

169885: biotite granodiorite, Stuarts Well

(Moorarie Supersuite, Gascoyne Province, Capricorn Orogen)

Location and sampling

WYLOO (SF 50-10), MOUNT STUART (2153)
MGA Zone 50, 397890E 7517398N

Sampled on 2 September 2011

This sample was collected from a low hill of granite outcrops (Fig. 1) on the south side of the Nanutarra–Wittenoom Road on Woodlands Station, about 5.2 km southeast of 90 Mile Bore, 4.7 km west of Mount Stuart Homestead, and 3.1 km southwest of Stuarts Bore.

Tectonic unit/relations

The unit sampled is a granodiorite assigned to the 1820–1775 Ma Moorarie Supersuite (Sheppard et al., 2010). The Moorarie Supersuite is dominated by granitoid rocks of granodioritic to monzogranitic composition, and was intruded into the Gascoyne Province, the adjacent Yarlalweelor Gneiss Complex, and the Ashburton Basin during the Capricorn Orogeny (Sheppard et al., 2010). At this locality, the rock is a non-foliated, equigranular, fine- to medium-grained biotite granodiorite.

Petrographic description

The sample is a slightly K-feldspar-phyric biotite granodiorite, composed of about 55% saussurite-altered plagioclase, 20% quartz, 10% K-feldspar, 10% biotite, and accessory chlorite, epidote, opaque oxide minerals, apatite, and zircon. Plagioclase is medium-grained (about 1–2 mm long), subhedral, albite-rimmed, and variably altered to saussurite. Quartz forms mosaics of amoeboid, recrystallized grains showing strain shadows, and is interstitial to plagioclase. K-feldspar (microcline) occurs as phenocrysts up to 7 mm long that contain inclusions of plagioclase. Biotite is evenly distributed and also occurs in clots, associated with chlorite, epidote, and opaque oxide minerals.

Zircon morphology

Zircons isolated from this sample are colourless to dark brown or opaque, and subhedral to euhedral. The crystals are up to 500 μm long, and equant to elongate, with aspect ratios up to 5:1. In cathodoluminescence (CL) images,

concentric zoning is ubiquitous, some zircons contain high-uranium, metamict zones, and a few appear to contain older cores. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 17–18 September 2012, using SHRIMP-B. Fifteen analyses of the BR266 standard were obtained during the session, of which 13 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 1.13% (1σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.47% (1σ). Isotopic mass fractionation of $^{207}\text{Pb}/^{206}\text{Pb}$ ratios was corrected by reference to the OGC1 standard; measured ratios in Table 1 were decreased by 0.17%. Calibration uncertainties are included in the errors of $^{238}\text{U}/^{206}\text{Pb}^*$ 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-seven analyses were obtained from 26 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3).

Interpretation

The analyses are concordant to moderately discordant (Fig. 3). Five analyses are >5% discordant. The dates obtained from these analyses (Group D; Table 1) are considered not to be geologically significant. The remaining 22 analyses can be divided into two groups, based on their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.

Group I comprises 21 analyses (Table 1), which yield a weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1796 ± 9 Ma (MSWD = 0.40).

Group X comprises one analysis (Table 1), which yields a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 2351 ± 12 Ma (1σ).

The date of 1796 ± 9 Ma for the 21 analyses in Group I is interpreted as the magmatic crystallization age of the granodiorite. The date of 2351 ± 12 Ma (1σ) for the single analysis in Group X is interpreted as the age of an inherited component.



Figure 1. Outcrop photograph for sample 169885: biotite granodiorite, Stuarts Well.

