

# 187403: quartzite, Robinson Bore

(Mumba Psammite, Moogie Metamorphics, Gascoyne Province)

## Location and sampling

MOUNT PHILLIPS (SG 50-2), YINNETHARRA (2148)  
MGA Zone 50, 400692E 7286139N

Sampled on 12 August 2006

The sample was collected from a 2-m high outcrop, approximately 3.7 km east-southeast of Robinson Bore and 6.3 km south of White Well on Bidgemia Station.

## Tectonic unit/relations

The unit sampled is a steeply inclined, coarse-grained orthoquartzite, 30 to 50 m thick, and overlain to the east by a biotite-rich semipelitic unit. This quartzite is assigned to the Mumba Psammite, a unit of quartzofeldspathic and quartz-rich psammitic schist, and metamorphosed quartz sandstone, all with minor interbedded pelitic schist. The Mumba Psammite is a component of the Moogie Metamorphics, a Paleoproterozoic 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 rocks from the Mumba Psammite sampled for detrital zircon geochronology include psammitic schist (GSA 183275 and 184160) and pelitic migmatite (GSA 184161) on DAURIE CREEK (Kirkland et al., 2009a,b; Wingate et al., 2010).

## Petrographic description

A petrographic report is not available for this sample.

## Zircon morphology

This sample yielded abundant zircons, which are anhedral to subhedral, and clear and colourless to dark brown and turbid. The crystals are up to 350  $\mu\text{m}$  long, and equant to elongate with aspect ratios up to 3:1. Concentric growth zoning in the zircon cores is typically truncated at (abraded) grain boundaries, consistent with sedimentary transport. Most cores are overgrown by high-U rims, although the latter are very thin in some crystals. A cathodoluminescence image of representative zircons is shown in Figure 1.

## Analytical details

This sample was analysed during two sessions, on 26–28 May 2007 and 31 May 2007, using SHRIMP-B. Analyses 1.1 to 43.1 (spot numbers 1–45) were obtained during the first session together with 20 analyses of the Temora standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 1.49% ( $1\sigma$ ), and a  $^{238}\text{U}/^{206}\text{Pb}^*$  calibration uncertainty of 0.42% ( $1\sigma$ ). Analyses 44.1 to 60.1 (spot numbers 46–64) were obtained during the second session together with nine analyses of the Temora standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% ( $1\sigma$ ), and a  $^{238}\text{U}/^{206}\text{Pb}^*$  calibration uncertainty of 0.31% ( $1\sigma$ ). 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 model of Stacey and Kramers (1975).

## Results

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

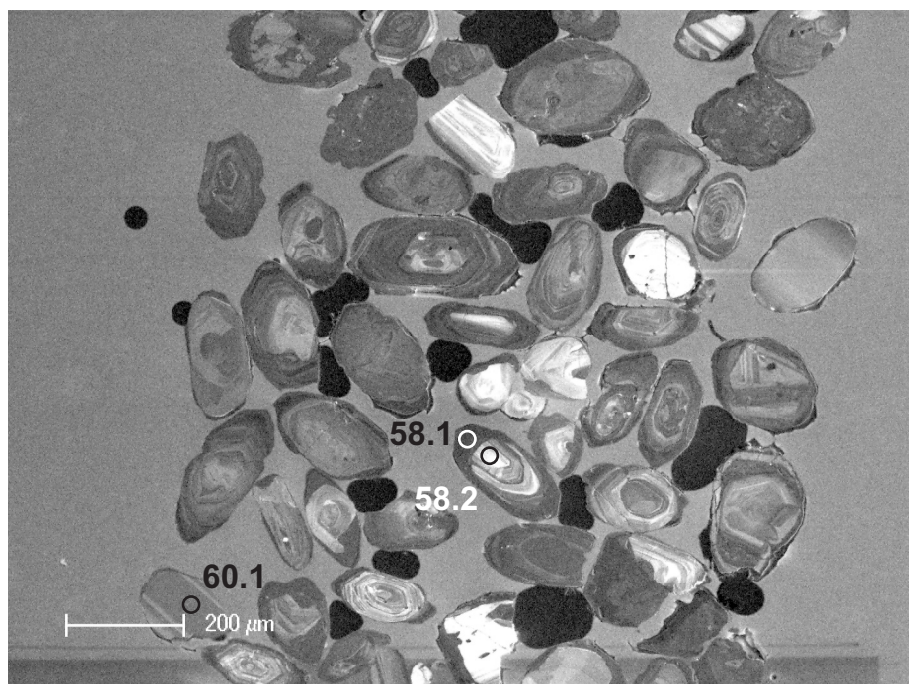
## Interpretation

The analyses are mainly concordant (Fig. 2). Three analyses are >5% discordant. The dates obtained from these three analyses (Group D; Table 1) are imprecise or unreliable, and not considered geologically significant. The remaining 61 analyses can be separated into three groups based on their positions within the crystals, U contents, and Th/U and  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  ratios.

