

Research Advances

First Zircon U-Pb Ages of the Pigeon Hill Fossil Locality of the Jehol Biota in the Greater Khingan Mountains, Inner Mongolia



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Objective

The Pigeon Hill fossil locality yielded a diversity of fossils of the Jehol Biota. It sheds new light on the evolution of the Jehol Biota in more distant paleogeographic locations. Although several taxa of extinct vertebrates were described from the Pigeon Hill, precise geochronological ages remain unknown. In order to compare the Jehol Biota in different areas, we firstly present LA-ICP-MS U-Pb dating of zircons in the fossil-bearing bed of the Pigeon Hill fossil locality.

Methods

Zircon LA-ICP-MS dating of volcanic tuff samples were conducted by using LA-ICP-MS at the Beijing Createch Testing Technology Co. Ltd. Laser sampling was performed by an ESI NWR 193nm laser ablation system. An AnalytikJena PQMS Elite ICP-MS instrument was used to acquire ion-signal intensities. Helium was applied as a carrier gas. Argon was used as the make-up gas and mixed with the carrier gas via a T-connector before entering the ICP. Each analysis incorporated a background acquisition of approximately 15 s (gas blank) followed by 45 s data acquisition from the sample. Zircon GJ-1 was used as external standard for U-Pb dating, and was analyzed twice every ten analyses. Time-dependent drifts of U-Th-Pb isotopic ratios were corrected by a linear interpolation for every ten analyses according to the variations of GJ-1. Uncertainty of preferred values (0.5%) for the external standard GJ-1 was propagated to the ultimate results of the samples. U, Th and Pb concentration was calibrated by NIST 610. Concordia diagrams and weighted mean calculations were made using the Isoplot/Ex_ver3.

Results

Zircon grains from volcanic tuff are prismatic, euhedral and colorless, and most have grain size ranging from 70 to

150 μm . The CL images of zircons exhibit an oscillatory zoning texture (Fig. 1). Most zircons have highly variable U and Th concentrations ($\text{U}=21\text{--}778$ ppm and $\text{Th}=39\text{--}1503$ ppm), as well as Th/U ratios of 0.58–2.93 (Appendix 1). These features suggest that these zircons are of a magmatic origin. A total of 120 zircon grains were performed U-Th-Pb analyses. A total of 99 analyses defined a weighted mean $^{206}\text{Pb}/^{238}\text{U}$ age of 121 ± 0.74 Ma (MSWD=1.5) (Fig. 2), which represents the formation age of volcanic tuff. This age is consistent with the geochronological range of the Jehol Biota (Early Cretaceous). Furthermore, the weighted $^{206}\text{Pb}/^{238}\text{U}$ age (121.23 ± 0.74 Ma) obtained from the Pigeon Hill of Inner Mongolia is also consistent with the $^{40}\text{Ar}/^{39}\text{Ar}$ age (125.4 ± 1.8 Ma) obtained from the Guanghua village of Longjiang County in Heilongjiang Province. The dating samples from two areas belong to the Dayangshu Basin and Longjiang Basin, respectively. Therefore, the new zircon ages firstly provide precise geochronological correlation of the same formation (upper part of the Longjiang Formation) in different areas.

Conclusions

The zircon LA-ICP-MS U-Pb dating for the fossil-bearing bed of the Pigeon Hill fossil locality is consistent with the geochronological range of the Jehol Biota. Furthermore, the precise geochronological age (121.23 ± 0.74 Ma) confirms that the fossil strata belong to the upper part of the Longjiang Formation in the Greater Khingan Mountains in Inner Mongolia, which can be correlated with the upper part of the Longjiang Formation in Heilongjiang Province and the Yixian Formation in western Liaoning.

