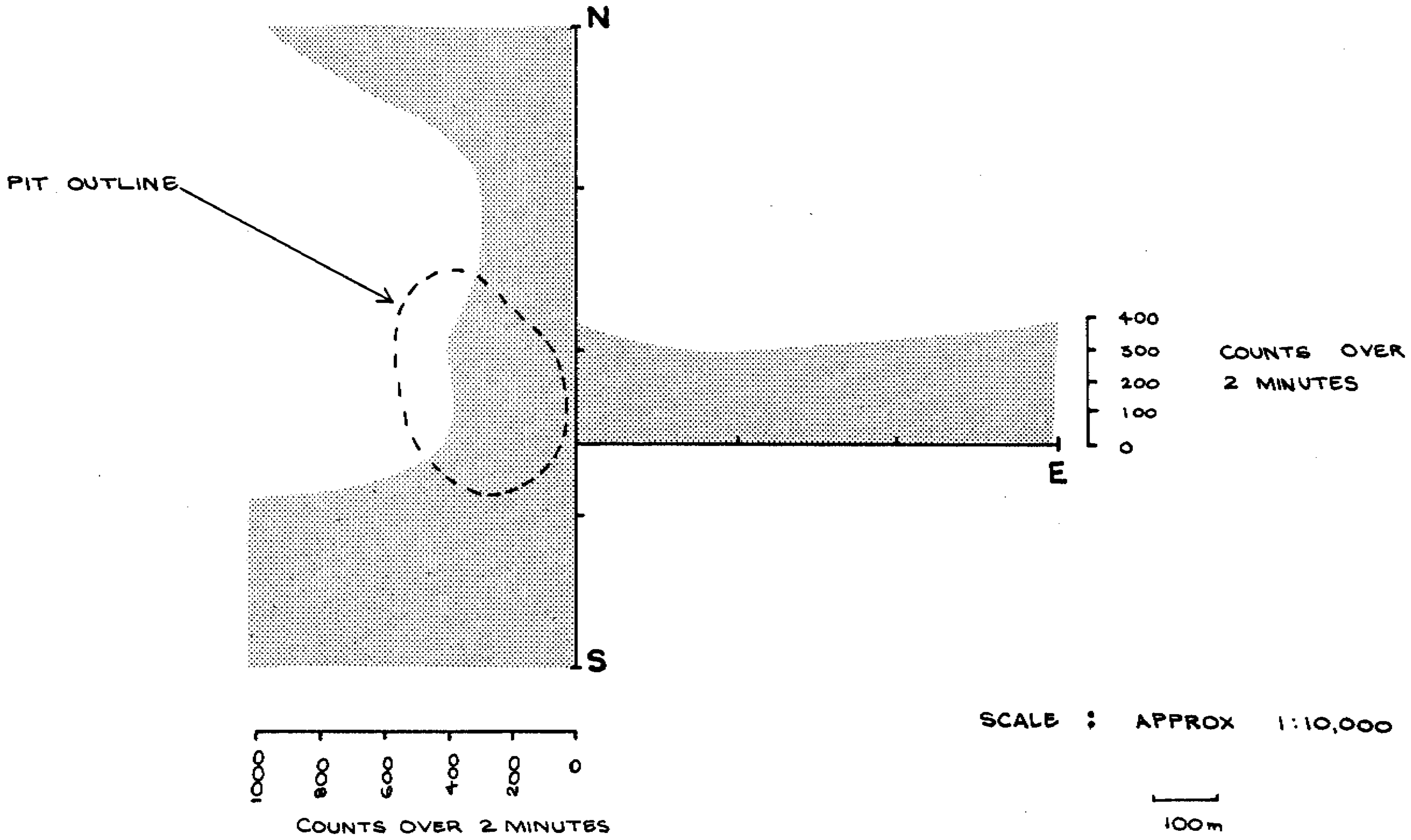


Fig. 3

RUM JUNGLE PROJECT

EL Nos 1181, 1700, 1701

DISTRIBUTION OF RADON COUNTS
USING AN RD200 RADON DETECTOR

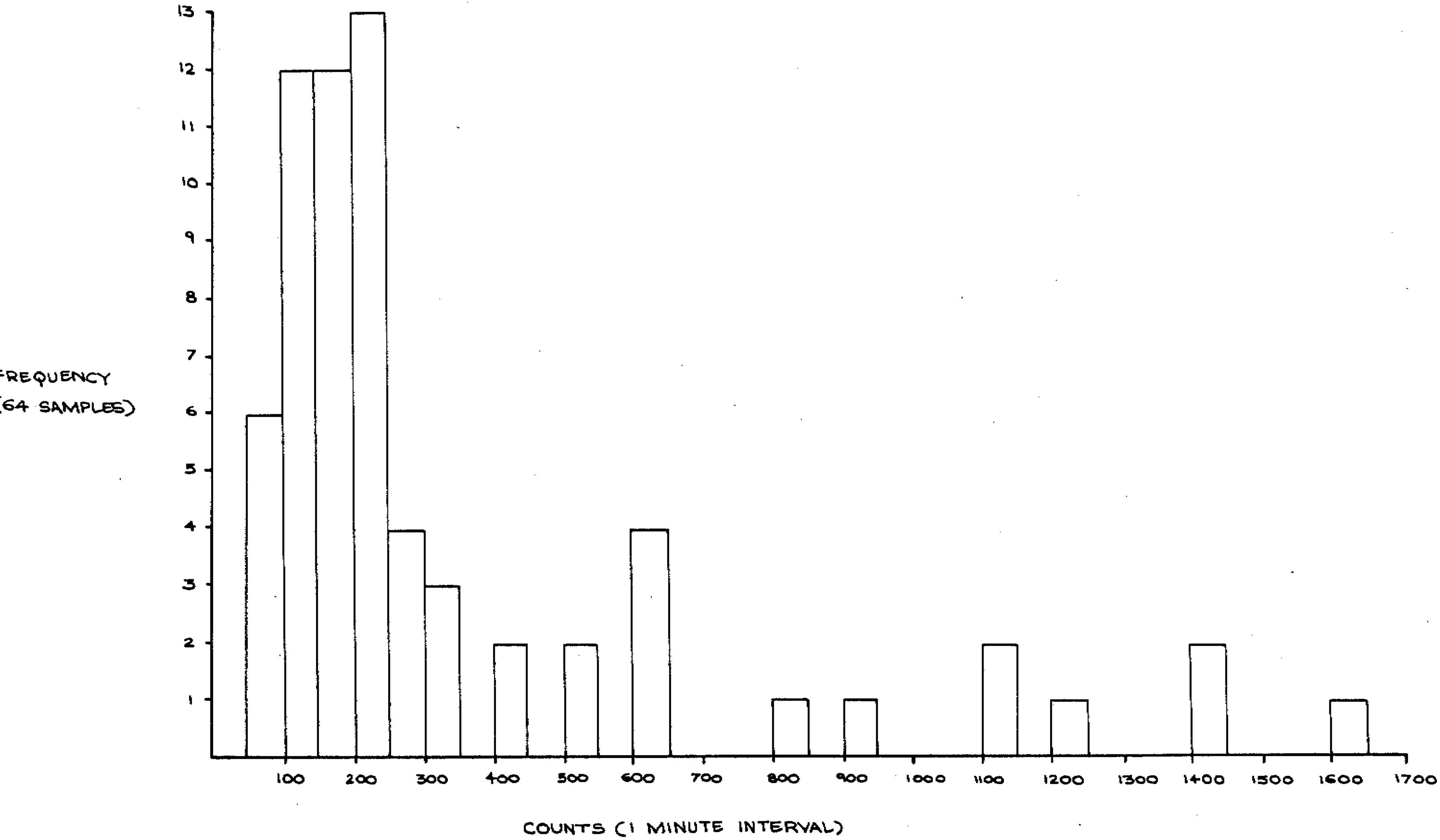


Fig. 2

RUM JUNGLE PROJECT

EL Nos 1181, 1700, 1701

DISTRIBUTION OF RADON COUNTS
USING AN RD200 RADON DETECTOR

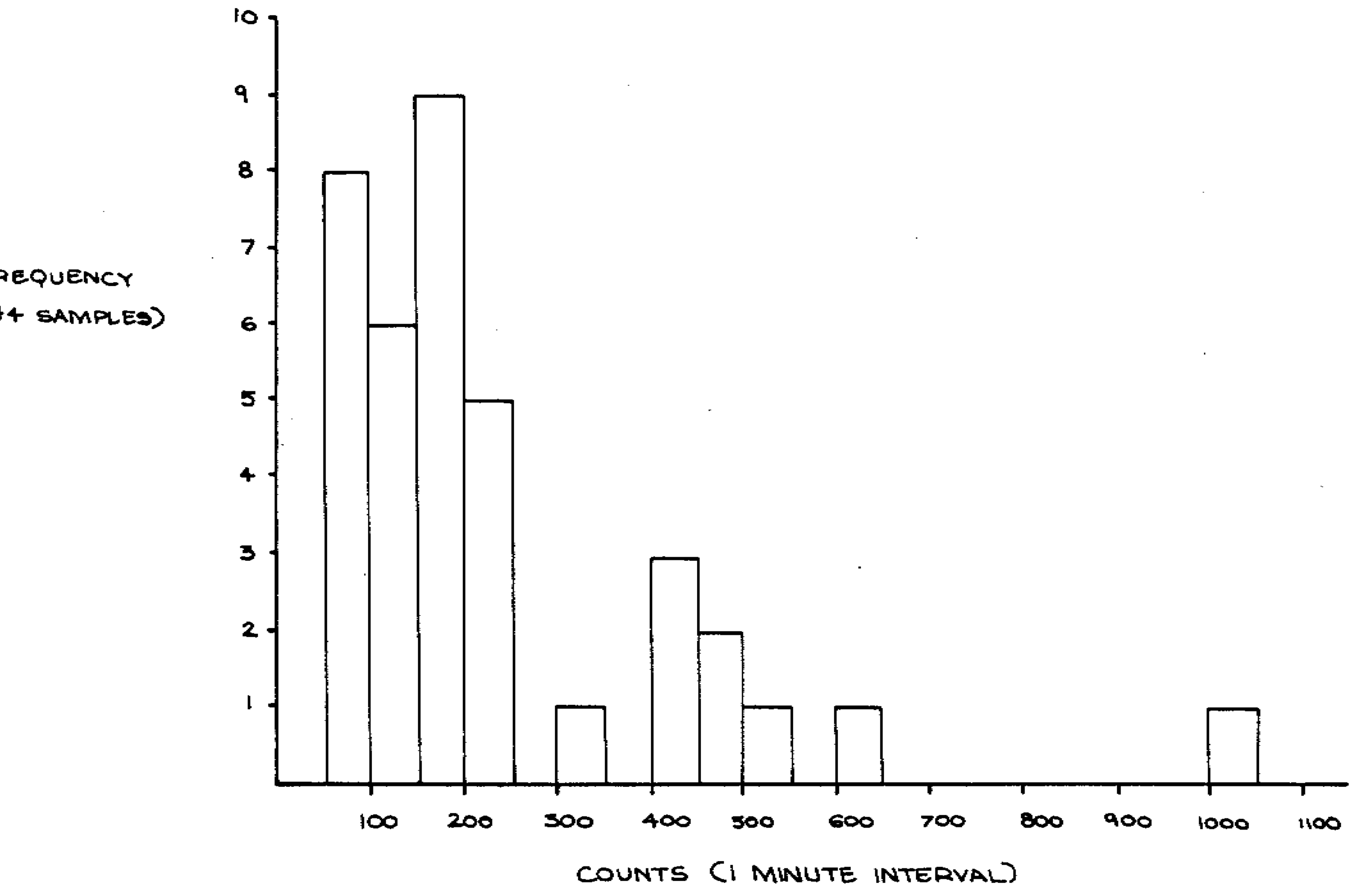


Table 1.

RADON IN SOIL GAS SAMPLE RESULTS

Sample No.	Radon Count RD200 (Background removed)	U p.p.m.	Th p.p.m.
		Calculated from GR-310 Spectrometer	
G1	1000/1 minute	34.0	11.6
G2	400	44.7	14.4
G3	600	19.1	22.3
G4	500	7.8	14.1
G5	300	27.1	23.3
G6	500	24.9	13.4
G7	100	23.0	6.0
G8	250	7.8	14.0
G9	300	3.0	4.6
G10	500	21.9	24.3
G11	600	18.7	17.2
G12	50		
G13	200	2.4	12.5
G14	150	3.5	9.7
G15	200	N.D. *	10.5
G16	400	0.5	20.7
G17	120	3.0	4.6
G18	160	N.D.	18.6
G19	140	4.8	9.5
G20	80	12.6	8.0
G21	80	0.5	20.7
G22	60	2.0	7.4
G23	170	2.2	9.9
G24	200	1.3	15.3
G25	90	15.2	8.0
G26	140	0.9	10.2
G27	80	3.5	9.7
G28	300	8.0	16.6
G29	200	4.1	1.8
G30	480	N.D.	26.8
G31	180	3.5	9.7
