

184160: psammitic schist, Weedarra Homestead

(Mumba Psammite, Moogie Metamorphics, Gascoyne Province)

Location and sampling

GLENBURGH (SG 50-6), DAURIE CREEK (2047)
MGA Zone 50, 383444E 7233694N

Sampled on 30 July 2006

The sample was collected from a low rise approximately 1.7 km west of Mooloo Pool, and 3.0 km northwest of Weedarra Homestead. The sample site is also 5–10 m west of a 2-m wide, north-trending dolerite dyke.

Tectonic unit/relations

The psammitic schist sampled is part of the Paleoproterozoic Mumba Psammite, a unit of quartzofeldspathic and quartz-rich psammitic schists, and metamorphosed quartz sandstone, all with minor interbedded pelitic schist. The Mumba Psammite is a component of the Moogie Metamorphics, a succession of largely retrogressed psammitic and pelitic rocks, and minor mafic meta-igneous and calc-silicate rocks, considered the oldest metasedimentary package in the Gascoyne Province (Occhipinti and Sheppard, 2000; Occhipinti et al., 2001). Other Mumba Psammite rocks sampled for detrital zircon geochronology include psammitic schist (GSWA 183275) and pelitic migmatite (GSWA 184161) on DAURIE CREEK (Kirkland et al., 2009a,b), and quartzite (GSWA 187403) on YINNETHARRA (Wingate et al., 2010).

Petrographic description

This metasedimentary rock exhibits a weak to moderate foliation defined by grains of quartz and chlorite, although recrystallization has obliterated all primary textural detail. The rock consists primarily of anhedral granular quartz (75%) about 0.2–0.4 mm long, with convoluted contacts against adjacent grains, and with a weak preferred orientation of grain long axes. Chlorite occurs in elongate clots parallel to the long axes of quartz grains. Chlorite appears to have formed as a result of biotite alteration, as a few small grains of fresh biotite are preserved. Also present are minor coarse flakes of muscovite (typically embedded in biotite aggregates), bladed narrow hematite crystals, and small leucoxene grains, the latter probably after titanite.

Zircon morphology

Zircons from this sample range from pale pink to pale brown, most with pitted surfaces and abraded terminations. The zircons are 50–300 µm long, and are equant to elongate

with aspect ratios up to 5:1. Most grains display concentric growth zoning, which, in many cases, is truncated at grain edges. The pitted external surfaces and high degree of rounding are consistent with mechanical abrasion during sedimentary transport. A cathodoluminescence image of representative zircons is shown in Figure 1.

Analytical details

The sample was analysed during two sessions, on 26–27 and 30–31 May 2007, using SHRIMP-B. Analyses 1.1 to 46.1 (spot numbers 1–48) were obtained during the first session, together with 20 analyses of the Temora standard, which yielded an external spot-to-spot (reproducibility) uncertainty of 1.70% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.44% (1σ). Analyses 47.1 to 60.1 (spot numbers 49–64) were obtained during the second session together with eight analyses of the Temora standard, from which seven analyses yielded an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.33% (1σ). Calibration uncertainties are included in the errors of $^{238}\text{U}/^{206}\text{Pb}^*$ ratios and dates listed in Table 1. Common-Pb corrections were applied to all analyses using contemporaneous common-Pb isotopic compositions determined according to the Pb isotopic evolution model of Stacey and Kramers (1975).

Results

Sixty-four analyses were obtained from 60 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 2) and a probability density diagram (Fig. 3).

Interpretation

Most analyses are concordant to slightly discordant (Fig. 2). Four analyses are characterized by slight to moderate discordance (>5%); the dates from these four analyses (Group D; Table 1) are imprecise or unreliable, and not considered geologically significant. The remaining 60 analyses can be divided into four groups, based on their positions within the crystals, and their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ and Th/U ratios.

Group Y comprises a single analysis (Table 1), which yields a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 2240 ± 8 Ma (1σ). This analysis was located in a zircon core with a Th/U ratio of 0.14.

