

The oldest Pacific carbonate fluorapatite and Fe-Mn crust: a new episode of Turonian–Coniacian phosphatization event

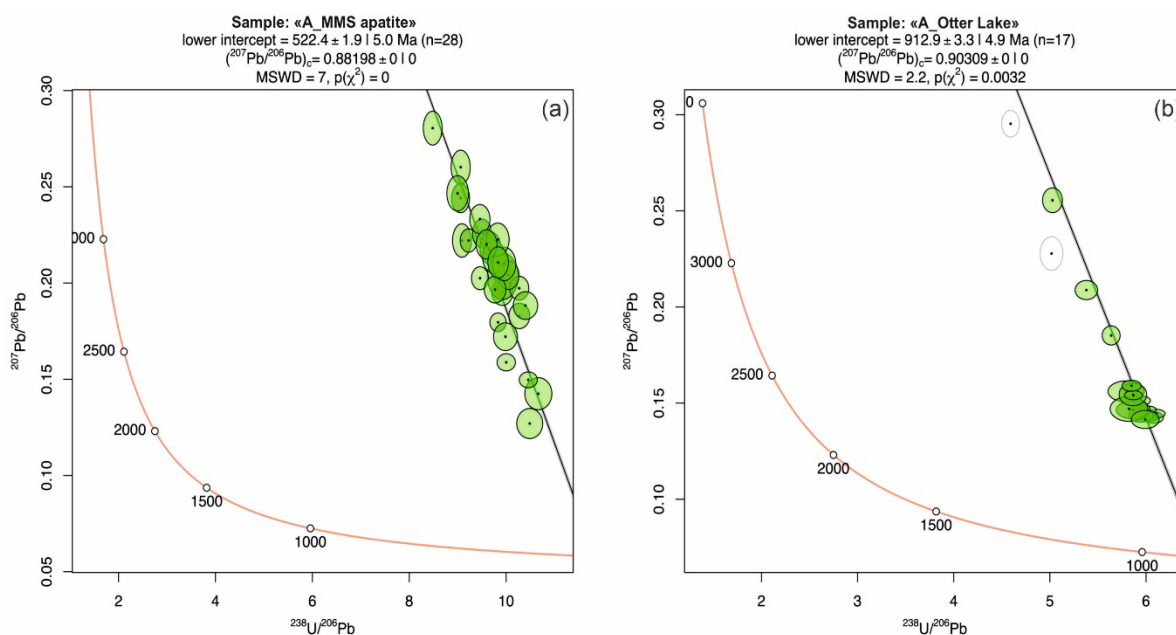
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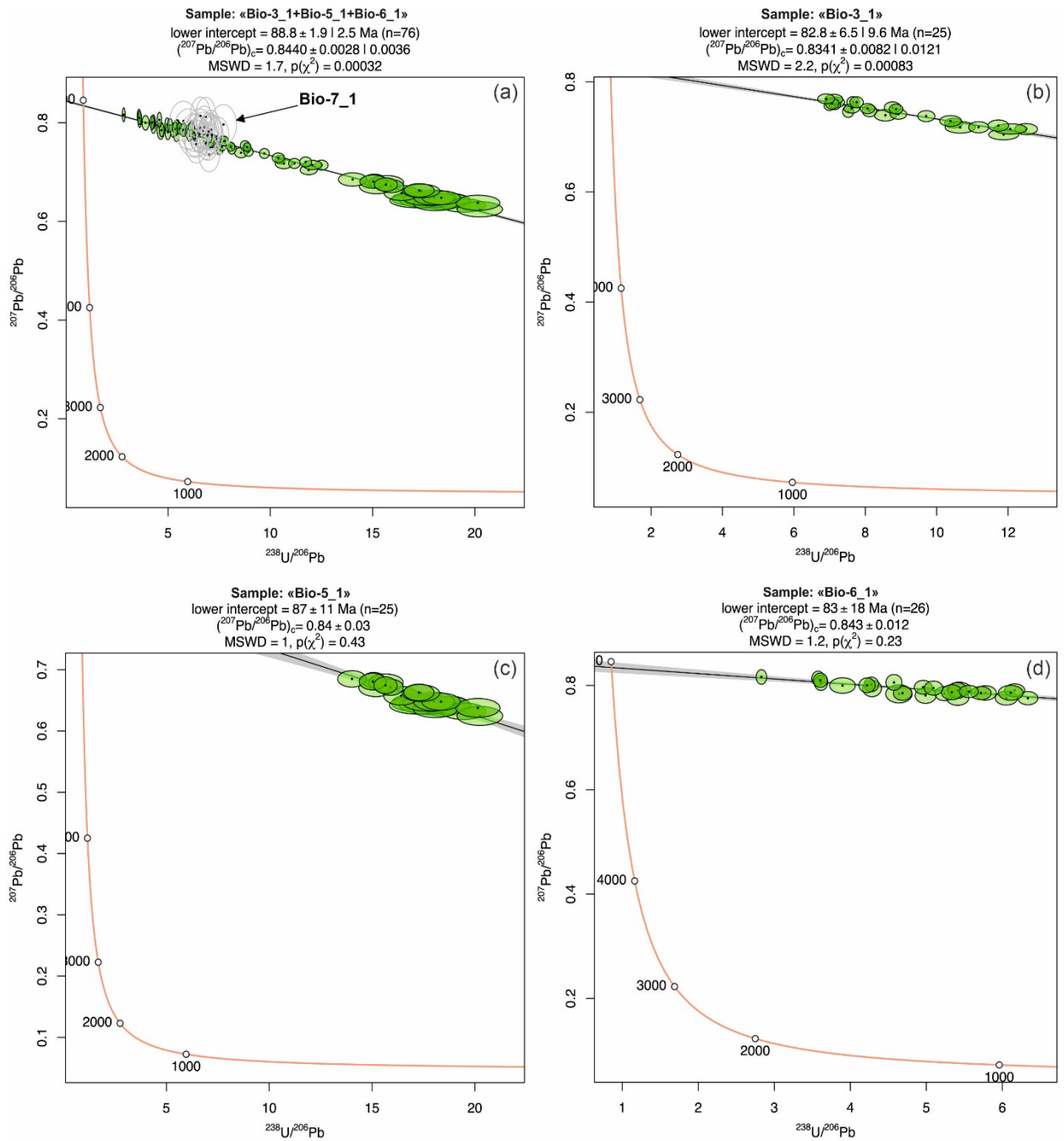
Contents of this file: Figures S1 to S3, Tables S1 to S5

