

195237: lithic sandstone, Townsend Ridges

(Townsend Quartzite, lower Buldya Group, Centralian Superbasin Supersequence 1)

Location and sampling

TALBOT (SG 52-9), MOUNT EVELINE (4345)
MGA Zone 52, 302887E 7087065N

Sampled on 9 August 2010

This sample was collected from the base of a cliff exposure on the north side of the prominent, east-trending Townsend Ridges, about 13.5 west of Well Knob, 8.4 km east of Beal Outstation, and 8.2 km west-southwest of Frank Scott Hill.

Tectonic unit/relations

The unit sampled is the Townsend Quartzite of the lower Buldya Group of the Centralian Superbasin Supersequence 1. The Townsend Quartzite is the basal sandstone of the Officer Basin succession (Grey et al., 2005) and forms a prominent discontinuous ridge at the southern margin of the western Musgrave Province. The unit consists mainly of fine- to coarse-grained sandstone with intercalated conglomeratic layers deposited in braided fluvial to nearshore marine environments. The contact with underlying volcanosedimentary rocks of the Bentley Supergroup appears in some areas to be structurally concordant but locally there is a clear low-angle unconformity. The Townsend Quartzite grades upwards into fine-grained siliciclastic rocks of the Lefroy Formation or is overlain conformably by the Browne Formation. The age of the Townsend Quartzite is thought to be about 1000–800 Ma (Grey et al., 2005). At this locality, the sandstone is hematitic, and exhibits trough cross-bedding and some mud cracks. A sample of Townsend Quartzite, collected about 74 km to the east, yielded a conservative maximum depositional age of 1134 ± 19 Ma (GSWA 189557, Wingate et al., 2017).

Petrographic description

The sample is a medium-grained, poorly sorted, lithic sandstone, consisting of about 75% quartz, 15% lithic fragments, and 10% interstitial matrix. Quartz grains are mostly well rounded and up to about 1 mm across. Other grains are similar in size to quartz, and include fragments of polycrystalline lithic clasts, chert, feldspar, and iron oxide granules. Quartz and lithic grains are tightly packed.

Zircon morphology

Zircons isolated from this sample are colourless to dark brown, anhedral to subhedral, and strongly rounded. The crystals are up to 400 μm long, and equant to elongate, with aspect ratios up to 5:1. In cathodoluminescence (CL) images, almost all zircons exhibit concentric zoning, and most crystals have pitted outer surfaces and concentric zoning truncated at grain boundaries, features consistent with sedimentary transport. A CL image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed on 19–20 February 2014, using SHRIMP-B, and 27–28 February 2014, using SHRIMP-A. Analyses 1.1 to 35.1 (spot numbers 1–35) were obtained during the first session, together with 13 analyses of the BR266 standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1 σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.15% (1 σ). Analyses 36.1 to 69.1 (spot numbers 36–69) were obtained during the second session, together with 10 analyses of the BR266 standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1 σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.42% (1 σ). 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 isotopic compositions determined according to the model of Stacey and Kramers (1975).

Results

Sixty-nine analyses were obtained from 69 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 strongly discordant (Fig. 2). Fifteen analyses are >5% discordant, and one analysis of a low-U zircon produced a very low-precision result. The dates obtained from these 16 analyses (Group D, Table 1) are unreliable, and considered not to be geologically significant. The remaining 53 analyses can be divided into two groups, based on their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.