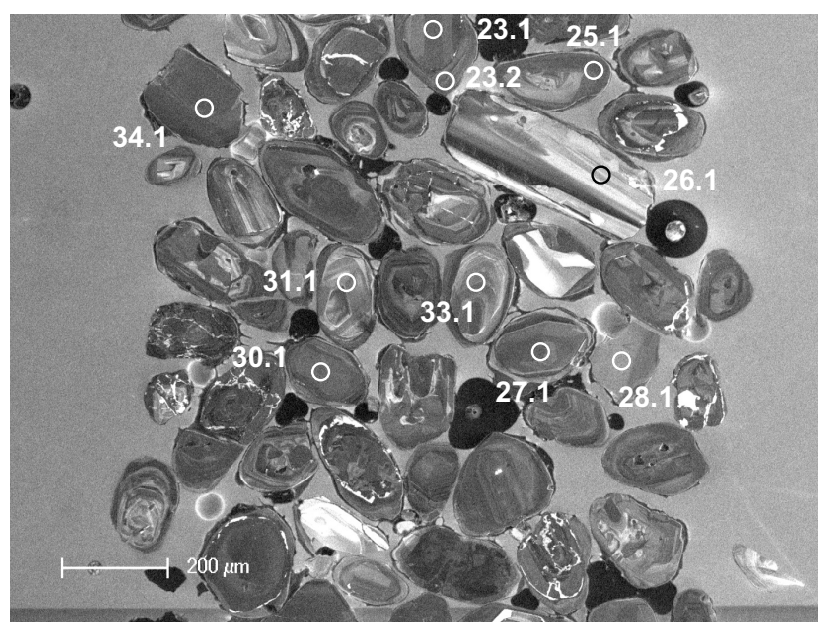


Figure 1. Cathodoluminescence image of representative zircons from sample 184160: psammitic schist, Weedarra Homestead. Numbered circles indicate approximate locations of analysis sites.

Group S comprises 46 analyses of 44 zircons (Table 1), which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates of 3165–2464 Ma. The analyses were located in zircon cores with Th/U ratios of 0.17–1.66.

Group P comprises six analyses of six zircon rims (Table 1), which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates of 1880–1795 Ma. These analyses indicate Th/U ratios of 0.01–0.13.

Group M comprises seven analyses of seven zircon rims (Table 1), which yield a weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1928 ± 7 Ma (MSWD = 1.1). These zircon rim analyses indicate Th/U ratios of 0.03–0.16.

It is possible that the single analysis (53.1) in Group Y reflects an unmodified detrital zircon, in which case the date of 2240 ± 8 Ma (1σ) represents a maximum age for deposition of the metasedimentary rock's sandstone protolith. A more conservative estimate of the maximum depositional age can be based on the weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 2485 ± 3 Ma (MSWD = 1.02) for the 26 youngest analyses in Group S.

The 47 analyses in Groups Y and S indicate significant age components at c. 2490, 2636, and 2664 Ma — defined by 30, 4, and 4 analyses, respectively — and several minor components in the range 3165–2239 Ma. These are interpreted as the ages of zircon-crystallizing rocks in the detrital source region(s), or as the ages of detrital components within reworked sediments.

The date of 1928 ± 7 Ma for the seven zircon rim analyses in Group M is interpreted as the age of a metamorphic event that affected this rock. Dates of 1880–1795 Ma for six analyses in Group P are interpreted to reflect ancient loss of radiogenic Pb from zircon rims that formed at c. 1930 Ma.

