

184341: quartzite, Lake Mackay

(Aileron Province, Arunta Orogen)

Location and sampling

WEBB (SF 52-10), DWARF WELL (4553)
MGA Zone 52, 418715 E 7543225N

Sampled on 1 August 2007

The sample was collected from an outcrop of quartzite with minor lithological variation within low hills and ridges of deformed and folded quartzite, in the north-central part of the WEBB 1:250 000 map sheet, west of Lake Mackay, and about 79 km north-northeast of the Kiwirrkurra town site.

Tectonic unit/relations

The quartzite is part of a series of unnamed, folded quartzites within the Aileron Province of the Arunta Orogen. These rocks are interpreted to overlie metamorphosed granites of the c. 1805–1770 Ma Carrington Suite (Edgoose et al., 2008). The sampled quartzite dips about 60° to the northwest, and exhibits an east-southeasterly striking, vertical cleavage.

Petrographic description

The sample is composed of inequigranular quartz, muscovite, and minor sericite (~1%). Biotite has been replaced by limonite. Quartz occurs both as large strained grains (up to 10 mm), and as neocrystallized grains (up to 1 mm). A weak foliation is defined by muscovite and by alignment of the larger quartz grains. Opaque oxide minerals have been replaced by rutile, limonite, or leucoxene. Rare zircon crystals, up to 0.2 mm, suggest that this sample was formerly a medium- to coarse-grained sandstone which has been partially recrystallized.

Zircon morphology

Zircons isolated from this sample are subspherical to subhedral. Most are brown to yellow and transparent, and several are opaque. The crystals are up to 500 µm long, with aspect ratios up to 5:1. Cathodoluminescence (CL) images reveal a variety of internal textures including oscillatory zoning. Many grains have abraded margins that cut across internal structures, consistent with sedimentary transport. A CL image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed over two sessions, on 8 August 2008 and 14–15 August 2008, using SHRIMP-A. Analyses 1.1 to 24.1 (spot numbers 1–24) were obtained during the first session, together with 11 analyses of the Temora standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 1.67% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.55% (1σ). Analyses 25.1 to 56.1 (spot numbers 25–56) were obtained during the second session, together with 14 analyses of the Temora standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 1.91% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.54% (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 model of Stacey and Kramers (1975).

Results

Fifty-six analyses were obtained from 56 zircons. 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 concordant to slightly discordant (Fig. 2). Four analyses are characterized by moderate discordance (>5%). These four analyses (Group D; Table 1) are imprecise or unreliable, and are not considered geologically significant. The remaining 52 analyses can be divided into two groups.

Group Y comprises a single analysis (37.1; Table 1), which yields a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1750 ± 19 Ma (1σ).

Group S comprises 51 analyses (Table 1), which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates of 2695–1753 Ma.

It is possible that all of the analyses are of unmodified detrital zircons, in which case the date of 1750 ± 19 Ma (1σ) for the single analysis in Group Y can be interpreted as the maximum age of deposition for the sandstone. A more conservative estimate of the maximum age of deposition is provided by the weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1775 ± 7 Ma (MSWD = 1.21) for the 15 youngest

