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Thermoluminescence Dating of Calcite Veins in the Zambales Ophiolite, Luzon, Philippines

OGATA, Manabu[1*], HASEBE, Noriko[1], FUJII, Naoki[2], YAMAKAWA, Minoru[2], SATO, Tsutomu[3], Fujita Kenta[3]

[1]Kanazawa University, [2]RWMC, [3]Hokkaido University

A Deep geological repository of radioactive wastes from nuclear reactors is composed of several barriers including cement and bentonite. High alkaline groundwater might be produced through the alternation of the cement, thus the stability of bentonite during the interaction with high alkaline groundwater is one of the important issues to be studied as bentonite plays an important role to prevent an outflow of the contaminated groundwater to the environment owing to its cation exchange and swelling properties.

To understand bentonite-alkaline groundwater reaction with the geological timescale, it is useful to investigate a similar phenomenon occurred in nature. There is an ophiolite suites covered with bentonite layer in Luzon, Philippines. High alkaline groundwater originated probably from the serpentinization of mafic rocks has been circulating along cracks in a rock and bentonite layers. To determine the timescale of fluid-bentonite interaction, calcite precipitated from high alkaline groundwater was dated using thermoluminescence (TL) dating method.

First, TL color of calcite samples was investigated, and they emit red TL. Paleodose was measured using this red TL and SARA(single-aliquot regeneration and added dose) method was applied to evaluate sensitivity change of calcite occurred through repeated heating of samples.

In annual dose measurement, we measured radioactive element concentrations of calcite and a surrounding mafic sample using XRF, EPMA, LA-ICP-MS analyses. Cosmic ray contributions to annual dose was calculated by an equation of Prescott (1994).

To know the annual dose of a heterogeneous sample, detailed three-dimensional rock distributions around the sample is necessary. Unfortunately, the analyzed sample was very small in size, therefore we do not know accurate distribution of surrounding rock facies. By assuming the ratio of calcite and the surrounding mafic rock, the age of calcite was calculated.

As a result, the order of calcite age is ˜10 ka (younger than 100 ka and older than 20 ka). For accurate dating, it will be necessary to consider errors in added dose, exact distribution of rock which contributes the annual dose, and development of a method to estimate an annual dose for a heterogeneous sample.

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Keywords: Thermoluminecsence dating, calcite vein