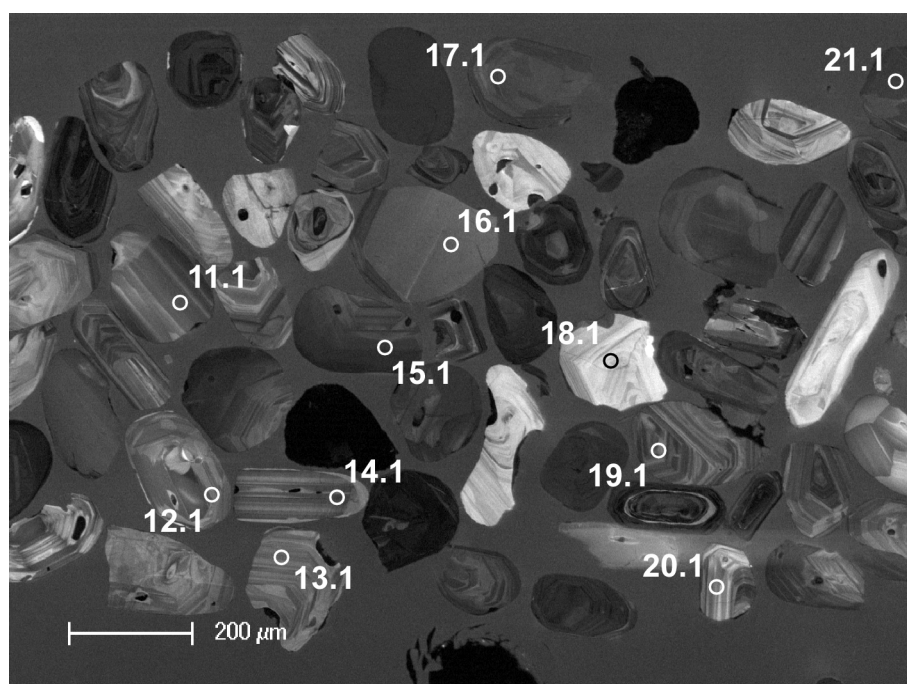


Figure 1. Cathodoluminescence image of representative zircons from sample 195237: lithic sandstone, Townsend Ridges. Numbered circles indicate the approximate locations of analysis sites

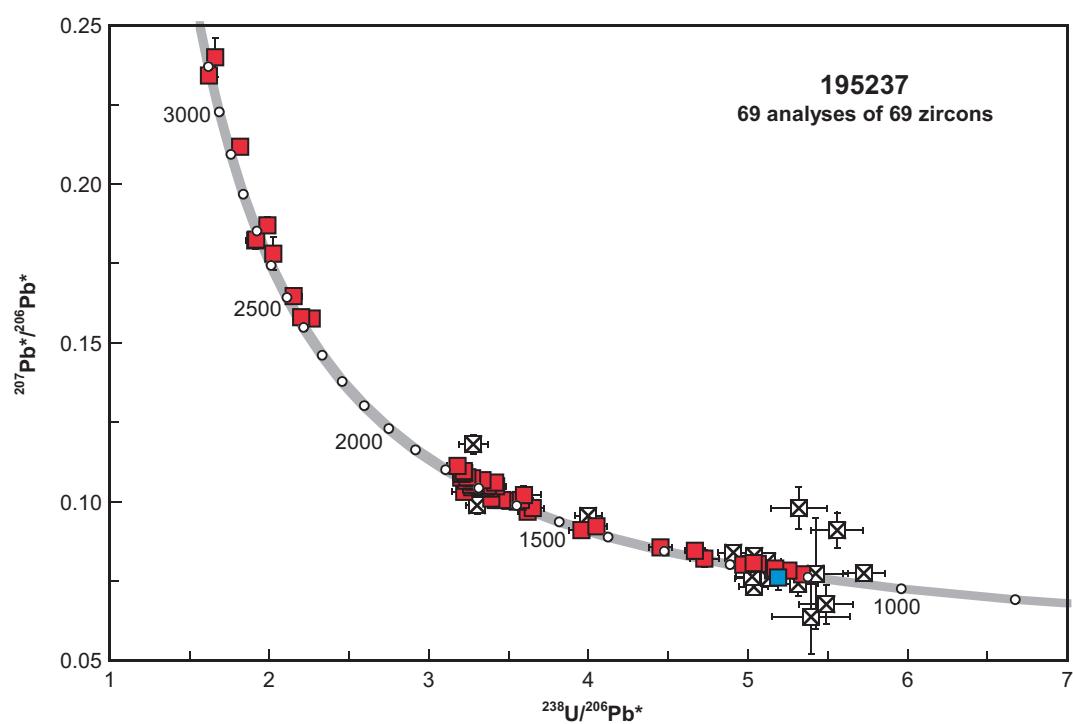


Figure 2. U-Pb analytical data for zircons from sample 195237: lithic sandstone, Townsend Ridges. Blue square indicates Group Y (youngest detrital zircon); red squares indicate Group S (older detrital zircons); crossed squares indicate Group D (discordance >5% or low precision)

Table 1. Ion microprobe analytical results for zircons from sample 195237: lithic sandstone, Townsend Ridges

