

155503: biotite monzogranite, Mundra Well

(Big Bell Suite, Austin Downs Supersuite, Murchison Domain,
Youanmi Terrane, Yilgarn Craton)

Location and sampling

CUE (SG 50-15), AUSTIN (2442)
MGA Zone 50, 550197E 6914574N

Sampled on 4 October 2010

This sample was collected from a large pavement outcrop (Fig. 1) on Mount Farmer Station, about 6.8 km east-southeast of Mungo Well, 4.2 km west-southwest of Mount Farmer Homestead, and 1.1 km west-northwest of Mundra Well.

Tectonic unit/relations

The unit sampled is a monzogranite assigned to the 2735–2690 Ma Big Bell Suite of the Austin Downs Supersuite (Van Kranendonk et al., 2013). The sampled pluton is part of a north-trending elongate batholith (c. 150 × 50 km) exposed west of the Meekatharra – Mount Magnet greenstone belt, and east of the Dalgarranga greenstone belt. The relationships between regional-scale shearing and pluton crystallization in this area are documented in Zibra (2012). At this locality, the dominant granitic type is mesocratic, equigranular to porphyritic, biotite tonalite to monzogranite. These granites generally form steeply dipping sheets, ranging from centimetres to hundreds of metres in thickness (Fig. 1). A granitic dyke that crosscuts the foliation in this rock is dated at 2686 ± 4 Ma (GSWA 155502, Wingate et al., 2014a). Another sample of this granite batholith, collected 27.8 km to the southeast, yielded a magmatic crystallization age of 2706 ± 4 Ma (GSWA 155504, Wingate et al., 2014b).

Petrographic description

The sample is a medium- to coarse-grained monzogranite, composed of about 40% plagioclase, 30% K-feldspar, 20% quartz, 5% biotite, and accessory muscovite, chlorite, iron-titanium oxide minerals, and apatite. Plagioclase (oligoclase, An_{35}) occurs as anhedral to subhedral prisms up to 10 mm long, exhibits albite twinning, and is weakly altered by sericite and saussurite. Zoning of some plagioclase crystals suggests originally more calcic centres. K-feldspar (perthitic microcline) and quartz are anhedral and up to 5 mm across. Brown biotite is up to 0.5 mm, and is interleaved with chlorite and muscovite. The monzogranite displays mild hydrothermal alteration

effects, including saussuritization and chlorite alteration of biotite. Sequence of crystallization: calcic plagioclase, sodic plagioclase, biotite, microcline, quartz, saussurite, and sericite.

Zircon morphology

Zircons isolated from this sample are pale to dark brown and subhedral to euhedral. The crystals are up to 450 μ m long, and elongate, with aspect ratios up to 6:1. In cathodoluminescence (CL) images, concentric zoning is ubiquitous, and most crystals contain small rounded non-zircon inclusions and high-uranium, metamict zones. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 1–2 February 2013, using SHRIMP-B. Eight analyses of the BR266 standard obtained during the session indicated an external spot-to-spot (reproducibility) uncertainty of 0.79% (1σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.34% (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

Ten analyses were obtained from 10 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3). Additional analyses were unsuccessful, owing to high contents of common Pb.

Interpretation

The analyses are concordant to slightly discordant (Fig. 3), and form a single group, based on their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.

Group I comprises 10 analyses (Table 1), which yield a weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 2702 ± 4 Ma (MSWD = 0.32). This result includes one analysis that is $>2.5\sigma$ above the mean; exclusion of this analysis does not significantly affect the date.



Figure 1. Outcrop image of sample 155503: biotite monzogranite, Mundra Well

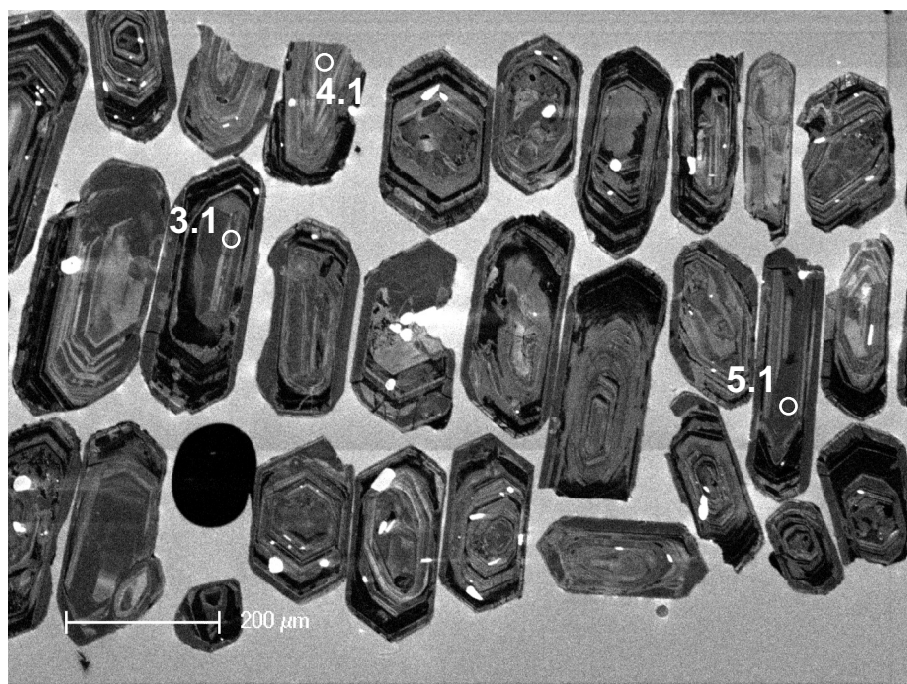


Figure 2. Cathodoluminescence image of representative zircons from sample 155503: biotite monzogranite, Mundra Well. Numbered circles indicate the approximate locations of analysis sites.

