184364: metasyenogranite, Buck Hills

(western Warumpi Province, West Arunta Orogen)

Location and sampling

MACDONALD (SF 52-14), MACDONALD (4651)
MGA Zone 52, 488706E 7432317N

Sampled on 10 August 2007

The sample was collected from an area of scattered, small whalebacks, boulders, and platform outcrops south of Buck Hills, in the northeast part of the MACDONALD 1:100 000 map sheet. The sample site is located approximately 28 km northeast of Gordon Hills and 7.8 km south of Mount Tietkins.

Tectonic unit/relations

The unit sampled is a metasyenogranite belonging to the Ininti Granite, part of a suite of intrusive rocks formed during the c. 1690–1660 Ma Argilke Igneous Event in the Warumpi Province (Meixner et al., 2004; Scrimgeour et al., 2005). The Warumpi Province is interpreted to have formed as a magmatic arc outboard of the North Australian Craton (NAC) (Scrimgeour et al., 2005). Transpressional accretion of the Warumpi Province onto the NAC occurred during the 1640–1635 Ma Liebig Orogeny, forming the Central Australian Suture (Scrimgeour et al., 2005). A metarhyodacite, also from the northeastern part of the MACDONALD map sheet and 21 km northeast of this sample, has been dated at c. 1650 Ma (GSWA 184359; Kirkland et al., 2009).

Petrographic description

This metasyenogranite is strongly foliated, leucocratic, and medium- to coarse-grained with pegmatite veins parallel to the gneissosity. Pegmatite segregations are also developed as cross-cutting patches, which may be related to in situ melting. The rock contains pelitic metasedimentary xenoliths, although the dated sample did not contain this material. The sample is composed of fine-grained quartz (25–30%), microcline (35–40%), and plagioclase (20–25%), which are accompanied by mafic aggregates (up to 4 mm long) of biotite, muscovite, epidote, magnetite, titanite, and zircon. Opaque oxide minerals in the mafic aggregates are rimmed by titanite and epidote. Microcrystalline opaque oxide minerals are also disseminated throughout the sample. Lenses of recrystallized quartz and feldspar are parallel to clots of mafic minerals. Some plagioclase grains have been altered to sericite and some biotite grains have been altered to chlorite. Muscovite and epidote occur as symplectites within quartz. The mineralogy implies that this sample has been metamorphosed to amphibolite facies with subsequent low-temperature alteration.

Zircon morphology

This sample yielded abundant euhedral zircons, which are colourless to pale brown, up to 300 μm long, and have aspect ratios up to 5:1. Cathodoluminescence (CL) images reveal idiomorphic zoning and, in some grains, disrupted internal structures are indicative of resorption and/or alteration. A CL image of representative zircons is shown in Figure 1.

Analytical details

This sample was analyzed over three sessions, on 28–29 March 2008, 7 April 2008, and 8 April 2008, using SHRIMP-B. Analyses 1.1 to 10.1 (spot numbers 1–10) were obtained during the first session, together with 13 analyses of the Temora standard, of which 11 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 1.04% (1σ), and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.40% (1σ). Analyses 11.1 to 14.1 (spot numbers 11–14) were obtained during the second session, together with four analyses of the Temora standard, of which three analyses indicated an external spot-to-spot (reproducibility) uncertainty of 1.13% (1σ), and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.65% (1σ). Analyses 15.1 to 18.1 (spot numbers 15–18) were obtained during the third session, together with eight analyses of the Temora standard that indicated an external spot-to-spot (reproducibility) uncertainty of 2.56% (1σ), and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.96% (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 common-Pb isotopic compositions determined according to the model of Stacey and Kramers (1975).