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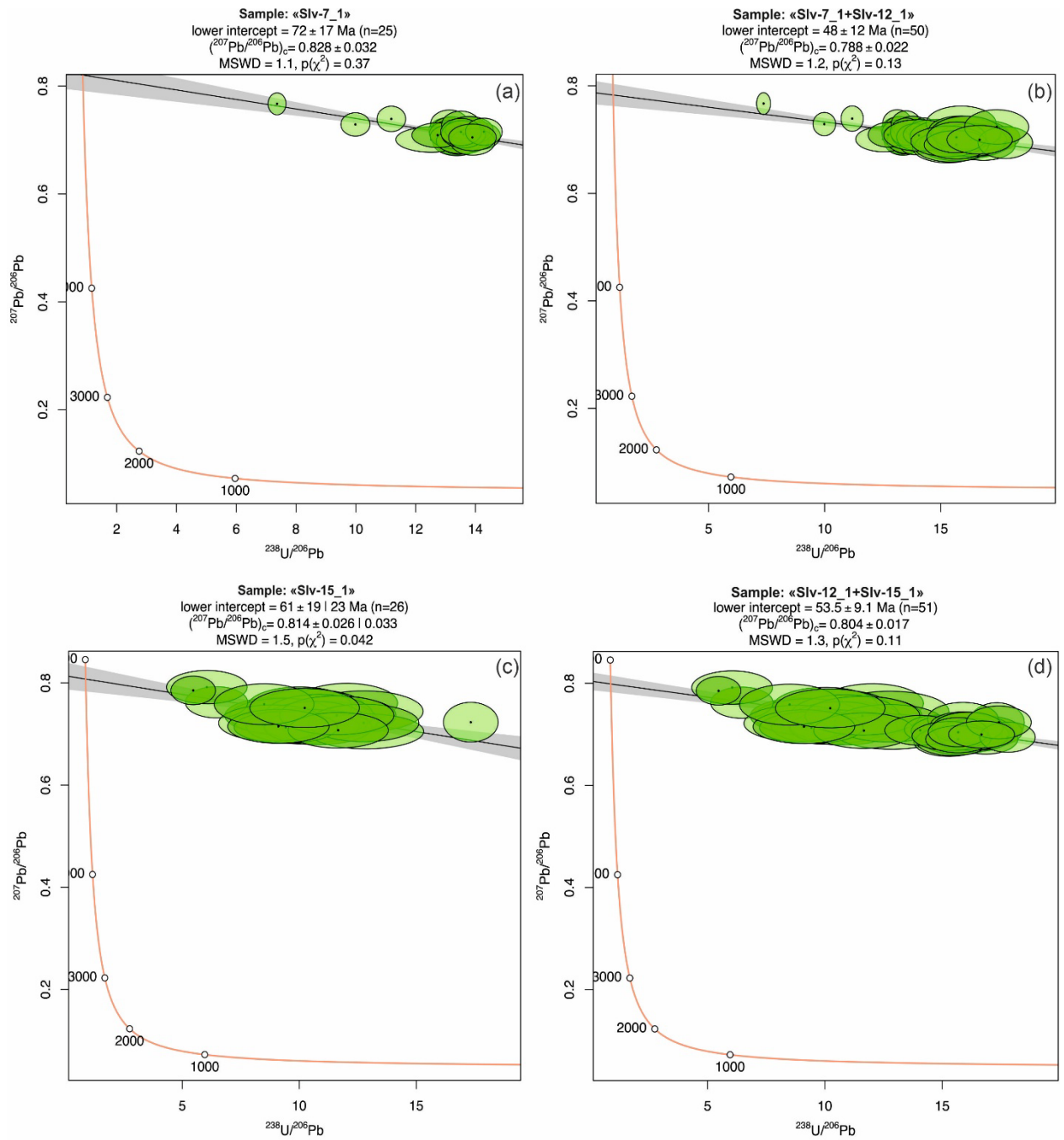
Apatite sample	Anchored initial $^{207}\text{Pb}/^{206}\text{Pb}$	The method determines initial $^{207}\text{Pb}/^{206}\text{Pb}$
A_MMS	0.88198	ID-TIMS total U-Pb isochron (Schoene and Bowring 2006)
A_Otter Lake	0.90309	$^{207}\text{Pb}/^{206}\text{Pb}$ apatite stepwise leaching (Barfod et al. 2005)

Figure S1 U-Pb LA-ICP-MS dating of standard apatite samples: (a) A_MMS; (b) A_Otter Lake.



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Figure S2 U-Pb LA-ICP-MS CFA dating from the biogenic region geode in sample 08D97 (Fig. 1): **(a)** Bio-3 + Bio-5 + Bio-6); **(b)** Bio-3; **(c)** Bio-5; **(d)** Bio-6.



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Figure S3 U-Pb LA-ICP-MS CFA dating from the chemogenic region geode in sample 08D97 (Fig. 1): **(a)** Slv-7); **(b)** Slv-7 + Slv-12; **(c)** Slv-15; **(d)** Slv-12 + Slv-15

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Table S1 Instrument parameters for carbonate fluorapatite LA-ICP-MS trace element data.

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Laser Ablation System	
Imaging	TESCAN MIRA IV LMS with an Oxford Instruments X-Max 80 mm ² EDS detector, 1 nA, 20 keV
Make, Model & type	Photon Machines, Inc., Redmond, USA, Photon Machines Analyte Exite
Ablation cell & volume	~10 x 10 cm HelEx II active double-volume sample cell with 9x1-inch and 4x0.25-inch glass standard holes, CETAC Teledyne, USA
Laser wavelength	UV 193 nm
Pulse width	<4 ns
Fluence	~4.75 J/cm ²
Repetition rate	10 Hz
Ablation duration	60 s
Ablation type	Static spot ablation
Spot diameter (nominal/actual)	110 μm / 110 μm
Carrier gas	Helium with a purity of 6.0
Cell carrier gas flow	~0.92 l/min
ICP-MS Instrument	
Make, Model & type	Agilent Technologies, Agilent 7900 Q-ICP-MS
Sample introduction	Ablation aerosol
RF forward power	1550 W
Reflect RF power	<1W
Interface cones	Nickel
Cooling gas	Ar: 16 l/min
Auxiliary gas	Ar: 0.98 l/min
ThO/Th ratio (248/232)	<0.5%
Detection system	Electron multiplier