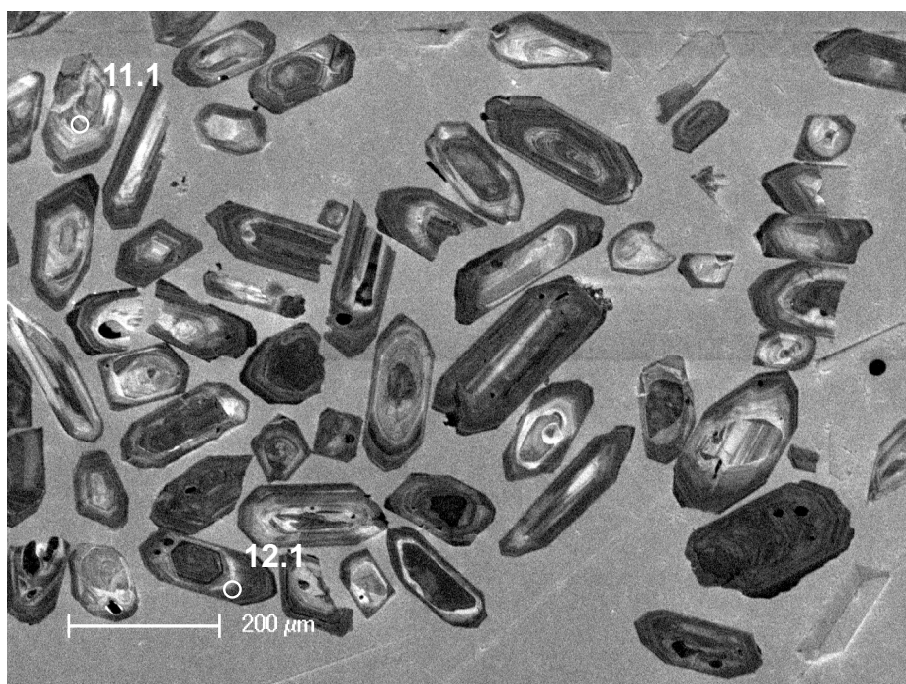


Figure 2. Cathodoluminescence image of representative zircons from sample 169885: biotite granodiorite, Stuarts Well. Numbered circles indicate the approximate locations of analysis sites.

Table 1. Ion microprobe analytical results for zircons from sample 169885: biotite granodiorite, Stuarts Well

Group ID	Spot no.	Grain. spot	²³⁸ U (ppm)	²³² Th (ppm)	²³² Th/ ²³⁸ U	f ₂₀₄ (%)	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	7	6.1	366	92	0.26	0.219	3.265 0.045	0.11020 0.00346	3.272 0.045	0.10830 0.00348	1719 21	1771 59	2.9
I	27	26.1	127	56	0.46	0.425	3.160 0.046	0.11209 0.00121	3.173 0.046	0.10839 0.00142	1766 23	1773 24	0.4
I	14	13.1	197	80	0.42	0.041	3.169 0.043	0.10884 0.00115	3.171 0.043	0.10849 0.00116	1767 21	1774 20	0.4
I	22	21.1	198	83	0.43	0.164	3.161 0.043	0.11015 0.00116	3.166 0.043	0.10873 0.00121	1769 22	1778 20	0.5
I	4	4.1	273	66	0.25	0.119	3.296 0.268	0.10985 0.00116	3.300 0.268	0.10881 0.00119	1706 131	1780 20	4.2
I	8	7.1	277	84	0.31	0.198	3.295 0.048	0.11072 0.00263	3.301 0.048	0.10900 0.00266	1706 22	1783 45	4.3
I	23	22.1	164	81	0.51	0.491	3.138 0.338	0.11330 0.00118	3.153 0.340	0.10902 0.00136	1776 185	1783 23	0.4
I	18	17.1	289	107	0.38	0.276	3.130 0.041	0.11196 0.00111	3.138 0.041	0.10956 0.00117	1783 21	1792 19	0.5
I	26	25.1	98	53	0.56	0.048	3.084 0.046	0.11006 0.00126	3.085 0.046	0.10965 0.00128	1810 24	1794 21	-0.9
I	25	24.1	247	110	0.46	0.122	3.126 0.043	0.11084 0.00114	3.130 0.043	0.10978 0.00116	1787 22	1796 19	0.5
I	19	18.1	180	109	0.63	0.041	3.122 0.043	0.11022 0.00115	3.123 0.043	0.10987 0.00117	1791 22	1797 19	0.3
I	15	14.1	179	54	0.31	-0.026	3.034 0.042	0.10969 0.00116	3.033 0.042	0.10992 0.00117	1837 22	1798 19	-2.2
I	13	12.1	237	82	0.36	0.028	3.097 0.041	0.11031 0.00112	3.098 0.041	0.11007 0.00112	1803 21	1801 19	-0.1
I	11	10.1	367	103	0.29	0.069	2.964 0.040	0.11068 0.00112	2.966 0.040	0.11008 0.00113	1873 22	1801 19	-4.0
I	17	16.1	273	70	0.26	0.045	3.038 0.040	0.11048 0.00112	3.040 0.040	0.11009 0.00113	1833 21	1801 19	-1.8
I	3	3.1	200	98	0.51	0.062	3.125 0.046	0.11082 0.00121	3.127 0.046	0.11027 0.00124	1789 23	1804 20	0.8
I	24	23.1	170	91	0.55	0.059	3.100 0.044	0.11080 0.00118	3.102 0.044	0.11029 0.00120	1801 23	1804 20	0.2
I	10	9.1	123	59	0.49	0.266	3.202 0.047	0.11281 0.00120	3.210 0.048	0.11049 0.00129	1748 23	1807 21	3.3
I	12	11.1	189	112	0.61	-0.008	3.059 0.042	0.11073 0.00115	3.059 0.042	0.11080 0.00115	1823 22	1813 19	-0.6
I	21	20.1	175	79	0.46	0.578	3.103 0.043	0.11589 0.00118	3.121 0.043	0.11086 0.00140	1792 22	1814 23	1.2
I	16	15.1	151	60	0.41	0.020	3.124 0.044	0.11138 0.00118	3.125 0.044	0.11121 0.00119	1790 22	1819 19	1.6
X	20	19.1	617	104	0.17	0.005	2.287 0.029	0.15051 0.00108	2.287 0.029	0.15046 0.00108	2338 25	2351 12	0.6
D	5	4.2	201	69	0.35	0.090	3.311 0.047	0.11101 0.00118	3.314 0.047	0.11023 0.00121	1700 22	1803 20	5.7
D	1	1.1	273	24	0.09	0.057	3.450 0.052	0.11134 0.00120	3.452 0.052	0.11084 0.00122	1640 22	1813 20	9.5
D	9	8.1	149	82	0.57	0.902	3.350 0.056	0.11994 0.00693	3.380 0.057	0.11208 0.00718	1671 25	1833 116	8.8
D	6	5.1	199	56	0.29	-0.030	3.276 0.049	0.11186 0.00125	3.275 0.049	0.11212 0.00127	1718 23	1834 20	6.3
D	2	2.1	116	58	0.52	2.292	3.426 0.066	0.13537 0.00166	3.506 0.068	0.11535 0.00335	1618 28	1885 52	14.2

