194367: syenogranite, Ngaturn

(Pitjantjatjara Supersuite, Musgrave Province)

Location and sampling

SCOTT (SG 52-6), FINLAYSON (4446)
MGA Zone 52, 369783E 7166857N

Sampled on 16 May 2008

This sample was collected from low-lying rubbly outcrop, about 31.2 km west-southwest of Mount Muir, 24.3 km east of Domeyer Hill, and 4.7 km northwest of Ngaturn aboriginal site.

Tectonic unit/relations

The unit sampled is a granite assigned to the 1220–1150 Ma Pitjantjatjara Supersuite (Smithies et al., 2009). The Pitjantjatjara Supersuite comprises syn- to post-tectonic granite magmas emplaced during the Musgrave Orogeny (Smithies et al., 2010; 2011). The Musgrave Orogeny caused intense deformation, widespread granulite-facies reworking, and granitic magmatism of the Pitjantjatjara Supersuite (Edgoose et al., 2004). The absence of clear evidence for significant compressional deformation associated with the prolonged Musgrave Orogeny implies an essentially intracontinental setting (Wade et al., 2008). The Pitjantjatjara granites are ferroan, calc-alkalic to alkali-calcic, emplaced at temperatures ≥ 1000ºC, and include orthopyroxene-bearing charnockites. These rocks formed through melting of a homogenized 1950–1900 Ma source that was refertilized by mantle input (Kirkland et al., 2012).

Petrographic description

The sample is a syenogranite containing about 45% K-feldspar, 25% quartz, 15% plagioclase + myrmekite, 13% hornblende, 1% opaque oxide minerals and accessory garnet, biotite, epidote, apatite, titanite, allanite, and zircon. The texture is allotriomorphic granular, with most quartz and feldspar grains and mafic aggregates (hornblende–opaque oxide ± biotite, apatite, epidote, titanite, and zircon) less than 2 mm long. Very minor myrmekite occurs in plagioclase and there is weak clay alteration in feldspar grains.

Zircon morphology

Zircons from this sample are colourless to dark brown or opaque, and mainly euhedral. The crystals are up to 500 μm long, and equant to elongate, with aspect ratios up to 6:1. In cathodoluminescence (CL) images, most crystals exhibit concentric zoning, and many contain high-uranium, metamict zones. A CL image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed over two sessions, on 29–30 January and 30–31 January 2009, using SHRIMP-B. Analyses 1.1 to 14.1 (spot numbers 1–14) were obtained during the first session, together with 12 analyses of the Temora standard, of which 11 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 1.22% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.44% (1σ). Analyses 15.1 to 20.1 (spot numbers 15–20) were obtained during the second session, together with 12 analyses of the Temora standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 1.51% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.53% (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

Twenty analyses were obtained from 20 zircons. Results are listed in Table 1, and shown in concordia diagrams (Figs 2 and 4), and an X–Y correlation plot (Fig. 3).

Interpretation

The analyses are concordant to slightly discordant. The analyses yield $^{207}Pb^*/^{206}Pb^*$ dates that correlate with their common-Pb contents (f204, Fig. 3), indicating that corrections using ^{204}Pb are inaccurate for some or all of these analyses. The date for this sample is therefore determined from the intersection with the concordia curve of a regression through uncorrected data (Fig. 4), anchored at contemporaneous initial Pb ($^{207}Pb/^{206}Pb$ = 0.9222 at 1160 Ma; Stacey and Kramers, 1975). The analyses define a single coherent group, based on their $^{207}Pb/^{206}Pb$ and $^{238}U/^{206}Pb$ ratios.

Group I comprises 20 analyses (Table 1), for which the regression intersects the concordia curve at 1159 ± 7 Ma (MSWD = 1.3).

