187103: granoblastic garnetiferous granite, Mount Aloysius

(Pitjantjatjara Supersuite, Musgrave Province)

Location and sampling

COOPER (SG 52-10), BELL ROCK (4645)
MGA Zone 52, 456819E 7121725N

Sampled on 19 September 2006

This sample was collected from a metre-high boulder at the southern edge of an outcrop, about 3.8 km southwest of the peak of Mount Aloysius.

Tectonic unit/relations

The unit sampled is a weakly foliated, fine- to medium-grained, granoblastic, garnetiferous granite attributed to the 1219–1155 Ma Pitjantjatjara Supersuite of the Musgrave Province from the northwestern corner of BELL ROCK (Howard et al., 2007). The rock is interpreted as a possible anatectic melt locally derived from pelitic gneiss.

Petrographic description

The sample is a medium-grained leucogranitic rock with a mylonitic texture in parts. Large strained quartz grains, up to several mm across, and anhedral K-feldspar grains (with albite exsolution) occur within a finer-grained granoblastic matrix of recrystallised quartz and feldspar (>90% K-feldspar, minor albite). There is effectively a continuum in grain size from the larger grains to the smallest matrix grains and long axes of the larger strained quartz grains are subparallel. Mafic minerals comprise only a small percentage of this rock. Biotite is typically altered to green chlorite–leucoxene aggregates. Pale-pink garnet is less than 1 mm in diameter, and has scalloped grain boundaries. Small grains of Fe–Ti oxide minerals are disseminated through the rock. Zircon grains are small and uncommon.

Zircon morphology

Zircons isolated from this sample are mostly rounded, although some are subrounded, and are mainly brown to black. Several colourless zircon grains were also observed. Grains are up to 200 μm long, with aspect ratios up to 3:1. The majority of zircons are homogeneous gray in cathodoluminescence (CL) images, although some show very faint indications of growth zoning. Cores showing well-developed concentric oscillatory zoning occur within about 20% of the zircons, and are overgrown by zircon rims which are identical in CL images to the grey, mainly homogeneous zircons. Some zircon cores display contorted zoning together with fading of primary igneous textures. A CL image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed on 12–13 July 2007, using SHRIMP-A. Twenty-five analyses of the Temora standard were obtained during the session. Significant secular drift of standard $^{238}U/^{206}Pb^*$ dates during part of the session was addressed by fitting a LOWESS curve (Cleveland, 1979), as implemented in the program Isoplot 2.50 (Ludwig, 2009; Wingate and Kirkland, 2009), using a smoothing window width of six analyses. Following rejection of two analyses as outliers, the remaining 23 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 1.05% (1σ), and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.0% (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-eight analyses were obtained from 64 zircons, with four grains (28, 29, 44, and 47) each analysed twice. Results are listed in Table 1, and shown in a concordia diagram (Fig. 2).

Interpretation

The analyses are mainly concordant (Fig. 2). Five analyses are characterized by slight to moderate discordance (>5%). The dates obtained from these five analyses (Group D; Table 1) are imprecise and unreliable, and are not considered geologically significant. The remaining 63 analyses can be divided into three groups, based on their locations within the crystals, U contents, and $^{207}Pb^*/^{206}Pb^*$ and Th/U ratios.

Group I consists of 33 analyses of 33 zircons (Table 1), which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 1191 ± 4 Ma (MSWD = 1.8). The analyses were located in discrete zircons as well as in three of four clearly-defined rims (e.g. 28.2; Fig. 1) that were analysed (the fourth rim analysis is in Group D). Two analyses (28.1, 42.1) were located in apparently zoned cores, but indicate

