

**Th, U and Pb analytical data of monazites  
used in the paper "Electron microprobe observations  
of Pb diffusion in metamorphosed detrital monazite"**

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**ABSTRACT**

This is a data-set paper, listing a total of 1052 electron microprobe ThO<sub>2</sub>, UO<sub>2</sub> and PbO analyses of monazites from gneiss and granitoid samples in the Ryoke metamorphic belt, Southwest Japan (Table 1). On the basis of these data, we have estimated the duration for the peak stage of the Ryoke metamorphism and evaluated diffusion parameters for Pb in monazite (Suzuki et al., 1994). The principal results are:

(1) Two samples of psammitic gneiss contain detrital monazites whose CHIME ages date back to the Precambrian as old as 1700 Ma. Several detrital grains are immune from overgrowth during the Ryoke metamorphism, and show marginal Pb-loss by diffusion from the surface. The width of the diffusion rims range 18–22  $\mu\text{m}$  for grains in the sample of the andalusite-sillimanite transition zone (620°C) and 48–58  $\mu\text{m}$  for those in the sample of the sillimanite-orthoclase zone (680°C).

(2) The temperature-time relation of the Ryoke gneiss are (a) first attainment of the amphibolite facies conditions ( $525 \pm 25^\circ\text{C}$ ) at 98.8–98.0 Ma, (b) peak metamorphism at  $95.2 \pm 3.9$  Ma, and (c) subsequent retrogression to 500° at 90 Ma and to 300°C at 84 Ma.

(3) The Pb diffusion coefficients, calculated from the observed Pb profiles on the assumption of an isothermal step of 5 Ma duration, are  $1.9 (\pm 0.3) \times 10^{-21}$  cm<sup>2</sup>/sec for 620°C and  $1.5 (\pm 0.3) \times 10^{-20}$  cm<sup>2</sup>/sec for 680°C. These data yielded an activation energy of  $2.44 (+2.85/-1.26) \times 10^5$  J/mol and a frequency factor of  $3.4 \times 10^{-7}$  ( $8.5 \times 10^{-12} - 2.2 \times 10^7$ ) cm<sup>2</sup>/sec for Pb diffusion in monazite.

**REFERENCE**

- Suzuki, K., Adachi, M. and Kajizuka, I. (1994) Electron microprobe observations of Pb diffusion in metamorphosed detrital monazites. *Earth Planet. Sci. Lett.*, **128**, 391–405.



Table 1. (continued).

Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)
M109-26	5.45	0.348	0.368	1282	6.68	M115-10	5.05	0.450	0.031	114	6.49	M177	7.08	0.319	0.434	1233	8.20
M109-27	5.60	0.273	0.282	1010	6.54	M115-11	7.11	0.687	0.501	1225	9.52	M178	4.98	0.375	0.020	77	6.18
M109-28	5.61	0.332	0.203	713	6.73	M115-12	5.35	0.506	0.031	106	6.97	M179	2.97	0.216	0.175	1099	3.72
M109-29	5.56	0.206	0.095	362	6.23	M115-13	6.75	0.660	0.423	1094	9.04	M180	11.8	0.192	0.635	1192	12.5
M109-30	5.57	0.256	0.062	231	6.40	M115-14	7.18	0.723	0.526	1259	9.73	M181	8.37	0.490	0.091	218	9.95
M109-31	5.53	0.290	0.219	793	6.51	M115-15	7.15	0.686	0.482	1177	9.55	M182	11.0	0.270	0.477	942	11.9
M109-32	5.54	0.272	0.429	1522	6.52	M115-16	5.42	0.431	0.025	88	6.80	M183	5.66	0.215	0.099	370	6.36
M109-33	5.81	0.306	0.433	1453	6.91	M115-17	5.45	0.470	0.030	103	6.96	M184	7.34	0.167	0.498	1453	7.94
M109-34	5.78	0.296	0.436	1475	6.84	M116-01	8.93	0.559	0.073	162	10.7	M185	9.45	0.293	0.041	94	10.4
M109-35	5.78	0.342	0.211	718	6.93	M116-02	8.84	0.501	0.069	158	10.5	M186	8.77	0.133	0.066	171	9.20
M109-36	5.49	0.298	0.092	339	6.46	M116-03	6.89	0.499	0.032	90	8.49	M187	6.15	0.107	0.309	1108	6.52
M109-37	5.57	0.318	0.072	260	6.60	M116-04	5.19	0.085	0.059	257	5.47	M188	5.26	1.02	0.613	1577	8.97
M109-38	5.53	0.329	0.432	1490	6.72	M117-01	5.75	0.338	0.090	313	6.85	M189	6.63	0.804	0.604	1469	9.52
M109-39	5.59	0.266	0.421	1488	6.55	M117-02	5.03	0.300	0.072	286	6.01	M190	6.69	0.668	0.582	1482	9.10
M109-40	5.45	0.300	0.426	1508	6.53	M117-03	5.60	0.329	0.077	275	6.67	M191	7.96	0.460	0.608	1465	9.61
M109-41	5.57	0.315	0.135	485	6.61	M117-04	7.74	0.499	0.032	82	9.34	M192	4.54	0.240	0.019	85	5.31
M109-42	5.76	0.323	0.063	221	6.80	M118	5.24	0.386	0.088	322	6.50	M193	6.75	0.090	0.403	1326	7.07
M109-43	5.89	0.299	0.177	608	6.89	M119	7.85	0.495	0.147	369	9.47	M194	6.84	0.188	0.260	819	7.48
M109-44	5.66	0.295	0.427	1471	6.72	M120	8.17	0.118	0.052	145	8.55	M195	5.64	0.675	0.226	676	7.90
M109-45	5.60	0.295	0.423	1471	6.66	M121	6.89	0.031	0.032	109	6.99	M196	7.92	0.421	0.038	98	9.27
M109-46	5.74	0.306	0.356	1218	6.81	M122	6.67	0.130	0.052	175	7.09	M197	6.00	0.405	0.323	1022	7.40
M109-47	5.28	0.261	0.030	117	6.12	M123	9.61	1.30	0.930	1506	14.3	M198	6.01	0.213	0.023	82	6.69
M109-48	5.63	0.280	0.112	407	6.55	M124	5.69	0.031	0.043	177	5.79	M199	4.93	0.292	0.116	467	5.89
M109-49	5.57	0.299	0.193	693	6.57	M125	7.10	0.833	0.675	1543	10.1	M200	13.9	0.375	0.529	818	15.2
M109-50	5.49	0.319	0.250	893	6.58	M126	10.3	0.076	0.523	1157	10.6	M201	8.34	0.288	0.351	885	9.32
M109-51	5.40	0.296	0.082	307	6.36	M127	6.18	0.272	0.082	277	7.06	M202	7.29	0.257	0.339	972	8.17
M110 (97 μm across)						M128	4.86	0.178	0.208	894	5.47	M203	8.36	0.221	0.035	92	9.07
5	6.83	0.429	0.202	579	8.26	M129	8.18	0.760	0.765	1612	11.0	M204	6.53	0.824	0.419	1046	9.38
8	6.83	0.526	0.320	873	8.62	M130	9.59	0.907	0.189	358	12.6	M205	7.71	0.385	0.425	1098	9.05
11	7.09	0.561	0.388	1007	9.02	M131	6.45	0.039	0.495	1728	6.59	M206	5.52	0.520	0.026	86	7.19
14	7.10	0.585	0.465	1186	9.15	M132	7.40	0.233	0.429	1217	8.22	M207	4.51	0.153	0.018	86	5.00
