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ベントナイトの熱年代学
Thermochronology of bentonite

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Bentonite consists mainly of montmorillonite and caused by diagenesis or hydrothermal alteration of tuff rock. In the geological disposal of high-level radioactive waste, compacted bentonite is planned to be used as the covering of carbon steel overpack. However, Fe(II)-bearing fluid originated from carbon steel may cause the alteration of bentonite. To predict what will happen in nature, natural analog study in the field where bentonite was altered by iron in nature is important. In Kawasaki and Shirosaki bentonite deposit, northeast Japan, one can find the greenish veins which may indicate the presence of interaction between iron bearing fluid and bentonite. To discuss the alteration temperature and period of bentonite, eruption event of parent rock of bentonite and formation event of bentonite, samples (greenish vein, altered bentonite, unaltered bentonite, original tuffaceous rock found in bentonite and so on) were collected, and fission track (FT) and 238U-206Pb dating were applied.

Apatite FT age could be calculated from samples both Kawasaki and Shirosaki deposit except for samples bearing no apatite grains. However, apatite FT age derived from most of the samples have large error because of small amount of apatite grains and low track density caused by relative low 238U content. Zircon FT and 238U-206Pb age was calculated for 6 samples (greenish vein, unaltered bentonite and original tuffaceous rock for each deposit). Samples from Kawasaki deposit were additionally FT dated by conventional method using neutron irradiation after FT dating using LA-ICP-MS. Apatite FT length data of all samples was not enough to discuss the thermal history of bentonite in detail, although 252Cf irradiation method was used. Because samples from Shirosaki deposit contained small amount of apatite grains and apatite FT length data, it is difficult to discuss in detail using analyzed data derived from Shirosaki samples.

Apatite from bentonite samples in Kawasaki deposit may indicate 238U diffusion or crystal dissolution and recrystallization process. Timing of these processes was probably consistent with formation of bentonite. Considering the results of this study and previous study, if 238U diffused, formation age, temperature and period of bentonite was estimated at about 15Ma, 46-48oC and more than 1m.y. If apatite dissolved and recrystallized, alteration temperature and period of bentonite was estimated at about less than 100oC and more than 1m.y. It may be considered from distribution of 238U-206Pb age that mixing of different rock into parent rock prevented parent rock from bentonite formation.

Two FT datings of same apatite grain from Kawasaki deposit using LA-ICP-MS and neutron irradiation indicated different FT age. Because this may suggest significant problem of FT dating using LA-ICP-MS, further discussion about this result is required.