Results

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

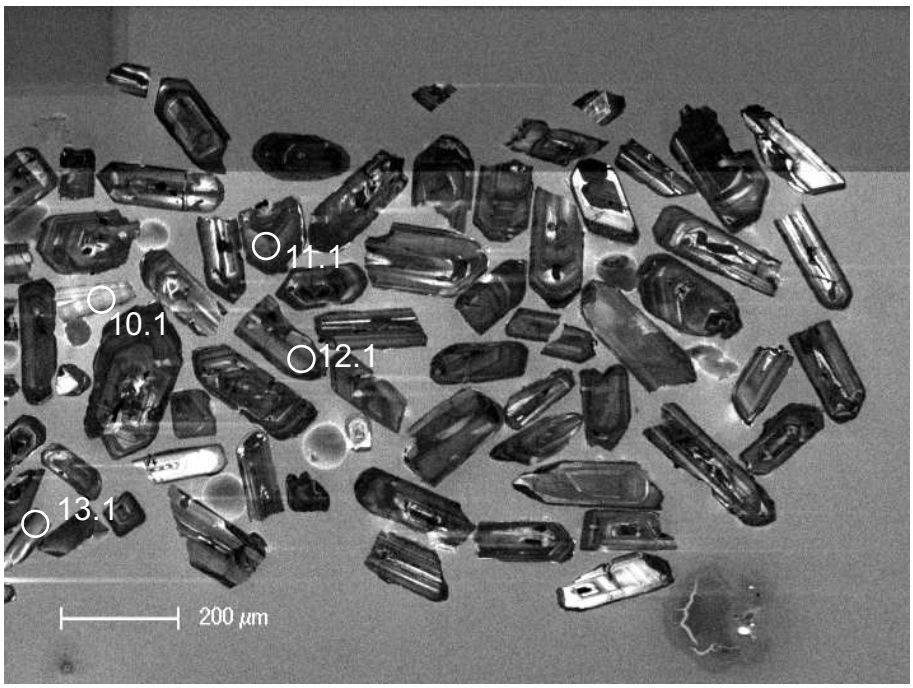

Figure 1. Cathodoluminescence image of representative zircons from sample 184364: metasyenogranite, Buck Hills. Numbered circles indicate the approximate positions of analysis sites.

Interpretation

The analyses are concordant to slightly discordant (Fig. 2). Two analyses are characterized by >5% discordance. These two analyses (Group D; Table 1) are imprecise or unreliable, and are not considered geologically significant. The remaining 16 analyses define one coherent group based on $^{207}Pb^*/^{206}Pb^*$ ratios.

Group I comprises 16 analyses (Table 1), which yield a concordia age of 1691 ± 5 Ma (MSWD = 0.88).

The date of 1691 ± 5 Ma for the 16 analyses in Group I is interpreted as the age of magmatic crystallization of the metasyenogranite. This date is identical, within uncertainty, to the 1688 ± 5 Ma age for the Ininti Granite, which outcrops to the east across the Northern Territory border (Meixner et al., 2004).

References

Kirkland, CL, Wingate, MTD, Spaggiari, CV and Tyler, IM 2009, 184359: metarhyodacite, Dovers Hills; Geochronology Record 815: Geological Survey of Western Australia, 4p.

Meixner, T, Close, DF, Scrimgeour, IR and Edgoose, CJ 2004, Mount Rennie, Northern Territory (First Edition), 1:250 000 interpreted geological map series, SF 52-15: Northern Territory Geological Survey, Darwin.

Scrimgeour, IR, Kinny, PD, Close, DF and Edgoose, CJ 2005, High–T granulites and polymetamorphism in the southern Arunta Region, central Australia: Evidence for a 1.64 Ga accretional event: Precambrian Research, v. 142, p. 1–27.

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

Kirkland, CL, Wingate, MTD, Spaggiari CV and Tyler, IM 2009, 184364: metasyenogranite, Buck Hills; Geochronology Record 845: Geological Survey of Western Australia, 4p.

Data obtained: 8 April 2008
Data released: 10 November 2009

Table 1. Ion microprobe analytical results for zircons from sample 184364: metasyenogranite, Buck Hills

