

143450: dolerite sill, Top Camp Well

(Edmund Basin, Capricorn Orogen)

Location and sampling

MOUNT EGERTON (SG 50-3), CANDOLLE (2348)
MGA Zone 50, 539013E 7255911N

Sampled on 20 September 2008

This sample was collected from the northwest-facing slope of a dolerite ridge on Waldburg Station, about 7.5 km northeast of Middle Bore, 5.1 km south of Tyne Bore, and 0.3 km northwest of Top Camp Well.

Tectonic unit/relations

The unit sampled is a dolerite sill within a silicified siltstone of the Kiangi Creek Formation of the Edmund Group, from a few decametres below the contact with the overlying Discovery Formation (Martin and Thorne, 2004). The Edmund Group unconformably overlies, and is younger than, 1680–1620 Ma granites of the Gascoyne Province, and is older than sills of the c. 1465 Ma Narimbunna Dolerite that intrude it (Wingate, 2002; Martin and Thorne, 2004). This report deals with zircon U–Pb geochronology. This sample also yielded baddeleyite crystals that provide a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1449 ± 10 Ma (GSWA 143450, Wingate et al., 2012).

Petrographic description

The sample is a medium- to coarse-grained granophyric dolerite (Fig. 1) consisting of 40–50% plagioclase, 30–40% clinopyroxene, 10–20% interstitial albite–quartz granophyre, 10–15% pseudomorphs of fibrous tremolite and minor green amphibole after orthopyroxene, 2–3% iron-oxide minerals, and accessory phlogopite and apatite. Plagioclase laths are subhedral, up to 3 mm long, and consist of labradorite (An60–64) that is clouded and transected by veinlets of cryptocrystalline to microcrystalline aggregates of saussurite (clinozoisite, epidote), sericite, chlorite, and albite. Clinopyroxene forms granular, anhedral to subhedral, prisms up to 7 mm long. Skeletal iron-oxide minerals are up to 2 mm across, and are partly replaced by titanite. The observed paragenetic sequence is: clinopyroxene, plagioclase, ilmenite, phlogopite, granophyre, amphibole, apatite, epidote, saussurite, sericite–chlorite.

Zircon morphology

Zircons isolated from this sample are colourless to dark brown, and mainly subhedral to euhedral. The crystals are up to 250 μm long, and equant to elongate, with aspect ratios up to 5:1. In cathodoluminescence (CL) images, most zircons are internally featureless or else exhibit broad concentric zoning. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 4 November 2011, using SHRIMP-A. Four analyses of the BR266 standard obtained during the session indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.37% (1σ). 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

Sixteen analyses were obtained from 16 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3).

Interpretation

The analyses are concordant to slightly discordant (Fig. 3). One analysis is >5% discordant. The date obtained from this analysis (Group D; Table 1) is unreliable, and is considered not to be geologically significant. The remaining 15 analyses form a single group, based on their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.

Group I comprises 15 analyses (Table 1), which yield a weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1453 ± 7 Ma (MSWD = 1.3).

The date of 1453 ± 7 Ma for the 15 analyses in Group I is interpreted as the magmatic crystallization age of the dolerite sill.



Figure 1. Field photograph of sample 143450: dolerite sill, Top Camp Well.

