THERMOLUMINESCENCE STUDY OF JAPANESE ANTARCTIC METEORITES XIV

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Natural TL (thermoluminescence), the luminescence of a sample that has received no irradiation in the laboratory, reflects the thermal history of the meteorite in space and on Earth. Natural TL data thus provide insights into such topics as the orbits of meteoroids, the effects of shock heating, and the terrestrial history of meteorites. Induced TL, the response of a luminescent phosphor to a laboratory dose of radiation, reflects the mineralogy and structure of the phosphor, and provides valuable information on the metamorphic and thermal history of meteorites. The sensitivity of the induced TL is used to determine petrologic subtype of type 3 ordinary chondrites.

As reliable pairing approach, TL properties within large chondrites were analyzed, taking advantage of the fact that serial samples from these meteorites is known to be paired [1]. Then a set of TL pairing criteria: 1) the natural TL peak height ratios, LT/HT, should be within 20%; 2) that ratios of raw natural TL signal to induced TL signal should be within 50%; 3) the TL peak temperatures should be within 20℃ and peak widths within 10℃ was proposed. This set of TL pairing criteria is less restrictive than previously used [1].

We have measured TLs of 163 Yamato and 136 Asuka unequilibrated ordinary chondrites [1-8]. We measured TL of additional 30 Yamato chondrites (H3:14, L3:14, LL3:2) for determining 1) subtype and 2) pairing.

The TL data of them are listed in Table1. The petrologic subtype was determined from their TL sensitivity. A chondrites, Y982240 (L3) were revealed to be primitive ordinary chondrites of petrologic subtype 3.3 as shown in Figure 1.

Natural and induced TL properties were also applied to find paired fragments. Above pairing criteria were applied to the 30 samples. However we could not find any TL potential paired fragments this time.

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References: [1] Ninagawa et al. (1998): Antarctic Meteorite Res., 11, 1-17. [2] Ninagawa et al. (2000): Antarctic Meteorite Res., 13, 112-120. [3] Ninagawa et al. (2002): Antarctic Meteorite Res., 15, 114-121. [4] Ninagawa et al. (2005): Antarctic Meteorite Res., 18, 1-16. [5] Ninagawa et al. (2006): 30th Symp. Antarctic Meteorites, Tokyo, p.85-86. [6] Ninagawa et al. (2007): 31th Symp. Antarctic Meteorites, Tokyo, p.75-76. [7] Matsui et al. (2010) 33th Symp. Antarctic Meteorites p.51-52. [8] Ninagawa et al. (2011) 34th Symp. Antarctic Meteorites p.60-61.

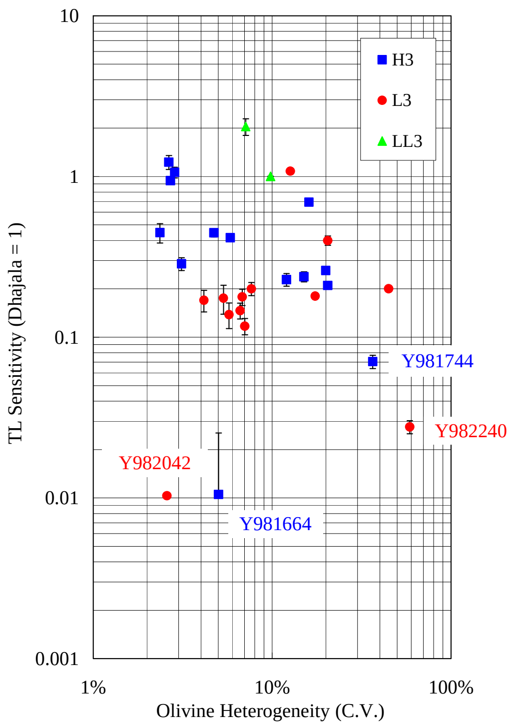

Figure 1 TL sensitivity vs. Olivine Heteroeity.