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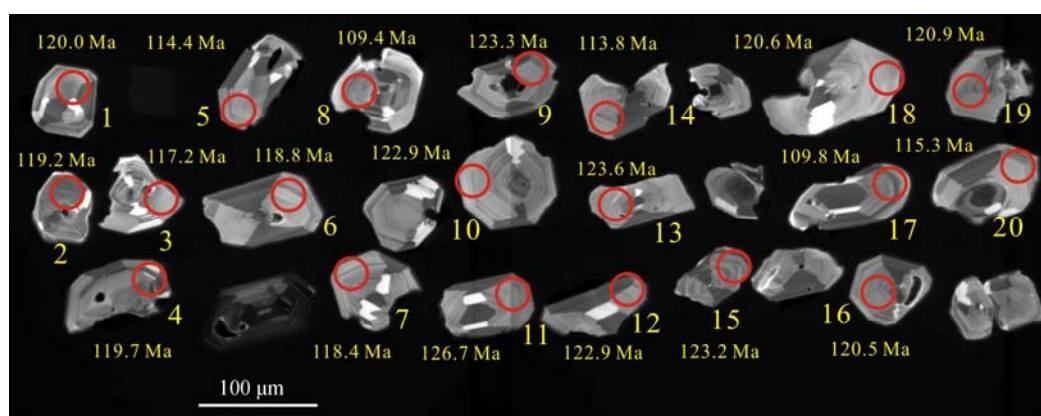


Fig. 1. Selected zircon CL images showing analyzed spots.

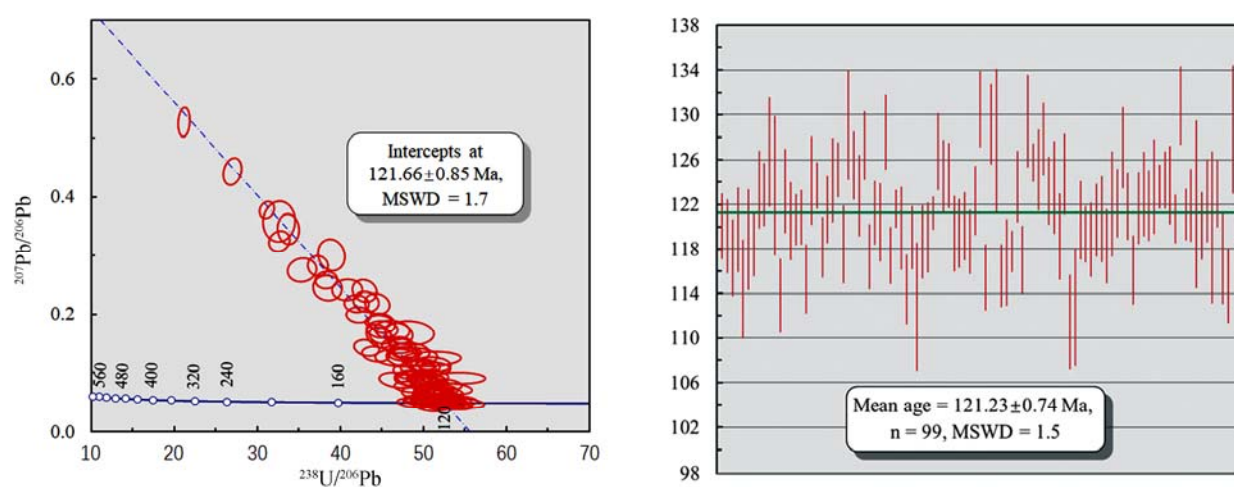


Fig. 2. Zircon U-Pb concordia diagrams for the volcanic tuff.