G32	60	5.6	4.1
G33	200	0.8	10.2
G34	400	9.1	13.8
G35	100	6.7	16.9
G36	70	0.2	18.1
G37	100	5.6	4.1
G38	150	1.3	15.3
G39	450	3.5	9.7
G40	50	1.1	12.8
G41	180	11.2	N.D.
G42	150	11.3	8.2

Sample No.	Radon Count RD200 (Background removed)	U p.p.m. Calculated from GR-310 Spectrometer	Th p.p.m.
G43	150/1 minute	9.1	13.8
G44	180	5.9	6.7
G45	470 /2 minutes	4.6	6.9
G46	400	1.1	12.8
G47	150	4.8	9.5
G48	160	N.D.	21.4
G49	200		
G50	600	4.4	19.9
G51	450	N.D.	10.5
G52	100	2.2	10.0
G53	160	2.0	23.0
G54	100	7.2	6.4
G55	200	5.6	4.1
G56	500	8.7	8.7
G57	120	N.D.	18.2
G58	250	0.7	2.2
G59	600	14.4	10.5
G60	200	5.9	6.7
G61	120	6.3	11.8
G62	220	N.D.	15.6
G63	1400	0.7	38.8
G64	1400	0.7	38.8
G65	1600	19.4	32.7
G66	230	N.D.	15.6
G67	460	5.7	19.7
G68	700	6.5	14.3
G69	70	6.5	14.3
G70	690	5.0	12.0
G71	330	N.D.	13.3
G72	1100	9.8	22.0
G73	1200	N.D.	37.0
G74	670	5.6	4.1
G75	850	6.5	14.3
G76	220	4.6	13.6
G77	200	2.2	10.0
G78	60	6.8	9.7
G79	600	6.0	11.8
G80	200	4.2	8.2
G81	400	2.8	17.6
G82	80	2.8	2.0
G83	280	11.8	10.8
G84	200	10.0	5.4

