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SADME / AMDEL PROJECT :

GEOCHRONOLOGY OF THE STUART SHELF

PROGRESS REPORTS

Submitted by

SADME
1981

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11.07.0516

The Director-General,
Department of Mines & Energy,
P O Box 151,
EASTWOOD SA 5063

27 September 1978

GEOCHRONOLOGY OF THE STUART SHELF

PROGRESS REPORT NO. 1

by

A. W. Webb

Geochronology by Dr A. W. Webb

D. K. Rowley
Manager
Analytical Chemistry Division

per [signature]

for Norton Jackson
Managing Director

hjj

GEOCHRONOLOGY OF THE STUART SHELF

1. REVIEW OF PROGRESS

Eight samples of shale from the Tapley Hill Formation intersected between 91.8 m and 94.7 m in Woomera No. 1 were described in Amdel Report GS 4686/78. These samples were selected on the basis of earlier chemical analyses that showed them to contain less carbonate than that found in other sections of the Tapley Hill Formation.

Calcite and dolomite are likely to contain strontium that has co-precipitated with calcium and magnesium from sea water. The Sr, therefore, will almost certainly have a different isotopic composition from that of the Sr in the clay fractions of the shale so, unless complete homogenisation of the Sr takes place during diagenesis, Rb-Sr isotopic analyses will not produce a true isochron and each point will represent a mixture of varying proportions of Sr of different isotopic composition. Thus, to reduce the possibility of isotopic inhomogeneity, samples with the smallest amount of carbonate were selected.

Approximate Rb and Sr analyses showed that there was little variation in Rb/Sr ratios between the samples and five, only, were chosen for accurate isotopic analysis.

2 GEOCHRONOLOGY

The Rb-Sr analyses are listed in Table 1 and plotted in Fig. 1. Regression of the data produced a Model 1 isochron of 750 ± 53 Ma with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7172 ± 0.0024. The Model 1 regression suggests that homogenisation of the Sr in the carbonate and clay fractions had taken place 750 Ma ago and this is probably the time of deposition or diagenesis since the Tapley Hill Formation was deposited between the two glacial periods $<$850 Ma and $\sim$650 Ma ago.

3. WORK IN HAND

Ten samples of the Woomera Shale and ten from the Willochra Subgroup intersected by SLT 101 are being examined for suitability for Rb-Sr dating. These samples, if suitable, will put upper and lower age limits on the Marinoan glacial period and the Willochra Subgroup will also serve as a check on the age of the Tapley Hill Formation reported in section 2.

TABLE 1

Rb-Sr Analyses - Tapley Hill Formation

Sample No.	Rb/Sr	$^{87}Rb/^{86}Sr$	# $^{87}Sr/^{86}Sr$
P880/78	1.225	3.5537	0.7552
P881/78	1.154	3.3472	0.7536
P882/78	1.320	3.8302	0.7576
P886/78	0.6886	1.9943	0.7383
P887/78	1.041	3.0184	0.7498

Ratios normalised to $^{88}Sr/^{86}Sr$ = 8.3752

Constants used: $^{85}Rb/^{87}Rb$ = 2.600

$\lambda^{87}Rb$ = $1.42 \times 10^{-11}\ y^{-1}$

9363 (1-1-219)

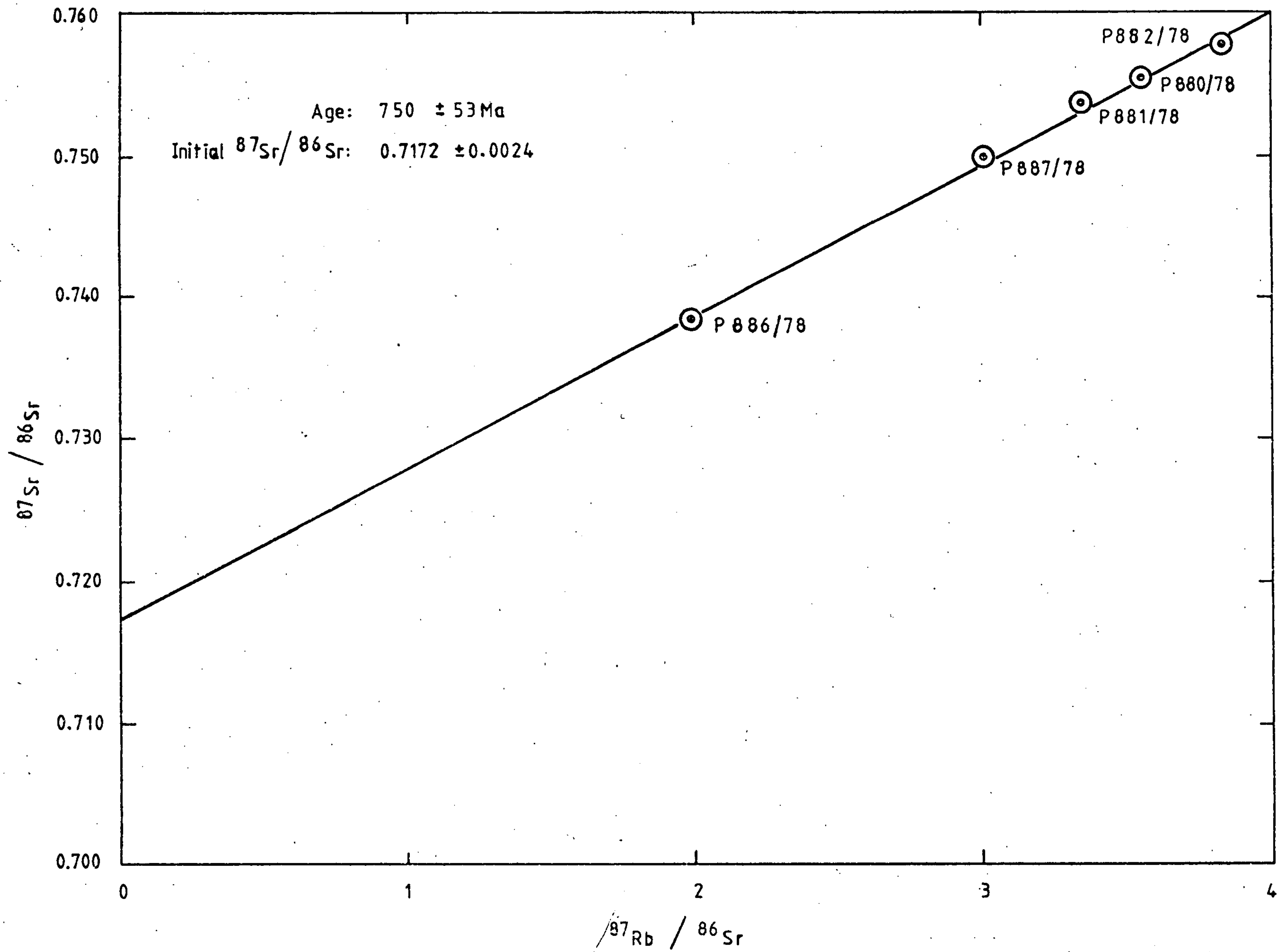

FIG. 1: TAPLEY HILL FORMATION (WOOMERA No.1)