17	7.09	0.608	0.478	1209	9.22	M133	5.70	0.138	0.062	240	6.15	M208	6.33	0.184	0.203	690	6.95
20	7.12	0.606	0.495	1246	9.25	M134	5.89	0.777	0.444	1202	8.62	M209	4.90	0.689	0.326	1047	7.28
23	7.18	0.629	0.506	1254	9.39	M135	4.89	0.031	0.047	225	4.99	M210	5.99	0.361	0.390	1251	7.26
26	7.20	0.554	0.517	1312	9.16	M136	7.07	0.031	0.554	1774	7.19	M201	5.37	0.411	0.029	104	6.69
29	7.20	0.546	0.508	1294	9.13	M137	12.8	0.031	0.908	1627	12.9	M202	7.63	1.66	0.856	1457	13.6
40	7.27	0.682	0.520	1252	9.67	M138	5.03	0.467	0.412	1424	6.70	M203	8.85	0.142	0.478	1193	9.35
50	7.22	0.650	0.491	1205	9.50	M139	6.79	0.241	0.090	283	7.57	M204	9.38	0.664	0.079	164	11.5
60	7.17	0.411	0.510	1372	8.63	M140	7.03	0.341	0.575	1604	8.27	M205	6.55	0.922	0.520	1237	9.79
70	7.37	0.350	0.507	1366	8.62	M141	2.34	0.029	0.031	303	2.43	M206	6.70	0.088	0.362	1205	7.01
80	7.30	0.366	0.484	1310	8.60	M142	18.1	0.686	0.201	236	20.3	M207	4.03	0.742	0.025	93	6.41
84	7.30	0.389	0.440	1185	8.66	M143	5.58	0.203	0.079	301	6.24	M208	3.94	0.606	0.038	154	5.89
87	7.16	0.391	0.381	1047	8.51	M144	14.0	0.160	0.906	1438	14.6	M209	6.16	0.284	0.061	205	7.08
90	7.09	0.367	0.284	803	8.33	M145	6.76	0.418	0.034	100	8.10	M210	5.77	0.764	0.560	1518	8.53
93	6.99	0.371	0.186	536	8.22	M146	5.36	0.710	0.525	1532	7.93	M211	7.29	0.442	0.587	1528	8.89
95	6.88	0.376	0.063	186	8.09	M147	8.13	0.324	0.230	591	9.21	M212	9.17	0.337	0.590	1324	10.4
M111	4.79	0.210	0.098	425	5.48	M148	9.80	0.169	0.515	1157	10.4	M213	6.46	0.094	0.028	99	6.76
M112	4.95	0.201	0.062	264	5.60	M149	27.7	0.588	0.212	171	29.6	M214	7.66	0.865	0.510	1117	10.7
M113-01	7.15	0.339	0.033	96	8.24	M150	6.54	0.111	0.117	403	6.90	M215	7.26	0.731	0.038	94	9.60
M113-02	10.0	0.406	0.046	97	11.3	M151	8.41	0.396	0.634	1492	9.84	M216	7.09	1.02	0.462	1020	10.6
M113-03	13.4	0.673	0.066	101	15.6	M152	7.58	0.324	0.039	108	8.62	M217	6.40	0.781	0.196	517	8.98
M113-04	13.1	0.678	0.064	100	15.3	M153	8.37	0.471	0.079	191	9.89	M218	6.77	0.695	0.340	875	9.14
M113-05	11.0	0.659	0.054	98	13.1	M154	14.4	0.661	0.141	203	16.5	M219	9.90	0.267	0.575	1236	10.8
M113-06	10.4	0.667	0.054	103	12.5	M155	12.8	0.147	0.556	983	13.3	M220	10.8	0.204	0.522	1059	11.5
M113-07	11.2	0.728	0.056	99	13.5	M156	4.95	1.04	0.072	206	8.31	M221	6.53	0.727	0.062	167	8.87
M114	6.71	0.048	0.084	291	6.87	M157	9.83	0.203	0.438	976	10.5	M222	17.3	0.544	1.16	1405	19.2
M115-01	6.90	0.632	0.476	1217	9.12	M158	7.27	0.497	0.613	1561	9.08	M223	12.9	0.569	0.670	1056	14.9
M115-02	5.32	0.540	0.028	95	7.05	M159	7.07	0.153	0.168	525	7.58	M224	4.87	1.14	0.492	1286	8.90
M115-03	4.12	0.396	0.021	93	5.39	M160	4.03	0.290	0.295	1354	5.06	M225	5.74	0.495	0.027	88	7.33
M115-04	7.41	0.691	0.332	802	9.75	M171	5.74	0.036	0.376	1483	5.87	M226	7.62	0.693	0.069	167	9.85
M115-05	6.34	0.535	0.304	876	8.16	M172	6.06	0.062	0.398	1469	6.28	M227	7.40	0.270	0.279	791	8.31
M115-06	5.04	0.480	0.027	98	6.58	M173	6.59	0.170	0.310	1012	7.18	M228	10.5	0.186	0.557	1163	11.2
M115-07	6.54	0.342	0.290	885	7.71	M174	6.72	0.089	0.448	1473	7.04	M229	7.68	0.414	0.207	542	9.05
M115-08	5.21	0.438	0.029	105	6.62	M175	6.03	0.315	0.022	75	7.04						
M115-09	6.60	0.516	0.301	847	8.35	M176	12.4	0.172	0.690	1234	13.0						