Table Thermoluminescence data of unequilibrated Japanese ordinary chondrites

Meteorite	Class	Natural TL				Induced TL				LT /TL Sens.	Low Ca-Py	Ol		Recom-	Sampling Location	
		LT/HT	LT (10^3 counts)	LT Peak Temp. (℃)	HT Peak Temp. (℃)	TL Sensitivity (Dhajala=1)	Peak Temp. (℃)	Width (℃)	TL Subtype	($x10^3$)	Heterogenity (C.V.)†	Heterogenity (C.V.)‡	Ol Subtype	mended Subtype		
Y981621	L3	2.09 ± 0.02	10.7 ± 0.9	237 ± 1	325 ± 2	1.08 ± 0.04	105 ± 3	87 ± 7	3.8	10 ± 1	35%	13%	3.8		35.092 E	72.181 S
Y981656	L3	1.85 ± 0.07	2.4 ± 0.3	201 ± 3	326 ± 2	0.20 ± 0.00	134 ± 3	129 ± 10	3.5	12 ± 1	64%	45%	3.5		35.159 E	72.161 S
Y981664	H3		0.2 ± 0.0	203 ± 3		0.011 ± 0.015	80 ±	19 ± 27	3.2-3.3	18 ± 25	4%	5%	3.9		35.110 E	72.148 S
Y981697	LL3	0.24 ± 0.00	2.1 ± 0.1	219 ± 3	338 ± 1	1.00 ± 0.00	147 ± 2	128 ± 1	3.8	2 ± 0	30%	10%	3.9		35.211 E	72.117 S
Y981705	H3	11.71 ± 0.10	32.2 ± 2.2	186 ± 2	335 ± 3	0.42 ± 0.01	133 ± 8	126 ± 9	3.6	77 ± 6	35%	6%	3.9		35.119 E	72.145 S
Y981736	LL3	3.03 ± 0.14	46.2 ± 3.8	202 ± 0	327 ± 3	2.04 ± 0.24	160 ± 3	144 ± 0	3.8-3.9	23 ± 3	18%	7%	3.9		35.091 E	72.137 S
Y981744	H3	0.55 ± 0.16	0.1 ± 0.0	208 ± 4	326 ± 2	0.07 ± 0.01	102 ± 4	70 ± 7	3.4	2 ± 1	49%	37%	3.6		35.158 E	72.164 S
Y981745	H3	0.70 ± 0.03	1.0 ± 0.1	268 ± 37	340 ± 12	0.24 ± 0.02	140 ± 8	130 ± 9	3.5-3.6	4 ± 0	21%	15%	3.8		35.169 E	72.147 S
Y981746	H3	1.25 ± 0.24	1.2 ± 0.3	208 ± 3	344 ± 3	0.23 ± 0.02	131 ± 3	114 ± 0	3.5-3.6	5 ± 1	42%	12%	3.8		35.169 E	72.147 S
Y981901	H3	0.95 ± 0.11	1.2 ± 0.0	225 ± 4	326 ± 1	0.29 ± 0.03	131 ± 5	114 ± 7	3.6	4 ± 0	22%	3%			35.381 E	72.038 S
Y981928	L3	0.79 ± 0.01	2.0 ± 0.1	206 ± 1	339 ± 3	0.40 ± 0.03	150 ± 6	128 ± 2	3.6-3.7	5 ± 0	36%	20%	3.8		35.350 E	72.066 S
Y981989	H3	0.07 ± 0.00	0.0 ± 0.0	195 ± 1	372 ± 6	0.26 ± 0.00	144 ± 5	128 ± 4	3.6	0 ± 0	18%	20%	3.8		35.416 E	72.000 S
Y982020	H3	1.21 ± 0.05	5.4 ± 0.0	207 ± 3	322 ± 2	0.94 ± 0.04	140 ± 1	125 ± 1	3.7-3.8	6 ± 0	10%	3%			35.346 E	72.072 S
