



Unravelling the tectonic framework of the Musgrave Province, central Australia

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Appendix 1

Geochemistry and Isotopes of ca. 1.60-1.54 Ga Musgravian Gneiss

Table 3.1 - Chemical data for Musgrave Felisc rocks

Sample	95/461	96/614	95/168b	96/617	95/464a	95/472	95/471C	95/361
Easting	52 594550	52 551150	52 634960	52 549800	52 597025	52 597075	52 597260	52 618820
Northing	7125725	7130210	7154000	7129000	7124000	7129300	7130780	7124980
(La/Yb) _N Group	Yb enriched	Yb enriched	Yb enriched	Yb enriched	Yb enriched	Yb enriched	Yb enriched	Yb enriched
SiO ₂	67.30	69.80	67.40	69.60	69.70	70.70	69.40	71.70
Al ₂ O ₃	13.60	13.50	14.00	13.60	14.10	13.30	13.40	13.80
Fe ₂ O ₃	5.67	4.73	4.88	3.99	3.84	3.41	3.98	3.30
MnO	0.13	0.11	0.14	0.10	0.11	0.11	0.10	0.08
MgO	1.19	0.97	1.28	0.76	0.73	0.63	0.83	0.64
CaO	3.77	3.24	3.24	2.28	3.81	2.46	2.84	2.44
Na ₂ O	3.18	2.88	2.95	2.95	3.57	3.41	2.92	2.89
K ₂ O	3.37	4.08	4.10	4.65	3.22	4.38	4.42	4.83
TiO ₂	0.83	0.69	0.73	0.66	0.69	0.56	0.63	0.55
P ₂ O ₅	0.19	0.15	0.17	0.11	0.14	0.12	0.13	0.10
LOI	0.11	0.26	0.60	0.55	0.27	0.20	0.44	0.19
Total, %	99.34	100.41	99.49	99.25	100.18	99.28	99.09	100.52
Ga	20.0	18.5	19.0	17.5	22.5	17.0	19.0	17.0
Cr	30.0	10.0	10.0	20.0	20.0	10.0	10.0	20.0
Ni	8.0	6.0	9.0	5.0	6.0	4.0	5.0	5.0
Sc	14.0	12.0	14.0	6.0	10.0	10.0	10.0	8.0
V	60.0	50.0	60.0	40.0	60.0	30.0	40.0	30.0
Y	54.0	40.5	46.5	37.0	44.5	44.5	45.0	29.5
Rb	94.0	130.0	165.0	135.0	110.0	140.0	155.0	145.0
Ba	850.0	950.0	900.0	1050.0	700.0	1000.0	950.0	1000.0
Th	2.4	6.0	19.0	5.0	22.5	14.5	21.5	4.9
U	0.2	0.5	2.5	0.6	1.3	1.6	1.0	0.3
Ta	1.0	1.0	2.0	3.0	3.0	1.0	2.0	1.0
Nb	15.5	13.0	18.0	19.0	21.0	15.0	17.0	13.0
Pb	28.5	30.0	40.0	36.5	31.5	29.0	34.0	32.0
Hf	8.0	7.0	7.0	8.0	9.0	8.0	8.0	9.0
Sr	150.0	140.0	180.0	150.0	150.0	135.0	145.0	135.0
Ti	4941.8	4103.2	4372.7	3923.5	4133.1	3324.5	3773.7	3294.5
Zr	280.0	230.0	250.0	260.0	250.0	260.0	260.0	280.0
La	48.0	42.0	46.5	38.5	54.0	52.0	58.0	40.0
Ce	100.0	84.0	96.0	86.0	105.0	100.0	110.0	76.0
Pr	12.5	10.0	10.5	8.5	12.0	12.0	13.0	8.5
Nd	46.5	35.5	39.0	31.5	41.0	42.0	44.0	31.5
Sm	10.5	7.5	8.5	7.0	8.5	8.5	8.5	6.0
Eu	2.0	1.9	1.9	2.0	1.7	1.8	1.9	1.7
Gd	9.0	6.5	7.0	6.5	7.0	7.5	7.0	5.0
Tb	1.7	1.3	1.3	1.2	1.3	1.3	1.4	1.0
Dy	10.5	7.5	8.0	7.0	8.0	8.0	8.5	5.5
Ho	2.0	1.5	1.8	1.5	1.7	1.7	1.7	1.2
Er	6.0	4.7	5.0	4.2	5.0	5.0	5.5	3.5
Tm	0.9	0.7	0.8	0.6	0.8	0.8	0.8	0.5
Yb	5.5	4.7	5.0	3.9	5.0	4.8	5.0	3.3
Lu	0.8	0.7	0.8	0.6	0.8	0.8	0.8	0.5
Total	255.81	208.45	231.85	198.96	251.62	246.12	266.00	184.10
ASI	0.86	0.90	0.92	0.97	0.87	0.90	0.91	0.96
(La/Yb) _N	5.90	6.04	6.28	6.67	7.30	7.32	7.84	8.19
(La/Sm) _N	2.88	3.52	3.44	3.46	4.00	3.85	4.29	4.20
(Gd/Yb) _N	1.33	1.12	1.13	1.35	1.13	1.27	1.13	1.23
(Eu/Eu*) _N	0.63	0.83	0.73	0.91	0.65	0.69	0.75	0.92

