

## Dissolution experiments of fresh and weathered granites in weakly acid solution at room temperature and pressure

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### [Introduction]

Dissolution of silicate minerals is one of the most significant processes of the chemical weathering of rocks. The granites are widely distributed in Japan and thus, to clarify the dissolution rate of granites is important to discuss the environmental problems, for example acidification of soils, rivers and lakes, in the areas underlain by the granites. We experimentally studied the release rates of fresh and weathered granites as the basic research for the study of the weathering rates on the granites.

### [Experimental Procedures]

Fresh and weathered granites and soils originating from Ikuchijima area, Hiroshima Prefecture, Japan, were used for dissolution experiments. The fresh granites were coarsely crushed by a hammer mill (Id), the weathered granites were weakly crushed by a hand hammer (Ib and Ic) and the soils were loosened by a rubber hammer (Ia). These were sieved to obtain the 45-90 micrometers size fractions. Fine particles were removed by repeatedly washing the fractions in an ultrasonic bath, using deionized water and acetone.

Column flow-through type of reactor was used for dissolution experiments. This was made of teflon tube and measured 6 x 100 mm (i.d. x length). It was filled with 3 g of fraction. Reacted solution passed through the reactor at about 0.02 ml/min. Reacted solutions at pH 4 were prepared with dilute HNO<sub>3</sub> and oxalate, respectively. The conditions for all experiments were as follows: temperature, 25 +/- 0.5 degree with the constant temperature water bath; pressure, room pressure. The concentrations of Si, Al, Ca, Mg and Fe in the output solutions were determined by ICP-AES and Na and K were by flame atomic absorption spectroscopy, and then the release rates were calculated.

### [Results]

pH values using HNO<sub>3</sub> solutions was about 6 in the initial experiment time and rapidly decreased to less than 4.3 after 100-500 hours. In the case of using oxalate solutions, the initial pH 6 gradually decreased to pH 4.5-4.9.

In both experiments using HNO<sub>3</sub> and oxalate solutions, Si, Mg, Ca, Na and K showed the initial high release rates and then gradually or rapidly decreased to the steady state values. Al and Fe had the very low release rates in first, gradually increased to the steady states. The initial high release rates of Ca were characteristically notable and after 100-500 hours, the rates rapidly decreased. The variation of Ca release was concordant with that of pH and thus, the initial high pH is considered to depend on the release of Ca. In the oxalate solutions, the pH values decreased with decreasing release rates of Ca and after achieving the steady state of Ca release, the values were gradually decreasing until the values became the steady state. In the HNO<sub>3</sub> solutions, some elements showed evidently higher release rates as the average release rates in all experimental times than the steady state release rates. It is dependent on the initial high release rates of the elements. Thus, the experiment using a batch type of reactor cannot evaluate the steady state dissolution rates.

Compared between the release rates of the fresh and the weathered granites and the soils in the HNO<sub>3</sub> solution, the release rates of Si had almost same values at all samples. The release rates of Al and Fe at steady states using the fresh granites and the soils were higher than those using the weathered granites, and the rates of Na showed an opposite tendency. The release rates of each element using the oxalate solutions were higher than those using the HNO<sub>3</sub> solutions, especially of Fe. The oxalate was considered to enhance the release rates of the samples, especially in relation to Fe.