182464: granodiorite gneiss, Splinter prospect

(Biranup Zone, Albany–Fraser Orogen)

Location and sampling

Norseman (SI 51-2), Mount Andrew (3432)
MGA Zone 51, 478406E 6351491N

Sampled on 16 August 2010

This sample was collected from the 391.8 – 392.7 m depth interval of diamond drillcore NSD001, an exploration hole drilled in 2006 at the Splinter prospect by Azure Minerals Ltd. The drillhole is located about 58 km east-northeast of Dingo Rock, 43.5 km north of Mount Beaumont, and 36.6 km south-southwest of Mount Andrew.

Tectonic unit/relations

The unit sampled is a granodiorite gneiss of the Biranup Zone, which is dominated by strongly deformed orthogneiss, with lesser amounts of metagabbroic and hybrid rocks that range in age from c. 1810 to 1625 Ma (Spaggiari et al., 2011). The Biranup Zone flanks the entire southern and southeastern margin of the Yilgarn Craton and includes isolated remnants of Archean granite with Yilgarn Craton affinity (Spaggiari et al., 2011). Isotopic and geochemical characteristics of Paleoproterozoic intrusive rocks indicate a direct association with the Yilgarn Craton during their emplacement (Smithies et al., 2015). In drillcore NSD001, mafic to intermediate gneiss (Splinter Gneiss) lies above and is in contact at 338.5 m with coarse-grained granitic gneiss, of which this sample is representative. The granitic gneiss makes up the lower portion of the hole to a total depth of 420 m, and contains a strong gneissic fabric that is locally boudinaged, and cut by pegmatite veins. Samples from higher in this drillcore include a metagabbro that yielded a crystallization age of 1276 ± 6 Ma (GSWA 182462, Wingate et al., 2016b), and a metatonalite that yielded a crystallization age of 1156 ± 5 Ma (GSWA 182459, Wingate et al., 2016a). Zircons in sample GSWA 182462 are overgrown by metamorphic rims that provided an age for high-grade metamorphism of 1163 ± 17 Ma (Wingate et al., 2016b). A similar age of 1178 ± 6 Ma was determined for crystallization of gabbro in drillcore NSD002, located about 1.0 km to the northeast (GSWA 182465, Wingate et al., 2016c).

Petrographic description

The sample is a granodiorite gneiss (Fig. 1), consisting of about 40% quartz, 35% plagioclase, 10% K-feldspar, 10% biotite and hornblende, minor granophyre, and accessory opaque oxide minerals, apatite, and zircon. Quartz grains are anhedral, and form elongate ribbons up to 5 mm long parallel to the foliation. Plagioclase (andesine, An_{35}) is subhedral, up to 1 mm long, transparent, and well twinned. K-feldspar (microcline) is anhedral, up to 1 mm across, and interstitial to plagioclase. Biotite, amphibole, and iron oxide minerals commonly occur as aggregates, and flakes of brown biotite, about 0.2 – 0.5 mm long, define a moderate foliation. Green pleochroic amphibole is partially replaced and overgrown by biotite.

Zircon morphology

Zircons isolated from this sample are colourless to dark brown, mainly subhedral, and variably rounded. The crystals are up to 450 μm long, and equant to elongate, with aspect ratios up to 6:1. In cathodoluminescence (CL) images, most zircons exhibit concentric zoning, and many crystals are overgrown by homogeneous, high-uranium rims. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 13–14 March 2014, using SHRIMP-B. Fifteen analyses of the BR266 standard were obtained during the session, of which 11 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.13% (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 isotopic compositions determined according to the model of Stacey and Kramers (1975).

Results

Twenty-three analyses were obtained from 22 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3).

Interpretation

The analyses are concordant to moderately 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

Figure 1. **Drillcore photograph for sample 182464: granodiorite gneiss, Splinter prospect.**