Group ID	Spot no.	Grain. spot	²³⁸ U (ppm)	²³² Th (ppm)	²³² Th / ²³⁸ U	f ₂₀₄ (%)	²³⁸ U/ ²⁰⁶ Pb ± 1σ	²⁰⁷ Pb/ ²⁰⁶ Pb ± 1σ	²³⁸ U/ ²⁰⁶ Pb* ± 1σ	²⁰⁷ Pb*/ ²⁰⁶ Pb* ± 1σ	²³⁸ U/ ²⁰⁶ Pb* date (Ma) ± 1σ	²⁰⁷ Pb*/ ²⁰⁶ Pb* date (Ma) ± 1σ	Disc. (%)						
Y	55	55.1	32	42	1.34	0.870	5.143	0.129	0.08340	0.00201	5.188	0.131	0.07609	0.00387	1136	27	1097	102	-3.5
S	13	13.1	60	51	0.87	0.244	5.325	0.100	0.07913	0.00160	5.339	0.101	0.07707	0.00217	1107	20	1123	56	1.4
S	15	15.1	141	89	0.65	-0.110	5.258	0.071	0.07727	0.00105	5.252	0.071	0.07820	0.00124	1124	14	1152	31	2.5
S	45	45.1	204	263	1.33	0.026	5.156	0.085	0.07855	0.00076	5.157	0.085	0.07833	0.00079	1142	18	1155	20	1.1
S	30	30.1	46	46	1.04	-0.156	5.178	0.112	0.07759	0.00181	5.170	0.112	0.07891	0.00223	1140	23	1170	56	2.6
S	50	50.1	201	181	0.93	0.000	4.969	0.082	0.08010	0.00077	4.969	0.082	0.08010	0.00077	1182	18	1199	19	1.4
S	19	19.1	90	114	1.32	-0.170	5.070	0.083	0.07889	0.00133	5.061	0.083	0.08033	0.00167	1162	18	1205	41	3.6
S	27	27.1	296	243	0.85	0.052	5.033	0.051	0.08100	0.00075	5.035	0.051	0.08056	0.00081	1168	11	1211	20	3.5
S	16	16.1	62	65	1.08	0.563	4.700	0.090	0.08683	0.00163	4.727	0.091	0.08206	0.00270	1237	22	1247	64	0.8
S	17	17.1	137	151	1.14	-0.103	4.672	0.062	0.08363	0.00107	4.667	0.062	0.08450	0.00123	1252	15	1304	28	4.0
S	64	64.1	244	251	1.06	0.000	4.451	0.073	0.08558	0.00071	4.451	0.073	0.08558	0.00071	1307	20	1329	16	1.7
S	44	44.1	87	80	0.95	0.000	3.956	0.075	0.09099	0.00111	3.956	0.075	0.09099	0.00111	1453	25	1446	23	-0.4
S	7	7.1	70	28	0.41	0.074	4.047	0.069	0.09283	0.00139	4.050	0.069	0.09220	0.00153	1423	22	1471	31	3.3
S	25	25.1	86	37	0.44	0.116	3.614	0.059	0.09777	0.00127	3.618	0.059	0.09677	0.00146	1573	23	1563	28	-0.7
S	58	58.1	89	98	1.14	0.169	3.645	0.069	0.09942	0.00113	3.651	0.069	0.09796	0.00135	1561	27	1586	26	1.6
S	36	36.1	42	28	0.69	-0.174	3.563	0.080	0.09853	0.00159	3.556	0.080	0.10003	0.00191	1597	32	1625	36	1.7
