**Thermoluminescence Study of Japanese Antarctic Meteorites XV.** K. Ninagawa[1], S. Fukuda[1], N. Imae[2], and H. Kojima[2], [1]Okayama University of Science, [2]National Institute of Polar Research.

Induced TL (thermoluminescence), 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. Especially the sensitivity of the induced TL is used to determine petrologic subtype of unequilibrated ordinary chondrites [1]. Natural TL, 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 [2]. Usually natural TL properties are applied to find paired fragments [3-5].

We have measured TLs of 193 Yamato and 136 Asuka unequilibrated ordinary chondrites [6]. This time we measured induced and natural TL properties of twenty-three Yamato unequilibrated ordinary chondrites (LL3: 1, L3: 15, H3: 7) from Japanese Antarctic meteorite collection. Sampling positions of these chondrites were measured by GPS.

As reliable pairing approach, TL properties within large chondrites were analyzed, taking advantage of the fact that serial samples from these meteorites are known to be paired. 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 (LT) to induced TL signal (TL Sensitivity) should be within 50%; 3) the TL peak temperatures should be within 20℃ and peak widths within 10℃ was proposed [3].

Above pairing criteria were applied to the 23 samples. Figure 1 shows how to search fragments satisfying the pairing criteria 1) and 2). We found 12 TL potential paired fragments. They constructed one H3, and a large chained L3 group.

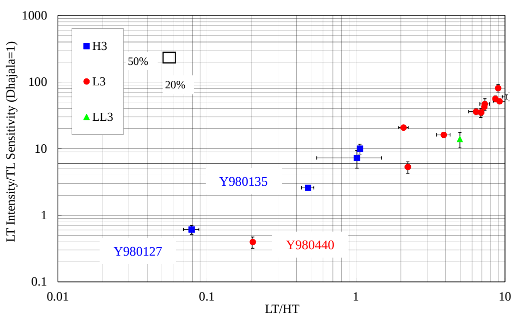


Fig.1. Ratio of LT to TL Sensitivity vs. LT/HT ratio to search fragments satisfying the pairing criteria 1) and 2).

Most of the chondrites had TL sensitivities over 0.1 (Dhajala=1), corresponding to petrologic subtype 3.5-3.9. Two chondrites, Y980465 (H3) and Y980576 (H3), were revealed to be primitive ordinary chondrites, petrologic subtype 3.2 and 3.3, respectively. They are not conflicted to olivine heterogeneity as shown in Fig.2. It is particularly significant in understanding the nature of primitive material in the solar system.

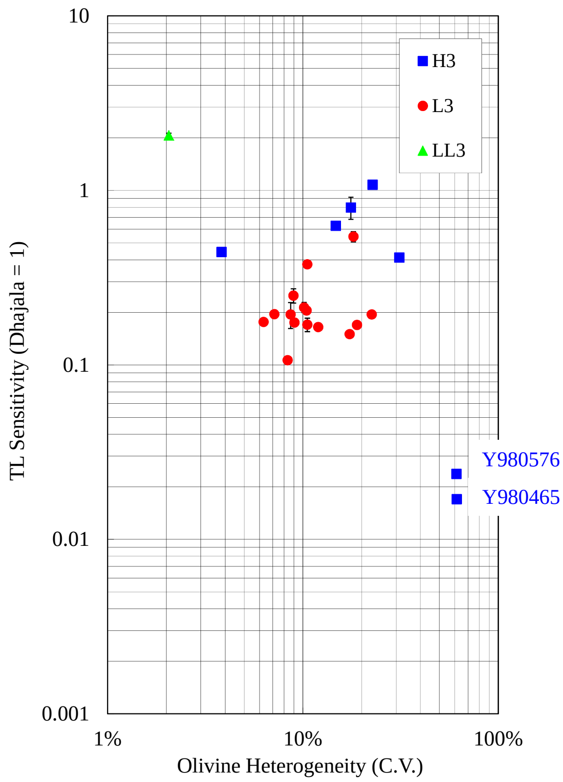


Fig.2. Dhajala-normalized TL sensitivity vs. olivine heterogeneity


References: [1] D. W. G. Sears et al. 1991. Proceedings of Lunar and Planetary Science 21:493-512. [2] P. H. Benoit et al. 1991. Icarus 94: 311-325. [3] K. Ninagawa et al. 1998. Antarctic Meteorite Research 11:1-17. [4] K. Ninagawa et al. 2002. Ant-arctic Meteorite Research 15:114-121.
[5] K. Ninagawa et al. 2005. Antarctic Meteorite Research 18:1-16. [6]K. Ninagawa et al., 2012. 35th Symposium on Antarctic Meteorites (NIPR, Tokyo), 114-116.

