

143747: pebbly sandstone, Pollock Hills

(*Paterson Formation?, Canning Basin?*)

Location and sampling

WEBB (SG 52-10), POLLOCK (4452)
MGA Zone 52, 348702E 7472939N

Sampled on 20 May 2009

This sample was collected from a small hill of sandstone (Fig. 1) exposed on the western side of the Pollock Hills, about 24.8 km west of Kiwirrkurra, 4.7 km south of the Kiwirrkurra – Gary Junction Road, and 3.5 km southeast of survey mark BM473.

Tectonic unit/relations

The sample was collected from near the base of a unit tentatively assigned to the Permo-Carboniferous Paterson Formation (Mory, 2010). If this association is correct, the outcrop area should be considered an outlier of Canning Basin unconformably overlying the Amadeus Basin. The Paterson Formation comprises sandstone, conglomerate, diamictite and mudstone with evidence of glacial influence including faceted and striated clasts. At the sample locality, the outcrop is dominated by pebbly sandstone and unconformably overlies the Neoproterozoic Bitter Springs Formation (Fig. 1). A sample of the Paterson Formation on the eastern side of the Dovers Hills (GSWA 143784, Wingate et al., 2013) yielded a maximum depositional age of 478 ± 13 Ma (2σ).

Petrographic description

The sample is a quartz-rich, fine- to coarse-grained sandstone, consisting of about 60–70% single-crystal quartz grains, 20–25% interstitial clays \pm limonite, 7–8% pore spaces partially or completely filled by granular barite, and accessory muscovite and tourmaline. The hand specimen is mostly pale yellow with some reddish, apparently hematite-stained, lenses. Single-crystal quartz grains are 0.2 to 1.0 mm in diameter (fine to coarse sand size). Much of the quartz is microfissured or etched or dissolved, and varies from rounded to angular, with some grains containing fine fibrous inclusions, locally altered to limonite. Some micas are clouded by limonite. Dispersed, angular grains of yellow and green tourmaline are up to 0.7 mm long. Interstitial clay is mostly orange-brown and may be limonite-stained kaolinite, with reddish hematite-stained zones locally rimming small patches of porosity. Most pores are less than 0.7 mm diameter.

Zircon morphology

Zircons isolated from this sample are pale to dark brown, anhedral to subhedral, and strongly rounded. The crystals are up to 300 μ m long, and equant to slightly elongate, with aspect ratios up to 5:1. Some crystals have pitted outer surfaces and, in cathodoluminescence (CL) images, most exhibit concentric zoning truncated at grain edges, features consistent with abrasion during sedimentary transport. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 21–23 February 2011, using SHRIMP-A. Twenty-three analyses of the BR266 standard were obtained during the session, of which 20 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.96% (1σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.24% (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 isotopic compositions determined according to the model of Stacey and Kramers (1975). Dates from analyses for which 204-corrected $^{238}\text{U}/^{206}\text{Pb}^*$ ratios indicate ages <1300 Ma are based on 207-corrected $^{238}\text{U}/^{206}\text{Pb}^*$ ratios; those >1300 Ma are based on 204-corrected $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.

Results

Seventy-three analyses were obtained from 73 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3), and a probability density diagram (Fig. 4).

Interpretation

Most analyses are concordant to slightly discordant (Fig. 3). Three analyses >1300 Ma are >5% discordant. The dates obtained from these three analyses (Group D; Table 1) are imprecise or unreliable, and are considered not to be geologically significant. The remaining 70 analyses can be divided into two groups, based on their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ and $^{238}\text{U}/^{206}\text{Pb}^*$ ratios.

Group Y comprises one analysis (Table 1), which yields a 207-corrected $^{238}\text{U}/^{206}\text{Pb}^*$ date of 565 ± 8 Ma (1σ).



Figure 1. Outcrop photograph for sample 143747: pebbly sandstone, Pollock Hills. The dip of bedding of Paterson Formation at this locality is due to proximity to a Mesozoic fault.

