

184336: sandstone, Pollock Hills

(Kiwirrkurra Formation, Amadeus Basin)

Location and sampling

WEBB (SF 52-10), POLLOCK (4452)
MGA Zone 52, 352888E 7475529N

Sampled on 29 July 2007

The sample was collected from a coarse-grained, locally pebbly, sandstone bed containing small, angular lithic fragments, in an outcrop of intercalated pebbly sandstone, sandstone, and minor siltstone, exposed in a series of rugged low hills on the northern side of the western part of Pollock Hills. The sample site is located southwest of the Kiwirrkurra–Gary Junction Road, and about 20 km west of the Kiwirrkurra town site.

Tectonic unit/relations

The unit sampled is a sandstone layer from a succession of red-weathering lithic sandstone, quartz sandstone and conglomerate, assigned to the Kiwirrkurra Formation, tentatively of the Amadeus Basin. This formation unconformably overlies the Pollock Hills Formation, and unconformably underlies the Heavitree Quartzite, of which sample GSWA 184339 is representative (Kirkland et al., 2009). Bedding is approximately horizontal.

Petrographic description

This quartz-lithic, medium- to coarse-grained sandstone contains abundant hematite- and sericite-clouded, single-crystal and polycrystalline quartz grains, up to 0.5 mm in diameter, as well as clear, single-crystal quartz grains, up to 0.8 mm in diameter. Scattered larger quartz grains up to 1.5 mm in diameter are also present. Some grains resemble myrmekite, found in plagioclase and formed by exsolution from alkali feldspar during cooling, under conditions in which silica was mobile in the rock. The myrmekite, sericite, and hematite-clouded quartz grains appear to represent altered acid volcanic materials. Rare tourmaline is present, up to 0.3 mm in size. Interstitial material is mostly decussate sericite or illite, but most grains are close-packed, rarely with hematite-rimmed detrital cores and optically continuous overgrowths.

Zircon morphology

Zircons from this sample show a diverse range of colours and textures. Many are clear and colourless, some are

pale brown, and others are yellow with phyllosilicate inclusions. The crystals range from subhedral and variably rounded to euhedral and well faceted. The zircons are up to 200 µm long with aspect ratios up to 4:1. Most crystals exhibit oscillatory growth zoning, which is truncated at abraded grain margins, consistent with sedimentary transport. Some grains exhibit core and overgrowth relationships indicating a history of growth and regrowth. A cathodoluminescence image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed on 29–30 May 2008, using SHRIMP-A. Twenty-seven analyses of the Temora standard were obtained during the session, and indicated an external spot-to-spot (reproducibility) uncertainty of 1.37% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.31% (1σ). 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

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

Interpretation

Most analyses are concordant to slightly discordant (Fig. 2). Six analyses are characterized by slight to moderate discordance (>5%). The dates obtained from these six analyses (Group D; Table 1) are imprecise or unreliable, and are not considered geologically significant. The remaining 54 analyses can be divided into two groups.

Group Y comprises a single analysis (56.1; Table 1), which yields a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1570 ± 22 Ma (1σ).

Group S comprises 53 analyses (Table 1), which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates of 2482–1578 Ma.

It is possible that all of the analyses are of unmodified detrital zircons, in which case the date of 1570 ± 22 Ma (1σ) for the single analysis in Group Y can be interpreted

