THE READ-OUT SYSTEM OF SPATIAL DISTRIBUTION OF THERMOLUMINESCENCE IN METEORITES

Kiyotaka Ninagawa, Isao Yamamoto and Yasumasa Takano
Okayama University of Science, Okayama Japan
Tomonori Wada and Yoshihiko Yamashita
Okayama University, Japan
Nobuo Takaoka
Yamagata University, Japan

1. Introduction The thermoluminescence [TL] technique used for dating the terrestrial age of the meteorites[1] was based on the TL fading of interior samples. The depth dependence of the TL for Antarctic meteorites with fusion crust was measured[2]. Usually, meteorites were powdered and their TL were measured under a photomultiplier. In this time, we have measured a TL spatial distribution of a cross section of antarctic meteorites by using a read-out system of spatial distribution of TL[3], because a meteorite is inhomogeneous material. Antarctic meteorites MET-78028[L6], ALH-77278[LL3] are used.

2. Methods The system is shown in Fig. 2 of this conference HE 7.1-7. TL data are recorded by video cassette tapes. TL data are able to be analysed repeatedly via image processor. For the case of taking emission spectra of TL, we have changed a camera lens with a filter for a spectroscope. One example of emission spectra is shown in Fig. 1. The sample is powdered

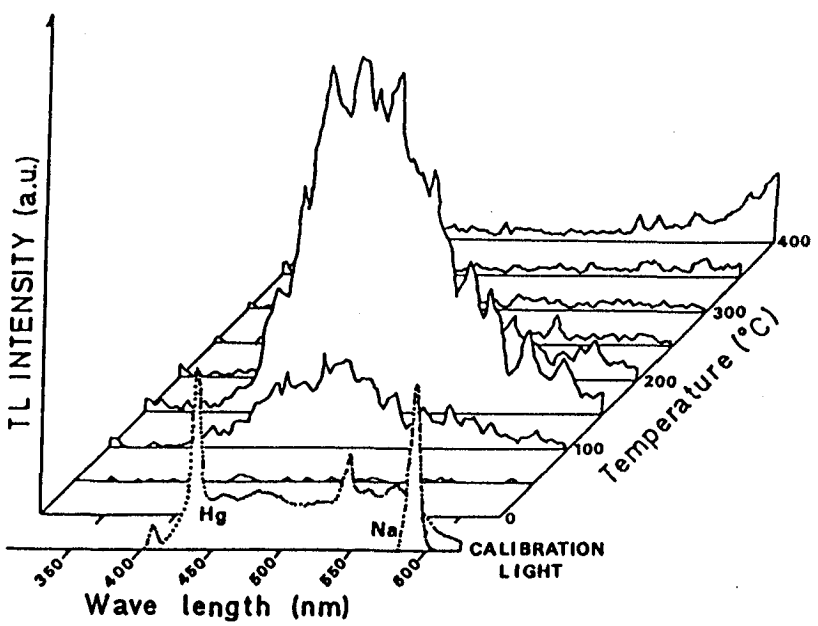

Fig. 1. Emission spectra of TL of MET-78028 at various temperature. For calibration, a Na-lamp and a fluorescent lamp are used.

meteorite MET-78028 irradiated with X-rays ($\sim 10^5$ R). The meteorite TL has a wide spectral band with a maximum at about 450 nm. So in the TL measurement of MET-78028, we have used the band pass filter, Corning 4-96 (blue-green).

3. The spatial distribution of TL for MET-78028 [L6].

Samples of slices of the meteorite are shown in Fig. 2. One slice of a pair was artificially exposed to ^{60}Co 1 kR γ-rays in addition to natural exposure. Using TV-camera system (Ref. 3), a pair of slices and an interior piece of the meteorite were heated (rising rate:2.3 °C/sec) and TL spatial distributions of these sample were recorded onto video cassette tape for about 160 sec ($\sim$5300 frames). Two examples of read out are shown in Fig. 3a, 3b. The Fig. 3a is TL spatial distribution

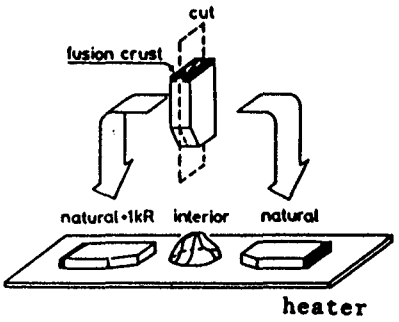

Fig. 2. Cutting and setting.

