Geophysical Research Abstracts
Vol. 13, EGU2011-4752, 2011
EGU General Assembly 2011

Biogeochemical caracteristics of plant-soil system in a limestone area: A case study of Mt. Kinsho-zan, Gifu prefecture, central Japan

Shinichiro Ueno, Morihiro Ono, and Kenichiro Sugitani
Nagoya University, Japan (ueno.shinichiro@e.mbox.nagoya-u.ac.jp)

Limestone contains few of the nutrients essential for plant growth, such as Si, K, and P. Owing to its high concentrations of alkali earth elements and the resulting high pH, P and Fe tend to be sparingly available for plants in soils developed in limestone areas. Because of this limited availability of nutrients in calcareous soils, certain typical calcareous plants are known to occasionally dominate. On Mt. Kinsho-zan, a limestone mountain in Gifu prefecture, central Japan, however, typical calcareous plants are not seen; various non-calcareous plants appear and do not seem to be malnourished. In addition to the nutrients supplied by precipitation and eolian dusts, litter decomposition may supply nutrients, which could circulate in the plant-soil system.

In this study, the soil properties (water content, loss on ignition, and pH) and the chemical compositions of soils, plant leaves (Chamaecyparis obtusa), and parental rocks (limestone) were analyzed to clarify the biogeochemical cycle of the plant-soil system on Mt. Kinsho-zan. A mountain composed of sandstone and mudstone, which lies near the main research area, was chosen for comparison. Chemical compositions were analyzed using an X-ray fluorescence spectrometer (Spectris Co., Ltd Panalytical Division Axios-N system). Ten major elements were analyzed in all samples, and 13 and 4 trace elements were analyzed for soils and plants and for limestones, respectively. In the limestone samples, the concentrations were as follows: SiO2 = 0.12–0.22wt%, Al2O3 = 0.054–0.13wt%, Fe2O3 = 0.021–0.057wt%, CaO = 55.12–55.33wt%, K2O = 40–55 ppm, TiO2 = 29–48 ppm, and Zr = 12–14 ppm. In soils developed in the limestone area, SiO2 = 43.48–55.46wt%, Al2O3 = 25.47–34.92wt%, Fe2O3 = 10.75–13.64wt%, CaO = 0.46–5.61wt%, K2O = 1.30–1.72wt%, TiO2 = 1.02–1.36wt%, and Zr = 240–319 ppm. Concentrations of Fe2O3, MnO, and P2O5 in soils from the limestone area are two times higher than those in soils from the sandstone–mudstone area; the concentrations of CaO are about 10 times higher than those in soils from the sandstone–mudstone area. Compared to the sandstone–mudstone area, 13 elements in soils and 10 elements in leaves from the limestone area have higher concentrations. Soils from the limestone area contain higher concentrations of MnO, Ni, and Zn than those from the sandstone–mudstone area. Concentrations of these elements in leaves, in contrast, tend to be lower in the limestone area than in the sandstone–mudstone area; Si shows the opposite result. Both soils and leaves in the limestone area contain more Ca and P than those in the sandstone–mudstone area.

In the limestone area, CaO/TiO2 and P2O5/TiO2 ratios in soils are lower than those in rocks, suggesting leaching of Ca and P, whereas the upper soil samples have higher values than the lower soil samples. Calcareous dust transported from a nearby excavated research field may have been deposited on the surface layer. Zr/TiO2 ratios in soils are lower than those in rocks, suggesting that materials with low Zr/TiO2 values have been transported into soils. The soils in the limestone area likely contain significant amounts of allochthonous materials, in addition to the weathering products of parental rocks.