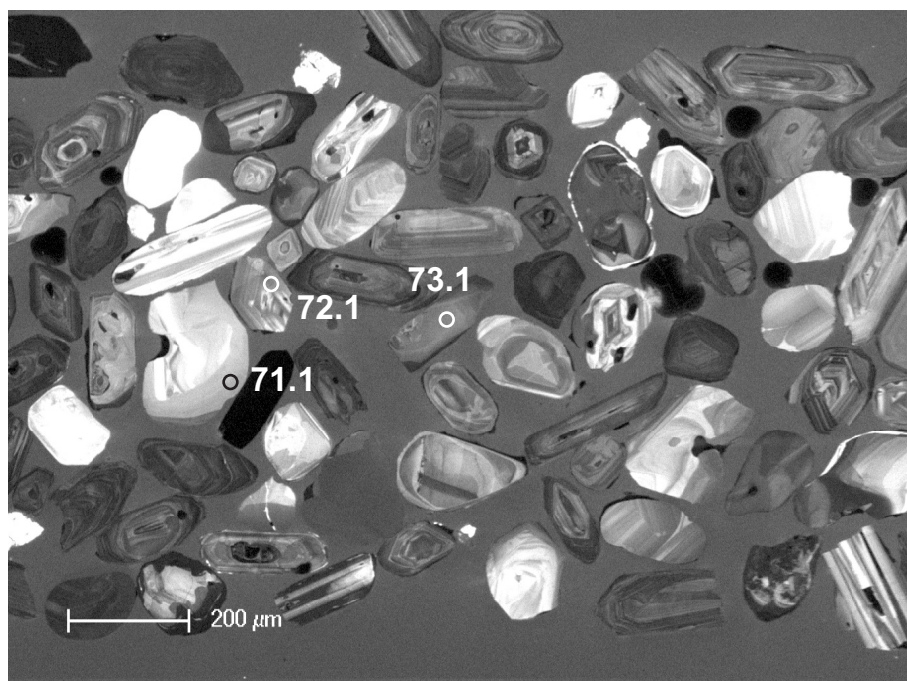


Figure 2. Cathodoluminescence image of representative zircons from sample 143747: pebbly sandstone, Pollock Hills. Numbered circles indicate the approximate locations of analysis sites.

Table 1. Ion microprobe analytical results for zircons from sample 143747: pebbly sandstone, Pollock Hills

