187196: leucogranite, Prostanthera Hill

(Pitjantjatjara Supersuite, Musgrave Province)

Location and sampling

SCOTT (SG 52-6), HOLT (4546)
MGA Zone 52, 419397E 7161586N

Sampled on 29 June 2007

This sample was collected from outcrop on the eastern flank of a prominent hill, about 11.3 km south of Lehmann Hills, 6.5 km northwest of Mount Holt, and 1.8 km southeast of the summit of Prostanthera Hill.

Tectonic unit/relations

The unit sampled is a leucogranite assigned to the Pitjantjatjara Supersuite of the Musgrave Province (Smithies et al., 2009). The Pitjantjatjara Supersuite comprises syn- to post-tectonic granites emplaced during the Musgrave Orogeny (Smithies et al., 2010; 2011). The Pitjantjatjara Supersuite, which accounts for a significant component of the exposed rocks in the Musgrave Province, comprises voluminous, A-type felsic intrusive magmatic rocks emplaced between c. 1220 and c. 1150 Ma. Magmatism was accompanied by ultrahigh-temperature, granulite-facies metamorphism during the Musgrave Orogeny (Smithies et al., 2009). Numerous samples of the Pitjantjatjara Supersuite have been dated previously (see Appendix 1 in Smithies et al., 2010).

This schlieric, granofelsic leucogranite has a heterogeneous grain size distribution that ranges to pegmatitic. The leucogranite contains rafts of gneissic porphyritic granite.

Petrographic description

The sample is a leucogranite, comprising about 45% quartz, 42% perthitic K-feldspar, 10% plagioclase, 2% opaque oxide minerals, and accessory biotite, orthopyroxene, zircon and apatite. Quartz occurs as lobate interstitial grains up to 8 mm long. K-feldspar (possibly orthoclase) is less than 1.5 mm long, with minor myrmekite developed at the boundaries with partly clay-altered, fine-grained plagioclase. Biotite may be retrograde and occurs as fine-grained aggregates adjacent to opaque oxide minerals and in partly clay-altered, fine-grained orthopyroxene. The presence of orthopyroxene suggests granulite-facies metamorphism.

Zircon morphology

Zircons isolated from this sample are subhedral to euhedral, colourless to brown-black, and typically have rounded terminations. The crystals are up to 300 μm long, and are elongate, with high aspect ratios up to 6:1. In cathodoluminescence (CL) images, the crystals exhibit a homogeneous low CL response with rare oscillatory zoned cores that exhibit high CL response. A CL image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed on 24 February 2009, using SHRIMP-B. Nine analyses of the TEMORA standard were obtained during the session, of which eight indicated an external spot-to-spot (reproducibility) uncertainty of 2.17% (1σ), and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.81% (1σ). Calibration uncertainties are included in the errors of $^{238}U/^{206}Pb^*$ 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

Nineteen analyses were obtained from 18 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 2).

Interpretation

The analyses are concordant to strongly discordant (Fig. 2). The reverse discordance of most analyses in this dataset correlates with high to very high uranium concentrations in the crystals. Reverse discordance is common in ion microprobe analyses of high-uranium zircons, and reflects sputtering characteristics different to those in the lower-uranium zircon standard, but does not affect the $^{207}Pb^*/^{206}Pb^*$ ratios (White and Ireland, 2012). The 19 analyses define three groups, based on their $^{207}Pb^*/^{206}Pb^*$ ratios and analytical positions within the crystals.

Group I comprises nine analyses (Table 1), which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 1200 ± 5 Ma