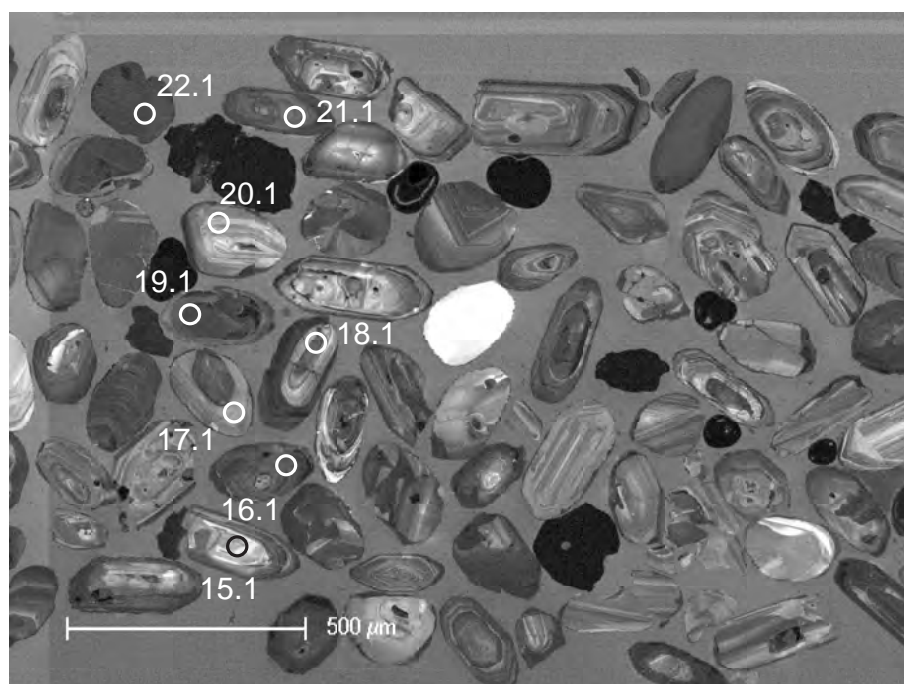


Figure 1. Cathodoluminescence image of representative zircons from sample 184341: quartzite, Lake Mackay. Numbered circles indicate the approximate positions of analysis sites.

analyses in Groups Y and S. This is consistent with the interpretation that the quartzite was deposited on c. 1805–1770 Ma Carrington Suite metagranitic rocks.

The 52 analyses in combined Groups Y and S indicate dates that define significant age components at c. 1849, 1964, and 2307 Ma, and several minor components spanning the range 2695–1750 Ma (Fig. 3). These are interpreted as the ages of zircon-crystallizing rocks in the detrital source region of the sandstone, or the ages of detrital components within sediments which have been reworked.

Recommended reference for this publication

Kirkland, CL, Wingate, MTD, Spaggiari CV and Tyler, IM 2009, 184341: quartzite, Lake Mackay; Geochronology Record 818: Geological Survey of Western Australia, 5p.

Data obtained: 15 August 2008

Data released: 30 June 2009

References

- Edgoose, CJ, Close, DF and Scrimgeour, IR 2008, Lake Mackay, Northern Territory (2nd Edition), 1:250 000 geological map series, SF 52-11: Northern Territory Geological Survey, Darwin.
- 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.

Table 1. Ion microprobe analytical results for zircons from sample 184341: quartzite, Lake Mackay

