TL dating of the quartz by the single grain technique using TL spatial readout system

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The first trial of the two dimensional photon counting (2D-PC) was archived by Yamamoto et al. (1986) using spatial distribution readout system (TL-SDRS). This method was applied to measure the TL spatial distribution of TL sheets and meteorites (Yamamoto et al., 1987; Ninagawa et al., 1986; 1990), and to dating by Ninagawa et al. (1988). Authors tried the 2D-PC of red TL from quartz grains to make the single grain technique simpler and easier.

In the usual TL dating of quartz, TL is collected, guided to photomultiplier tube, amplified, and its intensity during heating is measured by pulse counting. Therefore, sample usually is purified to quartz because mixed material of different TL characteristics can not give the accurate glow curve of the quartz. Single grain technique, sample preparation is very simple because of using coarse grains of quartz easily picked up by hand. But, TL measurement takes time because irradiation and heating are repeated about each grain many times. The 2D-PC which used TL-SDRS solves both problems.

In 2D-PC, the TL image of sample is focused on the photocathode of 2-D photon counting tubes. Then spots are brought about corresponding to the brightness of the TL image in the fluorescent side in the rear of 2-D photon counting tubes. These spots are counted as TL intensity by the image analysis. Therefore, glow curve of only aimed part of the sample can be measured, within a limit of the spatial resolution, even if the sample is mixed material.

This report is for an application to Toya pyroclastic flow deposits. NTL (tL due to the accumulation of the natural radiation) of nine quartz grains were detected with TL-SDRS. Two grains were set a pair and heated at a time, and the glow curve of each was gotten by the image analysis after heating. A pair of grains was more examined on the estimation of the total accumulation dose (TD) from their growth of the TL due to the artificial irradiation (RTL). Because quartz had a possibility to change its sensitivity during the repetition of the irradiation and heating, the test irradiation quantity (80.88Gy) was given to grains after every measurement to investigate the change in sensitivity.

Interesting phenomena in the result of the experiments are written in the following, especially contain problems of the single grain technique in (2) and (3), and whole problem of the TL dating in (4), too.

(1) A detection limit of TL of the quartz using TL-SDRS

S/N at the glow peak of NTL is from 50/1 to 80/1.This suggests a possibility to detect the faint TL from younger sample; of course it depends on the sensitivity of the quartz.

(2) The characteristics of the TL glow curve

Temperature of the main peak varies in the grains, and that showed a tendency to be in the portion to the thickness of the grains.Such peak shift is supposed to be caused by a time lag to the heat conduction due to the size variation of the grains.

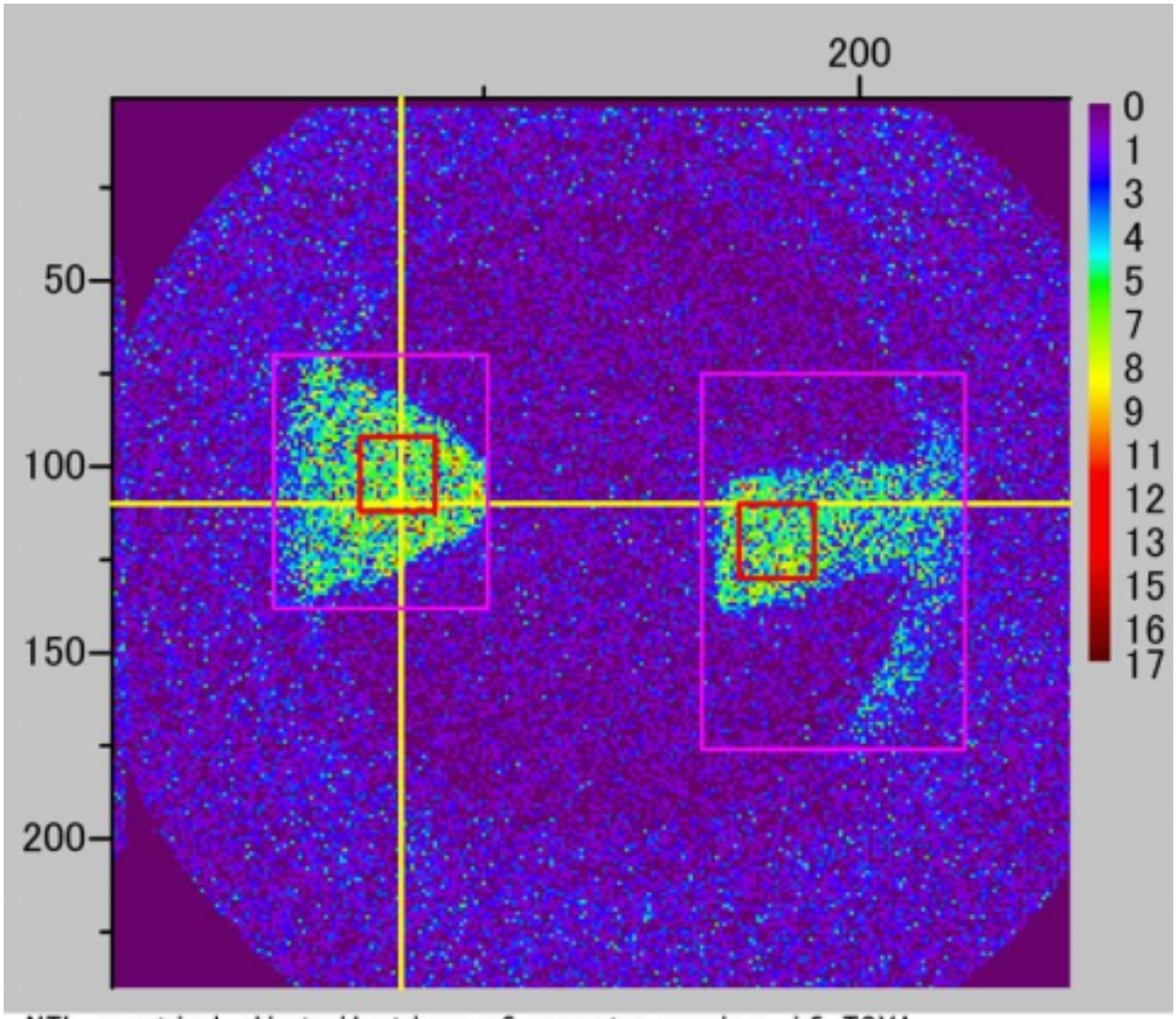
The peak temperature of RTL shifts to the lower side.

(3) Change in sensitivity

TL response to the test dose was measured five times repeatedly. Measured quartz grains showed tendency to increase the sensitivity or hardly changed. Kanemaki et al. (2000) pointed out that the sensitivity of the quartz declines during the repetition of the irradiation and heating. But in this time it was found that the tendency of sensitivity change of quartz is not uniform.

(4) The amount of TD and TL age

Though there were some differences by the way of analyzing it, TD was evaluated to about 70Gy. The age evaluated this TD is younger than the well-known age of Toya pyroclastic flow deposits. The detailed reason of this underestimation of the age is not known yet. It is necessary to reexamine for several condition having possibility to cause the underestimation of the age, such as a dose rate in the artificial irradiation, the peak of RTL shifting and s o on.



NTL spatial distribution of quartz grains if TOYA.

Squares and rectangles show the areas of 2-D photon counting.