Sample No.	Radon Count RD200 (Background removed)	U p.p.m. Calculated from GR-310 Spectrometer	Th p.p.m. Calculated from GR-310 Spectrometer
G86	190	8.5	6.1
G87	160	14.0	16.9
G88	180	15.5	11.3
G89	270	11.0	16.6
G90	195	10.9	22.0
G91	160	8.0	8.0
G92	130	2.2	10.0
G93	310	8.5	6.2
G94	120	11.8	16.4
G95	120	7.1	18.9
G96	60	11.8	13.8
G97	130	2.5	18.4
G98	120	2.9	11.2
G99	135	3.6	17.2
G100	90	4.2	3.9
G101	350	8.0	9.1
G102	240	1.8	11.6
G103	1130	4.4	9.3
G104	180	3.8	7.0
G105	100	5.4	6.0
G106	240	5.3	9.4
G107	160	5.5	14.8
G108	90	3.4	13.4

Table 2

RADIOMETRIC ANOMALY FOLLOW-UP

Sample No.	Location (Run No., Photo No.)	Rock Description	Stratigraphic Position	Data derived from GR-310 Portable Gamma Ray Spectrometer						
				Total Counts c.p.s.	K c.p.s.	U c.p.s.	Th c.p.s.	K%	U p.p.m.	Th p.p.m.
RJR 1	Batchelor (6, 1443)	Quartz vein Fe oxides	Burrell Creek	75	3.9	1.4	0.3	2.0	14.9	4.9
RJR 2	Batchelor (6, 1443)	Greywacke Micaceous Weathered Fe oxides, clays	Burrell Creek							
RJR 3	Batchelor (6, 1443)	Greywacke slightly weathered	Burrell Creek	67	3.7	1.0	1.0	2.2	2.2	25.5
RJR 4	Batchelor (6, 1443)	Greywacke Micaceous weathered	Burrell Creek	44	2.4	0.2	0.2	2.0	0.4	5.1
RJR 5	Batchelor (6, 1443)	Greywacke Weathered Clay rich matrix.	Burrell Creek	37	2.4	1.1	0.6	0.9	7.8	14.1
RJR 6	Batchelor (6, 1443)	Greywacke Weathered Clay rich matrix.	Burrell Creek	57	3.7	1.3	0.3	1.9	13.7	5.2
RJR 7	Batchelor (5,1339)	Greywacke coarse grained	Burrell Creek	30		0.8				
RJR 8	Batchelor (5,1339)	Siltstone Hematitic Fine Grained	Burrell Creek	63.7	5.2	1.1	0.7	3.6	6.7	16.9
RJR 9	Batchelor (Run 5, 1339)	Siltstone Hematitic well bedded	Burrell Creek	84.3	6.5	1.4	0.8	4.4	9.6	18.9
RJR 10	Batchelor (5, 1339)	Siltstone Hematitic	Burrell Creek	70.8	4.3	1.6	1.1	2.0	8.9	26.8
RJR 11	Batchelor (5, 1339)	Greywacke Micaceous	Burrell Creek	60.1	3.6	1.2	0.4	1.9	11.3	8.2

Sample No.	Location (Run No., Photo No.)	Rock Description	Stratigraphic Position	Data derived from GR-310 Portable Gamma Ray Spectrometer Total Counts c.p.s.	K c.p.s.	U c.p.s.	Th c.p.s.	K%	U p.p.m.	Th p.p.m.
RJR 12	Batchelor (5, 1339)	Greywacke Micaceous	Burrell Creek	53.4	3.0	0.9	0.7	1.7	4.1	17.4
RJR 13	Batchelor (5, 1339)	Greywacke	Burrell Creek	54.3	3.0	0.9	0.7	1.7	4.1	17.4
RJR 14	Waterhouse No. 2 Prospect	Mudstone Grey Fe Oxides	Masson f.m.	595.9	34.7	21.2	2.0	6.3	254.0	3.2
RJR 15	Waterhouse No. 2 Prospect	Mudstone, Shale Carbonaceous	Masson f.m.	1023.4	54.3	39.3	2.7	2.1	481.8	
RJR 16	Batchelor (4, 1192)	Gossan	Grater ?	89.6	2.8	2.6	3.0		1.4	77.5
RJR 17	Batchelor (3, 1296)	Gossan		37.4	1.3	1.3	0.4		12.6	8.0
RJR 18	Batchelor (3, 1296)	Gossan	Coomalie Dolomite ?	21.4	1.6	0.7	0.6	0.6	2.6	15.1
RJR 19	Batchelor (3, 1296)	Gossan Brecciated Fe oxides	Coomalie Dolomite	24.9	1.5	0.6	0.3		4.6	6.9
RJR 20	Batchelor (3, 1296)	Quartz vein in conglomerate bed.	Grater f.m.	310.0	8.4	8.2	9.2		7.3	237.2
RJR 21	Batchelor (3, 1296)	Conglomerate	Crater f.m.	208.1	6.0	4.7 5.23	7.0 6.11		2.5 2.1	184.3 158.0
RJR 22	Batchelor (3, 1296)	Banded Fe/qtz.	Crater f.m.	24.2	0.9	0.4	0.7			18.6
RJR 23	Batchelor (3, 1296)	Quartz vein	Crater f.m.	39.3	1.4	0.6	1.0			26.5
RJR 24	Batchelor (3, 1296)	Magnetite rich Banded iron	Crater f.m.	25.4	1.4	0.4	0.4		0.9	10.2
RJR 25	Batchelor (4, 1192)	Quartz vein		18.3	0.3	0.3	0.1		2.8	2.1

Sample No.	Location (Run No., Photo No.)	Rock Description	Stratigraphic Position	Data derived from GR-310 Portable Gamma Ray Spectrometer Total Counts c.p.s.	K c.p.s.	U c.p.s.	Th c.p.s.	K%	U p.p.m.	Th p.p.m.
RJR 26		Quartz vein								
RJR 27	Batchelor (5, 1336)	Sandstone Slightly feldspathic	Depot Creek	16.5	0.6	0.4	0.1		4.1	1.8
RJR 28	Batchelor (5, 1336)	Hematitic Quartz Breccia	Weathered L. Prot.	20.7	1.3	0.4	0.1		4.1	1.8
RJR 29	Batchelor (5, 1336)	Hematitic Quartz Breccia	Weathered Lower Prot.	17.5	0.8	0.3	0.1		2.8	2.1
RJR 30	Batchelor (5, 1336)	Hematitic Quartz Breccia	Weathered Lower Prot.	20.9	0.5	0.3			3.9	
RJR 31	Batchelor (5, 1336)	Hematitic Quartz Breccia	Weathered Lower Prot.	12.6	0.3	0.2	0.1		3.3	2.3
RJR 32	Gold Prospect (5, 1337)	Shale Carbonaceous	Burrell Creek							
RJR 33	Batchelor (3, 1296)	Quartzite Tourmaline veins	Crater	16.8	0.7	0.4 0.41	0.4 0.17		0.8 3.5	10.2 3.7
RJR 34	Batchelor (5, 1339)	Greywacke Micaceous	Burrell Creek	44.6	2.2	0.6 0.85	1.0 0.54		 5.2	26.5 13.0
RJR 35	Burnside	Basic Intrusive	Zamu Complex							
RJR 36	Burnside	Granite	Burnside Granite							
RJR 37	Burnside	Basic Intrusive	Zamu Complex							
RJR 38	Burnside	Shale Fe stain	Masson f.m.							
RJR 39	Batchelor (5, 1336)	Sandstone Hematitic Quartz veins	Depot Creek ?	21.2	0.9	0.6 0.40	0.4 0.36	0.06 0.32		
RJR 40	Batchelor	Quartzite	Beestons	30.2	1.4	0.53	0.26			
RJR 41		Sandstone		30.1	0.6	0.37	0.13			
RJR 42		Sandstone Argular quartz in Fe rich matrix	Depot Creek	33.0	1.1	0.83	0.35			

