THERMOLUMINESCENCE STUDY OF JAPANESE ANTARCTIC METEORITES XIII

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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 134 Yamato and 136 Asuka unequilibrated ordinary chondrites [1-7]. We measured TL of additional 30 Yamato chondrites (H3:10, L3:19, CV3:1) 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. Two chondrites, Y981221 (H3) and Y981327 (L3) were revealed to be primitive ordinary chondrites of petrologic subtype 3.2-3.4 and 3.0-3.2, respectively.

Natural and induced TL properties were also applied to find paired fragments. Above pairing criteria were applied to the 30 samples, respectively. We found 21 TL potential paired fragments. A group of L3 comprises a chain of 14 paired fragments, Y981283, Y981602, Y981606, Y981305, Y981303, Y981304, Y981490, Y981275, Y981301, Y981285, Y981274, Y981504, Y981588 and Y981591. They were sampled within 7km around 35°11’E 72.° 05’S.

This time we measured an unusual TL glow curve, different from ordinary chondrites. This sample was found to be CV3 chondrite. Then we measured it’s TL spectrum. TL spectrum was also different from that of ordinary chondrite as shown in figure 1. It seems that the difference between TL spectra was reflecting the difference in formation process of feldspar.

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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.

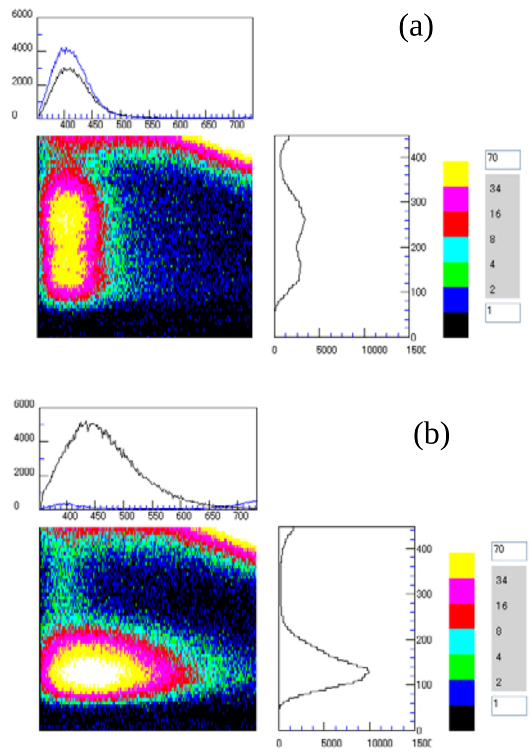

Figure 1 TL Spectra. (a) Y981208 (CV3) and (b) Y980660 (H3.6-3.7)