Group Y comprises a single analysis of a zircon core (26.1, Table 1), which yields a  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  date of  $2286 \pm 13$  Ma ( $1\sigma$ ).

Group S comprises 56 analyses of 53 zircon cores (Table 1), which yield  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  dates of 3212–2327 Ma. These analyses indicate variable U contents (33–722 ppm) and Th/U ratios (0.13–1.6).

Group M comprises four analyses of four zircon rims (Table 1), which yield a weighted mean  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  date



**Figure 1. Cathodoluminescence image of representative zircons from sample 187403: quartzite, Robinson Bore. Numbered circles indicate approximate locations of analysis sites.**

of  $1772 \pm 6$  Ma (MSWD = 0.89). These analyses indicate high U contents (1070–1530 ppm) and low Th/U ratios (0.004–0.007).

It is possible that all of the analyses in Groups Y and S are of unmodified detrital zircons, in which case the  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  date of  $2286 \pm 13$  Ma ( $1\sigma$ ) for the single analysis (26.1) in Group Y represents a maximum depositional age for the 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  $2327 \pm 14$  Ma (MSWD = 0.05) for the two youngest analyses in Group S.

The 57 analyses in combined Groups Y and S indicate dates that define significant age components at c. 2448, 2509, and 2562 Ma, and several minor components spanning the range 3212–2286 Ma (Fig. 3). 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  $1772 \pm 6$  Ma for the four zircon rim analyses in Group M is interpreted as the age of a metamorphic event that has affected this rock.

Geochronology Record 835: Geological Survey of Western Australia, 4p.

Sheppard, S, Johnson, SP, Groenewald, PB and Farrell, TR 2008, Yinnetharra, WA Sheet 2148: Geological Survey of Western Australia, 1:100 000 Geological Series map.

Stacey, JS and Kramers, JD 1975, Approximation of terrestrial lead isotope evolution by a two-stage model: *Earth and Planetary Science Letters*, v. 26, p. 207–221.

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

## Recommended reference for this publication

Wingate, MTD, Kirkland, CL, Bodorkos, S, Groenewald, PB and Sheppard, S 2010, 187403: quartzite, Robinson Bore; Geochronology Record 862: Geological Survey of Western Australia, 5p.

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

## References

- Kirkland, CL, Wingate, MTD, Bodorkos, S, Sheppard, S and Johnson, SP 2009a, 183275, psammitic schist, Mount Dalgety; Geochronology Record 836: Geological Survey of Western Australia, 4p.
- Kirkland, CL, Wingate, MTD, Bodorkos, S and Sheppard, S 2009b, 184161, quartzofeldspathic migmatite, Mount Dalgety;

Table 1. Ion microprobe analytical results for zircons from sample 187403: quartzite, Robinson Bore

