203749: altered granitic rock, Aileron prospect

(Aileron Province, North Australian Craton)

Location and sampling

Webb (SF 52-10), Dwarf Well (4553)
MGA Zone 52, 424990E 7547147N

Sampled on 23 Februaury 2022

This sample was collected from the 91.10 – 93.55 m depth interval of diamond drillcore EAL001, drilled in 2020 by Encounter Resources Limited at their Aileron prospect (Hendrickson, 2021), with support from the Western Australian Government's Exploration Incentive Scheme (EIS). The drillhole is located west of Lake Mackay in the Great Sandy Desert, about 88 km northeast of Kiwirrkurra community, 85 km north of Mount Webb, and 53 km southeast of Carnegie Bluff.

Geological context

The unit sampled is an altered granitic rock within crystalline basement in the Aileron Province of the North Australian Craton (Kelsey et al., 2021). Drillhole EAL001 targeted a discrete, concentric magnetic anomaly, to test prospectivity for iron oxide–copper–gold (IOCG) or Tennant Creek style gold–copper mineralization (Hendrickson, 2021). The drillhole intersected mainly hematite-altered granitic rocks that are intruded by minor mafic intrusive rocks and overlie banded iron-formation (Hendrickson, 2021). The present sample was collected from hematite-altered granitic rocks to determine their igneous crystallization age. Detrital zircons from a quartzite about 7.4 km to the southwest yielded a conservative maximum depositional age of 1775 ± 7 Ma (GSWA 184341, Kirkland et al., 2009a). Zircons from a siliciclastic schist about 13.5 km to the south-southwest in drillcore RDD01 yielded a conservative maximum depositional age of 1802 ± 7 Ma and an age of 1586 ± 8 Ma for high-grade metamorphism (GSWA 243061, Wingate et al., 2022). About 25 km to the west-southwest, a metagranodiorite of the Dwarf Well Granite, assigned to the 1779–1767 Ma Carrington Suite (Scrimgeour, 2013; Spaggiari and Kelsey, 2022), yielded an igneous crystallization age of 1773 ± 6 Ma (GSWA 184367, Kirkland et al., 2009b).

Petrographic description

The sample is a brecciated, altered granitic rock (Fig. 1). The petrographic description for this sample is based on examination of similar rocks at 82.4 m and 98.4 m depth in this drillcore. The rock is composed mainly of granitic fragments, which consist of medium-grained, crystalline aggregates of microperthitic orthoclase, quartz, minor sodic plagioclase, and minor muscovite and biotite (typically chlorite-altered), and accessory rutile, magnetite, pyrite, and titanite. Feldspars are variably altered by fine clay minerals and sericite, and weak clay–sericite alteration has selectively affected plagioclase lamellae in microperthite. Some orthoclase crystals, up to 2 mm in size, contain rounded plagioclase inclusions, indicating that the granitic rock is subsolvus. Areas of fine-grained albitic alteration are also present. Material between granitic fragments consists of milled, fine-grained granitic material and significant chlorite, with hydrothermal quartz, muscovite flakes, minor epidote and significant Fe-staining. Rare crystals of probable former pyrite up to 0.15 mm in size are replaced by goethite and other Fe-hydroxide minerals. Chlorite is locally coarse grained and also occurs in veinlets, suggesting the breccia has been altered hydrothermally.

Zircon morphology

Zircons isolated from this sample are mainly colourless, anhedral to euhedral, and variably rounded. The crystals are up to 350 µm long, and equant to elongate, with aspect ratios up to 6:1. In cathodoluminescence (CL) images, most zircons are concentrically zoned, and many are overgrown by very thin, metamict zircon rims. A few crystals consist mainly of high-U, non-zoned zircon, and either do not contain cores or contain only small vestigial zoned cores. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 21–22 April and 12 May 2022, using SHRIMP-B. Analyses 1.1 to 20.1 (spot numbers 1–20) were obtained during the first session, together with 13 analyses of the M257 standard, of which 12 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.20% (1σ). Analyses 21.1 to 25.1 (spot numbers 21–25) were obtained during the second session, together with three analyses of the M257 standard, of which two analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.68% (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).