Group ID.	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	^{235}U (%)	$^{238}\text{U}/^{206}\text{Pb}$ ± 1 σ	$^{207}\text{Pb}/^{206}\text{Pb}$ ± 1 σ	$^{238}\text{U}/^{206}\text{Pb}$ ± 1 σ	$^{207}\text{Pb}/^{206}\text{Pb}$ ± 1 σ	$^{238}\text{U}/^{206}\text{Pb}$ date (Ma) ± 1 σ	$^{207}\text{Pb}/^{206}\text{Pb}$ date (Ma) ± 1 σ	Disc. (%)
Y	37	37.1	105	46	0.45	3.354	0.075	3.360	0.077	1679	1750	4.1
S	8	8.1	300	184	0.63	3.264	0.058	3.273	0.061	1719	1753	13
S	2	2.1	111	47	0.44	3.222	0.059	3.224	0.062	1742	1756	27
S	48	48.1	315	116	0.38	3.260	0.064	3.261	0.066	1724	1760	9
S	17	17.1	136	55	0.42	3.121	0.058	3.124	0.060	1790	1762	14
S	5	5.1	157	75	0.50	3.146	0.056	3.147	0.059	1779	1764	14
S	52	52.1	137	65	0.49	3.327	0.067	3.333	0.069	1691	1766	18
S	55	55.1	295	90	0.32	3.173	0.062	3.177	0.065	1764	1772	11
S	1	1.1	301	58	0.20	3.153	0.055	3.155	0.057	1775	1773	10
S	33	33.1	270	137	0.52	3.190	0.063	3.191	0.065	1757	1779	9
S	29	29.1	263	91	0.36	3.200	0.063	3.201	0.065	1753	1783	10
S	13	13.1	306	200	0.68	3.157	0.055	3.157	0.057	1774	1784	11
S	43	43.1	407	210	0.53	3.136	0.062	3.136	0.064	1784	1790	8
S	23	23.1	129	47	0.37	3.132	0.057	3.132	0.059	1786	1791	14
S	39	39.1	54	42	0.79	3.145	0.068	3.154	0.070	1775	1793	38
S	35	35.1	321	127	0.41	3.131	0.062	3.130	0.065	1787	1835	12
S	53	53.1	354	258	0.75	2.889	0.060	2.890	0.062	1916	1843	9
S	9	9.1	1025	565	0.57	3.027	0.051	3.027	0.054	1840	1846	6
S	12	12.1	295	196	0.69	2.937	0.051	2.940	0.054	1887	1848	11
S	42	42.1	109	86	0.81	2.960	0.060	2.959	0.062	1877	1850	14
S	19	19.1	684	68	0.10	2.958	0.051	2.959	0.053	1877	1853	6
S	11	11.1	297	263	0.91	2.980	0.053	2.979	0.056	1866	1858	11
S	27	27.1	81	42	0.54	3.078	0.064	3.078	0.066	1814	1858	16
S	40	40.1	78	52	0.69	3.010	0.063	3.008	0.065	1850	1866	17
S	28	28.1	333	116	0.36	3.012	0.059	3.012	0.062	1848	1867	9
S	16	16.1	474	74	0.16	2.983	0.051	2.984	0.054	1863	1878	7
S	20	20.1	144	79	0.57	3.067	0.055	3.065	0.057	1820	1882	15
S	44	44.1	2349	499	0.22	3.042	0.058	3.042	0.061	1832	1899	3
S	56	56.1	167	227	1.41	2.864	0.057	2.865	0.059	1930	1921	12
S	22	22.1	950	1267	1.38	2.889	0.049	2.889	0.051	1916	1921	5
S	7	7.1	200	105	0.54	2.807	0.050	2.810	0.052	1962	1930	13
S	38	38.1	387	175	0.47	2.861	0.056	2.860	0.058	1933	1942	7
S	31	31.1	147	18	0.13	2.922	0.059	2.923	0.061	1897	1958	12
S	51	51.1	247	43	0.18	2.691	0.054	2.691	0.056	2037	1963	12
S	3	3.1	237	59	0.26	2.822	0.051	2.823	0.053	1955	1965	14
S	21	21.1	328	47	0.15	2.820	0.049	2.821	0.051	1956	1968	9
S	24	24.1	716	148	0.21	2.752	0.047	2.753	0.050	1998	1987	5
S	14	14.1	434	175	0.42	2.681	0.046	2.680	0.048	2044	2072	7
S	41	41.1	133	45	0.35	2.635	0.053	2.636	0.055	2073	2075	11
S	47	47.1	92	50	0.56	2.595	0.054	2.597	0.055	2100	2080	15
S	4	4.1	823	149	0.19	2.598	0.044	2.599	0.046	2099	2083	5

Table 1. (continued)

