4/6/08 (handwritten)

Geochronology Report: Age of Tropicana host syenite

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CL @ 22/10/1 (handwritten)

Samples:

Zircons were observed in polished thin sections of the following syenite samples:

- Sample 0805A = TPD 305 262-263m → MD 6 (handwritten)
- Sample 0805B = TPD 305 360.5-361.5m → = MD 7 (handwritten)

Zircons were separated by Minsep Laboratories and encased in epoxy resin with chips/grains of the zircon standards Temora2 and BR266. The mount (0805) was polished to expose grains in section and imaged by SEM in preparation for SHRIMP analysis.

The zircons from both samples are similar, typically in the 50-100 micron size range and generally rounded with an aspect ratio of 1.5-2.0. They show remnants of euhedral internal growth zoning in CL (cathodoluminescence) imaging, although most grains are uniformly dark in CL. These features are interpreted as igneous grains with relatively high U-content, leading to partial metamictisation.

SHRIMP analyses:

Zircons were analysed on 3/6/08, with U/Pb and U-content referenced to BR266 (559 Ma and 903 ppm U). Reproducibility of the U/Pb in the standard was 1.48% (2 sigma) from 14 analyses (no rejections). The data for both samples are presented in Table 1.

Table 1: Isotopic data for mount 0805.

Spot Name	ppm U	ppm Th	232Th/238U	% comm 206	207r/206r	+/- 1σ	207r/235	+/- 1σ	206r/238	+/- 1σ	206Pb/238U Age/Ma	+/- 1σ	207Pb/206Pb Age/Ma	+/- 1σ	Conc.
0805A															
1-1	344	64	0.19	0.15	.1785	.0006	12.09	0.11	.491	.004	2576	18	2639	6	98
2-1	496	116	0.24	0.00	.1778	.0005	12.39	0.11	.505	.004	2637	18	2632	4	100
2-1	1200	208	0.18	0.01	.1781	.0003	12.24	0.10	.498	.004	2607	17	2635	3	99
3-1*	1105	81	0.08	0.04	.1676	.0003	9.92	0.08	.429	.003	2302	15	2534	3	91
4-1	294	256	0.90	0.03	.1819	.0006	12.81	0.12	.511	.005	2660	19	2670	6	100
4-2	226	285	1.30	0.04	.1801	.0007	12.70	0.20	.511	.008	2663	34	2654	6	100
5-1	902	204	0.23	0.03	.1797	.0004	12.11	0.12	.489	.005	2566	20	2650	4	97
6-1	194	244	1.30	0.07	.1842	.0008	12.73	0.13	.501	.005	2619	20	2691	8	97
8-1	300	176	0.61	0.07	.1814	.0008	11.90	0.12	.476	.004	2509	18	2665	7	94
11-1*	1183	97	0.08	0.10	.1378	.0004	5.74	0.05	.302	.002	1701	12	2200	5	77
12-1	377	77	0.21	0.02	.1782	.0006	12.13	0.11	.494	.004	2587	18	2636	5	98
14-1*	1431	25	0.02	0.17	.1465	.0007	6.60	0.06	.327	.003	1824	12	2305	8	79
15-1*	245	6	0.03	0.82	.1717	.0012	10.86	0.13	.459	.004	2434	19	2574	12	95
16-1*	1228	75	0.06	0.14	.1397	.0004	5.87	0.05	.305	.002	1715	12	2224	5	77
19-1	348	65	0.19	0.33	.1778	.0013	11.49	0.13	.469	.004	2478	18	2632	13	94
20-1	724	130	0.19	0.01	.1796	.0004	12.14	0.10	.490	.004	2572	17	2649	4	97
0805B															
1-1	429	65	0.16	0.06	.1785	.0005	11.96	0.11	.486	.004	2554	18	2639	5	97
3-1	378	78	0.21	0.29	.1761	.0009	11.59	0.12	.477	.004	2516	19	2616	8	96
5-1	486	72	0.15	0.05	.1792	.0006	12.29	0.11	.497	.004	2602	18	2646	6	98
6-1	436	78	0.18	0.02	.1786	.0005	12.29	0.11	.499	.004	2610	18	2640	5	99
8-1	732	54	0.08	0.01	.1774	.0005	12.01	0.10	.491	.004	2575	17	2629	5	98

(Handwritten annotations in left margin: "(2-2)" pointing to row 2-1; "Xenos?" with bracket spanning rows 4-1 through 20-1.)