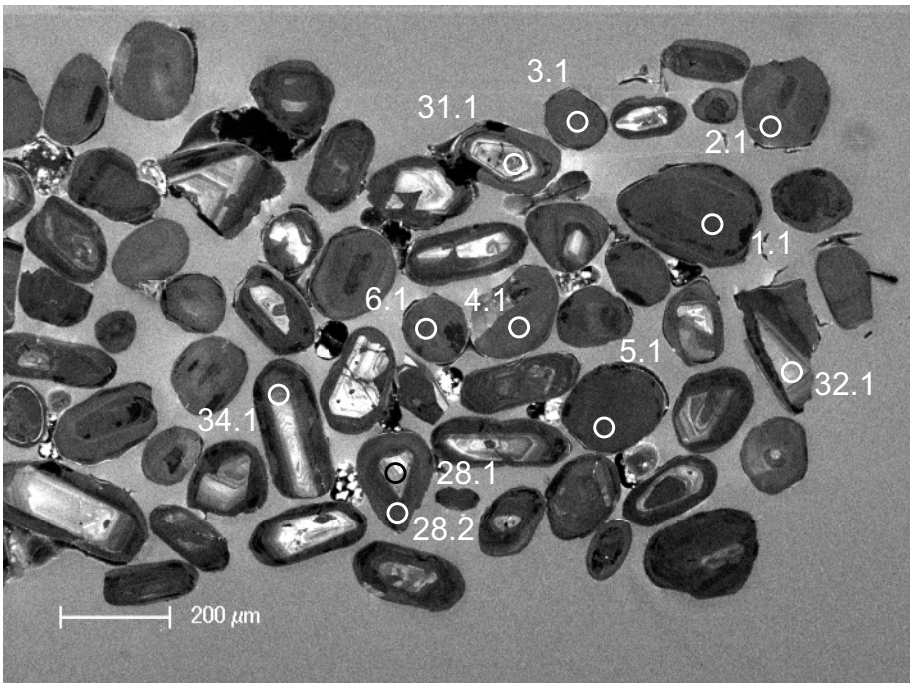

Figure 1. Cathodoluminescence image of representative zircons from sample 187103: granoblastic garnetiferous granite, Mount Aloysius. Numbered circles indicate the approximate positions of analysis sites.

$^{207}Pb^*/^{206}Pb^*$ dates of 1196 and 1193 Ma, near the centre of the range of dates for Group I. The analyses in Group I indicate mainly high U (median 1132 ppm) and low Th/U (median 0.32). The calculation of the weighted mean includes four dates that differ from the mean value by amounts slightly in excess of their individual analytical uncertainties (which are low and reflect the high U contents of these zircons). The zircons represented by these four analyses are similar in character to the other zircons in Group I, hence these analyses are retained and the MSWD of the group is acceptable.

Group P comprises seven analyses of seven zircons (Table 1), which yield $^{207}Pb^*/^{206}Pb^*$ dates of 1170–1155 Ma. The analyses were located mainly in discrete zircons that are homogeneous gray in CL images, and have uniformly high U (median 1052 ppm) and Th/U ratios (median 0.31).

Group X comprises 23 analyses of 23 zircons (Table 1), which yield $^{207}Pb^*/^{206}Pb^*$ dates of 1571–1255 Ma. The analyses were located mainly in zoned zircon cores, which have mainly moderate U contents (median 251 ppm) and Th/U ratios (median 0.70). The only exception is analysis 23.1, which was located in a zircon that is homogeneous and gray in CL images, but indicated a $^{207}Pb^*/^{206}Pb^*$ date of 1293 Ma.

The date of 1191 ± 4 Ma for the 33 analyses in Group I is tentatively interpreted as the age of magmatic crystallization of the granite. Alternatively, owing to the potential for Pb loss having affected these high-U zircons, this could be interpreted as a minimum age of crystallization. The dates of 1170–1155 Ma for the seven analyses in Group P are interpreted to reflect minor loss of radiogenic Pb in these zircons. The dates of 1571–1255 Ma for the 23 analyses in Group X are interpreted to represent the ages of xenocrystic zircons.