Group ID	Spot no.	Grain. spot	$^{238}\text{U}$ (ppm)	$^{232}\text{Th}$ (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	$f_{204}$ (%)	$\frac{^{238}\text{U}}{^{206}\text{Pb}} \pm 1\sigma$	$\frac{^{207}\text{Pb}}{^{206}\text{Pb}} \pm 1\sigma$	$\frac{^{238}\text{U}}{^{206}\text{Pb}^*} \pm 1\sigma$	$\frac{^{207}\text{Pb}^*}{^{206}\text{Pb}^*} \pm 1\sigma$	$\frac{^{238}\text{U}}{^{206}\text{Pb}^*} \pm 1\sigma$	$\frac{^{207}\text{Pb}^*}{^{206}\text{Pb}^*} \pm 1\sigma$	$\frac{^{238}\text{U}}{^{206}\text{Pb}^*} \pm 1\sigma$	$\frac{^{207}\text{Pb}^*}{^{206}\text{Pb}^*} \pm 1\sigma$	date (Ma) $\pm 1\sigma$	date (Ma) $\pm 1\sigma$	Disc. (%)		
Y	27	26.1	178	88	0.51	0.021	2.376	0.040	0.14508	0.00102	2.377	0.040	0.14489	0.00110	2264	32	2286	13	1.0
S	55	53.1	346	135	0.40	-0.005	2.323	0.013	0.14830	0.00065	2.323	0.013	0.14835	0.00065	2308	11	2327	7	0.8
S	11	11.1	286	93	0.33	-0.034	2.361	0.039	0.14860	0.00245	2.361	0.039	0.14890	0.00246	2277	32	2333	28	2.4
S	34	32.2	553	70	0.13	0.015	2.181	0.035	0.15641	0.00060	2.181	0.035	0.15628	0.00062	2433	32	2416	7	-0.7
S	32	31.1	312	124	0.41	-0.003	2.214	0.036	0.15792	0.00082	2.214	0.036	0.15794	0.00082	2403	33	2434	9	1.3
S	10	10.1	351	65	0.19	0.042	2.193	0.035	0.15835	0.00073	2.194	0.035	0.15798	0.00076	2421	33	2434	8	0.5
S	46	44.1	435	79	0.19	0.032	2.172	0.010	0.15862	0.00059	2.173	0.011	0.15833	0.00060	2440	10	2438	6	-0.1
S	35	33.1	184	63	0.36	0.000	2.161	0.036	0.15845	0.00102	2.161	0.036	0.15845	0.00102	2451	34	2439	11	-0.5
S	28	27.1	236	59	0.26	-0.020	2.202	0.036	0.15838	0.00094	2.201	0.036	0.15856	0.00095	2414	33	2440	10	1.1
S	60	57.1	441	78	0.18	-0.006	2.150	0.011	0.15860	0.00059	2.150	0.011	0.15866	0.00059	2462	11	2441	6	-0.8
S	13	13.1	238	54	0.23	0.060	2.203	0.036	0.15926	0.00091	2.205	0.036	0.15873	0.00093	2411	33	2442	10	1.3
S	37	35.1	77	119	1.60	-0.039	2.156	0.039	0.15847	0.00153	2.155	0.039	0.15882	0.00155	2457	37	2443	17	-0.6
S	19	19.1	193	56	0.30	-0.004	2.177	0.036	0.15899	0.00101	2.177	0.036	0.15902	0.00101	2437	34	2445	11	0.3
S	31	30.1	363	241	0.69	0.015	2.185	0.037	0.15917	0.00079	2.186	0.037	0.15904	0.00080	2429	34	2445	9	0.7
S	20	20.1	141	51	0.37	0.033	2.222	0.038	0.15950	0.00118	2.223	0.038	0.15921	0.00121	2395	34	2447	13	2.2