Appendix 1 Zircon LA-ICP-MS U-Pb isotopic data of porphyry from the Pigeon Hill

Spots	Pb	Th	U	Th/U	²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		Concordance
	ppm	ppm	ppm		Ratio	1σ	Ratio	1σ	Ratio	1σ	Age (Ma)	1σ	Age (Ma)	1σ	Age (Ma)	1σ	
Rep-1	17.91	70.69	47.39	1.49	0.1365	0.0097	0.3957	0.0291	0.0210	0.0005	2183.6	123.8	338.5	21.2	134.2	2.9	13%
Rep-2	42.94	153.03	73.50	2.08	0.1878	0.0074	0.5794	0.0262	0.0224	0.0005	2723.2	65.1	464.1	16.9	143.0	3.3	-6%
Rep-3	33.50	91.98	55.27	1.66	0.2215	0.0125	0.7072	0.0420	0.0232	0.0005	2991.7	91.4	543.1	25.0	147.9	3.4	-15%
Rep-4	21.83	81.61	51.64	1.58	0.1467	0.0094	0.4274	0.0283	0.0213	0.0006	2309.3	109.7	361.4	20.1	135.7	3.8	9%
Rep-5	37.65	71.58	48.14	1.49	0.2993	0.0179	1.0665	0.0722	0.0257	0.0007	3466.6	92.1	737.0	35.5	163.5	4.4	-28%
Rep-6	35.06	93.05	53.50	1.74	0.2475	0.0184	0.8156	0.0455	0.0245	0.0007	3168.8	118.2	605.6	25.5	156.0	4.5	-19%
Rep-7	21.80	103.50	61.58	1.68	0.1140	0.0073	0.3120	0.0192	0.0201	0.0005	1864.5	116.1	275.7	14.9	128.5	2.9	27%
Rep-8	15.82	78.71	50.61	1.56	0.1257	0.0089	0.3240	0.0220	0.0189	0.0005	2039.2	124.8	285.0	16.9	120.6	2.9	18%
Rep-9	38.44	112.48	63.75	1.76	0.2013	0.0109	0.6502	0.0331	0.0237	0.0006	2836.7	89.0	508.6	20.4	150.9	3.5	-9%
Rep-10	22.39	85.91	51.79	1.66	0.1617	0.0090	0.5022	0.0323	0.0223	0.0004	2473.1	94.4	413.2	21.8	142.2	2.8	2%
Rep-11	31.46	74.71	47.36	1.58	0.2471	0.0157	0.8775	0.0580	0.0260	0.0008	3166.4	100.9	639.6	31.4	165.5	4.9	-18%
Rep-12	21.81	77.44	49.10	1.58	0.1411	0.0170	0.4516	0.0700	0.0217	0.0008	2242.6	210.0	378.4	49.0	138.2	5.0	7%
Rep-13	82.10	125.33	57.46	2.18	0.4433	0.0134	2.2636	0.0874	0.0370	0.0010	4062.9	45.0	1201.0	27.2	234.4	6.2	-35%
Rep-14	30.63	89.81	51.51	1.74	0.2433	0.0161	0.7704	0.0458	0.0233	0.0005	3141.7	105.6	580.0	26.3	148.5	3.3	-19%
Rep-15	126.18	225.11	103.06	2.18	0.3786	0.0111	1.6727	0.0477	0.0321	0.0006	3827.8	44.2	998.2	18.1	203.7	3.8	-33%
Rep-16	30.66	82.43	53.27	1.55	0.2209	0.0115	0.7166	0.0369	0.0238	0.0006	2987.4	84.0	548.6	21.8	151.8	3.5	-14%
Rep-17	26.31	143.87	74.75	1.92	0.0967	0.0068	0.2418	0.0150	0.0182	0.0004	1562.0	131.5	219.9	12.3	116.6	2.8	38%
Rep-18	10.93	59.66	42.20	1.41	0.0562	0.0072	0.1445	0.0174	0.0191	0.0004	461.2	285.1	137.1	15.5	121.7	2.3	88%
Rep-19	13.24	87.79	57.72	1.52	0.0509	0.0046	0.1333	0.0118	0.0190	0.0004	235.3	209.2	127.0	10.6	121.2	2.4	95%
Rep-20	12.09	72.64	48.09	1.51	0.0734	0.0070	0.1867	0.0177	0.0186	0.0005	1027.8	194.4	173.8	15.1	118.9	3.1	62%
Rep-21	21.64	115.45	60.76	1.90	0.0905	0.0080	0.2482	0.0210	0.0205	0.0006	1436.1	168.5	225.1	17.1	130.7	4.0	46%
Rep-22	11.83	66.68	46.99	1.42	0.0795	0.0095	0.2185	0.0256	0.0201	0.0003	1187.0	238.9	200.6	21.3	128.5	2.1	56%
Rep-23	21.08	79.68	52.14	1.53	0.1537	0.0084	0.4421	0.0215	0.0212	0.0004	2387.4	93.2	371.7	15.1	135.2	2.7	6%