Table 3.1 cont

Sample	95/598	95/402c	96/582a	96/574a	95/347a	95/574	95/495eB
Easting	52 614780	52 601900	52 620900	52 514180	52 627152	52 514180	52 517830
Northing	7125200	7124560	7126000	7131100	7124370	7131100	7130436
(La/Yb) _N Group	Yb enriched	Yb enriched	Yb enriched	Yb depleted	Yb depleted	Yb depleted	Yb depleted
SiO ₂	66.80	67.70	69.20	74.40	72.60	66.00	68.70
Al ₂ O ₃	14.20	14.90	14.40	11.90	13.70	16.70	13.70
Fe ₂ O ₃	6.27	3.88	3.28	3.21	2.21	6.05	5.03
MnO	0.17	0.11	0.09	0.14	0.07	0.30	0.14
MgO	1.79	0.97	0.84	0.48	0.48	1.56	1.58
CaO	3.97	3.54	2.70	1.72	2.07	0.84	2.30
Na ₂ O	3.08	3.40	3.23	2.79	3.33	1.60	2.79
K ₂ O	2.44	3.62	4.92	4.13	4.28	5.46	4.44
TiO ₂	0.88	0.58	0.52	0.51	0.29	0.62	0.57
P ₂ O ₅	0.18	0.11	0.10	0.09	0.10	0.04	0.01
LOI	0.11	0.52	0.41	0.28	0.42	0.03	0.03
Total, %	99.89	99.33	99.69	99.65	99.55	99.20	99.29
Ga	21.5	21.5	20.0	15.5	17.0	19.0	21.0
Cr	20.0	10.0	10.0	10.0	10.0	40.0	20.0
Ni	15.0	7.0	5.0	3.0	5.0	16.0	14.0
Sc	16.0	10.0	8.0	12.0	5.0	10.0	12.0
V	90.0	50.0	40.0	20.0	20.0	60.0	50.0
Y	36.0	27.5	40.0	23.5	15.0	29.0	9.0
Rb	70.0	100.0	145.0	125.0	140.0	140.0	290.0
Ba	550.0	1050.0	1350.0	1100.0	900.0	1250.0	1200.0
Th	1.8	5.5	13.0	1.5	17.5	31.0	3.2
U	0.2	0.4	0.4	0.2	1.2	1.0	0.2
Ta	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nb	14.5	11.5	13.0	8.0	9.0	7.0	4.5
Pb	24.5	33.0	33.0	31.5	36.0	45.5	43.0
Hf	8.0	6.0	9.0	6.0	5.0	6.0	6.0
Sr	160.0	230.0	310.0	145.0	210.0	210.0	220.0
Ti	5271.2	3474.2	3114.8	3054.9	1737.1	3713.8	3384.4
Zr	280.0	220.0	310.0	220.0	150.0	190.0	190.0
La	52.0	38.0	64.0	42.0	44.0	72.0	48.0
Ce	105.0	66.0	120.0	78.0	82.0	145.0	82.0
Pr	12.5	8.0	14.0	8.5	9.0	15.5	8.0
Nd	44.0	28.5	50.0	30.0	29.5	54.0	26.5
Sm	9.0	5.5	9.5	5.5	5.0	8.5	3.5
Eu	1.6	1.9	2.2	1.7	1.2	2.0	1.7
Gd	7.0	5.0	8.0	4.7	3.6	6.5	2.5
Tb	1.3	0.9	1.3	0.8	0.6	1.1	0.3
Dy	7.5	5.5	7.5	4.7	3.6	6.0	1.8
Ho	1.5	1.0	1.5	0.9	0.6	1.1	0.4
Er	4.1	3.0	4.6	2.6	1.6	3.0	1.2
Tm	0.6	0.4	0.7	0.4	0.3	0.4	0.2
Yb	3.7	2.7	4.2	2.3	1.7	2.6	1.5
Lu	0.5	0.4	0.6	0.3	0.2	0.4	0.2
Total	250.22	166.78	288.03	182.51	182.79	318.05	177.72
ASI	0.95	0.93	0.93	0.98	0.99	1.66	1.01
(La/Yb) _N	9.50	9.51	10.30	12.34	18.02	18.71	22.37
(La/Sm) _N	3.64	4.35	4.24	4.81	5.54	5.33	8.63
(Gd/Yb) _N	1.53	1.50	1.54	1.66	1.77	2.03	1.40
(Eu/Eu*) _N	0.62	1.11	0.77	1.02	0.83	0.82	1.76

