Sr isotopic ratios of organic and silicate components in allophanic Andosols and nonallophanic Andosols in Japan

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(Introduction)

Volcanic ash soils, termed as Kuroboku from its black color, are widely distributed in Japan. Most volcanic ash soils are classified to Andisols. Andisols in Japan are divided into two types. One Andisols have clay fraction dominated by allophane, noncrystalline hydrous aluminosilicate, named as allophanic Andisols. In other hand, namely nonallophanic Andisols contain crystalline 2:1 type clay minerals. Due to the dominant existence of 2:1 type minerals, the nonallophanic Andisols show some distinctive properties, such as the amount of exchangeable Al, compared to the allophonic ones. Factors of the genesis of the nonallophanic Andisols reported by previous studies are annual precipitation, soil acidity, accumulation of humus, and/or the addition of eolian dust from China. Stable isotope of Sr is powerful provenance tracer, because minerals and rocks have distinct 87Sr/86Sr ratios depending on their geological regime, and the isotope ratios are altered little during transport in the atmosphere or after deposition in sediments. In order to evaluate the provenance of Andisol minerals, I determined Sr isotopic ratio and elemental compositions of allophanic (4 sites) and nonallophanic Andisols (6 sites).

(Samples and Experiments)

The sampling sites for the allophanic Andosols were Miyakonojo, Imaichi, Takizawa, and Chashikotsu, and those for the nonallophanic Andosols were Erimo, Wakami, Kitakami, Shinjo, Naruko, and Tottori. Soil samples were collected from the A, B, and C horizons at each site. One gram of the air-dried soil was reacted with 50 ml of 10% hydrogen peroxide solution (H2O2) to separate organic matter. The residual inorganic component and organic component (H2O2-leachate) were used for the isotopic and chemical analysis.

(Results and Discussion)

The 87Sr/86Sr ratios of the residual silicate components in the allophanic Amdisols fall in a narrow range from 0.7034 to 0.7070. There are the positive correlations among Fe, Mg, Cr, V, and Zn. These results indicate that the allophanic Andisol minerals are largely originated from mafic volcanic ash. In other hand, the nonallophanic Andisols have higher 87Sr/86Sr (0.7055 - 0.7192) than those of the allophanic ones and are closed to aeolian minerals originated from the insoluble minerals of Chinese loess. The clay mineral content in the nonallophanic Andisols is larger than those of the allophanic ones, and has good correlations with Al, Mg, K, Ba, and Li concentrations and Sr isotope ratios. These suggest that the incorporation of eolian clay minerals originated from arid areas in northern China contribute to the part of clay minerals in the nonallophanic Andisols, although there is no systematic change of Sr isotopic ratios in nonallopanic soils.

Strontium isotopes have been used in recent years as tracers to improve our understanding of the circulation of elements, such as calcium, in the soil-vegetation system. The organic component (H2O2-leachat) in the nonallophanic Andosols show higher 87Sr/86Sr (0.7084 - 0.7113) than those of the allophanic ones (0.7055 - 0.7075). This results suggest that aeolian input of elements from China contribute to the organic and plant-available (exchangeable) components in the nonallphanic soils as well as silicate minerals.

(Acknowledgements)

The author thanks to Prof. M. Saigusa and Dr. T. Ito at the Experimental Farm of Tohoku University for their help soil sampling. Thanks are due to Dr. M. Tanimizu at Center for Advanced Marine Core Research Kochi University for sincere assistance of analysis by TIMS.