Continued Appendix 1

Spots	Pb	Th	U	Th/U	$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		Concordance
	ppm	ppm	ppm		Ratio	1 σ	Ratio	1 σ	Ratio	1 σ	Age (Ma)	1 σ	Age (Ma)	1 σ	Age (Ma)	1 σ	
Rep-24	17.01	95.49	55.85	1.71	0.0847	0.0059	0.2305	0.0161	0.0199	0.0005	1309.3	135.2	210.6	13.3	127.0	3.0	50%
Rep-25	39.10	98.68	54.12	1.82	0.2595	0.0112	0.9286	0.0401	0.0261	0.0006	3243.5	68.2	666.9	21.1	166.1	3.8	-21%
Rep-26	20.60	102.33	59.47	1.72	0.1021	0.0082	0.2930	0.0236	0.0209	0.0004	1662.7	149.5	260.9	18.5	133.7	2.5	35%
Rep-27	11.95	60.95	42.44	1.44	0.0961	0.0078	0.2564	0.0209	0.0197	0.0006	1550.0	154.0	231.8	16.9	125.6	3.5	40%
Rep-28	29.26	90.92	52.02	1.75	0.2262	0.0178	0.7619	0.0546	0.0249	0.0009	3025.0	125.8	575.1	31.5	158.7	5.4	-14%
Rep-29	43.16	72.89	43.25	1.69	0.3295	0.0162	1.3702	0.0559	0.0306	0.0008	3616.7	74.7	876.3	24.0	194.4	4.9	-28%
Rep-30	13.42	74.24	46.66	1.59	0.0473	0.0056	0.1271	0.0152	0.0196	0.0005	61.2	259.2	121.5	13.7	125.3	3.0	96%
Rep-31	41.09	95.54	54.81	1.74	0.2825	0.0118	1.0444	0.0488	0.0268	0.0006	3376.9	65.1	726.1	24.3	170.5	3.6	-24%
Rep-32	13.34	64.66	42.00	1.54	0.0653	0.0075	0.1815	0.0212	0.0203	0.0005	784.9	242.6	169.4	18.3	129.9	3.1	73%
Rep-33	17.09	85.61	56.82	1.51	0.1128	0.0083	0.3062	0.0227	0.0199	0.0005	1855.6	133.2	271.2	17.6	127.1	2.9	27%
Rep-34	12.46	83.77	54.65	1.53	0.0628	0.0051	0.1694	0.0148	0.0193	0.0005	699.7	174.1	158.9	12.8	123.3	2.9	74%
Rep-35	11.74	59.25	50.74	1.17	0.0731	0.0078	0.1869	0.0179	0.0194	0.0006	1018.2	218.5	174.0	15.3	124.1	3.5	66%
Rep-36	14.10	80.84	49.50	1.63	0.0512	0.0049	0.1419	0.0141	0.0202	0.0005	255.6	220.3	134.7	12.5	128.8	3.3	95%
Rep-37	14.04	88.35	54.43	1.62	0.0692	0.0071	0.1728	0.0163	0.0189	0.0004	903.4	213.0	161.9	14.1	120.4	2.6	70%
Rep-38	82.70	99.74	52.00	1.92	0.4238	0.0150	2.2162	0.0755	0.0382	0.0010	3996.0	53.0	1186.2	23.8	241.8	6.2	-33%
Rep-39	68.32	460.20	328.98	1.40	0.0519	0.0017	0.1366	0.0045	0.0191	0.0003	283.4	80.5	130.0	4.0	122.1	1.7	93%
Rep-40	17.36	86.04	52.85	1.63	0.1087	0.0103	0.2985	0.0256	0.0202	0.0006	1788.9	173.9	265.2	20.0	129.2	3.7	31%
Rep-41	32.22	87.48	53.78	1.63	0.2175	0.0121	0.6757	0.0409	0.0225	0.0005	2962.7	89.5	524.2	24.8	143.4	3.1	-15%
Rep-42	29.26	169.45	143.45	1.18	0.0530	0.0029	0.1517	0.0080	0.0210	0.0003	327.8	128.7	143.4	7.0	133.7	2.1	92%