Masses measured	9, 23, 25, 27, 29, 31, 39, 43, 45, 49, 51, 52, 55, 57, 59, 60, 63, 66, 71, 85, 88, 89, 90, 93, 95, 118, 121, 133, 137, 139, 140, 141, 146, 147, 153, 157, 159, 163, 165, 166, 169, 172, 175, 178, 181, 184, 205, 208, 209, 232, 238
Dwell time	⁹ Be (25 ms), ²³ Na (5 ms), ²⁵ Mg (5 ms), ²⁷ Al (5 ms), ²⁹ Si (5 ms), ³¹ P (5 ms), ³⁹ K (5 ms), ⁴³ Ca (5 ms), ⁴⁵ Sc (15 ms), ⁴⁷ Ti (5 ms), ⁵¹ V (15 ms), ⁵² Cr (20 ms), ⁵⁵ Mn (5 ms), ⁵⁷ Fe (5 ms), ⁵⁹ Co (15 ms), ⁶⁰ Ni (15 ms), ⁶³ Cu (15 ms), ⁶⁶ Zn (15 ms), ⁷¹ Ga (15 ms), ⁸⁵ Rb (15 ms), ⁸⁸ Sr (15 ms), ⁸⁹ Y (15 ms), ⁹⁰ Zr (15 ms), ⁹³ Nb (25 ms), ⁹⁵ Mo (15 ms), ¹¹⁸ Sn (5 ms), ¹²¹ Sb (15 ms), ¹³³ Cs (15 ms), ¹³⁷ Ba (15 ms), ¹³⁹ La (30 ms), ¹⁴⁰ Ce (30 ms), ¹⁴¹ Pr (30 ms), ¹⁴⁶ Nd (30 ms), ¹⁴⁷ Sm (30 ms), ¹⁵³ Eu (30 ms), ¹⁵⁷ Gd (30 ms), ¹⁵⁹ Tb (30 ms), ¹⁶³ Dy (30 ms), ¹⁶⁵ Ho (30 ms), ¹⁶⁶ Er (30 ms), ¹⁶⁹ Tm (30 ms), ¹⁷² Yb (30 ms), ¹⁷⁵ Lu (30 ms), ¹⁷⁸ Hf (30 ms), ¹⁸¹ Ta (30 ms), ¹⁸⁴ W (25 ms), ²⁰⁵ Tl (20 ms), ²⁰⁸ Pb (25 ms), ²⁰⁹ Bi (30 ms), ²³² Th (30 ms), ²³⁸ U (30 ms)
Total integration time per output datapoint	1.086 s
Data Processing	
Gas blank	40 second on-peak zero subtracted
Calibration strategy	NIST SRM 610 used as primary reference material, NIST SRM 612 used as secondaries/validation
Reference Material info	NIST SRM 610 (Pearce et al., 1997) NIST SRM 612 (Pearce et al., 1997)
Mass discrimination	Standard sample bracketing
Reduction software	Iolite v.4.10.8 software (Paton et al., 2011)

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Table S2 Instrument parameters for carbonate fluorapatite U-Pb LA-ICP-MS dating.

Laser Ablation System	
Imaging	Elemental, TESCAN MIRA IV LMS, with an Oxford Instruments X-Max 80 mm ² EDS detector, 1 nA, 20 keV
Make, Model & type	Photon Machines, Inc., Redmond, USA, Photon Machines Analyte Exite
Ablation cell & volume	~10 x 10 cm HelEx II active double-volume sample cell with 9x1-inch and 4x0.25-inch glass standard holes, CETAC Teledyne, USA
Laser wavelength	UV 193 nm
Pulse width	<4 ns
Fluence	~4.31 J/cm ²
Repetition rate	10 Hz
Ablation duration	40 s

Ablation type	Static spot ablation
Spot diameter (nominal/actual)	50 μm /50 μm
Carrier gas	Helium with a purity of 6.0
Cell carrier gas flow	~0.92 l/min
ICP-MS Instrument	
Make, Model & type	Agilent Technologies, Agilent 7900 Q-ICP-MS
Sample introduction	Ablation aerosol
RF forward power	1550 W
Reflect RF power	<1W
Interface cones	Nickel
Cooling gas	Ar: 16 l/min
Auxiliary gas	Ar: 0.98 l/min
ThO/Th ratio (248/232)	<0.5%
Detection system	Electron multiplier
Masses measured	206, 207, 238
Dwell time	30 ms for 206, 40 ms for 207 and 25 ms for 238
Total integration time per output datapoint	~0.1 s
Data Processing	
Gas blank	40 second on-peak zero subtracted
Calibration strategy	NIST SRM 610 used as primary reference material, MMS, and Otter Lake apatites used as secondaries/validation
Reference Material info	NIST SRM 610 (Pearce et al., 1997) MMS (Schoene et al., 2006) Otter Lake (Barfod et al., 2005)
Data processing package used / Correction for LIEF	Initial signal integration using Agilent MassHunter TRA software. Spreadsheet data processing using iolite v4.10.8. No LIEF correction (mean of uncorrected ratios used). IsoplotR software (Vermeesch, 2018) for isochrons, intercept ages, and initial Pb compositions.
Mass discrimination / Mass fractionation	NIST SRM 610 to account for mass discrimination effects and correction for U/Pb mass fractionation was performed using the MMS apatite standard

Common-Pb correction, composition and uncertainty	No common-Pb correction applied to the data
Uncertainty level & propagation	Ages are quoted at 2s absolute, propagation is by quadratic addition. Excess variance of reference material propagated into sample data. Systematic uncertainties include age uncertainty of reference material
Quality control / Validation	MMS apatite – Lower intercept age = 522.4 ± 5 (2s, MSWD = 7, n=28) Otter Lake apatite – Lower intercept age = 912.9 ± 4.9 (2s, MSWD = 2.2, n=17)

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Table S3 Carbonate fluorapatite in biogenic region and Calcite LA-ICP-MS data (ppm).

	Bio-1	Bio-3	Bio-4	Bio-5	Bio-6	Average	Cal-18	Cal-19	Cal-20	Average
Si	1447	2557	2608	<d/l	2495	2276	799	896	1294	996
Ti	105.7	64.7	45.6	27.7	58.2	60.4	3.57	6.41	2.35	4.11
Mg	2909	2730	3199	3406	2883	3026	4525	3869	3914	4103
Na	11261	8931	10330	10603	10717	10368	40.58	65.63	48.73	51.65
K	391	493	347	285	487	401	13.42	54.63	13.92	27.32
Mn	82.1	55.8	94.7	87.5	82.6	80.5	42.51	51.24	40.63	44.79
Fe	630.9	782.3	517.0	422.4	888.3	648.2	170.29	291.21	146.78	202.76
P	124674	115264	126973	119805	121383	121620	321.85	277.72	274.29	291.29
Al	544	758	432	510	704	590	151.88	216.75	249.45	206.03
Be	0.91	0.29	0.34	0.44	1.16	0.63	<d/l	<d/l	<d/l	<d/l
Sc	3.86	0.91	0.40	0.28	0.95	1.28	<d/l	<d/l	<d/l	<d/l
V	69.89	55.51	33.41	23.12	67.47	49.88	0.26	0.60	0.22	0.36
Cr	15.73	5.28	21.98	<d/l	21.61	16.15	3.39	<d/l	16.20	9.79
Co	0.98	0.72	0.99	0.88	0.53	0.82	0.74	0.59	0.65	0.66
Ni	9.12	9.37	9.99	8.93	6.62	8.81	2.78	3.51	3.17	3.15
Cu	10.39	7.77	6.54	6.05	6.47	7.44	0.27	0.63	0.44	0.45
Zn	113.75	99.48	96.17	86.71	90.23	97.27	6.00	8.16	8.70	7.62
Ga	0.54	0.51	0.34	0.26	0.42	0.41	<d/l	0.03	<d/l	0.03
Rb	1.09	1.73	0.65	0.59	1.44	1.10	<d/l	0.26	<d/l	0.26
Sr	2589	2297	2597	2635	2593	2542	92.74	99.55	118.29	103.53