Appendix 1

INTERPRETATION OF AIRBORNE GEOPHYSICAL DATA

INTERPRETATION OF AIRBORNE SPECTROMETRIC AND MAGNETIC DATA OVER PART OF THE RUM JUNGLE SHEET AREA, NORTHERN TERRITORY

(Exploration Licences 1181, 1219, 1700 and 1701)

Undertaken on behalf of

MARATHON PETROLEUM AUSTRALIA LIMITED

May 1979

Hunting Geology and Geophysics (Australia) Pty. Limited
P.O. Box 25
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Canberra, ACT 2603

GA.20/79

A B S T R A C T

Interpretation of approximately 550 line kilometres of airborne spectrometer and magnetometer data has resulted in twelve anomalous uranium zones being delineated.

These uranium zones are variously located within and on the boundaries of zones of very high thorium and potassium activity, and have been accorded priority ratings depending on relative uranium count rates and uranium to thorium and uranium to potassium ratios.

Northwesterly and northeasterly structural directions are interpreted to predominate in the area, and a number of narrow magnetic horizons are interpreted in the otherwise relatively non-magnetic strata.

The possible effects of mine tailings, road works, rock crushers, drill sites, housing and a railway have been noted and must be borne in mind when evaluating the data.

Parts of the area are known to be partially covered by Tertiary laterites which may contain uneconomic uranium concentrations not differentiable spectrometrically from economic deposits.

C O N T E N T S

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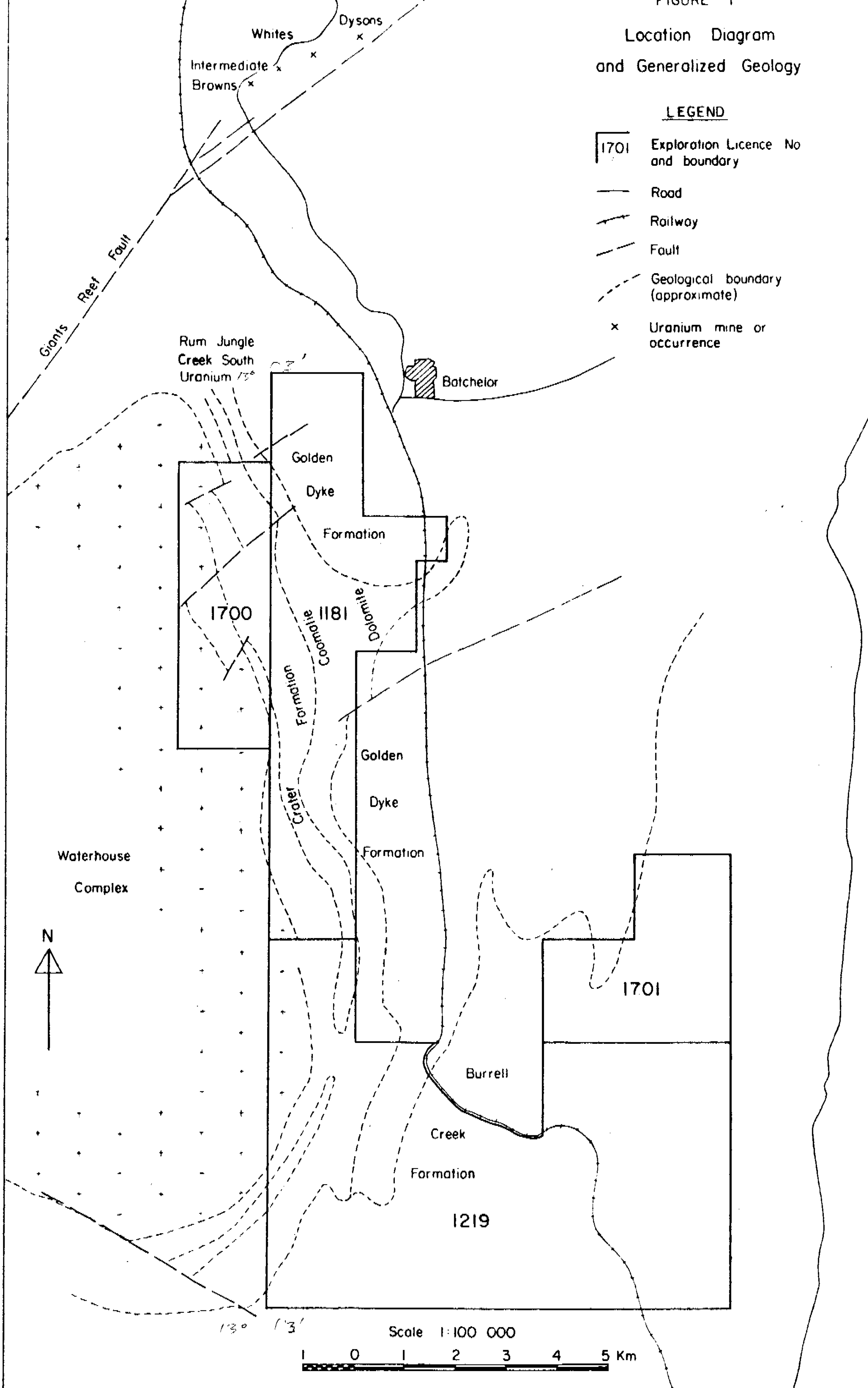
I. INTRODUCTION

This report describes the interpretation of approximately 550 line kilometres of airborne spectrometric and magnetic data over exploration licences 1181, 1219, 1700 and 1701 south of Batchelor in the Northern Territory (Figure 1). The study was undertaken by Hunting Geology and Geophysics (Australia) Pty. Limited on behalf of Marathon Petroleum Australia Limited, in May 1979.

The survey data was acquired and compiled by Geometrics International Corporation, and presented in the form of original Mars-6 six-channel analogue charts, computer-generated seven-channel Mini-Plots and a computer-generated magnetic contour map at approximately 1:25 000 scale. This data was supplemented by regional geophysical data at 1:250 000 scale obtained from the Bureau of Mineral Resources.

The object of the study was to define zones of anomalous radioactivity levels which may be indicative of concentrations of radioactive minerals, in particular uranium.



Hunting Geology and Geophysics (Australia) Pty. Limited. Canberra, May 1979. GA 20/79

II. SURVEY DATA

A. General

The survey area consists of four adjacent exploration licences lying to the south of the Rum Jungle Creek uranium mine and the town of Batchelor in the Northern Territory. It has an irregular shape, being less than 19 kilometres long and between 2 and 8 kilometres wide (Figure 1).

