178106: basaltic andesite, White Horse Well

(Murchison Domain, Youanmi Terrane, Yilgarn Craton)

Location and sampling

BELELE (SG 50-11), TIERACO (2545)
MGA Zone 50, 637477E 7079862N

Sampled on 12 October 2005

This sample was collected from the top of a small hill located approximately 1.0 km west of White Horse Well, and 24.5 km north-northwest of the town of Meekatharra.

Tectonic unit/relations

This porphyritic andesite is part of the Abbotts greenstone belt, within the Murchison Domain of the Youanmi Terrane, Yilgarn Craton (Cassidy et al., 2006).

Petrographic description

This sample contains abundant (25–30%) saussuritized plagioclase phenocrysts up to 3 mm long and aggregates of tremolite–actinolite, chlorite, and titanite derived from pyroxene phenocrysts up to 3 mm long. There are also patches, up to 6 × 4 mm, of altered plagioclase. Tremolite–actinolite–chlorite also forms patches. Other minerals include clinozoisite, and microcrystalline titanite replacing opaque oxide minerals. Many of these patches may be altered and metamorphosed lithic fragments or glomeroporphyritic aggregates. The groundmass is mostly fine-grained granular albite with fibrous or fine prismatic amphibole, clinozoisite, and titanite. Small circular amygdales contain quartz, chlorite, and albite. This sample is a metamorphosed andesite.

Zircon morphology

Zircons from this sample are mainly subhedral to euhedral, and range from pale brown and transparent to dark brown and turbid. They are up to 120 μm long, with aspect ratios up to 3:1, although several are broken fragments of larger crystals. Concentric growth zoning is ubiquitous. A transmitted-light image of representative zircon crystals is shown in Figure 1.

Analytical details

This sample was analysed on 21–22 August 2006, using SHRIMP-B. Fourteen analyses of the CZ3 standard obtained during the session indicated an external spot-to-spot (reproducibility) uncertainty of 1.16% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.44% (1σ). 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

Sixteen analyses were obtained from 15 zircons. Results are listed in Table 1 and shown on a concordia diagram (Fig. 2).

Interpretation

The analyses are concordant to slightly discordant, and the pattern of discordance is consistent with ancient, and probably also some geologically recent, loss of radiogenic Pb from some zircons (Fig. 2). The 16 analyses can be divided into three groups, based on their $^{207}Pb^*/^{206}Pb^*$ ratios.

Group 1 comprises eight analyses of eight zircons, which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 2744 ± 4 Ma (MSWD = 0.51).

Group 2 comprises two analyses of two zircons, which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 2763 ± 8 Ma (MSWD = 0.34).

Group 3 comprises six analyses of six zircons, which yield $^{207}Pb^*/^{206}Pb^*$ dates of 2720–2655 Ma.

The date of 2744 ± 4 Ma for the eight analyses in Group 1 is interpreted as the age of igneous crystallization of the andesite. The two analyses in Group 2 have $^{207}Pb^*/^{206}Pb^*$ dates older than Group 1, and may have included some inherited material. The six analyses in Group 3 indicate younger and more discordant dates, and are interpreted to reflect loss of radiogenic Pb from the analysed sites. A weak correlation between U content and discordance is consistent with the effects of radiogenic Pb loss.

References

Cassidy, KF, Champion, DC, Krapež, B., Barley, ME, Brown, SJA, Blewett, RS, Groenewald, PB, and Tyler, IM, 2006, A revised geological framework for the Yilgarn Craton, Western Australia: Geological Survey of Western Australia, Record 2006/8, 8p.

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.

Figure 1. Transmitted-light image of representative zircons from sample 178106: basaltic andesite, White Horse Well

Recommended reference for this publication

Wingate, MTD, Bodorkos, S, and Kirkland, CL, 2008, 178106: basaltic andesite, White Horse Well; Geochronology dataset 731, *in* Compilation of geochronology data: Geological Survey of Western Australia.

Data obtained: 22 August 2006
Data released: 31 July 2008

Table 1. Ion microprobe analytical results for zircons from sample 178106: basaltic andesite, White Horse Well

