

Fundamental Study on TL and OSL of MgSO₄ and Its Hydrates for Future Dating on Europa's Icy Fault

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Many icy faults due to tidal force from Jupiter are observed on Europa's icy crusts. Double-ridged structures along the faults are considered to be associated with extruded liquid water from icy fractures [Hoppa et al., 1999]. On the other hand, a magnetic field observation from Galileo spacecraft suggests an existence of underground ocean, which has high electrical conductivity. This is explained by soluble sulfates in liquid water [Kargel et al., 2000].

If sulfate-rich water extrudes from active faults, soluble sulfates can be precipitated in recrystallization process of ice. Radiations from cosmic rays and natural radioactive elements produce radiation-induced defects in the sulfate crystal and are accumulated as time goes on. Electron spin resonance (ESR), thermoluminescence (TL) and optically stimulated luminescence (OSL) dating are based on measurements of the concentrations of accumulated defects produced by natural radiation and are applied to dating of terrestrial active faults using gouge quartz. Particularly, TL and OSL methods are useful to date thermal events (e.g. frictional heat) and optically shutoff events (sedimentation), respectively. We can estimate the precipitation age of the sulfates (active fault age) by measuring the sulfates around Europa's icy faults. A significant advantage of TL and OSL measurements is that the equipments can be easily simplified and downsized. Remote TL/OSL method is developed using a laser excitation [Takaki et al., 1997] and thus this method is suitable to remote sensing surveys.

In this study, the samples of MgSO₄, MgSO₄(7H₂O) and ice of MgSO₄ aqueous solution were irradiated by gamma-rays of 1 MeV at 77K and then luminescence measurements were carried out. TL was measured with a photo multiplier tube, arising the temperature linearly (15K/min.) from 90 to 250K. High-brightness red LED's (623nm wave-length) were used as excitation light for OSL measurements. The gamma-rays dose response curves of the TL and OSL intensities, which are very important to dating, will be reported mainly in this presentation.

References)

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