Rep-43	127.61	84.71	53.41	1.59	0.5662	0.0232	3.9554	0.2068	0.0508	0.0020	4423.8	59.7	1625.1	42.4	319.6	12.3	-35%
Rep-44	18.12	97.24	60.12	1.62	0.0571	0.0044	0.1460	0.0113	0.0188	0.0004	494.5	165.7	138.4	10.0	120.3	2.8	85%
Rep-45	14.36	68.50	47.46	1.44	0.1317	0.0136	0.3335	0.0256	0.0196	0.0009	2121.3	181.5	292.3	19.5	125.3	5.8	20%
Rep-46	13.81	83.39	51.88	1.61	0.0538	0.0063	0.1379	0.0152	0.0187	0.0005	361.2	264.8	131.2	13.5	119.4	3.3	90%
Spots	Pb	Th	U	Th/U	$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		Concordance
	ppm	ppm	ppm		Ratio	1 σ	Ratio	1 σ	Ratio	1 σ	Age (Ma)	1 σ	Age (Ma)	1 σ	Age (Ma)	1 σ	
Rep-47	24.60	104.06	61.68	1.69	0.1352	0.0065	0.3835	0.0180	0.0208	0.0005	2165.7	84.3	329.6	13.2	132.8	3.1	14%
Rep-48	230.44	1503.17	777.94	1.93	0.0575	0.0019	0.1519	0.0049	0.0192	0.0002	509.3	76.8	143.6	4.3	122.5	1.5	84%
Rep-49	12.03	73.76	51.98	1.42	0.0454	0.0074	0.1265	0.0230	0.0198	0.0005	error		120.9	20.8	126.2	3.4	95%
Rep-50	62.73	65.57	113.07	0.58	0.0686	0.0024	0.8746	0.0291	0.0927	0.0012	887.0	78.7	638.1	15.7	571.6	7.0	89%
Rep-51	10.04	63.79	44.82	1.42	0.0493	0.0057	0.1334	0.0157	0.0195	0.0005	161.2	251.8	127.2	14.1	124.6	3.3	97%
Rep-52	11.69	72.17	45.30	1.59	0.0614	0.0050	0.1668	0.0133	0.0198	0.0005	653.7	169.4	156.6	11.6	126.5	2.9	78%
Rep-53	11.26	77.73	48.16	1.61	0.0482	0.0066	0.1145	0.0138	0.0187	0.0005	105.6	300.0	110.0	12.5	119.3	3.4	91%
Rep-54	16.68	84.58	52.99	1.60	0.0901	0.0069	0.2422	0.0176	0.0197	0.0005	1427.8	146.0	220.2	14.4	125.7	3.1	45%
Rep-55	29.32	84.55	52.45	1.61	0.0647	0.0068	0.1691	0.0180	0.0192	0.0005	764.8	224.1	158.6	15.6	122.4	3.0	74%
Rep-56	11.81	78.65	47.56	1.65	0.0474	0.0052	0.1201	0.0123	0.0186	0.0005	77.9	231.5	115.2	11.2	118.5	2.9	97%
Rep-57	9.10	50.41	31.27	1.61	0.0549	0.0084	0.1381	0.0198	0.0193	0.0005	405.6	341.6	131.4	17.7	123.3	3.1	93%
Rep-58	51.32	93.11	53.32	1.75	0.3577	0.0208	1.2569	0.0697	0.0258	0.0008	3740.0	88.5	826.5	31.4	164.3	4.7	-34%
Rep-59	16.50	58.07	41.30	1.41	0.1455	0.0120	0.4543	0.0332	0.0232	0.0005	2294.1	141.2	380.3	23.2	147.6	3.4	11%
Rep-60	22.11	101.45	61.08	1.66	0.1076	0.0064	0.2892	0.0194	0.0195	0.0005	1758.3	104.6	257.9	15.3	124.3	3.0	30%