Table 1. (continued).

Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)
Sample 1704, Yanai																	
M001-01	5.75	0.643	0.032	98	7.81	M052	6.01	0.076	0.026	99	6.25	M088-02	4.83	0.641	0.030	104	6.89
M001-02	5.91	0.950	0.035	93	8.95	M053	5.83	0.511	0.029	93	7.47	M088-03	6.06	0.713	0.060	171	8.36
M002	5.84	0.126	0.404	1487	6.29	M054	6.39	0.085	0.028	100	6.66	M088-04	4.70	0.472	0.030	115	6.22
M003	5.95	1.10	0.038	96	9.48	M055	5.39	1.04	0.450	1165	9.03	M088-05	5.91	1.01	0.490	1211	9.46
M004	7.50	0.829	0.315	722	10.3	M056	5.21	0.883	0.055	163	8.05	M088-06	5.85	1.08	0.555	1334	9.69
M005	6.51	0.656	0.130	357	8.65	M057	6.31	0.513	0.034	102	7.96	M088-07	5.80	1.13	0.448	1078	9.72
M006	4.55	0.953	0.028	88	7.60	M058	5.33	0.470	0.028	98	6.84	M088-08	6.22	0.891	0.300	766	9.23
M007	5.59	1.16	0.642	1520	9.79	M059	5.55	0.089	0.347	1374	5.87	M088-09	5.49	0.778	0.298	861	8.14
M008	6.11	0.171	0.026	93	6.66	M060	4.88	0.654	0.033	113	6.98	M088-10	5.34	0.782	0.234	693	7.96
M009	6.38	0.524	0.367	1049	8.19	M061	5.64	0.880	0.638	1659	8.87	M088-11	5.46	1.24	0.633	1475	9.93
M010-01	5.76	0.843	0.033	93	8.46	M062	8.20	0.523	0.563	1303	10.1	M088-12	5.28	1.13	0.553	1380	9.31
M010-02	5.93	0.806	0.036	101	8.51	M063	6.19	0.046	0.026	98	6.34	M088-13	5.59	0.808	0.370	1034	8.38
M011	6.89	0.926	0.695	1566	10.3	M064	6.56	0.179	0.339	1104	7.18	M088-14	5.27	0.709	0.170	529	7.62
M012-01	6.14	0.247	0.030	103	6.93	M065-01	6.50	0.853	0.037	96	9.23	M088-15	4.83	0.816	0.447	1344	7.73
M012-02	5.64	0.632	0.034	106	7.67	M065-02	5.40	0.746	0.033	101	7.79	M088-16	5.16	0.945	0.584	1570	8.60
M012-03	6.00	0.443	0.033	106	7.42	M065-03	6.50	0.385	0.037	114	7.74	M088-17	5.81	0.691	0.276	797	8.15
M013	5.14	0.805	0.031	96	7.72	M066	7.39	0.492	0.039	104	8.97	M088-18	6.16	0.736	0.063	176	8.53
M014	6.21	0.148	0.025	89	6.68	M067	22.1	0.749	0.112	109	24.5	M088-19	6.06	0.633	0.252	726	8.19
M015-01	4.99	0.527	0.032	114	6.68	M068	6.12	0.284	0.331	1089	7.11	M088-20	5.88	0.787	0.067	190	8.42
M015-02	6.25	0.684	0.038	107	8.44	M069	8.04	0.339	0.045	118	9.13	M088-21	5.57	0.600	0.030	96	7.49
M016-01	6.25	0.836	0.034	91	8.93	M070-01	6.13	0.143	0.266	943	6.62	M088-22	5.63	0.854	0.038	108	8.37
M016-02C	5.92	1.03	0.059	152	9.24	M070-02	7.50	0.574	0.373	925	9.46	M088-23	6.22	0.881	0.259	667	9.17
M016-03	6.52	0.558	0.033	95	8.31	M071-01	5.69	1.76	0.712	1380	12.0	M088-24	5.70	0.380	0.097	333	6.94
M017	2.36	0.384	0.016	106	3.59	M071-02	7.05	1.12	0.667	1400	11.1	M088-25	4.54	0.625	0.226	800	6.66
M018-01	6.30	0.723	0.036	100	8.62	M072	6.10	0.452	0.032	101	7.55	M088-26	4.24	0.874	0.544	1681	7.45
M018-02	6.11	0.544	0.036	109	7.86	M073	5.97	0.274	0.029	101	6.85	M088-27	3.69	0.828	0.486	1666	6.73
M019	5.24	1.01	0.550	1437	8.86	M074-01	6.31	0.258	0.033	110	7.14	M088-28	4.03	0.900	0.538	1688	7.34
M020	6.31	0.742	0.037	102	8.69	M074-02	6.61	0.794	0.040	104	9.16	M088-29	5.45	0.677	0.239	730	7.73
M021	6.57	0.326	0.381	1154	7.71	M075-01	6.09	0.619	0.038	112	8.08	M088-30	5.76	0.620	0.344	1021	7.90
M022	7.92	0.341	0.559	1418	9.14	M075-02	6.65	0.534	0.035	100	8.36	M088-31	6.03	0.772	0.340	921	8.67
M023	2.26	0.402	0.016	108	3.55	M076-01	5.24	0.322	0.454	1631	6.42	M088-32	5.68	0.890	0.180	495	8.62
M024-01	7.38	0.160	0.545	1581	7.96	M076-02	5.32	0.387	0.476	1631	6.74	M088-33	4.96	0.543	0.044	157	6.71