S	1	1.1	118	130	1.13	0.000	3.511	0.047	0.10023	0.00101	3.511	0.047	0.10023	0.00101	1616	19	1628	19	0.8
S	46	46.1	138	102	0.76	0.130	3.415	0.059	0.10155	0.00091	3.420	0.060	0.10043	0.00105	1654	26	1632	19	-1.3
S	68	68.1	68	91	1.39	0.280	3.566	0.073	0.10288	0.00132	3.576	0.074	0.10046	0.00171	1590	30	1633	32	2.6
S	47	47.1	154	114	0.76	0.067	3.457	0.059	0.10105	0.00085	3.459	0.059	0.10047	0.00091	1637	25	1633	17	-0.3
S	63	63.1	145	197	1.40	0.124	3.386	0.060	0.10201	0.00090	3.391	0.060	0.10094	0.00102	1666	26	1641	19	-1.5
S	42	42.1	20	17	0.90	-0.188	3.603	0.106	0.10046	0.00236	3.596	0.106	0.10208	0.00286	1582	42	1662	52	4.9
S	24	24.1	42	33	0.83	0.232	3.215	0.075	0.10502	0.00190	3.222	0.076	0.10302	0.00238	1742	37	1679	43	-3.8
S	12	12.1	63	120	1.98	0.064	3.380	0.061	0.10461	0.00141	3.382	0.061	0.10405	0.00152	1670	27	1698	27	1.6
S	43	43.1	149	124	0.86	0.246	3.264	0.056	0.10665	0.00088	3.272	0.056	0.10452	0.00109	1719	26	1706	19	-0.8
S	29	29.1	65	42	0.67	0.061	3.353	0.060	0.10519	0.00138	3.355	0.061	0.10466	0.00148	1682	27	1708	26	1.5
S	37	37.1	72	57	0.82	0.089	3.418	0.066	0.10556	0.00121	3.421	0.066	0.10478	0.00133	1653	29	1710	23	3.3
S	11	11.1	70	82	1.22	0.000	3.323	0.058	0.10486	0.00136	3.323	0.058	0.10486	0.00136	1696	26	1712	24	0.9
S	2	2.1	74	83	1.15	0.050	3.369	0.054	0.10548	0.00125	3.371	0.054	0.10504	0.00132	1675	24	1715	23	2.3
S	8	8.1	86	199	2.40	0.394	3.281	0.051	0.10870	0.00120	3.294	0.051	0.10527	0.00167	1709	24	1719	29	0.6
S	10	10.1	200	136	0.70	0.120	3.261	0.037	0.10636	0.00080	3.265	0.037	0.10531	0.00090	1722	17	1720	16	-0.1
S	31	31.1	197	437	2.29	0.091	3.412	0.040	0.10673	0.00085	3.415	0.040	0.10593	0.00094	1656	17	1731	16	4.3
S	35	35.1	168	88	0.54	0.200	3.274	0.041	0.10797	0.00096	3.281	0.041	0.10623	0.00117	1715	19	1736	20	1.2
S	32	32.1	246	211	0.89	0.019	3.260	0.035	0.10661	0.00077	3.260	0.035	0.10645	0.00078	1725	17	1740	14	0.9