Zr	27.22	27.89	9.76	11.40	21.46	19.55	0.47	0.64	0.47	0.52
Nb	0.32	0.37	0.24	0.18	0.24	0.27	0.03	0.18	0.35	0.19
Mo	0.63	0.55	0.55	0.49	0.58	0.56	0.06	<d/l	0.10	0.08
Sn	<d/l	0.47	<d/l	0.48	<d/l	0.47	<d/l	<d/l	<d/l	
Sb	0.78	0.85	0.56	0.51	1.36	0.81	0.07	<d/l	<d/l	0.07
Cs	0.17	0.18	0.14	0.16	0.12	0.15	0.12	0.28	0.18	0.19
Ba	26.37	23.24	27.70	27.53	28.27	26.62	1.34	46.76	1.42	16.51
Hf	0.32	0.28	0.12	0.11	0.24	0.22	<d/l	0.01	0.01	0.01
Ta	0.01	0.01	0.02	0.00	0.00	0.01	0.00	0.01	0.04	0.02
W	0.08	0.11	0.11	0.13	0.04	0.09	0.02	0.16	0.44	0.21
Tl	0.04	0.05	0.05	0.07	0.04	0.05	0.36	0.30	0.45	0.37
Pb	13.36	11.17	8.50	7.01	17.88	11.59	0.67	0.84	0.60	0.70
Bi	0.16	0.14	0.11	0.06	0.14	0.12	<d/l	<d/l	<d/l	
Th	0.11	0.11	0.09	0.05	0.09	0.09	0.00	0.01	<d/l	0.00
U	24.25	37.65	50.73	54.80	23.26	38.14	0.11	0.08	0.09	0.09
La	39.03	11.45	3.94	2.79	10.12	13.47	0.07	0.17	0.07	0.10
Ce	24.48	3.18	2.52	0.97	3.44	6.92	0.21	0.32	0.22	0.25
Pr	4.73	0.77	0.44	0.19	0.67	1.36	0.00	0.03	0.01	0.01
Nd	19.43	2.89	1.83	0.80	2.63	5.52	0.03	0.13	0.02	0.06
Sm	3.58	0.47	0.23	0.15	0.40	0.97	0.01	0.02	<d/l	0.02
Eu	1.00	0.12	0.09	0.05	0.10	0.27	0.00	0.01	0.00	0.01
Gd	5.44	0.75	0.38	0.21	0.66	1.49	<d/l	0.03	<d/l	0.03
Tb	0.78	0.10	0.08	0.03	0.10	0.22	<d/l	0.00	<d/l	0.00
Dy	5.73	0.84	0.51	0.23	0.81	1.62	0.01	0.03	<d/l	0.02
Y	77.67	17.46	6.94	4.16	18.19	24.89	0.08	0.30	0.11	0.16
Ho	1.47	0.26	0.12	0.06	0.23	0.43	<d/l	0.01	0.00	0.00
Er	4.97	0.85	0.43	0.17	0.86	1.46	0.01	0.01	0.00	0.01
Tm	0.75	0.14	0.06	0.03	0.13	0.22	<d/l	<d/l	0.00	0.00
Yb	4.87	0.99	0.39	0.19	0.86	1.46	<d/l	0.02	0.01	0.01
Lu	0.84	0.18	0.06	0.04	0.18	0.26	<d/l	0.00	0.00	0.00
Ce*	0.39	0.21	0.41	0.26	0.25	0.30	2.22	1.00	1.98	1.42
REE+Y	194.77	40.47	18.03	10.06	39.38	60.54	0.42	1.08	0.45	0.69

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Table S4 Carbonate fluorapatite in chemogenic region LA-ICP-MS data (ppm).

	Slv-2	Slv-7	Slv-8	Slv-9	Slv-10	Slv-11	Slv-12	Slv-13	Slv-14	Slv-15	Average
Si	7603	10113	8832	10370	8999	10490	10628	9950	4396	4145	8553
Ti	121.6	155.1	126.5	164.9	113.5	91.3	76.0	89.2	41.6	50.9	103.1
Mg	1374	1394	1366	1552	1415	1502	1460	1452	788	827	1313
Na	7112	6774	6902	7059	7414	6828	7320	7459	7719	7744	7233
K	1012	1358	1150	1591	1416	1617	1606	1658	549	710	1267
Mn	22.2	22.4	19.7	34.3	33.5	31.9	27.7	34.2	45.8	46.0	31.8
Fe	17010	1939	1762	2565	2002	2249	2431	24522	879	905	1889
P	121744	115758	120094	116608	120610	118526	122474	126523	122850	122463	120765
Al	2863	3680	3175	4447	3839	4503	4491	4530	1498	1575	3460
Be	0.54	0.48	0.52	0.54	0.35	0.58	<d/l	0.36	0.33	0.22	0.43
Sc	1.01	2.57	4.68	2.21	2.11	1.90	2.03	3.94	17.04	15.09	5.26
V	17.31	18.77	17.47	20.94	19.00	17.98	18.10	18.88	12.78	12.75	17.40
Cr	5.14	4.05	16.03	<d/l	9.26	4.10	21.66	<d/l	<d/l	<d/l	10.04
Co	0.80	0.68	0.57	0.77	0.78	0.59	0.68	0.84	0.66	0.72	0.71
Ni	3.24	3.00	2.42	3.76	3.35	3.34	3.28	3.77	3.27	3.57	3.30
Cu	3.63	4.95	4.85	5.75	5.02	4.92	5.14	5.74	2.81	3.03	4.58
Zn	37.93	39.85	38.99	43.57	40.92	39.56	40.00	40.99	27.06	26.20	37.51
Ga	0.93	1.23	1.04	1.18	1.10	1.18	1.20	1.19	0.55	0.71	1.03
Rb	5.10	6.57	5.98	8.02	6.90	8.34	8.27	8.38	2.56	2.64	6.28
Sr	1338	1320	1364	1347	1333	1226	1172	1217	1106	1068	1249
Zr	70.35	115.18	117.25	83.92	71.08	56.10	50.47	54.04	57.18	48.33	72.39
Nb	0.36	0.42	0.37	0.59	0.42	0.33	0.26	0.30	0.13	0.17	0.33
Mo	0.64	0.69	0.76	0.48	0.60	0.43	0.45	0.50	0.63	0.59	0.58
Sn	<d/l	0.47	0.59	0.57	0.48	0.57	0.52	0.40	0.55	0.66	0.53
Sb	2.50	2.47	2.53	2.55	2.43	1.98	2.00	2.04	2.04	2.03	2.26
Cs	0.55	0.70	0.69	0.88	0.69	0.94	0.87	1.05	0.34	0.33	0.70
Ba	11.44	14.71	12.81	12.78	12.25	12.23	12.23	13.92	27.62	469	59.89