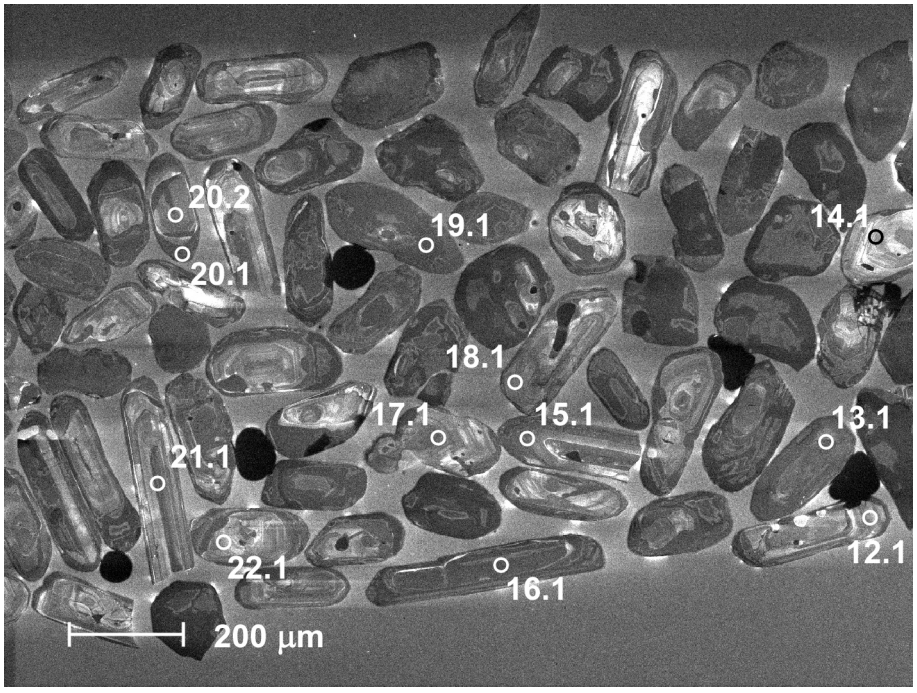

Figure 2. **Cathodoluminescence image of representative zircons from sample 182464: granodiorite gneiss, Splinter prospect. Numbered circles indicate the approximate locations of analysis sites.**

Table 1. Ion microprobe analytical results for zircons from sample 182464: granodiorite gneiss, Splinter prospect

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}Th}{^{238}U}$	$f204$ (%)	$^{238}U/^{206}Pb$ ± 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. (%)
I	12	12.1	116	52	0.46	0.936	3.482	0.038	0.10806	0.00087	3.515	0.038	0.09996	0.00174	1614	16	1623	32	0.6
I	17	17.1	276	141	0.53	0.107	3.442	0.030	0.10230	0.00059	3.446	0.030	0.10138	0.00067	1642	13	1650	12	0.4
I	5	5.1	927	172	0.19	0.009	3.439	0.022	0.10190	0.00030	3.439	0.022	0.10182	0.00030	1645	10	1658	6	0.7
I	4	4.1	464	383	0.85	0.006	3.456	0.026	0.10216	0.00043	3.456	0.026	0.10211	0.00043	1638	11	1663	8	1.5
I	21	20.2	396	91	0.24	0.026	3.416	0.092	0.10247	0.00051	3.416	0.092	0.10224	0.00053	1655	40	1665	10	0.6
I	16	16.1	1398	267	0.20	0.002	3.479	0.066	0.10232	0.00103	3.479	0.066	0.10230	0.00103	1629	28	1666	19	2.3
I	23	22.1	139	73	0.54	0.108	3.375	0.037	0.10336	0.00081	3.378	0.037	0.10242	0.00091	1671	16	1669	16	-0.2
I	22	21.1	549	304	0.57	0.092	3.225	0.024	0.10330	0.00040	3.228	0.024	0.10251	0.00044	1740	11	1670	8	-4.2
I	14	14.1	106	57	0.56	-0.214	3.329	0.039	0.10072	0.00087	3.322	0.039	0.10257	0.00109	1697	18	1671	20	-1.5
I	8	8.1	126	76	0.63	0.023	3.203	0.037	0.10285	0.00083	3.203	0.037	0.10265	0.00086	1751	18	1673	15	-4.7
I	7	7.1	168	84	0.52	0.031	3.351	0.033	0.10333	0.00067	3.352	0.033	0.10307	0.00070	1683	15	1680	12	-0.2
I	11	11.1	1613	653	0.42	0.000	3.401	0.021	0.10309	0.00107	3.401	0.021	0.10309	0.00107	1662	9	1680	19	1.1
I	15	15.1	224	109	0.50	0.081	3.464	0.128	0.10385	0.00064	3.467	0.128	0.10315	0.00070	1634	55	1682	13	2.8
I	18	18.1	226	102	0.46	0.125	3.464	0.113	0.10515	0.00070	3.468	0.113	0.10406	0.00080	1633	48	1698	14	3.8
X	2	2.1	204	104	0.52	-0.079	3.367	0.032	0.10483	0.00069	3.365	0.032	0.10551	0.00076	1677	14	1723	13	2.7
M	13	13.1	223	5	0.02	0.144	5.046	0.050	0.08010	0.00065	5.053	0.050	0.07889	0.00080	1164	11	1169	20	0.5
M	6	6.1	2306	65	0.03	0.010	5.053	0.030	0.07916	0.00021	5.054	0.030	0.07907	0.00021	1164	6	1174	5	0.9
M	9	9.1	951	32	0.04	0.066	5.003	0.033	0.07980	0.00031	5.007	0.033	0.07925	0.00035	1174	7	1178	9	0.4
M	3	3.1	927	6	0.01	0.020	5.067	0.033	0.07968	0.00032	5.068	0.033	0.07951	0.00033	1161	7	1185	8	2.0
M	19	19.1	1840	88	0.05	0.005	5.001	0.030	0.08001	0.00023	5.001	0.030	0.07997	0.00023	1175	7	1196	6	1.8
M	10	10.1	1804	30	0.02	0.000	4.957	0.083	0.08019	0.00023	4.957	0.083	0.08019	0.00023	1185	18	1202	6	1.4
M	20	20.1	689	2	0.00	0.000	5.066	0.166	0.08084	0.00044	5.066	0.166	0.08084	0.00044	1161	36	1218	11	4.6
D	1	1.1	325	204	0.65	-0.069	3.710	0.032	0.10040	0.00216	3.708	0.032	0.10100	0.00218	1539	12	1643	40	6.3

