Production of solutes in brown forest soil under conditions of a laboratory experiment

Mitsuo Manaka[1], Terumasa Nakajima[1], Katsuhiro Tsukimura[2]

[1] Research Center for Deep Geological Environments, AIST, [2] AIST

As the first step to understand the chemical formation of underground water, column-experiments on the soil-water reaction at 30 degrees C were conducted. We used a brown forest soil from Kasama area in a central part of Ibaraki Prefecture, 100km northeast of Tokyo in Japan. The soil at this site is a typical forest soil above a granitic rock in the temperate zone. We used a large undisturbed soil core consisted of surface and subsurface materials (0-0.3 m depth). The undisturbed soil core was taken in 155-mm-i.d. and 300-mm-long PVC (polyvinyl chloride) cylinder. Before leaching experiments, the soil core was flushed by a large amount of deionized distilled water to remove high concentration solutes in it. After flushing, the soil core was kept in an incubator at 30 degrees C. After aging of the soil, the soil core was recharged by deionized distilled water as a pulse input to flush solutes in it. At this time, the leachate was sampled at regular intervals and pH and EC (electric conductivity) of the leachate were measured. The recharge of deionized distilled water to the soil core and the leachate sampling were repeated until the value of EC became constant. After filtering of the leachate, Na+, K+, Ca2+, Mg2+, SiO2, F-, Cl-, NO3- and SO42- were measured. Similar experiments with two and four weeks aging were conducted.

Amount of each of solutes formed in the soil was assumed to be summation (mol) of each solute in the leachate. Solutes are divided into two groups. First group (H+, Na+, K+, SiO2, F- and Cl-)) shows the reaction order of 0th. Second group (Ca2+, Mg2+ and NO3-) shows the reaction order of 1st. As for SO42-, we can not determine the reaction order from experimental results. Moreover, extraction types of solutes are divided into three. First type shows that the value of solute has the peak during initial extraction and after then decreases gradually. SiO2 corresponded to this type. Second type shows that the value of solute is characterized by asymmetric BTC (breakthrough curve). This type includes H+, Na+, K+, Ca2+, Mg2+, F-, Cl-, and NO3-. Third type shows that the value of solute is characterized by two peaks of asymmetric BTC. This type includes SO42-.