M024-02R	8.38	0.560	0.511	1154	10.3	M076-03R	6.08	0.453	0.146	458	7.57	M088-34	5.75	1.09	0.570	1374	9.64
M025	6.80	0.607	0.122	331	8.78	M077	5.76	0.291	0.029	103	6.69	M088-35	5.67	1.28	0.618	1402	10.2
M026-01	5.69	0.842	0.034	97	8.39	M078-01	5.31	0.112	0.128	534	5.68	M088-36	5.92	1.09	0.430	1041	9.69
M026-02	6.36	0.643	0.038	108	8.42	M078-02R	5.81	1.01	0.037	98	9.05	M088-37	5.72	0.875	0.343	924	8.71
M026-03	5.87	0.755	0.032	92	8.29	M079 (112 μm across)						M088-38	4.56	0.885	0.550	1628	7.80
M027	4.17	0.565	0.181	704	6.07	5 μm	5.65	0.073	0.024	97	5.88	M088-39	3.96	0.756	0.445	1537	6.70
M028	5.57	0.640	0.029	91	7.62	15	4.75	0.918	0.032	99	7.69	M088-40	5.04	0.735	0.280	872	7.54
M029	6.06	0.693	0.054	156	8.29	22	4.75	0.839	0.031	99	7.44	M088-41	5.35	0.460	0.179	615	6.88
M030	6.47	0.454	0.034	102	7.93	35	5.72	0.666	0.032	97	7.86	M088-42	5.46	0.911	0.241	669	8.51
M031	6.44	0.246	0.033	109	7.23	42	4.55	0.756	0.039	133	6.98	M088-43	5.60	0.796	0.035	102	8.15
M032	6.92	1.05	0.064	148	10.3	49	5.09	0.906	0.051	152	8.01	M088-44	5.19	0.284	0.026	102	6.10
M033	6.25	0.363	0.038	122	7.42	58	4.72	0.853	0.048	153	7.47	M088-45	6.24	0.850	0.281	729	9.10
M034	6.52	0.295	0.296	923	7.53	66	4.95	0.862	0.052	161	7.73	M088-46	6.10	0.725	0.194	541	8.50
M035	6.46	0.798	0.036	95	9.02	79	5.12	0.888	0.052	156	7.98	M088-47	6.15	0.498	0.200	606	7.81
M036	6.69	0.751	0.044	115	9.10	91	5.89	0.425	0.048	158	7.26	M088-48	5.40	0.834	0.216	624	8.18
M037	3.32	0.587	0.021	96	5.20	100	6.41	0.045	0.043	157	6.55	M088-49	4.96	0.659	0.130	433	7.13
M038	6.40	0.502	0.034	101	8.01	108	6.38	0.051	0.043	157	6.54	M088-50	5.91	1.08	0.453	1098	9.66
M039	6.77	0.239	0.036	114	7.54	M080	6.64	0.037	0.030	106	6.76	M088-51	5.58	0.851	0.572	1528	8.66
M040-01	5.69	0.888	0.469	1240	8.82	M081	4.20	0.277	0.024	112	5.09	M088-52	3.98	0.536	0.322	1276	5.87
M040-02	7.45	1.14	0.691	1394	11.5	M082	3.20	0.093	0.018	123	3.50	M088-53	4.94	0.580	0.171	589	6.87
M041	6.48	0.393	0.034	105	7.74	M083	6.17	0.262	0.028	95	7.01	M088-54	6.05	0.701	0.445	1219	8.51
M042	6.88	0.190	0.447	1374	7.56	M084-01	7.48	0.186	0.195	570	8.10	M088-55	5.73	0.751	0.374	1051	8.33
M043	6.88	0.200	0.102	322	7.53	M084-02R	6.28	0.203	0.158	538	6.95	M088-56	6.13	0.583	0.116	344	8.03
M044	6.31	0.495	0.178	531	7.95	M085-01	6.42	0.432	0.044	134	7.81	M088-57	6.05	0.426	0.132	421	7.45
M045-01	6.00	1.19	0.066	160	9.83	M085-02	6.23	0.444	0.073	227	7.67	M088-58	4.22	0.333	0.098	438	5.32
M045-02	5.44	0.660	0.032	101	7.56	M085-03R	6.80	0.483	0.034	97	8.35	M088-59	4.56	0.388	0.025	103	5.80
M046	4.52	0.336	0.026	111	5.60	M086-01	6.54	0.307	0.033	105	7.52	M088-60	4.98	0.357	0.025	97	6.12
M047	7.04	0.034	0.042	140	7.15	M086-02	6.28	0.121	0.028	100	6.67	M088-61	5.05	0.641	0.031	104	7.11
M048	6.43	0.139	0.114	393	6.89	M087-01	6.59	0.374	0.036	110	7.79	M088-62	4.84	0.878	0.316	945	7.85
M049	7.05	0.474	0.457	1222	8.72	M087-02	7.35	0.198	0.137	407	8.00	M088-63	5.60	0.897	0.357	965	8.68
M050	5.25	0.768	0.034	105	7.71	M087-03R	7.87	0.196	0.112	313	8.51	M088-64	5.39	0.391	0.028	100	6.64
M051	6.79	0.168	0.337	1069	7.37	M088-00	6.17	0.418	0.063	200	7.52	M088-65	4.45	0.645	0.443	1512	6.78
						M088-01	5.52	0.840	0.201	572	8.31	M088-66	6.06	1.17	0.393	918	10.1