References

- Kirkland, CL, Bodorkos, S and Wingate, MTD 2009a, 183275: psammitic schist, Mount Dalgety; Geochronology Record 836: Geological Survey of Western Australia, 4p.
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- Occhipinti, SA and Sheppard, S 2000, Geology of the Glenburgh 1:100 000 sheet: Geological Survey of Western Australia, 1:100 000 Geological Series Explanatory Notes, 37p.
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- Stacey, JS and Kramers, JD 1975, Approximation of terrestrial lead isotope evolution by a two stage model: Earth and Planetary Science Letters, v. 26, pp. 207–221.
- Wingate, MTD, Kirkland, CL, Bodorkos, S, Groenewald, PB and Sheppard, S 2010, 187403: quartzite, Robertson Bore; Geochronology Record 862: Geological Survey of Western Australia, 5p.

Recommended reference for this publication

- Wingate, MTD, Kirkland, CL, Bodorkos, S and Sheppard, S 2010, 184160: psammitic schist, Weedarra Homestead; Geochronology Record 863: Geological Survey of Western Australia, 5p.

Data obtained: 31 May 2007
Data released: 31 January 2010

Table 1. Ion microprobe analytical results for zircons from sample 184160: psammitic schist, Weedarra Homestead

Group	Spot	Grain.	^{238}U	^{232}Th	^{232}Th	f_{204}	$^{238}\text{U}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{238}\text{U}/^{206}\text{Pb}^*$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$	$\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$	$\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$	$\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$	$\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$	$\pm 1\sigma$	date (Ma)	$\pm 1\sigma$	date (Ma)	$\pm 1\sigma$	Disc. (%)
ID	no.	spot	(ppm)	(ppm)	^{232}Th	^{238}U	(%)	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	(%)
Y	55	53.1	346	46	0.14	0.022	0.022	2.508	0.018	0.14119	0.00061	2.509	0.020	0.14099	0.00062	2163	20	2239	8	3.4				
S	20	19.1	77	71	0.95	-0.080	-0.080	2.187	0.046	0.16009	0.00145	2.185	0.047	0.16081	0.00151	2429	64	2464	16	1.4				
S	53	51.1	220	135	0.64	-0.034	-0.034	2.167	0.017	0.16064	0.00074	2.166	0.019	0.16095	0.00075	2447	26	2466	8	0.8				
S	7	6.1	253	204	0.83	0.033	0.033	2.147	0.040	0.16170	0.00081	2.148	0.041	0.16140	0.00083	2464	57	2470	9	0.3				
S	40	38.1	192	137	0.74	0.111	0.111	2.272	0.043	0.16252	0.00096	2.275	0.044	0.16153	0.00101	2349	55	2472	11	5.0				
S	5	4.1	177	98	0.57	0.045	0.045	2.170	0.041	0.16215	0.00095	2.171	0.042	0.16175	0.00098	2443	57	2474	10	1.3				
S	30	28.1	270	166	0.63	0.094	0.094	2.149	0.039	0.16276	0.00076	2.151	0.041	0.16192	0.00080	2461	56	2476	8	0.6				
S	18	17.1	97	113	1.20	-0.085	-0.085	2.227	0.045	0.16123	0.00131	2.225	0.047	0.16198	0.00136	2393	60	2476	14	3.4				
S	13	12.1	167	89	0.55	0.103	0.103	2.151	0.041	0.16316	0.00098	2.153	0.042	0.16224	0.00103	2459	58	2479	11	0.8				
S	49	47.1	354	146	0.43	0.009	0.009	2.152	0.015	0.16244	0.00071	2.152	0.017	0.16236	0.00071	2460	23	2480	7	0.8				