References

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Recommended reference for this publication

Kirkland, CL, Bodorkos, S, Wingate, MTD, Smithies, RH and Evins, PM 2009, 187103: granoblastic garnetiferous granite, Mount Aloysius; Geochronology dataset 795: Geological Survey of Western Australia, 5p.

Data obtained: 13 July 2007
Data released: 30 June 2009

Table 1. Ion microprobe analytical results for zircons from sample 187103: granoblastic garnetiferous granite, Mount Aloysius

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$^{232}Th/^{238}U$	f204 (%)	$^{238}U/^{206}Pb$ ± 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. (%)
I	12	12.1	999	315	0.33	0.018	4.910	0.160	0.08220	0.00112	4.910	0.160	0.08205	0.00112	1195	36	1247	27	4.2
I	6	6.1	1157	285	0.25	0.008	4.730	0.169	0.08166	0.00299	4.730	0.169	0.08159	0.00300	1236	40	1236	72	-0.1
I	59	55.1	1018	348	0.35	0.038	4.795	0.156	0.08166	0.00346	4.797	0.156	0.08134	0.00346	1221	36	1230	84	0.7
I	66	62.1	1075	339	0.33	0.013	4.851	0.121	0.08116	0.00535	4.852	0.121	0.08105	0.00535	1208	27	1223	130	1.2
I	62	58.1	984	305	0.32	0.010	4.831	0.053	0.08095	0.00164	4.831	0.053	0.08087	0.00164	1213	12	1218	40	0.5
I	46	44.1	610	244	0.41	0.005	4.980	0.093	0.08088	0.00033	4.980	0.093	0.08084	0.00034	1180	20	1218	8	3.1
I	8	8.1	1011	408	0.42	0.028	4.825	0.248	0.08084	0.00487	4.826	0.249	0.08060	0.00488	1214	57	1212	119	-0.2
I	64	60.1	2002	390	0.20	0.096	4.806	0.052	0.08131	0.00116	4.810	0.052	0.08049	0.00117	1218	12	1209	29	-0.7
I	5	5.1	2306	410	0.18	0.001	4.805	0.051	0.08037	0.00017	4.805	0.051	0.08036	0.00017	1219	12	1206	4	-1.1
I	13	13.1	1155	273	0.24	-0.009	5.050	0.085	0.08027	0.00220	5.049	0.085	0.08034	0.00220	1165	18	1205	54	3.4
I	63	59.1	1643	319	0.20	0.002	4.917	0.104	0.08022	0.00024	4.917	0.104	0.08020	0.00024	1193	23	1202	6	0.7
I	9	9.1	930	309	0.34	0.016	4.948	0.123	0.08018	0.00029	4.948	0.123	0.08004	0.00029	1187	27	1198	7	1.0
I	51	47.2	860	239	0.29	0.029	4.781	0.053	0.08027	0.00126	4.783	0.053	0.08002	0.00126	1224	12	1198	31	-2.2
I	28	28.1	355	228	0.66	-0.020	4.907	0.057	0.07981	0.00044	4.906	0.057	0.07998	0.00046	1196	13	1196	11	0.0
I	44	42.1	179	75	0.43	0.000	4.887	0.148	0.07985	0.00060	4.887	0.148	0.07985	0.00060	1200	33	1193	15	-0.6
I	20	20.1	1176	370	0.32	0.027	4.931	0.093	0.08003	0.00025	4.932	0.093	0.07980	0.00026	1190	20	1192	6	0.2
I	22	22.1	1428	373	0.27	0.008	4.959	0.113	0.07981	0.00023	4.960	0.113	0.07975	0.00023	1184	25	1191	6	0.6