Table 1. (continued).

Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)
M088-67	5.96	0.544	0.191	582	7.77	M114	5.01	0.461	0.027	99	6.49	M122 (198 $\mu$ m across)					
M089-01	5.67	0.594	0.037	117	7.58	M115-01	5.01	0.461	0.026	96	6.49	5 $\mu$ m	6.31	0.803	0.093	249	8.91
M089-02	5.62	0.277	0.028	103	6.51	M115-02	5.92	0.134	0.029	109	6.35	10	6.01	0.731	0.173	487	8.42
M090-01	6.19	0.115	0.030	109	6.56	M116	8.44	1.21	0.253	483	12.4	20	6.37	0.705	0.385	1024	8.80
M090-02	5.51	0.765	0.033	99	7.96	M117	5.08	0.938	0.036	106	8.09	30	6.39	0.826	0.548	1364	9.33
M090-03	5.88	0.305	0.031	108	6.86	M118 (107 $\mu$ m across)						40	6.43	0.805	0.640	1579	9.36
M091-01	6.18	0.137	0.026	94	6.62	3 $\mu$ m	6.66	0.105	0.027	92	7.00	60	6.61	0.762	0.720	1754	9.43
M091-02	5.76	0.201	0.029	108	6.40	8	6.19	0.105	0.031	113	6.53	80	6.54	0.965	0.760	1730	10.1
M091-03	6.71	0.625	0.039	107	8.72	15	5.97	0.511	0.036	113	7.61	90	6.36	0.904	0.748	1770	9.71
M092	6.74	0.322	0.056	172	7.78	24	5.24	0.931	0.038	110	8.23	105	5.94	1.13	0.781	1772	10.1
M092-01	5.74	0.148	0.028	108	6.21	32	4.96	0.952	0.041	122	8.02	120	6.34	0.991	0.756	1739	10.0
M092-02	5.36	0.242	0.026	101	6.14	40	5.35	0.868	0.041	120	8.14	130	6.26	0.874	0.734	1775	9.50
M093-01	6.21	0.604	0.040	117	8.15	45	4.72	0.864	0.032	102	7.49	140	6.04	1.07	0.716	1654	9.96
M093-02	6.47	0.913	0.045	114	9.40	58	4.86	0.939	0.036	109	7.87	160	6.22	0.676	0.614	1630	8.69
M093-03	7.25	0.047	0.035	113	7.40	67	4.96	0.979	0.040	118	8.10	170	6.21	0.687	0.496	1333	8.65
M094-01	7.06	0.218	0.033	102	7.76	73	5.34	0.991	0.038	106	8.52	180	6.80	0.744	0.403	1009	9.36
M094-02	4.64	0.746	0.029	98	7.03	83	5.21	0.794	0.034	105	7.76	190	6.72	0.543	0.143	400	8.50
M094-03	3.60	0.415	0.022	106	4.93	91	5.28	0.722	0.030	94	7.59	M123 (87 $\mu$ m across)					
M095	6.42	0.214	0.029	97	7.11	97	6.14	0.178	0.029	103	6.71	5 $\mu$ m	5.92	0.512	0.034	107	7.56
M096-01	6.25	0.483	0.035	107	7.80	103	6.26	0.058	0.021	78	6.45	11	6.15	0.513	0.035	107	7.80
M096-02	6.01	0.386	0.031	102	7.25	M119 (78 $\mu$ m across)						23	6.14	0.482	0.035	109	7.69
M097-01	6.01	0.686	0.037	108	8.21	4 $\mu$ m	6.78	0.134	0.027	89	7.21	30	5.90	0.453	0.033	107	7.35
M097-02	6.01	0.686	0.037	108	8.21	8	6.80	0.166	0.030	98	7.33	37	5.93	0.449	0.036	117	7.37
M098-01	5.84	0.470	0.029	94	7.35	15	6.62	0.127	0.033	112	7.03	40	5.86	0.602	0.035	107	7.79
M098-02	6.41	0.231	0.035	117	7.15	23	6.55	0.126	0.030	103	6.95	47	6.17	0.598	0.039	115	8.09
M099-01C	4.74	0.818	0.058	188	7.38	31	6.25	0.150	0.026	92	6.73	55	6.60	0.566	0.042	119	8.42
M099-02	4.65	0.771	0.032	107	7.12	40	6.45	0.168	0.028	96	6.99	62	6.63	0.569	0.039	110	8.46
M100-01	6.21	0.811	0.040	108	8.81	46	6.24	0.177	0.030	105	6.81	71	6.32	0.532	0.037	110	8.03
M100-02	6.72	0.726	0.039	103	9.05	52	6.08	0.146	0.031	113	6.55	77	6.49	0.537	0.038	110	8.21
M101	5.66	0.400	0.034	117	6.94	60	6.08	0.110	0.021	78	6.43	83	5.82	0.366	0.033	113	6.99
M102-01	5.01	0.527	0.027	96	6.70	68	6.13	0.116	0.026	95	6.50	M124 (176 $\mu$ m across)					