B. Geological Summary

The regional setting for the survey area is the western flank of the Pine Creek Geosyncline which consists of presumed Archaean basement rocks, the Rum Jungle and Waterhouse Granite Complexes, apparently unconformably overlain by a sequence of Lower Proterozoic sediments, generally comprising arkoses, dolomites and shales (Knight, 1975).

Northwesterly and northeasterly structural directions predominate, the best known being the Giants Reef Fault which extends northeast for about 200 kilometres, and bisects the Rum Jungle Complex in the immediate vicinity of the survey area.

A number of significant uranium, lead and copper deposits are known in the Rum Jungle area, most in the so-called embayment of the Rum Jungle Complex (Knight, 1975).

The survey area lies to the south of the Rum Jungle Complex, is bounded to the west by the eastern margin of the Waterhouse Complex and extends across the Proterozoic sedimentary sequence. Sediment strike adjacent to the granite contact is concentric and dips are generally steep; however to the east strikes are aligned roughly north-south. Banded ironstones and amphibolites occur irregularly in the sequence which is occasionally overlain by presumed Adelaidean sandstone and conglomerate and by the remnants of Tertiary laterites.

III. GEOPHYSICAL STUDY

A. Summary of Data

The specification for data acquisition was as follows :

Flight line direction	:	east-west
Flight line spacing	:	200 metres
Flying height	:	80 metres (mean terrain clearance)
Flying speed	:	105 knots
Spectrometer type	:	4-channel differential gamma-ray, recording total count, potassium, uranium and thorium.
Crystal volume	:	2000 cubic inches
Magnetometer	:	proton precession recording total field.

The data available to the interpreter was in the form of Mars-6 six channel analogue records of spectrometer, magnetometer and altimeter data, computer-produced seven-channel "Mini-Plots", showing corrected magnetometer, total count, potassium, uranium and thorium channel spectrometer, uranium to thorium ratio and altimeter data, and a computer produced magnetic contour map at 1:25 000 scale.

These data were supplemented by 1:250 000 scale contour maps of magnetometer and spectrometer data from the Bureau of Mineral Resources' survey of the Pine Creek sheet (flown 1974-75).

B. Discussion of Results

1. Regional Summary

(a) Spectrometric Data:- Rapid evaluation of the spectrometric data in the Pine Creek area reveals that high activity is confined almost exclusively to exposed granite bodies, with the greatest activity occurring in the southeastern corner of the sheet (surrounding and northwest of Pine Creek township). An exception to this is the Rum Jungle Complex to the north, which exhibits equally high count-rates. Those granite complexes to the west of the Giants Reef Fault but including the Waterhouse Complex exhibit only marginally higher than average count-rates.

In addition to the granite complexes, rocks of the Finnis River Group (the Burrell Creek and Noltenius Formations) exhibit count-rates differentiable from background. This is also true at times of the Golden Dyke Formation.

It should be borne in mind that the regional survey employed a 225 cubic inch crystal (compared with 2000 cubic inches on the detailed survey) resulting in lack of definition in areas of Quaternary cover, and that mining operations, particularly for uranium, clearly result in anomalous count-rates in the vicinity of each mine.

(b) Magnetic Data:- Regional trends expressed in the magnetic data vary from north-west to north-northeast and are associated with major faulting or shearing in these directions, accompanied by the occurrence of dyke-like bodies (amphibolites).

Most of the granite complexes are identifiable as zones of low magnetic activity surrounded by high frequency, high amplitude magnetic anomaly zones apparently associated with broad belts of amphibolite. Sedimentary ironstone belts appear as narrow high amplitude anomaly trends.

The Giants Reef Fault does not have strong magnetic relief but its east-northeast trend in the vicinity of the Rum Jungle Complex can be traced in the magnetic data to the southwest, where no fault exists on the geological map.

2. The Survey Data

(a) Spectrometric Data:- The entire survey area is marked by high to very high count-rates in the three narrow spectrometer channels. The distribution of this high count-rate activity is significant and yields considerable information on the distribution of lithological units across the area. For the same reason "background" count-rates against which high count-rates can be compared to determine their relative priority, are difficult to determine. Uranium mineralization is well known in the vicinity of the survey area however, and the importance of this fact is less than would be the case in a virgin exploration area. Approximate background values were determined to be :

	K channel	100 cps
	U channel	30 cps
	T channel	60 cps
yielding	U/T ratio	0.5
	U/K ratio	0.3

These ratios are typical of areas of low relative uranium concentration and imply that the estimated background values are correct.

Subdivision of the spectrometric data into zones of anomalous count-rates has been based on the following threshold values:

Total count channel	3000 cps
K channel	150 cps
U channel	60 cps
T channel	75 cps

An analysis was then made of the potassium (K) and thorium (T) channels in an attempt to differentiate broad spectrometric zones.

The western margin of the survey area has been defined on the basis of the above threshold selection to be a zone of high T count-rates (R1 of Figure 2). The boundary of the zone is arcuate eastwards and correlates closely with the boundary of the Waterhouse Complex. Average count-rates within the zone are presented in Table 1 and indicate the zone to have marginally high K and U count-rates and anomalously high T count-rates. This is reflected in the average U/T ratio. A zonation of the higher K count-rates is observed sub-parallel to the zone boundary, suggesting a zonation in chemical properties of the grante complex.

The southeastern half of the area is marked by a zone (R2 of Figure 2) of very high K count-rates and high to very high U and T count-rates (Table 1). The resultant U/K ratio is observed to be below average while the U/T ratio is about the same as that recorded in areas of "background" activity. Thus despite the relatively high uranium count-rates, the zone as a whole may not contain concentrations of uranium relative to the other radioactive minerals (particularly thorium). The zone correlates broadly with the mapped outcrop of the Burrell Creek Formation, and variations in recorded count-rates across the zone probably reflect slight changes of lithology within the formation.

Between the zones R1 and R2 is an area of low to very high T and U channel count-rates, in the form of narrow trends sub-parallel to the R1 zone boundary. Of these, the zone R3 (Figure 2 and Table 1) is the most prominent. This is a zone of high T and low K count-rates yielding below average U/T ratios but considerably above average U/K ratios. The zone appears to correlate well with the outcrop of a quartz-haematite boulder conglomerate of the Crater Formation. The high U/K ratio reflects a depletion in potassium and not a general concentration of uranium in that unit.

Table 1. Analysis of Potassium and Thorium Channel Zones

Zone	K (cps)	U (cps)	T (cps)	U/K	U/T
R1	150	50	175	0.3	0.3
R2	350	80	150	0.2	0.5
R3	60	50	180	0.8	0.3

The distribution of Quaternary sand cover, drainage patterns and the location of a number of water holes should be noted when viewing the data in detail, as all of these factors combine to increase the uncertainty in interpreting anomalous uranium concentration.

(b) Anomalous Uranium Channel Zones:- Analysis of uranium channel data has resulted in the selection of twelve anomalous zones. The numbering of these zones has been based on their location relative to the zones R1, R2 and R3, and to interpreted magnetic features. As a result most zones comprise a number of parts which are considered to have the same or similar source. The zones are presented on Figure 2 and described in Table 2. Anomaly priorities have been determined from a consideration of the uranium channel count-rates, the U/T ratio and the U/K ratio. If all three factors are "high" then the zone has been assigned the highest priority. In view of the known association of structural features, particularly faulting, with mineralization in the vicinity of the survey area, the interpreted existence of faulting (from magnetic data) near a uranium zone also resulted in increased priority being assigned to the zone.

