OSL signal changes in friction experiments of high accumulated dose quartz: for air-dry and water-saturated conditions

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Optically stimulated luminescence (OSL) dating is generally used for sediment dating. It targets quartz and feldspar that are universally present on the earth, and is good at dating hundreds of thousands of years ago (Tsukamoto and Iwata, 2005). In addition, it has been suggested that it may be suitable for Quaternary faults dating because the closing temperature is low and it is sensitive to heat (Ganzawa et al., 2013). The OSL method uses the action of resetting the captured electrons accumulated in the mineral by natural radiation by external stimuli such as heat and light, but there are some unclear points regarding what kind of stimuli related to faulting contribute to the dating reset. Oohashi et al. (2020) conducted friction experiments for powdered quartz at variously slip rates and reported that the OSL signal decrease exponentially with increasing slip rates and frictional heat. However, since the accumulated dose of quartz is low, the amount of reduction process of the OSL signal has not been examined in detail. Therefore, in this study, we attempted to examine the relationship between the faulting and the amount of OSL signal reduction in more detail by accumulating a high dose in quartz. In addition, by conducting friction experiments under water-saturated conditions in addition to air-dry conditions, we show changes in the OSL signal in humid areas such as Japan.

The starting material is 150-250 μm quartz grains separated and extracted from the sediment close to the Maruo Port in Ube City, Yamaguchi Prefecture, with gamma rays of about 200 Gy accumulated. The experiments were conducted at constant slip rate of 0.65 m/s, constant displacement of 2.1 m, and normal stress of 0.5 MPa to 5.0 MPa. We placed thermocouples at the boundary between the quartz slip surface and the fixed cylinder to measure the maximum temperature in the quartz band. The quartz with a grain size of >150 μm, which has the minimum effect of crushing, was used for OSL measurement.

As a result of the measurement, it was found that the OSL signal decrease exponentially with the increase normal stress and frictional heat in both air-dry and water-saturated conditions. Although the accumulated dose of starting material is high, it was not possible to strictly examine the relationship between the faulting and the amount of OSL signal reduction because the accumulated dose was not constant between grains. However, according to the temperature measurement of the experiment in which the OSL signal decreased and completely reset, the OSL signal may begin to decrease when the maximum temperature in the quartz band is 385 to 532 ℃ (equivalent to the experiment of normal stress 3.0 MPa in water-saturated and 2.0 MPa in air-dry) and the complete reset may occur when the minimum temperature is 238 ℃.

References

Ganzawa, Y., Takahashi, C., Miura, K., and Shimizu, S. (2013). Dating of active fault gouge using optical stimulated luminescence and thermoluminescence. *Journal of the Geological Society of Japan*, Vol.119, No.11, p.714–726.

Oohashi, K., Minomo, Y., Akasegawa, K., Hasebe, N., and Miura, K. (2020) . Optically stimulated luminescence signal resetting of quartz gouge during subseismic to seismic frictional sliding: A case study using granite derived quartz. *Journal of Geophysical Research: Solid Earth*, 125, e2020JB019900.

Tsukamoto, S., and Iwata, S. (2005). Recent development in luminescence dating; on the age range and the behavior of different OSL components from quartz. *Journal of the Geological Society of Japan*, Vol.111, No.11, p.643–653.

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