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1/1/219 - AC 4145/81

29 May 1981

PART REPORT 2

The Director General
SA Dept of Mines and Energy
PO Box 151
EASTWOOD SA 5063

REPORT AC 4145/81

YOUR REFERENCE:	Project No 11.~~02~~.0516 07
IDENTIFICATION:	As listed
DATE RECEIVED:	24 February 1981

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for Norton Jackson
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THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Form 38

REPORT AC 4145/81

ANALYSIS PERCENT

Sample No	P554/77	P555/77	P556/77	P557/77	P558/77	P559/77	P560/77	P561/77
SiO_2	75.6	75.5	75.6	75.4	75.3	75.9	76.5	75.2
TiO_2	0.13	0.11	0.12	0.12	0.12	0.16	0.09	0.10
Al_2O_3	12.6	12.3	12.5	12.3	12.2	12.1	12.0	12.6
TOTAL IRON AS Fe_2O_3	0.77	0.63	0.80	0.70	0.84	1.01	0.74	0.79
MnO	0.03	0.10	0.06	0.03	0.07	0.06	0.04	0.05
MgO	0.07	0.05	0.07	0.06	0.05	0.13	0.08	0.10
CaO	0.46	0.47	0.46	0.45	0.46	0.66	0.54	0.58
Na_2O	3.67	3.41	3.63	3.62	3.61	3.58	3.54	3.79
K_2O	5.03	5.26	4.99	4.87	4.81	4.43	4.66	4.59
P_2O_5	0.04	0.02	0.04	0.02	0.02	0.04	0.01	0.02
L.O.I.	0.56	0.47	0.50	0.50	0.50	0.42	0.30	0.46
TOTAL	99.0	98.3	98.8	98.1	98.0	98.5	98.5	98.3

SAMPLE No.	P125/72	P126/72	P127/72	P128/72	P129/72	P130/72	P131/72	P132/72
SiO_2	67.7	67.7	68.2	67.4	70.5	69.4	70.5	71.2
TiO_2	0.46	0.57	0.50	0.48	0.42	0.47	0.42	0.38
Al_2O_3	13.9	13.8	13.1	12.8	12.7	12.9	13.1	12.5
TOTAL IRON AS Fe_2O_3	4.60	5.06	6.56	5.78	3.59	3.64	3.92	3.66
MnO	0.05	0.07	0.05	0.06	0.05	0.05	0.05	0.05
MgO	0.59	0.76	0.75	0.68	0.71	0.67	0.78	0.79
CaO	0.79	1.16	0.39	0.85	0.90	1.30	0.62	0.68
Na_2O	3.03	3.14	1.29	1.62	2.72	2.79	2.80	2.74
K_2O	5.43	5.33	7.17	6.56	4.93	5.13	5.02	4.62
P_2O_5	0.12	0.16	0.18	0.15	0.12	0.13	0.12	0.10
L.O.I	1.52	1.75	1.45	1.78	1.51	1.85	1.38	1.48
TOTAL	98.2	99.5	99.6	98.2	98.2	98.3	98.7	98.2

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ANALYSIS PERCENT

Sample No	P133/72	P134/72	SD14/75	SD20/75	SD29/77	SD19/78	SD1/74	SD40/74
SiO_2	68.4	69.3	75.9	73.3	69.7	72.2	74.0	74.8
TiO_2	0.54	0.48	0.14	0.23	0.56	0.41	0.17	0.17
Al_2O_3	13.8	13.3	12.2	13.2	13.0	14.1	12.9	12.2
TOTAL IRON AS Fe_2O_3	4.23	4.23	0.94	1.55	4.27	1.83	1.49	1.16
MnO	0.05	0.04	0.02	0.11	0.06	0.06	0.03	0.07
MgO	0.64	0.59	0.18	0.28	0.22	0.29	0.10	0.14
CaO	0.97	0.71	0.25	0.80	1.54	0.69	0.33	0.27
Na_2O	2.69	3.02	2.66	2.43	3.39	1.87	3.93	3.80
K_2O	5.90	5.22	4.99	5.27	4.78	5.69	5.64	4.85
P_2O_5	0.13	0.11	0.03	0.02	0.13	0.04	0.03	0.03
L.O.I	1.48	1.33	0.88	0.96	0.57	1.33	0.22	0.55
TOTAL	98.8	98.1	98.2	98.3	98.2	98.5	98.8	98.0

SAMPLE No.	SD41/74	SD44/74	SD55/74	SD12/78	SD13/78	P1481/76	P1482/76	P1483/76
SiO_2	74.7	75.9	74.9	75.9	62.7	67.5	68.0	68.1
TiO_2	0.18	0.17	0.14	0.12	0.82	0.63	0.62	0.60
Al_2O_3	12.2	12.0	12.2	12.2	17.8	14.0	13.9	14.0
TOTAL IRON AS Fe_2O_3	1.14	0.84	1.83	1.65	3.68	3.89	3.79	3.68
MnO	0.02	0.02	0.12	0.02	0.06	0.10	0.10	0.10
MgO	0.15	0.14	0.45	1.16	1.08	0.79	0.77	0.74
CaO	0.14	0.22	0.42	0.44	2.18	2.07	2.00	1.95
Na_2O	3.20	3.04	3.70	0.55	3.48	3.84	3.82	3.87
K_2O	5.54	4.83	4.77	4.89	5.81	4.93	5.00	4.99
P_2O_5	0.03	0.04	0.04	0.05	0.24	0.24	0.22	0.23
L.O.I.	0.69	0.90	0.66	1.68	1.09	0.72	0.69	0.56
TOTAL	98.0	98.1	99.2	98.7	99.9	98.7	98.9	98.8

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Form 38

REPORT AC 4/45/81

ANALYSIS PERCENT

Sample No	P1484/76	P1485/76	P1486/76	P1487/76	P1447/76	P1448/76	P1449/76	P1450/76
SiO_2	67.3	69.4	67.3	69.6	73.7	71.7	71.6	69.1
TiO_2	0.64	0.63	0.73	0.55	0.22	0.22	0.24	0.28
Al_2O_3	13.9	14.0	15.0	14.2	13.9	14.1	14.1	15.8
TOTAL IRON AS Fe_2O_3	3.79	3.78	4.14	3.54	1.72	1.50	1.91	2.02
MnO	0.10	0.10	0.09	0.10	0.01	0.02	0.02	0.02
MgO	0.76	0.70	0.90	0.65	0.47	0.43	0.54	0.58
CaO	1.99	1.92	2.14	1.88	1.71	1.30	1.55	1.65
Na_2O	3.84	3.87	4.05	3.84	3.48	3.71	3.62	4.03
K_2O	4.99	4.97	5.12	5.02	4.34	4.17	3.98	4.82
P_2O_5	0.23	0.24	0.26	0.21	0.07	0.04	0.06	0.09
L.O.I	0.63	0.55	0.96	1.15	0.54	0.98	1.02	0.97
TOTAL	98.2	100.2	100.7	100.8	100.2	98.2	98.6	99.4

