

Appendix 2

EPMA analyses of Monazite

All successful monazite analyses

Elements shown as weight%

“TOTAL” shown as weight% includes oxygen estimated by cation stoichiometry

“ $\sigma\%$ ” Relative analytical error (one $\sigma\%$) estimated from counting statistics, including on standards, shown for Pb, Th and U.

“ 1σ age” is the one σ error (Ma) in age based on propagating the analytical error through the age equations assuming normally distributed errors.

SAMPLE	Si	P	Ca	Fe	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Pb	Th	U	TOTAL	Pb σ%	Th σ%	U σ%	Age Ma	1σ age
R025293 Mnz 1	0.37	13.2	0.64	0.00	1.05	11.9	24.9	2.66	9.9	1.50	0.37	0.86	0.24	0.21	5.81	0.17	101.7	2.3	0.3	2.7	732	18
R025293 Mnz 1	0.42	12.9	0.75	0.00	1.14	11.3	24.0	2.66	9.8	1.51	0.35	0.83	0.25	0.25	6.63	0.20	100.3	2.0	0.2	2.3	762	16
R025293 Mnz 1	0.36	12.8	0.89	0.03	1.41	10.8	23.5	2.62	9.7	1.60	0.34	0.96	0.34	0.26	6.69	0.22	99.7	1.9	0.2	2.1	786	16
R025293 Mnz 1	0.20	13.1	0.12	0.01	0.41	13.7	28.0	3.00	10.8	1.63	0.43	0.92	0.15	0.02	1.42	0.02	101.4	20.7	0.6	19.1	325	67
R025293 Mnz 1	0.29	12.9	0.29	0.02	1.29	12.1	25.8	2.87	10.5	1.79	0.39	1.10	0.30	0.08	3.49	0.05	100.6	6.1	0.4	8.7	459	28
R025293 Mnz 2	0.11	13.1	0.31	0.03	0.97	13.2	26.8	2.86	10.3	1.52	0.42	1.10	0.28	0.09	1.98	0.18	100.8	5.4	0.5	2.6	746	40
R025293 Mnz 2	0.20	13.0	0.60	0.03	1.14	12.4	25.4	2.65	10.0	1.47	0.35	0.90	0.25	0.15	3.92	0.21	99.8	3.2	0.3	2.2	731	24
R025293 Mnz 2	0.38	12.7	0.24	0.01	0.67	12.8	26.4	2.82	10.3	1.53	0.36	0.94	0.20	0.14	3.83	0.09	100.5	3.5	0.3	5.1	733	26
R025293 Mnz 2	0.35	12.8	0.67	0.00	1.00	11.6	24.5	2.60	9.9	1.55	0.37	0.89	0.21	0.23	5.58	0.16	99.5	2.2	0.3	2.8	822	19
R025293 Mnz 2	0.26	12.8	0.76	0.05	1.28	11.9	24.8	2.66	9.8	1.48	0.35	0.90	0.28	0.21	5.09	0.21	100.0	2.4	0.3	2.2	783	19
R025293 Mnz 2	0.28	12.9	0.80	0.02	1.65	10.7	23.8	2.67	9.9	1.82	0.35	1.15	0.41	0.21	5.55	0.23	99.6	2.3	0.3	2.0	751	18
R025293 Mnz 3	0.27	12.9	0.11	0.06	0.43	13.0	27.0	3.01	10.8	1.96	0.49	1.32	0.24	0.06	1.99	0.03	100.9	7.9	0.5	16.0	623	49
R025293 Mnz 3	0.41	12.5	0.18	0.05	0.60	12.3	26.4	2.91	10.6	2.07	0.46	1.30	0.32	0.09	3.27	0.04	100.4	5.0	0.4	11.6	610	31
R025293 Mnz 3	0.35	12.7	0.16	0.07	0.26	13.3	27.7	2.89	10.4	1.51	0.42	0.95	0.18	0.07	2.85	0.02	100.8	6.7	0.4	21.3	530	35
R025293 Mnz 3	0.42	12.5	0.26	0.07	0.07	12.2	28.8	3.10	10.8	1.20	0.46	0.48	0.00	0.07	2.77	0.06	100.1	7.0	0.4	7.0	489	34