Table 1. continued

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}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	49	49.1	119	64	0.56	0.084	3.230	0.057	0.10730	0.00098	3.233	0.057	0.10657	0.00107	1737	27	1742	18	0.2
S	57	57.1	124	79	0.66	-0.139	3.340	0.059	0.10551	0.00099	3.336	0.059	0.10673	0.00113	1690	27	1744	19	3.1
S	34	34.1	94	89	0.98	0.050	3.268	0.053	0.10780	0.00130	3.270	0.053	0.10737	0.00137	1720	25	1755	23	2.0
S	5	5.1	83	91	1.13	0.193	3.196	0.051	0.10926	0.00126	3.202	0.051	0.10758	0.00152	1752	25	1759	26	0.4
S	62	62.1	110	63	0.59	0.030	3.239	0.060	0.10788	0.00103	3.240	0.060	0.10762	0.00106	1734	29	1759	18	1.4
S	52	52.1	152	58	0.39	0.084	3.204	0.055	0.10945	0.00088	3.207	0.055	0.10872	0.00095	1750	27	1778	16	1.6
S	61	61.1	198	188	0.98	-0.049	3.223	0.054	0.10858	0.00098	3.222	0.054	0.10901	0.00101	1743	26	1783	17	2.3
S	21	21.1	148	145	1.02	0.126	3.215	0.043	0.11072	0.00103	3.219	0.043	0.10962	0.00117	1744	21	1793	19	2.8
S	54	54.1	60	97	1.67	-0.105	3.182	0.066	0.11028	0.00135	3.179	0.066	0.11120	0.00150	1763	33	1819	24	3.1
S	40	40.1	207	175	0.87	0.031	2.266	0.037	0.15795	0.00088	2.267	0.037	0.15767	0.00090	2356	33	2431	10	3.1
S	33	33.1	69	71	1.07	0.338	2.193	0.043	0.16107	0.00170	2.200	0.043	0.15806	0.00206	2415	40	2435	22	0.8
S	23	23.1	39	75	1.98	0.065	2.152	0.051	0.16532	0.00203	2.153	0.051	0.16474	0.00211	2459	49	2505	22	1.8
S	67	67.1	93	78	0.86	0.139	2.022	0.038	0.17934	0.00521	2.025	0.038	0.17811	0.00524	2587	41	2635	49	1.8
S	53	53.1	24	24	1.04	0.000	1.913	0.055	0.18226	0.00288	1.913	0.055	0.18226	0.00288	2711	65	2673	26	-1.4
S	6	6.1	159	160	1.04	0.026	1.918	0.023	0.18270	0.00097	1.919	0.023	0.18247	0.00099	2704	27	2675	9	-1.1
S	4	4.1	31	16	0.53	0.258	1.984	0.048	0.18928	0.00224	1.989	0.048	0.18698	0.00252	2626	54	2716	22	3.3
S	41	41.1	41	253	6.45	0.000	1.818	0.045	0.21179	0.00195	1.818	0.045	0.21179	0.00195	2826	58	2919	15	3.2
S	39	39.1	72	34	0.48	-0.017	1.622	0.031	0.23411	0.00150	1.622	0.031	0.23426	0.00151	3097	48	3081	10	-0.5
S	56	56.1	120	51	0.44	0.075	1.660	0.029	0.24060	0.00619	1.661	0.029	0.23994	0.00620	3038	44	3120	41	2.6
D	48	48.1	9	22	2.54	2.173	5.278	0.227	0.08151	0.00495	5.395	0.242	0.06363	0.01171	1096	47	729	390	-50.3
D	18	18.1	23	54	2.39	1.327	5.417	0.164	0.07860	0.00259	5.490	0.171	0.06759	0.00616	1079	32	856	189	-26.0
D	59	59.1	117	143	1.26	0.658	5.003	0.089	0.07859	0.00099	5.036	0.090	0.07308	0.00179	1168	19	1016	50	-14.9
D	26	26.1	42	72	1.77	0.805	5.271	0.122	0.08088	0.00206	5.314	0.125	0.07413	0.00398	1112	25	1045	108	-6.4
D	3	3.1	231	199	0.89	0.178	5.121	0.214	0.07738	0.00077	5.131	0.215	0.07588	0.00098	1148	46	1092	26	-5.1
D	66	66.1	79	71	0.93	0.076	5.022	0.100	0.07692	0.00124	5.026	0.100	0.07629	0.00139	1170	22	1103	37	-6.1
D	9	9.1	14	45	3.31	0.488	5.397	0.198	0.08146	0.01695	5.423	0.201	0.07734	0.01753	1091	38	1130	451	3.5
D	65	65.1	45	61	1.40	-0.147	5.734	0.132	0.07613	0.00209	5.726	0.132	0.07737	0.00243	1038	23	1131	63	8.2
D	14	14.1	72	203	2.90	0.000	5.121	0.089	0.08114	0.00141	5.121	0.089	0.08114	0.00141	1150	19	1225	34	6.1
D	20	20.1	51	109	2.21	-0.144	5.047	0.107	0.08165	0.00178	5.039	0.107	0.08287	0.00216	1167	23	1266	51	7.8
D	60	60.1	81	90	1.15	-0.131	4.915	0.095	0.08274	0.00123	4.909	0.095	0.08385	0.00146	1195	22	1289	34	7.3
D	38	38.1	20	31	1.63	-1.334	5.633	0.163	0.07949	0.00242	5.559	0.164	0.09092	0.00558	1066	30	1445	117	26.2
D	51	51.1	57	40	0.73	-0.628	4.024	0.086	0.09009	0.00143	3.999	0.086	0.09549	0.00237	1439	28	1538	47	6.4
D	28	28.1	21	43	2.12	-1.404	5.394	0.171	0.08571	0.00294	5.319	0.173	0.09783	0.00664	1110	34	1583	127	29.9
D	22	22.1	52	44	0.87	0.660	3.281	0.069	0.10446	0.00171	3.303	0.070	0.09875	0.00277	1705	33	1601	52	-6.5
D	69	69.1	21	27	1.32	-0.397	3.292	0.092	0.11455	0.00220	3.279	0.092	0.11803	0.00297	1716	44	1927	45	10.9