Group ID.	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	^{232}Th ^{238}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	6	6.1	153	161	1.09	-0.089	2.468 0.046	0.13556 0.00084	2.466 0.048	0.13635 0.00085	2194 51	2181 11	-0.6
S	45	45.1	204	354	1.79	0.032	2.431 0.052	0.13664 0.00066	2.432 0.053	0.13636 0.00067	2220 58	2181 9	-1.8
S	50	50.1	168	62	0.38	-0.021	2.450 0.049	0.14134 0.00076	2.450 0.051	0.14153 0.00092	2207 54	2246 11	1.8
S	54	54.1	221	74	0.35	0.029	2.520 0.050	0.14301 0.00066	2.521 0.052	0.14276 0.00068	2154 53	2261 8	4.7
S	34	34.1	93	29	0.32	0.192	2.374 0.049	0.14818 0.00099	2.379 0.051	0.14648 0.00112	2262 57	2305 13	1.9
S	18	18.1	339	210	0.64	0.012	2.354 0.041	0.14668 0.00053	2.354 0.043	0.14657 0.00054	2282 49	2306 6	1.1
S	26	26.1	276	124	0.47	0.072	2.350 0.046	0.14863 0.00058	2.352 0.048	0.14799 0.00062	2284 56	2323 7	1.7
S	25	25.1	288	402	1.44	0.039	2.199 0.043	0.16181 0.00058	2.199 0.045	0.16146 0.00060	2416 59	2471 6	2.2
S	32	32.1	117	62	0.55	0.085	2.119 0.043	0.16475 0.00092	2.121 0.045	0.16399 0.00095	2490 64	2497 10	0.3
S	46	46.1	47	45	1.01	0.128	2.060 0.045	0.16792 0.00144	2.063 0.047	0.16678 0.00146	2548 70	2526 15	-0.9
S	15	15.1	79	27	0.35	0.062	1.934 0.036	0.18514 0.00173	1.935 0.038	0.18459 0.00174	2686 65	2695 16	0.3
D	49	49.1	125	67	0.55	0.444	3.331 0.067	0.11291 0.00084	3.345 0.070	0.10904 0.00154	1686 40	1783 26	5.5
D	36	36.1	180	92	0.53	0.028	3.364 0.067	0.10912 0.00069	3.365 0.069	0.10888 0.00072	1677 39	1781 12	5.8
D	30	30.1	342	291	0.88	-0.028	3.386 0.067	0.10938 0.00055	3.385 0.070	0.10963 0.00055	1669 39	1793 9	7.0
D	10	10.1	350	187	0.55	0.025	3.546 0.061	0.11088 0.00053	3.546 0.064	0.11067 0.00054	1601 33	1810 9	11.6