R025293 Mnz 4	0.33	12.7	0.76	0.02	1.23	11.3	24.5	2.65	9.9	1.60	0.36	0.96	0.28	0.21	5.81	0.18	100.0	2.4	0.3	2.6	724	18
R025293 Mnz 4	0.14	13.0	0.11	0.04	0.29	13.0	27.8	2.97	11.2	1.93	0.43	1.17	0.19	0.02	1.05	0.03	100.5	19.6	0.8	14.7	442	86
R025293 Mnz 4	0.28	12.8	0.84	0.02	1.18	11.8	25.1	2.65	9.5	1.47	0.33	0.79	0.25	0.20	4.91	0.20	99.4	2.4	0.3	2.3	785	20
R025293 Mnz 4	0.29	12.8	0.99	0.05	1.44	11.3	24.3	2.64	9.8	1.57	0.33	0.92	0.33	0.22	5.23	0.20	99.4	2.2	0.3	2.4	825	19
R025293 Mnz 4	0.38	12.6	0.50	0.10	0.66	12.4	25.7	2.71	9.9	1.48	0.35	1.09	0.28	0.16	4.69	0.10	100.2	3.0	0.3	4.5	710	22
R025293 Mnz 4	0.34	12.7	0.84	0.05	0.86	11.8	25.2	2.71	10.0	1.52	0.37	0.83	0.22	0.18	5.02	0.12	99.9	2.7	0.3	3.9	722	20
R025293 Mnz 5	0.53	12.5	0.08	0.03	0.39	12.6	26.7	2.94	10.7	1.76	0.44	1.18	0.23	0.12	3.93	0.02	101.4	4.0	0.3	18.0	667	27
R025293 Mnz 5	0.32	12.6	0.10	0.03	0.33	13.1	27.2	2.97	10.8	1.79	0.44	1.12	0.18	0.05	2.36	0.02	100.4	9.7	0.5	18.8	436	42
R025293 Mnz 5	0.48	12.4	0.19	0.04	0.43	12.3	26.5	2.93	10.8	1.81	0.44	1.14	0.20	0.09	3.62	0.05	100.3	5.2	0.4	9.2	531	28
R025293 Mnz 5	0.21	13.1	0.13	0.04	0.33	13.2	28.1	3.01	11.1	1.71	0.47	1.07	0.15	0.03	1.36	0.02	101.6	13.6	0.7	24.6	523	71
R025293 Mnz 5	0.19	12.8	0.19	0.20	0.13	14.0	28.5	3.01	10.6	1.39	0.45	0.84	0.08	0.03	1.35	0.01	101.1	16.6	0.7	47.2	440	73
R025293 Mnz 5	0.32	12.7	0.14	0.01	0.37	12.4	26.9	2.99	10.9	1.89	0.45	1.30	0.21	0.07	2.78	0.03	100.6	6.4	0.4	14.3	555	36
R025293 Mnz 6	0.43	12.6	0.66	0.01	0.88	12.1	25.1	2.63	9.6	1.35	0.33	0.75	0.17	0.23	6.14	0.17	100.1	2.2	0.3	2.7	747	17
R025293 Mnz 6	0.34	12.7	0.60	0.00	0.86	12.5	25.2	2.66	9.7	1.31	0.36	0.69	0.17	0.21	5.34	0.16	99.6	2.4	0.3	2.9	773	19
R025293 Mnz 6	0.31	12.7	0.60	0.02	0.88	12.9	25.4	2.62	9.4	1.31	0.34	0.73	0.18	0.19	4.92	0.17	99.6	2.6	0.3	2.7	751	20
R025293 Mnz 6	0.38	12.7	0.54	0.04	0.68	12.8	25.6	2.72	9.7	1.25	0.34	0.63	0.14	0.19	5.05	0.14	99.9	2.6	0.3	3.3	767	20
R025293 Mnz 6	0.40	12.7	0.53	0.02	0.71	12.7	25.5	2.74	9.8	1.29	0.37	0.72	0.15	0.20	5.28	0.14	100.2	2.4	0.3	3.1	767	19
R025293 Mnz 6	0.38	12.7	0.55	0.02	0.86	12.1	25.4	2.79	9.9	1.39	0.36	0.79	0.16	0.20	5.28	0.14	99.9	2.5	0.3	3.2	763	19
R025293 Mnz 6	0.38	12.6	0.59	0.04	0.68	12.8	25.8	2.72	9.7	1.27	0.37	0.68	0.16	0.17	4.87	0.12	99.9	2.8	0.3	3.6	719	21