I	58	54.1	2701	495	0.19	0.001	4.883	0.101	0.07973	0.00117	4.883	0.101	0.07972	0.00117	1201	23	1190	29	-0.9
I	11	11.1	1377	344	0.26	0.019	4.705	0.051	0.07988	0.00121	4.706	0.051	0.07971	0.00121	1242	12	1190	30	-4.4
I	21	21.1	1255	312	0.26	0.006	4.935	0.139	0.07975	0.00115	4.935	0.139	0.07970	0.00115	1189	31	1189	28	0.0
I	55	51.1	1666	399	0.25	0.018	4.906	0.091	0.07978	0.00020	4.907	0.091	0.07962	0.00021	1196	20	1188	5	-0.7
I	65	61.1	1118	381	0.35	0.130	5.085	0.133	0.08067	0.00028	5.092	0.133	0.07957	0.00035	1156	28	1186	9	2.6
I	60	56.1	1145	374	0.34	0.003	4.894	0.054	0.07953	0.00025	4.894	0.054	0.07951	0.00025	1199	12	1185	6	-1.2
I	3	3.1	1000	375	0.39	0.011	4.826	0.323	0.07955	0.00033	4.827	0.323	0.07945	0.00033	1214	74	1183	8	-2.6
I	16	16.1	1009	333	0.34	0.017	4.999	0.055	0.07960	0.00257	5.000	0.055	0.07945	0.00257	1175	12	1183	64	0.7
I	24	24.1	1300	303	0.24	0.023	4.973	0.087	0.07960	0.00024	4.975	0.087	0.07941	0.00025	1181	19	1182	6	0.1
I	4	4.1	961	342	0.37	0.025	4.779	0.186	0.07961	0.00210	4.780	0.186	0.07940	0.00210	1225	43	1182	52	-3.6
I	7	7.1	1200	358	0.31	0.012	4.898	0.054	0.07943	0.00024	4.899	0.054	0.07934	0.00025	1197	12	1181	6	-1.4
I	31	29.2	853	341	0.41	0.012	4.791	0.387	0.07928	0.00347	4.792	0.387	0.07918	0.00347	1222	90	1177	87	-3.8
I	25	25.1	1058	279	0.27	0.003	4.920	0.125	0.07907	0.00026	4.920	0.125	0.07904	0.00026	1193	28	1173	7	-1.7
I	56	52.1	1148	429	0.39	0.019	5.061	0.055	0.07915	0.00025	5.062	0.055	0.07899	0.00026	1162	12	1172	7	0.8
I	61	57.1	1825	353	0.20	0.002	4.916	0.068	0.07897	0.00079	4.916	0.068	0.07896	0.00079	1194	15	1171	20	-1.9
I	15	15.1	1072	343	0.33	0.018	5.230	0.141	0.07889	0.00166	5.231	0.141	0.07873	0.00166	1128	28	1165	42	3.2
P	57	53.1	1052	438	0.43	0.013	4.863	0.118	0.07901	0.00030	4.864	0.118	0.07890	0.00030	1205	27	1170	8	-3.0
P	26	26.1	1072	287	0.28	0.011	5.109	0.056	0.07895	0.00031	5.110	0.056	0.07886	0.00032	1152	11	1169	8	1.4
P	1	1.1	1698	314	0.19	0.005	5.019	0.082	0.07884	0.00021	5.019	0.082	0.07881	0.00021	1171	18	1167	5	-0.3
P	17	17.1	1005	344	0.35	0.000	4.901	0.054	0.07871	0.00032	4.901	0.054	0.07871	0.00032	1197	12	1165	8	-2.8
P	19	19.1	1014	407	0.41	0.007	5.091	0.110	0.07863	0.00027	5.091	0.110	0.07857	0.00027	1156	23	1161	7	0.4
P	29	28.2	1008	251	0.26	0.003	5.257	0.133	0.07844	0.00031	5.258	0.133	0.07842	0.00031	1122	26	1157	8	3.0
P	14	14.1	1119	331	0.31	0.019	5.132	0.109	0.07848	0.00030	5.133	0.109	0.07832	0.00031	1147	22	1155	8	0.7

Table 1. (continued)