Hf	0.69	1.06	1.15	0.94	0.85	0.72	0.68	0.74	0.53	0.43	0.78
Ta	0.02	0.02	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.02
W	0.04	0.05	0.03	0.05	0.05	0.02	0.03	0.03	0.02	0.03	0.03
Tl	0.06	0.08	0.06	0.09	0.09	0.10	0.10	0.11	0.05	0.06	0.08
Pb	2.73	2.39	2.13	1.74	1.59	1.27	1.13	1.24	1.15	1.13	1.65
Bi	0.04	0.04	0.03	0.04	<d/l	0.03	0.03	<d/l	<d/l	0.03	0.03
Th	0.34	0.54	0.42	0.46	0.33	0.28	0.19	0.22	0.09	0.07	0.29
U	12.65	12.72	12.48	11.53	11.21	8.86	8.11	8.33	7.13	6.68	9.97
La	8.26	26.83	57.25	28.70	26.53	18.08	15.40	24.28	40.79	38.57	28.47
Ce	3.64	7.26	15.68	7.04	6.22	3.53	2.96	4.23	5.99	7.05	6.36
Pr	0.78	1.76	4.02	1.83	1.82	1.06	0.93	1.76	3.68	4.46	2.21
Nd	3.08	6.67	16.14	7.08	7.21	4.06	3.61	6.74	14.64	18.33	8.76
Sm	0.53	1.03	2.47	1.11	1.17	0.61	0.52	1.01	2.38	3.33	1.42
Eu	0.14	0.32	0.70	0.30	0.32	0.18	0.14	0.32	0.67	0.98	0.41
Gd	0.74	1.76	4.30	1.77	1.90	1.06	0.89	1.75	4.42	5.46	2.41
Tb	0.10	0.26	0.61	0.23	0.25	0.14	0.12	0.25	0.64	0.77	0.34
Dy	0.74	2.00	4.97	1.83	1.84	1.03	0.94	1.73	5.30	5.77	2.61
Y	9.81	35.78	78.47	31.20	28.37	18.95	16.84	29.03	71.25	66.06	38.58
Ho	0.19	0.60	1.45	0.52	0.49	0.30	0.26	0.52	1.51	1.50	0.73
Er	0.60	2.21	5.02	1.72	1.61	0.99	0.90	1.73	5.19	5.06	2.50
Tm	0.09	0.36	0.75	0.25	0.21	0.16	0.14	0.27	0.83	0.74	0.38
Yb	0.63	2.60	5.34	1.79	1.72	1.04	1.10	1.95	6.30	5.67	2.81
Lu	0.13	0.53	1.03	0.33	0.30	0.23	0.21	0.35	1.15	1.02	0.53
Ce*	0.30	0.20	0.20	0.18	0.17	0.15	0.15	0.13	0.10	0.12	0.17
REE+Y	29.47	89.95	198.18	85.71	79.96	51.41	44.98	75.91	164.73	164.78	98.51

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Ce anomaly was calculated as $Ce^* = 2Ce/(La + Pr)$ for PAAS (Post-Archean Australian Shale)-normalized values (McLennan, 1989).

Spot	Data for Tera-Wasserburg Plots				Dates (for age)						% Conc*
	$^{238}\text{U}/^{206}\text{Pb}$	2s	$^{207}\text{Pb}/^{206}\text{Pb}$	2s	$^{207}\text{Pb}/^{206}\text{Pb}$	2s (abs)	$^{206}\text{Pb}/^{238}\text{U}$	2s (abs)	$^{207}\text{Pb}/^{235}\text{U}$	2s (abs)	
Bio-3_1	8.5648	0.2509	0.7393	0.0084	4808	16	712	20	2596	29	27.4
	8.9275	0.1869	0.7413	0.0075	4812	15	684	14	2560	22	26.7
	7.5224	0.1272	0.7458	0.0084	4821	16	805	13	2727	19	29.5
	7.1937	0.1826	0.7628	0.0076	4853	14	839	20	2790	26	30.1
	7.1512	0.1264	0.7592	0.0079	4846	15	844	14	2792	20	30.2
	6.9994	0.1246	0.7567	0.0071	4842	13	861	14	2809	19	30.7
	7.6195	0.1754	0.7516	0.0069	4832	13	795	17	2722	23	29.2
	7.6584	0.1400	0.7633	0.0080	4854	15	791	14	2732	20	29.0
	7.1216	0.2009	0.7682	0.0074	4863	14	847	22	2807	28	30.2
	7.0728	0.1497	0.7604	0.0080	4849	15	853	17	2804	23	30.4
	8.7640	0.1857	0.7533	0.0083	4835	16	697	14	2592	22	26.9
	6.9065	0.1910	0.7691	0.0072	4865	13	872	23	2837	28	30.7
	7.7563	0.1520	0.7628	0.0081	4853	15	782	14	2719	21	28.7
	8.8629	0.1543	0.7505	0.0072	4830	14	689	11	2578	19	26.7
	8.1174	0.1621	0.7472	0.0086	4824	17	749	14	2657	22	28.2
	8.0634	0.1642	0.7514	0.0074	4832	14	754	15	2668	21	28.2
	9.7090	0.1939	0.7377	0.0081	4805	16	632	12	2477	21	25.5
	10.4760	0.2050	0.7250	0.0071	4780	14	588	11	2391	20	24.6
	10.6576	0.3407	0.7173	0.0084	4765	17	578	18	2366	31	24.4
	12.5039	0.2558	0.7141	0.0081	4759	16	496	10	2216	21	22.4
11.8753	0.3395	0.7042	0.0077	4739	16	521	14	2250	28	23.2	
12.0616	0.3752	0.7144	0.0075	4759	15	514	15	2249	30	22.8	
11.1746	0.2270	0.7175	0.0082	4766	16	553	11	2323	21	23.8	
11.7268	0.2336	0.7205	0.0082	4772	16	528	10	2283	21	23.1	
10.3878	0.2445	0.7289	0.0079	4788	16	593	13	2404	24	24.6	