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	f^{204} (%)	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{208}\text{Pb}^* \pm 1\sigma$	$^{207}\text{Pb}^*/^{208}\text{Pb}^* \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^* \text{ date (Ma)} \pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^* \text{ date (Ma)} \pm 1\sigma$	Disc. (%)
Y	61	61.1	171	52	0.31	0.504	10.857 0.151	0.06316 0.00112	10.912 0.154	0.05905 0.00203	565 8	569 75	0.6
S	40	40.1	228	98	0.45	0.125	10.504 0.485	0.05826 0.00094	10.517 0.485	0.05724 0.00118	586 27	501 45	-16.9
S	59	59.1	182	164	0.94	0.475	10.364 0.143	0.06191 0.00108	10.414 0.145	0.05805 0.00192	591 8	531 72	-11.2
S	68	68.1	39	16	0.42	0.736	10.088 0.224	0.07114 0.00256	10.163 0.232	0.06507 0.00504	605 13	776 163	22.1
S	31	31.1	23	22	0.99	2.158	6.887 0.230	0.07641 0.00286	7.039 0.245	0.05881 0.00856	856 29	560 317	-52.9
S	27	27.1	134	121	0.93	0.481	5.633 0.083	0.07464 0.00106	5.661 0.084	0.07063 0.00178	1049 15	947 52	-10.8
S	39	39.1	26	16	0.63	0.916	5.462 0.147	0.07780 0.00246	5.512 0.151	0.07017 0.00509	1075 28	933 149	-15.2
S	23	23.1	64	89	1.44	0.730	5.444 0.101	0.07663 0.00154	5.484 0.103	0.07055 0.00294	1080 19	944 85	-14.3
S	32	32.1	61	40	0.68	0.000	5.422 0.100	0.07834 0.00812	5.422 0.100	0.07834 0.00812	1091 19	1156 206	5.6
S	45	45.1	176	102	0.60	-0.105	5.366 0.074	0.08047 0.00088	5.360 0.074	0.08136 0.00102	1103 14	1230 25	10.4
S	54	54.1	60	73	1.26	0.326	5.203 0.098	0.08300 0.00155	5.220 0.099	0.08024 0.00223	1130 20	1203 55	6.1
S	33	33.1	82	61	0.76	0.990	5.221 0.089	0.07834 0.00129	5.274 0.091	0.07010 0.00273	1119 18	931 80	-20.2
S	5	5.1	83	75	0.94	0.216	5.121 0.084	0.08091 0.00123	5.132 0.084	0.07909 0.00162	1148 18	1174 41	2.3
S	21	21.1	187	157	0.87	-0.068	5.106 0.069	0.07734 0.00082	5.102 0.069	0.07791 0.00092	1154 14	1145 23	-0.8
S	53	53.1	155	99	0.66	-0.045	5.080 0.073	0.08062 0.00098	5.078 0.073	0.08100 0.00105	1159 15	1221 25	5.1
S	29	29.1	105	77	0.76	0.798	5.039 0.080	0.08103 0.00118	5.080 0.081	0.07433 0.00228	1158 17	1051 62	-10.3
S	47	47.1	210	73	0.36	0.233	5.053 0.068	0.07850 0.00082	5.065 0.068	0.07654 0.00111	1161 14	1109 29	-4.7
S	73	73.1	132	106	0.83	0.363	5.043 0.075	0.07941 0.00103	5.062 0.076	0.07635 0.00155	1162 16	1104 41	-5.2
S	25	25.1	58	60	1.08	0.568	5.010 0.094	0.08434 0.00160	5.038 0.096	0.07954 0.00269	1167 21	1186 67	1.6
S	57	57.1	251	226	0.93	0.052	5.032 0.065	0.07910 0.00073	5.034 0.065	0.07867 0.00079	1168 14	1164 20	-0.4
S	71	71.1	130	101	0.80	0.458	5.017 0.075	0.08061 0.00605	5.041 0.076	0.07676 0.00621	1167 16	1115 161	-4.6
S	28	28.1	299	191	0.66	0.168	4.980 0.062	0.08007 0.00071	4.988 0.062	0.07865 0.00089	1178 14	1163 22	-1.2
S	35	35.1	53	125	2.45	0.244	4.987 0.098	0.07840 0.00158	4.999 0.098	0.07635 0.00215	1175 21	1104 56	-6.4
S	52	52.1	347	156	0.46	0.080	4.958 0.061	0.07968 0.00065	4.962 0.061	0.07900 0.00073	1183 13	1172 18	-1.0
S	26	26.1	59	55	0.97	0.971	4.927 0.094	0.07816 0.00156	4.976 0.097	0.07007 0.00329	1181 21	930 96	-26.9
S	11	11.1	147	146	1.02	0.251	4.886 0.070	0.07890 0.00093	4.898 0.070	0.07679 0.00127	1198 16	1116 33	-7.3
S	2	2.1	53	81	1.57	0.619	4.843 0.092	0.08514 0.00153	4.874 0.094	0.07991 0.00265	1203 21	1195 65	-0.7
S	66	66.1	414	143	0.36	0.176	4.862 0.058	0.08117 0.00056	4.870 0.058	0.07968 0.00071	1204 13	1189 18	-1.2
S	19	19.1	119	130	1.13	0.250	4.769 0.072	0.08071 0.00103	4.781 0.072	0.07860 0.00140	1224 17	1162 35	-5.3
S	9	9.1	92	49	0.55	0.921	4.586 0.082	0.08294 0.00116	4.628 0.083	0.07521 0.00233	1261 21	1074 62	-17.4
S	10	10.1	247	211	0.88	0.118	4.000 0.051	0.09271 0.00072	4.004 0.051	0.09169 0.00083	1437 17	1461 17	1.6
S	18	18.1	109	81	0.77	0.279	3.673 0.057	0.09521 0.00104	3.684 0.057	0.09282 0.00138	1548 22	1484 28	-4.3
S	3	3.1	52	33	0.66	0.558	3.823 0.073	0.09898 0.00150	3.845 0.074	0.09418 0.00237	1490 26	1512 48	1.4
S	34	34.1	131	82	0.65	0.235	3.486 0.052	0.09873 0.00099	3.494 0.052	0.09671 0.00125	1623 22	1562 24	-3.9
S	7	7.1	107	57	0.55	0.202	3.764 0.057	0.09874 0.00107	3.772 0.058	0.09700 0.00133	1516 21	1567 26	3.3
S	30	30.1	127	96	0.79	-0.039	3.491 0.053	0.09855 0.00105	3.489 0.053	0.09889 0.00110	1624 22	1603 21	-1.3