S	50	48.1	106	170	1.66	0.044	0.044	2.224	0.023	0.16295	0.00109	2.225	0.024	0.16256	0.00111	2392	31	2482	12	3.6				
S	46	44.1	152	93	0.63	0.045	0.045	2.160	0.042	0.16302	0.00111	2.161	0.043	0.16262	0.00113	2452	59	2483	12	1.3				
S	36	34.1	344	207	0.62	0.019	0.019	2.153	0.039	0.16281	0.00071	2.153	0.040	0.16264	0.00071	2459	56	2483	7	1.0				
S	35	33.1	207	120	0.60	0.071	0.071	2.177	0.042	0.16340	0.00091	2.179	0.043	0.16278	0.00094	2435	59	2485	10	2.0				
S	32	30.1	246	91	0.38	0.008	0.008	2.133	0.039	0.16289	0.00083	2.133	0.040	0.16281	0.00083	2478	57	2485	9	0.3				
S	27	25.1	452	112	0.26	0.008	0.008	2.118	0.038	0.16297	0.00058	2.118	0.039	0.16289	0.00059	2493	56	2486	6	-0.3				
S	52	50.1	615	133	0.22	0.018	0.018	2.140	0.014	0.16312	0.00045	2.141	0.015	0.16297	0.00046	2471	22	2487	5	0.6				
S	22	21.1	327	443	1.40	0.091	0.091	2.246	0.041	0.16380	0.00073	2.248	0.042	0.16299	0.00076	2372	53	2487	8	4.6				
S	47	45.1	280	110	0.41	0.008	0.008	2.170	0.040	0.16310	0.00079	2.171	0.041	0.16303	0.00079	2443	56	2487	8	1.8				
S	51	49.1	178	107	0.62	0.034	0.034	2.132	0.018	0.16334	0.00084	2.133	0.020	0.16303	0.00085	2479	28	2487	9	0.4				
S	15	14.1	456	244	0.55	0.032	0.032	2.253	0.040	0.16345	0.00061	2.254	0.041	0.16317	0.00062	2367	52	2489	6	4.9				
S	19	18.1	205	120	0.61	0.099	0.099	2.139	0.040	0.16424	0.00090	2.141	0.041	0.16336	0.00094	2471	58	2491	10	0.8				
S	31	29.1	399	309	0.80	-0.005	-0.005	2.159	0.039	0.16333	0.00063	2.159	0.040	0.16337	0.00064	2453	55	2491	7	1.5				
S	4	3.1	498	135	0.28	0.031	0.031	2.115	0.037	0.16377	0.00054	2.116	0.038	0.16350	0.00055	2495	55	2492	6	-0.1				
S	14	13.1	435	91	0.22	-0.009	-0.009	2.119	0.038	0.16361	0.00062	2.119	0.039	0.16369	0.00063	2492	56	2494	6	0.1				
S	34	32.1	400	160	0.41	0.005	0.005	2.110	0.038	0.16386	0.00065	2.110	0.039	0.16381	0.00065	2501	56	2495	7	-0.2				
S	48	46.1	331	216	0.68	-0.027	-0.027	2.168	0.039	0.16364	0.00074	2.167	0.041	0.16388	0.00075	2446	55	2496	8	2.0				
S	42	40.1	396	80	0.21	0.013	0.013	2.185	0.040	0.16404	0.00073	2.186	0.041	0.16393	0.00073	2429	55	2497	7	2.7				
S	8	7.1	668	184	0.28	0.000	0.000	2.156	0.038	0.16401	0.00053	2.156	0.039	0.16401	0.00053	2457	54	2497	5	1.6				
S	12	11.1	306	103	0.35	0.026	0.026	2.139	0.039	0.16436	0.00073	2.140	0.040	0.16413	0.00074	2472	56	2499	8	1.1				
S	45	43.1	498	354	0.73	0.016	0.016	2.154	0.038	0.16437	0.00057	2.154	0.039	0.16423	0.00058	2458	55	2500	6	1.7				
S	62	58.2	403	67	0.17	0.016	0.016	2.147	0.015	0.16460	0.00058	2.147	0.017	0.16446	0.00058	2465	23	2502	6	1.5				
S	56	54.1	317	312	1.02	0.018	0.018	2.152	0.016	0.16464	0.00061	2.153	0.017	0.16448	0.00061	2459	24	2502	6	1.7				
S	54	52.1	77	59	0.79	0.020	0.020	2.138	0.025	0.16494	0.00129	2.138	0.026	0.16476	0.00131	2474	37	2505	13	1.3				
S	33	31.1	118	150	1.30	0.000	0.000	2.150	0.043	0.16577	0.00119	2.150	0.044	0.16577	0.00119	2462	61	2515	12	2.1				