S	54	52.1	178	134	0.78	0.069	2.167	0.014	0.15991	0.00092	2.169	0.014	0.15929	0.00094	2444	13	2448	10	0.2
S	53	51.1	560	87	0.16	0.018	2.140	0.010	0.15952	0.00050	2.140	0.010	0.15936	0.00051	2472	10	2449	5	-0.9
S	7	7.1	391	151	0.40	0.073	2.179	0.035	0.16040	0.00072	2.181	0.035	0.15975	0.00074	2433	33	2453	8	0.8
S	40	38.1	298	89	0.31	0.011	2.215	0.036	0.15994	0.00077	2.216	0.036	0.15984	0.00077	2401	33	2454	8	2.1
S	48	46.1	359	177	0.51	0.018	2.159	0.011	0.16028	0.00064	2.160	0.011	0.16012	0.00065	2453	10	2457	7	0.2
S	6	6.1	280	54	0.20	0.003	2.233	0.036	0.16023	0.00085	2.233	0.036	0.16020	0.00085	2386	33	2458	9	2.9
S	45	43.1	128	64	0.51	0.139	2.242	0.038	0.16151	0.00120	2.245	0.038	0.16027	0.00125	2375	34	2458	13	3.4
S	41	39.1	233	58	0.26	0.033	2.208	0.036	0.16058	0.00107	2.208	0.036	0.16029	0.00109	2408	33	2459	11	2.1
S	4	4.1	246	56	0.24	0.054	2.151	0.035	0.16097	0.00092	2.153	0.035	0.16049	0.00097	2460	34	2461	10	0.1
S	29	28.1	225	59	0.27	-0.053	2.186	0.036	0.16003	0.00093	2.185	0.036	0.16050	0.00097	2430	33	2461	10	1.3
S	44	42.1	447	213	0.49	0.021	2.185	0.035	0.16138	0.00078	2.186	0.035	0.16120	0.00079	2429	32	2468	8	1.6
S	59	56.1	179	158	0.92	0.086	2.133	0.014	0.16473	0.00092	2.135	0.014	0.16397	0.00097	2476	13	2497	10	0.8
S	23	23.1	190	94	0.51	0.104	2.172	0.036	0.16540	0.00104	2.174	0.036	0.16447	0.00108	2439	34	2502	11	2.5
S	36	34.1	430	254	0.61	0.029	2.192	0.035	0.16475	0.00075	2.192	0.035	0.16449	0.00078	2422	33	2502	8	3.2
S	3	3.1	176	87	0.51	0.121	2.090	0.035	0.16615	0.00095	2.093	0.035	0.16506	0.00114	2518	35	2508	12	-0.4
S	49	47.1	269	191	0.73	-0.008	2.092	0.012	0.16536	0.00075	2.092	0.012	0.16543	0.00075	2519	12	2512	8	-0.3
S	17	17.1	121	73	0.62	0.131	2.117	0.037	0.16681	0.00128	2.120	0.037	0.16564	0.00133	2491	36	2514	14	0.9
S	42	40.1	233	198	0.88	0.108	2.158	0.036	0.16720	0.00097	2.160	0.036	0.16624	0.00102	2452	34	2520	10	2.7
S	8	8.1	242	189	0.81	0.032	2.106	0.035	0.16658	0.00090	2.107	0.035	0.16630	0.00093	2504	34	2521	9	0.7
S	52	50.1	265	162	0.63	-0.001	2.098	0.012	0.16738	0.00075	2.098	0.012	0.16739	0.00075	2513	12	2532	7	0.8
S	43	41.1	313	218	0.72	-0.024	2.108	0.034	0.16764	0.00080	2.107	0.034	0.16785	0.00081	2503	34	2536	8	1.3

