B001-P010 Time: May 26 17:15-18:45

Amount of amorphous material and its chemical composition in a soil

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Because soil contains clay minerals, amorphous material and organic material, the adsorption-desorption capacities and the buffering capacities for chemical reactions of soils are large compared with those of hard rocks. The chemical reactions between amorphous materials and water are fast because of the large reaction surface of amorphous material. However, the relation between amorphous material in soils and chemical reactions has not been studied systematically. Characterization of amorphous material in soils is the first step to the research. We have studied the amount of amorphous material and its chemical composition in a soil.

The natural soil sample we used in this research was a brown forest soil overlying granite in a central part of Ibaraki Prefecture. We took soil from the depth from 0 to 100 cm. The sample without moisture nor organic materials was divided into seven fractions, 2 mm or more, 2-1 mm, 1 mm-250 mm, 250-64 mm, 64-16 mm, 16-4 mm and 4 mm or less. First, we collected 4 mm or less fraction with a hydaulic elucidation method. Second, we collected 16-4 mm fraction with the hydaulic elucidation method. Then, the sample was separated with sieves into five fractions. Amount of the amorphous materials in the soil was quantified with an X-ray powder diffraction method. We determined the quantity of amorphous materials assuming that the materials other than crystalline minerals are amorphous. We determined the ratios of crystalline minerals in the soil with the internal standard method of Alexander & Klug (1948). Second, we determined the chemical compositions of amorphous materials in 64-16 mm, 16-4 mm and 4 mm or less fractions, respectively. The chemical composition was assumed to be the value by subtracting chemical compositions of each mineral from whole chemical composition in each fraction. The whole chemical composition is analyzed by XRF.

Amount of amorphous material at each depth increased with decreasing size of particle. The total amount of amorphous materials decreased from 32 at 0-10 cm to 9 wt% at 90-100 cm. On the other hand, the chemical composition of amorphous material depended on the fraction rather than the depth. For example, average chemical compositions (mole fraction) of amorphous materials are $0.56SiO_2+0.38Al_2O_3+0.06Fe_2O_3$ in 64-16 mm fraction, $0.50SiO_2+0.40Al_2O_3+0.10Fe_2O_3$ in 16-4 mm fraction and$0.36SiO_2+0.41Al_2O_3+0.23Fe_2O_3$ in 4 mm or less fraction.