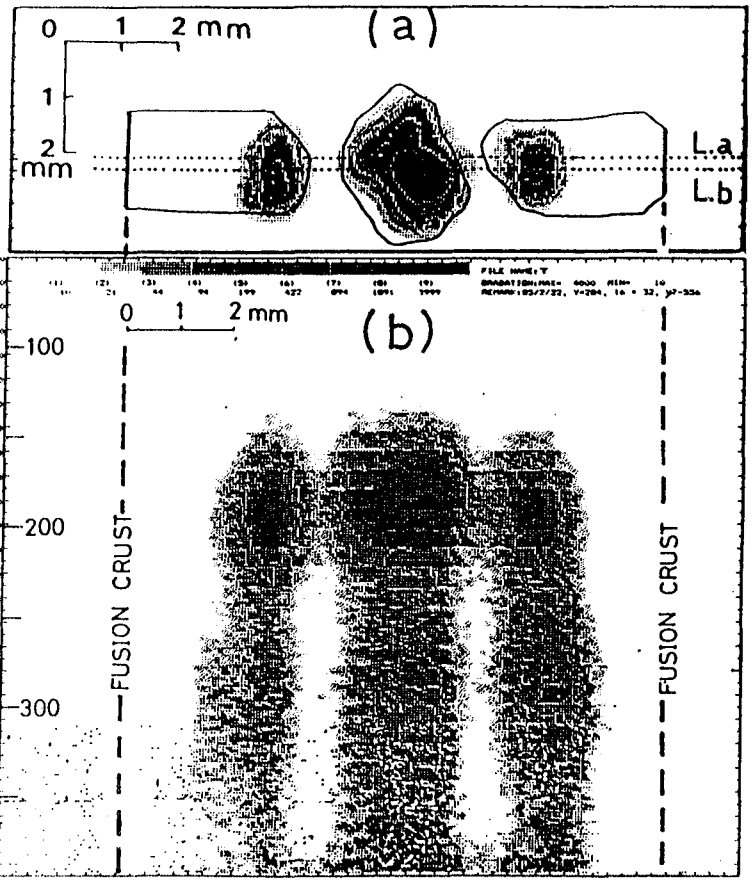

Fig. 3a. TL spatial distribution of slices in pair and of interior one. [MET-78028]

Fig. 3b. Time variation (corresponding to temperature) of TL for the area from line L.a to L.b in Fig. 3a. [MET-78028]

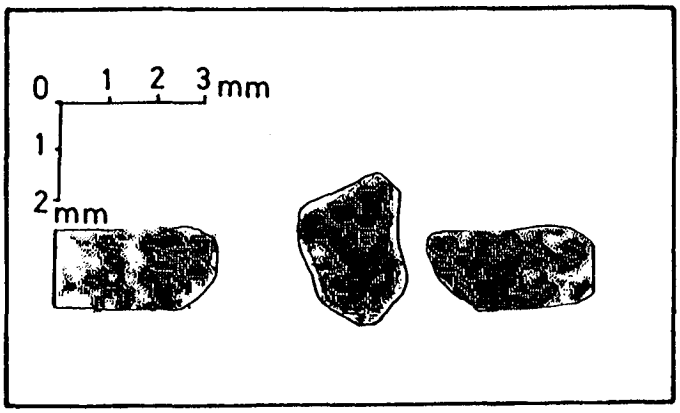

Fig. 4. Spatial distribution of TL sensitivity for antarctic meteorite, MET-78028 (L6). The meteorites were irradiated with 10^5 R X-rays.