Table 1. (continued)

Group ID	Spot no.	Grain. spot	$^{238}\text{U}$ (ppm)	$^{232}\text{Th}$ (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	$f_{204}$ (%)	$^{238}\text{U}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	Disc. (%)
S	15	15.1	119	104	0.91	0.006	2.082 0.036	0.16936 0.00130	2.082 0.036	0.16930 0.00135	2529 36	2551 13	0.9
S	64	60.1	353	349	1.02	0.005	2.066 0.014	0.16986 0.00069	2.066 0.014	0.16981 0.00069	2545 14	2556 7	0.4
S	38	36.1	368	382	1.07	0.001	2.084 0.034	0.17040 0.00076	2.084 0.034	0.17040 0.00076	2527 34	2562 7	1.4
S	56	54.1	722	211	0.30	-0.013	2.086 0.009	0.17047 0.00046	2.086 0.009	0.17059 0.00047	2525 9	2563 5	1.5
S	21	21.1	318	216	0.70	-0.028	2.031 0.033	0.17232 0.00092	2.031 0.033	0.17257 0.00093	2581 35	2583 9	0.1
S	30	29.1	212	87	0.42	0.033	2.061 0.034	0.17693 0.00098	2.061 0.034	0.17663 0.00098	2549 35	2622 9	2.8
S	26	25.1	104	84	0.83	0.186	2.010 0.036	0.18040 0.00142	2.014 0.036	0.17873 0.00149	2599 38	2641 14	1.6
S	62	58.2	207	81	0.41	-0.013	2.050 0.013	0.17973 0.00092	2.050 0.013	0.17985 0.00093	2562 13	2651 9	3.4
S	14	14.1	33	27	0.85	0.478	1.945 0.042	0.18941 0.00250	1.954 0.042	0.18515 0.00305	2664 47	2700 27	1.3
S	50	48.1	659	308	0.48	0.005	1.933 0.008	0.18932 0.00051	1.933 0.008	0.18928 0.00052	2688 10	2736 5	1.8
S	9	9.1	67	63	0.98	0.169	1.896 0.035	0.19152 0.00175	1.900 0.035	0.19002 0.00188	2726 42	2742 16	0.6
S	1	1.1	95	57	0.62	0.045	1.927 0.034	0.19185 0.00138	1.928 0.034	0.19145 0.00141	2693 38	2755 12	2.2
S	51	49.1	176	61	0.36	0.060	1.831 0.019	0.19903 0.00098	1.832 0.019	0.19849 0.00102	2808 24	2814 8	0.2
S	18	18.1	105	45	0.44	0.089	1.886 0.033	0.20106 0.00144	1.887 0.033	0.20026 0.00151	2741 39	2828 12	3.1
S	25	24.2	140	172	1.27	-0.034	1.838 0.031	0.20379 0.00129	1.837 0.031	0.20409 0.00131	2802 39	2859 10	2.0
S	5	5.1	171	73	0.44	0.020	1.781 0.030	0.21947 0.00138	1.781 0.030	0.21929 0.00141	2872 39	2975 10	3.5
S	16	16.1	77	23	0.31	0.168	1.704 0.031	0.22131 0.00172	1.707 0.031	0.21982 0.00182	2973 44	2979 13	0.2
S	39	37.1	98	61	0.64	0.177	1.728 0.031	0.22790 0.00171	1.731 0.031	0.22633 0.00179	2940 43	3026 13	2.9
S	47	45.1	698	317	0.47	0.019	1.672 0.007	0.23716 0.00053	1.673 0.007	0.23700 0.00053	3021 10	3100 4	2.5
S	58	55.1	307	113	0.38	0.005	1.618 0.009	0.23973 0.00080	1.618 0.009	0.23969 0.00080	3103 13	3118 5	0.5
S	2	2.1	128	63	0.51	-0.024	1.536 0.026	0.25416 0.00129	1.536 0.026	0.25436 0.00130	3233 43	3212 8	-0.6
M	24	24.1	1526	8	0.01	0.031	3.194 0.050	0.10818 0.00034	3.195 0.050	0.10791 0.00036	1756 24	1764 6	0.5
M	33	32.1	1329	5	0.00	-0.005	3.118 0.049	0.10827 0.00037	3.118 0.049	0.10831 0.00037	1793 25	1771 6	-1.2
M	57	54.2	1072	6	0.01	0.008	3.106 0.012	0.10846 0.00034	3.106 0.012	0.10839 0.00034	1799 6	1772 6	-1.5
M	61	58.1	1881	12	0.01	0.012	3.182 0.012	0.10875 0.00027	3.182 0.012	0.10865 0.00028	1762 6	1777 5	0.9
D	63	59.1	838	116	0.14	0.158	3.492 0.016	0.12278 0.00058	3.498 0.016	0.12140 0.00066	1621 7	1977 10	18.0
D	12	12.1	293	125	0.44	0.069	2.389 0.039	0.15852 0.00085	2.391 0.039	0.15791 0.00088	2253 31	2433 9	7.4
D	22	22.1	849	67	0.08	0.050	2.121 0.034	0.20249 0.00077	2.122 0.034	0.20205 0.00078	2489 33	2843 6	12.5

