Fe behavior during forsterite dissolution under low oxygen conditions

Hirokazu Sugimori[1]; Takashi Murakami[1]

[1] Deprt. of Earth Planet. Sci.., Univ. of Tokyo

Oxic weathering is dominated at the present earth's surface because of 21% O_2 gas in the atmosphere. On the other hand, weathering in the Precambrian occurs under low O_2 or reducing conditions and is different from oxic weathering in terms of kinetics, mechanisms and processes. Iron behavior during chemical weathering is a good indicator of the redox conditions because Fe(II) oxidation rate is a function of the concentration of dissolved oxygen ($[O_2]$).

The dissolution experiments of forsterite ($(Mg,Fe(II))_2SiO_4$) were carried out at low O_2 conditions in order to investigate the effects of dissolved oxygen on the forsterite dissolution and Fe behavior. An input solution was bubbled with a mixture of Ar and O_2 gases to exchange dissolved gases in the solution. Concentration of dissolved oxygen was controlled by altering the mixing ratio of Ar and O_2 in the input gas. The dissolution rate of forsterite at low O_2 conditions is slightly faster than that under present atmosphere The ratios of precipitated Fe in the reactor to total Fe dissolved from forsterite, which expressed as f, depend on the $[O_2]$ and thus Fe(II) oxidation rate. The kinetic model of f calculated from the Fe(II) oxidation rate law:

$-d[Fe(II)]/dt = k[Fe(II)][O_2]^x[OH^-]^y$

can explain the variation of f for the experimental data when the power of $[O_2]^x$ in the equation of oxidation rate (x) decreases from 1.0 to 0.7 as $[O_2]$ decrease from 8.1 ppm to 0.0035 ppm.