9-1	430	73	0.18	0.05	.1782	.0005	12.25	0.11	.499	.004	2608	18	2636	5	99
*10-1**	*1029*	*81*	*0.08*	*0.01*	*.1704*	*.0003*	*10.27*	*0.09*	*.437*	*.004*	*2338*	*16*	*2561* ×	*3*	*91*
11-1	341	67	0.20	0.21	.1777	.0007	12.07	0.11	.493	.004	2582	18	2632	7	98
12-1	348	230	0.68	0.02	.1805	.0005	12.36	0.11	.497	.004	2600	18	2657 ×	5	98

Th/U

* and italics: discordance >8% and/or common Pb > 0.5%. Conc. = concordance.

Interpretation:

Sixteen analyses of fifteen grains from 0805A resulted in eleven analyses with <8% discordance and low common Pb content (i.e. f206<0.5%). These eleven analyses showed a range of 207Pb/206Pb ages from 2691 to 2632 Ma (Fig. 1), indicative of a complex age inventory.
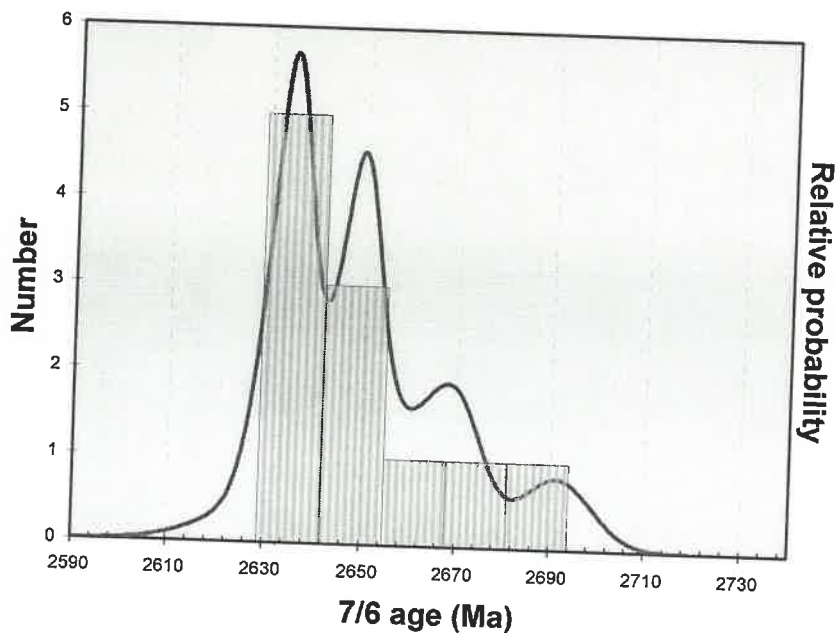

Figure 1: Probability density plot of concordant to near concordant 207Pb/206Pb ages from sample 0805A.

There was no discernible difference in morphology between the grains yielding different ages, although the older grains tended to have higher Th/U (i.e. 1.30-0.23 for grains 2691 to 2650 Ma in age, compared to 0.24-0.18 for grains 2649 Ma and younger). The MSWD (mean square of weighted deviates) for the eleven analyses is 9.3, whereas omitting the 3 older analyses reduces this to 3.3 (n = 8). This is still too large for a single-aged population, and omitting a further 3 older analyses is needed to lower the MSWD to below 1.0 (i.e. MSWD = 0.23 for n = 5). The age for this group is 2635+/-4 Ma (2 sigma), which is considered to be the formation age of the zircons. Considering the magmatic host rock of the zircons and their igneous morphology, this age is interpreted as the crystallisation age of the syenite, and older analyses are considered to be xenocrysts.