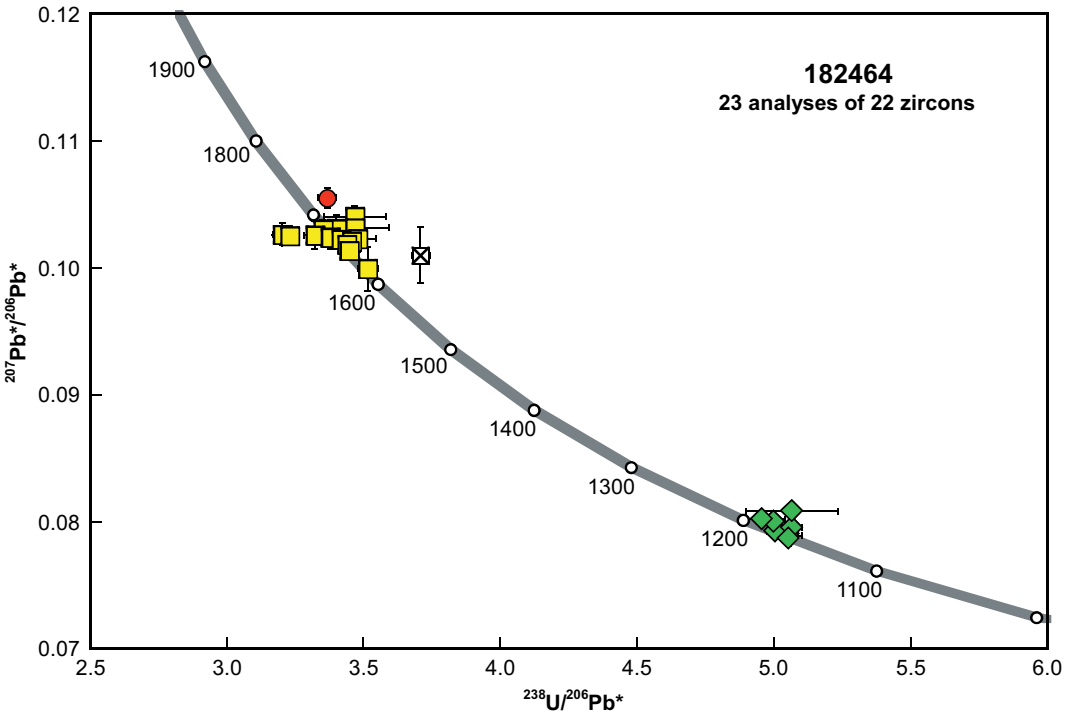

Figure 3. U–Pb analytical data for sample 182464: granodiorite gneiss, Splinter prospect. Yellow squares indicate Group I (magmatic zircon cores); red circle indicates Group X (xenocrystic zircon core); green diamonds indicate Group M (metamorphic zircon rims); crossed squares indicate Group D (discordance >5%).

significant. The remaining 22 analyses can be divided into three groups, based on their $^{207}Pb^*/^{206}Pb^*$, $^{238}U/^{206}Pb^*$ and Th/U ratios, and positions within the crystals.

Group I comprises 14 analyses of 14 zircon cores (Table 1), which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 1666 ± 6 Ma (MSWD = 1.2). These analyses indicate moderate Th/U ratios (median 0.51).

Group M comprises seven analyses of seven zircon rims (Table 1), which yield a weighted mean $^{238}U/^{206}Pb^*$ date of 1168 ± 6 Ma (MSWD = 0.72). These analyses indicate very low Th/U ratios (median 0.02).

Group X comprises one analysis of a zircon core (Table 1), which yields a $^{207}Pb^*/^{206}Pb^*$ date of 1723 ± 13 Ma (1σ).

The date of 1666 ± 6 Ma for the 14 analyses in Group I is interpreted as the magmatic crystallization age of the granodiorite. The date of 1168 ± 6 Ma for the seven analyses in Group M is interpreted as the age of high-grade metamorphism. The date of 1723 ± 13 Ma (1σ) for the single analysis in Group X is interpreted as the age of an inherited component.

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Recommended reference for this publication

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