M103-01	5.75	0.384	0.031	106	6.98	74	5.75	0.094	0.023	91	6.05	5 $\mu$ m	6.12	0.781	0.130	357	8.67
M103-02	4.65	0.165	0.022	101	5.18	M120 (99 $\mu$ m across)						10	6.14	0.886	0.229	596	9.09
M104	5.34	0.710	0.036	113	7.62	3 $\mu$ m	6.29	0.726	0.028	77	8.61	15	6.21	0.739	0.315	850	8.72
M105-01	4.93	0.563	0.027	96	6.73	6	6.34	0.945	0.045	115	9.37	25	6.33	0.599	0.424	1174	8.42
M105-02	5.98	0.443	0.034	110	7.40	12	6.42	1.16	0.048	113	10.1	38	5.48	0.529	0.524	1630	7.41
M106-01	7.61	0.182	0.038	111	8.19	18	6.61	0.985	0.047	115	9.77	53	5.22	0.597	0.560	1734	7.43
M106-02	7.41	0.108	0.034	105	7.76	28	6.68	0.778	0.037	96	9.17	65	5.21	0.556	0.541	1715	7.26
M106-03	7.67	0.179	0.033	95	8.24	35	6.34	0.708	0.036	100	8.61	75	5.21	0.440	0.516	1736	6.84
M107-01	6.47	0.576	0.081	232	8.33	43	6.60	0.695	0.046	124	8.83	90	5.43	0.447	0.520	1711	7.08
M107-02	6.07	0.415	0.078	251	7.42	49	6.39	0.702	0.041	113	8.64	105	5.28	0.516	0.537	1720	7.18
M107-03	6.21	0.608	0.055	161	8.17	55	5.87	0.646	0.031	93	7.94	115	5.25	0.449	0.525	1747	6.91
M107-04	5.80	1.23	0.046	113	9.75	61	6.05	0.629	0.038	112	8.07	130	5.26	0.456	0.520	1723	6.94
M107 (77 $\mu$ m across)						69	6.74	0.673	0.041	110	8.90	145	5.78	0.481	0.450	1393	7.50
3 $\mu$ m	6.45	0.428	0.042	128	7.83	76	7.09	0.714	0.040	102	9.38	160	6.17	0.558	0.302	880	8.07
6	6.48	0.338	0.050	158	7.57	82	6.56	0.745	0.042	112	8.95	170	7.03	0.482	0.150	414	8.61
14	5.87	0.826	0.068	190	8.54	89	6.68	0.706	0.032	85	8.94	173	6.29	0.365	0.079	252	7.47
24	5.75	0.745	0.069	202	8.16	95	6.26	0.820	0.031	83	8.89	M125 (148 $\mu$ m across)					
30	5.82	0.491	0.065	209	7.41	M121 (84 $\mu$ m across)						5 $\mu$ m	6.69	0.448	0.086	252	8.14
35	4.71	0.224	0.058	254	5.44	3 $\mu$ m	6.63	0.146	0.027	91	7.10	10	6.27	0.549	0.147	433	8.07
42	5.48	0.236	0.055	210	6.24	7	6.10	0.071	0.030	113	6.33	15	6.28	0.683	0.205	568	8.55
47	6.19	0.239	0.065	223	6.96	11	6.40	0.139	0.030	105	6.85	20	7.25	0.540	0.259	675	9.06
53	5.03	0.420	0.068	254	6.39	17	6.32	0.157	0.034	119	6.82	35	7.27	0.402	0.358	970	8.65
56	6.96	0.092	0.064	210	7.26	22	6.03	0.119	0.032	119	6.41	45	6.77	0.406	0.410	1168	8.19
62	6.79	0.137	0.063	208	7.23	29	6.05	0.137	0.031	114	6.49	55	6.72	0.351	0.431	1261	7.96
70	5.87	0.334	0.045	155	6.95	36	6.04	0.148	0.030	110	6.51	65	6.41	0.512	0.440	1247	8.21
74	5.65	0.286	0.031	113	6.57	45	5.80	0.111	0.029	112	6.16	75	6.24	0.538	0.430	1232	8.13
M108-01	5.59	0.269	0.027	100	6.45	55	5.84	0.281	0.030	106	6.74	90	6.14	0.552	0.423	1220	8.08
M108-02	7.16	0.278	0.037	110	8.05	59	6.05	0.128	0.032	118	6.46	100	5.91	0.533	0.408	1221	7.78
M109-01	7.46	0.355	0.036	100	8.60	67	6.00	0.139	0.032	118	6.45	110	6.85	0.611	0.370	970	8.95
M109-02	5.89	0.209	0.025	91	6.56	75	6.11	0.148	0.031	112	6.58	120	6.64	0.641	0.310	828	8.81
M110	5.97	0.379	0.036	120	7.19	81	5.86	0.154	0.028	105	6.35	130	6.35	0.675	0.229	629	8.60
M111	6.35	0.684	0.034	95	8.54							135	6.93	0.461	0.171	480	8.45
M112	7.64	0.166	0.030	88	8.17							140	6.87	0.493	0.110	309	8.48
M113	6.90	0.712	0.095	246	9.21							145	6.40	0.426	0.053	163	7.77