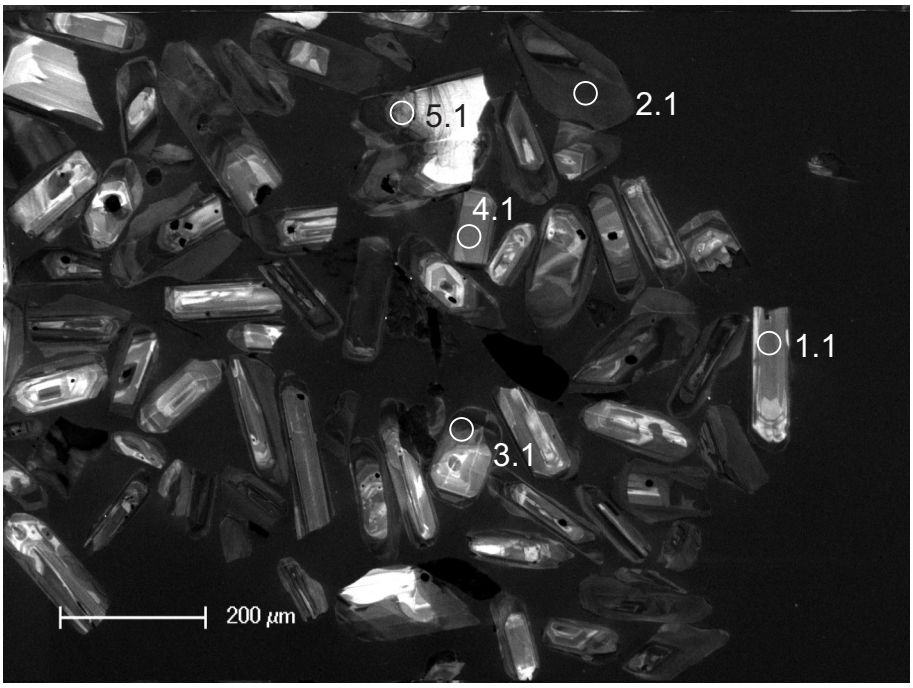

Figure 1. Cathodoluminescence image of representative zircons from sample 194367: syenogranite, Ngaturn. Numbered circles indicate the approximate positions of analysis sites.

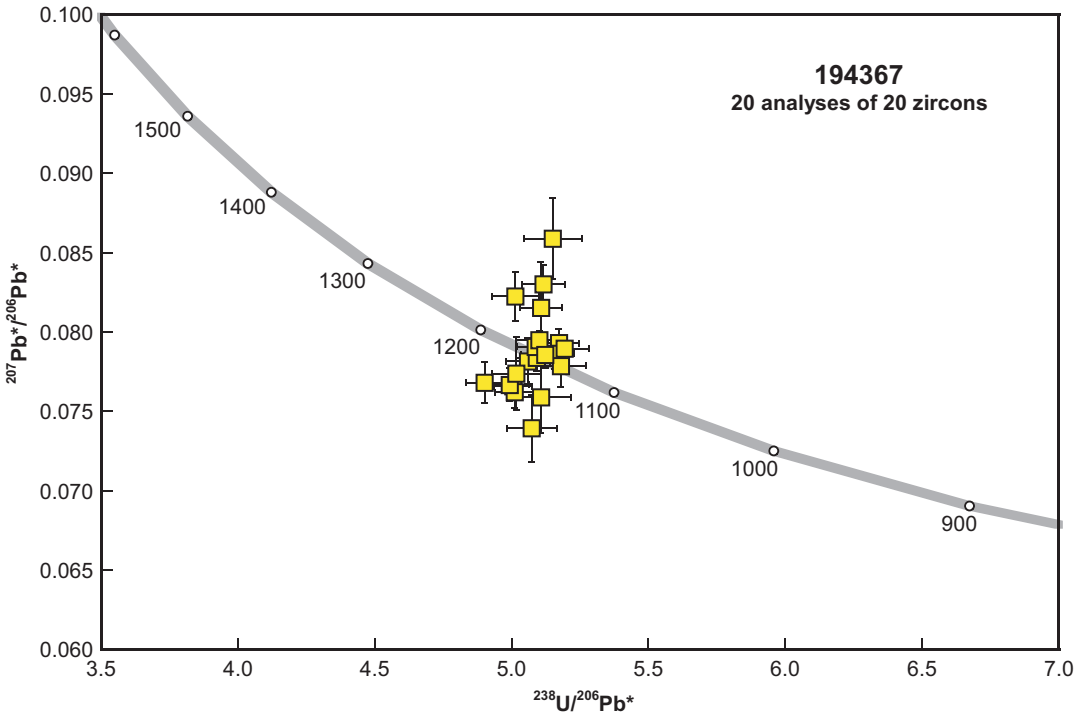

Figure 2. U–Pb analytical data for sample 194367: syenogranite, Ngaturn. Yellow squares indicate Group I (magmatic zircons).

