203703: metarhyolite, Golden Grove mine

(Golden Grove Member, Gossan Hill Formation, Murchison Supergroup, Murchison Domain, Youanmi Terrane, Yilgarn Craton)

Location and sampling

YALGOO (SG 50-2), BADJA (2240)
MGA Zone 50, 496131E 6816811N

Sampled on 18 December 2012

This sample was collected from the 506.40 – 509.40 m depth interval of diamond drillhole G12/501, at MMG's Golden Grove copper–lead–zinc mine, located about 230 km east of Geraldton and 56 km southeast of Yalgoo. The drillhole is located on the west side of a track, about 4.1 km northeast of Minjar Well, 2.4 km north-northeast of Minjar Hill, and 2.2 km southwest of the southeast end of Golden Grove airstrip.

Tectonic unit/relations

The unit sampled is a metarhyolite assigned to the Golden Grove Member of the Gossan Hill Formation of the Murchison Supergroup (Van Kranendonk et al., 2013). The 3000–2700 Ma Murchison Supergroup consists mainly of metabasalt, felsic metavolcanic and metavolcaniclastic rocks, and clastic and chemical metasedimentary rocks (Van Kranendonk et al., 2013). The 2963–2947 Ma Gossan Hill Formation consists of rhyolitic to dacitic metavolcanic and metavolcaniclastic rocks, locally hosting economic massive sulfide mineralization (e.g. Sharpe and Gemmell, 2001). Volcanic rocks of the Gossan Hill Formation were coeval with metatonalite and metagranodiorite of the 2964–2945 Ma Bunnawarra Suite, which consists of deformed rafts within plutons of the c. 2750 Ma Rothsay Suite of the 2820–2735 Ma Annean Supersuite (Van Kranendonk et al., 2013; Chen et al., in prep.). The Gnows Nest Granodiorite of the Thundelarra Suite intrudes the base of the Gossan Hill Formation and may be subvolcanic to the Scuddles Member (Chen et al., in prep.). The Golden Grove Member consists of metarhyodacite, metarhyolite, and laminated felsic metavolcaniclastic rocks. Within the Gossan Hill Formation, the Golden Grove Member underlies felsic metavolcanic rocks of the Scuddles Member and overlies felsic metavolcanic rocks of the Gossan Valley Member. Metadacite of the overlying Scuddles Member, sampled at approximately 804–809 m depth in drillhole G12/501, yielded a crystallization age of 2962 ± 4 Ma (GSWA 203702, Wingate et al., 2015a). A metarhyolite of the underlying Gossan Valley Member, sampled at approximately 8–10 m depth in drillhole G12/501, yielded a crystallization age of 2959 ± 5 Ma (GSWA 203704, Wingate et al., 2015b).

Petrographic description

The sample is a metarhyolite, and consists mainly of a strongly foliated assemblage of micro- to cryptocrystalline quartz (mostly <0.02 mm) intergrown with aligned sericite (mostly <0.05 mm). Minor to trace components include possible sillimanite, chloritoid, clinozoisite, epidote, and iron–titanium oxide minerals. Clouded pseudomorphs and irregular aggregates may represent unidentified deformed and recrystallized components.

Zircon morphology

Only 10 zircons were isolated from this sample, and they are colourless and anhedral to subhedral. The crystals are up to 300 µm long, and equant to slightly elongate, with aspect ratios up to 4:1. In cathodoluminescence (CL) images, concentric zoning is ubiquitous, and one zircon exhibits sector zoning. A CL image of all zircons is shown in Figure 1.

Analytical details

This sample was analysed on 31 May – 1 June 2013, using SHRIMP-B, and 10–11 June 2013, using SHRIMP-A. Analyses 1.1 to 8.1 (spot numbers 1–10) were obtained during the first session, together with 11 analyses of the BR266 standard, of which eight analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.55% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.26% (1σ). Isotopic mass fractionation of $^{207}Pb/^{206}Pb$ ratios during the first session was corrected by reference to the OGC1 standard; measured ratios were increased by 0.71%. Analyses 1.2 to 7.2 (spot numbers 11–15) were obtained during the second session, together with 12 analyses of the BR266 standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.20% (1σ). Isotopic mass fractionation of $^{207}Pb/^{206}Pb$ ratios during the second session was corrected by reference to the OGC1 standard; measured ratios were increased by 0.24%. 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 isotopic compositions determined according to the model of Stacey and Kramers (1975).