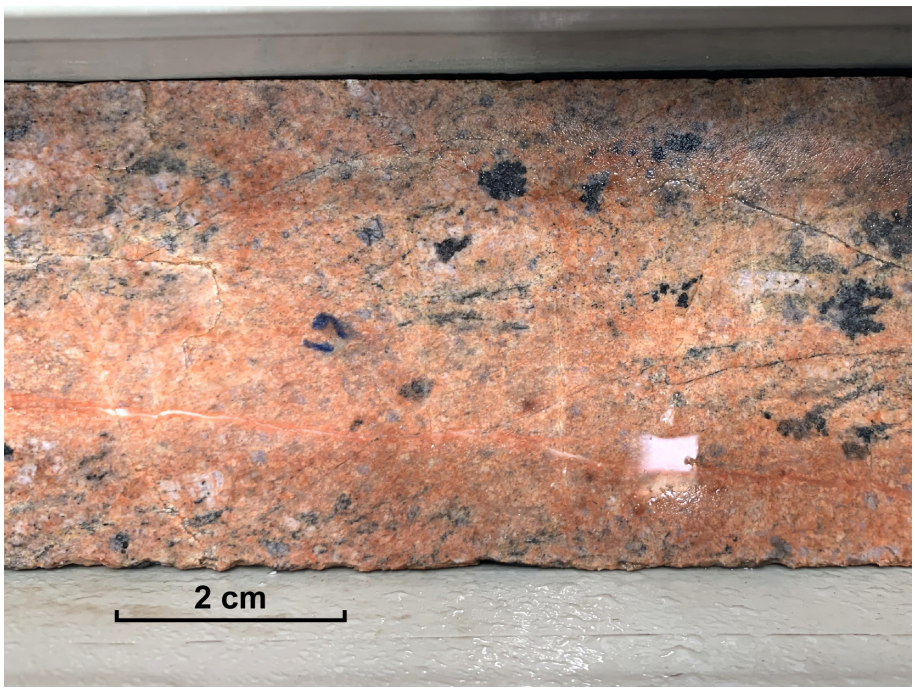

Figure 1. **Drillcore image (wet surface) of sample 203749: altered granitic rock, Aileron prospect**

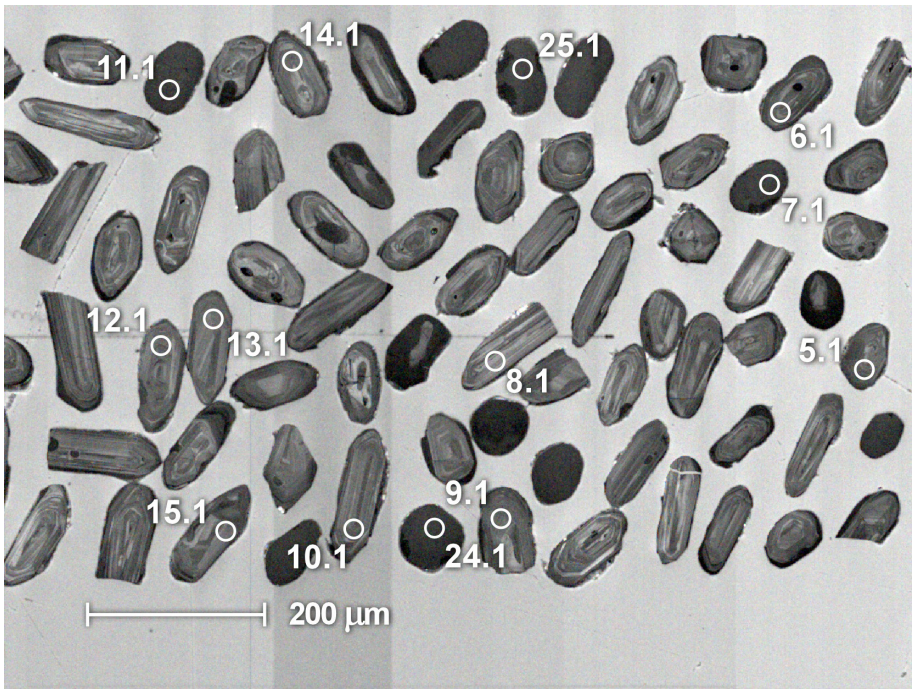

Figure 2. **Cathodoluminescence image of representative zircons from sample 203749: altered granitic rock, Aileron prospect. Numbered circles indicate the approximate locations of analysis sites**

