

149691: quartz sandstone, Mount Methwin

Location and sampling

NABBERU (SG 51-5), METHWIN (3047)
MGA Zone 51, 264190E 7223320N

Sampled on 1 September 2002

The sample was taken from a large, fire-cracked face in a fresh cliff exposure located 19.5 km north of Good Camp Rockhole and 3 km west of Mount Methwin.

Tectonic unit/relations

The sample is a dark-brown, locally laminated, medium-grained, well-sorted, compositionally homogeneous, silicified quartz-rich sandstone from the Wonyulgunna Sandstone, Scorpion Group, Edmund Basin (Hocking et al., 2003). It was collected from the 'tidal flat' facies, about 250 m above the stratigraphic base of the unit. Palaeocurrent measurements indicate derivation broadly from the south to west. The sample was taken to constrain the depositional age of the Wonyulgunna Sandstone.

Petrographic description

The sample consists principally of quartz (85 vol.%), with intergranular porosity (15 vol.%) partly occupied by limonite staining with or without clay-sericite, locally concentrated to form stylolite-like laminae, and accessory detrital (and composite authigenic) tourmaline grains. It is a weakly bedded, medium- to coarse-grained quartz sandstone. The rock mainly consists of a weakly bedded and compact aggregate of mostly subrounded to rounded single-crystal detrital quartz grains, ranging from 0.2 mm to (rarely) 1.3 mm in size. The degree of sorting is moderate to good within poorly defined individual beds, with the average grain size ranging from about 0.4 mm in finer beds up to 0.8 mm in coarse beds. Up to 10 vol.% of the quartz grains are internally clouded, with some comprising cryptocrystalline to microcrystalline micromosaics. There is minor evidence of authigenic quartz overgrowth. Intergranular porosity, on a size scale of about 0.2 mm, is partly occupied by a limonitic(–hematitic) lining with or without iron-stained clay–sericite with a void inner core. Limonite(–hematite) and clay–sericite are more abundant in some thin beds, filling porosity and being locally concentrated to form ferruginized or fine micaceous microcrenulated laminae. Scattered grains of bluish-green tourmaline, 0.1 to 0.2 mm in size, are detrital, but partly modified by authigenic overgrowths. There are no discrete individual flakes of detrital muscovite.

Zircon morphology

The zircons isolated from this sample are colourless or pale yellowish-brown, generally between $50 \times 70 \mu\text{m}$ and $200 \times 250 \mu\text{m}$ in size, internally structureless, commonly fractured, and equant or slightly elongate, rounded or elliptical in shape, or form irregularly shaped fragments. Fluid and mineral inclusions are common. The surfaces of many grains are pitted, consistent with detrital transport. Cathodoluminescence images of representative zircons are given in Figure 1.

Analytical details

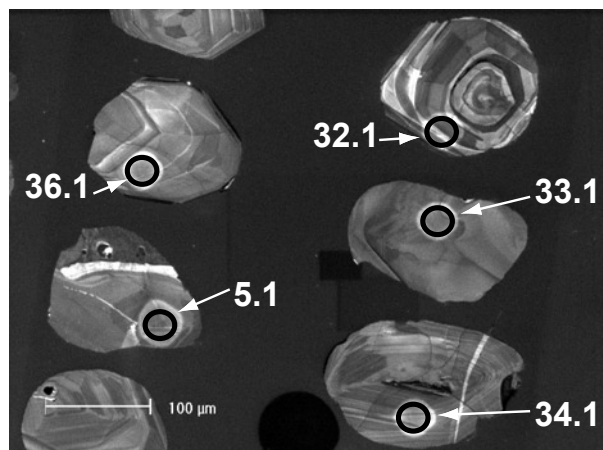
This sample was analysed on 21 and 27 July 2003. The counter deadtime during both analysis sessions was 24 ns. During the first analysis session, 17 analyses of the CZ3 standard indicated a Pb^*/U calibration uncertainty of 3.23% (1σ). Analyses 1.1 to 19.1 were obtained during the first analysis session. During the second analysis session, five analyses of the CZ3 standard indicated a Pb^*/U calibration uncertainty of 2.60% (1σ). Common-Pb corrections were applied assuming Broken Hill common-Pb isotopic compositions for all analyses, with the exception of analysis 20.1, for which isotopic compositions determined using the method of Cumming and Richards (1975) were assumed.