Table 1. (continued)

Group	Spot	Grain.	²³⁸ U	²³² Th	²³² Th ²³⁸ U	f ₂₀₄	²³⁸ U/ ²⁰⁶ Pb ± 1 σ	²⁰⁷ Pb/ ²⁰⁶ Pb ± 1 σ	²³⁸ U/ ²⁰⁶ Pb* ± 1 σ	²⁰⁷ Pb*/ ²⁰⁶ Pb* ± 1 σ	²³⁸ U/ ²⁰⁶ Pb* date (Ma) ± 1 σ	²⁰⁷ Pb*/ ²⁰⁶ Pb* date (Ma) ± 1 σ	Disc. (%)
S	9	8.1	123	61	0.52	-0.016	2.138 0.042	0.16585 0.00115	2.137 0.043	0.16599 0.00116	2474 61	2518 12	1.7
S	28	26.1	111	151	1.40	-0.056	2.105 0.042	0.16744 0.00126	2.104 0.043	0.16794 0.00129	2507 62	2537 13	1.2
S	17	16.1	246	82	0.34	0.042	2.160 0.040	0.16927 0.00086	2.161 0.041	0.16890 0.00088	2452 57	2547 9	3.7
S	16	15.1	326	276	0.87	0.036	2.049 0.037	0.16989 0.00072	2.050 0.038	0.16957 0.00073	2562 58	2553 7	-0.3
S	37	35.1	338	371	1.13	0.000	1.984 0.036	0.17778 0.00074	1.984 0.037	0.17778 0.00074	2631 61	2632 7	0.1
S	1	1.1	210	163	0.80	0.069	2.023 0.037	0.17905 0.00085	2.025 0.038	0.17844 0.00087	2588 60	2638 8	1.9
S	39	37.1	138	72	0.54	0.200	1.966 0.041	0.18152 0.00136	1.970 0.042	0.17974 0.00148	2647 69	2650 14	0.1
S	58	55.1	96	68	0.73	0.000	1.953 0.021	0.18094 0.00117	1.953 0.022	0.18094 0.00117	2665 37	2661 11	-0.1
S	29	27.1	439	299	0.70	-0.016	1.973 0.035	0.18131 0.00064	1.973 0.036	0.18145 0.00064	2643 60	2666 6	0.9
S	41	39.1	116	142	1.27	0.151	1.927 0.039	0.18399 0.00128	1.930 0.040	0.18265 0.00136	2692 68	2677 12	-0.5
S	25	23.2	326	329	1.04	0.016	1.934 0.035	0.18508 0.00073	1.934 0.036	0.18493 0.00074	2687 62	2698 7	0.4
S	10	9.1	373	220	0.61	0.050	1.678 0.030	0.24733 0.00078	1.678 0.031	0.24690 0.00079	3013 71	3165 5	4.8
P	61	58.1	378	20	0.06	0.188	3.100 0.023	0.11137 0.00054	3.106 0.025	0.10973 0.00062	1799 17	1795 10	-0.2