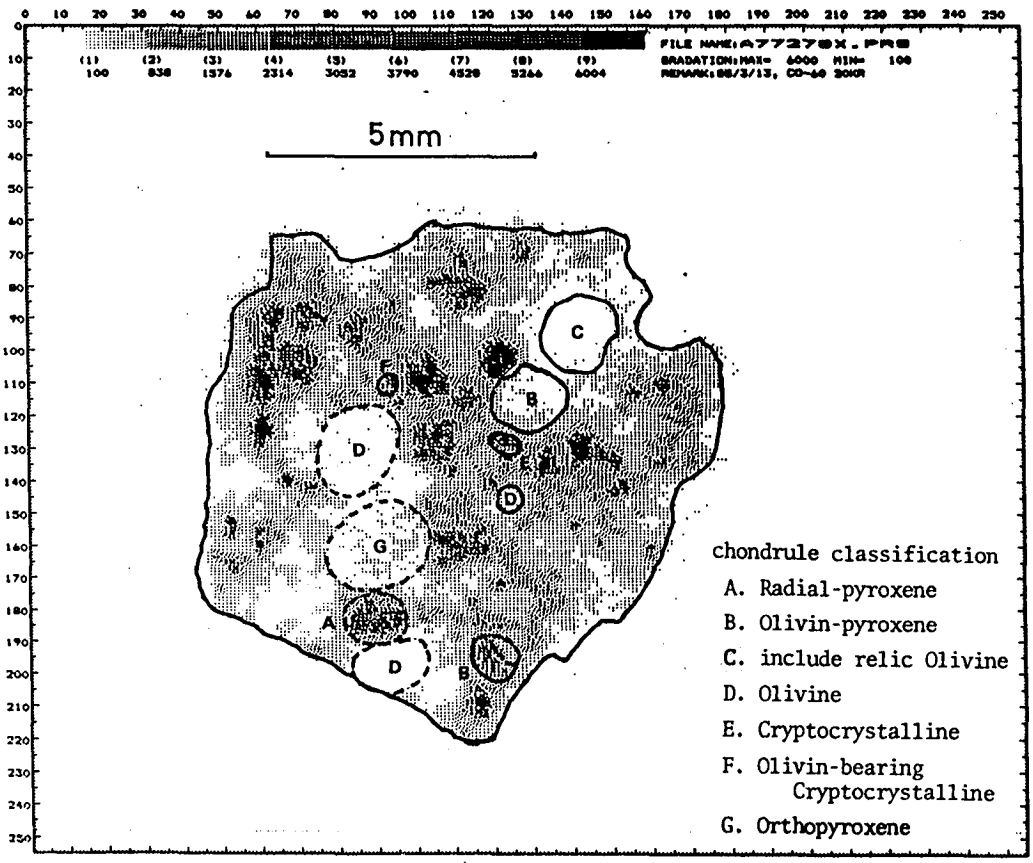

Fig. 5. Spatial distribution of TL sensitivity for antarctic meteorite, chondrite ALH-77278 (LL3). The meteorite was irradiated with 20 kR γ-ray.

of samples. The TL yeild of both slices was not detectable at near fusion crust. The fig. 3b shows the TL variation vs. heating temperature at the area from line L.a to L.b. The TL on the fusion crust side was obtained at higher temperature region.

4. Spatial distributions of TL sensitivity

(A) MET-78028 (L6): After reading out of natural TL, samples corresponding to Fig. 3a were irradiated with X-rays (10^5 R) and were heated. TL spatial distributions of these samples are shown in Fig. 4, which shows spatial distributions of TL sensitivity of these samples. Slices in pair of MET-78028 have low TL sensitivity near fusion crust. Here, the TL sensitivity is represented with logarithmic intensity.

(B) Chondrite, ALH-77278 (LL3): After reading out of natural TL, the sample was irradiated with ^{60}Co γ-rays (20 kR) and was heated. TL spatial distribution is shown in Fig. 5, which shows spatial distribution of TL sensitivity of the sample. Some chondrules have high TL sensitivity and other chondrules have low TL sensitivity or no sensitivity.

5.Conclusions. As shown in Fig. 4 and 5, the TL spatial sensitivity is not uniform, it may occur since meteorites are inhomogeneous material. So, when one searches the terrestrial age of antarctic meteorites or classifies the petrologic type of chondrites by using TL technique, one must investigate thoroughly TL spatial sensitivities. It is not only meteorites but also natural materials on the occation to measure natural TL.

6. Acknowledgements. The authors are greatly indebted to Prof. T.Nagata and Dr. K.Yanai, National Institute of Polar Research for the meteorite samples. They also thank Dr. Y.Ikeda, Ibaragi University for the chonrule classification.

References

1. Sears, D.W. and Durrani, S.A. (1980), Earth Planet. Sci. Lett., 46, 159.
2. Ninagawa, K. et. al., (1983), Lettere al Nuovo Cimento, Serie 2, 38, 33.
3. Yamamoto, I. et. al., (1985), This conference paper, HE 7.1-7.