Table 1. Ion microprobe analytical results for zircons from sample 194367: syenogranite, Ngaturn

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	20	20.1	98	231	2.44	0.639	5.041	0.087	0.07930	0.00092	5.074	0.092	0.07394	0.00210	1160	23	1040	57	11.5
I	13	13.1	131	140	1.10	0.297	5.093	0.104	0.07837	0.00080	5.108	0.108	0.07588	0.00226	1153	27	1092	60	5.6
I	8	8.1	182	159	0.90	0.280	4.998	0.066	0.07856	0.00061	5.012	0.070	0.07620	0.00100	1173	18	1100	26	6.6
I	3	3.1	282	286	1.05	0.175	4.997	0.065	0.07805	0.00049	5.006	0.068	0.07658	0.00081	1174	18	1110	21	5.8
I	14	14.1	205	203	1.02	0.283	4.980	0.066	0.07905	0.00060	4.994	0.070	0.07666	0.00104	1177	18	1112	27	5.8
I	11	11.1	183	205	1.16	0.223	4.891	0.065	0.07867	0.00062	4.902	0.069	0.07680	0.00130	1197	19	1116	34	7.2
I	19	19.1	114	225	2.04	0.246	5.005	0.084	0.07945	0.00086	5.018	0.090	0.07738	0.00230	1172	23	1131	59	3.6
I	16	16.1	171	156	0.95	0.117	5.175	0.086	0.07885	0.00132	5.181	0.091	0.07786	0.00135	1138	22	1143	35	0.5
I	4	4.1	64	184	2.96	0.145	5.053	0.075	0.07936	0.00103	5.060	0.079	0.07814	0.00145	1163	20	1150	37	1.1
I	9	9.1	248	278	1.16	0.043	5.089	0.071	0.07874	0.00053	5.092	0.074	0.07838	0.00086	1156	18	1157	22	0.0
I	18	18.1	238	259	1.13	0.126	5.117	0.082	0.07962	0.00060	5.123	0.087	0.07856	0.00084	1149	21	1161	21	1.0
I	6	6.1	192	159	0.85	0.219	5.146	0.068	0.08049	0.00061	5.157	0.072	0.07864	0.00096	1142	17	1163	24	1.8
I	17	17.1	228	156	0.71	0.090	5.189	0.083	0.07972	0.00063	5.194	0.088	0.07896	0.00081	1135	21	1171	20	3.1
I	10	10.1	319	479	1.55	0.014	5.088	0.065	0.07918	0.00048	5.089	0.069	0.07906	0.00067	1156	17	1174	17	1.5
I	2	2.1	216	157	0.75	0.099	5.169	0.068	0.08013	0.00058	5.174	0.072	0.07930	0.00087	1139	17	1180	22	3.4
I	15	15.1	287	319	1.15	0.085	5.107	0.081	0.07878	0.00055	5.102	0.085	0.07949	0.00057	1154	21	1184	14	2.6
I	7	7.1	108	189	1.81	0.143	5.101	0.072	0.08274	0.00088	5.108	0.078	0.08152	0.00288	1152	19	1234	69	6.6
I	5	5.1	94	201	2.21	0.076	5.018	0.083	0.08159	0.00154	5.014	0.086	0.08224	0.00156	1172	22	1251	37	6.3
I	12	12.1	66	181	2.83	0.156	5.125	0.077	0.08168	0.00109	5.117	0.080	0.08300	0.00123	1151	20	1269	29	9.3
I	1	1.1	63	200	3.28	0.219	5.162	0.103	0.08402	0.00113	5.151	0.107	0.08588	0.00253	1144	26	1336	57	14.4