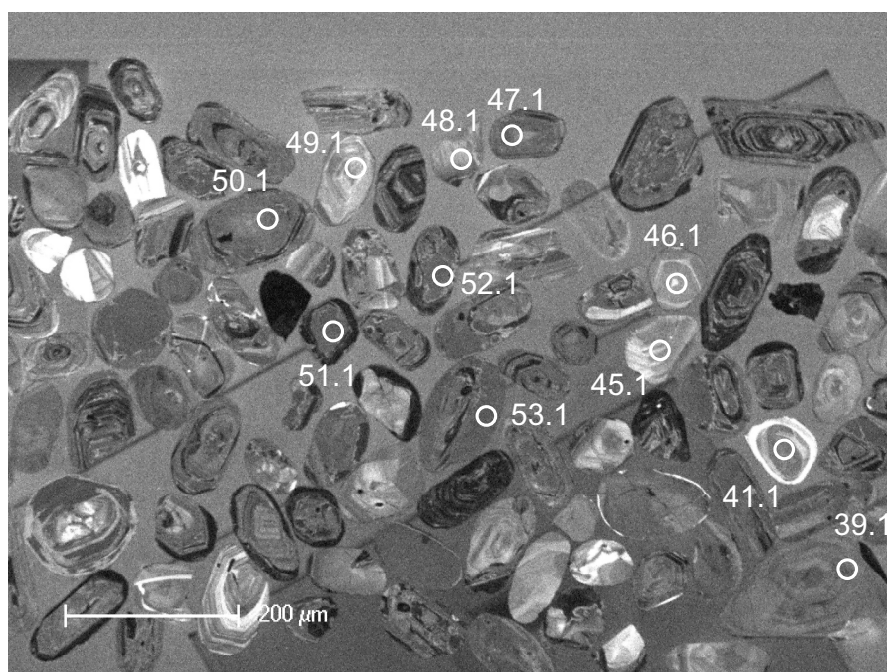


Figure 1. Cathodoluminescence image of representative zircons from sample 184336: sandstone, Pollock Hills. Numbered circles indicate approximate locations of analysis sites.

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 1633 ± 6 Ma (MSWD = 1.4) for the youngest 40 analyses in Groups Y and S.

The 54 analyses in combined Groups Y and S indicate dates that define significant age components at c. 1640 and 1855 Ma, and several minor components spanning the range 2482–1570 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. Felsic volcanic rocks of the Pollock Hills Formation that unconformably underlie the Kiwirrkurra Formation are a likely source for the c. 1640 Ma zircons (Wyborn et al., 1998), indicating that the more conservative estimate of 1633 ± 6 Ma for the maximum depositional age is the more robust.

Recommended reference for this publication

Kirkland, CL, Wingate, MTD, Spaggiari CV and Tyler, IM 2009, 184336: sandstone, Pollock Hills; Geochronology Record 816: Geological Survey of Western Australia, 5p.

Data obtained: 30 May 2008

Data released: 30 June 2009

References

- Kirkland, CL, Wingate, MTD, Spaggiari, CV and Tyler, IM 2009, 184339: sandstone, Pollock Hills; Geochronology Record 817: Geological Survey of Western Australia, 5p.
- 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.
- Wyborn, L, Hazell, M, Page, R, Idnurm, M and Sun, S 1998, A newly discovered major Proterozoic granite-alteration system in the Mount Webb region, central Australia, and implications for Cu–Au mineralisation: AGSO Research Newsletter, 28, 5p.

Table 1. Ion microprobe analytical results for zircons from sample 184336: sandstone, Pollock Hills