Table 1. (continued).

Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)	Grain No.	ThO <sub>2</sub> (wt%)	UO <sub>2</sub> (wt%)	PbO (wt%)	Age (Ma)	ThO <sub>2</sub> * (wt%)
M15	5.76	0.677	0.033	99	7.93	M50-01	1.90	0.340	0.011	88	2.99	Sample 1110: Gamano, Yanai					
M16	7.98	0.403	0.039	100	9.27	M50-02	2.39	0.458	0.014	87	3.86	M01-01	7.47	0.262	0.031	92	8.31
M17-01	6.04	0.733	0.035	100	8.39	M50-03	1.93	0.279	0.010	84	2.82	M01-02	7.56	0.288	0.033	93	8.48
M17-02	5.40	0.742	0.032	98	7.78	M52	2.06	0.406	0.013	92	3.36	M01-03	9.99	0.293	0.042	96	10.9
M18	6.03	1.46	0.046	103	10.7	M53	2.10	0.540	0.014	87	3.83	M01-04	6.85	0.473	0.032	97	8.36
M19	3.67	0.761	0.026	101	6.11	M54-01	3.72	0.914	0.025	90	6.65	M02-01	7.51	0.407	0.034	92	8.81
M20-01	5.91	1.28	0.042	100	10.0	M54-02	3.11	0.716	0.021	93	5.40	M02-02	7.22	0.367	0.031	94	8.40
M20-02	5.59	0.916	0.035	98	8.53	M54-03	2.07	0.642	0.015	87	4.13	M02-03	7.96	0.440	0.035	97	9.37
M20-03	5.57	1.08	0.037	98	9.03	M55-01	2.77	0.434	0.014	80	4.16	M03-01	7.17	0.233	0.030	96	7.92
M21-01	2.56	0.167	0.013	100	3.10	M55-02	2.33	0.367	0.013	88	3.51	M03-02	6.63	0.281	0.028	95	7.53
M21-02	2.48	0.190	0.012	93	3.09	M55-03	3.60	0.535	0.019	85	5.31	M03-03	7.38	0.520	0.034	95	9.05
M22-01	4.55	0.450	0.026	104	5.99	M56-01	3.01	0.654	0.018	84	5.10	M03-04	7.46	0.246	0.032	95	8.25
M22-02	4.53	0.643	0.028	101	6.59	M56-02	2.63	0.398	0.014	85	3.90	M03-05	7.23	0.281	0.030	94	8.13
M23-01	4.71	0.706	0.028	96	6.97	M56-03	2.71	0.665	0.018	89	4.84	M04-01	6.58	0.586	0.032	93	8.46
M23-02	4.85	0.895	0.034	105	7.72	Sample 0826: Mitsuhashi, Shitara						M04-02	5.60	0.337	0.025	94	6.68
M24-01	4.28	1.42	0.038	103	8.83	M01	2.93	0.057	0.011	84	3.11	M04-03	6.77	0.576	0.033	94	8.61
M24-02	4.52	1.67	0.040	97	9.88	M02-01	4.01	0.096	0.015	83	4.32	M05-01	5.40	0.138	0.022	94	5.84
M25	5.03	0.588	0.029	100	6.92	M02-02	4.64	0.118	0.017	80	5.02	M05-02	6.89	0.178	0.027	93	7.46
M26-01	6.00	0.479	0.032	101	7.54	M02-03	5.60	0.131	0.021	83	6.02	M05-03	8.54	0.130	0.034	96	8.96
M26-02	5.29	0.518	0.030	103	6.95	M02-04	4.50	0.101	0.017	84	4.82	M06-01	7.93	0.437	0.035	97	9.33
M27	6.41	0.768	0.039	105	8.87	M03-01	3.36	0.095	0.013	85	3.66	M06-02	7.56	0.222	0.031	92	8.27
M28-01	4.55	0.467	0.026	103	6.05	M03-02	2.95	0.086	0.012	86	3.22	M06-03	7.92	0.205	0.033	97	8.58
M28-02	4.53	0.366	0.022	92	5.70	M04-01	3.53	0.136	0.014	85	3.97	M06-04	8.18	0.202	0.033	95	8.83
M29	5.30	0.652	0.032	103	7.39	M04-02	4.45	0.119	0.016	79	4.83	M06-05	8.68	0.170	0.035	96	9.22
M30	5.22	0.541	0.030	103	6.95	M04-03	4.23	0.124	0.017	88	4.63	M07-01	7.57	0.330	0.032	97	8.63
M31	5.82	0.863	0.036	100	8.59	M04-04	4.31	0.098	0.016	82	4.62	M07-02	6.18	0.177	0.025	96	6.75
M32	5.05	0.555	0.032	112	6.83	M05-01	8.64	0.778	0.039	84	11.1	M07-03	5.81	0.344	0.026	97	6.91
M33	5.68	0.689	0.033	100	7.89	M05-02	8.67	0.778	0.040	85	11.2	M08-01	6.14	0.352	0.028	95	7.27
M34-01	5.20	1.01	0.037	105	8.44	M06-01	3.81	0.116	0.015	85	4.18	M08-02	6.42	0.511	0.030	95	8.06
M34-02	4.83	0.778	0.032	104	7.32	M06-02	4.42	0.126	0.018	87	4.82	M09-01	5.44	0.649	0.029	95	7.52
M35-01	4.18	0.812	0.029	102	6.78	M06-03	4.53	0.137	0.017	82	4.97	M09-02	5.15	0.629	0.028	93	7.17
M35-02	4.27	0.874	0.030	101	7.07	M06-04	5.08	0.147	0.020	86	5.55	M10-01	6.64	0.537	0.031	95	8.36
M36	4.51	0.352	0.027	114	5.64	Sample 2430: Mitsuhashi, Shitara						M10-02	6.84	0.185	0.027	96	7.43
M37-01	5.02	0.778	0.033	105	7.51	M01-01	4.46	0.214	0.018	83	5.15	M10-03	8.45	0.109	0.033	94	8.80
M37-02	2.91	0.555	0.019	97	4.69	M02	4.48	0.152	0.018	88	4.97	M11-01	6.31	0.312	0.028	94	7.31
M38	4.87	0.536	0.030	109	6.59	M03	5.39	0.148	0.021	85	5.86	M11-02	5.92	0.351	0.026	91	7.04
M39	5.34	0.674	0.031	99	7.50	M04	5.35	0.159	0.021	85	5.86	M11-03	5.51	0.201	0.024	97	6.15
M40	5.73	1.15	0.040	101	9.42	M05	5.42	0.166	0.021	84	5.95	M11-04	6.88	0.329	0.030	99	7.93
M41	5.39	0.456	0.027	94	6.85	M06	5.66	0.276	0.023	83	6.54	M11-05	6.05	0.537	0.029	95	7.77
M42	5.38	0.569	0.027	89	7.20	M07	4.13	0.189	0.017	88	4.74	M11-06	6.26	0.566	0.031	94	8.07
M43	6.68	1.75	0.050	97	12.3	M08-01	3.84	0.216	0.016	84	4.53	M12	7.59	0.243	0.032	94	8.37
M44	6.61	1.39	0.047	101	11.1	M08-02	3.67	0.205	0.016	88	4.33	M13	7.16	0.128	0.029	95	7.57
M45	5.82	1.10	0.038	97	9.35	M09	5.91	0.155	0.023	86	6.41	M14-01	6.38	0.140	0.026	94	6.83
M46	4.07	0.249	0.023	113	4.87	M10-01	4.32	0.221	0.018	83	5.03	M14-02	6.84	0.312	0.029	91	7.84
M47	5.66	0.908	0.037	103	8.57	M10-02	4.99	0.243	0.020	83	5.77	M15-01	8.23	0.078	0.032	96	8.48
Granitoids						M10-03	4.79	0.216	0.020	87	5.48	M15-02	7.39	0.200	0.031	95	8.03
Sample 0601: Mitsuhashi, Shitara						M11-01	3.74	0.176	0.016	89	4.30	M16-01	6.10	0.191	0.026	95	6.71
M41-01	3.42	0.605	0.021	93	5.36	M11-02	4.90	0.194	0.019	81	5.52	M16-02	6.90	0.170	0.028	95	7.44
M41-02	2.47	0.654	0.017	89	4.57	M12	6.20	0.196	0.025	86	6.83	M16-03	7.33	0.083	0.028	97	7.60
M41-03	2.52	0.496	0.015	87	4.11							M16-04	6.49	0.220	0.028	93	7.20
M42	2.17	0.385	0.012	84	3.40							M17-01	6.09	0.278	0.027	96	6.98
M48	2.70	0.374	0.014	86	3.90							M17-02	6.25	0.192	0.025	94	6.87
M49-01	2.75	0.500	0.016	88	4.35							M17-03	6.47	0.300	0.029	93	7.43
M49-02	2.23	0.447	0.014	91	3.66							M17-04	6.52	0.197	0.026	93	7.15
												M17-05	6.42	0.203	0.026	94	7.07
												M17-05	6.22	0.057	0.024	97	6.40