Experimental study on the underground disposal of carbon dioxide into heating rock

Masakatsu Mizukami[1]; Masanori Shinohara[2]; Sachiko Ohmori[3]

[1] Material and Environmental Eng., Hakodate National Coll; [2] Environmental Systems Eng,Hakodate National Coll; [3] Material and Envi, Hakodate College of Tech.

1. Introduction

In order to reduce CO2 emissions to the Earth`s atmosphere, a method disposing CO2 as a supercritical fluid into the underground deeper than a thousand meters have been investigated. In this study, to examine the possibility of such underground disposal into heating rocks, an experiment of CO2/water/rock interaction were carried out by using high-temperature and pressure hydrothermal system. In the experiment, a granodiorite at Okachi of Akita Prefecture was reacted with ground water and CO2 in analogous to the field experiment carried out at this area.

2. Experiment and Results

To react CO2 with groundwater and rock under critical conditions, we used a modified Barnes-type hydrothermal system of which titanium vessel equipped three types of high-pressure valves for a) CO2 injection, b) pressure measurement, and c) water sample collection. Aliquot of powdered granodiorite sample, ground water and liquid CO2 were sealed into the titanium-vessel of hydrothermal system, and then reacted at 6-9 MPa and 150-200oC. The reacting solution was collected by high-pressure valve and analyzed by atomic absorption photometry, ion-chromatography and ICP-MS. The reaction products were determined by X-ray, SEM and EPMA.

Under high temperature and vapor-pressure, the composition of the solution reacted with rock changed rapidly on the early stage. The increase in Ca is remarkable, especially, and this was caused by the dissolution of gypsum (CaSO4) in the rock. Then Ca and Mg in solution decreased rapidly, possibly due to precipitation of calcite and dolomite.

Gypsum = Ca2+ + SO42-

Ca2+ + CO32- = Calcite

Ca2+ + Mg2+ + CO32- = dolomite

Such reaction mechanism implies that carbon dioxide disposed in underground gradually decrease in time, suggesting some important information about the field of the CO2 disposal. These results accord well with the data from the field examination which was carried out by inject carbon dioxide into a drill hole (ca.1000m deep) at Okachi granodiorite area (ca. 200oC).