Group ID.	Spot no.	Grain. spot	²³⁸ U (ppm)	²³² Th (ppm)	²³⁵ Th/ ²³⁸ U	f ₂₀₄ (%)	²³⁸ U/ ²⁰⁶ Pb ± 1 σ	²⁰⁷ Pb/ ²⁰⁶ Pb ± 1 σ	²³⁸ U/ ²⁰⁶ Pb* ± 1 σ	²⁰⁷ Pb*/ ²⁰⁶ Pb* ± 1 σ	²³⁸ U/ ²⁰⁶ Pb* date (Ma) ± 1 σ	²⁰⁷ Pb*/ ²⁰⁶ Pb* date (Ma) ± 1 σ	Disc. (%)
Y	56	56.1	117	84	0.74	0.333	3.439 0.051	0.10001 0.00079	3.450 0.052	0.09714 0.00113	1641 22	1570 22	-4.5
S	22	22.1	190	187	1.01	0.047	3.507 0.053	0.09799 0.00067	3.508 0.053	0.09758 0.00070	1617 22	1578 13	-2.4
S	20	20.1	161	157	1.01	0.123	3.491 0.051	0.09879 0.00071	3.495 0.051	0.09773 0.00082	1622 21	1581 16	-2.6
S	58	58.1	152	121	0.82	0.094	3.414 0.059	0.09920 0.00097	3.417 0.059	0.09839 0.00105	1655 25	1594 20	-3.8
S	49	49.1	229	131	0.59	0.032	3.471 0.050	0.09882 0.00078	3.472 0.050	0.09855 0.00116	1632 21	1597 22	-2.2
S	48	48.1	165	111	0.70	0.304	3.550 0.052	0.10154 0.00069	3.560 0.052	0.09891 0.00097	1596 21	1604 18	0.5
S	50	50.1	153	90	0.60	0.163	3.431 0.055	0.10033 0.00069	3.437 0.055	0.09892 0.00084	1646 23	1604 16	-2.6
S	12	12.1	119	98	0.85	0.181	3.495 0.052	0.10058 0.00081	3.502 0.053	0.09902 0.00104	1619 21	1606 20	-0.9
S	38	38.1	148	108	0.76	0.150	3.405 0.050	0.10032 0.00073	3.410 0.050	0.09903 0.00080	1658 22	1606 15	-3.2
S	4	4.1	139	102	0.76	0.255	3.409 0.051	0.10134 0.00079	3.418 0.051	0.09914 0.00103	1654 22	1608 19	-2.9
S	17	17.1	172	114	0.68	0.115	3.422 0.050	0.10016 0.00066	3.426 0.050	0.09916 0.00071	1651 21	1608 13	-2.6
S	15	15.1	141	119	0.87	0.282	3.399 0.050	0.10166 0.00077	3.409 0.051	0.09923 0.00104	1658 22	1610 19	-3.0
S	21	21.1	164	111	0.70	0.160	3.481 0.051	0.10086 0.00074	3.486 0.051	0.09948 0.00108	1626 21	1614 20	-0.7
S	30	30.1	123	88	0.74	0.048	3.397 0.051	0.10003 0.00081	3.398 0.051	0.09961 0.00088	1663 22	1617 16	-2.8
S	28	28.1	165	119	0.74	0.076	3.408 0.050	0.10035 0.00070	3.411 0.050	0.09969 0.00072	1657 21	1618 13	-2.4
S	24	24.1	149	139	0.97	0.155	3.528 0.052	0.10112 0.00070	3.534 0.052	0.09978 0.00084	1606 21	1620 16	0.8
S	14	14.1	139	98	0.73	0.054	3.378 0.050	0.10032 0.00075	3.380 0.050	0.09985 0.00079	1671 22	1621 15	-3.1
S	46	46.1	128	90	0.72	0.106	3.411 0.051	0.10090 0.00077	3.415 0.051	0.09998 0.00087	1656 22	1624 16	-2.0
S	60	60.1	153	100	0.68	0.025	3.422 0.050	0.10040 0.00069	3.422 0.050	0.10018 0.00076	1652 21	1627 14	-1.5