Results

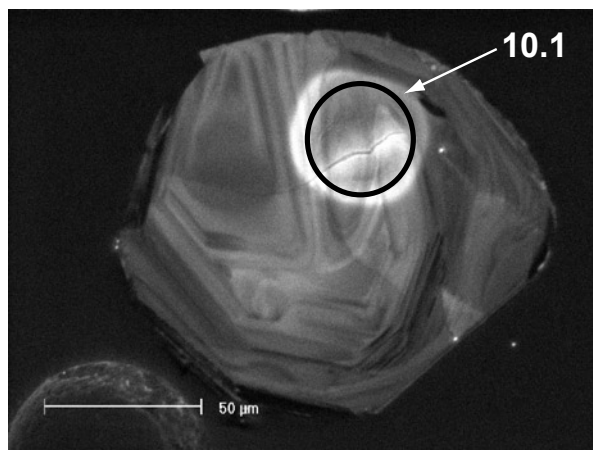
Thirty-six analyses were obtained from 36 zircons. Results are given in Table 1, and shown on concordia and Gaussian-summation probability density plots in Figures 2 and 3, respectively.

Interpretation

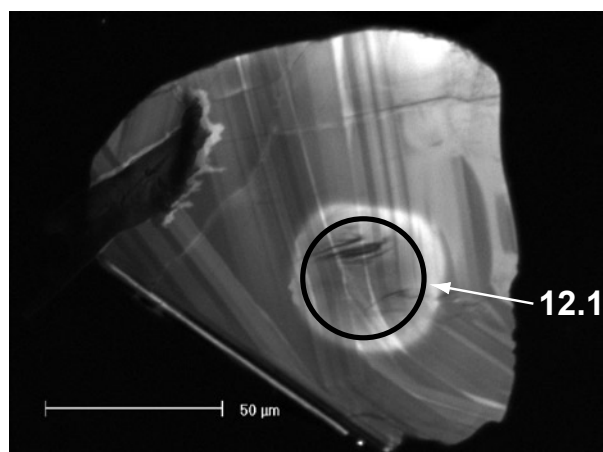
The analyses are concordant to slightly discordant and indicate a range of $^{207}\text{Pb}/^{206}\text{Pb}$ dates from c. 1780 to 3290 Ma. On the basis of their $^{207}\text{Pb}/^{206}\text{Pb}$ ratios, many analyses can be assigned to one of four groups. Twenty-six concordant or slightly discordant analyses of 26 zircons, assigned to Group 1, have $^{207}\text{Pb}/^{206}\text{Pb}$ ratios defining a single population and indicating a weighted mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of $1788 \pm 8 \text{ Ma}$ (chi-squared = 0.74). Concordant analyses 22.1 and 36.1, assigned to Group 2, have $^{207}\text{Pb}/^{206}\text{Pb}$ ratios defining a single population and indicating a weighted mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of $2012 \pm 19 \text{ Ma}$ ($\pm 1\sigma$ uncertainty). Concordant analyses 5.1 and 33.1, assigned to Group 3, have $^{207}\text{Pb}/^{206}\text{Pb}$ ratios defining a single population and indicating a weighted



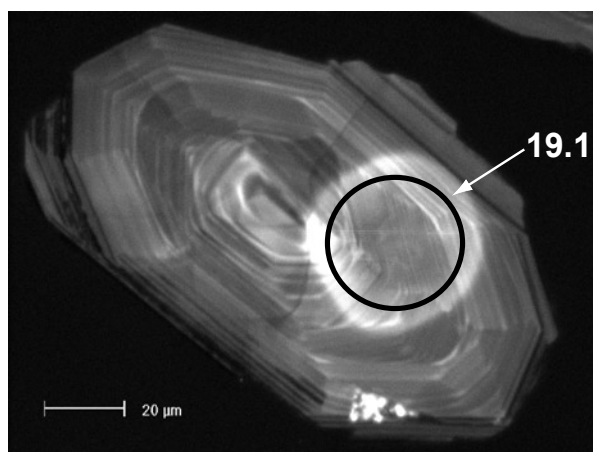
(a)