SAMPLE No	P1453/76	P1454/76	P1455/76	P1456/76	P1457/76	P1459/76	SD20/78	742082
SiO_2	74.5	70.6	74.0	72.1	71.9	69.1	68.4	16.9
TiO_2	0.13	0.44	0.21	0.20	0.19	0.38	0.47	0.34
Al_2O_3	13.4	15.6	12.9	13.8	13.9	14.9	14.4	12.1
TOTAL IRON AS Fe_2O_3	1.08	2.07	1.42	1.63	1.29	3.48	4.85	62.9
MnO	0.01	0.01	0.01	0.02	0.02	0.03	0.09	0.04
MgO	0.19	0.99	0.36	0.29	0.39	1.07	1.34	0.07
CaO	1.14	3.09	1.72	1.52	1.43	3.04	2.00	0.18
Na_2O	3.45	3.87	3.04	3.26	3.20	3.96	3.51	0.07
K_2O	4.81	2.50	3.94	4.81	5.10	2.39	3.24	0.26
P_2O_5	0.04	0.05	0.03	0.06	0.05	0.10	0.19	0.04
L.O.I	0.57	1.08	0.73	0.58	0.74	0.96	1.10	8.51
TOTAL	99.3	100.3	98.4	98.3	98.2	99.4	99.6	100.4

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Form 38

REPORT AC 4145/81

ANALYSIS PERCENT

Sample No	742083	742084	742085	742086	742087	742088	742089	742090
SiO_2	16.4	16.1	19.3	12.6	12.6	20.4	16.6	22.5
TiO_2	0.38	0.29	0.27	0.09	0.25	0.29	0.15	0.10
Al_2O_3	12.8	11.6	7.66	3.69	6.02	5.91	3.66	2.43
TOTAL IRON AS Fe_2O_3	60.3	62.2	65.0	79.2	73.3	66.7	71.7	70.8
MnO	0.02	0.02	0.03	0.03	0.04	0.03	0.04	0.06
MgO	0.07	0.07	0.06	0.08	0.06	0.05	0.07	0.07
CaO	0.18	0.19	0.17	0.13	0.16	0.15	0.13	0.13
Na_2O	0.05	0.05	0.05	0.12	0.06	0.03	0.07	<0.01
K_2O	0.17	0.18	0.16	0.17	0.15	0.16	0.15	0.16
P_2O_5	0.05	0.04	0.07	0.13	0.15	0.10	0.14	0.19
L.O.I	9.64	9.72	7.09	4.13	7.79	6.58	5.82	3.97
TOTAL	100.1	100.5	99.9	100.4	100.6	100.4	98.5	100.4

SAMPLE No.	742091	742092	742093	742094	742095	742096	742097	742098
SiO_2	20.0	39.6	40.0	41.5	41.5	45.5	46.0	51.4
TiO_2	0.18	0.19	0.48	0.56	0.45	0.36	0.91	0.62
Al_2O_3	3.08	2.56	6.52	5.59	4.92	5.44	8.49	13.3
TOTAL IRON AS Fe_2O_3	69.2	48.8	29.9	38.2	33.9	34.3	28.6	15.0
MnO	0.04	0.05	0.24	0.11	0.13	0.15	0.11	0.14
MgO	0.34	1.87	8.30	4.52	5.51	5.42	4.80	9.58
CaO	0.24	0.80	2.35	2.38	2.02	1.71	3.12	4.15
Na_2O	0.01	0.14	0.55	0.65	0.37	0.61	0.93	1.97
K_2O	0.16	0.19	0.36	0.24	0.42	0.57	0.52	0.76
P_2O_5	0.19	0.13	0.11	0.15	0.26	0.22	0.33	0.04
L.O.I.	6.99	6.59	10.68	5.29	9.50	4.98	4.63	3.18
TOTAL	100.4	100.9	98.8	99.2	99.0	99.3	98.4	100.1

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THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Form 38

REPORT AC 4145/81

ANALYSIS PERCENT.

Sample No	742099	742100	742101	742102	742103	742104	742105	
SiO_2	57.9	53.4	64.1	61.9	46.9	52.5	53.6	
TiO_2	0.65	0.56	0.44	0.49	0.50	0.31	0.31	
Al_2O_3	14.2	14.2	15.9	16.4	10.9	7.13	6.47	
TOTAL IRON AS Fe_2O_3	12.2	8.87	4.65	5.31	11.8	8.96	9.65	
MnO	0.11	0.07	0.02	0.03	0.06	0.09	0.17	
MgO	4.67	9.66	2.62	2.92	12.1	13.2	12.9	
CaO	3.61	4.10	2.75	3.08	2.76	2.60	2.61	
Na_2O	1.96	2.32	3.85	4.16	1.79	1.38	1.39	
K_2O	1.17	1.77	2.86	2.47	1.12	0.54	0.55	
P_2O_5	0.05	0.10	0.10	0.11	0.15	0.14	0.17	
L.O.I.	2.88	5.30	2.01	1.83	11.34	12.05	11.67	
TOTAL	99.4	100.4	99.3	98.7	99.4	98.9	99.5	

METHOD: H1

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30 November 1978

NATA CERTIFICATE

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Department of Mines & Energy
P O Box 151
EASTWOOD

GEOCHRONOLOGY OF THE STUART SHELF

PROGRESS REPORT NO. 2

by

A. W. Webb

Geochronology by Dr A. W. Webb

D. K. Rowley
Manager
Analytical Chemistry Division

for Norton Jackson
Managing Director

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GEOCHRONOLOGY OF THE STUART SHELF

1 REVIEW OF PROGRESS

Twenty samples of drill core from SLT 101 were examined for suitability for Rb-Sr age determination and the petrographic descriptions were reported in Amdel Report GS 959/79. The samples represent the Willochra Subgroup and the Woomera Shale and were selected in an attempt to confirm previously determined dates on the Tapley Hill Formation and Woomera Shale in Woomera No. 1

Although the petrographic examination showed the Willochra Subgroup samples to contain abundant dolomite, previous experience with the calcareous Tapley Hill Formation samples suggested that homogenisation of the chemically precipitated Sr with the Sr in the clay fractions had occurred during diagenesis and it was decided to select the most favourable of the Willochra Subgroup samples for isotopic analysis.