SAMPLE	Si	P	Ca	Fe	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Pb	Th	U	TOTAL	Pb σ%	Th σ%	U σ%	Age Ma	1σ age
R025293 Mnz 6	0.47	12.5	0.62	0.00	0.75	12.3	25.0	2.55	9.5	1.25	0.35	0.68	0.16	0.22	6.31	0.14	99.7	2.2	0.3	3.2	724	17
R025293 Mnz 6	0.37	12.7	0.62	0.07	0.65	12.8	25.9	2.72	9.7	1.27	0.36	0.70	0.13	0.18	4.93	0.12	100.1	2.7	0.3	3.9	760	21
R025293 Mnz 7	0.42	12.6	0.50	0.07	0.51	12.7	25.9	2.77	9.9	1.36	0.39	0.84	0.15	0.14	4.82	0.08	100.3	3.4	0.3	5.8	623	21
R025293 Mnz 7	0.49	12.4	0.13	0.03	0.06	14.2	27.6	2.89	10.0	1.17	0.42	0.60	0.02	0.09	3.84	0.04	100.9	5.4	0.3	11.8	484	26
R025293 Mnz 7	0.25	12.8	0.43	0.04	0.05	14.7	28.4	2.88	10.1	1.07	0.41	0.59	0.01	0.03	1.78	0.03	100.8	14.5	0.5	15.7	372	54
R025293 Mnz 7	0.33	12.6	0.62	0.02	0.43	13.5	26.7	2.83	9.9	1.28	0.39	0.69	0.09	0.12	3.63	0.09	100.3	3.8	0.4	5.2	701	27
R025293 Mnz 7	0.36	12.5	0.56	0.02	0.73	12.4	25.4	2.76	9.8	1.38	0.36	0.80	0.18	0.18	5.05	0.14	99.3	2.8	0.3	3.4	708	20
R025293 Mnz 7	0.42	12.4	0.53	0.02	0.51	12.9	25.5	2.62	9.7	1.27	0.37	0.79	0.12	0.18	5.27	0.09	99.3	2.7	0.3	5.0	721	20
R025293 Mnz 7	0.42	12.5	0.57	0.00	0.80	12.8	25.1	2.63	9.6	1.36	0.38	0.81	0.20	0.18	5.44	0.14	99.8	2.7	0.3	3.4	692	19
R025294 Mnz 1	0.30	12.9	0.57	0.20	0.95	11.3	25.1	2.80	10.8	1.86	0.42	1.32	0.31	0.13	4.41	0.10	100.6	3.7	0.3	4.6	602	23
R025294 Mnz 1	0.25	13.1	0.50	0.14	1.01	11.1	25.1	2.89	10.8	2.08	0.43	1.48	0.41	0.11	3.82	0.08	100.8	4.4	0.3	5.5	583	26
R025294 Mnz 1	0.22	13.2	1.03	0.08	1.97	10.3	22.8	2.53	9.7	1.75	0.37	1.37	0.53	0.25	6.57	0.29	100.7	2.0	0.2	1.7	728	15
R025294 Mnz 1	0.21	13.2	1.04	0.08	1.88	10.5	22.9	2.58	9.6	1.73	0.37	1.29	0.50	0.25	6.52	0.28	100.8	2.0	0.3	1.7	748	16
R025294 Mnz 1	0.30	13.0	1.09	0.31	0.57	11.8	25.3	2.81	10.4	1.74	0.42	1.18	0.24	0.12	3.84	0.07	100.8	4.0	0.3	6.1	638	26
R025294 Mnz 3	0.16	13.2	1.26	0.02	1.93	10.0	22.2	2.46	9.2	1.80	0.32	1.07	0.46	0.35	6.38	1.15	99.4	1.5	0.3	0.5	766	12
R025294 Mnz 3	0.23	12.9	0.86	0.04	1.57	11.1	23.8	2.70	9.8	1.65	0.35	1.04	0.44	0.22	5.63	0.22	99.9	2.3	0.3	2.1	748	18
R025294 Mnz 3	0.12	13.3	1.16	0.05	1.79	10.8	22.8	2.59	9.2	1.80	0.34	1.10	0.48	0.33	5.16	1.19	99.8	1.6	0.3	0.5	787	13
R025294 Mnz 5	0.24	13.3	0.93	0.25	1.34	10.7	23.6	2.63	10.2	1.81	0.37	1.01	0.35	0.24	6.46	0.24	101.5	2.1	0.3	2.0	725	16
R025294 Mnz 4	0.16	13.2	0.38	0.21	0.27	11.6	29.1	3.04	9.8	1.74	0.52	1.00	0.21	0.01	0.98	0.10	100.1	52.8	0.8	4.8	148	78
R025294_2_MNZ1	0.31	13.1	0.12	0.14	0.29	12.3	27.0	3.05	11.6	2.10	0.45	1.37	0.20	0.07	1.98	0.01	101.8	7.0	0.5	31.9	726	51
R025294_2_MNZ1	0.14	13.1	0.17	0.03	0.17	12.7	28.0	3.20	11.7	2.03	0.45	1.19	0.10	0.02	0.81	0.01	101.3	18.9	1.0	66.3	638	120
R025294_2_MNZ1	0.36	12.7	0.10	0.02	0.35	12.3	26.8	2.94	11.4	2.06	0.45	1.45	0.21	0.08	2.33	0.02	100.9	5.6	0.5	24.7	770	44
R025294_2_MNZ2	0.29	12.8	0.35	0.01	0.38	11.5	26.1	2.94	11.4	2.05	0.40	1.24	0.30	0.09	3.65	0.04	100.6	5.1	0.3	12.3	547	28
R025294_2_MNZ3	0.30	13.2	0.84	0.06	1.57	10.4	23.8	2.68	10.3	1.72	0.35	1.00	0.27	0.25	6.46	0.19	101.1	2.0	0.3	2.4	764	16
R025296 Mnz 1	0.21	13.0	0.83	0.01	1.07	11.3	25.1	2.92	11.0	2.20	0.40	1.60	0.44	0.08	3.44	0.05	101.1	5.6	0.4	9.6	507	29
R025296 Mnz 1	0.14	13.0	0.53	0.01	0.54	12.3	26.5	2.95	11.0	2.07	0.40	1.36	0.32	0.06	2.20	0.03	100.8	8.1	0.5	13.5	543	44
R025296 Mnz 1	0.31	12.7	0.80	0.00	1.15	11.0	24.7	2.81	10.6	2.10	0.39	1.40	0.42	0.10	4.51	0.04	100.2	4.5	0.3	11.4	497	23
R025296 Mnz 1	0.12	13.0	0.38	0.01	0.61	12.5	26.8	3.01	10.9	2.08	0.41	1.34	0.34	0.05	1.89	0.03	100.6	8.7	0.5	13.6	578	50
R025296 Mnz 1	0.33	12.6	0.49	0.01	0.46	12.1	27.1	3.00	11.1	1.98	0.43	1.25	0.27	0.05	2.40	0.03	100.7	8.3	0.5	17.0	489	41
R025296 Mnz 1	0.22	12.8	0.38	0.01	0.42	11.9	26.3	3.07	11.5	2.23	0.42	1.39	0.21	0.06	2.38	0.04	100.4	7.4	0.5	10.6	547	41
R025296 Mnz 1	0.31	12.7	0.47	0.02	0.21	12.6	28.0	3.02	10.6	1.55	0.43	0.79	0.10	0.06	2.80	0.04	100.8	7.3	0.4	12.1	480	35
R025296 Mnz 3	0.05	12.5	0.73	0.03	0.33	12.6	26.1	2.76	10.3	2.18	0.49	1.48	0.20	0.04	1.26	0.32	98.0	11.0	0.7	1.5	398	43