P	64	60.1	419	41	0.10	0.054	3.117 0.021	0.11238 0.00053	3.119 0.024	0.11190 0.00055	1793 16	1831 9	2.1
P	3	2.2	306	3	0.01	0.114	3.015 0.054	0.11332 0.00060	3.018 0.056	0.11233 0.00066	1845 39	1837 11	-0.4
P	24	23.1	356	5	0.02	0.066	3.013 0.054	0.11456 0.00063	3.015 0.056	0.11399 0.00066	1846 40	1864 10	0.9
P	6	5.1	374	4	0.01	0.017	2.981 0.054	0.11423 0.00063	2.981 0.055	0.11409 0.00064	1865 40	1866 10	0.0
P	43	41.1	348	45	0.13	0.125	3.087 0.056	0.11611 0.00071	3.091 0.058	0.11502 0.00078	1807 39	1880 12	3.9
M	59	56.1	274	8	0.03	0.014	2.860 0.021	0.11740 0.00060	2.860 0.023	0.11727 0.00061	1933 18	1915 9	-0.9
M	11	10.1	365	13	0.04	0.080	2.833 0.051	0.11816 0.00061	2.835 0.053	0.11745 0.00064	1948 42	1918 10	-1.6
M	44	42.1	322	15	0.05	0.064	2.947 0.054	0.11825 0.00073	2.949 0.056	0.11769 0.00077	1882 41	1921 12	2.0
M	23	22.1	543	31	0.06	0.031	2.936 0.053	0.11823 0.00051	2.937 0.054	0.11796 0.00053	1889 41	1925 8	1.9
M	63	59.1	475	22	0.05	0.024	2.879 0.019	0.11867 0.00049	2.879 0.022	0.11846 0.00050	1922 17	1933 8	0.6
M	57	55.2	373	57	0.16	0.095	2.915 0.020	0.11938 0.00055	2.918 0.022	0.11855 0.00059	1900 17	1934 9	1.8
M	26	24.1	623	67	0.11	0.185	2.987 0.053	0.12057 0.00048	2.992 0.054	0.11895 0.00056	1859 39	1940 8	4.2
D	60	57.1	317	155	0.51	0.116	2.304 0.017	0.16055 0.00062	2.307 0.018	0.15952 0.00066	2321 22	2451 7	5.3
D	21	20.1	350	226	0.67	0.089	2.758 0.050	0.16442 0.00072	2.761 0.051	0.16363 0.00075	1993 43	2494 8	20.1
D	2	2.1	293	357	1.26	0.072	3.088 0.056	0.16572 0.00087	3.090 0.058	0.16508 0.00090	1808 39	2508 9	27.9
D	38	36.1	112	60	0.56	0.408	1.940 0.123	0.24050 0.00178	1.948 0.124	0.23690 0.00196	2671 208	3099 13	13.8