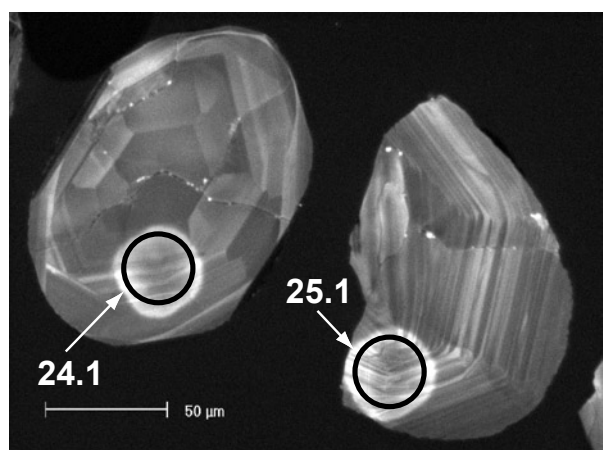
(b)



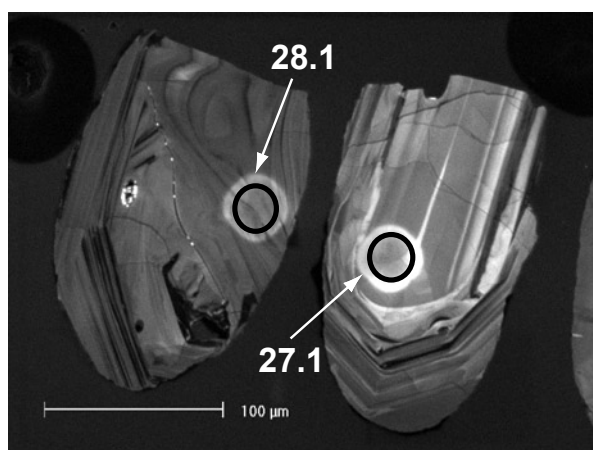
(c)



(d)



(e)



(f)

Figure 1. Cathodoluminescence images of representative zircons from sample 149691: quartz sandstone, Mount Methwin

Table 1. Ion microprobe analytical results for zircons from sample 149691: quartz sandstone, Mount Methwin

