キレート剤存在下での結晶構造によるケイ酸塩鉱物溶解への影響

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Silicate minerals dissolution behaviours and reordered preference in the presence of a chelating agent

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The rates of mineral dissolution contribute to many geochemical processes and phenomena, such as geothermal exploration and CO_2 mineralization by reacting with leached Ca and Mg ions, the latter is one of the crucial ways to reduce atmospheric CO_2 concentration. Recently, the remarkable enhancement of mineral dissolution using chelating agents is increasingly reported. To clarify the issues that arise accordingly, i.e., the dissolution behaviours of various minerals in chelating agent solutions, basic dissolution experiments using 2 wt.% GLDA-Na_4 (*N*,*N*-Dicarboxymethyl glutamic acid tetrasodium salt) solution and seven minerals, i.e., olivine, epidote, tourmaline, enstatite, hornblende, biotite and anorthite, respectively belonging to seven major silicate groups, were conducted in this study, at the room temperature and pressure.

The rate of Si and Al being released from per unit area of mineral surface (e.g., mmol/m^2min), which is often used to present the mineral dissolution rate, was generally higher in acid GLDA solutions (pH of 4) than in alkaline GLDA solutions (pH of 8), during 120 min reactions, due to the joint effect of proton and the chelator. Moreover, at pH 4, the rate of Al being released from minerals was higher than that of Si, whereas at pH 8, except for biotite, Si leaching was preferred. At both pH 4 and 8, among the 7 types of silicates, the extractions in Si+Al and in divalent cations (i.e., Ca, Mg, Fe, Mn) showed a similar sequence: phyllosilicate biotite dissolved the fastest, followed by olivine (nesosilicate), anorthite (tectosilicates), tourmaline (cyclosilicate), epidote (sorosilicate), enstatite (inosilicates: single-chain), hornblende (inosilicates: double-chain). Biotite, the dissolution rate has been reported to be slower than pyroxenes, showed a remarkable increase in the presence of GLDA, regardless of the solution pH. This kind of enhancement in biotite dissolution, as well as reordered mineral dissolution preference in chelating agent solution may potentially contribute to the application of chelating agents for rock dissolutions and elements extractions, and further studies will be focused on developing a better understanding of the relationship between minerals lattices and chelating agent attacks.

Keywords: Silicates, Minerals, Dissolution, Chelating agent

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