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$^{232}Th/^{238}U$	f204 (%)	$^{238}U/^{206}Pb$ ± 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. (%)
X	10	10.1	343	133	0.40	0.036	3.530	0.041	0.09734	0.00209	3.532	0.041	0.09703	0.00209	1607	17	1568	40	-2.5
X	34	32.1	513	296	0.60	0.005	3.599	0.107	0.09664	0.00035	3.599	0.107	0.09660	0.00035	1581	42	1559	7	-1.4
X	48	45.1	423	198	0.48	0.022	3.681	0.124	0.09594	0.00507	3.682	0.124	0.09575	0.00507	1549	46	1543	100	-0.4
X	42	40.1	145	101	0.72	0.049	3.761	0.049	0.09589	0.00066	3.763	0.049	0.09546	0.00070	1519	18	1537	14	1.2
X	54	50.1	154	131	0.87	0.060	3.589	0.046	0.09567	0.00350	3.591	0.046	0.09515	0.00352	1584	18	1531	70	-3.4
X	47	44.2	157	115	0.76	0.047	3.812	0.049	0.09464	0.00064	3.814	0.049	0.09424	0.00068	1501	17	1513	14	0.8
X	35	33.1	344	192	0.58	0.038	3.709	0.092	0.09433	0.00456	3.710	0.092	0.09401	0.00457	1538	34	1508	92	-2.0
X	37	35.1	219	162	0.77	0.082	3.714	0.045	0.09468	0.00222	3.717	0.045	0.09397	0.00224	1536	17	1508	45	-1.9
X	43	41.1	227	165	0.75	0.043	3.920	0.048	0.09410	0.00052	3.922	0.048	0.09373	0.00056	1464	16	1503	11	2.6
X	53	49.1	2436	667	0.28	0.026	3.844	0.068	0.09370	0.00016	3.845	0.068	0.09348	0.00016	1490	23	1498	3	0.5
X	45	43.1	82	60	0.75	0.183	3.926	0.057	0.09237	0.00087	3.933	0.057	0.09080	0.00108	1460	19	1442	23	-1.2
X	32	30.1	394	208	0.54	0.028	4.469	0.052	0.08650	0.00040	4.471	0.052	0.08627	0.00042	1301	14	1344	9	3.2
X	50	47.1	276	185	0.69	0.010	4.255	0.130	0.08592	0.00048	4.255	0.130	0.08584	0.00048	1361	37	1334	11	-2.0
X	33	31.1	540	772	1.48	0.156	4.383	0.126	0.08713	0.00219	4.390	0.126	0.08580	0.00221	1323	34	1334	50	0.8
X	38	36.1	175	189	1.11	-0.124	4.538	0.057	0.08440	0.00062	4.533	0.057	0.08546	0.00074	1285	15	1326	17	3.1
X	36	34.1	252	161	0.66	0.046	4.382	0.176	0.08518	0.00418	4.385	0.176	0.08479	0.00419	1324	48	1311	96	-1.0
X	40	38.1	931	579	0.64	0.047	4.517	0.049	0.08472	0.00117	4.519	0.049	0.08431	0.00117	1289	13	1300	27	0.9
X	27	27.1	181	129	0.74	0.073	4.534	0.143	0.08478	0.00279	4.537	0.143	0.08416	0.00281	1284	37	1296	65	1.0
X	41	39.1	107	73	0.71	0.298	4.721	0.066	0.08667	0.00079	4.735	0.067	0.08414	0.00110	1235	16	1296	25	4.7
X	23	23.1	1043	524	0.52	0.020	4.440	0.049	0.08419	0.00025	4.441	0.049	0.08402	0.00026	1309	13	1293	6	-1.2
X	18	18.1	129	93	0.74	0.741	4.688	0.064	0.08965	0.00451	4.723	0.065	0.08335	0.00470	1238	15	1277	110	3.1
X	49	46.1	88	52	0.61	0.209	4.424	0.064	0.08463	0.00088	4.434	0.064	0.08286	0.00114	1311	17	1266	27	-3.6
X	39	37.1	141	141	1.03	0.107	4.528	0.059	0.08333	0.00068	4.532	0.059	0.08242	0.00079	1285	15	1255	19	-2.4
D	67	63.1	368	202	0.57	0.071	3.155	0.088	0.09779	0.00413	3.157	0.088	0.09718	0.00414	1774	43	1571	80	-12.9
D	68	64.1	1363	434	0.33	0.015	4.645	0.050	0.08011	0.00025	4.646	0.050	0.07998	0.00025	1257	12	1197	6	-5.0
D	2	2.1	1371	326	0.25	-0.003	5.317	0.083	0.07904	0.00026	5.317	0.083	0.07906	0.00026	1111	16	1174	7	5.3
D	30	29.1	580	401	0.72	0.051	4.720	0.053	0.08533	0.00352	4.723	0.053	0.08490	0.00352	1238	13	1313	80	5.7
D	52	48.1	249	146	0.61	0.217	4.057	0.128	0.09654	0.00053	4.066	0.128	0.09467	0.00067	1418	40	1522	13	6.8