Table Thermoluminescence data of Japanese Antarctic Meteorites

Meteorite	Class	Natural TL				Induced TL				LT	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	/TL Sens. ($x10^3$)	Heterogenity (C.V.)†	Heterogenity (C.V.)‡	Ol Subtype	mended Subtype		
Y981121	H3	0.07 ± 0.00	0.3 ± 0.0	239 ± 45	359 ± 4	0.67 ± 0.02	165 ± 5	160 ± 3	3.7	0 ± 0	13%	9%	3.9		35.104 E	71.992 S
Y981139	H3	3.19 ± 0.11	3.7 ± 0.1	199 ± 1	326 ± 3	0.24 ± 0.02	126 ± 6	127 ± 4	3.5-3.6	16 ± 1	17%	9%	3.9		35.207 E	72.037 S
Y981140	H3	3.45 ± 0.04	13.8 ± 1.4	192 ± 2	347 ± 2	0.76 ± 0.08	141 ± 10	113 ± 3	3.7	18 ± 3	24%	30%	3.7	3.7	35.207 E	72.037 S
Y981175	H3	0.70 ± 0.05	2.1 ± 0.2	235 ± 3	329 ± 4	0.57 ± 0.08	139 ± 1	117 ± 3	3.6-3.7	4 ± 1	17%	24%	3.7	3.7	35.246 E	72.043 S
Y981186	H3	0.69 ± 0.09	1.1 ± 0.0	242 ± 3	334 ± 6	0.33 ± 0.02	142 ± 2	119 ± 5	3.6	3 ± 0	27%	18%	3.8		35.245 E	72.037 S
Y981221	H3					0.031 ± 0.010	74 ± 4	61 ± 6	3.2-3.4		77%	65%	≤3.4	3.2-3.4	35.121 E	71.990 S
Y981232	H3	0.88 ± 0.01	17.6 ± 0.5	211 ± 0	338 ± 1	1.57 ± 0.16	145 ± 0	119 ± 1	3.8	11 ± 1	4%	3%			35.103 E	71.992 S
Y981274	L3	8.61 ± 0.13	11.6 ± 2.1	186 ± 1	323 ± 0	0.23 ± 0.06	123 ± 2	136 ± 4	3.5-3.6	49 ± 15	42%	13%	3.8		35.181 E	72.088 S
Y981275	L3	7.36 ± 0.31	11.7 ± 0.1	189 ± 1	322 ± 16	0.24 ± 0.01	143 ± 5	134 ± 2	3.6	50 ± 2	44%	13%	3.8		35.190 E	72.091 S
Y981277	L3	2.97 ± 0.03	4.0 ± 0.1	201 ± 0	318 ± 0	0.45 ± 0.02	75 ± 6	119 ± 10	3.6-3.7	9 ± 1	44%	18%	3.8		35.172 E	72.080 S
Y981278	L3	4.52 ± 1.07	6.0 ± 1.3	192 ± 0	317 ± 3	0.20 ± 0.00	122 ± 9	140 ± 3	3.5	30 ± 7	47%	10%	3.8		35.167 E	72.077 S
Y981283	L3	5.16 ± 0.16	6.7 ± 0.7	194 ± 0	318 ± 7	0.21 ± 0.01	130 ± 0	129 ± 2	3.5-3.6	31 ± 3	39%	6%	3.9		35.222 E	72.095 S
Y981285	L3	8.58 ± 0.02	14.0 ± 0.0	189 ± 0	313 ± 6	0.24 ± 0.01	145 ± 1	133 ± 2	3.6	59 ± 1	29%	16%	3.8		35.191 E	72.092 S
Y981301	L3	8.47 ± 0.40	31.6 ± 2.2	189 ± 0	304 ± 0	0.69 ± 0.06	125 ± 8	140 ± 4	3.7	46 ± 5	43%	4%			35.173 E	72.132 S
Y981302	L3	3.01 ± 0.10	5.0 ± 0.1	198 ± 1	330 ± 3	0.30 ± 0.03	135 ± 14	135 ± 0	3.6	16 ± 2	50%	3%			35.172 E	72.080 S
Y981303	L3	6.22 ± 0.52	7.9 ± 0.2	201 ± 7	334 ± 9	0.17 ± 0.01	127 ± 0	149 ± 6	3.5	46 ± 3	43%	11%	3.8		35.187 E	72.088 S
Y981304	L3	6.34 ± 0.56	7.5 ± 0.6	193 ± 2	324 ± 10	0.20 ± 0.01	125 ± 2	136 ± 5	3.5-3.6	37 ± 4	52%	5%	3.9		35.192 E	72.091 S
Y981305	L3	5.93 ± 0.61	7.6 ± 0.3	191 ± 0	327 ± 4	0.16 ± 0.01	134 ± 1	145 ± 3	3.5	49 ± 4	44%	15%	3.8		35.192 E	72.091 S
Y981327	L3		0.1 ± 0.0	197 ± 2	±	0.01 ± 0.00	151 ± 6		3.0-3.2	9 ± 5	71%	46%	3.5	3.0-3.2	35.271 E	71.992 S
Y981380	L3	0.14 ± 0.01	0.3 ± 0.0	183 ± 0	316 ± 0	0.39 ± 0.02	142 ± 3	117 ± 0	3.6	1 ± 0	6%	3%			35.269 E	71.979 S
Y981399	H3	2.11 ± 0.01	38.8 ± 2.3	200 ± 0	334 ± 3	1.27 ± 0.02	150 ± 1	120 ± 2	3.8	30 ± 2	4%	3%			35.304 E	71.989 S
Y981428	H3	5.77 ± 0.33	11.0 ± 0.6	194 ± 3	332 ± 4	0.32 ± 0.06	140 ± 1	126 ± 1	3.5-3.7	34 ± 7	24%	27%	3.7		35.263 E	72.033 S
Y981490	L3	6.99 ± 0.61	9.5 ± 0.2	194 ± 2	335 ± 2	0.21 ± 0.02	144 ± 3	145 ± 0	3.5-3.6	45 ± 3	42%	10%	3.9		35.210 E	72.093 S
Y981504	L3	9.76 ± 0.30	18.8 ± 2.6	195 ± 6	333 ± 9	0.36 ± 0.01	134 ± 14	133 ± 1	3.6	53 ± 7	22%	10%	3.9		35.229 E	72.099 S
Y981536	H3	2.46 ± 0.12	4.5 ± 0.2	210 ± 0	332 ± 4	0.50 ± 0.06	95 ± 6	120 ± 2	3.6-3.7	9 ± 1	28%	3%			35.256 E	71.977 S
Y981588	L3	10.31 ± 0.14	11.7 ± 0.2	189 ± 1	332 ± 2	0.17 ± 0.05	131 ± 3	142 ± 4	3.4-3.6	71 ± 19	56%	12%	3.8		35.188 E	72.117 S
Y981591	L3	10.78 ± 0.83	13.9 ± 0.9	195 ± 3	340 ± 0	0.24 ± 0.01	142 ± 4	133 ± 0	3.6	58 ± 4	47%	5%			35.229 E	72.099 S
Y981602	L3	5.51 ± 0.39	7.2 ± 0.5	197 ± 1	339 ± 7	0.25 ± 0.02	139 ± 1	140 ± 1	3.5-3.6	29 ± 3	38%	10%	3.9		35.229 E	72.099 S
Y981606	L3	5.53 ± 0.09	6.9 ± 0.3	199 ± 2	330 ± 3	0.19 ± 0.00	148 ± 4	135 ± 3	3.5	35 ± 2	40%	18%	3.8		35.117 E	72.073 S
Y981208	CV3				286 ± 0	0.44 ± 0.25	153 ± 5	197 ± 22			90%	140%			35.238 E	72.031 S