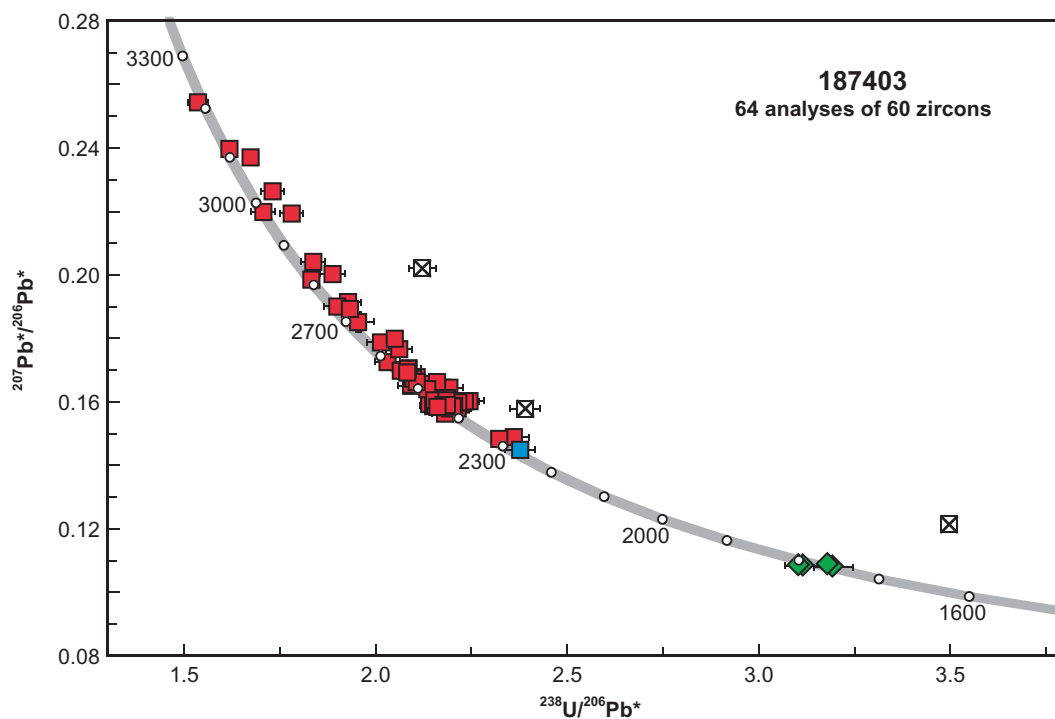


Figure 2. U-Pb analytical data for sample 187403: quartzite, Robinson Bore. Blue square indicates Group Y (youngest detrital zircon); red squares indicate Group S (older detrital zircons); green diamonds indicate Group M (zircon rims); crossed squares indicate Group D (discordance >5%).

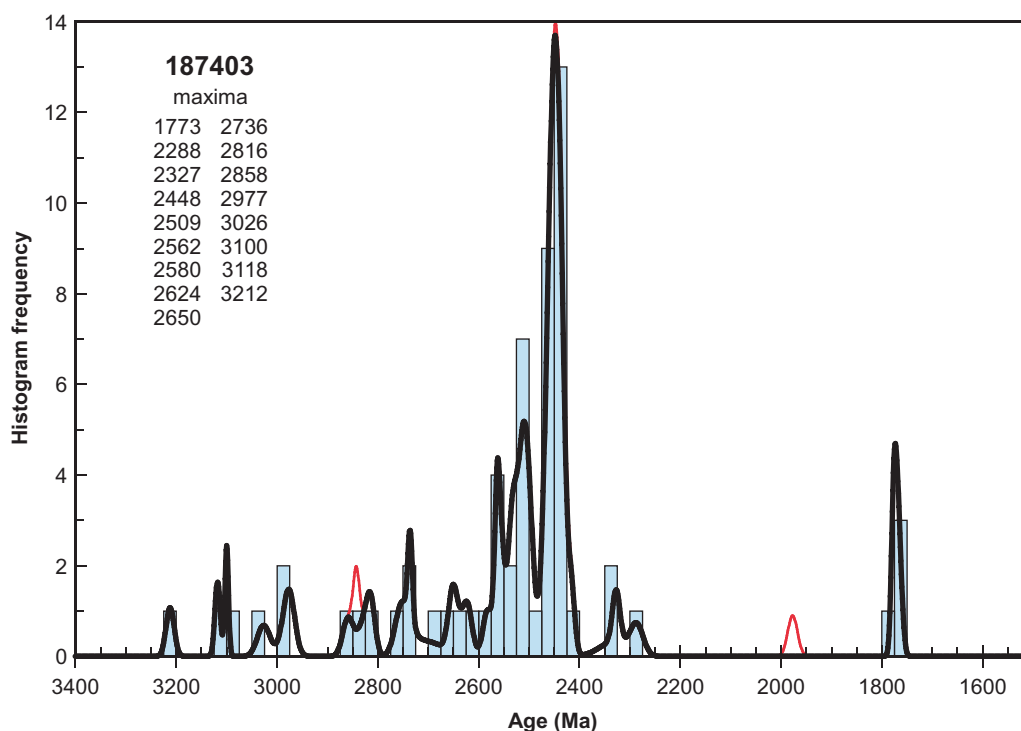


Figure 3. Probability density diagram for sample 187403: quartzite, Robinson Bore. Thicker curve, maxima values, and frequency histogram (bin width 25 Ma) only include results with <5% discordance (61 analyses of 58 zircons). Thinner curve includes all data (64 analyses of 60 zircons).