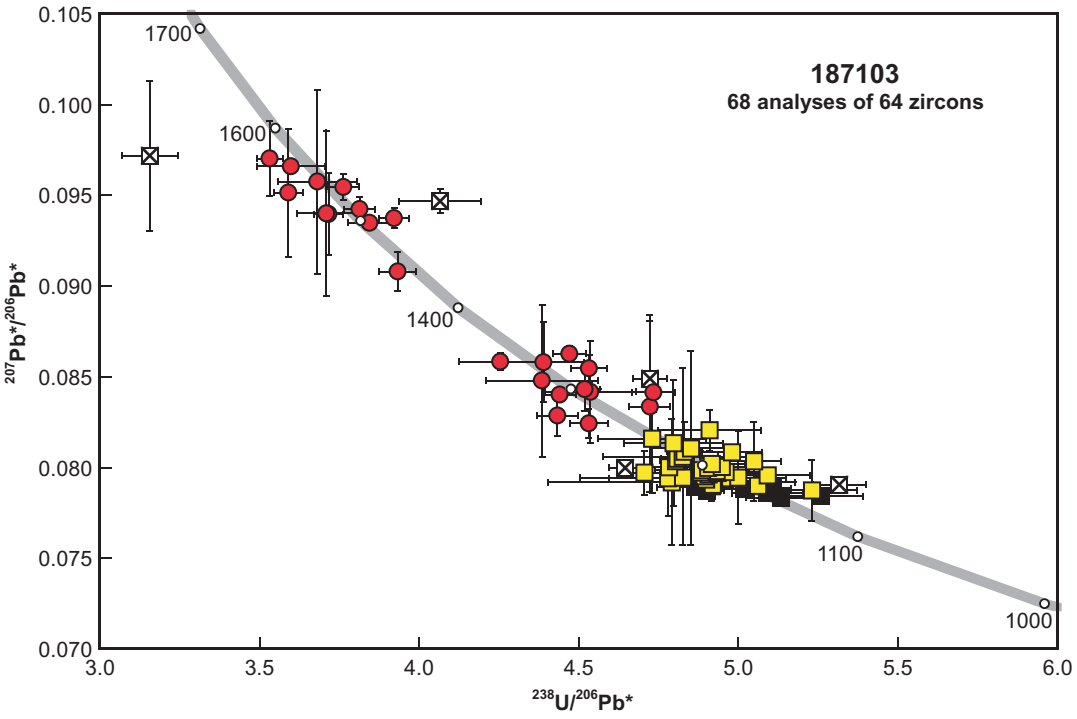

Figure 2. **U–Pb analytical data for sample 187103: granoblastic garnetiferous granite, Mount Aloysius. Yellow squares indicate Group I (magmatic zircons); black squares indicate Group P (radiogenic-Pb loss); red circles indicate Group X (xenocrystic zircons); crossed squares indicate Group D (discordance >5%).**