Bio-5_1	16.9959	0.8494	0.6457	0.0112	4614	25	369	18	1859	45	19.8
	17.7448	0.8893	0.6414	0.0119	4604	27	353	17	1816	45	19.5
	18.3999	0.8659	0.6387	0.0116	4598	26	341	16	1782	42	19.1
	18.7486	0.8566	0.6410	0.0115	4603	26	335	15	1769	41	18.9
	18.7900	0.7717	0.6426	0.0114	4607	26	334	13	1770	38	18.9
	17.8558	0.8597	0.6425	0.0114	4607	26	351	17	1812	43	19.4
	17.2987	0.7979	0.6432	0.0115	4608	26	362	16	1840	42	19.7
	15.1945	0.6751	0.6706	0.0117	4668	25	411	18	1988	42	20.7
	19.4508	0.8690	0.6322	0.0109	4583	25	323	14	1727	40	18.7
	17.1703	1.0681	0.6423	0.0118	4606	27	365	22	1845	55	19.8
	18.0779	0.8702	0.6357	0.0111	4591	25	347	16	1793	43	19.4
	17.7657	1.0105	0.6457	0.0109	4614	24	353	20	1821	50	19.4
	20.2420	0.8950	0.6246	0.0125	4566	29	311	13	1684	40	18.5
	20.1438	0.8677	0.6377	0.0124	4596	28	312	13	1705	39	18.3
	18.0105	0.8020	0.6482	0.0123	4619	27	348	15	1813	41	19.2
	15.0829	0.4616	0.6829	0.0103	4695	22	414	12	2010	30	20.6
	14.0230	0.5613	0.6850	0.0108	4699	23	444	17	2077	38	21.4
	16.4149	0.6880	0.6576	0.0123	4640	27	381	16	1904	40	20.0
	15.6704	0.6794	0.6789	0.0114	4686	24	399	17	1972	40	20.2
	15.8910	0.5075	0.6714	0.0106	4670	23	393	12	1950	31	20.2
	15.0317	0.5307	0.6806	0.0109	4690	23	415	14	2010	34	20.7
	15.6522	0.4550	0.6746	0.0110	4677	24	399	11	1967	29	20.3
	18.3540	0.7526	0.6478	0.0112	4618	25	342	14	1796	38	19.0
17.3813	0.7267	0.6617	0.0110	4649	24	361	15	1860	38	19.4	
17.2802	0.5916	0.6630	0.0110	4652	24	363	12	1867	33	19.4	
	5.7785	0.1150	0.7856	0.0112	4895	20	1029	19	3028	24	34.0
	5.4113	0.1198	0.7765	0.0118	4879	22	1093	22	3081	26	35.5
	5.2371	0.1021	0.7843	0.0109	4893	20	1127	20	3122	23	36.1
	3.8968	0.1366	0.7998	0.0120	4921	21	1473	46	3429	37	42.9
	5.4320	0.1247	0.7924	0.0112	4908	20	1089	23	3096	26	35.2
	5.4105	0.0999	0.7903	0.0122	4904	22	1093	19	3098	23	35.3

Bio-6_1	6.0526	0.1177	0.7758	0.0109	4877	20	986	18	2972	23	33.2
	4.6399	0.1403	0.7839	0.0140	4892	26	1258	35	3239	34	38.8
	4.9901	0.1111	0.7807	0.0121	4886	22	1178	24	3164	26	37.2
	5.3343	0.1094	0.7869	0.0116	4898	21	1108	21	3107	24	35.6
	4.9587	0.0947	0.7965	0.0107	4915	19	1184	21	3190	23	37.1
	4.6872	0.0973	0.7851	0.0110	4894	20	1247	24	3231	24	38.6
	4.2851	0.1002	0.7942	0.0127	4911	23	1352	29	3329	28	40.6
	4.2773	0.0761	0.8020	0.0113	4925	20	1354	22	3341	22	40.5
	3.5762	0.0673	0.8135	0.0112	4945	20	1590	27	3530	23	45.0
	3.6136	0.0703	0.8048	0.0116	4930	21	1575	27	3509	24	44.9
	4.2204	0.0855	0.8003	0.0114	4922	20	1371	25	3352	24	40.9
	3.6055	0.0754	0.8099	0.0111	4939	20	1578	29	3518	25	44.9
	5.7184	0.1079	0.7853	0.0102	4895	19	1039	18	3038	22	34.2
	6.3353	0.1055	0.7756	0.0103	4877	19	945	15	2928	20	32.3
	6.1624	0.1063	0.7907	0.0100	4904	18	969	16	2973	21	32.6
	6.1097	0.1308	0.7859	0.0115	4896	21	977	19	2975	25	32.8
	4.5739	0.0853	0.8058	0.0123	4931	22	1275	22	3280	24	38.9
	5.5595	0.1015	0.7884	0.0095	4900	17	1066	18	3069	21	34.7
	5.0948	0.0987	0.7949	0.0109	4912	20	1155	21	3162	23	36.5
2.8308	0.0553	0.8162	0.0113	4950	20	1950	33	3764	24	51.8	
Bio-7_1	6.3104	0.4323	0.7741	0.0339	4874	63	948	60	2930	78	32.4
	6.7705	0.4138	0.7904	0.0352	4904	64	888	51	2882	72	30.8
	6.5549	0.4915	0.7894	0.0312	4902	56	915	64	2912	81	31.4
	6.0100	0.5697	0.7872	0.0330	4898	60	992	87	2993	100	33.2
	7.7084	0.5135	0.7965	0.0325	4915	58	786	49	2766	74	28.4
	6.7057	0.4660	0.7839	0.0302	4892	55	896	58	2883	76	31.1
	7.4277	0.4393	0.7734	0.0309	4873	57	814	45	2773	68	29.4
	7.0911	0.4821	0.7772	0.0328	4880	60	850	54	2822	76	30.1
	7.1554	0.3938	0.7749	0.0308	4876	57	843	44	2811	65	30.0
	6.9219	0.4532	0.7674	0.0273	4862	51	870	53	2833	71	30.7
	6.3836	0.4356	0.7569	0.0309	4842	58	938	60	2897	76	32.4