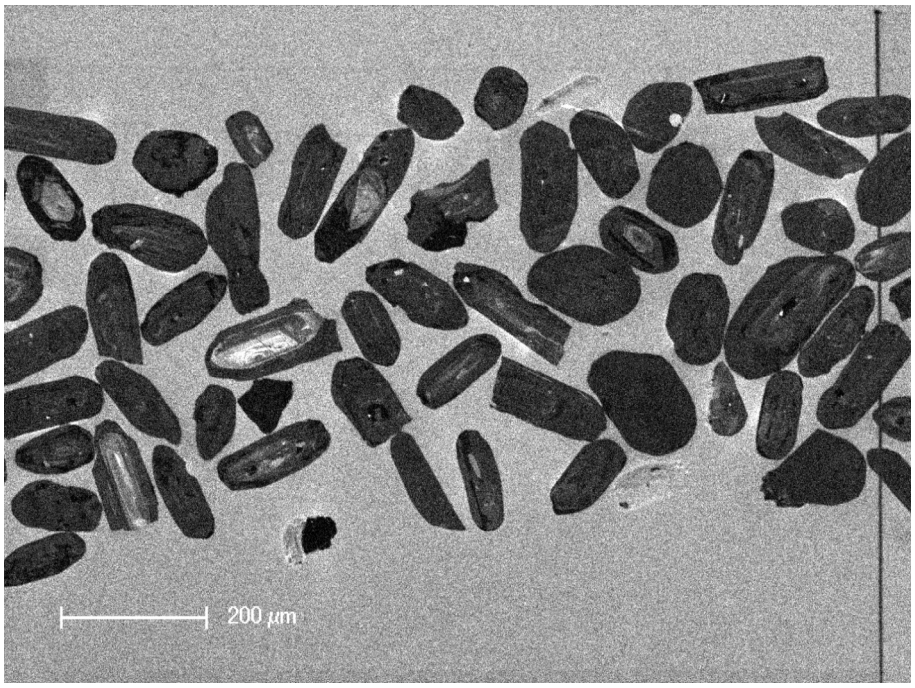

Figure 1. Cathodoluminescence image of representative zircons from 187196: leucogranite, Prostanthera Hill.

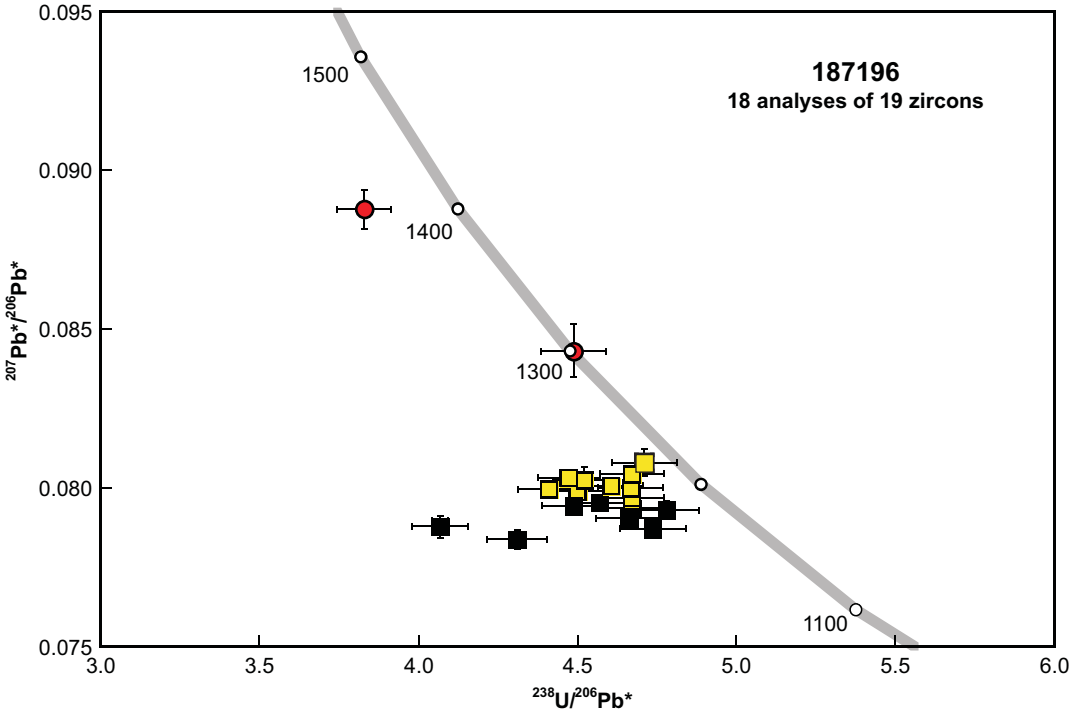

Figure 2. U–Pb analytical data for sample 187196: leucogranite, Prostanthera Hill. Yellow squares indicate Group I (magmatic zircons); black squares indicate Group P (radiogenic Pb loss and matrix effects); red circles indicate Group X (inherited zircons).