Table 1. Ion microprobe analytical results for zircons from sample 155503: biotite monzogranite, Mundra 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	32	22	0.70	0.303	1.930	0.035	0.18505	0.00156	1.936	0.035	0.00181	2674	16	-0.4
I	2	2.1	93	41	0.46	0.135	1.981	0.027	0.18573	0.00105	1.983	0.027	0.00112	2692	30	2.3
I	7	7.1	655	849	1.34	0.045	1.945	0.019	0.18552	0.00036	1.946	0.019	0.00037	2673	21	3
I	8	8.1	1095	407	0.38	0.018	1.945	0.018	0.18534	0.00028	1.945	0.018	0.00029	2674	20	3
I	3	3.1	615	912	1.53	0.025	1.854	0.018	0.18550	0.00039	1.855	0.018	0.00039	2780	22	3
I	4	4.1	180	212	1.22	0.054	1.939	0.022	0.18620	0.00071	1.940	0.022	0.00073	2680	25	6
I	1	1.1	327	128	0.40	0.027	1.973	0.076	0.18613	0.00360	1.974	0.076	0.00361	2642	86	32
I	5	5.1	373	422	1.17	0.010	1.955	0.046	0.18600	0.00049	1.955	0.046	0.00049	2663	53	4
I	6	6.1	112	65	0.60	0.222	1.994	0.026	0.18851	0.00120	1.998	0.026	0.00130	2616	28	11
I	10	10.1	351	58	0.17	0.000	1.952	0.020	0.18694	0.00053	1.952	0.020	0.00053	2666	22	5

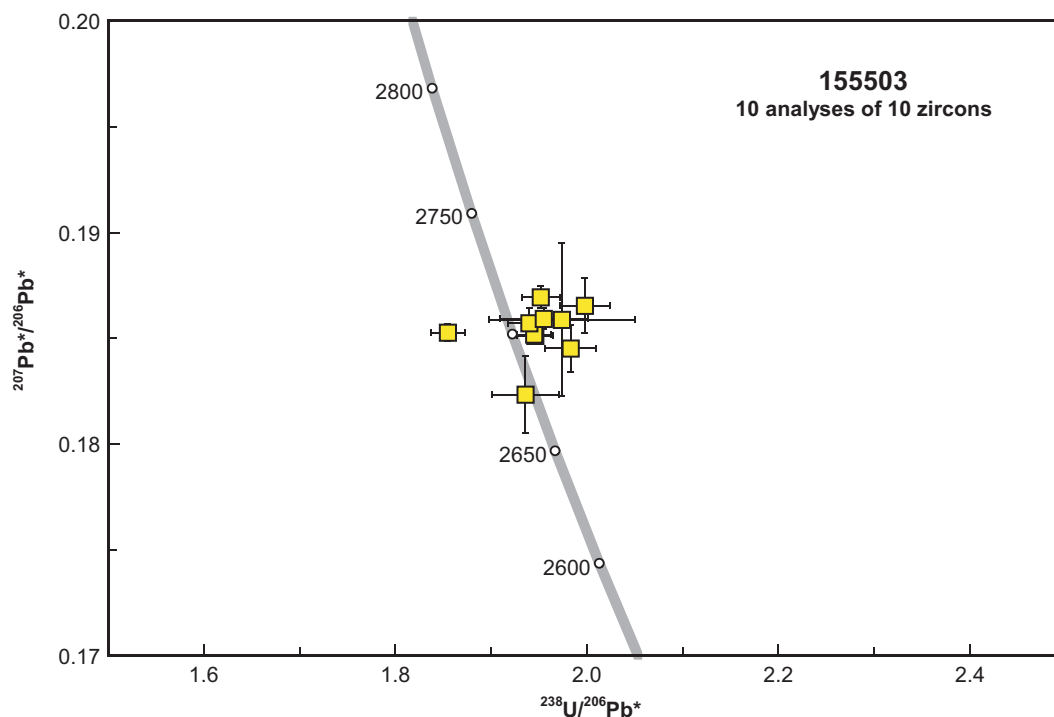


Figure 3. U–Pb analytical data for sample 155503: biotite monzogranite, Mundra Well. Yellow squares indicate Group I (magmatic zircons).

The date of 2702 ± 4 Ma for the 10 analyses in Group I is interpreted as the magmatic crystallization age of the monzogranite

References

- 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.
- Van Kranendonk, MJ, Ivanic, TJ, Wingate, MTD, Kirkland, CL and Wyche, S 2013, Long-lived, autochthonous development of the Archean Murchison Domain, and implications for Yilgarn Craton tectonics: *Precambrian Research*, v. 229, p. 49–92.
- Wingate, MTD, Kirkland, CL and Zibra, I 2014a, 155502: biotite monzogranite, Mundra Well; *Geochronology Record* 1146: Geological Survey of Western Australia, 4p.
- Wingate, MTD, Kirkland, CL and Zibra, I 2014b, 155504: biotite monzogranite, 30 Feet Bore; *Geochronology Record* 1148: Geological Survey of Western Australia, 5p.

Recommended reference for this publication

Wingate, MTD, Kirkland, CL and Zibra, I 2014, 155503: biotite monzogranite, Mundra Well; *Geochronology Record* 1147: Geological Survey of Western Australia, 4p.

Data obtained: 2 February 2013

Data released: 31 January 2014