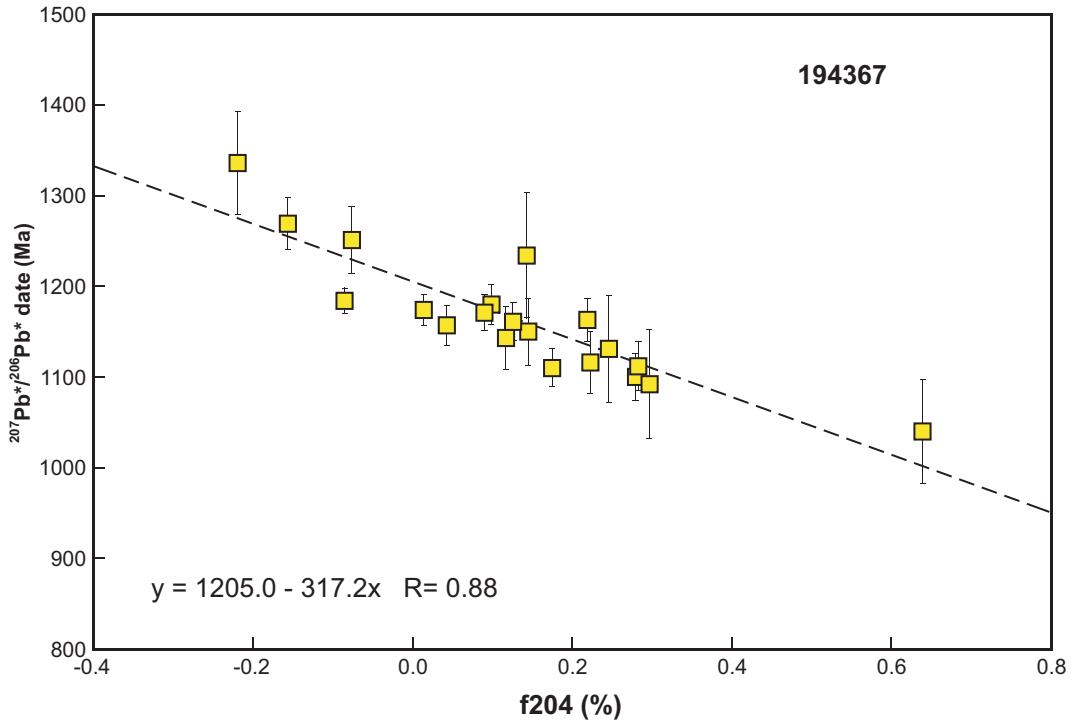

Figure 3. Correlation between ^{207}Pb*/^{206}Pb* age (corrected for common Pb using measured ^{204}Pb) and f204 for sample 194367: syenogranite, Ngaturn. The dashed line indicates a regression through data in Group I, and the equation of the best-fit line is shown. R is Pearson's correlation coefficient. Symbols as in Figure 2.

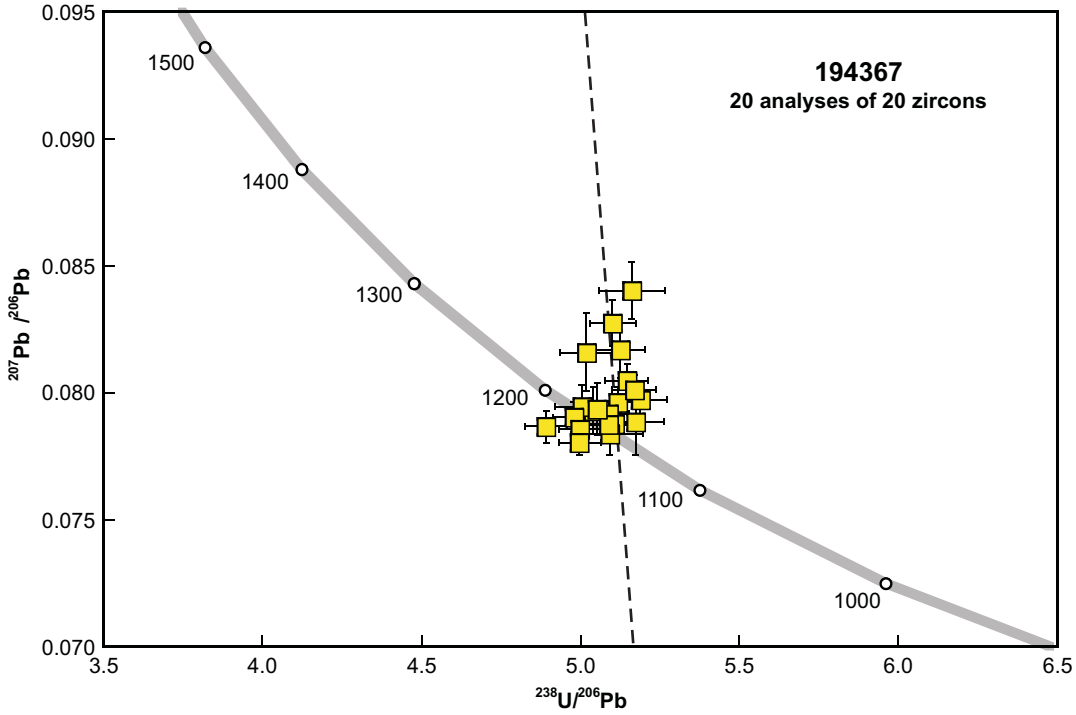

Figure 4. U–Pb analytical data, not corrected for common Pb, for sample 194367: syenogranite, Ngaturn. The dashed line indicates a regression from initial Pb, through data in Group I. Symbols as in Figure 2.

The date of 1159 ± 7 Ma for the 20 analyses in Group I is interpreted as the magmatic crystallization age of the granite.

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Recommended reference for this publication

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