Grp no.	*Spot no.*	*Grain .spot*	^{238}U *(ppm)*	^{232}Th *(ppm)*	$^{232}Th/^{238}U$	*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 (%)*
1	1	1.1	194	115	0.61	0.098	1.890 ± 0.024	0.19210 ± 0.00072	1.892 ± 0.024	0.19122 ± 0.00078	2735 ± 29	2753 ± 7	0.6
1	4	4.1	188	125	0.68	0.084	1.933 ± 0.025	0.19142 ± 0.00073	1.934 ± 0.025	0.19067 ± 0.00076	2686 ± 28	2748 ± 7	2.2
1	13	2.2	162	102	0.65	0.030	1.899 ± 0.025	0.19087 ± 0.00075	1.900 ± 0.025	0.19060 ± 0.00077	2726 ± 29	2747 ± 7	0.8
1	16	15.1	328	235	0.74	0.009	1.861 ± 0.023	0.19024 ± 0.00053	1.862 ± 0.023	0.19017 ± 0.00053	2772 ± 28	2744 ± 5	–1.0
1	6	6.1	272	236	0.90	0.126	1.941 ± 0.026	0.19111 ± 0.00061	1.944 ± 0.026	0.18999 ± 0.00066	2676 ± 30	2742 ± 6	2.4
1	11	11.1	233	143	0.63	0.030	1.869 ± 0.024	0.19021 ± 0.00063	1.869 ± 0.024	0.18995 ± 0.00066	2762 ± 28	2742 ± 6	–0.8
1	3	3.1	248	206	0.86	0.068	1.955 ± 0.028	0.19053 ± 0.00072	1.957 ± 0.028	0.18993 ± 0.00075	2661 ± 31	2742 ± 7	2.9
1	9	9.1	418	405	1.00	0.009	1.875 ± 0.023	0.18977 ± 0.00056	1.875 ± 0.023	0.18969 ± 0.00057	2755 ± 27	2739 ± 5	–0.6
2	2	2.1	198	114	0.60	0.043	1.943 ± 0.025	0.19317 ± 0.00072	1.944 ± 0.025	0.19279 ± 0.00074	2675 ± 28	2766 ± 6	3.3
2	5	5.1	246	161	0.68	0.015	1.911 ± 0.024	0.19235 ± 0.00064	1.911 ± 0.024	0.19222 ± 0.00065	2713 ± 28	2761 ± 6	1.7
3	8	8.1	294	249	0.87	0.047	1.984 ± 0.025	0.18785 ± 0.00058	1.985 ± 0.025	0.18743 ± 0.00060	2630 ± 27	2720 ± 5	3.3
3	7	7.1	456	458	1.04	0.080	1.957 ± 0.025	0.18570 ± 0.00046	1.959 ± 0.025	0.18498 ± 0.00049	2659 ± 28	2698 ± 4	1.5
3	14	13.1	551	449	0.84	0.034	1.994 ± 0.024	0.18430 ± 0.00041	1.995 ± 0.024	0.18400 ± 0.00042	2620 ± 26	2689 ± 4	2.6
3	12	12.1	253	201	0.82	0.048	2.126 ± 0.027	0.18282 ± 0.00061	2.127 ± 0.027	0.18239 ± 0.00064	2484 ± 26	2675 ± 6	7.1
3	15	14.1	334	331	1.02	0.064	2.024 ± 0.025	0.18217 ± 0.00052	2.026 ± 0.025	0.18160 ± 0.00057	2587 ± 26	2668 ± 5	3.0
3	10	10.1	309	272	0.91	0.042	2.187 ± 0.027	0.18063 ± 0.00057	2.188 ± 0.027	0.18026 ± 0.00058	2427 ± 25	2655 ± 5	8.6

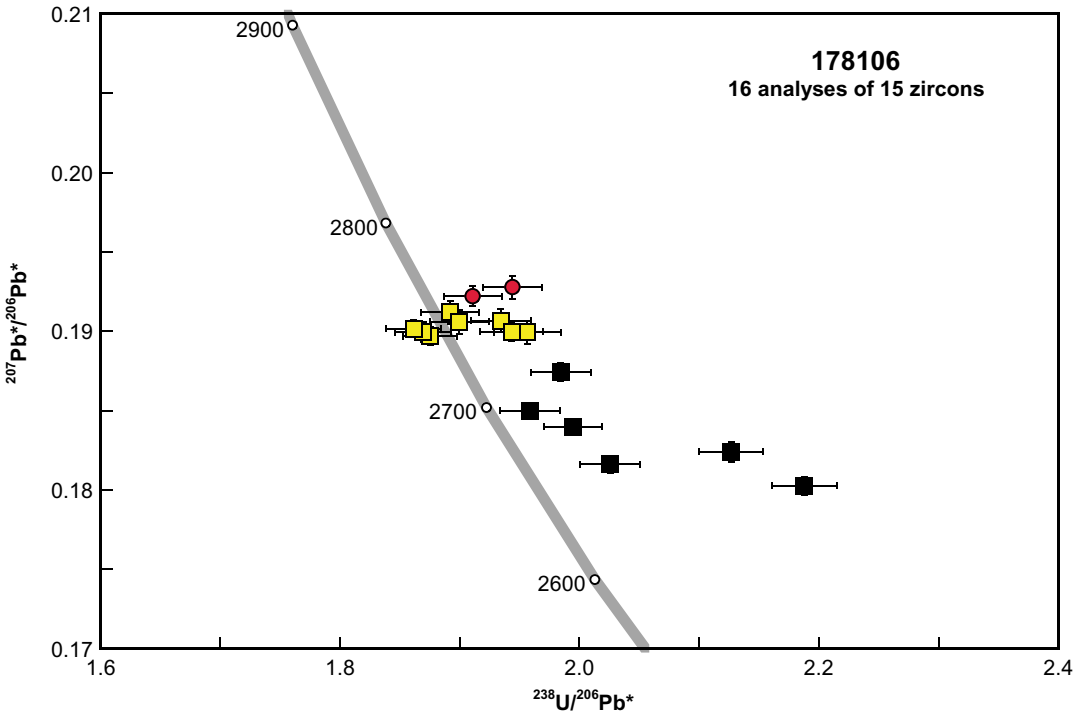

Figure 2. **U–Pb analytical data for sample 178106: basaltic andesite, White Horse Well. Yellow squares indicate Group 1 (magmatic zircons); red circles indicate Group 2 (possible xenocrystic material); black squares indicate Group 3 (radiogenic Pb loss)**