SAMPLE	Si	P	Ca	Fe	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Pb	Th	U	TOTAL	Pb σ%	Th σ%	U σ%	Age Ma	1σ age
R025296 Mnz 3	0.12	12.7	0.74	0.03	0.71	10.3	23.9	2.94	11.9	2.99	0.56	2.33	0.43	0.04	1.45	0.54	98.9	10.1	0.6	0.9	315	31
R025296 Mnz 3	0.16	12.4	0.75	0.02	0.48	12.3	25.7	2.86	10.8	2.14	0.46	1.53	0.26	0.02	0.97	0.28	97.7	18.2	0.8	1.7	295	53
R025296 Mnz 3	0.14	12.6	0.74	0.04	0.44	12.4	25.8	2.89	10.7	2.15	0.45	1.45	0.26	0.03	0.66	0.17	97.8	14.9	1.1	2.6	544	79
R025296 Mnz 3	0.12	12.6	0.54	0.09	0.43	11.2	25.3	2.90	11.9	2.72	0.55	1.68	0.23	0.01	0.91	0.09	98.3	37.9	0.9	4.8	221	83
R025296 Mnz 7	0.16	12.6	1.01	0.02	0.44	10.1	26.3	3.04	11.7	2.19	0.49	1.11	0.20	0.06	1.71	0.68	98.6	7.6	0.6	0.8	343	25
R025296 Mnz 7	0.08	12.8	0.75	0.03	0.35	10.7	25.5	3.03	11.9	2.06	0.47	1.20	0.16	0.04	1.83	0.31	98.1	10.5	0.5	1.5	341	35
R025296 Mnz 7	0.10	12.7	0.70	0.06	0.34	11.1	25.3	2.91	12.0	1.89	0.46	1.34	0.15	0.03	1.89	0.30	98.3	14.9	0.5	1.6	239	35
R025296 Mnz 7	0.16	12.7	1.01	0.03	0.46	7.5	23.8	3.12	13.0	2.74	0.51	1.71	0.29	0.08	3.09	1.24	98.6	5.7	0.4	0.5	260	15
R025296 Mnz 8	0.04	12.9	0.97	0.06	0.32	7.2	20.8	3.05	14.4	4.10	0.64	2.72	0.32	0.13	2.47	2.29	99.6	3.7	0.4	0.3	292	11
R025296 Mnz 8	0.25	12.7	1.32	0.09	0.24	6.8	20.0	2.84	13.3	3.49	0.57	2.01	0.20	0.13	6.65	1.21	100.0	3.6	0.2	0.5	280	10
R025296 Mnz 8	0.12	12.7	1.41	0.08	0.24	7.4	20.6	2.91	13.2	3.56	0.56	2.04	0.17	0.12	5.64	1.05	99.1	3.9	0.3	0.5	302	12
R025296 Mnz 9	0.19	12.8	0.65	0.09	0.31	12.3	25.9	2.80	10.3	1.59	0.49	0.99	0.13	0.05	2.52	0.29	99.0	9.0	0.4	1.7	326	29
R025296 Mnz 9	0.23	12.8	0.91	0.08	0.24	11.2	24.4	2.59	10.0	1.58	0.44	0.92	0.11	0.08	4.68	0.46	98.4	5.8	0.3	1.1	289	17
R025296 Mnz 9	0.19	12.8	0.62	0.05	0.67	12.8	25.1	2.76	10.6	1.55	0.42	0.72	0.14	0.05	1.97	0.36	98.0	9.2	0.5	1.3	349	32
R030021 Mnz1	0.24	13.1	0.79	0.04	0.96	11.2	23.8	2.66	10.6	1.87	0.44	1.09	0.31	0.36	5.23	0.17	100.1	1.5	0.3	2.8	1336	22
R030021 Mnz1	0.61	12.7	1.93	0.06	0.81	10.8	22.8	2.64	10.3	1.89	0.42	1.24	0.31	0.23	5.12	0.12	100.0	2.1	0.3	3.8	933	21
R030021 Mnz1	0.26	13.0	1.07	0.10	1.61	10.1	22.8	2.65	10.0	2.03	0.37	1.42	0.51	0.24	6.13	0.25	100.1	2.1	0.3	1.9	774	17
R030021 Mnz1	0.19	13.3	1.09	0.06	2.19	9.8	22.4	2.55	9.8	1.97	0.33	1.31	0.56	0.25	6.23	0.35	100.0	2.0	0.3	1.4	745	16
R030021 Mnz1	0.34	12.7	0.37	0.04	0.94	11.8	25.2	2.88	10.9	2.00	0.53	1.25	0.38	0.13	3.75	0.11	100.2	3.6	0.3	4.1	704	26
R030021 Mnz1	0.29	12.9	0.87	0.09	1.31	11.1	24.2	2.68	10.0	1.75	0.35	1.06	0.39	0.20	5.42	0.16	100.1	2.5	0.3	2.9	729	19
R030021 Mnz2	0.55	13.0	0.93	0.20	0.99	10.4	24.4	2.87	10.5	2.59	0.40	1.52	0.45	0.15	4.14	0.31	101.8	3.3	0.3	1.6	626	21
R030021 Mnz2	0.38	13.6	1.76	0.19	2.11	8.8	20.8	2.50	9.1	2.33	0.36	1.66	0.72	0.42	5.60	1.82	100.9	1.3	0.3	0.4	792	10
R030022 Mnz 1	0.25	12.8	0.27	0.00	0.35	11.8	26.4	3.00	11.4	2.07	0.39	1.03	0.15	0.11	2.74	0.05	99.7	4.3	0.4	8.8	808	36
R030022 Mnz 1	0.30	12.7	0.39	0.03	0.23	11.7	26.1	2.80	11.0	1.76	0.28	0.91	0.05	0.12	3.28	0.08	98.3	3.8	0.4	5.6	750	29
R030022 Mnz 1	0.21	12.7	0.21	0.00	0.23	12.3	27.2	2.96	11.3	2.02	0.38	0.83	0.04	0.08	1.92	0.10	99.1	5.7	0.5	4.5	775	45
R030022 Mnz 1	0.46	12.6	0.17	0.00	0.15	11.9	26.7	2.97	11.2	1.99	0.35	0.78	0.03	0.07	2.91	0.07	98.9	6.0	0.4	6.3	532	32
R030022 Mnz 1	0.34	12.7	0.41	0.01	0.32	11.3	25.7	2.83	10.8	2.10	0.33	1.14	0.19	0.13	3.78	0.02	98.9	3.7	0.3	18.5	732	28
R030022 Mnz 1	0.17	12.8	0.12	0.01	0.17	12.4	27.6	3.05	11.5	2.01	0.38	0.90	0.07	0.05	1.64	0.05	99.7	9.0	0.6	9.5	613	55
R030022 Mnz 1	0.13	13.0	0.19	0.00	0.15	12.4	27.4	3.04	11.3	2.02	0.40	1.02	0.07	0.07	1.50	0.06	99.7	6.8	0.6	6.9	852	58
R030022 Mnz 1	0.26	12.7	0.24	0.01	0.22	12.3	26.4	3.04	11.8	2.08	0.40	1.04	0.08	0.07	1.97	0.06	99.3	6.2	0.5	6.9	748	47
R030022 Mnz 2	0.24	12.7	1.04	0.30	2.09	9.9	22.4	2.43	9.6	1.67	0.29	1.13	0.53	0.27	6.06	0.34	98.0	1.9	0.3	1.4	814	16
R030022 Mnz 2	0.25	12.7	0.87	0.26	1.87	10.5	23.2	2.65	9.9	1.85	0.35	1.25	0.45	0.22	5.28	0.27	99.0	2.3	0.3	1.7	772	18

