169081: pebbly sandstone, Meteorite Bore

Location and sampling

Mount Bruce (SF 50-11), Rocklea (2352)

MGA Zone 50, 504960E 7460930N

Sampled on 1 September 2001

The sample was taken from the lowest beds exposed at the eastern end of an east-west-striking sandstone and conglomerate ridge, 3.8 km south-southeast of Meteorite Bore.

Tectonic unit/relations

This sample is a dark grey, medium-grained, lithic sandstone containing rounded pebbles, up to 3 cm in diameter, of banded iron-formation. It was collected from the stratigraphically lower part of the Mount McGrath Formation of the Wyloo Group, Ashburton Basin (Thorne and Tyler, 1996), to provide a maximum age for the lower part of the Mount McGrath Formation.

Petrographic description

This sample is a massive, pebbly, quartz-rich sandstone. It contains grains of single-crystal quartz, cherty quartz with or without limonite and clays, limonite or earthy hematite-flooded grains, minor opaque oxide, and rare possible monazite. A sparse matrix consists of quartz and sericite. There is a large pebble in this sample, which is mostly a quartz-rich sandstone with rounded single-crystal quartz grains (65–70 vol.%) from 0.2 to 1 mm in diameter (coarse-grained sandstone). Some of the quartz grains have optically continuous overgrowths, and most have narrow rims of limonite. Rare larger single-crystal quartz grains, up to 2 mm long, are less rounded and lack overgrowths. Much of this quartz has undulose extinction. There are also abundant grains of fine-grained quartz, partly chert (10 vol.%), with microcrystalline opaque oxide, or a diffuse hematite stain in most. Other grains, to 3 mm in length, have microcrystalline quartz that could represent thermal recrystallization of former chalcedony (10 vol.%), and some have granular to columnar quartz (3 vol.%). The largest pebble, forming about 3 vol.% of the section, is 5 mm long with layers of microcrystalline cherty quartz and coarser-grained quartz, possibly in veins to 1.5 mm wide, with undulose extinction and deformation lamellae. There is also a large clast, 4 mm long, of limonite or earthy hematite-flooded fine sedimentary rock with minor quartz in lamellae parallel to the length of the clast. Smaller limonite or hematite-flooded clasts are also scattered (5 vol.%), as well as oxidized small oxide grains. A single large clast, 3 mm long, has abundant cherty quartz with sericite, leucoxene, and limonite-lined fractures and could have a volcanic precursor. Interstitial quartz and sericite occur as a matrix but only form about 5 vol.% of the rock. There is little evidence of more than very low grade metamorphism in this sample.

Zircon morphology

The zircons isolated from this sample are typically colourless, yellowish- or pinkish-brown or black fragments and whole grains, between 35 × 50 μm and 200 × 250 μm in size, and equant to elongate and rounded. Many grains are internally structureless and most have pitted terminations, consistent with detrital transport. Cathodoluminescence images of representative zircons are given in Figure 1.

Analytical details

This sample was analysed on 7 May 2002. The counter deadtime during the analysis session was 32 ns. Fourteen analyses of the CZ3 standard obtained during the analysis session indicated a Pb*/U calibration uncertainty of 1.28% (1σ). Common-Pb corrections were applied assuming Broken Hill common-Pb isotopic compositions for all analyses.

Results

Thirty-four analyses were obtained from 34 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, with the discordance pattern consistent with a dominant recent episode of radiogenic-Pb redistribution. On the basis of their ^{207}Pb/^{206}Pb ratios, many analyses can be assigned to four groups. Concordant analyses 1.1 and 24.1, assigned to Group 1, have ^{207}Pb/^{206}Pb ratios defining a single population and indicating a weighted mean ^{207}Pb/^{206}Pb date of 2455 ± 12 Ma (±1σ uncertainty). Concordant analyses 2.1, 15.1, and 20.1, assigned to Group 2, have ^{207}Pb/^{206}Pb ratios defining a single population and indicating a weighted mean ^{207}Pb/^{206}Pb date of 2604 ± 36 Ma (chi-squared = 1.30). Seventeen concordant and slightly discordant analyses of seventeen zircons (3.1, 4.1, 8.1, 9.1, 10.1, 12.1, 16.1, 17.1, 19.1, 22.1, 23.1, 25.1, 26.1, 28.1, 29.1, 31.1, 33.1), assigned to Group 3, have ^{207}Pb/^{206}Pb ratios defining a single population and indicating a weighted mean ^{207}Pb/^{206}Pb date of 2695 ± 7 Ma (chi-squared = 1.43). Concordant and slightly discordant analyses 11.1, 30.1, and 32.1, assigned to Group 4, have ^{207}Pb/^{206}Pb ratios