Grain .spot	U (ppm)	Th (ppm)	Pb (ppm)	f ₂₀₆ %	$^{207}\text{Pb}/^{206}\text{Pb}$	$\pm 1\sigma$	$^{208}\text{Pb}/^{206}\text{Pb}$	$\pm 1\sigma$	$^{206}\text{Pb}/^{238}\text{U}$	$\pm 1\sigma$	$^{207}\text{Pb}/^{235}\text{U}$	$\pm 1\sigma$	% concordance	$^{207}\text{Pb}/^{206}\text{Pb}$ Age	$\pm 1\sigma$
1.1	138	94	51	0.132	0.10903	0.00139	0.19719	0.00290	0.3260	0.0106	4.901	0.179	102	1783	23
2.1	294	242	107	0.189	0.11025	0.00092	0.23574	0.00199	0.3105	0.0101	4.721	0.163	97	1804	15
3.1	111	64	40	0.077	0.11098	0.00157	0.16315	0.00312	0.3245	0.0106	4.965	0.185	100	1816	26
4.1	204	121	73	0.052	0.10808	0.00095	0.16466	0.00175	0.3249	0.0106	4.842	0.168	103	1767	16
5.1	167	31	89	-0.007	0.17328	0.00103	0.05079	0.00083	0.5082	0.0166	12.143	0.411	102	2590	10
6.1	104	140	43	0.184	0.10966	0.00138	0.38685	0.00375	0.3196	0.0105	4.832	0.177	100	1794	23
7.1	109	83	40	0.060	0.10821	0.00194	0.21806	0.00427	0.3219	0.0106	4.802	0.189	102	1770	33
8.1	169	40	55	0.036	0.10945	0.00097	0.06768	0.00109	0.3245	0.0106	4.898	0.171	101	1790	16
9.1	196	126	72	0.179	0.10798	0.00110	0.17707	0.00219	0.3296	0.0107	4.907	0.173	104	1766	19
10.1	187	57	91	0.160	0.16133	0.00107	0.07523	0.00131	0.4525	0.0148	10.066	0.343	97	2470	11
11.1	102	205	47	0.192	0.10823	0.00153	0.55825	0.00498	0.3168	0.0104	4.728	0.176	100	1770	26
12.1	67	31	40	-0.011	0.18484	0.00164	0.13282	0.00181	0.5215	0.0173	13.289	0.471	100	2697	15
13.1	152	113	57	0.121	0.10935	0.00122	0.20911	0.00253	0.3304	0.0108	4.982	0.178	103	1789	20
14.1	147	90	55	0.081	0.10806	0.00150	0.17487	0.00312	0.3345	0.0109	4.984	0.185	105	1767	25
15.1	130	76	48	0.066	0.10926	0.00117	0.16366	0.00209	0.3374	0.0110	5.084	0.181	105	1787	19
16.1	126	86	47	0.090	0.10921	0.00129	0.19476	0.00259	0.3315	0.0108	4.992	0.180	103	1786	22
17.1	244	92	83	0.052	0.11017	0.00093	0.10832	0.00150	0.3230	0.0105	4.906	0.170	100	1802	15
18.1	90	56	54	0.222	0.18339	0.00169	0.17000	0.00270	0.5153	0.0170	13.031	0.461	100	2684	15
19.1	160	114	59	0.008	0.11111	0.00104	0.20274	0.00201	0.3280	0.0107	5.024	0.176	101	1818	17
20.1	625	64	225	0.373	0.11238	0.00067	0.03530	0.00111	0.3592	0.0094	5.566	0.153	108	1838	11
21.1	265	164	92	0.188	0.10839	0.00101	0.17273	0.00197	0.3116	0.0082	4.657	0.135	99	1773	17
22.1	89	49	36	0.263	0.12428	0.00236	0.15526	0.00481	0.3608	0.0097	6.182	0.215	98	2019	34
23.1	102	89	43	0.039	0.11743	0.00141	0.24675	0.00294	0.3587	0.0096	5.807	0.178	103	1917	22
24.1	126	56	43	0.300	0.10782	0.00177	0.12286	0.00348	0.3156	0.0084	4.693	0.155	100	1763	30
25.1	140	88	50	0.150	0.10892	0.00152	0.17627	0.00310	0.3189	0.0085	4.790	0.151	100	1781	26
26.1	77	49	29	0.491	0.10794	0.00253	0.17537	0.00542	0.3296	0.0089	4.905	0.186	104	1765	43
27.1	81	130	35	0.254	0.11119	0.00225	0.46996	0.00624	0.3139	0.0085	4.813	0.172	97	1819	37
28.1	285	106	89	0.374	0.10791	0.00111	0.04453	0.00189	0.3097	0.0081	4.608	0.135	99	1764	19
29.1	212	439	99	0.085	0.10836	0.00105	0.59169	0.00368	0.3167	0.0083	4.732	0.138	100	1772	18
30.1	124	160	49	-0.067	0.11053	0.00264	0.37169	0.00642	0.3096	0.0082	4.718	0.179	96	1808	43
31.1	183	69	57	0.359	0.11007	0.00150	0.09723	0.00281	0.2949	0.0078	4.475	0.140	93	1801	25
32.1	127	229	120	0.114	0.26764	0.00155	0.45525	0.00288	0.6317	0.0169	23.310	0.655	96	3292	9
33.1	124	82	73	0.128	0.17303	0.00143	0.17766	0.00228	0.5046	0.0135	12.039	0.348	102	2587	14
34.1	122	72	43	0.189	0.11174	0.00169	0.17203	0.00340	0.3194	0.0085	4.921	0.159	98	1828	27
35.1	317	196	110	0.124	0.11024	0.00093	0.17574	0.00182	0.3132	0.0082	4.761	0.136	97	1803	15
36.1	128	44	47	0.138	0.12353	0.00168	0.09847	0.00304	0.3513	0.0094	5.983	0.188	97	2008	24