SAMPLE	Si	P	Ca	Fe	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Pb	Th	U	TOTAL	Pb σ%	Th σ%	U σ%	Age Ma	1σ age
R030022 Mnz 2	0.24	12.7	0.97	0.26	1.89	10.2	22.7	2.51	9.7	1.60	0.27	1.24	0.55	0.24	5.91	0.24	98.5	2.1	0.3	2.0	788	17
R030022 Mnz 2	0.31	12.6	0.89	0.26	1.36	10.8	23.7	2.61	10.0	1.61	0.31	1.08	0.33	0.25	5.72	0.18	99.0	2.0	0.3	2.6	869	18
R030022 Mnz 6	0.24	13.0	1.08	0.13	1.73	10.5	22.8	2.59	9.8	1.94	0.36	1.11	0.45	0.26	5.94	0.45	99.7	1.9	0.3	1.1	764	15
R030022 Mnz 6	0.23	12.9	0.97	0.12	1.33	11.0	23.8	2.68	10.1	1.54	0.28	0.60	0.22	0.23	5.52	0.23	98.7	2.1	0.3	2.0	809	18
R030022 Mnz 6	0.46	12.7	1.73	0.09	0.31	11.0	24.9	2.76	10.6	1.34	0.28	0.75	0.04	0.13	3.63	0.06	97.9	3.4	0.3	7.6	776	28
R030022 Mnz 6	0.17	13.1	1.22	0.09	1.98	10.6	23.1	2.63	9.6	1.75	0.34	1.09	0.47	0.24	5.44	0.40	99.7	2.1	0.3	1.2	769	17
R030022 Mnz 7	0.31	13.1	1.25	0.00	1.81	10.5	22.9	2.51	9.7	1.58	0.28	0.89	0.40	0.25	5.84	0.24	99.1	2.0	0.3	1.9	825	17
R030022 Mnz 7	0.54	12.5	0.64	0.02	0.87	12.0	25.0	2.16	9.8	1.29	0.26	0.60	0.24	0.22	5.30	0.21	98.5	2.2	0.3	2.1	812	19
R030022 Mnz 3	0.26	12.7	0.98	0.12	1.98	10.4	22.8	2.59	9.9	1.81	0.32	1.18	0.49	0.23	6.00	0.26	99.2	2.1	0.3	1.8	750	17
R030022 Mnz 3	0.23	13.0	1.02	0.10	1.96	10.2	23.1	2.63	9.8	1.78	0.33	0.94	0.44	0.24	6.04	0.25	99.5	2.1	0.3	1.9	762	17
R030022 Mnz 9	0.40	13.2	0.81	0.00	1.42	10.8	24.1	2.70	10.0	1.68	0.39	1.00	0.34	0.21	5.91	0.19	100.7	2.4	0.3	2.5	707	17
R031085 Mnz 1	0.17	13.5	1.05	0.00	2.11	10.1	22.8	2.44	9.7	1.80	0.28	0.83	0.28	0.26	5.70	0.58	99.1	1.9	0.3	0.9	766	15
R031085 Mnz 1	0.20	13.2	1.00	0.00	2.00	10.2	22.9	2.54	9.8	1.67	0.29	1.04	0.39	0.25	5.98	0.31	99.1	2.0	0.3	1.5	791	16
R031085 Mnz 1	0.14	13.3	1.10	0.05	2.19	9.8	22.3	2.43	9.5	1.90	0.28	1.52	0.70	0.29	5.58	0.81	99.5	1.7	0.3	0.7	784	14
R031085 Mnz 2	0.20	13.4	0.99	0.11	2.04	10.2	22.4	2.55	9.5	1.81	0.37	1.54	0.62	0.25	6.23	0.33	100.8	2.0	0.3	1.5	744	16
R031085 Mnz 2	0.19	13.3	0.85	0.08	1.75	10.7	23.4	2.66	9.8	1.71	0.35	1.16	0.39	0.22	5.31	0.30	99.6	2.3	0.3	1.6	758	18
R031085 Mnz 2	0.16	13.0	0.95	0.02	2.02	10.2	22.6	2.55	9.7	1.79	0.31	0.94	0.26	0.26	5.80	0.41	97.7	1.9	0.3	1.2	801	16
R031085 Mnz 3	0.18	13.0	1.01	0.16	2.17	9.8	22.6	2.46	9.7	1.86	0.32	1.43	0.62	0.24	5.97	0.34	99.2	2.1	0.3	1.5	764	16
R031085 Mnz 3	0.27	12.6	1.24	0.33	2.13	9.9	22.0	2.45	9.3	1.83	0.34	1.50	0.63	0.25	6.35	0.34	98.8	2.0	0.3	1.5	729	15
R031085 Mnz 3	0.20	13.0	1.03	0.11	1.91	10.5	22.7	2.54	9.7	1.67	0.30	1.12	0.52	0.24	5.89	0.33	99.1	2.1	0.3	1.5	771	16
R031085 Mnz 4	0.45	12.4	0.51	0.04	1.05	11.1	24.2	2.70	10.1	1.81	0.36	1.06	0.33	0.18	5.67	0.27	99.0	2.7	0.3	1.8	598	17
R031085 Mnz 4	0.20	12.9	0.87	0.00	1.81	10.9	23.6	2.55	9.8	1.66	0.31	0.60	0.04	0.26	5.38	0.37	97.6	1.8	0.3	1.2	868	17
R031085 Mnz 4	0.18	13.0	0.96	0.00	2.20	10.3	22.5	2.58	9.8	1.80	0.29	1.02	0.42	0.25	5.73	0.34	98.3	2.0	0.3	1.4	801	17
R031085 Mnz 4	0.17	12.9	0.91	0.00	2.00	10.6	23.3	2.59	9.7	1.65	0.29	0.90	0.31	0.25	5.51	0.35	98.1	1.9	0.3	1.3	824	17
R031085 Mnz 4	0.12	13.2	0.75	0.01	2.31	10.5	23.6	2.60	10.3	1.83	0.32	1.14	0.46	0.19	3.85	0.40	99.0	2.6	0.3	1.2	809	21
R031085 Mnz 4	0.26	12.6	1.41	0.34	1.72	10.3	22.5	2.56	9.5	1.72	0.37	1.27	0.47	0.31	6.03	0.32	99.3	1.6	0.3	1.5	966	17
R031085 Mnz 6	0.23	12.9	0.86	0.07	1.29	11.1	24.3	2.72	10.2	1.95	0.37	1.30	0.40	0.44	4.61	0.27	100.3	1.2	0.3	1.7	1691	24
R031085 Mnz 6	0.24	12.8	0.84	0.00	1.62	10.6	23.8	2.65	10.0	1.74	0.30	0.72	0.21	0.24	5.58	0.30	98.5	2.0	0.3	1.6	814	17
R031085 Mnz 6	0.29	12.8	0.74	0.14	1.35	11.2	24.2	2.73	10.1	1.66	0.33	1.10	0.41	0.19	5.09	0.22	99.7	2.6	0.3	2.1	731	19
R031085 Mnz 6	0.31	12.6	0.66	0.09	1.27	11.3	24.1	2.67	10.0	1.81	0.32	1.27	0.50	0.19	5.26	0.24	99.5	2.6	0.3	2.0	700	18
R031085 Mnz 6	0.20	13.0	1.15	0.08	2.33	9.8	22.2	2.51	9.6	1.72	0.28	1.19	0.52	0.26	6.46	0.33	98.9	1.9	0.3	1.5	763	15
R031086 Mnz 5	0.20	13.1	1.42	0.02	1.48	11.0	23.6	2.65	9.8	1.72	0.39	1.07	0.35	0.21	5.61	0.26	100.3	2.3	0.3	1.8	729	17

