Approaches to estimate alteration age and temperature of bentonite

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In the geological disposal of high-level radioactive waste, compacted bentonite is planed to be used as the covering of carbon steel overpack. Bentonite plays a buffer role and is expected to give the long-term performance as a barrier to radionuclide migration. 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. Purpose of this study is to estimate the alteration period and temperature of bentonite. Bentonite samples were collected from Kawasaki bentonite deposit, Miyagi prefecture, and fission track (FT) method was applied. Because bentonite will be exposed to the temperature below 100 degrees C in the waste disposal, apatite FT method whose closure temperature is around 100 degrees C is useful.

As a result, detailed thermal history of bentonite couldn't be analyzed due to small number of measurable tracks. FT ages of altered and unaltered bentonite were concordant at about 28Ma. This suggests that alteration temperature of bentonite may not be high enough to leave evidence in apatite FT system (below 100 degrees C). However, based on apatite FT age of tuff from parent rock of bentonite (about 17Ma) and zircon FT and U-Pb ages of altered and unaltered bentonite (14-17Ma), eruption age of parent rock should be Miocene, which is consistent to 13-15Ma microfossil age of Sakunami formation which interbeds bentonite layer (Otsuki et al.,1986). Apatite ^{238}U concentration of bentonite samples are about 1-5ppm, on the other hand, apatite of parent rock have ^{238}U concentration about 1-35ppm. This may suggest U escaped from apatite when bentonite was formed.