	6.9461	0.4252	0.7604	0.0295	4849	55	867	50	2821	69	30.7
	6.3176	0.6181	0.7681	0.0307	4863	57	947	86	2921	101	32.4
	5.7526	0.5394	0.8036	0.0322	4928	57	1033	90	3055	98	33.8
	6.2789	0.4982	0.7802	0.0308	4885	56	953	70	2942	85	32.4
	6.8432	0.4021	0.8120	0.0317	4942	56	879	48	2898	68	30.3
	6.5846	0.3973	0.8140	0.0306	4946	54	911	51	2937	68	31.0
	6.5380	0.3686	0.7764	0.0285	4878	52	918	48	2898	64	31.7
	7.1013	0.3894	0.7856	0.0323	4895	59	849	44	2831	65	30.0
	6.8554	0.3425	0.7581	0.0261	4844	49	878	41	2830	58	31.0
	6.5172	0.3451	0.7721	0.0267	4871	49	920	45	2896	61	31.8
	7.0107	0.4052	0.7349	0.0277	4800	54	860	47	2780	66	30.9
	6.9893	0.3953	0.7820	0.0306	4889	56	862	46	2842	66	30.3
	6.5254	0.4218	0.7769	0.0281	4879	52	919	55	2901	71	31.7
	6.9255	0.4057	0.7743	0.0323	4875	60	870	48	2841	69	30.6
Slv-7_1	13.0784	0.5150	0.7178	0.0190	4766	38	475	18	2181	43	21.8
	13.3250	0.5299	0.6967	0.0195	4723	40	467	18	2137	43	21.8
	13.1324	0.5089	0.7296	0.0210	4790	41	473	18	2192	43	21.6
	13.2008	0.5368	0.7185	0.0196	4768	39	471	19	2173	44	21.7
	13.3795	0.6450	0.6956	0.0199	4721	41	465	22	2132	50	21.8
	12.5214	0.9532	0.7008	0.0189	4732	39	495	36	2198	73	22.5
	13.2404	0.6261	0.7124	0.0198	4755	40	469	21	2163	49	21.7
	11.1874	0.3859	0.7391	0.0190	4808	37	552	18	2349	39	23.5
	13.4335	0.4936	0.7053	0.0198	4741	40	463	16	2141	41	21.6
	13.5288	0.6582	0.6998	0.0197	4730	41	460	22	2128	50	21.6
	9.9861	0.3918	0.7289	0.0174	4788	34	615	23	2440	42	25.2
	14.1395	0.5596	0.7075	0.0204	4745	41	441	17	2098	43	21.0
	13.4764	0.6011	0.6995	0.0209	4729	43	461	20	2131	48	21.7
	13.3033	0.6555	0.7067	0.0185	4744	38	467	22	2151	50	21.7
	13.5586	0.7017	0.6981	0.0191	4726	39	459	23	2124	52	21.6
	13.7848	0.5486	0.7179	0.0196	4766	39	452	17	2134	43	21.2
12.7345	0.6914	0.7090	0.0184	4748	37	487	26	2194	54	22.2	

	13.5116	0.5165	0.7281	0.0205	4787	40	460	17	2164	43	21.3
	13.7990	0.6446	0.7180	0.0206	4767	41	451	20	2133	49	21.1
	13.9087	0.5991	0.6965	0.0199	4723	41	448	19	2099	46	21.3
	13.6015	0.5964	0.7108	0.0204	4752	41	457	19	2137	47	21.4
	13.5179	0.5504	0.7148	0.0204	4760	41	460	18	2147	44	21.4
	7.3650	0.2419	0.7671	0.0164	4861	31	821	25	2773	37	29.6
	14.2832	0.4943	0.7152	0.0203	4761	41	436	15	2099	40	20.8
	13.8992	0.6410	0.7048	0.0200	4740	41	448	20	2110	48	21.2
Slv-12_1	15.3015	1.2177	0.6854	0.0230	4700	48	408	32	2001	76	20.4
	14.8416	1.1703	0.7098	0.0225	4750	46	420	32	2058	75	20.4
	16.8700	1.2408	0.7054	0.0243	4741	50	371	27	1941	70	19.1
	15.3566	1.3466	0.7066	0.0246	4744	50	407	35	2024	83	20.1
	15.7374	1.3229	0.6912	0.0248	4712	52	397	32	1984	80	20.0
	16.1846	1.1113	0.7133	0.0243	4757	49	387	26	1987	67	19.5
	16.4521	1.1380	0.6954	0.0236	4721	49	380	26	1950	67	19.5
	16.8585	1.0987	0.6911	0.0240	4712	50	372	24	1924	64	19.3
	15.8270	1.1562	0.7003	0.0251	4731	52	395	28	1990	71	19.8
	15.4631	1.2781	0.6873	0.0233	4704	49	404	32	1994	78	20.3
	15.8816	1.2122	0.7302	0.0260	4791	51	394	29	2024	74	19.5
	16.6338	1.0788	0.7071	0.0229	4745	47	376	24	1955	63	19.2
	15.9806	1.2697	0.7024	0.0249	4735	51	391	30	1984	76	19.7
	16.4454	1.3372	0.7000	0.0253	4730	52	381	30	1956	77	19.4
	14.0619	1.2138	0.7079	0.0236	4746	48	443	37	2104	82	21.1
	15.8782	1.1156	0.7177	0.0211	4766	42	394	27	2009	67	19.6
	16.1313	1.1808	0.7144	0.0234	4759	47	388	28	1991	70	19.5
	16.3171	1.2310	0.6994	0.0245	4729	50	383	28	1962	72	19.5
	16.0922	1.2169	0.7129	0.0247	4756	50	389	29	1991	73	19.5
	15.3334	1.3019	0.6967	0.0229	4723	47	407	34	2013	80	20.2
15.6784	1.1175	0.6904	0.0213	4710	44	399	28	1986	68	20.1	
15.6806	1.0278	0.7042	0.0230	4739	47	399	25	2003	64	19.9	
17.7873	0.9489	0.6944	0.0238	4719	49	353	18	1882	54	18.7	