Nine analyses of 9 grains from 0805B resulted in 8 analyses with <8% discordance and low common Pb content (i.e. f206<0.5%). These 8 analyses showed a range of

207Pb/206Pb ages from 2657 to 2616 Ma (Fig. 2). Note that many analyses on grains in this sample were terminated after the first scan as the 204Pb-content was unacceptably high to obtain good data. This was a particular problem with this sample.
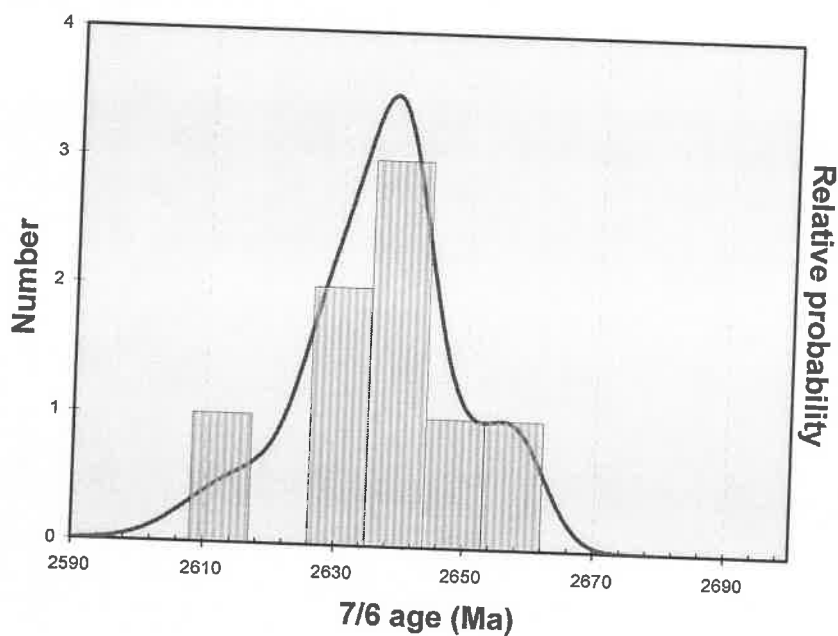

Figure 2: Probability density plot of concordant to near concordant 207Pb/206Pb ages from sample 0805B.

As with 0805A, there was no discernible difference in morphology between the grains yielding different ages. Also as with 0805A, the oldest grain had the highest Th/U (i.e. 0.68), whereas the remainder had Th/U ratios similar to the younger grains in 0805A (i.e. 0.21-0.08). The MSWD of the 8 analyses is 4.1. Omitting the youngest analysis as an obvious outlier (Fig. 2) and the oldest analysis reduces the MSWD to 1.4 (n = 6). This is slightly too high for a single-aged population, and omitting a further older analyses is needed to lower the MSWD to 1.0 (i.e. MSWD = 0.79 for n = 5). The age for this group is 2639+/-5 Ma (2 sigma), which is considered to be the formation age of the zircons.

The interpreted crystallization ages for 0805A and 0805B are identical within experimental error. Given their similarities in morphology and U-Th chemistry, together with their occurrence in the same drillhole about 1 metre apart, they are considered to have come from the same rock unit. Combining the data for both samples, omitting the one young outlier from 0805B and progressively culling older analyses until the MSWD approaches 1.0, a combined age of 2636+/-3 Ma is obtained (n = 11, MSWD = 0.83). This is interpreted as the crystallization age of the syenite. Older analyses are considered xenocrysts, or mixtures of xenocrysts and magmatic zircon. The youngest analysis and the discordant data are all considered to have suffered Pb-loss, almost certainly due to the relative high U(-Th) contents of the zircons, and the accumulated radiation damage to the zircons.