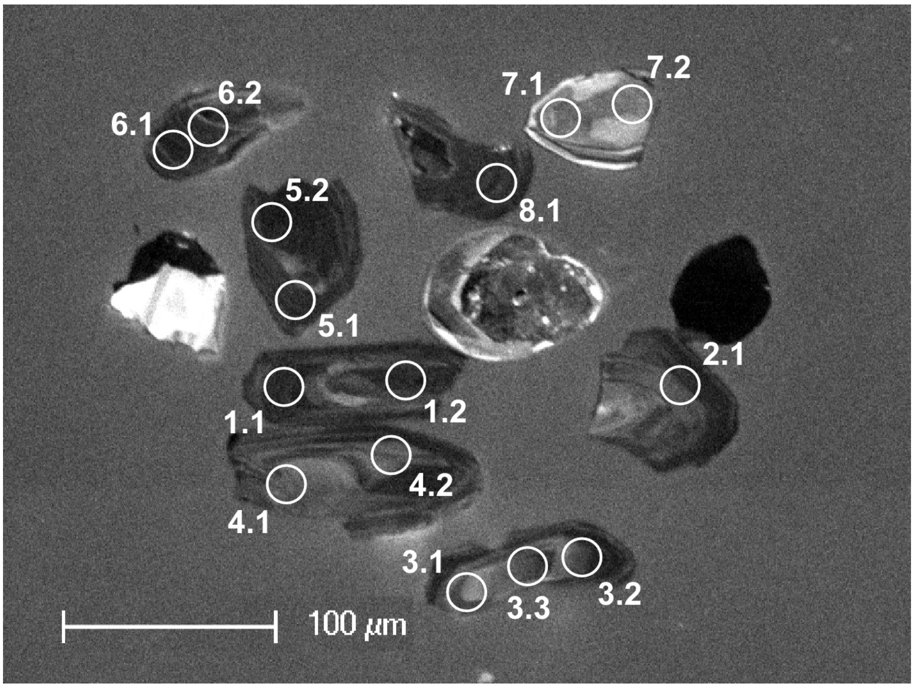

Figure 1. **Cathodoluminescence image of zircons from sample 203703: metarhyolite, Golden Grove mine. Numbered circles indicate the approximate positions of analysis sites.**

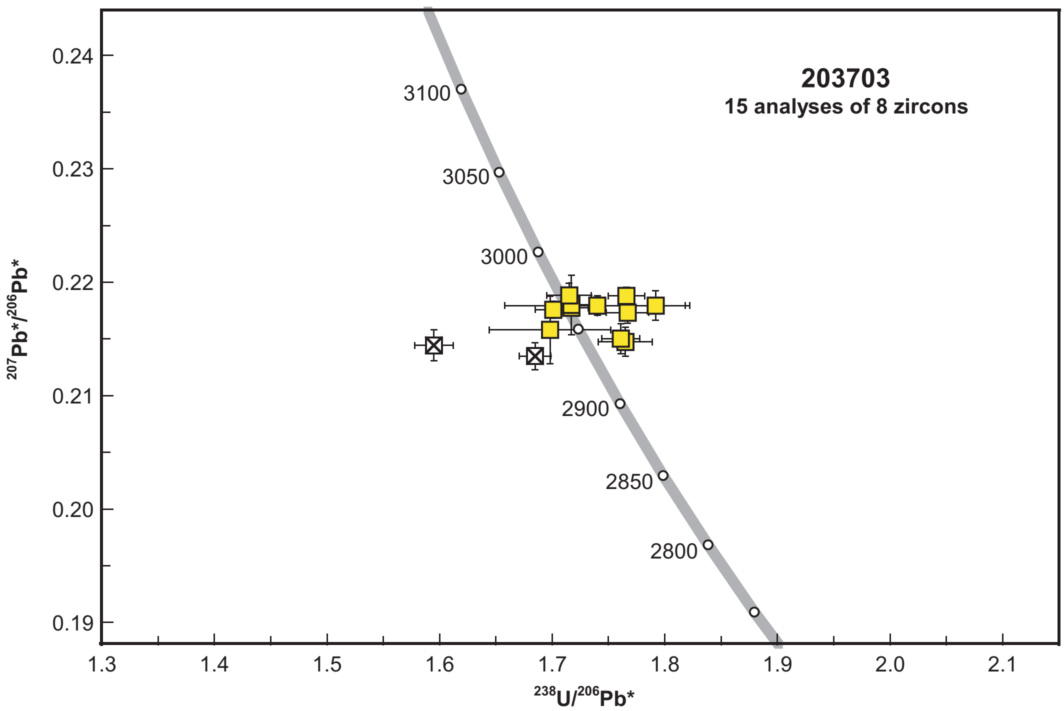

Figure 2. **U–Pb analytical data for sample 203703: metarhyolite, Golden Grove mine. Yellow squares indicate Group I (magmatic zircons); crossed squares indicate Group D (discordance >5% or instrument instability). One analysis in Group D and one in Group Z (processing contaminant) are not shown.**