Table Thermoluminescence data of unequilibrated Japanese ordinary chondrites

| 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. (x103) | Heterogenity (C.V.)† | Heterogenity (C.V.)‡ | Ol Subtype | mended Subtype | | |
| Y980400 | L3 | 6.39 ± 0.70 | 7.0 ± 0.7 | 223 ± 3 | 359 ± 7 | 0.20 ± 0.01 | 156 ± 2 | 145 ± 1 | 3.5-3.6 | 36 ± 4 | 37% | 7% | 3.9 | | 35.148 E | 72.070 S |
| Y980413 | LL3 | 4.98 ± 0.03 | 28.6 ± 7.3 | 221 ± 7 | 361 ± 10 | 2.06 ± 0.07 | 164 ± 4 | 132 ± 0 | 3.8-3.9 | 14 ± 4 | 20% | 2% | | | 34.999 E | 72.083 S |
| Y980422 | L3 | 3.88 ± 0.40 | 2.7 ± 0.2 | 219 ± 0 | 351 ± 0 | 0.17 ± 0.00 | 155 ± 1 | 138 ± 1 | 3.5 | 16 ± 1 | 41% | 19% | 3.8 | | 35.143 E | 72.069 S |
| Y980423 | L3 | 7.26 ± 0.06 | 7.0 ± 0.5 | 213 ± 3 | 365 ± 1 | 0.16 ± 0.00 | 153 ± 3 | 142 ± 1 | 3.5 | 42 ± 3 | 48% | 12% | 3.8 | | 35.158 E | 72.071 S |
| Y980439 | L3 | 6.93 ± 0.13 | 8.8 ± 0.1 | 219 ± 5 | 357 ± 4 | 0.25 ± 0.02 | 167 ± 2 | 135 ± 1 | 3.5-3.6 | 35 ± 3 | 45% | 9% | 3.9 | | 35.110 E | 72.068 S |
| Y980440 | L3 | 0.20 ± 0.00 | 0.1 ± 0.0 | 219 ± 11 | 367 ± 7 | 0.19 ± 0.03 | 122 ± 6 | 180 ± 3 | 3.5-3.6 | 0 ± 0 | 38% | 9% | 3.9 | | 35.172 E | 72.079 S |
| Y980446 | L3 | 2.23 ± 0.09 | 1.1 ± 0.2 | 232 ± 6 | 363 ± 1 | 0.21 ± 0.01 | 139 ± 24 | 143 ± 2 | 3.5-3.6 | 5 ± 1 | 35% | 10% | 3.9 | | 35.211 E | 72.091 S |
| Y980448 | L3 | 10.82 ± 0.15 | 12.6 ± 1.8 | 205 ± 1 | 349 ± 0 | 0.20 ± 0.01 | 163 ± 4 | 140 ± 0 | 3.5-3.6 | 61 ± 9 | 39% | 10% | 3.9 | | 35.350 E | 72.066 S |
| Y980452 | L3 | 6.88 ± 0.10 | 6.1 ± 1.0 | 213 ± 5 | 355 ± 2 | 0.18 ± 0.01 | 147 ± 2 | 150 ± 1 | 3.5 | 35 ± 6 | 28% | 6% | 3.9 | | 35.135 E | 72.071 S |
| Y980465 | H3 | | 0.2 ± 0.0 | 237 ± 2 | | 0.02 ± 0.00 | 95 ± 7 | 79 ± 6 | 3.2 | 9 ± 0 | 72% | 61% | ≤3.4 | 3.2 | 34.987 E | 72.098 S |
| Y980472 | H3 | | | | 376 ± 1 | 0.44 ± 0.02 | 155 ± 0 | 122 ± 2 | 3.6-3.7 | | 7% | 4% | | | 35.024 E | 72.077 S |