The samples of the Woomera Shale had a very restricted range in Rb/Sr ratio and would be unlikely to produce a precise Rb-Sr isochron. However, it was hoped that this isochron could be used in conjunction with the previously determined one to produce a pooled aged with a significantly reduced error.

Six samples of the Willochra Subgroup and five from the Woomera Shale were analysed and the results and interpretation are given in the following section.

2 GEOCHRONOLOGY

The eleven Rb-Sr isotopic analyses are listed in Table 1 and plotted in Fig. 1.

2.1 Willochra Subgroup

Regression of the 6 analyses produced an isochron with a significant residual variance beyond that due to experimental error. It is obvious from Fig. 1 that this variance is due largely to sample 6434 RS 39, which contained alternating beds of distinctly different lithology and appears to be of very heterogeneous character.

If this analysis is omitted, the remaining 5 analyses produce a Model 1 isochron of 724 ± 40 Ma with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7122 ± 0.0016. This result is in close agreement with the date of 750 ± 53 Ma determined on the Tapley Hill Formation in Woomera No. 1.

2.2 Woomera Shale

The analyses of the 5 samples of the Woomera Shale are plotted in Fig. 1 and do not define a single straight line. In addition, the range in Rb/Sr ratio is very small and it is not possible to draw any conclusions from these data as to the age of the shale.

TABLE 1

Rb-Sr Analyses - SLT 101

Sample No.	Depth m	Rb/Sr	$^{87}Rb/^{86}Sr$	$\#^{87}Sr/^{86}Sr$
Woomera Shale				
6434 RS 25	177.6	2.073	6.0223	0.7698
6434 RS 27	184.1	1.907	5.5386	0.7670
6434 RS 28	184.6	1.978	5.7460	0.7692
6434 RS 31	191.6	1.817	5.2759	0.7646
6434 RS 32	193.7	2.062	5.9902	0.7695
Willochra Subgroup				
6434 RS 35	511.0	1.024	2.9672	0.7432
6434 RS 38	520.8	1.238	3.5896	0.7498
6434 RS 39	521.2	1.928	5.5996	0.7671
6434 RS 40	522.7	1.311	3.8016	0.7509
6434 RS 41	526.0	0.7027	2.0341	0.7329
6434 RS 42	526.4	0.5773	1.6706	0.7296

Ratios normalised to $^{88}Sr/^{86}Sr$ = 8.3752

Constants used: $^{85}Rb/^{87}Rb$ = 2.600

$\lambda\ ^{87}Rb = 1.42 \times 10^{-11}\ y^{-1}$

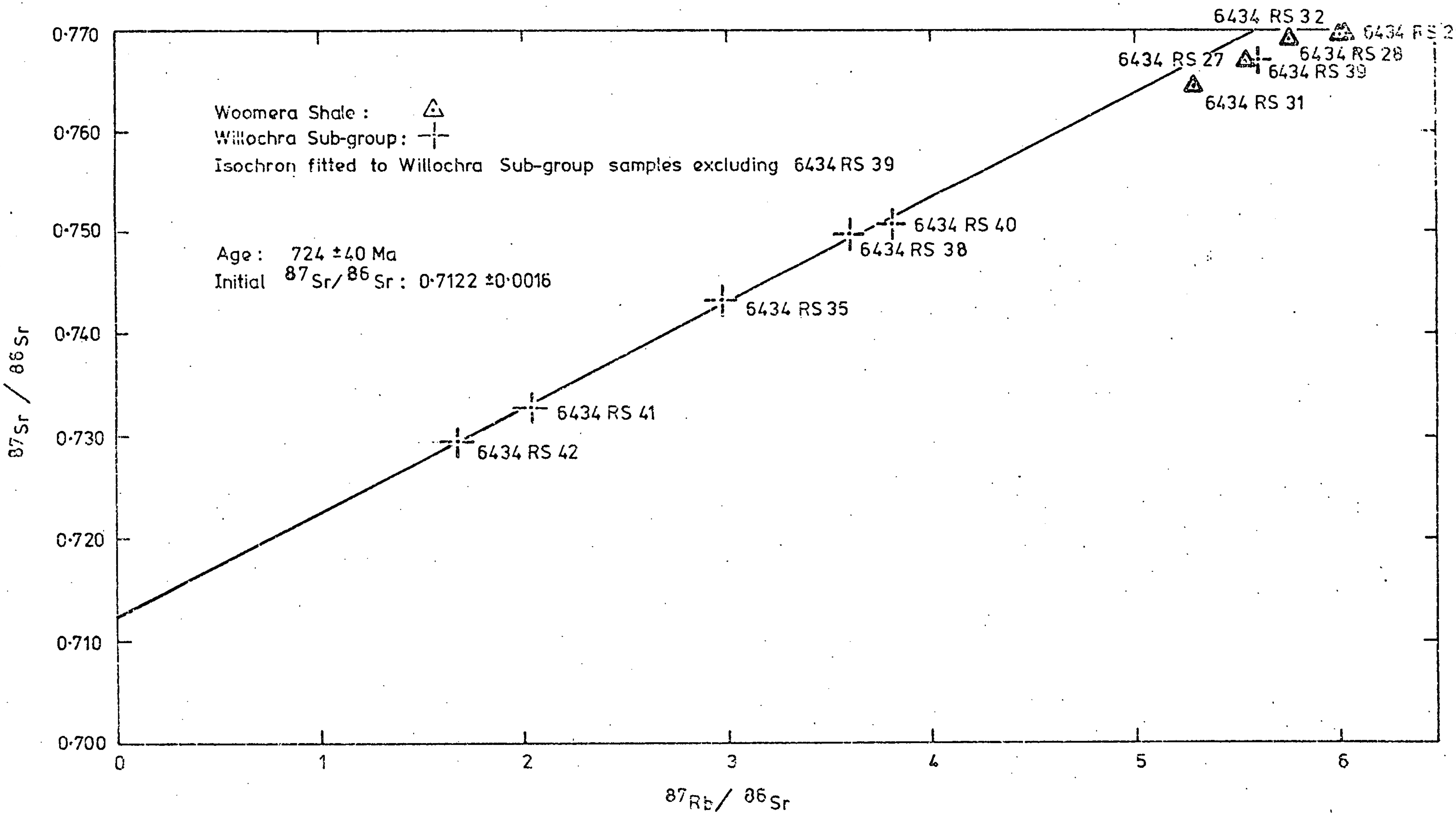

FIG.1 : WILLOCHRA SUB GROUP ISOCHRON

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11.07.0516

The Director-General,
S.A. Department of Mines and Energy,
P.O. Box 151,
EASTWOOD. S.A. 5063

20th May, 1981.