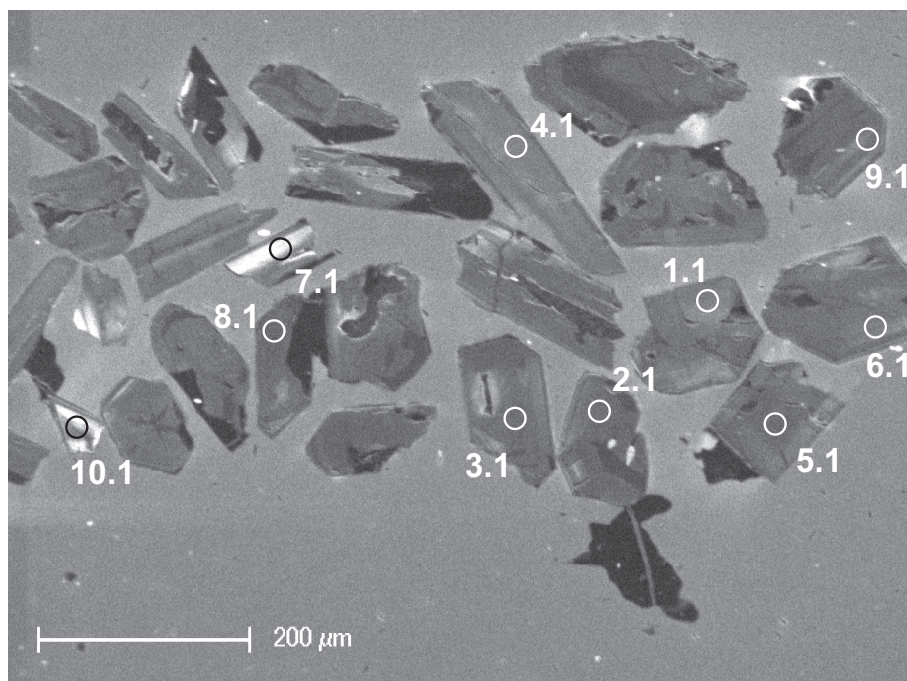


Figure 2. Cathodoluminescence image of representative zircons from sample 143450: dolerite sill, Top Camp Well. Numbered circles indicate the approximate locations of analysis sites.

Table 1. Ion microprobe analytical results for zircons from sample 143450: dolerite sill, Top Camp Well

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	f_{204} (%)	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^* \pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^* \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	Disc. (%)
I	9	9.1	415	1152	2.87	0.209	3.876 0.044	0.09108 0.00072	3.884 0.045	0.08929 0.00091	1477 15	1410 20	-4.7
I	11	11.1	864	2476	2.96	-0.046	3.829 0.037	0.09018 0.00048	3.827 0.037	0.09057 0.00051	1496 13	1438 11	-4.1
I	12	12.1	1829	6824	3.85	0.021	3.800 0.033	0.09110 0.00033	3.801 0.033	0.09092 0.00034	1506 12	1445 7	-4.2
I	2	2.1	2097	7004	3.45	0.020	3.816 0.033	0.09111 0.00032	3.816 0.033	0.09094 0.00033	1500 12	1445 7	-3.8
I	10	10.1	183	504	2.84	0.132	3.988 0.060	0.09218 0.00104	3.993 0.061	0.09105 0.00123	1441 20	1448 26	0.5
I	6	6.1	1299	6132	4.88	0.060	3.863 0.035	0.09178 0.00041	3.866 0.035	0.09127 0.00045	1483 12	1452 9	-2.1
I	3	3.1	913	3276	3.71	0.069	3.940 0.038	0.09183 0.00050	3.943 0.038	0.09124 0.00055	1457 13	1452 11	-0.4
I	8	8.1	1722	8873	5.32	0.075	3.938 0.034	0.09203 0.00036	3.941 0.034	0.09139 0.00040	1458 11	1455 8	-0.2
I	5	5.1	1472	4235	2.97	0.079	3.953 0.035	0.09221 0.00040	3.956 0.035	0.09153 0.00044	1453 12	1458 9	0.3
I	1	1.1	520	2733	5.43	0.091	3.971 0.044	0.09235 0.00062	3.975 0.044	0.09157 0.00070	1447 14	1458 15	0.8
I	13	13.1	1498	1257	0.87	0.046	3.900 0.034	0.09198 0.00039	3.902 0.034	0.09158 0.00041	1471 12	1459 9	-0.8
I	15	15.1	210	554	2.72	0.317	4.043 0.059	0.09466 0.00109	4.056 0.059	0.09194 0.00150	1421 19	1466 31	3.1
I	14	14.1	625	2358	3.90	0.088	3.859 0.040	0.09305 0.00057	3.863 0.040	0.09229 0.00064	1484 14	1473 13	-0.7
I	4	4.1	690	2128	3.18	-0.043	3.853 0.039	0.09196 0.00052	3.852 0.039	0.09233 0.00055	1488 14	1474 11	-0.9
I	16	16.1	583	2103	3.73	0.052	3.971 0.042	0.09283 0.00058	3.973 0.042	0.09239 0.00062	1447 14	1475 13	1.9
D	7	7.1	145	294	2.09	0.185	4.332 0.072	0.09237 0.00124	4.340 0.072	0.09079 0.00155	1337 20	1442 32	7.3