Table 3.1 cont

Sample	95/387	95/355a	95/574b	Continental	Island
Easting	52 607700	52 627625	52 514180		
Northing	7123565	7125275	7131100		
(La/Yb) _N Group	Yb depleted	Yb depleted	Yb depleted	(ADR)	(ADR)
SiO ₂	76.00	74.40	73.40	63.87	67.72
Al ₂ O ₃	12.40	13.30	13.80	17.02	15.44
Fe ₂ O ₃	1.33	1.82	1.46	4.34	4.43
MnO	0.02	0.06	0.05	0.11	0.11
MgO	0.29	0.41	0.16	2.22	1.48
CaO	1.31	1.74	1.19	4.80	3.98
Na ₂ O	2.67	3.02	3.33	4.38	3.29
K ₂ O	5.18	4.97	5.65	2.37	2.95
TiO ₂	0.25	0.25	0.19	0.68	0.49
P ₂ O ₅	0.04	0.04	0.02	0.21	0.11
LOI	0.45	0.41	0.56	-	-
Total, %	99.94	100.42	99.81	100.00	100.00
Ga	15.5	17.0	22.0	-	-
Cr	10.0	10.0	10.0	29.0	21.0
Ni	3.0	4.0	3.0	19.0	9.0
Sc	5.0	5.0	5.0	12.1	10.9
V	20.0	20.0	20.0	84.0	71.0
Y	6.5	12.5	6.0	27.4	28.5
Rb	135.0	170.0	280.0	83.0	109.0
Ba	500.0	850.0	600.0	501.0	514.0
Th	3.0	26.0	28.5	13.2	5.0
U	0.2	0.9	3.6	3.6	0.7
Ta	1.0	1.0	1.0	1.2	0.5
Nb	4.5	7.5	3.0	15.0	15.8
Pb	35.0	40.0	76.0	-	-
Hf	4.0	4.0	5.0	5.5	2.6
Sr	135.0	200.0	84.0	424.0	229.0
Ti	1497.5	1497.5	1108.2	-	-
Zr	120.0	130.0	110.0	190.0	133.0
La	24.5	44.0	47.5	29.9	32.0
Ce	38.0	80.0	82.0	60.2	55.3
Pr	4.0	8.5	7.5	-	-
Nd	13.0	28.0	22.0	28.3	17.9
Sm	2.1	4.9	3.0	5.3	6.4
Eu	1.3	1.2	0.8	1.2	3.6
Gd	1.6	3.5	2.1	4.3	7.0
Tb	0.2	0.5	0.3	-	-
Dy	1.4	3.0	1.4	3.6	6.9
Ho	0.3	0.5	0.2	-	-
Er	0.7	1.3	0.6	2.2	5.0
Tm	0.1	0.2	0.1	-	-
Yb	0.5	0.8	0.6	2.4	4.3
Lu	0.1	0.1	0.1	0.4	0.5
Total	87.71	176.37	168.08	-	-
ASI	1.00	0.98	1.00	0.92	0.97
(La/Yb) _N	33.11	39.64	58.36	8.29	5.08
(La/Sm) _N	7.34	5.65	9.97	3.57	3.15
(Gd/Yb) _N	2.59	3.78	3.09	1.36	1.85
(Eu/Eu*) _N	2.17	0.85	0.94	0.76	1.64

Table 3.2 Sm-Nd isotope data for felsic rocks (from this study)

Sample No.	(La/Yb) _N Group	Est. Age (Ma)	Nd (ppm)	Sm (ppm)	¹⁴⁷ Sm/ ¹⁴⁴ Nd	¹⁴³ Nd/ ¹⁴⁴ Nd	2σ ¹	ε _{Nd} (0)	ε _{Nd} (1550)	T _{DM} ²
95/598	Yb enriched	1550	43.3	8.5	0.1188	0.511783	9	-16.7	-1.2	2169
95/361	Yb enriched	1548±28	33.1	6.5	0.1189	0.511839	8	-15.6	-0.2	2083
95/168b	Yb enriched	1550	41.6	8.5	0.1236	0.511885	8	-14.7	-0.2	2114
95/472	Yb enriched	1550	43.6	8.6	0.1199	0.511858	8	-15.2	0.0	2074
96/614	Yb enriched	1550	38.3	7.8	0.1232	0.511891	9	-14.6	0.0	2096
95/402c	Yb enriched	1550	29.3	5.7	0.1185	0.511845	9	-15.5	0.1	2065
96/574a	Yb depleted	1550	30.8	5.8	0.1130	0.511772	9	-16.9	-0.3	2062
95/355a	Yb depleted	1550	30.5	5.2	0.1028	0.511706	10	-18.2	0.5	1963
95/387	Yb depleted	1550	13.8	2.3	0.0996	0.511698	9	-18.3	0.9	1921

¹ Isotope error measurements are 2 S.E. ¹⁴³Nd/¹⁴⁴Nd_{CHUR}(0)=0.512638, ¹⁴⁷Sm/¹⁴⁴Nd_{CHUR}=0.1967

² DM model ages as per Goldstein et al. 1984 (¹⁴³Nd/¹⁴⁴Nd=0.51315 ¹⁴⁷Sm/¹⁴⁴Nd=0.2145)