GEOCHRONOLOGY OF THE STUART SHELF

Progress Report No. 3

By

A.W. Webb

D.K. Rowley
Manager
Analytical Chemistry Division

for Norton Jackson
Managing Director

glj

GEOCHRONOLOGY OF THE STUART SHELF

1. REVIEW OF PROGRESS

A previous attempt to date sedimentary rocks from the Curnamona Nucleus (from Bumbarlow No. 1) suggested that this region may have escaped the effects of the Delamerian Orogeny. It was hoped, therefore, that Adelaidean sediments from Mined BMW 1A-1 would provide useful geochronological data to complement the work done on rocks of Adelaidean age on the Stuart Shelf.

Twenty samples of drill core were selected from two sections representing the Angepena Formation and the Brachina Formation. The intervals sampled were 255.9 - 264.2 m and 188.5 - 203.1 m respectively.

Two samples from each unit were taken for thin sectioning and petrographic descriptions (see Section 2) and all 20 samples were crushed and approximate Rb and Sr concentrations determined. The samples showed only a narrow range in Rb/Sr ratio, but 5 samples of the Brachina Formation and 6 of the Angepena Formation were selected for Rb-Sr isotopic dating.

2. PETROGRAPHY

Sample: 6935 RS 78; TS43900

Rock Name:
Argillaceous and dolomitic siltstone/mudstone

Hand Specimen:
This is an aphanitic rock which has a distinctive brown to purple colour. The sample splits along planes aligned at right angles to the core length.

Thin Section:
The sample is extremely fine-grained and precise mineral proportions cannot be given; however, the sample consists of subequal amounts of carbonate, quartz and phyllosilicates with much less heavy minerals and opaques.

Quartz crystals are commonly not more than 0.02 mm in size and the sample is therefore essentially a siltstone. The quartz crystals are equant anhedra but most are essentially angular in outline. Other detrital components in the rock are numerous flakes of colourless phyllosilicates. Many of these have rather low birefringence and are possibly somewhat degraded muscovite and possibly partly altered to illite. Other flakes are fresher muscovite, chlorite and, rarely, biotite. There is some alignment of these flakes but this is shown by a tendency towards a parallel orientation of the long axes rather than any parallelism which is shown by everyone of the detrital flakes of phyllosilicate. Individual flakes are commonly not more than 0.04 mm in length and are generally much smaller. The origin of the carbonate in the rock is rather difficult to determine but since the material forms one or two rather large patches, it seems almost certain that much of the carbonate is in some way introduced into the rock and is of authigenic origin. There are one or two places where there are porous aggregates of carbonate as much as 0.15 mm in size. Within these aggregates bulk extinction is shown on the scale of about 0.05 to 0.08 mm. Fine-grained quartz and phyllosilicate material is generally enclosed in these larger aggregates of carbonate. Elsewhere the carbonate is much finer-grained and similar in appearance in terms of shape and size of grains to the quartz. None of the carbonate appears to have been stained by alizarin red-S and it seems most likely that the material is dolomite.

It is possible that the sample contains a little very fine-grained clay matrix but this was not specifically identified even during examination under high magnification. The sample contains trace amounts of detrtial heavy minerals (including green tourmaline) and a little opaque material also.

The sample is probably suitable for whole rock rubidium-strontium geochronology.

Sample: 6935 RS 87; TS43899

Rock Name:
Silty dolomite

Hand Specimen:
This is an aphanitic dark brown to purple rock very similar to RS 78.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Carbonate	50
Quartz	35
Phyllosilicates	15
Opaques	2

This is a homogeneous fine-grained rock in which quartz and phyllosilicates are clearly silt-grade detrital components but the abundant carbonate may be of partly detrital origin but partly a cementing phase. The minerals occur together in fairly granular textures dominated by the carbonate. The latter has not been stained with alizarin red-S and hence is not calcite. It seems most likely, therefore, that the mineral is dolomite.

Quartz grains/crystals are commonly not more than about 0.02 mm in size and many are much smaller than this. As far as can be determined the grains are equant anhedra somewhat corroded by adjacent carbonate. Phyllosilicates are a less abundant detrital phase and they are present as widely dispersed wisps which show little or no preferred orientation. The material is essentially colourless and most is probably referable to muscovite.

The bulk of the rock consists of a mosaic of fine-grained granular ?dolomite. This may be intergrown with a proportion of clay but the material is so fine-grained that it is difficult to give a quantitative assessment of this. In some fields of view under plane polarized light, the material appears to be somewhat turbid and under crossed nicols shows a slight bulk extinction and both these characteristics suggest the presence of possibly a fine-grained clay of some kind.

The sample contains dispersed opaque and semi-opaque material and the former is probably of detrital origin whereas the latter may represent weathering or some kind of late alteration. The sample is probably suitable for whole rock rubidium-strontium geochronology.

Sample: 6935 RS 89; TS43901

Rock Name:
Dolomite

Hand Specimen:
This is buff to purple-coloured rock which is massive and compact. As far as can be determined the sample is essentially aphanitic apart from a few places where there are small but well defined greenish spots.

Thin Section:
In plane polarized light the rock consists of an essentially homogeneous mosaic of turbid brown material but under crossed nicols this shows a high birefringence and is clearly essentially a carbonate mineral. The lack of staining with alizarin red-S suggests that the mineral is most likely to be dolomite. The dolomite forms an essentially granular mosaic but individual crystals can rarely be positively identified. This is a result both of the fine-grained nature of the material and the overall brown turbidity. The latter is probably due to dispersed secondary ferruginous material. Within this aggregate of dolomite are some clearer patches of a grey dolomite which are characteristically rounded in shape and are of the order of 0.1 to 0.2 mm in size. These aggregates comprise only a small proportion of the rock but they are distinctive, not least because they contain identifiable crystals as much as 0.05 mm in size.

The sample contains a small proportion (less than 5%) of detrital silicate minerals and both quartz and muscovite can be identified. There are rare quartz crystals as much as 0.05 mm in size but most of the quartz is much finer-grained than this and all of the phyllosilicate is present as flakes not more than 0.04 mm in length. The detrital silicates are widely dispersed throughout the rock and in no way form any kind of framework.

The sample contains a considerable amount of dispersed semi-opaque brown to red material which is interpreted as being secondary goethite or limonitic material. It is also possible that there is dispersed fine-grained clay but the sample is clearly essentially an extremely fine-grained dolomite with a minor terrigenous component. The rock may be suitable for rubidium-strontium geochronology.

Sample: 6935 RS 96; TS43902

Rock Name:
Laminar-bedded silty dolomite

Hand Specimen:
The bulk of this rock is similar to the three described above but the sample shows bedding in terms of variations in the colour of the material. The hand specimen contains a central bed approximately 3 mm in width which is a distinct grey colour whereas the bulk of the sample is the purple to brownish colour characteristic of most of these dolomitic rocks. The bedding is noticeably fine and laminar and is essentially at right angles to the core length.