Table 1. continued

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	f^{204} (%)	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^* \pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^* \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^* \text{ date (Ma)} \pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^* \text{ date (Ma)} \pm 1\sigma$	Disc. (%)						
S	50	50.1	231	181	0.81	0.132	3.480	0.046	0.10132	0.00074	3.485	0.046	0.10018	0.00086	1626	19	1627	16	0.1
S	1	1.1	93	20	0.22	0.211	3.386	0.054	0.10238	0.00112	3.393	0.054	0.10055	0.00139	1665	24	1634	26	-1.9
S	49	49.1	73	89	1.27	0.238	3.568	0.063	0.10262	0.00133	3.576	0.063	0.10056	0.00169	1590	25	1634	31	2.7
S	72	72.1	66	53	0.83	0.489	3.294	0.060	0.10509	0.00137	3.310	0.060	0.10086	0.00204	1702	28	1640	38	-3.8
S	56	56.1	274	29	0.11	0.016	3.354	0.043	0.10537	0.00070	3.354	0.043	0.10523	0.00071	1682	19	1718	12	2.1
S	13	13.1	81	63	0.80	0.386	3.147	0.052	0.10931	0.00119	3.159	0.053	0.10596	0.00164	1773	26	1731	28	-2.4
S	42	42.1	272	96	0.36	0.071	3.180	0.040	0.10714	0.00067	3.182	0.040	0.10652	0.00073	1762	20	1741	13	-1.2
S	4	4.1	308	136	0.46	0.108	3.212	0.040	0.10790	0.00062	3.215	0.040	0.10697	0.00070	1746	19	1748	12	0.1
S	16	16.1	320	181	0.59	0.054	3.113	0.038	0.10748	0.00059	3.114	0.038	0.10701	0.00063	1795	19	1749	11	-2.6
S	6	6.1	306	215	0.73	0.082	3.139	0.038	0.10817	0.00062	3.142	0.038	0.10746	0.00067	1781	19	1757	11	-1.4
S	65	65.1	188	130	0.71	0.140	3.190	0.043	0.10884	0.00081	3.194	0.043	0.10762	0.00094	1756	21	1760	16	0.2
S	63	63.1	475	174	0.38	0.000	3.126	0.037	0.10834	0.00052	3.126	0.037	0.10834	0.00052	1789	19	1772	9	-1.0
S	22	22.1	195	88	0.47	0.000	3.106	0.041	0.10853	0.00077	3.106	0.041	0.10853	0.00077	1799	21	1775	13	-1.4
S	67	67.1	239	112	0.48	0.112	3.036	0.047	0.10958	0.00073	3.040	0.047	0.10860	0.00082	1833	25	1776	14	-3.2
S	64	64.1	417	90	0.22	0.057	3.202	0.038	0.10918	0.00056	3.204	0.038	0.10869	0.00060	1751	19	1778	10	1.5
S	43	43.1	336	47	0.14	0.070	3.187	0.039	0.10931	0.00062	3.189	0.039	0.10870	0.00067	1758	19	1778	11	1.1
S	8	8.1	86	83	0.99	0.117	3.191	0.052	0.11000	0.00114	3.195	0.052	0.10897	0.00128	1756	26	1782	21	1.5
S	41	41.1	399	114	0.30	0.167	3.279	0.039	0.11049	0.00058	3.284	0.039	0.10904	0.00068	1714	18	1783	11	3.9
S	55	55.1	162	102	0.65	0.024	3.126	0.044	0.10930	0.00088	3.127	0.044	0.10910	0.00091	1789	22	1784	15	-0.2
S	48	48.1	389	51	0.13	0.027	2.954	0.036	0.11347	0.00057	2.955	0.036	0.11323	0.00058	1879	20	1852	9	-1.5
S	51	51.1	253	66	0.27	0.042	2.987	0.038	0.11369	0.00070	2.988	0.038	0.11332	0.00073	1861	21	1853	12	-0.4
S	60	60.1	181	145	0.82	0.041	2.974	0.041	0.11407	0.00085	2.976	0.041	0.11371	0.00088	1868	23	1860	14	-0.4
S	62	62.1	524	49	0.10	0.053	2.949	0.034	0.11446	0.00049	2.950	0.034	0.11400	0.00052	1882	19	1864	8	-0.9
S	37	37.1	240	69	0.30	0.074	3.004	0.039	0.11502	0.00073	3.007	0.039	0.11437	0.00078	1851	21	1870	12	1.0
S	44	44.1	194	58	0.31	0.085	2.973	0.040	0.11600	0.00078	2.976	0.040	0.11526	0.00085	1868	22	1884	13	0.9
S	36	36.1	467	268	0.59	0.036	2.962	0.035	0.11560	0.00051	2.963	0.035	0.11528	0.00053	1874	19	1884	8	0.5
S	46	46.1	222	124	0.58	0.060	2.818	0.037	0.12181	0.00076	2.820	0.037	0.12129	0.00081	1957	22	1975	12	0.9
S	15	15.1	119	76	0.66	0.192	2.519	0.038	0.13316	0.00103	2.524	0.038	0.13146	0.00119	2152	28	2118	16	-1.6
S	20	20.1	148	88	0.61	0.284	2.484	0.035	0.13692	0.00092	2.491	0.036	0.13442	0.00112	2176	27	2156	15	-0.9
S	14	14.1	287	209	0.75	0.075	2.151	0.027	0.16151	0.00067	2.152	0.027	0.16085	0.00070	2460	26	2465	7	0.2
S	24	24.1	59	29	0.52	0.235	2.163	0.041	0.16969	0.00921	2.168	0.041	0.16759	0.00927	2445	39	2534	93	3.5
S	17	17.1	508	337	0.69	0.023	1.972	0.023	0.17320	0.00052	1.973	0.023	0.17300	0.00052	2644	25	2587	5	-2.2
S	58	58.1	279	143	0.53	0.051	2.127	0.093	0.17533	0.00077	2.128	0.093	0.17487	0.00079	2483	93	2605	8	4.7
S	69	69.1	337	76	0.23	0.058	1.867	0.023	0.19545	0.00070	1.869	0.023	0.19493	0.00072	2763	28	2784	6	0.8
D	12	12.1	42	57	1.41	0.943	3.579	0.077	0.09957	0.00172	3.613	0.078	0.09149	0.00323	1575	31	1457	67	-8.1
D	38	38.1	169	141	0.86	0.100	2.692	0.046	0.11933	0.01000	2.695	0.046	0.11846	0.01002	2034	30	1933	151	-5.2
D	70	70.1	830	534	0.66	0.010	2.447	0.027	0.16045	0.00338	2.447	0.027	0.16037	0.00338	2209	21	2460	36	10.2

