Constraining thermal/denudation histories in the last 0.1 Myr using multi-OSL-thermochronometry applied to samples from deep boreholes

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Constraining the denudation history is necessary for evaluating change of the Earth’s surface. Terrestrial cosmogenic nuclide (^{10}Be, ^{26}Al) dating is used to evaluate denudation rates averaged over a few meters at 10^2-10^4 year timescales, whereas low-temperature thermochronology, such as fission-track and (U-Th)/He methods, is applied to estimate denudation histories over a few to several kilometers in the last 10^6-10^8 years. However, the method of constraining the middle-term (10^4-10^5 years) denudation history remains challenging.
Recently, optically stimulated luminescence (OSL) thermochronometry has been proposed as a tool that offers potential for tight constraint of cooling histories in the low-temperature domain (30-100 ℃) over 10^4-10^5 year timescales. This method consists of determining the timing and rate at which electrons are trapped and thermally released in minerals, in response to in situ radiation and rock cooling. Luminescence signals can be converted into a rock cooling rate, or denudation history, by constraining the kinetic parameters that describe electron trapping and detrapping.

Application of OSL-thermochronometry is currently limited to regions that have experienced denudation rates higher than 5 mm/year (assuming a general geothermal gradient in Japan, which is ~0.03 ℃/m); luminescence signals saturate before the rocks are exhumed to the surface in slowly-denuding regions. However, constraining the slow cooling histories may be possible if unsaturated samples are obtained from within deep boreholes. Here we apply multi-OSL-thermochronometry to deep borehole cores drilled at the Tono and Rokko regions, southwest Japan, that have experienced slow (~0.1 mm/year) and moderate (~0.5 mm/year) denudation rates, respectively. We used the MIZ-1 core at Tono region, Gifu, and the Kabutyama core (National Research Institute for Earth Science and Disaster Resilience) at Rokko Mountains, Hyogo. In this presentation, we will present the preliminary results of the analyses.

This study was carried out under a contract with METI (Ministry of Economy, Trade and Industry) as part of its R&D supporting program for advanced research on long-term stability of geological environment.

Keywords: Luminescence