Thin Section:
This is a bedded sample and the relative proportions of the minerals vary somewhat from place to place in the thin section. The pale grey lithology is colourless in plane polarized light and is both free from ferruginous material (hence the colour difference) and also somewhat coarser-grained than the bulk of the brown material in the hand specimen. The grey lithology contains about 30 to 40% of quartz and much of the remainder is dolomite. Quartz grains are commonly up to about 0.04 mm in size and possibly as much as one-third of the dolomite has a similar crystal size. Some of the dolomite even shows the development of crystal faces and this is clear evidence that the material is essentially of authigenic origin. The quartz crystals are equant anhedra and are probably partly resolved detrital grains. The sample contains a small amount of detrital muscovite but this comprises not more than about 5 to 7% of the volume of this part of the rock. Even within this grey lithology there is bedding shown by variations of the crystal size of both the quartz and the dolomite.

The darker lithologies in the hand specimen are silty dolomites similar in many respects to the three samples described above. The bulk of the material is a turbid brown colour in plane polarized light and partly rather dark in crossed nicols. It is thought likely that the bulk of the material is dolomite but the turbidity may well be the result of the intergrowth of fine-grained clay with the carbonate. The material contains a significant terrigenous component and possibly as much as 30% of the rock consists of detrital quartz and muscovite. This material is generally the medium-fine silt grade and the quartz is present as randomly distributed equant angular grains whereas the muscovite forms disoriented small wisps generally not more than about 0.04 mm in length. The dark parts of the rock are distinctly homogeneous.

This is a dolomite with a moderate terrigenous component. The sample is probably suitable for whole rock rubidium-strontium geochronology.

3. GEOCHRONOLOGY

The Rb-Sr analyses on samples from the Brachina and Angepena Formations are listed in Table 1 and plotted in Fig. 1

The Brachina Formation samples have very little variation in Rb/Sr ratio and although the isotopic analyses define a Model 1 isochron, the restricted range in Rb/Sr ratio results in the poor precision (±11%) of the age. The isochron indicates an age of 601±68 Ma and an initial $^{87}Sr/^{86}Sr$ ratio of 0.7195±0.0058. Since this unit is younger than the Marinoan glacial deposits, an age less than approximately 670 Ma is expected. However, the mean age (601 Ma) determined for the Brachina Formation is probably too young when considered in conjunction with the result for the Angepena Formation.

The samples for the Angepena Formation have a wider range of Rb/Sr ratio than that found for the Brachina Formation but the isochron produced by the 7 analyses is not as good a fit (Model 2) and gives an age of 614±98 Ma with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7188±0.0102.

The line in Fig. 1 is the isochron fitted to the data for the Brachina Formation. It can be seen that the analyses of the Angepena Formation plot closely about this line and statistically, the age and initial ratios of the two formations are indistinguishable.

The Angepena Formation, from previous dating made on the Stuart Shelf, must be about 750 Ma old and it is obvious that the samples from Minad BMW 1A-1 have had their Rb-Sr systems reset at about 600 million years ago. This conclusion also implies that the Brachina Formation at this locality has suffered the same resetting and that its depositional age must be older than 600 Ma.

The similarity in initial ratios of the two formations could be indicative of a fairly large scale homogenisation of the Sr isotopes 600 Ma ago but in the absence of signs of matamorphism in these rocks, the similarity of initial ratios is probably fortuitous.

TABLE 1

Rb-Sr Analyses

SAMPLE NO.	DEPTH (m)	Rb/Sr	$^{87}Rb/^{86}Sr$	‡ $^{87}Sr/^{86}Sr$
Brachina Formation				
6935RS79	189.0	2.306	6.7039	0.7769
6935RS80	189.8	2.247	6.5315	0.7755
6935RS83	192.0	2.018	5.8625	0.7698
6935RS84	192.8	1.829	5.3110	0.7649
6935RS85	193.4	1.924	5.5882	0.7675
Angepena Formation				
6935RS88	255.9	3.132	9.1267	0.8012
			9.1270	0.8016
6935RS89	257.4	2.682	7.8033	0.7854
6935RS90	257.6	2.764	8.0439	0.7878
6935RS91	258.2	2.813	8.1881	0.7899
6935RS93	259.3	2.290	6.6581	0.7781
6935RS97	264.2	1.882	5.4658	0.7667