Table 1. Ion microprobe analytical results for zircons from sample 203749: altered granitic rock, Aileron 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	6	6.1	445	368	0.83	0.007	3.531	0.025	0.09783	0.00072	3.531	0.025	0.09777	0.00072	1607	10	1582	14	-1.6
I	3	3.1	359	223	0.62	0.008	3.607	0.027	0.09856	0.00049	3.608	0.027	0.09849	0.00049	1577	11	1596	9	1.2
I	12	12.1	457	181	0.40	0.013	3.748	0.027	0.09880	0.00042	3.748	0.027	0.09869	0.00043	1525	10	1599	8	4.7
I	16	16.1	439	313	0.71	0.052	3.581	0.026	0.09929	0.00043	3.583	0.026	0.09884	0.00046	1587	10	1602	9	1.0
I	10	10.1	437	190	0.44	0.013	3.680	0.027	0.09905	0.00044	3.681	0.027	0.09893	0.00045	1549	10	1604	8	3.4
I	8	8.1	254	175	0.69	0.073	3.570	0.029	0.09956	0.00058	3.573	0.029	0.09893	0.00064	1591	11	1604	12	0.8
I	19	19.1	354	188	0.53	0.048	3.666	0.027	0.09961	0.00047	3.668	0.027	0.09920	0.00050	1554	10	1609	9	3.4
I	5	5.1	384	239	0.62	0.032	3.593	0.026	0.09953	0.00048	3.594	0.026	0.09925	0.00049	1582	10	1610	9	1.7
I	15	15.1	441	111	0.25	0.088	3.675	0.039	0.10042	0.00044	3.678	0.039	0.09966	0.00049	1550	15	1618	9	4.2
I	14	14.1	425	187	0.44	0.000	3.572	0.026	0.09974	0.00045	3.572	0.026	0.09974	0.00045	1591	10	1619	8	1.7
I	1	1.1	287	159	0.56	-0.022	3.602	0.029	0.09958	0.00056	3.601	0.029	0.09977	0.00057	1580	11	1620	11	2.5
I	17	17.1	408	218	0.54	-0.007	3.521	0.026	0.09993	0.00049	3.520	0.026	0.10000	0.00049	1612	10	1624	9	0.8
M	23	23.1	3338	41	0.01	-0.004	3.562	0.040	0.09674	0.00040	3.562	0.040	0.09678	0.00040	1595	17	1563	8	-2.1
M	11	11.1	3060	40	0.01	0.010	3.578	0.022	0.09728	0.00018	3.578	0.022	0.09719	0.00018	1589	9	1571	4	-1.1
M	4	4.1	2320	36	0.02	0.005	3.547	0.030	0.09727	0.00062	3.547	0.030	0.09722	0.00062	1601	12	1572	12	-1.9
M	21	21.1	2792	38	0.01	0.006	3.587	0.035	0.09737	0.00026	3.588	0.035	0.09732	0.00026	1585	15	1573	5	-0.7
M	25	25.1	3264	40	0.01	0.006	3.613	0.035	0.09764	0.00024	3.613	0.035	0.09759	0.00025	1575	15	1579	5	0.2
M	24	24.1	3750	52	0.01	-0.002	3.466	0.033	0.09762	0.00023	3.466	0.033	0.09763	0.00023	1634	15	1579	4	-3.5
M	20	20.1	3186	43	0.01	0.002	3.545	0.184	0.09805	0.00025	3.545	0.184	0.09803	0.00025	1602	74	1587	5	-0.9
M	7	7.1	2610	34	0.01	0.010	3.547	0.023	0.09851	0.00041	3.547	0.023	0.09842	0.00042	1601	9	1594	8	-0.4
P	2	2.1	386	132	0.34	-0.017	3.662	0.028	0.09727	0.00049	3.661	0.028	0.09742	0.00050	1557	11	1575	10	1.2
P	13	13.1	446	144	0.32	0.022	3.572	0.026	0.09777	0.00045	3.573	0.026	0.09758	0.00046	1591	10	1578	9	-0.8
P	9	9.1	503	241	0.48	0.006	3.484	0.038	0.09782	0.00041	3.484	0.038	0.09777	0.00042	1627	16	1582	8	-2.8
D	22	22.1	3374	54	0.02	0.003	3.341	0.039	0.09858	0.00023	3.341	0.039	0.09855	0.00023	1688	18	1597	4	-5.7
D	18	18.1	472	276	0.59	0.188	3.949	0.028	0.10045	0.00072	3.957	0.028	0.09882	0.00078	1453	9	1602	15	9.3