defining a single population and indicating a weighted mean $^{207}Pb/^{206}Pb$ date of 2742 ± 22 Ma (chi-squared = 0.14). The remaining analyses cannot be confidently grouped.
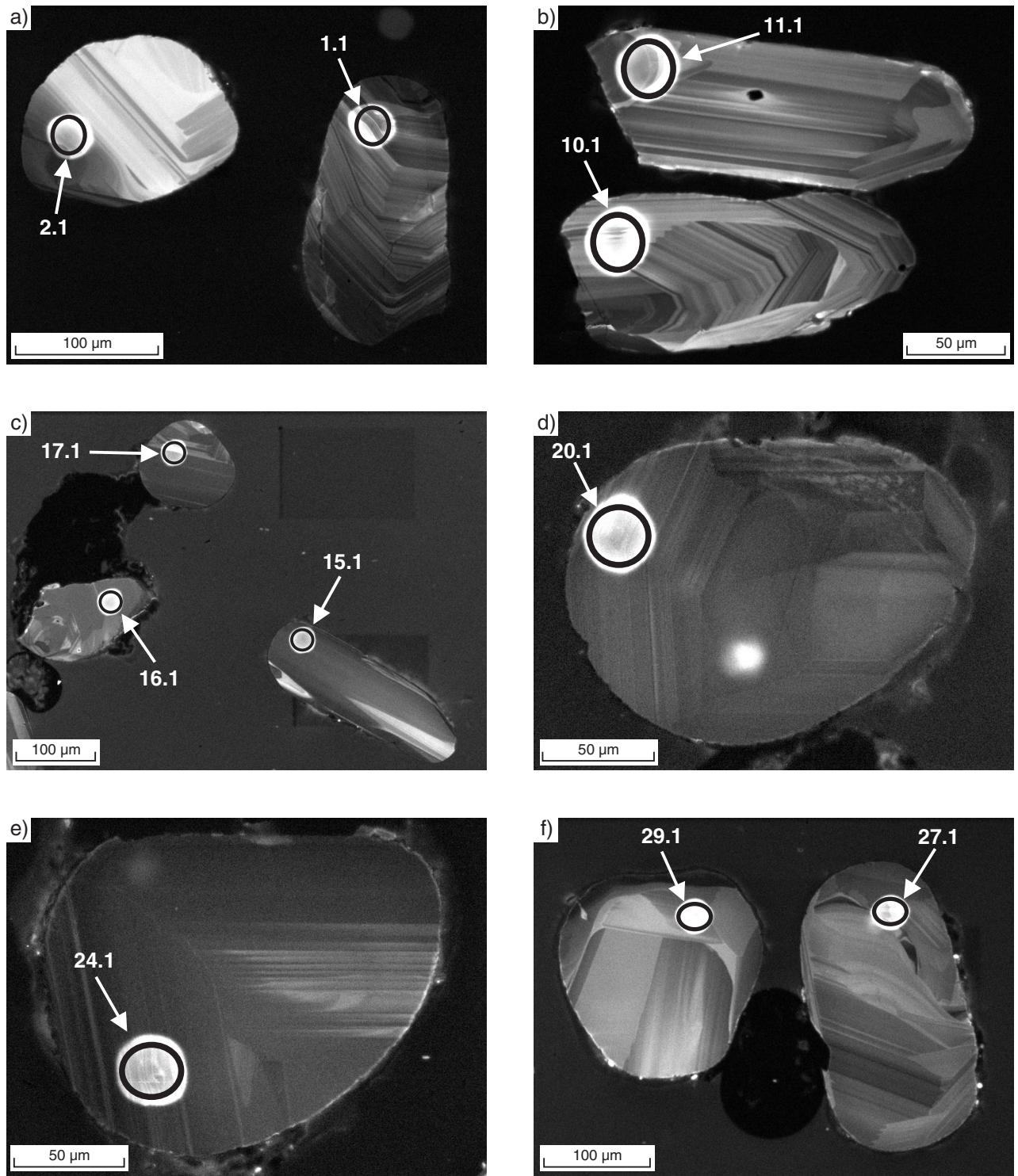
The date of 2455 ± 24 Ma (±2σ uncertainty) indicated by the weighted mean $^{207}Pb/^{206}Pb$ ratio of concordant analyses 1.1 and 24.1 of Group 1 is interpreted as a maximum age for deposition of the sandstone. The older dates provided by the remaining analyses are interpreted

to be of detrital zircons. Possible source rocks within the western part of Australia having ages matching those of the zircons within this sample include those of the Pilbara and Yilgarn Cratons.

