Natural analogue study on high level nuclear waste-Migration behavior of elements in shallow geologic environments-

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It is important to elucidate migration behavior of radioactive elements in various geologic environments for the safety assesment of geologic disposal of radioactive waste. To evaluate the repositary safety performance assesment (simulation on the radiological dose for periods of up to ten thousands to a million years near human environment) and natural analogue studies have been used. According to the simulations on the radiological dose by JNC(JNC, 2000), the highest level of radiological dose in caused by the uprift and eronsion during the long period, resulting to the occurrence of the radioactive waste in the shallow geologic environment. This high level is due to the assumption for the calculation that radioactive elements are highly mobile and not retarded by the geologic media through whch the elements pass in shallow and oxidizing environment.

In order to evaluate the migration behavior of radioactive elements in the shallow and oxidizing geologic environments, the chemical weathering of various kinds of rocks (volcanic ash soil(Andosol, loam), sedimentary rocks(shale, limestone), and granitic rocks) in Japan was investigated. Constituent minerals were identified by X-ray diffraction method, and major(alkali, alkali earth, Si, Fe, Al, Mn, Ti, P) and minor elements (base metal elements(Cu,Z, Pb, Co, Ni etc.), heavy elements(U, Th, Zr, Hf etc), REE) were analyzed by X-ray fluorescence and ICP, respectively. Elemental mobility for each element and the relationship between elemental mobility and depth roughly corresponding to the time for weathering. The geochemical and mineralogical studies clarified the followings.

1.REE in Andosol tend to dissolve with the weathering, but they fix in the loam underlying the Andosol. The mobility of major elements (alkali, alkali earth, Si) is higher than REE.

2.REE in pyrite-bearing shale migrates significantly due to low pH, but REE in pyrite-free and carbonate-bearing shale do not, accompanied by the formation of iron hydroxides and adsorption of REE on to iron hydroxides in high pH environment.

3.Mobility of REE during the weathering of limestone is small. This is caused by ionic exchange between Ca and REE, and increased tendency of adsorption in high pH environment.

In summary, above results indicate that mobility of radioactive elements like REE is not large in shallow and oxidizing environment, although they are mobile in very low pH condition.

Further works on the mobility of radioactive elements in shallow geologic environment should be done based on natural analogue studies.