Table 1. Ion microprobe analytical results for zircons from sample 203703: metarhyolite, Golden Grove mine

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}Th}{^{238}U}$	f204 (%)	$^{238}U/^{206}Pb$	$\pm 1\sigma$	$^{207}Pb/^{206}Pb$	$\pm 1\sigma$	$^{238}U/^{206}Pb^*$	$\pm 1\sigma$	$^{207}Pb^*/^{206}Pb^*$	$\pm 1\sigma$	$^{238}U/^{206}Pb^*$ date (Ma)	$\pm 1\sigma$	$^{207}Pb^*/^{206}Pb^*$ date (Ma)	$\pm 1\sigma$	Disc. (%)
I	4	4.1	110	29	0.27	0.152	1.762	0.024	0.21608	0.00123	1.765	0.024	0.21473	0.00129	2894	32	2942	10	1.6
I	14	3.3	165	60	0.38	0.081	1.759	0.017	0.21575	0.00132	1.761	0.017	0.21502	0.00134	2899	23	2944	10	1.5
I	11	5.2	661	432	0.68	0.011	1.697	0.054	0.21589	0.00298	1.698	0.054	0.21579	0.00298	2986	78	2950	22	-1.2
I	5	5.1	243	95	0.40	0.040	1.766	0.019	0.21766	0.00091	1.767	0.019	0.21731	0.00092	2891	26	2961	7	2.4
I	8	8.1	408	138	0.35	0.026	1.700	0.016	0.21782	0.00075	1.701	0.016	0.21758	0.00075	2981	22	2963	6	-0.6
I	6	6.1	526	284	0.56	0.008	1.717	0.015	0.21781	0.00069	1.717	0.015	0.21774	0.00069	2959	20	2964	5	0.2
I	10	4.2	269	172	0.66	0.011	1.739	0.082	0.21803	0.00087	1.740	0.082	0.21793	0.00087	2928	116	2965	6	1.2
I	7	7.1	94	59	0.64	-0.016	1.792	0.026	0.21779	0.00130	1.792	0.026	0.21794	0.00131	2859	34	2966	10	3.6
I	1	1.1	352	177	0.52	-0.009	1.717	0.016	0.21791	0.00262	1.717	0.016	0.21799	0.00262	2959	23	2966	19	0.2
I	3	3.1	427	175	0.42	-0.004	1.766	0.016	0.21876	0.00073	1.766	0.016	0.21879	0.00074	2893	21	2972	5	2.7
I	9	3.2	171	53	0.32	0.097	1.713	0.020	0.21969	0.00107	1.715	0.020	0.21883	0.00110	2961	28	2972	8	0.4
Z	2	2.1	334	74	0.23	0.022	3.033	0.030	0.11498	0.00240	3.033	0.030	0.11479	0.00241	1837	16	1877	38	2.1
D	12	6.2	308	197	0.66	0.009	1.685	0.014	0.21355	0.00120	1.685	0.014	0.21347	0.00120	3004	20	2932	9	-2.4
D	13	7.2	150	90	0.62	0.047	1.594	0.017	0.21485	0.00135	1.595	0.017	0.21443	0.00137	3138	26	2939	10	-6.8
D	15	1.2	1291	893	0.71	0.008	1.235	0.008	0.21938	0.01448	1.235	0.008	0.21931	0.01448	3824	20	2976	106	-28.5

Results

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

Interpretation

The analyses are concordant to strongly discordant (Fig. 2). Two analyses are >5% discordant, and one analysis was obtained during a period of instrument instability. The dates obtained from these three analyses (Group D, Table 1) are unreliable, and are considered not to be geologically significant. The remaining 12 analyses can be divided into two groups, based on their $^{207}Pb^{*}/^{206}Pb^{*}$ ratios.

Group I comprises 11 analyses of seven zircons (Table 1), which yield a weighted mean $^{207}Pb^{*}/^{206}Pb^{*}$ date of 2963 ± 6 Ma (MSWD = 1.4).

Group Z comprises one analysis (Table 1), which yields a $^{207}Pb^{*}/^{206}Pb^{*}$ date of 1877 ± 38 Ma (1σ).

The date of 2963 ± 6 Ma for the 11 analyses in Group I is interpreted as the magmatic crystallization age of the rhyolite protolith. The date of 1877 ± 38 Ma (1σ) for the single analysis in Group Z is interpreted as the age of a contaminant zircon introduced during laboratory processing.

References

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Recommended reference for this publication

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