Figure 1. Cathodoluminescence images of representative zircons from sample 169081: pebbly sandstone, Meteorite Bore

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Table 1. Ion microprobe analytical results for sample 169081: pebbly sandstone, Meteorite Bore

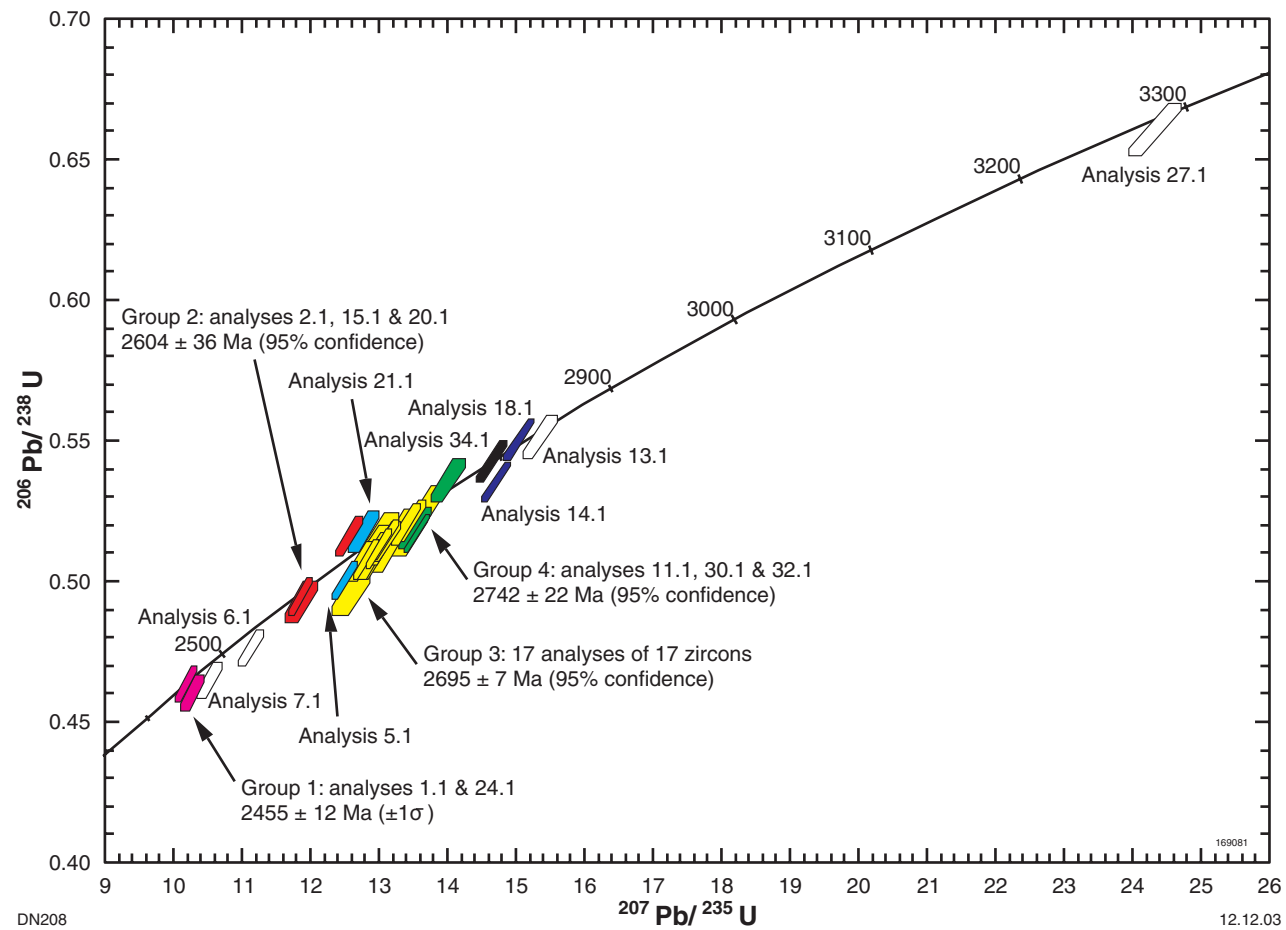| Grain .spot	U (ppm)	Th (ppm)	Pb (ppm)	f206%	$^{207}Pb/^{206}Pb$	±1σ	$^{208}Pb/^{206}Pb$	±1σ	$^{206}Pb/^{238}U$	±1σ	$^{207}Pb/^{235}U$	±1σ	% concordance	$^{207}Pb/^{206}Pb$ Age	±1σ
1.1	97	88	55	0.499	0.16194	0.00149	0.25182	0.00300	0.4602	0.0064	10.276	0.182	99	2 476	16
2.1	62	60	38	0.481	0.17454	0.00197	0.27196	0.00383	0.4928	0.0074	11.859	0.236	99	2 602	19
3.1	104	82	65	0.086	0.18675	0.00114	0.21305	0.00178	0.5203	0.0072	13.397	0.212	100	2 714	10
4.1	213	167	132	0.071	0.18420	0.00078	0.21683	0.00121	0.5115	0.0068	12.991	0.188	99	2 691	7
5.1	164	114	97	0.124	0.18136	0.00091	0.19310	0.00141	0.5003	0.0067	12.510	0.187	98	2 665	8
6.1	129	115	75	0.164	0.16952	0.00119	0.24530	0.00226	0.4761	0.0065	11.128	0.179	98	2 553	12
7.1	90	52	48	0.387	0.16445	0.00154	0.15291	0.00278	0.4646	0.0065	10.534	0.187	98	2 502	16
8.1	193	166	120	0.069	0.18294	0.00087	0.23885	0.00148	0.5078	0.0068	12.808	0.189	99	2 680	8
9.1	71	89	49	0.327	0.18632	0.00157	0.34991	0.00321	0.5107	0.0073	13.120	0.229	98	2 710	14
10.1	31	13	18	0.748	0.18765	0.00328	0.10657	0.00623	0.5172	0.0083	13.381	0.337	99	2 722	29
11.1	68	10	38	0.261	0.18921	0.00153	0.04017	0.00188	0.5188	0.0074	13.534	0.234	98	2 735	13
12.1	43	14	24	0.649	0.18427	0.00254	0.08426	0.00455	0.4953	0.0076	12.585	0.275	96	2 692	23
13.1	99	62	65	0.114	0.20204	0.00147	0.16905	0.00249	0.5511	0.0077	15.352	0.253	100	2 843	12
14.1	180	125	119	0.040	0.19819	0.00087	0.19266	0.00125	0.5506	0.0074	15.047	0.220	101	2 811	7