	17.4138	1.1140	0.7235	0.0259	4778	51	360	22	1935	63	18.6
	16.6776	1.1333	0.6997	0.0214	4730	44	375	25	1944	65	19.3
Slv-15_1	12.0329	1.7474	0.7606	0.0311	4849	58	515	72	2308	137	22.3
	12.7599	2.0401	0.7445	0.0322	4819	62	486	75	2236	150	21.8
	17.3301	0.9427	0.7231	0.0313	4777	62	362	19	1939	60	18.6
	10.4981	1.8854	0.7501	0.0299	4829	57	587	101	2421	170	24.2
	9.6772	1.8243	0.7364	0.0263	4803	51	634	114	2479	178	25.6
	9.0392	1.7874	0.7361	0.0285	4802	55	676	127	2542	188	26.6
	11.6913	1.9668	0.7365	0.0297	4803	58	529	85	2305	158	23.0
	11.0995	1.8168	0.7267	0.0301	4784	59	556	87	2340	154	23.8
	10.0187	1.7951	0.7543	0.0304	4837	58	613	105	2469	170	24.8
	9.2781	1.8180	0.7339	0.0289	4798	56	660	123	2515	186	26.2
	10.8433	1.8635	0.7371	0.0325	4804	63	569	94	2375	163	23.9
	6.4614	1.0718	0.7620	0.0246	4852	46	928	143	2892	162	32.1
	10.6567	1.8083	0.7236	0.0324	4778	64	578	94	2374	161	24.4
	10.1423	1.9450	0.7149	0.0276	4760	55	606	111	2408	180	25.2
	10.7984	1.8456	0.7132	0.0275	4757	55	571	93	2348	160	24.3
	12.8390	1.9949	0.7052	0.0276	4741	56	484	72	2181	144	22.2
	8.8397	1.8441	0.7215	0.0286	4774	57	691	137	2544	198	27.2
	6.0484	1.3881	0.7917	0.0263	4906	47	986	210	2992	223	33.0
	12.7506	1.9001	0.7217	0.0296	4774	59	487	70	2208	139	22.0
	9.4199	1.7789	0.7132	0.0251	4757	51	650	117	2474	178	26.3
	5.4674	0.7665	0.7853	0.0225	4895	41	1083	140	3081	138	35.1
	11.6005	1.9677	0.7366	0.0307	4803	60	533	87	2312	159	23.0
	11.6627	1.7223	0.7073	0.0280	4745	57	530	75	2271	139	23.4
	9.1066	1.7457	0.7150	0.0267	4761	54	672	122	2508	182	26.8
8.4956	1.7155	0.7583	0.0323	4845	61	717	137	2628	194	27.3	
10.2291	1.8843	0.7511	0.0307	4831	59	601	106	2446	174	24.6	
	9.0877	0.1566	0.2221	0.0070	2995	51	673	11	1497	28	45.0
	9.2255	0.1405	0.2221	0.0049	2995	36	663	10	1485	21	44.7
	10.0012	0.1526	0.1588	0.0036	2442	38	614	9	1177	19	52.2

MMS apatite	8.4835	0.1558	0.2805	0.0071	3365	40	718	13	1741	26	41.2
	9.8324	0.1355	0.1796	0.0039	2648	36	624	8	1277	19	48.9
	9.5013	0.1579	0.2258	0.0060	3022	43	645	10	1475	24	43.7
	9.0594	0.1493	0.2441	0.0061	3146	40	675	11	1574	24	42.9
	9.9208	0.1739	0.1952	0.0055	2786	46	619	10	1332	25	46.5
	9.6750	0.1736	0.2181	0.0068	2966	50	634	11	1434	28	44.2
	9.9301	0.2567	0.2035	0.0097	2854	78	619	15	1362	41	45.4
	10.6648	0.2249	0.1425	0.0067	2257	81	578	12	1060	34	54.5
	10.4872	0.2161	0.1270	0.0063	2056	88	587	12	997	34	58.9
	9.7463	0.1868	0.2135	0.0069	2932	52	630	12	1412	29	44.6
	10.2698	0.1590	0.1973	0.0050	2803	41	599	9	1314	22	45.6
	10.0476	0.1746	0.2041	0.0060	2859	48	612	10	1355	26	45.1
	9.4577	0.1680	0.2332	0.0061	3073	42	648	11	1504	25	43.1
	9.0606	0.1596	0.2602	0.0071	3247	43	675	11	1626	26	41.5
	10.4567	0.1503	0.1497	0.0033	2342	38	589	8	1106	18	53.2
	9.4601	0.1422	0.2025	0.0048	2846	39	648	9	1395	21	46.4
	9.7716	0.1794	0.1966	0.0056	2797	47	628	11	1348	25	46.6
	9.9594	0.1933	0.2099	0.0070	2904	54	617	11	1383	29	44.6
	9.8281	0.1878	0.2226	0.0069	2999	50	625	11	1438	28	43.4
	9.5940	0.1720	0.2201	0.0061	2981	45	639	11	1448	26	44.1
	10.2717	0.1741	0.1829	0.0053	2679	48	599	10	1259	24	47.6
	10.3991	0.2029	0.1883	0.0058	2727	51	592	11	1271	26	46.6
	9.8348	0.1701	0.2107	0.0065	2910	50	624	10	1396	27	44.7
9.9857	0.1991	0.1721	0.0058	2577	56	615	12	1235	28	49.8	
8.9984	0.1795	0.2466	0.0074	3162	48	679	13	1588	29	42.8	
5.7933	0.1519	0.1561	0.0044	2413	48	1027	25	1574	31	65.2	
4.5912	0.0747	0.2953	0.0056	3445	29	1270	19	2324	23	54.7	
6.0787	0.0824	0.1425	0.0024	2257	29	982	12	1465	17	67.0	
5.9538	0.0740	0.1513	0.0019	2360	21	1001	12	1528	14	65.5	
6.1081	0.0727	0.1445	0.0018	2281	21	977	11	1472	13	66.4	

Otter Lake apatite	6.0187	0.0703	0.1466	0.0015	2306	18	991	11	1494	12	66.3
	6.0236	0.0719	0.1425	0.0015	2257	18	990	11	1472	12	67.3
	5.9227	0.0700	0.1467	0.0016	2307	19	1006	11	1508	13	66.7
	5.3793	0.0942	0.2088	0.0040	2896	31	1099	18	1877	22	58.6
	5.9458	0.1016	0.1437	0.0029	2272	35	1002	16	1488	21	67.3
	5.8675	0.1426	0.1465	0.0038	2305	45	1015	23	1514	28	67.0
	5.8221	0.1576	0.1470	0.0052	2311	61	1022	26	1523	35	67.1
	5.8634	0.1160	0.1545	0.0047	2396	52	1015	19	1557	29	65.2
	5.8685	0.0752	0.1541	0.0019	2391	21	1014	12	1554	14	65.3
	5.9917	0.1163	0.1415	0.0038	2245	46	995	18	1470	26	67.7
	5.6370	0.0751	0.1852	0.0040	2699	36	1053	13	1736	21	60.6
	5.8492	0.0803	0.1590	0.0023	2444	25	1017	13	1581	16	64.3
	5.0270	0.0832	0.2555	0.0052	3219	32	1170	18	2112	23	55.4
	5.0170	0.0958	0.2278	0.0070	3036	49	1172	21	2013	32	58.2

56

57 % Conc – Degree of concordance = $(^{206}\text{Pb}/^{238}\text{U age} * 100) / (^{207}\text{Pb}/^{235}\text{U age})$.