SAMPLE	Si	P	Ca	Fe	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Pb	Th	U	TOTAL	Pb σ%	Th σ%	U σ%	Age Ma	1σ age
R031086 Mnz 5	0.21	12.8	1.29	0.04	1.76	10.5	22.9	2.59	9.6	1.73	0.37	1.37	0.53	0.24	6.33	0.26	99.9	2.1	0.3	1.9	732	16
R031086 Mnz 7	0.31	12.5	0.97	0.15	0.91	11.9	24.5	2.61	9.7	1.40	0.37	0.80	0.20	0.19	5.14	0.15	98.5	2.6	0.3	3.1	736	20
R031086 Mnz 7	0.39	12.5	0.72	0.03	1.87	10.3	23.5	2.61	10.1	1.80	0.28	0.92	0.41	0.21	5.66	0.20	98.2	2.3	0.3	2.3	745	18
R031086 Mnz 7	0.39	12.1	0.98	0.08	0.90	11.5	24.2	2.64	9.9	1.45	0.37	0.97	0.24	0.18	5.38	0.15	97.8	2.7	0.3	3.1	672	19
R031086 Mnz 6	0.20	12.7	1.16	0.03	1.68	10.8	23.1	2.54	9.3	1.54	0.30	0.73	0.30	0.31	5.32	0.95	97.5	1.7	0.3	0.6	799	13
R031086 Mnz 6	0.19	12.9	1.08	0.07	1.90	10.7	22.8	2.56	9.6	1.71	0.33	1.36	0.54	0.24	5.41	0.53	99.2	2.1	0.3	1.0	740	16
R031086 Mnz 9	0.20	13.1	1.31	0.07	2.05	10.4	22.8	2.55	9.5	1.70	0.32	1.11	0.45	0.28	5.64	0.75	99.6	1.8	0.3	0.7	771	14
R031086 Mnz 9	0.33	12.8	1.42	0.11	2.01	9.9	21.4	2.44	9.2	1.67	0.32	1.32	0.56	0.27	5.87	0.71	97.5	1.9	0.3	0.8	716	14
R031086 Mnz 9	0.13	13.0	1.07	0.02	1.94	10.5	22.9	2.58	9.7	1.70	0.33	1.03	0.45	0.30	5.50	0.77	99.0	1.7	0.3	0.7	810	14
R031086 Mnz 9	0.18	13.4	1.04	0.06	1.94	10.4	23.0	2.66	9.8	1.86	0.36	1.40	0.58	0.26	5.86	0.66	101.5	2.0	0.3	0.8	707	14
R031086 Mnz 9	0.15	13.0	1.09	0.03	2.11	9.9	22.6	2.64	9.8	1.93	0.32	1.11	0.46	0.28	6.19	0.52	99.2	1.8	0.3	1.0	769	14
R031086 Mnz 9	0.21	12.9	1.08	0.03	2.14	10.2	22.6	2.58	9.9	1.76	0.31	1.03	0.44	0.25	6.12	0.32	98.9	2.0	0.3	1.5	767	16
R031086 Mnz 15	0.25	12.9	1.16	0.28	2.26	8.9	22.5	2.63	10.8	1.99	0.34	1.50	0.64	0.21	4.95	0.20	98.9	2.3	0.3	2.4	838	20
R031086 Mnz 15	0.23	12.5	0.89	0.28	2.17	9.2	23.2	2.87	11.0	2.14	0.37	1.38	0.54	0.13	4.18	0.25	98.4	3.8	0.3	1.9	573	22
R031086 Mnz 11	0.26	12.8	1.13	0.09	1.54	10.7	23.1	2.61	9.8	1.67	0.38	1.29	0.45	0.23	6.17	0.25	99.8	2.2	0.3	1.9	731	16
R031086 Mnz 11	0.26	12.7	1.12	0.06	1.64	10.5	23.0	2.62	9.7	1.70	0.36	1.28	0.48	0.24	6.03	0.28	99.1	2.1	0.3	1.7	760	16
R031086 Mnz 11	0.26	12.8	1.04	0.03	1.38	10.9	23.6	2.67	9.9	1.67	0.34	0.91	0.26	0.25	6.09	0.26	99.2	2.0	0.3	1.8	800	17
R031086 Mnz 11	0.23	12.8	0.83	0.04	1.42	10.8	24.1	2.68	10.1	1.79	0.38	1.19	0.34	0.21	5.23	0.25	99.4	2.3	0.3	1.9	778	19
R014692 Mnz 1-2	0.36	12.9	0.25	0.24	0.77	12.8	25.6	2.93	10.6	1.83	0.44	1.22	0.32	0.08	3.22	0.04	101.2	5.7	0.4	10.1	543	22
R014692 Mnz 1-3	0.10	13.2	0.76	0.20	1.70	11.7	24.0	2.70	10.1	1.76	0.39	1.13	0.44	0.17	3.92	0.25	100.0	3.0	0.3	1.9	768	6
R014692 Mnz 1-4	0.11	13.3	0.67	0.18	2.05	12.1	24.0	2.68	9.8	1.65	0.38	1.15	0.48	0.15	3.91	0.11	100.3	3.2	0.3	3.9	759	22
R014692 Mnz 2-1	0.08	13.4	0.80	0.11	1.03	11.8	24.3	2.83	11.0	2.08	0.70	1.38	0.42	0.11	2.72	0.12	100.5	4.4	0.4	3.6	751	26
R014692 Mnz 2-2	0.11	13.3	0.97	0.08	1.74	11.3	23.1	2.70	9.9	1.74	0.40	1.01	0.40	0.21	5.28	0.24	99.9	2.4	0.3	2.0	762	25
R014692 Mnz 2-3	0.12	13.3	0.92	0.08	1.69	11.5	23.3	2.66	9.9	1.66	0.39	1.06	0.44	0.20	4.97	0.21	99.9	2.8	0.3	2.5	762	36
R014692 Mnz 2-4	0.06	13.1	0.78	0.10	1.05	12.3	24.3	2.81	10.6	1.93	0.66	1.41	0.42	0.12	3.02	0.14	100.1	4.4	0.4	3.8	764	6
R014692 Mnz 3-1,	0.35	12.8	1.84	0.97	1.05	11.9	23.4	2.58	9.7	1.52	0.43	1.17	0.42	0.11	4.59	0.06	100.6	4.7	0.3	8.4	519	29
R014692 Mnz 3-2	0.16	13.4	1.10	0.31	1.44	11.2	22.7	2.62	9.9	1.75	0.49	1.29	0.48	0.20	5.72	0.17	100.8	2.7	0.3	3.1	717	22
R014692 Mnz 4-1	0.18	13.0	0.50	0.33	0.79	12.0	24.6	2.90	11.1	2.07	0.62	1.44	0.38	0.08	2.98	0.07	100.6	6.5	0.4	7.7	562	21
R014692 Mnz 4-2	0.07	13.2	0.53	0.33	0.96	12.5	25.0	2.88	11.1	2.00	0.67	1.30	0.44	0.08	2.02	0.08	100.7	6.6	0.6	6.4	775	17
R014692 Mnz 5-1	0.07	13.6	0.79	0.14	1.41	11.8	23.9	2.78	10.5	1.97	0.65	1.47	0.52	0.12	3.32	0.11	101.3	4.4	0.4	4.5	732	24
R014692 Mnz 5-2	0.23	13.2	0.92	0.12	1.77	11.8	23.3	2.69	9.5	1.48	0.36	0.83	0.46	0.18	5.48	0.09	99.9	3.0	0.3	5.6	700	19
R014692_2 Mnz 1 1	0.12	12.6	0.61	0.18	1.50	12.0	24.5	2.78	10.2	1.73	0.42	1.30	0.48	0.14	3.41	0.20	98.9	4.7	0.5	3.4	787	37
R014692_2 Mnz 1 2	0.39	12.7	0.61	0.30	0.57	13.0	25.6	2.95	10.9	1.85	0.45	1.44	0.35	0.06	2.48	0.03	101.4	11.1	0.6	19.1	504	56