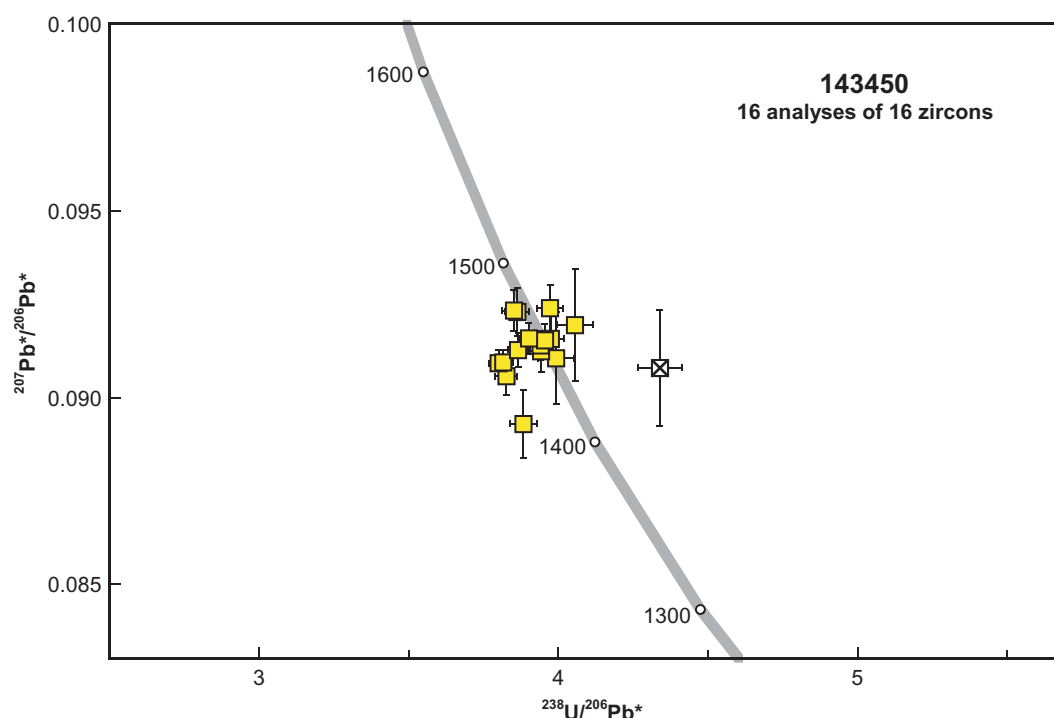


Figure 3. U–Pb analytical data for sample 143450: dolerite sill, Top Camp Well. Yellow squares indicate Group I (magmatic zircons); crossed square indicates Group D (discordance >5%).

This result is in good agreement with the date of 1449 ± 10 Ma obtained for baddeleyites from the same sample (GSWA 143450, Wingate et al., 2012). Therefore, the best estimate of the crystallization age of the dolerite sill, based on the combined results for baddeleyite and zircon, is the weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 1452 ± 5 Ma ($n = 41$, MSWD = 1.4).

This result is slightly younger than the previously recorded c. 1465 Ma age of the Narimbunna Dolerite (Wingate, 2002), and suggests that mafic magmatism was protracted, and accompanied extension and the development of the Edmund Basin. The new date also provides a minimum depositional age for the Kiangi Creek Formation of the lower Edmund Group (Martin and Thorne, 2004).

References

- Martin, DM and Thorne, AM 2004, Tectonic setting and basin evolution of the Bangemall Supergroup in the northwestern Capricorn Orogen: *Precambrian Research*, v. 128, p. 385–409.
- 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.
- Wingate, MTD 2002, Age and palaeomagnetism of dolerite sills of the Bangemall Supergroup on the Edmund 1:250 000 sheet, Western Australia: Geological Survey of Western Australia, Record 2002/4, 48p.
- Wingate, MTD, Kirkland, CL, Cutten, HN and Thorne, AM 2012, 143450: dolerite sill, Top Camp Well; *Geochronology Record* 1079: Geological Survey of Western Australia, 4p.

Recommended reference for this publication

Wingate, MTD, Kirkland, CL, Cutten, HN and Thorne, AM 2012, 143450: dolerite sill, Top Camp Well; *Geochronology Record* 1078: Geological Survey of Western Australia, 4p.

Data obtained: 4 November 2011

Data released: 30 June 2012