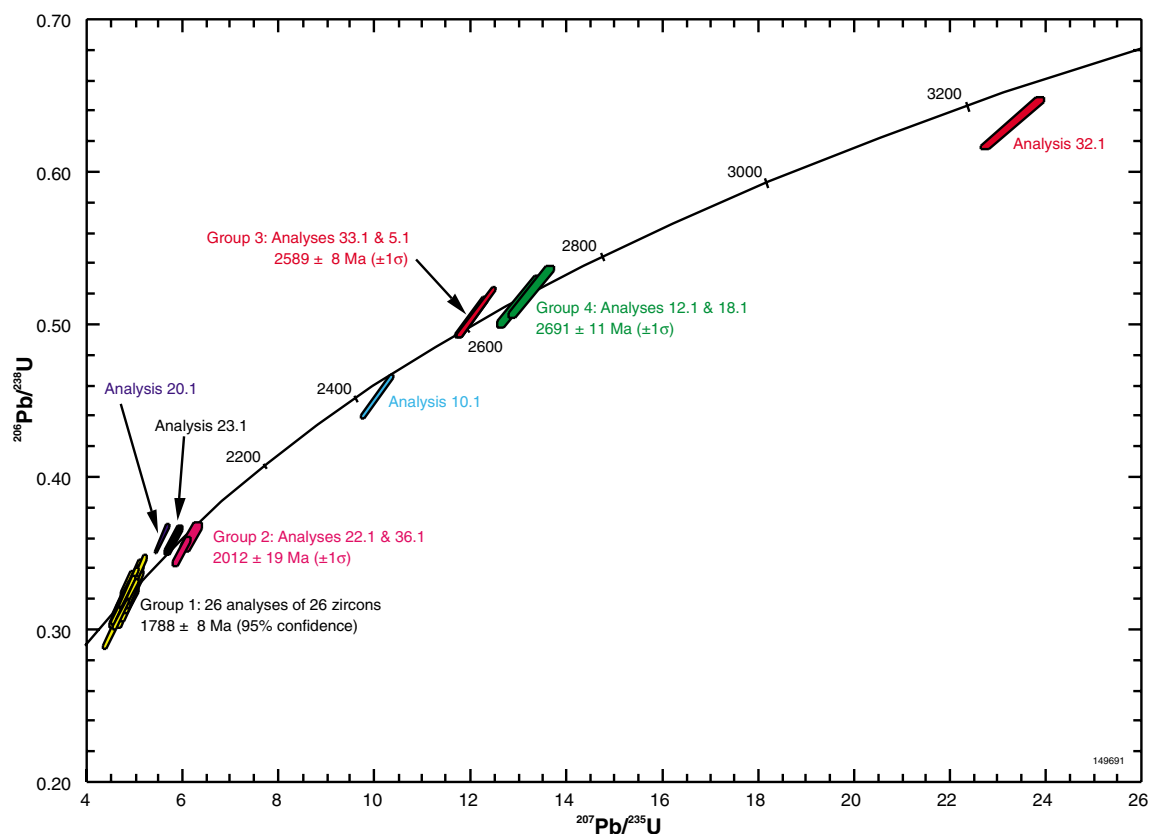


Figure 2. Concordia plot for sample 149691: quartz sandstone, Mount Methwin

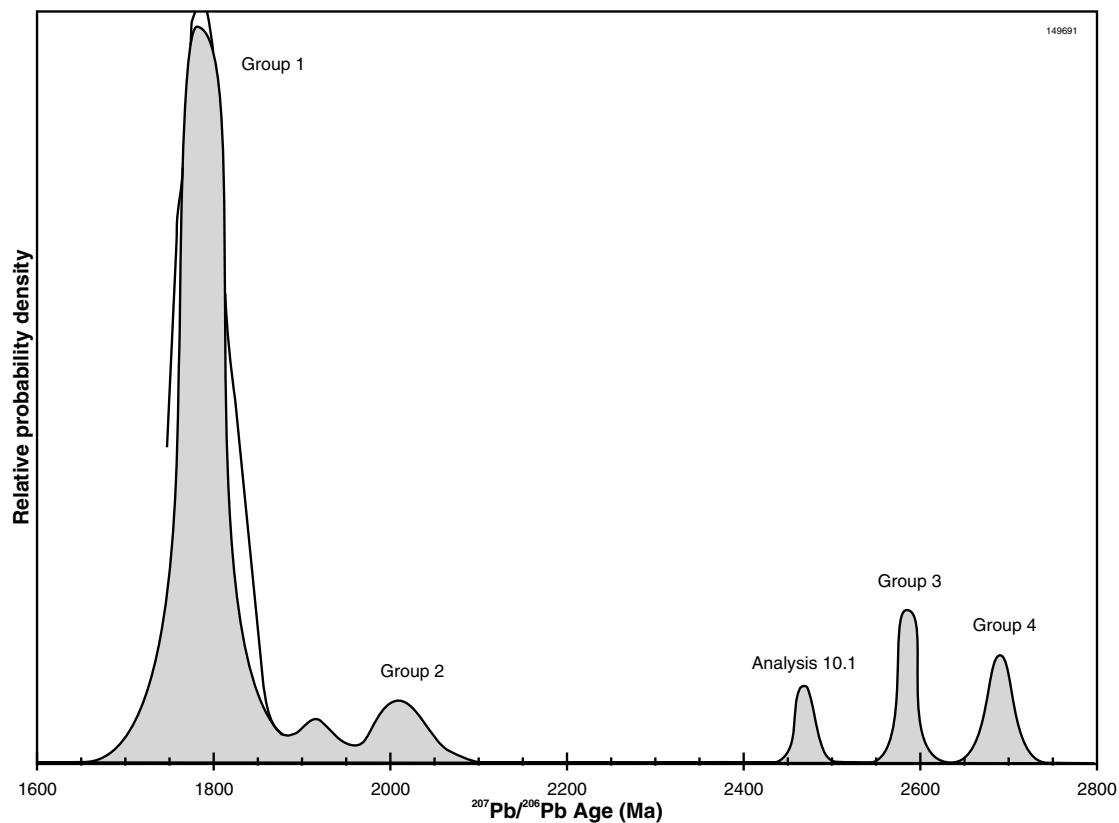


Figure 3. Gaussian-summation probability density plot for sample 149691: quartz sandstone, Mount Methwin

mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of 2589 ± 8 Ma ($\pm 1\sigma$ uncertainty). Concordant analyses 12.1 and 18.1, assigned to Group 4, have $^{207}\text{Pb}/^{206}\text{Pb}$ ratios defining a single population and indicating a weighted mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of 2691 ± 11 Ma ($\pm 1\sigma$ uncertainty). The remaining analyses (10.1, 20.1, 23.1, 32.1) cannot be confidently grouped.

Many of the grains from which the analyses of Group 1 were obtained are subrounded and have pitted surfaces, consistent with a detrital origin. Consequently, the weighted mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of 1788 ± 8 Ma indicated by the analyses of Group 1 is interpreted as a maximum age for deposition of the sandstone. The remaining analyses are also interpreted to be of detrital grains.

Possible source rocks within the western part of Australia having ages matching those of the zircons within

this sample include rocks from the Rudall (Nelson, 1995, 1996), Arunta (Williams et al., 1996 and references cited therein), and Gascoyne (Nelson, 1997, 1998, 1999, 2000, this compilation) Complexes, whereas grain 32 could have been derived from the East Pilbara Granite–Greenstone Terrane or the Narryer Terrane in the northwestern part of the Yilgarn Craton (Geological Survey of Western Australia, 2004).

Recommended reference for this publication:

NELSON, D. R., 2005, 149691: quartz sandstone, Mount Methwin; Geochronology dataset 542; in Compilation of geochronology data, June 2006 update: Western Australia Geological Survey.

Data obtained: 27/07/2003; Data released: 30/06/2005