The possible effects of cultural interference, in the form of mine tailings, roads, old stone crushers, drill sites, the railway line and housing, have been noted but cannot be proved without detailed field checking.

(i) Zone U1:- This is a zone of high to very high uranium count-rates exceeding 400 cps in places, which extends around and to the south-east of the Rum Jungle Creek South Uranium Mine. The location of the zone correlates with the mapped extent of the Coomalie Dolomite and it forms a border around a central zone of low count-rates correlating with the overlying Tower Group Sandstone (Buldiva Sandstone).

The zone is interpreted to comprise four main parts (figure 2 and Table 2) which exhibit variations in character. The area of the Rum Jungle Mine and that in the northeast have associated high K and T count-rates, while retaining high U/T and U/K ratios. This similarity may be significant, however the mine area is considerably disturbed spectrometrically so that the similarity may be artificial. Those parts of the zone to the south have less associated K and T activity.

There is some overlap of U1 onto the mapped outcrop of the Golden Dyke Formation in the south, and the zone is generally

Anomaly No.	"Ave" U cps	"Ave" U/K	"Ave" U/T	Geological Association	Comments on Possible "Cultural" Interference	Priority	General Comments
U1 (around mine) (central & NE) (south-west) (south-east)	400 75 160 235	13.5 1.0 6.4 9.4	9.0 2.0 4.0 6.0	Coomalie Dolomite on boundary of Buldiva Sst and Golden Dyke Formation.	Tailings around mine area and ore spillage along roads (carried into stream beds?)	1	A broad area of high U with associated high K and T extends south of U1 conforming generally with mapped Golden Dyke Formation
U2	65	2.5	2.0	Golden Dyke Formation and amphibolite	Trends apparently across strike. Partially along road south of Batchelor.	2	Trend conforms to proposed fault direction generally in the area.
U3 (north) (central) (south)	55 80 55	1.4 2.3 2.8	1.4 2.0 1.3	Coomalie Dolomite and on boundary with amphibolite and Crater Formation.	Northern part near old stone crusher (?also southern part)	2	
U4 (north) (south) (within R1)	110 120	0.8 1.0	1.0 0.5	Waterhouse Complex	None	2	Southern part coincides with shear zone mapped on 1:100 000 Rum Jungle sheet.
U5	150	3.3	1.8	Golden Dyke Formation + amphibolite overlain by laterite?	None	1	Extent of laterites unknown hence effects inconclusive.
U6	45	?2.3	1.0	Crater Formation	?? House and track nearby	3	Quartz vein mapped.
U7	125	1.3	1.7	Amphibolites, banded ironstone + laterite cover.	Main road and railway south of Batchelor.	2	Best on line 55/0 near Waterhouse No.2 prospect where U=195, U/K = 2.6
U8 (north) (central) (south)	110 85 70	3.3 1.7 1.8	2.2 2.5 2.0	Golden Dyke Formation + "calcareous amphibolite" ?boundary with Coomalie Dolomite.	None. (North disrupted by waterhole)	1	Magnetic body association particularly in north. High uranium in low "windows" in T and K.
U9 (north) (south)	70 75	3.2 3.8	1.7 1.8	Burrell Creek Formation boundary with Buldiva Sandstone.	Road across northern part.	2	
U10 (north) (central) (south) (within R2)	110 115 65	0.6 0.6 0.7	1.2 1.3 1.0	Burrell Creek Formation proposed boundary with Golden Dyke Formation (subsurface)	??Close to main road and railway in places.	3	Partial association with laterite and banded ironstone in north.
U11	100	2.5	2.1	?Burrell Creek Formation.	None	1	Lies outside of Zone R2 . Magnetic association similar to U8
U12 (north) (central (south) (within R2)	105 95 80	0.5 0.4 0.4	1.1 0.8 1.2	Burrell Creek Formation (massive greywacke in south)	None	3	

TABLE 2 : LIST OF URANIUM CHANNEL ANOMALY ZONES

"Ave" = approximate averages derived from mean count-rates surrounded by above average uranium channel count-rates. This surrounding area of high count-rates is associated with increased thorium channel activity and appears to be confined to the Golden Dyke Formation.

The lack of spectrometric response over the Buldiva Sandstone does not preclude the possibility that the zone U1 extends beneath this unit, as the overlying rocks may be acting as a barrier to radiation from beneath.

A large number of boreholes designated "BMR stratigraphic hole" on the 1:100 000 Rum Jungle geology sheet, could provide valuable information regarding the source of anomalous radioactivity in this zone.

(ii) Zone U2:- This is a narrow line of low amplitude uranium peaks trending south-southeast and lying to the south of Batchelor. The anomalies exhibit good character but appear to lie mostly along a road, possibly reducing their significance. The trend also crosses that of the mapped sub-outcrop of the Coomalie Dolomite and Golden Dyke Formation. The anomaly trend is however sub-parallel to that of interpreted faulting in the area although no fault has been interpreted at this location.

(iii) Zone U3:- This zone is interpreted to comprise three areas of moderate uranium activity lying within the mapped sub-outcrop of Coomalie Dolomite south of zone U1. The northern part correlates with the location of an old stone crusher on the Pine Creek 1:250 000 topographic sheet suggesting this as its source. The central and southern parts lie on and adjacent to a road, however the existence of a broad area of above average uranium activity around the main zones suggests that the road is not entirely responsible for the recorded anomalies.

(iv) Zone U4:- This zone comprises three isolalated areas of anomalous uranium count-rates lying within and on the boundary of the main spectrometric zone R1 (the Waterhouse Complex).

Uranium count-rates are very high but are associated with high count-rates in the potassium and thorium channels resulting in only marginally higher than average ratios. Of particular note is the association of the southernmost part of the zone with a mapped shear zone and interpreted fault which may have provided the location for uranium concentration.

(v) Zone U5:- This is a zone of very high uranium activity comparable in intensity to parts of zone U1, but with associated high thorium activity. The ratios U/T and U/K are however sufficiently high to warrant giving this zone a high priority. Factors which may detract from this priority rating are that the zone is broad, suggesting a lithological unit rather than a mineral concentration, and that there is at least a partial association with Cainozoic laterites. The extent of the zone to the east is unknown since it lies along this edge of the survey area. It is correlated with rock mapped as Golden Dyke Formation, and some associated amphibolites.

(vi) Zone U6:- This low priority zone consists of a narrow line of moderate to weak uranium peaks exhibiting high U/K ratios and U/T ratios that are marginally above average. The zone lies within the Crater Formation close to mapped quartz veining. The existence of a nearby track and house is noted but their effect is not known.

(vii) Zone U7:- This is a narrow north-south trending zone of high to very high uranium count-rates interpreted at the northern edge of the southern half of the area. Maximum count-rates are recorded adjacent to the Waterhouse Number 2 prospect where U/K ratios are also higher than average for the zone (Table 2). The zone lies within a broad area of moderately high thorium and potassium activity close to the boundary of zone R2. It is correlated with the mapped subsurface extent of para-amphibolite but extends south of the mapped culmination of this unit. The existence of a waterhole south of the zone disturbs the spectrometric data and may mask a continuation of the zone in this direction. The general area of the zone is marked by the occurrence of laterites which may be responsible for the high uranium activity. A strong magnetic anomaly is associated with the zone, and is interpreted to be due to the "dyke-like" amphibolite body.