S	55	55.1	124	71	0.59	0.080	3.454 0.051	0.10090 0.00079	3.457 0.051	0.10021 0.00081	1638 21	1628 15	-0.6
S	43	43.1	125	85	0.71	0.106	3.427 0.051	0.10127 0.00078	3.431 0.051	0.10036 0.00088	1649 22	1631 16	-1.1
S	39	39.1	185	131	0.73	0.178	3.413 0.050	0.10190 0.00067	3.419 0.050	0.10036 0.00086	1654 21	1631 16	-1.4
S	31	31.1	161	107	0.68	0.103	3.433 0.050	0.10125 0.00069	3.437 0.050	0.10036 0.00084	1646 21	1631 16	-0.9
S	37	37.1	205	134	0.68	0.181	3.412 0.049	0.10196 0.00062	3.418 0.049	0.10039 0.00077	1654 21	1631 14	-1.4
S	9	9.1	146	103	0.73	0.088	3.458 0.051	0.10121 0.00073	3.461 0.051	0.10044 0.00097	1636 21	1632 18	-0.2
S	47	47.1	183	104	0.59	0.004	3.455 0.050	0.10082 0.00065	3.455 0.050	0.10078 0.00066	1639 21	1639 12	0.0
S	35	35.1	170	140	0.85	0.086	3.492 0.051	0.10157 0.00067	3.495 0.051	0.10082 0.00080	1622 21	1639 15	1.1
S	41	41.1	92	77	0.86	0.151	3.561 0.054	0.10229 0.00145	3.567 0.055	0.10098 0.00150	1593 22	1642 28	3.0
S	29	29.1	150	112	0.77	0.035	3.440 0.051	0.10133 0.00072	3.441 0.051	0.10102 0.00082	1645 21	1643 15	-0.1
S	23	23.1	140	97	0.71	0.022	3.445 0.054	0.10123 0.00074	3.446 0.054	0.10104 0.00080	1643 23	1643 15	0.0
S	1	1.1	132	88	0.69	-0.016	3.514 0.052	0.10094 0.00080	3.513 0.053	0.10108 0.00095	1615 21	1644 17	1.8
S	45	45.1	120	78	0.67	-0.005	3.471 0.052	0.10116 0.00080	3.471 0.052	0.10120 0.00080	1632 21	1646 15	0.9
S	3	3.1	197	131	0.69	0.016	3.458 0.050	0.10136 0.00066	3.458 0.050	0.10123 0.00093	1637 21	1647 17	0.6
S	36	36.1	94	67	0.73	0.140	3.414 0.052	0.10246 0.00093	3.419 0.052	0.10126 0.00096	1654 22	1647 18	-0.4
S	54	54.1	264	180	0.70	0.040	3.424 0.049	0.10162 0.00055	3.426 0.049	0.10127 0.00058	1651 21	1648 11	-0.2
S	44	44.1	257	139	0.56	0.056	3.492 0.050	0.10186 0.00056	3.494 0.050	0.10137 0.00060	1622 20	1649 11	1.6
S	26	26.1	161	118	0.76	0.034	3.436 0.050	0.10182 0.00071	3.438 0.050	0.10152 0.00074	1646 21	1652 13	0.4
S	7	7.1	177	125	0.73	0.041	3.464 0.051	0.10196 0.00068	3.465 0.051	0.10160 0.00112	1634 21	1654 20	1.2
S	10	10.1	129	98	0.78	0.077	3.550 0.053	0.10232 0.00080	3.552 0.053	0.10166 0.00101	1599 21	1655 18	3.4
S	13	13.1	78	48	0.64	0.055	3.417 0.053	0.10216 0.00101	3.419 0.054	0.10169 0.00188	1654 23	1655 34	0.1
S	52	52.1	137	90	0.68	0.022	3.326 0.049	0.10190 0.00075	3.327 0.049	0.10170 0.00075	1694 22	1655 14	-2.4