15.1	121	74	73	0.279	0.17658	0.00116	0.16564	0.00193	0.5160	0.0071	12.563	0.200	102	2 621	11
16.1	69	68	44	0.135	0.18390	0.00145	0.27403	0.00264	0.5100	0.0073	12.933	0.222	99	2 688	13
17.1	91	101	61	0.119	0.18740	0.00125	0.30971	0.00239	0.5215	0.0073	13.474	0.218	99	2 719	11
18.1	230	191	151	0.079	0.19919	0.00078	0.22704	0.00122	0.5355	0.0071	14.706	0.210	98	2 820	6
19.1	41	19	25	0.440	0.18311	0.00215	0.12954	0.00363	0.5165	0.0077	13.039	0.263	100	2 681	19
20.1	179	95	101	0.089	0.17385	0.00085	0.14401	0.00123	0.4946	0.0066	11.857	0.175	100	2 595	8
21.1	81	24	46	0.348	0.17903	0.00151	0.07719	0.00240	0.5177	0.0073	12.778	0.221	102	2 644	14
22.1	113	173	81	0.164	0.18484	0.00114	0.42530	0.00252	0.5140	0.0070	13.099	0.205	99	2 697	10
23.1	88	62	54	0.093	0.18468	0.00124	0.19806	0.00192	0.5129	0.0071	13.061	0.211	99	2 695	11
24.1	183	113	97	0.062	0.15935	0.00083	0.16789	0.00129	0.4636	0.0062	10.185	0.152	100	2 449	9
25.1	179	160	113	0.068	0.18448	0.00083	0.24293	0.00138	0.5146	0.0069	13.090	0.192	99	2 694	7
26.1	81	56	49	0.217	0.18408	0.00136	0.19095	0.00225	0.5079	0.0071	12.891	0.213	98	2 690	12
27.1	80	96	72	0.243	0.26725	0.00146	0.32053	0.00240	0.6603	0.0093	24.332	0.382	99	3 290	9
28.1	65	47	39	0.153	0.18444	0.00154	0.20474	0.00263	0.5079	0.0072	12.916	0.224	98	2 693	14
29.1	74	32	42	0.361	0.18227	0.00154	0.11561	0.00253	0.5072	0.0071	12.745	0.220	99	2 674	14
30.1	57	60	39	0.170	0.18961	0.00159	0.28840	0.00294	0.5357	0.0077	14.005	0.246	101	2 739	14
31.1	61	47	38	0.262	0.18278	0.00156	0.21358	0.00272	0.5127	0.0073	12.921	0.226	100	2 678	14
32.1	248	75	141	0.068	0.19014	0.00071	0.08348	0.00084	0.5171	0.0068	13.558	0.192	98	2 743	6
33.1	55	41	35	0.263	0.18882	0.00187	0.20521	0.00340	0.5262	0.0076	13.700	0.254	100	2 732	16
34.1	128	70	81	0.094	0.19572	0.00098	0.15175	0.00131	0.5428	0.0073	14.649	0.220	100	2 791	8