(viii) Zone U8:- This zone comprises four separate anomaly groups trending in a southerly direction south of zone U7. The groups are considered together because of their general correlation with calcareous amphibolites within the Golden Dyke Formation. The continuity of the zone may be affected by Quaternary sands and the Buldiva Sandstone overlying the Proterozoic formation. Ratios of U/T and U/K are high and the zone has been given very high priority. The northward extent of the zone is questionable due to the interfering affect of a large waterhole. The northern part of the zone is marked by associated strong magnetic activity similar to that of zone U7, suggesting that this part of the zone U8 may be included with U7.

(ix) Zone U9:- Three anomaly groups are interpreted to comprise this zone in the southwestern corner of the area. The anomaly trends are narrow and are correlated with the mapped sub-surface contact of the Burrell Creek Formation with the overlying Buldiva Sandstone. The southern group, consisting of a line of narrow anomalies, lies within a broad area of generally high uranium count-rates. As with zone U1, the possible masking of radiation from beneath the Buldiva Sandstone should be considered when field checking this zone.

(x) Zone U10:- This zone lies within the spectrometric zone R2 along its western boundary, and comprises six groups of anomalies. Recorded count-rates are high in the three channels resulting in only marginally higher than average U/T and U/K ratios. Correlation in the south is with the Burrell Creek Formation, while to the north there is partial association with mapped Golden Dyke Formation and overlying Cainozoic laterites. The two easternmost expressions of the zone lie on a major interpreted fault and the margin of a massive graywacke unit of the Burrell Creek Formation. The lack of a uranium anomaly over the Waterhouse No.3 prospect suggests that this may be incorrectly positioned on the 1:100 000 Rum Jungle geology sheet.

(xi) Zone U11:- This is a localized zone of high uranium count-rates interpreted outside the western boundary of R2. It correlates with mapped extent of the Burrell Creek Formation, however it exhibits considerable similarity to zone U8, including magnetic association, suggesting that the two zones are related and that the geological mapping may be incorrect at this location. The high uranium count-rates and high U/T and U/K ratios have resulted in the zone being given a high priority.

(xii) Zone U12: Along the eastern margin of the survey area and within the Burrell Creek Formation sedimentary sequence are a number of uranium peaks which stand out above the very high backgrounds. These peaks have been grouped together as zone U12. Ratios of U/K and U/T are only marginally higher than average yielding a low priority for the zone. There is a partial correlation between some parts of the zone and rock outcrop exposed through the Quaternary cover suggesting that this may be partly the source. The northernmost part of the zone correlates with a mapped geological lineament.

Numerous other minor uranium peaks have been located, mainly within areas of high to very high "background" (zones R1 and R2) and these are not numbered as their significance is considered to be low. A re-evaluation of this interpretation may be required if the zones U10 or U12 prove to be due to significant concentrations of uranium.

(c) Magnetic Data:- The magnetic data exhibit a broad gradient increasing from north to south, and on which are superimposed narrow arcuate north-south trending positive anomalies. The western band of moderate strength anomalies trends around the boundary of the Waterhouse

Complex and represents thin magnetic horizons surrounding the complex. These horizons lie between the spectrometric zones R1 and R3 which are both relatively non-magnetic.

A second intermittent group of strong positive anomalies trends sub-parallel to the above magnetic horizons and is particularly strong in the central part of the area. The strongest of these anomalies correlate with mapped sedimentary ironstones in the Golden Dyke Formation. The spectrometric zone R3 is bounded to the west by the magnetic units and is itself relatively non-magnetic. Three anomalous zone (U7, U8 and U9) are associated with this band of magnetic units.

Fault and fracture directions interpreted from the magnetic data are predominantly northwest to north-northwest and northeast to north-northeast. Of these the former is the most pronounced being a direction occurring strongly on a regional scale (for example in the Pine Creek area).

IV. CONCLUSIONS AND RECOMMENDATIONS

1. The survey area is marked by high to very high count-rates in the three narrow spectrometer channels. Zonation of this activity has enabled the definition of three geological units as being highly radioactive: the Waterhouse Complex (R1), the Burrell Creek Formation (R2), and part of the Crater Formation (R3).

2. A total of twelve anomalous uranium channel zones have been interpreted, one within the Waterhouse Complex, one in the Crater Formation, two in the Coomalie Dolomite, four in the Golden Dyke Formation and four in the Burrell Creek Formation. These zones are variously associated with the boundaries of the above units, with amphibolites and banded ironstones, and with laterite cover. Of the twelve zones, gour have been assigned highest priority, five moderate priority and three lowest priority.

3. The possible effects of cultural interference in the form of mine tailings, roads, rock crushing plants, drill sites, the railway and housing have been noted where appropriate and require testing during ground checking of anomalies.

4. Major structural directions, predominantly north-west and north-east have been interpreted from magnetic data over the area. The data reflects the occurrence of narrow magnetic horizons around the Waterhouse Complex, and sedimentary ironstones or amphibolites within the Proterozoic sequence.

5. Routine geophysical ground follow-up methods could include magnetic surveying, particularly in the vicinity of sedimentary ironstones and amphibolites, and hand-held spectrometer surveying. In areas of very high radiometric backgrounds a discriminating spectrometer and long sampling intervals are called for.

6. In view of the probable correlation of uranium mineralisation with structural features, a photogeological study of the survey area may provide valuable information.

REFERENCES

KNIGHT, C.L. (editor), 1975. Economic Geology of Australia and Papua New Guinea, 1, Metals. Aust. I.M.M. Monograph Series No.5, pp 269-284.

Appendix 2.

PHOTOGEOLOGICAL INTERPRETATION

Appendix 3.

FIELD PROGRAMME/SAMPLE LOCATIONS


CR79/117
Figure 1.
RUM JUNGLE PROJECT
PHOTO INTERPRETATION OF THE STRUCTURAL GEOLOGY
(Worksheet only)
Scale 1:25,000
1 0 1 2 3 Km
Puo Depot Creek Formation
Plb Burrell Creek Formation
Pda Amphibolite
Pld Goodparla Sediments
Plo Coomalie Dolomite Formation
Ple Crater Formation Sandstone and Celia Dolomite underlain by Beestons Formation quartzite
A Archaean granite and gneiss
Bedding
Formational contacts
Fractures, joints
Faults - proven and probable
Strike and dip 15°-30°
Strike and dip 30°-45°
Strike and dip 45°-60°
FOG BAY SD 52-3
DARWIN SD 52-4
CAPE SCOTT SD 52-7
PINE CREEK SD 52-8
1:250 000 sheet areas
APPROXIMATE STUDY AREA
Rum Jungle
RUM JUNGLE CREEK SOUTH
BATCHELOR
Eva Valley
Stapleton
Sargents
Smoky Creek
Stapleton Plain
Black Soil
Snake Creek
1700
1181
1701
1219
13°10'
131°00'
Compilation of this map resulted from a stereoscopic investigation of 1:25 000 colour photography. Reference was made to the BMR Geological map of the Batchelor area (Sheet 5171 : Scale 1:100 000)
E.L boundaries 1700, 1701, 1181 and 1219 obtained from 1:25 000 scale Marathon map
Undertaken on behalf of
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FIGURE 2

GEOPHYSICAL INTERPRETATION MAP

RUM JUNGLE AREA URANIUM PROJECT

E. L. 1181, 1219, 1700 and 1701

SCALE 1:25 000 (approx)

0 0.5 1 2 3 4 5 Km

LEGEND

SPECTROMETRIC DATA

- R3 — Major spectrometric zone
- Zone of strongest (K and T channel) response
- Zone of high (K and T channel) response
- Anomalous uranium channel response
- High uranium channel response
- Local uranium channel increase