Table 1. (continued)

Group ID.	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	f^{204} (%)	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	Disc. (%)
S	51	51.1	131	150	1.18	0.059	3.387 0.053	0.10240 0.00078	3.389 0.053	0.10189 0.00081	1667 23	1659 15	1667 23	1659 15	-0.5
S	16	16.1	205	164	0.83	0.021	3.548 0.051	0.10211 0.00065	3.549 0.051	0.10192 0.00066	1600 21	1659 12	1600 21	1659 12	3.6
S	18	18.1	210	164	0.80	0.100	3.352 0.048	0.10337 0.00060	3.356 0.048	0.10250 0.00065	1681 21	1670 12	1681 21	1670 12	-0.7
S	5	5.1	140	111	0.82	0.134	3.481 0.052	0.10440 0.00109	3.486 0.052	0.10323 0.00127	1626 21	1683 23	1626 21	1683 23	3.4
S	33	33.1	118	90	0.78	-0.267	3.441 0.051	0.10162 0.00079	3.432 0.052	0.10394 0.00221	1648 22	1696 39	1648 22	1696 39	2.8
S	34	34.1	215	97	0.47	0.042	3.139 0.045	0.10883 0.00062	3.141 0.045	0.10847 0.00066	1782 22	1774 11	1782 22	1774 11	-0.5
S	59	59.1	120	100	0.86	0.351	3.035 0.045	0.11503 0.00084	3.045 0.045	0.11197 0.00117	1830 24	1832 19	1830 24	1832 19	0.1
S	42	42.1	322	173	0.56	-0.010	3.019 0.043	0.11336 0.00048	3.019 0.043	0.11345 0.00054	1844 23	1855 9	1844 23	1855 9	0.6
S	53	53.1	192	106	0.57	0.047	2.955 0.043	0.11387 0.00064	2.957 0.043	0.11346 0.00083	1878 24	1856 13	1878 24	1856 13	-1.2
S	27	27.1	193	70	0.37	0.148	2.922 0.042	0.11510 0.00063	2.926 0.042	0.11381 0.00080	1895 24	1861 13	1895 24	1861 13	-1.8
S	19	19.1	102	159	1.61	-0.025	2.754 0.042	0.12228 0.00088	2.753 0.042	0.12251 0.00098	1998 26	1993 14	1998 26	1993 14	-0.2
S	32	32.1	191	95	0.52	0.026	2.289 0.033	0.15932 0.00070	2.290 0.033	0.15910 0.00071	2336 28	2446 8	2336 28	2446 8	4.5
S	8	8.1	174	182	1.08	0.064	2.212 0.032	0.16310 0.00077	2.213 0.032	0.16253 0.00082	2404 29	2482 9	2404 29	2482 9	3.2
D	11	11.1	68	48	0.73	0.588	2.956 0.047	0.11354 0.00109	2.974 0.048	0.10842 0.00207	1869 26	1773 35	1869 26	1773 35	-5.4
D	2	2.1	292	166	0.59	0.120	3.878 0.055	0.09898 0.00056	3.883 0.055	0.09795 0.00078	1477 19	1585 15	1477 19	1585 15	6.8
D	6	6.1	223	147	0.68	-0.027	3.720 0.054	0.10127 0.00064	3.719 0.054	0.10150 0.00064	1535 20	1652 12	1535 20	1652 12	7.1
D	40	40.1	130	150	1.19	0.539	3.956 0.076	0.10295 0.00080	3.977 0.077	0.09830 0.00134	1446 25	1592 25	1446 25	1592 25	9.2
D	25	25.1	299	166	0.57	0.118	4.101 0.058	0.10488 0.00053	4.106 0.058	0.10386 0.00071	1405 18	1694 13	1405 18	1694 13	17.1
D	57	57.1	346	158	0.47	0.256	3.776 0.053	0.12456 0.00053	3.786 0.053	0.12231 0.00075	1511 19	1990 11	1511 19	1990 11	24.1