SAMPLE	Si	P	Ca	Fe	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Dy	Pb	Th	U	TOTAL	Pb σ%	Th σ%	U σ%	Age Ma	1σ age
R014692_2 Mnz 1 3	0.28	12.4	0.64	0.50	1.67	11.9	23.6	2.62	10.1	1.63	0.37	1.23	0.54	0.14	4.01	0.19	98.5	5.0	0.5	3.4	646	33
R014692_2 Mnz 2 1	0.05	13.3	0.65	0.13	0.81	13.2	26.1	3.01	11.1	1.94	0.67	1.20	0.32	0.04	0.89	0.10	101.2	16.2	1.3	6.4	718	115
R014692_2 Mnz 2 2	0.12	13.1	0.91	0.14	0.98	12.1	24.1	2.81	10.8	1.97	0.65	1.48	0.48	0.12	3.20	0.08	100.6	5.6	0.5	8.7	778	45
R014692_2 Mnz 2 3	0.53	12.4	0.51	0.13	0.33	13.8	25.5	2.73	10.6	1.45	0.50	0.91	0.30	0.09	3.22	0.06	100.1	7.5	0.5	10.7	571	43
R014692_2 Mnz 2 4	0.17	13.3	1.18	0.16	1.46	11.6	23.2	2.81	10.3	1.78	0.40	1.37	0.47	0.19	4.42	0.28	101.1	3.7	0.4	2.4	791	30
R014692_2 Mnz 1 4	0.16	13.3	0.78	0.19	1.81	11.5	23.9	2.70	10.2	1.76	0.40	1.38	0.55	0.16	4.27	0.20	101.2	4.3	0.5	3.3	711	31
R014692_2 Mnz 1 5	0.14	13.1	1.02	0.18	1.89	11.4	23.1	2.70	10.3	1.74	0.40	1.45	0.56	0.18	4.40	0.28	100.6	3.8	0.4	2.4	761	30
R014692_2 Mnz 3 1	0.44	12.9	0.29	0.29	0.68	13.4	25.5	2.97	11.0	1.63	0.45	1.19	0.22	0.07	3.59	0.05	102.3	9.6	0.5	14.1	411	40
R014692_2 Mnz 3 2	0.15	13.4	1.61	0.37	0.98	12.0	23.6	2.78	10.5	1.92	0.62	1.61	0.48	0.10	2.99	0.11	101.3	6.9	0.6	6.1	647	45
R014692_2 Mnz 3 3	0.28	13.1	0.30	0.28	0.77	13.0	26.0	3.05	11.6	1.72	0.47	1.23	0.37	0.03	1.26	0.02	101.3	22.4	1.0	31.7	480	107
R014692_2 Mnz 1 7	0.22	12.2	0.19	0.28	0.34	12.9	26.0	2.86	10.9	1.82	0.45	1.37	0.32	0.03	1.57	0.02	97.6	22.4	0.8	25.9	390	87