MAGNETIC DATA

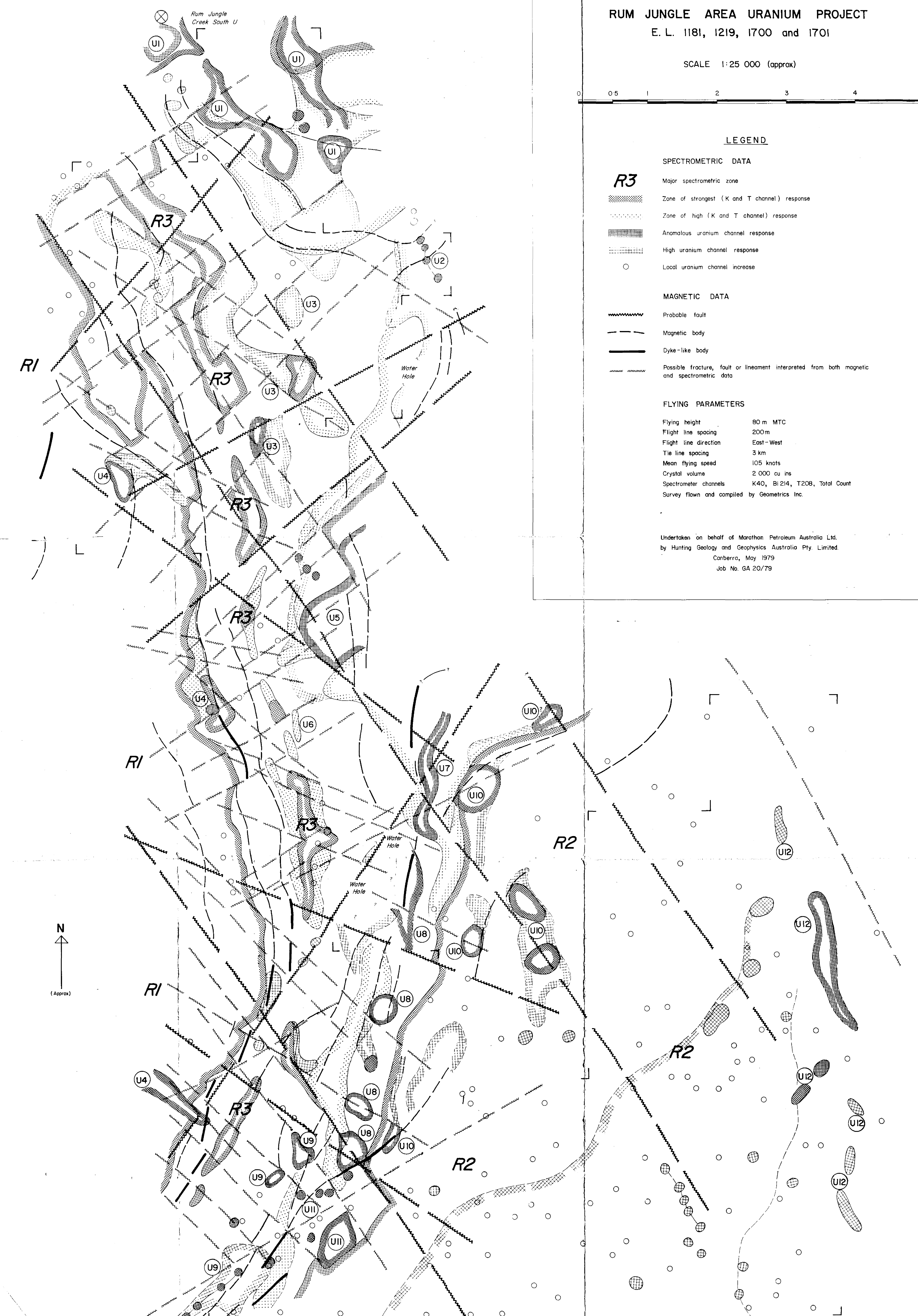
- Probable fault
- Magnetic body
- Dyke-like body
- Possible fracture, fault or lineament interpreted from both magnetic and spectrometric data

FLYING PARAMETERS

Flying height	80 m MTC
Flight line spacing	200m
Flight line direction	East-West
Tie line spacing	3 km
Mean flying speed	105 knots
Crystal volume	2 000 cu ins
Spectrometer channels	K40, Bi 214, T208, Total Count

Survey flown and compiled by Geometrics Inc.

Undertaken on behalf of Marathon Petroleum Australia Ltd.
by Hunting Geology and Geophysics Australia Pty. Limited.
Canberra, May 1979
Job No. GA 20/79



GR79/117
Figure 2
GEOLOGY OF THE
RUM JUNGLE AREA
STRUCTURAL AND STRATIGRAPHIC INTERPRETATION
Scale 1: 25,000
1 0 1 2 3 Km
Euo Depot Creek Formation
Elb Burrell Creek Formation
Eda Amphibolite
Eld Goodparla Sediments
Elo Coomalie Dolomite Formation
Ele Crater Formation Sandstone and Celia Dolomite underlain by Beestons Formation quartzite
A Archaean granite and gneiss
Bedding
Formational contacts
Fault - proven and probable
Fracture zone
Antiform
Synform
Strike and dip 15°-30°
Strike and dip 30°-45°
Strike and dip 45°-60°
Road
Track
Railway track
Creek or river
Building
Built-up area
1700 Marathon E.L. boundary
M1 Areas of special interest
129°00' 132°00'
12°00' 12°00'
FOG BAY SD.52-3
DARWIN SD.52-4
1:250 000 map sheet boundaries
CAPE SCOTT SD.52-7
PINE CREEK SD.52-8
APPROXIMATE LOCATION OF STUDY AREA
14°00' 14°00'
129°00' 132°00'
N
Rum Jungle
RUM JUNGLE CREEK SOUTH
Dump
BATCHELOR
Finniss
River
This displacement to be checked in the field - based on B.M.R. mapping
M2
M1
1700
1181
1701
1219
Eva Valley
Stapleton
Creek
Sargents
Stapleton
Plain
Soil
Black
Smoky
Creek
13°10'
131°00'
NOTES
This is an interpretation of the photogeological compilation represented in Figure 1.
The base map was derived from a stereoscopic investigation of 1: 25 000 scale colour photography.
E.L. boundaries 1700, 1701, 1181, 1219 obtained from 1: 25 000 scale Marathon map
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by
Hunting Geology and Geophysics (Australia) Pty. Limited


Batchelor
Airfield
E.L.1700
E.L.1181
E.L.1701
E.L.1219
Waterhouse No.2
Waterhouse No.3
Sargents
NORTH AUSTRALIAN RAILWAY
LEGEND
SOIL SAMPLE SITE AND NUMBER
ROCK SAMPLE SITE AND NUMBER
SOIL GAS SAMPLE SITE AND NUMBER
ROAD
RAILWAY
HOMESTEAD
EXPLORATION LICENSE BOUNDARY
MINE WORKINGS
SCALE 1: 25 000
TN
MN
MARATHON PETROLEUM AUSTRALIA, LTD.
BRISBANE
AUSTRALIA
E.L.'s 1700, 1701, 1219, 1181
RUM JUNGLE
NORTHERN TERRITORY
LOCATION OF SOIL GAS SAMPLES
AND ROCK SAMPLES
JULY 79
CR79/117