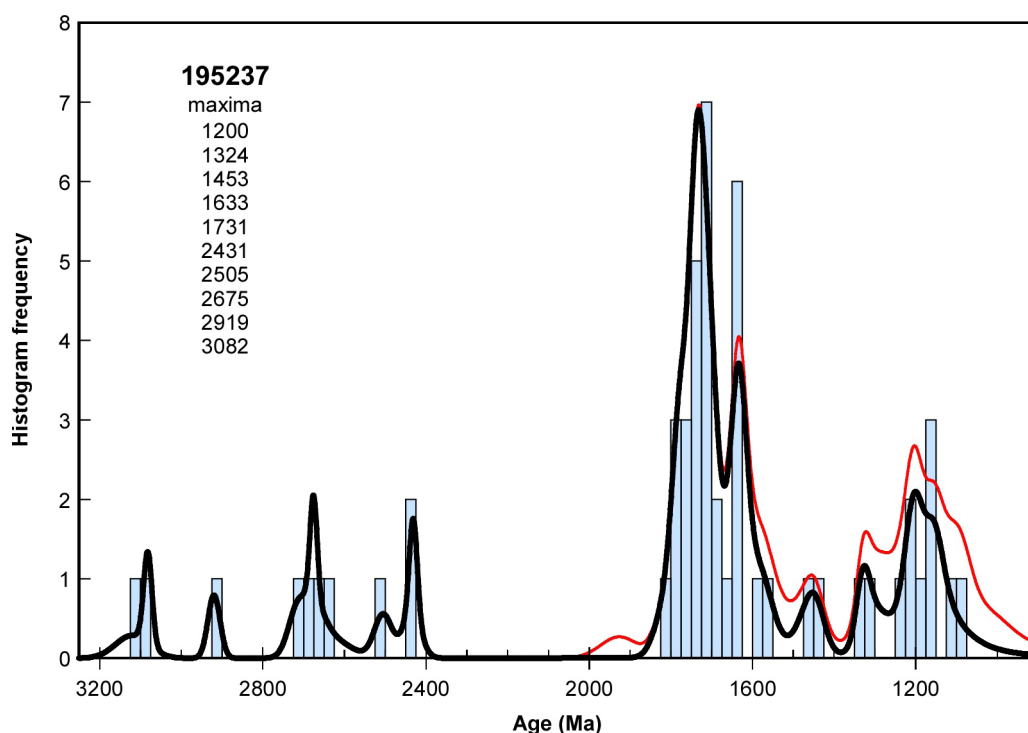


Figure 3. Probability density diagram and histogram for sample 195237: lithic sandstone, Townsend Ridges. Thick curve, maxima values, and frequency histogram (bin width 25 Ma) include only accepted data (53 analyses of 53 zircons). Thin curve includes all data (69 analyses of 69 zircons).

Group Y comprises one analysis (Table 1), which yields a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1097 ± 102 Ma (1σ).

Group S comprises 52 analyses (Table 1), which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates of 3120–1123 Ma.

It is possible all analyses in Groups Y and S are of unmodified detrital zircons, in which case the date of 1097 ± 102 Ma (1σ) for the single analysis in Group Y represents a maximum depositional age for the sedimentary protolith. A more conservative estimate of the maximum depositional age can be based on a concordia age of 1134 ± 15 Ma (MSWD = 0.53) for the five youngest analyses in combined Groups Y and S.

The data for combined Groups Y and S indicate significant age components at c. 2675, 1731, 1633, 1324, and 1200 Ma (Fig. 3), based on contributions from approximately 4, 18, 9, 3, and 8 analyses, respectively. These are interpreted as the ages of zircon-crystallizing rocks in the detrital source region(s), or the ages of detrital components within sediments that have been reworked into this rock.

References

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Recommended reference for this publication

- Wingate, MTD, Lu, Y, Kirkland, CL, Haines, PW and Werner, M 2017, 195237: lithic sandstone, Townsend Ridges; *Geochronology Record* 1372: Geological Survey of Western Australia, 5p.

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Data released: 28 April 2017