Methods

Compositional analyses were acquired on a JEOL JXA-8530F Plus field emission electron microprobe equipped with 5 wavelength dispersive spectrometers housed at the Central Science Laboratory, University of Tasmania

Key standards and measurement conditions

Element/Line	Crystal	OnPeak Time	OffPeak Time	Standard
Pb mb	PETL	200	200	K-227 Pb-Si glass (L4)
Th ma	PETL	120	120	Huttonite Hanchar (Q8)
U mb	PETL	180	175	U oxide (Geochron block)

Operating conditions were a beam energy of 16 keV, beam current was 100 nA, beam diameter 2 microns.

Off Peak correction method was Multi-Point for U mb, Pb mb, Th ma.

The MAN background intensity data was calibrated and continuum absorption corrected for Mg ka, Al ka, Si ka, P ka, S ka, K ka, Ca ka, Mn ka, Fe ka, Y la, Ce la, Nd la, Sm la, Eu la, Gd la, Dy la, Er la, Yb la, Sr la, La la, Pr lb.

J.J. Donovan and T.N. Tingle, An Improved Mean Atomic Number Correction for Quantitative Microanalysis, *Journal of Microscopy*, v. 2, 1, p. 1-7, 1996

Donovan, Singer and Armstrong, A New EPMA Method for Fast Trace Element Analysis in Simple Matrices, *American Mineralogist*, v101, p1839-1853, (2016)

Interference corrections were applied to Mn for interference by Eu, Gd, Nd, and to Fe for interference by Eu, Dy, and to Nd for interference by Ce, and to Sm for interference by Ce, and to Eu for interference by Mn, Gd, Nd, and to Gd for interference by Ce, Nd, Sm, and to Dy for interference by Fe, Mn, Eu, Sm, and to Er for interference by Fe, Nd, Sm, and to Yb for interference by Dy, Eu, Sm, and to Pb for interference by U, and to U for interference by K, Th, and to La for interference by Nd.

J.J. Donovan, D.A. Snyder and M.L. Rivers, An Improved Interference Correction for Trace Element Analysis in Microbeam Analysis, 2: 23-28, 1993

Standard values in Ma

Standards	Reference	UTAS LA-ICPMS	UTAS EPMA	This session	
	Values	(in house values)	all time average	1	2
14971	909	913	896	881	898
95% conf.	3	4	11	18	11
RW-1		905	899	893	903
95% conf.			7	9	11
94-222	467		474	474	475
95% conf.	8		11	8	8
RGL-4B	1566	1569	1571	1596	1602
95% conf.	3	10	12	13	14
Thompson Mine	1767	1747	1739	1722	
95% conf.	10	8	19	7	
Wilson Lake	1000		1003	1026	
95% conf.	2		28	15	
Torrington	246	248	279	253	
95% conf.	2	3	29	26	