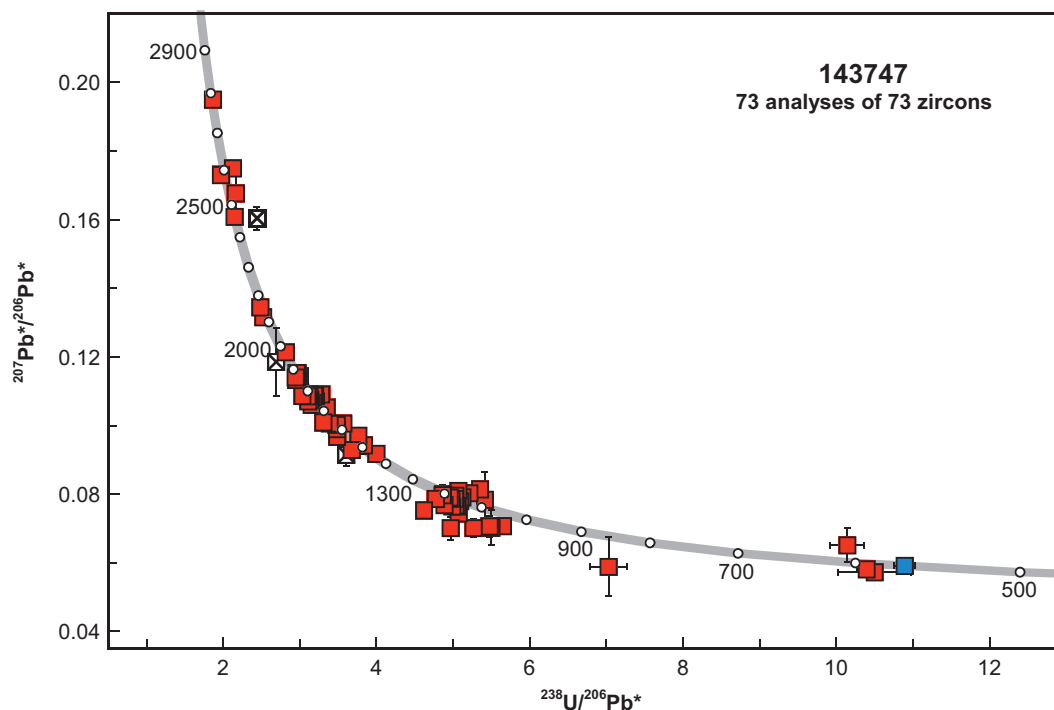


Figure 3. U-Pb analytical data for zircons from sample 143747: pebbly sandstone, Pollock Hills. Data are corrected for common Pb using measured $^{204}\text{Pb}/^{206}\text{Pb}$. Blue square indicates Group Y (youngest detrital zircon); red squares indicate Group S (older detrital zircons); crossed squares indicate Group D (date >1300 Ma and discordance >5%).