Y982023	H3	0.05 ± 0.00	0.2 ± 0.0	194 ± 1	308 ± 0	1.06 ± 0.08	139 ± 3	135 ± 7	3.7-3.8	0 ± 0	26%	3%			35.368 E	72.054 S
Y982038	H3	0.28 ± 0.01	4.8 ± 0.1	223 ± 2	339 ± 8	1.23 ± 0.12	148 ± 0	126 ± 4	3.8	4 ± 0	4%	3%			35.384 E	71.984 S
Y980379	H3	3.51 ± 0.07	23.7 ± 1.1	215 ± 1	349 ± 3	0.69 ± 0.01	165 ± 2	164 ± 8	3.7	34 ± 2	32%	16%	3.8		35.034 E	72.076 S
Y980389	L3	7.26 ± 0.10	7.4 ± 1.0	216 ± 4	353 ± 5	0.18 ± 0.00	153 ± 7	150 ± 11	3.5	41 ± 5	46%	17%	3.8		35.150 E	72.080 S
Y982042	L3	0.00 ± 0.00			347 ± 6	0.010 ± 0.000	175 ± 4	173 ± 4	3.2		21%	3%			35.312 E	71.990 S
Y982074	H3	0.09 ± 0.00	0.2 ± 0.0	213 ± 4	383 ± 5	0.45 ± 0.06	164 ± 0	162 ± 1	3.6-3.7	0 ± 0	8%	2%			35.378 E	71.977 S
Y982121	H3					0.45 ± 0.03	177 ± 2	176 ± 3	3.6-3.7		6%	5%			35.286 E	71.985 S
Y982144	L3	10.11 ± 0.11	10.0 ± 1.6	204 ± 0	354 ± 1	0.16 ± 0.00	158 ± 9	155 ± 12	3.5	64 ± 10					35.175 E	72.080 S
Y982145	L3	5.06 ± 0.26	3.9 ± 0.5	212 ± 1	353 ± 1	0.12 ± 0.01	156 ± 12	154 ± 13	3.4-3.5	33 ± 6	43%	7%	3.9		35.124 E	72.063 S
Y982170	L3	3.40 ± 0.23	2.3 ± 0.2	214 ± 8	369 ± 9	0.15 ± 0.02	153 ± 2	156 ± 10	3.5	16 ± 2	21%	7%	3.9		35.172 E	72.075 S
Y982171	L3	7.65 ± 0.69	6.6 ± 0.1	215 ± 2	346 ± 4	0.14 ± 0.03	163 ± 3	160 ± 7	3.4-3.5	48 ± 9	25%	6%	3.9		35.158 E	72.072 S
Y982232	L3	0.74 ± 0.12	0.8 ± 0.1	261 ± 23	357 ± 4	0.18 ± 0.02	159 ± 1	156 ± 1	3.5-3.6	5 ± 1	35%	7%	3.9		35.188 E	72.085 S
Y982233	L3	9.21 ± 0.62	9.8 ± 1.0	209 ± 2	356 ± 7	0.17 ± 0.03	161 ± 0	160 ± 1	3.5-3.6	58 ± 11	32%	4%			35.157 E	72.076 S
Y982234	L3	5.99 ± 0.53	6.8 ± 0.2	216 ± 4	360 ± 9	0.17 ± 0.04	166 ± 2	164 ± 3	3.5-3.6	39 ± 8	36%	5%	3.9		35.149 E	72.075 S
Y982235	L3	2.70 ± 0.04	2.3 ± 0.0	219 ± 0	359 ± 8	0.20 ± 0.02	141 ± 6	140 ± 8	3.5-3.6	11 ± 1	28%	8%	3.9		35.122 E	72.059 S
Y982239	H3	0.00 ± 0.00			437 ± 16	0.21 ± 0.01	155 ± 0	154 ± 0	3.5-3.6		19%	20%	3.8		35.176 E	72.018 S
Y982240	L3	0.56 ± 0.26	0.0 ± 0.0	197 ± 4	371 ± 63	0.03 ± 0.00	105 ± 8	105 ± 8	3.3	1 ± 1	53%	59%	≤3.4	3.3	35.206 E	72.020 S