‡ Ratios normalised to $^{88}Sr/^{86}Sr = 8.3752$

Constants used: $^{85}Rb/^{87}Rb = 2.600$

$\lambda\ ^{87}Rb = 1.42 \times 10^{-11}\ y^{-1}$

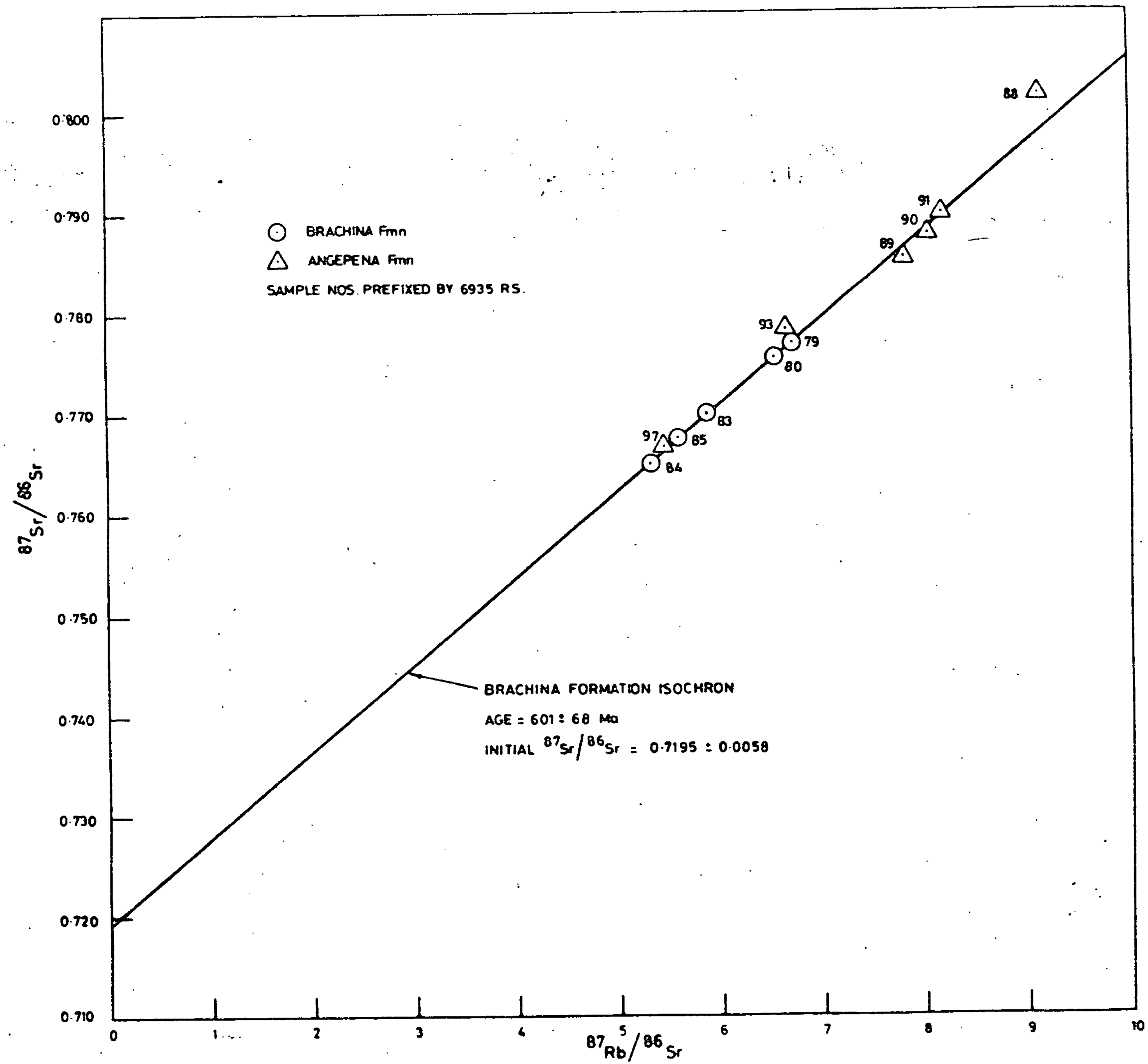

FIG. 1 BRACHINA AND ANGEPENA FORMATIONS

The Australian Mineral Development Laboratories

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In reply quote:

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1/1/219 - AC 4145/81

24 June 1981

NATA CERTIFICATE

REPORT COMPLETE

The Director General,
S.A. Department of Mines & Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

REPORT AC 4145/81

YOUR REFERENCE:	Project No. 11.~~02~~ 07.0516
IDENTIFICATION:	As listed
DATE RECEIVED:	24 February 1981

D.K. Rowley
Manager
Analytical Chemistry Division

D.C. Bowditch
for Norton Jackson
Managing Director

ij

RECEIVED
8 JUL 1981
DEPT. OF MINES AND ENERGY
SECURITY
3332.

Pilot Plant: Osman Place
Thebarton S.A.
Telephone 43 8053
Branch Laboratory: Perth

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NATA Certificate Results in ppm

Sample	U	Th	W	Rb	Ta	Cs
5736 RS 1	4	30	<10	310	<10	<20
5736 RS 2	8	28	<10	320	10	<20
5736 RS 3	6	32	<10	310	<10	<20
5736 RS 4	8	32	10	320	<10	<20
5736 RS 5	<4	30	<10	300	<10	<20
5736 RS 6	6	38	<10	300	<10	<20
5736 RS 7	8	40	<10	330	<10	<20
5736 RS 8	10	40	<10	330	<10	<20
5836 RS 3	4	16	<10	150	<10	<20
5836 RS 4	6	24	<10	150	<10	<20
5836 RS 5	<4	22	10	170	<10	<20
5836 RS 6	4	14	<10	170	<10	<20
5836 RS 7	<4	24	<10	170	<10	<20
5836 RS 8	6	20	<10	160	<10	<20
5836 RS 9	4	26	<10	160	<10	<20
5836 RS 10	6	16	<10	160	<10	<20
5836 RS 11	4	20	<10	160	<10	<20
5836 RS 12	4	16	<10	150	<10	<20
5737 RS 15	4	36	10	200	10	<20
5737 RS 16	6	34	<10	240	<10	<20
5737 RS 21	6	30	<10	160	<10	<20
5737 RS 25	6	28	10	230	<10	<20
5837 RS 8	6	28	<10	200	<10	<20
5837 RS 9	8	26	<10	220	<10	<20
5837 RS 10	6	28	<10	230	<10	<20
5837 RS 11	4	24	<10	180	<10	<20
5837 RS 12	8	34	<10	200	<10	<20
5837 RS 14	12	32	10	330	10	<20
5837 RS 15	10	44	<10	220	<10	<20
5737 RS 8	4	18	<10	160	<10	<20
5737 RS 9	4	24	<10	160	<10	<20
5737 RS 10	4	20	10	160	<10	<20
5737 RS 11	6	22	10	160	<10	<20
5737 RS 12	6	22	<10	170	10	<20
5737 RS 13	4	20	<10	180	<10	<20
5737 RS 14	6	26	<10	170	<10	<20
5836 RS 21	4	26	<10	120	<10	<20
5836 RS 22	4	38	<10	130	<10	<20
5836 RS 23	<4	60	<10	120	<10	<20
5836 RS 24	4	55	<10	150	<10	<20
Detn limit	(4)	(4)	(10)	(2)	(10)	(20)

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Analysis code B1/1 Report AC 4145/81

NATA Certificate Results in ppm

Sample	U	Th	W	Rb	Ta	Cs
5836 RS 25	6	18	<10	130	<10	<20
5836 RS 26	<4	8	<10	75	<10	<20
5836 RS 27	4	24	<10	100	<10	<20
5836 RS 28	<4	44	<10	130	<10	<20
5836 RS 29	<4	36	<10	130	<10	<20
Detn limit	(4)	(4)	(10)	(2)	(10)	(20)

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NATA Certificate Results in ppm

Sample	W
5836 RS 31	<10
5836 RS 47	<10
5836 RS 48	<10
5836 RS 49	<10
5836 RS 54	<10
5836 RS 98	<10
5836 RS 99	<10
5836 RS 100	<10
5736 RS 20	<10
5736 RS 21	10
5736 RS 22	<10
5736 RS 23	15
5737 RS 1~~2~~8	<10
5737 RS 20	10
5737 RS 24	<10
5737 RS 26	<10
Detn limit	(10)

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NATA Certificate Results in ppm

Sample	U	Th
5836 RS 31	<4	<4
5836 RS 47	6	10
5836 RS 48	4	20
5836 RS 49	<4	12
5836 RS 54	4	16
5836 RS 98	<4	4
5836 RS 99	<4	8
5836 RS 100	8	28
5736 RS 20	8	28
5736 RS 21	<4	24
5736 RS 22	6	28
5736 RS 23	8	30
5737 RS 28	<4	14
5737 RS 20	8	16
5737 RS 24	6	26
5737 RS 26	6	24
Detn limit	(4)	(4)

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NATA Certificate Results in ppm

