A preliminary study on source of high CO_2 fluid in Oku-Aizu geothermal area, Japan, by the isotopic compositions of carbonate minerals

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In Oku-Aizu geothermal area, Northeast Japan, high CO_2-rich fluids (1 vol%) with high salt concentration (Cl=6,000 ~ 14,000 mg/L) are used for producing the geothermal electricity (65MW). The source of the CO2 is not clear so far. A final goal of our study is to advance zero emission geothermal power generation by mineralization of most of CO_2 into carobonates (Georeactor) during fluid injection. The purpose of this study is to analyze the carbon and oxygen isotopic compositions of calcites in borehole cores and to examine the source of the CO_2 rich fluid and mechanism of CO_2 mineralization.

Rock samples were collected from borehole cores obtained at the depth of 1,235~1,835m in the approximate center of the geothermal well (84N-3t) of the Oku-Aizu geothermal plant. The rock consisits of mainly homogeneous rhyolite tuff-lapilli. Anhydrite ($CaSO_4$) is commonly observed as an alteration mineral but calcite was rare. Rock sample was grounded (~1mm). Calcite for the isotopic analyses were pick up by soaking the rock fragments in 1N-HCl solution and check the CO_2 bubble. The calcite was then washed immediately with distilled water and dried in the oven at 110°C. The carbon and oxygen isotopic compositions were analyzed using a mass spectrometer (PRISM).

The $\delta^{13}C$(PDB) values of calcite of depth 1257m ~ 1819m were -1.99 ‰ ~ -4.91 ‰ and $\delta^{18}O$(SMOW) values were + 5.84 ‰ ~ + 11.2‰. Based on the measured well temperature and relationship between carbon isotope fractionation of CO_2 and HCO_3 in the geothermal fluid (O'Neil et al., 1961), carbon isotopic composition of HCO_3 is calculated to be -5.94‰~ -4.8‰. In addition, oxygen isotopic composition of the coexisting geothermal fluid is estimated to be -2.25 ‰ ~ + 3.84 ‰. These values suggest that high CO_2 fluid in the study area are of volcanic origin.