Some experimental evidences showing potential of plant-induced weathering as geochemical feedback

Tasuku Akagi[1]

[1] Kyushu Univ.

http://coffee.geo.kyushu-u.ac.jp/

In the surface of the Earth, which is roughly equal to the biosphere, the main circulation of materials starts from the Continents (or lands) and ends at the ocean floor. Chemical weathering is a process, by which the elements in land-forming rock are liberated. Recently the rate of the chemical weathering has been found to be enhanced by the presence of plants. It is no exaggeration, therefore, to say that the supply of nutrient circulated in the biosphere is determined by land plants. However, the response of the plants, which is a core of the feedback system of the weathering, remains to be studied. To understand the role of plants in the earth history, it is essential to understand how plants respond to an environmental condition. In this study, some experimental results on the plant-induced weathering are summarized and the relationship between environmental changes and plant-induced weathering is considered.

1. The enhancement of weathering rates by plants

A number of studies revealed that the rate of chemical weathering was enhanced by the presence of plants. In this study, the release rate of elements from rocks was directly determined using a closed system. The rate was enhanced by 2 to 5 times by the presence of plants. In an experimental forest in France Nd isotope ratios of soil and vegetation were determined to understand the source of weathered materials. I reached to the conclusion that the elements in plagioclase were released only by the action of plants and that the weathering rate was enhanced at least twice by the action.

2. Evidences of chemical weathering as one of physiological activity of plants

Plants secrete organic acids or carbon dioxide into the rhizosphere and it has been considered that plants play only a subordinate role on the weathering. Several other sets of experiments were carried out with varying nutritious conditions by us. It was revealed that a deficient nutritious condition induced a higher rate of weathering than a sufficient condition, irrespective of plant species or rock types weathered. It was considered that the plants took in some nutritious elements like potassium, calcium, etc. from rocks in a deficient condition. It is implied that the plant-induced weathering is one of strategy to take in nutrient in short from rock.

3. Link of weathering rate and vegetation

Our hydrological analysis and chemical analysis of circulating water revealed that the weathering rate in a deciduous forest was greater by two or three times than that in coniferous forest from. Coniferous trees are common in a colder region and deciduous ones in a warmer region. This implies that the weathering rate changes dependent on temperature conditions via vegetation shift.

The results of the present studies show some interesting responses of plants in the feedback system in question.

1) The weathering rate may increase on more barren lands

2) It may increase in warmer conditions

The two responses seem to provide very promising features with the feedback system and may lead to a novel viewpoint of chemical weathering.