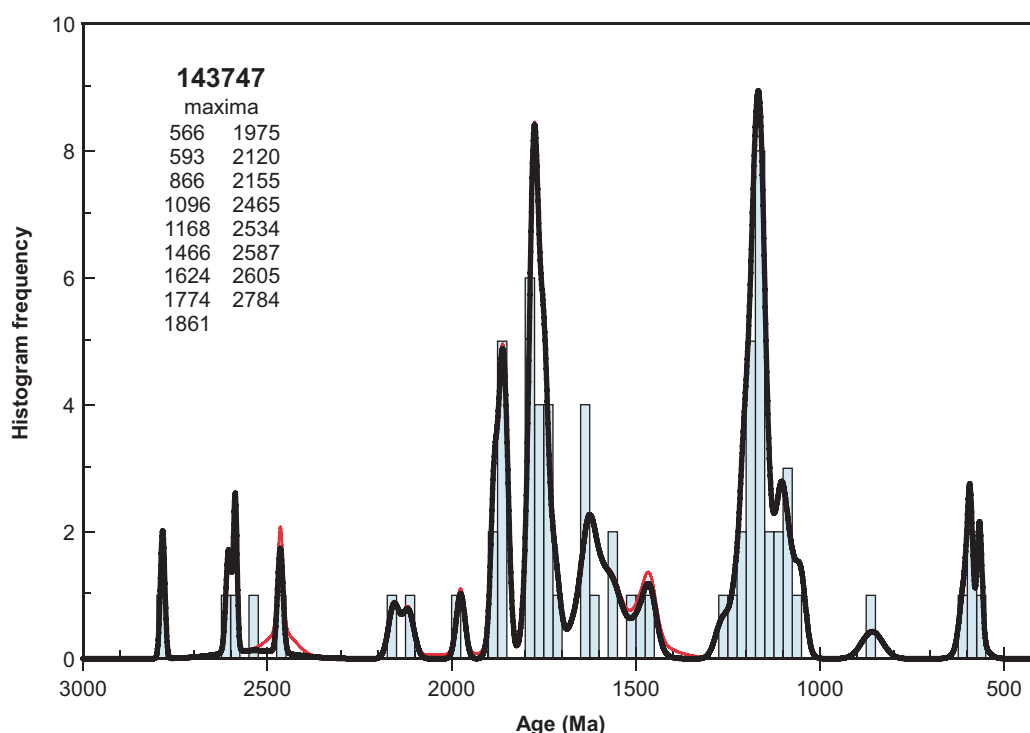


Figure 4. Probability density diagram and histogram for sample 143747: pebbly sandstone, Pollock Hills. Dates <1300 Ma are based on ^{207}Pb -corrected $^{238}\text{U}/^{206}\text{Pb}^*$ ratios. Thick curve, maxima values, and frequency histogram (bin width 25 Ma) include only accepted data (70 analyses of 70 zircons). Thin curve includes all data (73 analyses of 73 zircons).

Group S comprises 69 analyses (Table 1), which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ or $^{238}\text{U}/^{206}\text{Pb}^*$ dates of 2784–587 Ma.

It is possible that all of the analyses are of unmodified detrital zircons, in which case the date of 565 ± 8 Ma (1σ) for the single analysis in Group Y represents a maximum depositional age for the sandstone. A more conservative estimate of the maximum depositional age can be based on the weighted mean 207-corrected $^{238}\text{U}/^{206}\text{Pb}^*$ date of 594 ± 13 Ma (MSWD = 0.21) for the three youngest analyses in Group S.

The data for combined Groups Y and S indicate significant age components at c. 1861, 1774, 1624, 1168, and 593 Ma (Fig. 4). These are interpreted as the ages of zircon-crystallizing rocks in the detrital source region(s), or as the ages of detrital components within sediments that have been reworked into this rock.

References

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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, p. 207–221.
- Wingate, MTD, Kirkland, CL and Haines, PW 2013, 143784: sandstone, Dovers Hills; Geochronology Record 1109: Geological Survey of Western Australia, 6p.

Recommended reference for this publication

Wingate, MTD, Kirkland, CL and Haines, PW 2013, 143747: pebbly sandstone, Pollock Hills; Geochronology Record 1107: Geological Survey of Western Australia, 6p.

Data obtained: 23 February 2011

Data released: 30 June 2013