Rep-61	24.64	96.84	53.99	1.79	0.1343	0.0110	0.4092	0.0303	0.0226	0.0006	2155.2	143.2	348.3	21.8	144.0	3.6	16%
Rep-62	22.41	93.77	56.22	1.67	0.1378	0.0089	0.3519	0.0205	0.0188	0.0005	2199.1	113.0	306.2	15.4	120.0	3.4	12%
Rep-63	117.46	80.73	51.79	1.56	0.5253	0.0133	3.4296	0.1215	0.0472	0.0010	4313.9	37.1	1511.2	27.9	297.5	6.4	-35%
Rep-64	10.92	67.45	48.05	1.40	0.0482	0.0055	0.1197	0.0143	0.0181	0.0004	122.3	238.9	114.8	13.0	115.6	2.8	99%
Rep-65	21.85	93.19	55.59	1.68	0.1412	0.0129	0.3861	0.0320	0.0206	0.0006	2242.3	158.2	331.5	23.4	131.4	3.9	13%
Rep-66	48.16	318.66	125.64	2.54	0.0557	0.0041	0.1428	0.0105	0.0186	0.0003	438.9	130.5	135.5	9.3	118.8	1.8	86%
Rep-67	24.62	92.32	53.87	1.71	0.1607	0.0138	0.5018	0.0460	0.0224	0.0005	2462.7	150.8	412.9	31.1	142.7	3.2	2%
Rep-68	13.80	83.13	52.70	1.58	0.0524	0.0053	0.1347	0.0144	0.0184	0.0005	301.9	231.5	128.3	12.9	117.6	3.1	91%
Rep-69	23.31	61.29	40.94	1.50	0.0897	0.0102	0.2579	0.0282	0.0213	0.0007	1420.4	224.2	232.9	22.8	136.1	4.1	47%
Spots	Pb	Th	U	Th/U	$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		Concordance
	ppm	ppm	ppm		Ratio	1 σ	Ratio	1 σ	Ratio	1 σ	Age (Ma)	1 σ	Age (Ma)	1 σ	Age (Ma)	1 σ	
Rep-70	53.82	356.54	121.67	2.93	0.0498	0.0033	0.1355	0.0090	0.0197	0.0003	187.1	155.5	129.0	8.1	125.9	1.7	97%
Rep-71	15.20	95.20	54.44	1.75	0.0551	0.0059	0.1450	0.0142	0.0197	0.0006	416.7	235.0	137.5	12.6	126.1	3.6	91%
Rep-72	10.25	55.88	40.10	1.39	0.0547	0.0055	0.1510	0.0147	0.0202	0.0005	466.7	223.1	142.8	13.0	128.7	3.2	89%
Rep-73	16.24	92.69	52.61	1.76	0.0673	0.0066	0.1771	0.0164	0.0197	0.0005	855.6	205.6	165.6	14.1	126.1	3.0	72%
Rep-74	7.27	38.54	36.03	1.07	0.0529	0.0072	0.1349	0.0171	0.0194	0.0007	324.1	281.4	128.5	15.3	124.2	4.1	96%
Rep-75	21.75	76.43	46.12	1.66	0.1813	0.0148	0.5328	0.0339	0.0222	0.0006	2664.5	136.1	433.7	22.4	141.6	3.9	-2%
Rep-76	10.30	50.63	34.09	1.49	0.0907	0.0092	0.2542	0.0270	0.0206	0.0006	1442.6	200.2	229.9	21.9	131.3	3.6	45%
Rep-77	15.40	80.96	52.96	1.53	0.0905	0.0062	0.2307	0.0185	0.0184	0.0007	1436.1	131.5	210.8	15.3	117.3	4.3	43%
Rep-78	15.55	50.93	36.14	1.41	0.1703	0.0150	0.4786	0.0450	0.0207	0.0008	2560.2	148.3	397.1	30.9	132.0	5.3	-1%
Rep-79	15.17	64.41	45.85	1.40	0.1327	0.0086	0.3814	0.0260	0.0210	0.0006	2200.0	113.1	328.1	19.1	134.1	3.5	16%