| Y980484 | L3 | 8.61 ± 0.31 | 9.5 ± 0.5 | 213 ± 1 | 349 ± 1 | 0.17 ± 0.02 | 144 ± 3 | 144 ± 0 | 3.5 | 56 ± 6 | 27% | 11% | 3.8 | | 35.142 E | 72.071 S |
| Y980505 | L3 | 8.98 ± 0.06 | 30.5 ± 3.7 | 210 ± 1 | 343 ± 5 | 0.38 ± 0.01 | 154 ± 4 | 151 ± 1 | 3.6 | 81 ± 10 | 55% | 11% | 3.8 | | 35.152 E | 72.092 S |
| Y980576 | H3 | | 0.2 ± 0.0 | 218 ± 6 | | 0.024 ± 0.000 | 82 ± 2 | 75 ± 1 | 3.3 | 7 ± 0 | 83% | 61% | ≤3.4 | 3.3 | 34.926 E | 72.050 S |
| Y980588 | L3 | 9.21 ± 0.86 | 9.0 ± 0.1 | 213 ± 1 | 343 ± 4 | 0.17 ± 0.00 | 114 ± 6 | 144 ± 2 | 3.5 | 51 ± 2 | 46% | 9% | 3.9 | | 35.122 E | 72.079 S |
| Y980597 | L3 | 7.32 ± 0.54 | 7.0 ± 1.4 | 211 ± 4 | 357 ± 17 | 0.15 ± 0.00 | 129 ± 12 | 142 ± 3 | 3.5 | 47 ± 9 | 38% | 17% | 3.8 | | 35.163 E | 72.077 S |
| Y980768 | L3 | | 0.1 ± 0.0 | 213 ± 0 | | 0.11 ± 0.00 | 154 ± 6 | 149 ± 1 | 3.5 | 1 ± 0 | 35% | 8% | 3.9 | | 35.243 E | 72.084 S |
| Y980056 | H3 | 1.02 ± 0.47 | 4.5 ± 1.3 | 232 ± 2 | 362 ± 4 | 0.63 ± 0.03 | 160 ± 6 | 134 ± 2 | 3.7 | 7 ± 2 | 19% | 15% | 3.8 | | 35.337 E | 72.153 S |
| Y980057 | H3 | 1.06 ± 0.02 | 8.0 ± 0.7 | 234 ± 4 | 364 ± 3 | 0.80 ± 0.12 | 157 ± 3 | 132 ± 0 | 3.7-3.8 | 10 ± 2 | 40% | 18% | 3.8 | 3.8 | 35.337 E | 72.153 S |
| Y980127 | H3 | 0.08 ± 0.01 | 0.7 ± 0.1 | 235 ± 2 | 369 ± 2 | 1.08 ± 0.06 | 152 ± 3 | 133 ± 4 | 3.8 | 1 ± 0 | 36% | 23% | 3.7 | | 35.512 E | 72.381 S |
| Y980135 | H3 | 0.48 ± 0.05 | 1.1 ± 0.0 | 266 ± 0 | 366 ± 7 | 0.41 ± 0.02 | 169 ± 7 | 149 ± 3 | 3.6-3.7 | 3 ± 0 | 41% | 31% | 3.6 | 3.6 | 35.409 E | 72.494 S |
| Y980180 | L3 | 2.08 ± 0.16 | 11.3 ± 0.3 | 230 ± 1 | 346 ± 7 | 0.54 ± 0.04 | 157 ± 0 | 147 ± 3 | 3.7 | 21 ± 1 | 36% | 18% | 3.8 | | 35.321 E | 72.449 S |
| Y980331 | L3 | 10.21 ± 0.62 | 11.6 ± 0.8 | 206 ± 3 | 337 ± 2 | 0.19 ± 0.00 | 165 ± 0 | 144 ± 2 | 3.5 | 60 ± 4 | 41% | 22% | 3.7 | | 35.232 E | 72.093 S |