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Analysis and Application of Water-Rock-CO2 Reaction Using Basalt

KATAYAMA, Tomohiro[1*], SHIKAZONO, Naotatsu[1], TAKAYA, Yutaro[2], KATO, Yasuhiro[2]

[1]Graduate School, Keio University, [2]Graduate School, University of Tokyo

Carbon dioxide underground sequestration is able to reduce enormous quantities of CO_2 emission. It has been attracted and researched.

But, there are several unclear mechanism of CO_2 behavior in underground. Therefore, it is difficult to estimate exact time for CO_2 storage.

For estimating time of CO_2 sequestration, we consider water-rock-CO_2 reaction.

Water-rock-CO_2 reaction attract attention in many parts of science. It consists of three following reactions:

$CO_2 + H_2O = H_2CO_3 = H^+ + HCO_3^-$ (1)

$MSiO_3 + 2CO_2 + H_2O = M^{2+} + H_4SiO_4 + 2HCO_3^-$ (2)

$M^{2+} + 2HCO_3^- = MCO_3 + CO_2 + H_2O$ (3)

where M is bivalent metal ion.

There are two steps. First, CO_2 dissolves in the water by (1) or mineral and water react CO_2 by (2). Next, bivalent metal ion and hydrogen carbonate ion generate and carbonate minerals (MCO_3) precipitate by (3).

If CO_2 is fixed as MCO_3 by (3), it is very safety. But, this reaction mechanism is very complex. And calculation method of dissolution rate constant is not clear. Furthermore, water-rock-CO_2 reaction is useful for estimating ancient CO_2 concentration and considering carbon flux in the global circulation, too.

In this study, the purposes are

1)To consider dissolution mechanism in water-rock-CO_2 reaction.

2)To compare many calculation method of dissolution rate constant.

3)To estimate time of CO_2 storage by precipitation of carbonate minerals.

We used basalt samples for the dissolution experiment. Because,

1) It contains metals which can become divalent cation.

2) It is widely distributed in the world.

3) Oceanic ridge is almost composed of basalt.

The basalt samples ware obtained nearby Mt. Fuji.

Keywords: Basalt, Water-Rock Reaction, CO2 Sequestration