Sample	Sn	W	U
742001	<4	<10	6
742002	<4	<10	<4
742003	<4	<10	4
742004	<4	<10	6
742005	<4	<10	6
742006	<4	<10	<4
742007	10	<10	4
742008	<4	<10	4
742009	4	<10	<4
742010	6	<10	<4
742011	4	<10	<4
742012	<4	15	<4
742013	6	15	<4
742014	<4	<10	<4
742015	8	<10	<4
742016	<4	<10	<4
742017	<4	<10	6
742018	<4	70	<4
742019	<4	<10	<4
742020	<4	<10	<4
742021	<4	<10	<4
742022	<4	<10	4
742023	<4	<10	<4
742024	<4	<10	<4
742025	6	<10	<4
742026	<4	25	<4
742027	<4	<10	<4
742028	<4	<10	<4
742029	<4	15	<4
742030	<4	<10	<4
742031	<4	<10	<4
742032	<4	<10	<4
742033	6	<10	8
742034	<4	<10	<4
742035	4	<10	<4
742036	<4	10	6
742037	<4	<10	<4
742038	<4	10	<4
742039	<4	<10	<4
742040	<4	<10	<4
Detn limit	(4)	(10)	(4)

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NATA Certificate   Results in ppm

Sample	Sn	W	U
742041	<4	<10	<4
742042	<4	<10	<4
742043	<4	20	<4
742044	<4	<10	<4
742045	<4	<10	<4
742046	6	25	<4
742047	<4	15	6
742048	<4	<10	6
742049	<4	<10	4
742050	<4	<10	4
742051	8	<10	4
742052	<4	65	8
742053	<4	20	<4
742054	<4	<10	<4
742055	<4	10	6
742056	<4	10	<4
742057	<4	<10	4
742058	<4	<10	<4
742059	<4	<10	<4
742060	<4	<10	4
742061	<4	10	<4
742062	<4	<10	<4
742063	<4	<10	<4
742064	<4	15	<4
742065	<4	<10	<4
742066	<4	<10	<4
742067	<4	<10	6
742068	<4	<10	<4
742069	6	<10	<4
742070	<4	<10	4
742071	<4	10	<4
742072	<4	<10	<4
742073	<4	<10	6
742074	6	<10	<4
742075	<4	<10	<4
742076	<4	<10	<4
742077	<4	15	<4
742078	<4	<10	4
742079	<4	<10	<4
742080	<4	<10	<4
Detn limit	(4)	(10)	(4)

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NATA Certificate Results in ppm

Sample	Sn	W	U
742081	<4	<10	<4
742082	<4	<10	<4
742083	<4	<10	6
742084	<4	25	<4
742085	4	<10	6
742086	8	<10	4
742087	<4	30	<4
742088	<4	10	<4
742089	<4	<10	<4
742090	<4	<10	6
742091	<4	10	4
742092	<4	<10	<4
742093	4	<10	<4
742094	8	15	<4
742095	<4	<10	4
742096	<4	<10	4
742097	<4	<10	<4
742098	<4	<10	<4
742099	6	<10	<4
742100	<4	<10	<4
742101	<4	<10	4
742102	<4	<10	4
742103	<4	<10	<4
742104	<4	<10	<4
742105	<4	<10	4
742106	4	<10	<4
742107	<4	<10	<4
742108	<4	10	10
742109	<4	<10	<4
742110	4	10	<4
742111	6	<10	8
742112	4	<10	4
742113	<4	<10	<4
742114	<4	<10	<4
742115	4	10	6
742116	<4	<10	<4
742117	<4	<10	<4
742118	<4	<10	<4
742119	<4	<10	<4
742120	<4	<10	6
Detn limit	(4)	(10)	(4)

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NATA Certificate Results in ppm

Sample	Sn	W	U
742121	4	<10	<4
742122	10	<10	6
742123	<4	<10	4
742124	<4	<10	4
742125	<4	<10	4
742126	150	10	4
742127	150	10	<4
742128	<4	<10	6
742129	<4	<10	<4
742130	<4	<10	<4
742131	<4	<10	4
742132	<4	<10	<4
Detn. limit	(4)	(10)	(4)

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Analysis code B1/1   Report AC 4145/81

NATA Certificate   Results in ppm

Sample	Th
742001	8
742002	<4
742003	4
742004	4
742005	10
742006	6
742007	<4
742008	<4
742009	4
742010	4
742011	4
742012	10
742013	<4
742014	10
742015	28
742016	20
742017	20
742018	8
742019	<4
742020	12
742021	55
742022	14
742023	8
742024	<4
742025	8
742026	10
742027	6
742028	10
742029	4
742030	8
742031	12
742032	8
742033	4
742034	14
742035	12
742036	6
742037	16
742038	6
742039	8
742040	26
Detn limit	(4)

Analysis code B1/1 Report AC 4145/81

NATA Certificate Results in ppm

Sample	Th
742041	28
742042	40
742043	20
742044	22
742045	10
742046	18
742047	<4
742048	8
742049	6
742050	6
742051	4
742052	20
742053	6
742054	14
742055	<4
742056	8
742057	10
742058	<4
742059	<4
742060	12
742061	10
742062	8
742063	4
742064	10
742065	4
742066	10
742067	8
742068	8
742069	4
742070	4
742071	10
742072	12
742073	10
742074	6
742075	10
742076	8
742077	4
742078	4
742079	4
742080	16
Detn limit	(4)

amdel

Analysis code B1/1 Report AC 4145/81

NATA Certificate Results in ppm

Sample	Th
742081	14
742082	12
742083	10
742084	8
742085	12
742086	6
742087	8
742088	6
742089	6
742090	4
742091	6
742092	4
742093	<4
742094	<4
742095	4
742096	6
742097	4
742098	14
742099	24
742100	24
742101	28
742102	30
742103	10
742104	4
742105	<4
742106	<4
742107	4
742108	4
742109	4
742110	12
742111	6
742112	4
742113	10
742114	<4
742115	<4
742116	<4
742117	10
742118	6
742119	8
742120	12
Detn limit	(4)

amdel

Analysis code B1/1 Report AC 4145/81

NATA Certificate Results in ppm

Sample	Th
742121	6
742122	4
742123	<4
742124	6
742125	18
742126	6
742127	18
742128	14
742129	6
742130	4
742131	6
742132	8
Detn limit	(4)

amdel

NATA Certificate

Results in ppm

Sample	Ta	Cs	Rb
5836 RS 31	<10	<20	85
5836 RS 47	<10	<20	85
5836 RS 48	<10	<20	160
5836 RS 49	<10	<20	120
5836 RS 54	<10	<20	75
5836 RS 98	<10	<20	60
5836 RS 99	<10	<20	85
5836 RS 100	<10	<20	140
5736 RS 20	<10	20	520
5736 RS 21	<10	30	460
5736 RS 22	<10	<20	340
5736 RS 23	<10	<20	330
5737 RS 28	<10	<20	150
5737 RS 20	<10	<20	170
5737 RS 24	<10	<20	170
5737 RS 26	<10	<20	140
Detn limit	(10)	(20)	(2)