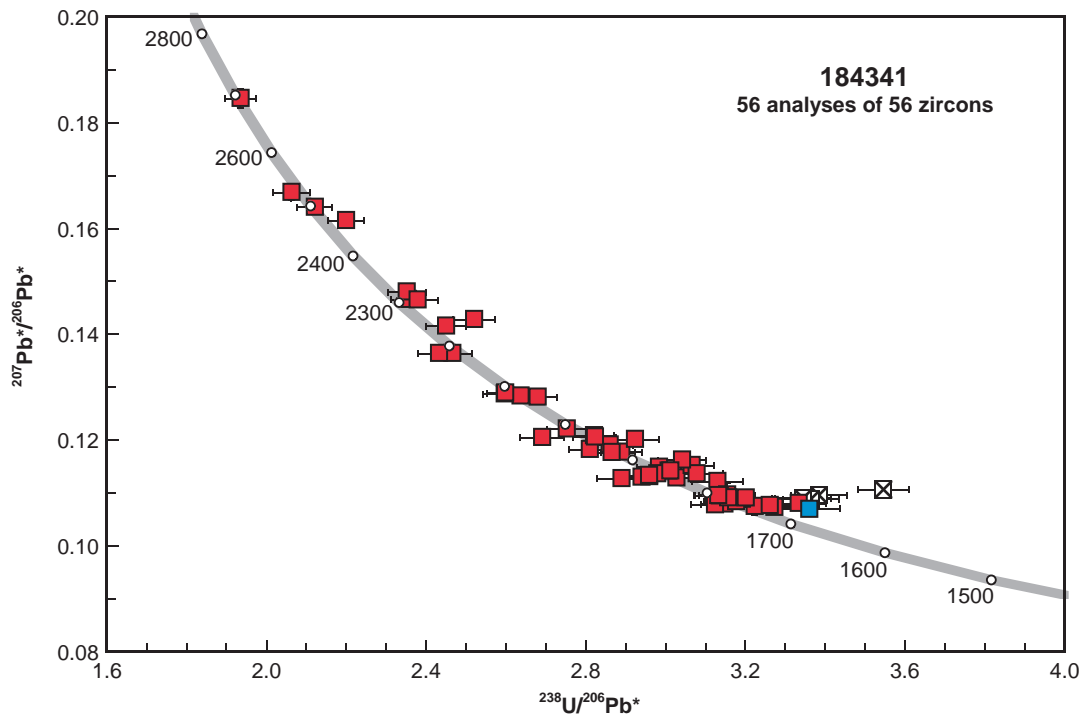


Figure 2. U–Pb analytical data for zircons from sample 184341: quartzite, Lake Mackay. Blue square indicates Group Y (youngest detrital zircon); red squares indicate Group S (older detrital zircons); crossed squares indicate Group D (discordance >5%).

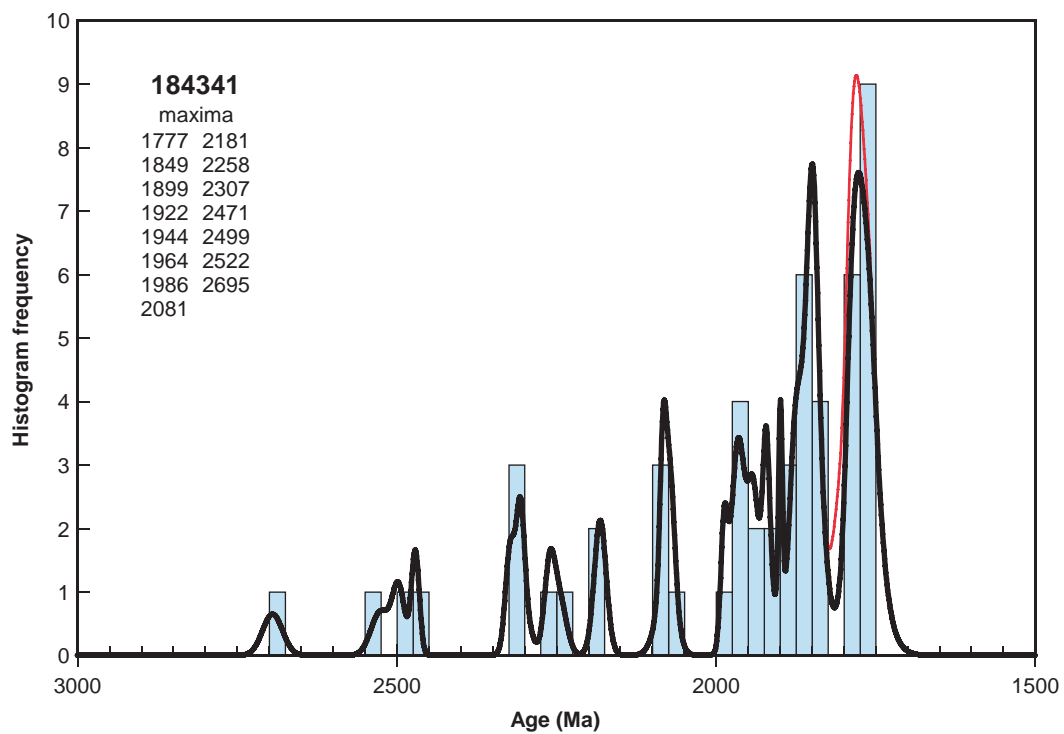


Figure 3. Probability density diagram and histogram for sample 184341: quartzite, Lake Mackay. Heavy curve, maxima values, and frequency histogram (bin width 25 Ma) include only accepted data (52 analyses of 52 zircons). Light curve includes all data (56 analyses of 56 zircons).