Continued Appendix 1

Spots	Pb	Th	U	Th/ U	²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		Concordance
	ppm	ppm	ppm		Ratio	1σ	Ratio	1σ	Ratio	1σ	Age (Ma)	1σ	Age (Ma)	1σ	Age (Ma)	1σ	
Rep-80	9.80	67.31	47.00	1.43	0.0507	0.0059	0.1301	0.0155	0.0187	0.0004	227.8	248.1	124.2	13.9	119.7	2.5	96%
Rep-81	44.89	44.08	20.95	2.10	0.0664	0.0037	1.2194	0.0643	0.1344	0.0021	820.4	116.7	809.5	29.4	812.6	11.9	99%
Rep-82	10.24	51.49	40.63	1.27	0.0762	0.0080	0.1912	0.0182	0.0192	0.0005	1099.1	213.0	177.7	15.5	122.9	3.3	63%
Rep-83	12.04	61.28	42.76	1.43	0.0860	0.0062	0.2317	0.0181	0.0198	0.0005	1338.9	138.9	211.6	14.9	126.3	3.2	49%
Rep-84	152.63	152.48	133.23	1.14	0.1970	0.0090	1.6466	0.0950	0.0604	0.0016	2801.5	74.4	988.3	36.5	378.0	9.7	10%
Rep-85	152.81	212.39	260.39	0.82	0.0918	0.0034	0.7630	0.0280	0.0603	0.0007	1464.8	69.8	575.8	16.1	377.3	4.3	58%
Rep-86	2.25	88.43	55.98	1.58	0.0853	0.0085	0.2375	0.0254	0.0198	0.0006	1324.1	194.0	216.4	20.8	126.3	3.8	47%
Rep-87	18.90	110.47	57.23	1.93	0.0726	0.0055	0.2103	0.0159	0.0216	0.0007	1002.8	153.7	193.8	13.3	137.6	4.7	66%
Rep-88	15.29	52.97	38.17	1.39	0.1868	0.0138	0.5663	0.0385	0.0222	0.0005	2714.5	121.9	455.6	25.0	141.7	3.3	-6%
Rep-89	62.02	103.93	58.23	1.78	0.3424	0.0161	1.4106	0.0807	0.0296	0.0008	3673.8	71.8	893.4	34.0	188.3	4.7	-31%
Rep-90	34.67	129.61	65.52	1.98	0.2012	0.0115	0.5385	0.0263	0.0199	0.0006	2835.5	92.9	437.4	17.3	127.1	3.5	-10%
Rep-91	11.23	67.82	47.10	1.44	0.0522	0.0069	0.1340	0.0167	0.0192	0.0005	294.5	277.8	127.7	14.9	122.7	3.0	96%
Rep-92	16.93	104.67	57.49	1.82	0.0771	0.0073	0.2161	0.0198	0.0206	0.0006	1125.0	190.7	198.7	16.5	131.5	3.6	59%
Spots	Pb	Th	U	Th/ U	²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		Concordance
	ppm	ppm	ppm		Ratio	1σ	Ratio	1σ	Ratio	1σ	Age (Ma)	1σ	Age (Ma)	1σ	Age (Ma)	1σ	
Rep-93	8.18	48.80	36.99	1.32	0.0516	0.0054	0.1330	0.0134	0.0192	0.0005	333.4	242.6	126.8	12.0	122.3	3.0	96%
Rep-94	25.18	94.14	54.54	1.73	0.1682	0.0127	0.4917	0.0384	0.0213	0.0005	2539.8	127.2	406.0	26.1	135.6	3.1	0%
Rep-95	9.52	55.25	43.21	1.28	0.0643	0.0069	0.1703	0.0183	0.0194	0.0005	753.7	229.6	159.7	15.9	124.0	3.2	74%
Rep-96	9.68	58.71	44.13	1.33	0.0594	0.0078	0.1542	0.0179	0.0195	0.0006	588.9	254.6	145.6	15.8	124.5	3.8	84%
Rep-97	13.76	76.60	49.67	1.54	0.0723	0.0081	0.1931	0.0195	0.0197	0.0005	994.4	227.8	179.3	16.6	125.5	3.2	64%
Rep-98	71.94	65.84	38.04	1.73	0.4767	0.0266	3.1509	0.2801	0.0456	0.0026	4170.7	81.9	1445.2	68.6	287.2	15.8	-34%
Rep-99	9.01	52.32	35.85	1.46	0.0537	0.0080	0.1411	0.0204	0.0195	0.0007	366.7	298.1	134.1	18.2	124.4	4.2	92%