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$^{232}Th/^{238}U$	f204 (%)	$^{238}U/^{206}Pb$ ± 1 σ		$^{207}Pb/^{206}Pb$ ± 1 σ		$^{238}U/^{206}Pb^*$ ± 1 σ		$^{207}Pb^*/^{206}Pb^*$ ± 1 σ		$^{238}U/^{206}Pb^*$ date (Ma) ± 1 σ		$^{207}Pb^*/^{206}Pb^*$ date (Ma) ± 1 σ		Disc. (%)
I	9	9.1	111	56	0.52	0.257	3.309	0.047	0.10438	0.00077	3.318	0.049	0.10216	0.00099	1698	28	1664	18	-2.1
I	1	11.1	319	149	0.48	0.038	3.360	0.042	0.10286	0.00204	3.361	0.048	0.10253	0.00205	1679	27	1671	37	-0.5
I	1	15.1	285	380	1.38	0.240	3.264	0.085	0.10484	0.00047	3.271	0.091	0.10276	0.00063	1719	55	1675	11	-2.7
I	10	10.1	302	383	1.31	0.017	3.309	0.041	0.10312	0.00050	3.310	0.043	0.10297	0.00051	1702	25	1678	9	-1.4
I	8	8.1	320	245	0.79	0.226	3.334	0.041	0.10496	0.00048	3.341	0.043	0.10300	0.00060	1688	25	1679	11	-0.5
I	2	12.1	363	354	1.01	0.041	3.372	0.257	0.10342	0.00225	3.373	0.258	0.10307	0.00226	1674	145	1680	40	0.4
I	4	18.1	177	143	0.83	-0.038	3.211	0.085	0.10301	0.00061	3.210	0.091	0.10334	0.00064	1748	57	1685	11	-3.7
I	5	5.1	508	283	0.57	0.064	3.293	0.038	0.10405	0.00036	3.295	0.041	0.10349	0.00039	1709	24	1688	7	-1.3
I	3	13.1	221	210	0.98	0.022	3.349	0.044	0.10372	0.00057	3.350	0.049	0.10353	0.00058	1684	28	1688	10	0.3
I	6	6.1	208	175	0.87	0.021	3.313	0.042	0.10373	0.00056	3.314	0.044	0.10355	0.00057	1700	26	1689	10	-0.7
I	2	16.1	397	213	0.56	0.224	3.213	0.084	0.10555	0.00045	3.220	0.090	0.10361	0.00061	1743	55	1690	11	-3.2
I	2	2.1	380	248	0.67	0.077	3.238	0.038	0.10441	0.00038	3.240	0.040	0.10374	0.00041	1734	24	1692	7	-2.5
I	7	7.1	253	189	0.77	0.052	3.331	0.042	0.10443	0.00051	3.333	0.044	0.10398	0.00055	1692	25	1696	10	0.3
I	1	1.1	104	104	1.03	0.000	3.381	0.046	0.10417	0.00075	3.381	0.048	0.10417	0.00075	1670	27	1700	13	1.7
I	3	3.1	166	56	0.35	0.057	3.371	0.045	0.10500	0.00066	3.373	0.047	0.10451	0.00070	1674	26	1706	12	1.9
I	4	4.1	267	83	0.32	0.046	3.343	0.041	0.10498	0.00048	3.345	0.043	0.10459	0.00051	1686	25	1707	9	1.2
D	3	17.1	321	144	0.46	0.059	3.180	0.083	0.10329	0.00050	3.182	0.089	0.10278	0.00053	1762	56	1675	10	-5.2
D	4	14.1	276	263	0.98	0.447	3.766	0.048	0.10940	0.00058	3.783	0.055	0.10552	0.00088	1512	25	1723	15	12.3

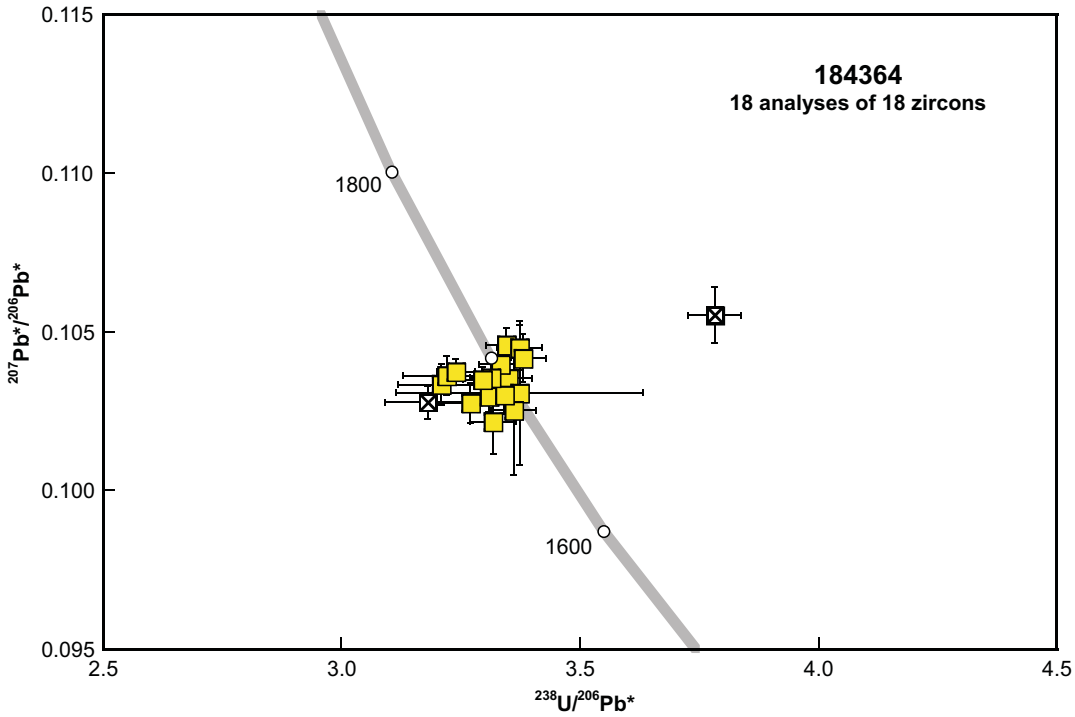

Figure 2. **U–Pb analytical data for zircons from sample 184364: metasyenogranite, Buck Hills. Yellow squares indicate Group I (magmatic zircons); crossed squares indicate Group D (discordance >5%).**