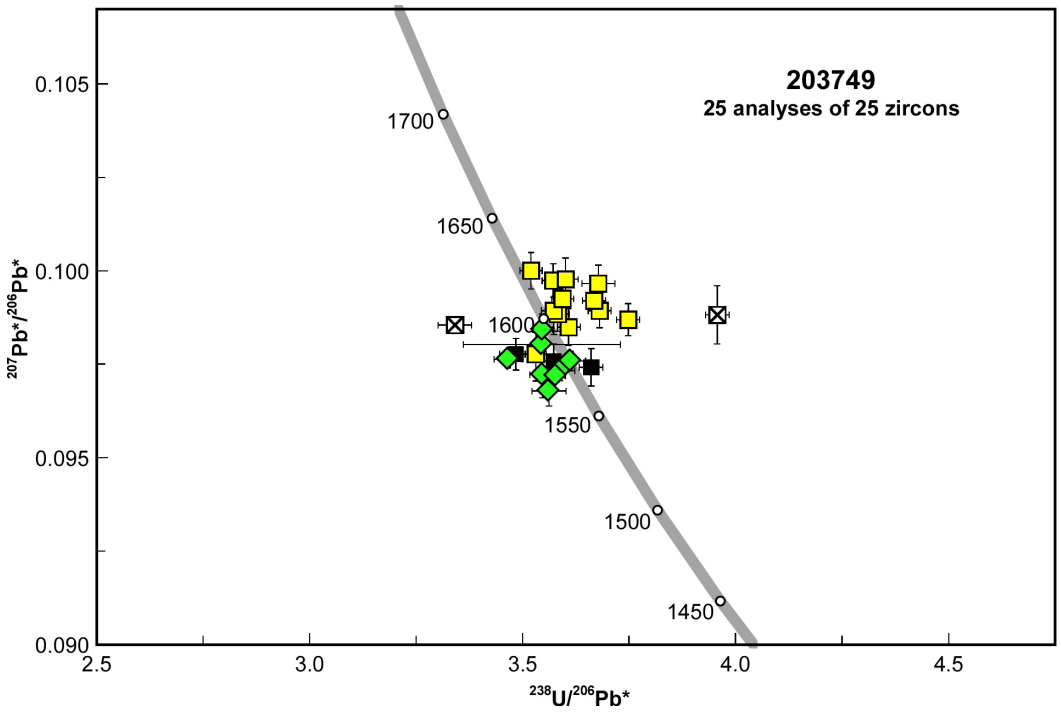

Figure 3. U–Pb analytical data for zircons from sample 203749: altered granitic rock, Aileron prospect. Yellow squares indicate Group I (magmatic zircon cores); green diamonds indicate Group M (metamorphic zircons); black squares indicate Group P (radiogenic-Pb loss from zircon cores); crossed squares indicate Group D (discordance >5%)

Results

Twenty-five analyses were obtained from 25 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). Two analyses are >5% discordant. The dates obtained from these two analyses (Group D; Table 1) are unreliable, and considered not to be geologically significant. The remaining 23 analyses can be divided into three groups, based on their $^{207}Pb^*/^{206}Pb^*$ and Th/U ratios, their U concentrations, and their locations within zoned or non-zoned zircons (Fig. 2).

Group I comprises 12 analyses of zoned zircons (Table 1), which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 1608 ± 7 Ma (MSWD = 1.3). These analyses indicate moderate U contents (254–457 ppm) and moderate Th/U ratios (0.25 – 0.83).

Group M comprises eight analyses of non-zoned zircons (Table 1), which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 1577 ± 7 Ma (MSWD = 2.4). These analyses indicate very high U contents (2320–3750 ppm) and very low Th/U ratios (0.012 – 0.016).

Group P comprises three analyses of three zoned zircons (Table 1), which yield $^{207}Pb^*/^{206}Pb^*$ dates of 1582–1575 Ma. These analyses indicate moderate U contents (132–241 ppm) and moderate Th/U ratios (0.32 – 0.48).

The date of 1608 ± 7 Ma for the 12 analyses in Group I is interpreted as the igneous crystallization age of the granitic rock.

The date of 1577 ± 7 Ma for the eight analyses in Group M is interpreted as the age of high-grade metamorphism or hydrothermal alteration. Minor reverse discordance of these analyses compared to those in Group I (Fig. 3) is interpreted to be the result of matrix effects related to their very high U contents.

The dates of 1582–1575 Ma for the three analyses in Group P are interpreted to reflect loss of radiogenic Pb during high-grade metamorphism or hydrothermal alteration.

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