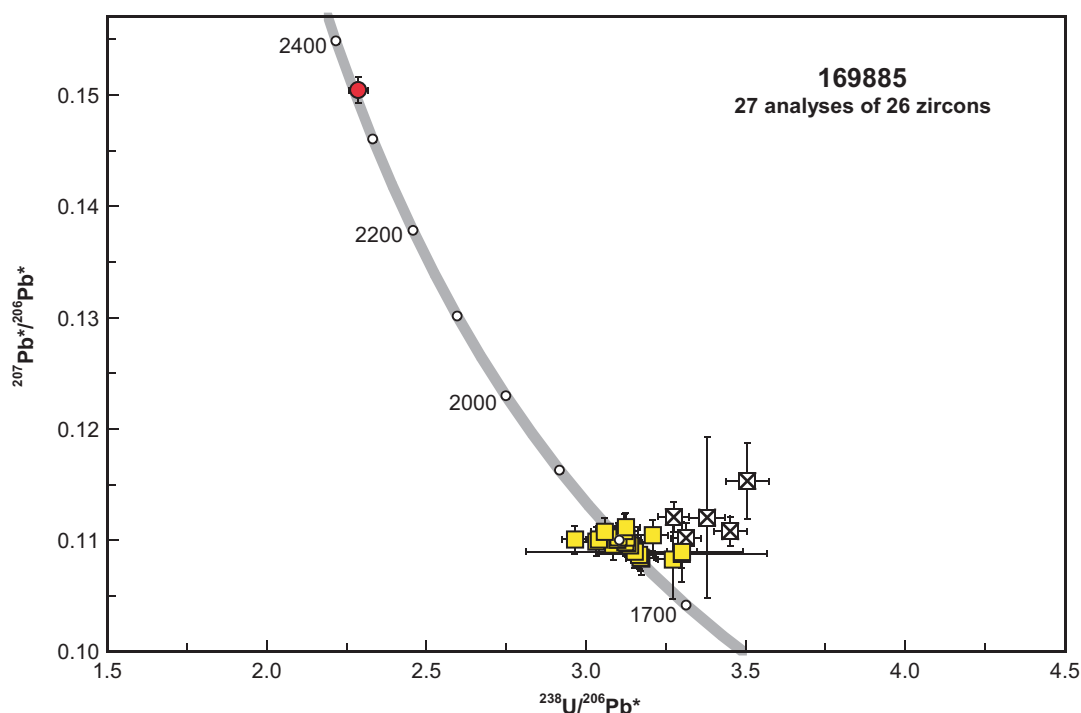


Figure 3. U–Pb analytical data for sample 169885: biotite granodiorite, Stuarts Well. Yellow squares indicate Group I (magmatic zircons); red circle indicates Group X (xenocrystic zircon); crossed squares indicate Group D (discordance >5%).

References

- Sheppard, S, Johnson, SP, Wingate, MTD, Kirkland, CL and Pirajno, F 2010, Explanatory Notes for the Gascoyne Province: Geological Survey of Western Australia, 336p.
- 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.

Recommended reference for this publication

- Wingate, MTD, Kirkland, CL, Thorne, AM and Johnson, SP 2014, 169885: biotite granodiorite, Stuarts Well; *Geochronology Record* 1208: Geological Survey of Western Australia, 4p.

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Data released: 30 June 2014