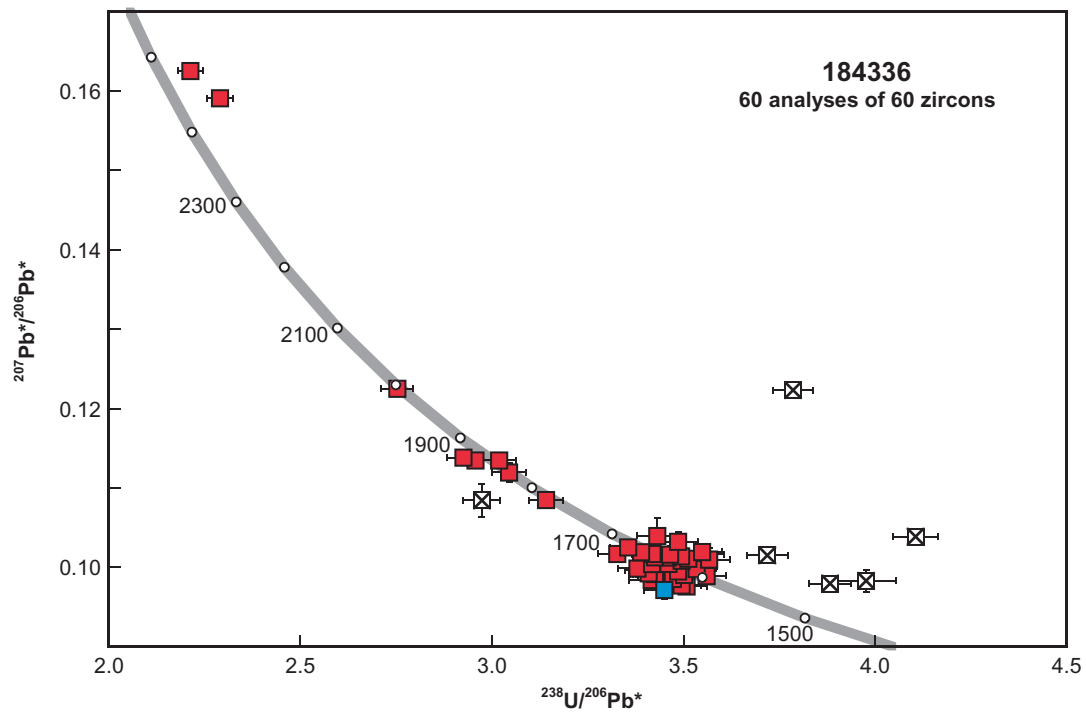


Figure 2. U-Pb analytical data for zircons from sample 184336: sandstone, Pollock Hills; blue square indicates Group Y (youngest detrital zircon); red squares denote Group S (older detrital zircons); crossed squares denote Group D (discordance >5%).

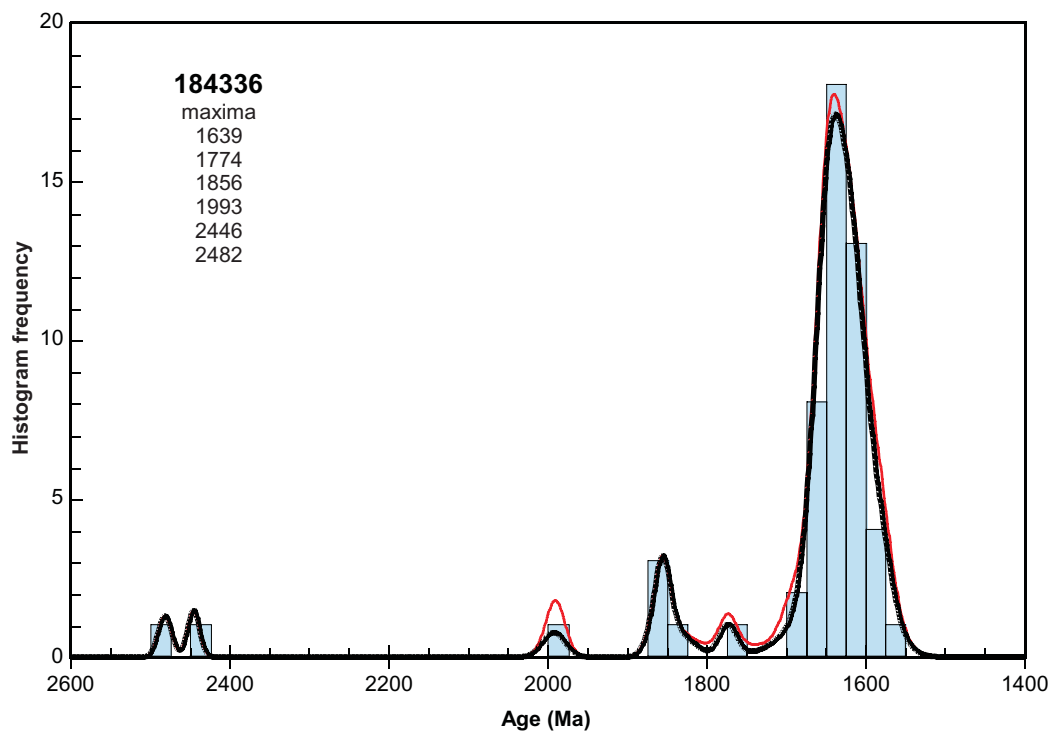


Figure 3. Probability density diagram and histogram for sample 184336: sandstone, Pollock Hills. Heavy curve, maxima values, and frequency histogram (bin width 25 Ma) includes only concordant data (54 analyses of 54 zircons). Light curve includes all data (60 analyses of 60 zircons).