Table 1. Ion microprobe analytical results for zircons from sample 187196: leucogranite, Prostanthera Hill

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}Th}{^{238}U}$	$f204$ (%)	$^{238}U/^{206}Pb$ ± 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. (%)
I	15	15.1	3165	190	0.06	0.009	4.668	0.102	0.07977	0.00021	4.669	0.102	0.07969	0.00021	1251	25	1189	5	5.2
I	2	2.1	1794	97	0.06	0.074	4.498	0.100	0.08053	0.00043	4.501	0.100	0.07990	0.00047	1293	26	1195	12	8.3
I	4	3.1	5146	422	0.08	0.002	4.410	0.096	0.07996	0.00025	4.410	0.096	0.07997	0.00025	1318	26	1196	6	10.1
I	17	17.1	3320	304	0.09	0.013	4.665	0.103	0.07989	0.00021	4.665	0.103	0.08000	0.00021	1252	25	1197	5	4.6
I	9	8.1	3914	297	0.08	0.002	4.604	0.100	0.08009	0.00019	4.604	0.100	0.08008	0.00021	1267	25	1199	5	5.7
I	13	13.1	1894	1772	0.97	0.005	4.522	0.099	0.08029	0.00042	4.522	0.099	0.08024	0.00042	1288	25	1203	10	7.1
I	7	6.1	5247	433	0.09	0.001	4.472	0.097	0.08030	0.00016	4.472	0.097	0.08031	0.00017	1301	26	1205	4	8.0
I	18	18.1	2976	184	0.06	0.067	4.668	0.102	0.08102	0.00022	4.671	0.102	0.08045	0.00025	1251	25	1208	6	3.5
I	8	7.1	1338	253	0.20	0.145	4.702	0.103	0.08203	0.00033	4.709	0.103	0.08080	0.00042	1241	25	1216	10	2.0
X	16	16.1	955	162	0.18	0.467	4.467	0.103	0.08829	0.00064	4.488	0.103	0.08432	0.00084	1297	27	1300	19	0.3
X	19	11.1	360	476	1.36	0.000	3.829	0.085	0.08878	0.00061	3.829	0.085	0.08878	0.00061	1496	30	1399	13	6.9
P	10	9.1	3754	225	0.06	0.478	4.290	0.094	0.08249	0.00018	4.310	0.095	0.07838	0.00030	1345	27	1156	7	16.3
P	12	12.1	2227	184	0.09	0.004	4.737	0.103	0.07875	0.00025	4.737	0.103	0.07872	0.00026	1235	25	1165	7	6.0
P	1	1.1	5331	384	0.07	0.091	4.065	0.089	0.07957	0.00034	4.068	0.089	0.07878	0.00035	1417	28	1167	9	21.4
P	11	10.1	4058	289	0.07	0.016	4.661	0.101	0.07893	0.00019	4.660	0.101	0.07906	0.00019	1253	25	1174	5	6.8
P	6	5.1	1849	69	0.04	0.012	4.779	0.104	0.07942	0.00028	4.780	0.104	0.07932	0.00028	1225	24	1180	7	3.8
P	14	14.1	3201	182	0.06	0.011	4.671	0.102	0.07947	0.00045	4.672	0.102	0.07938	0.00045	1250	25	1182	11	5.8
P	3	2.2	4193	316	0.08	0.003	4.488	0.098	0.07945	0.00018	4.488	0.098	0.07943	0.00018	1297	26	1183	5	9.6
P	5	4.1	4334	453	0.11	0.010	4.570	0.099	0.07946	0.00018	4.570	0.099	0.07955	0.00018	1276	25	1186	4	7.6

(MSWD = 1.4). These analyses indicate very high uranium contents (1794–5247 ppm).

Group P comprises eight analyses (Table 1), which yield $^{207}Pb^*/^{206}Pb^*$ dates of 1186–1156 Ma. These analyses also indicate very high uranium contents (1849–5331 ppm).

Group X comprises two analyses of zircon cores (Table 1), which yield $^{207}Pb^*/^{206}Pb^*$ dates (1σ) of 1399 ± 13 and 1300 ± 19 Ma. These analyses indicate moderate to high uranium contents (360–955 ppm).

The date of 1200 ± 5 Ma for the nine analyses in Group I is interpreted as the magmatic crystallization age of the leucogranite. The dates of 1186–1156 Ma for the eight analyses in Group P are interpreted to reflect the combined effects of radiogenic-Pb loss (which moves data points to the right and/or down in Fig. 2) and matrix effects (which are common in ion probe analyses of high-U zircons and move points to the left in Fig. 2). The dates (1σ) of 1399 ± 13 and 1300 ± 19 Ma for the two analyses in Group X are interpreted as the ages of inherited components within the leucogranite.

References

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Recommended reference for this publication

Kirkland, CL, Wingate, MTD and Smithies, RH 2013, 187196: leucogranite, Prostanthera Hill; Geochronology Record 1130: Geological Survey of Western Australia, 4p.

Data obtained: 24 February 2009

Data released: 30 June 2013