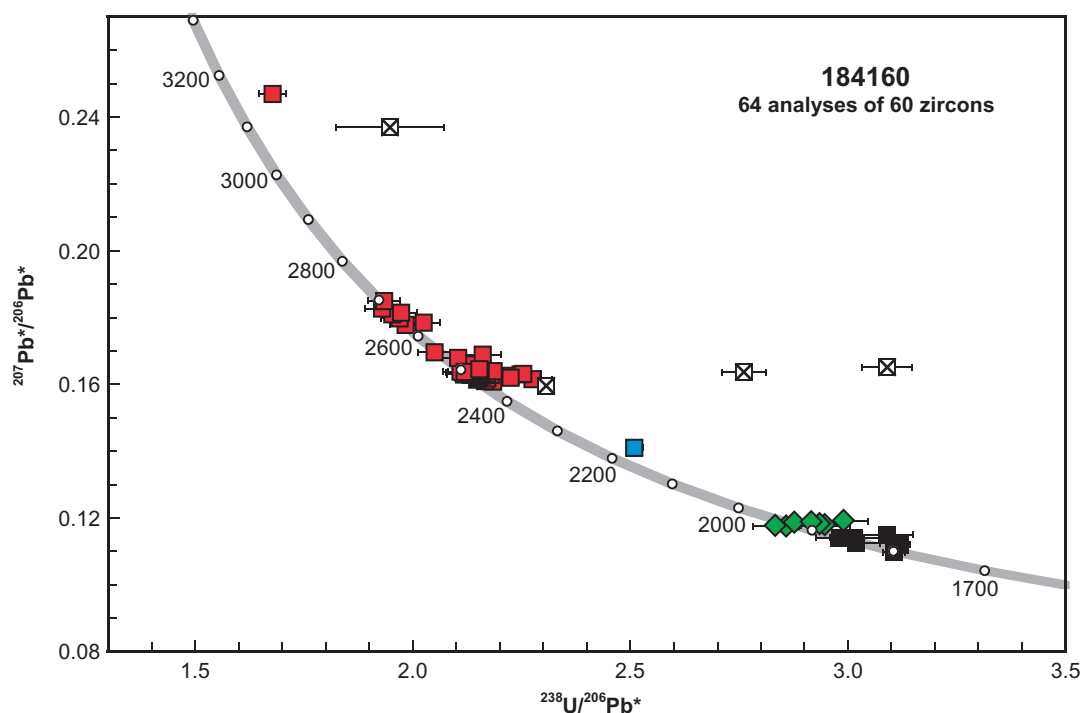


Figure 2. U–Pb analytical data for zircons from sample 184160: psammitic schist, Weedarra Homestead. Blue square indicates Group Y (youngest detrital zircon); red squares indicate Group S (older detrital zircons); black squares indicate Group P (Pb loss); green diamonds indicate Group M (metamorphic zircon rims); crossed squares indicate group D (discordance >5%).

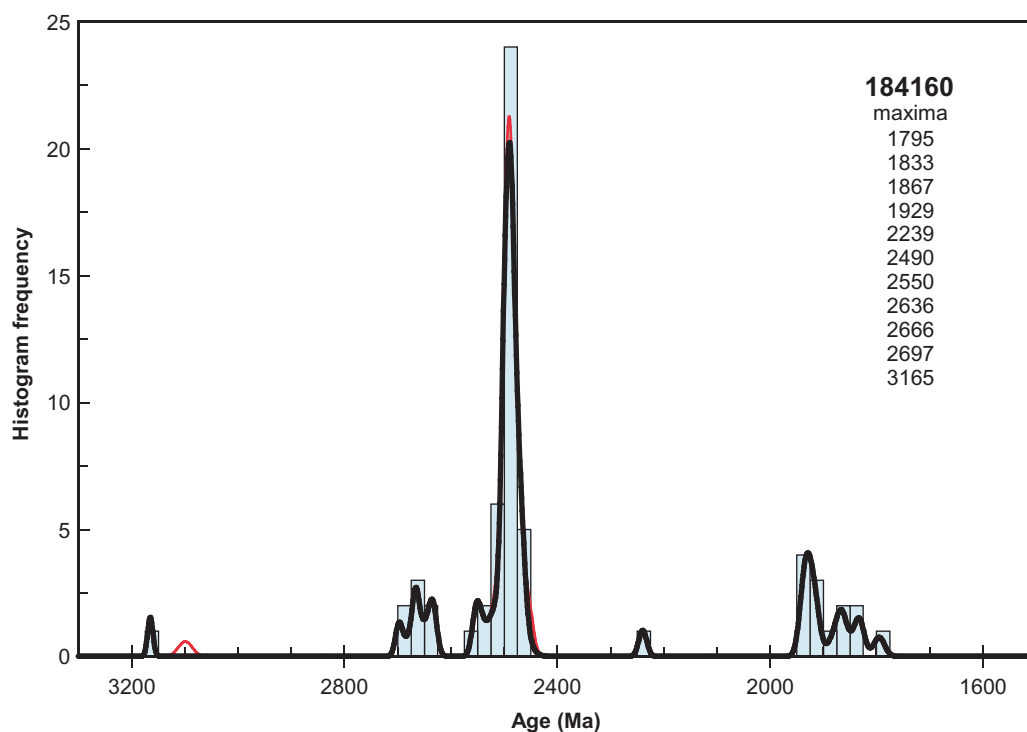


Figure 3. Probability density diagram and histogram for sample 184160: psammitic schist, Weedarra Homestead. Thicker curve, maxima values, and frequency histogram (bin width 25 Ma) only includes data <5% discordant (60 analyses of 57 zircons). Thinner curve includes all data (64 analyses of 60 zircons).