Figure 2. Concordia plot for sample 169081: pebbly sandstone, Meteorite Bore
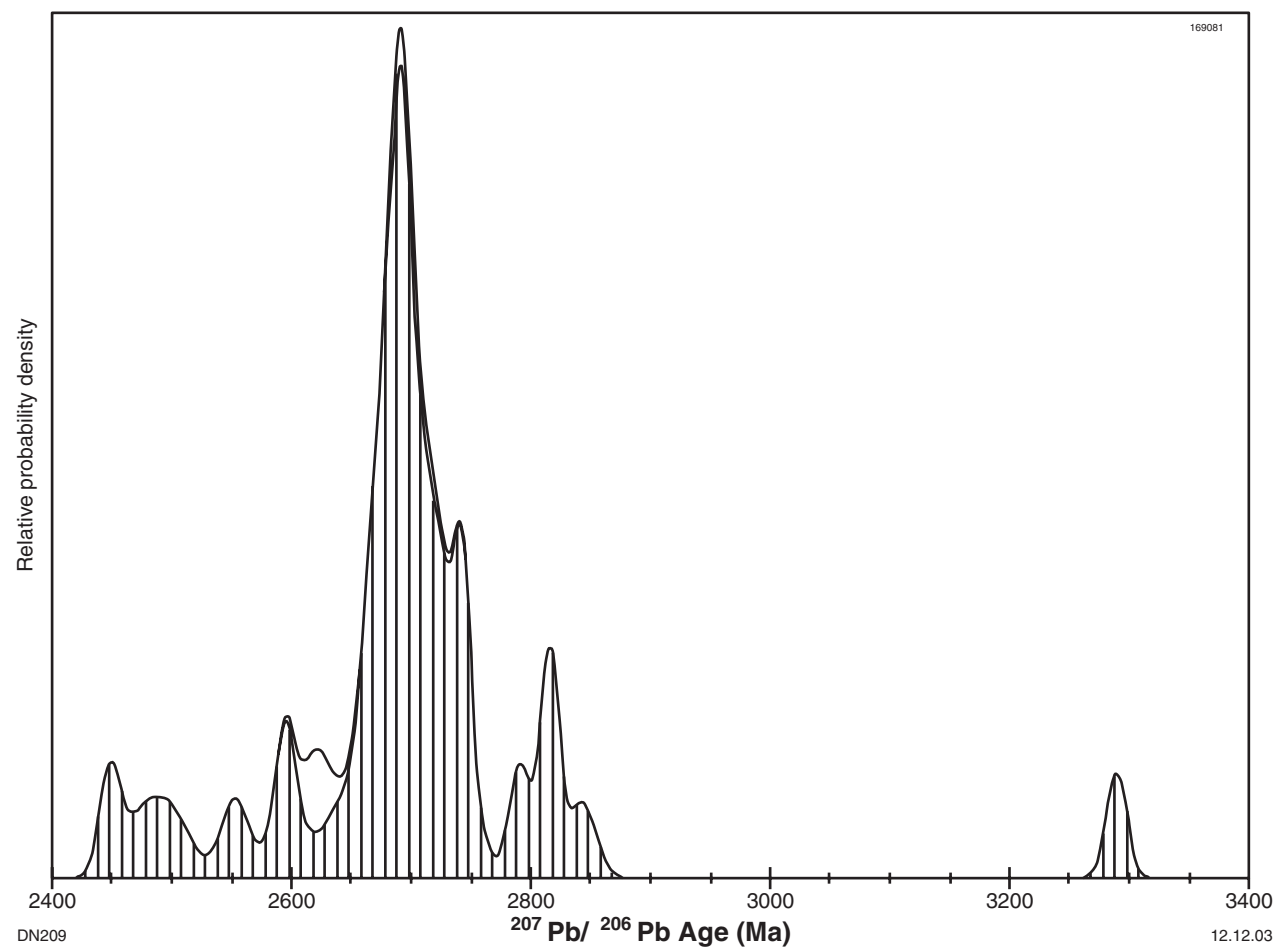
Figure 3. Gaussian-summation probability density plot for sample 169081: pebbly sandstone, Meteorite Bore