Rep-100	29.91	181.20	124.80	1.45	0.0540	0.0033	0.1434	0.0078	0.0195	0.0003	372.3	137.0	136.1	6.9	124.4	2.0	91%
Rep-101	194.30	106.82	49.34	2.17	0.6392	0.0203	6.1484	0.2224	0.0704	0.0025	4599.7	46.0	1997.1	31.6	438.8	14.9	-28%
Rep-102	9.85	60.24	45.54	1.32	0.0450	0.0058	0.1197	0.0156	0.0194	0.0004	error		114.8	14.1	123.6	2.6	92%
Rep-103	23.10	65.42	44.09	1.48	0.1895	0.0168	0.5946	0.0571	0.0223	0.0008	2738.9	146.3	473.8	36.4	142.5	5.1	-8%
Rep-104	14.27	53.26	41.72	1.28	0.0931	0.0113	0.2535	0.0282	0.0205	0.0006	1500.0	232.6	229.4	22.8	130.7	3.5	45%
Rep-105	13.69	79.28	49.58	1.60	0.0544	0.0051	0.1417	0.0131	0.0190	0.0003	387.1	211.1	134.5	11.7	121.5	2.2	89%
Rep-106	12.84	82.66	50.74	1.63	0.0473	0.0054	0.1365	0.0165	0.0205	0.0006	61.2	261.1	130.0	14.7	130.6	3.5	99%
Rep-107	24.52	88.99	53.73	1.66	0.1458	0.0134	0.4421	0.0411	0.0225	0.0007	2298.2	158.9	371.7	28.9	143.4	4.7	11%
Rep-108	17.31	107.02	87.43	1.22	0.0538	0.0048	0.1420	0.0129	0.0191	0.0004	361.2	203.7	134.8	11.5	121.8	2.3	89%
Rep-109	14.96	75.81	49.28	1.54	0.0866	0.0074	0.2438	0.0219	0.0200	0.0005	1353.7	165.9	221.5	17.9	127.8	3.3	46%
Rep-110	46.81	65.71	46.32	1.42	0.3603	0.0227	1.5140	0.1117	0.0307	0.0012	3751.2	94.9	936.0	45.1	194.6	7.5	-32%
Rep-111	8.95	58.89	49.74	1.18	0.0520	0.0064	0.1365	0.0172	0.0189	0.0005	287.1	259.2	130.0	15.4	120.6	3.0	92%
Rep-112	24.35	108.65	61.82	1.76	0.1222	0.0097	0.3624	0.0327	0.0210	0.0006	1988.0	142.4	314.0	24.4	134.1	3.7	19%
Rep-113	19.17	84.09	50.93	1.65	0.1309	0.0141	0.3641	0.0361	0.0209	0.0011	2109.6	189.4	315.3	26.9	133.1	6.8	18%
Rep-114	24.37	102.90	59.00	1.74	0.0561	0.0048	0.1598	0.0128	0.0209	0.0005	457.5	188.9	150.5	11.2	133.2	3.0	87%
Rep-115	11.36	70.60	48.19	1.46	0.0492	0.0067	0.1264	0.0165	0.0193	0.0005	153.8	301.8	120.9	14.9	123.1	3.0	98%
Spots	Pb	Th	U	Th/ U	²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		²⁰⁷ Pb/ ²⁰⁶ Pb		²⁰⁷ Pb/ ²³⁵ U		²⁰⁶ Pb/ ²³⁸ U		Concordance
	ppm	ppm	ppm		Ratio	1σ	Ratio	1σ	Ratio	1σ	Age (Ma)	1σ	Age (Ma)	1σ	Age (Ma)	1σ	
Rep-116	21.55	72.70	47.56	1.53	0.1742	0.0131	0.5147	0.0376	0.0216	0.0006	2597.8	119.9	421.6	25.2	137.9	4.1	-2%
Rep-117	24.13	108.29	62.94	1.72	0.1152	0.0093	0.3076	0.0247	0.0195	0.0005	1883.6	145.1	272.3	19.2	124.7	3.3	25%
Rep-118	31.34	67.23	41.51	1.62	0.2856	0.0200	1.0728	0.0603	0.0283	0.0009	3394.1	109.1	740.1	29.5	179.6	5.7	-22%
Rep-119	29.23	88.12	52.93	1.66	0.1822	0.0136	0.6071	0.0399	0.0305	0.0066	2672.5	123.8	481.7	25.2	193.6	41.3	14%
Rep-120	20.00	97.90	60.66	1.61	0.0809	0.0065	0.2092	0.0167	0.0189	0.0004	1220.4	157.9	192.9	14.0	120.6	2.5	53%