Determination of PVTX data and the phase change of crustal fluids

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Crustal fluids are the aqueous solution of salts (NaCl, KCl, $CaCl_2$ etc.) and gases (CO_2, CH_4, N_2 etc.), most commonly a H_2O-CO_2-NaCl system. However, because of the effects of charged species, we have a little information on the phase change and the thermodynamic properties over the wide range of P and T, especially, around critical region for the ternary system. The equation of state (EOS) is the most important for understanding several geochemical processes. However, the EOS that is specified for high salinity (>25wt%) systems has not been also established yet, because experiments have not been done successfully around the critical point. In this study, we have determined the fundamental thermodynamic properties (PVTX relation and phase change) experimentally using new apparatus up to 200MPa and 600^{o}C.

We have developed a new experimental apparatus, which is composed of a mini-piston/cylinder system set in the pressure vessel and CO_2 injector. PVT data is measured continuously and synchronously and error of measurement is within 1%. The phase change can be determined from differential V with respect to P or T. We verified the performance of our apparatus by comparing our experimental data with EOS for pure water, H_2O-CO_2 and H_2O-NaCl binary system over the P-T conditions attainable. Those results are in good agreement with preexisting EOS within accuracy of about 3%. Our experimental method serves for the determination of the thermodynamic properties on high saline crustal fluids with high CO_2 concentrations around critical region.

Preliminary geochemical results on the CO_2 Georeactor sequestration test at the Ogachi HDR site

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This paper reports a preliminary result of field experiments of CO_2 sequestration into the Ogachi HDR site, where a part of CO_2 will be expected to be fixed as carbonates by interaction with rocks (Georeactor; Ca extraction from rocks and carbonate fixation). The Ogachi HDR (Hot-Dry Rock) field is situated at the northeast Japan and have been studied to produce geothermal electricity.

Experimental Procedure

River water had been continuously injected (380 L/min, 15 MPa) into an injection well (OGC-1) and produced (40 L/min) from an prodcution well (OGC-2) during the experiment (2 weeks). After the fluid flow rate became constant, CO_2 dissolved water (0.2 wt%) was injected with tracers (KI; 2kg/200L and uranine; 150g.18m^3). The fluids from OGC-2 were geochemically monitored for their isotope and chemical compositions. The final output temperature at the OGC-2 well site is 127.5 ºC.

Results and Discussion

During the experiments, major chemical compositions of fluids from OGC-2 are almost constant. The tracers are first detected at 34 hours after the injection and showed the maximum concentration at 67 hours. The dilution rates of the obserbed to injected concentrations of KI and uranine are calculated to be 6×10^{-5}.and 1×10^{-3}, respectively. CO_2 concentrations in the fluids varied from 600 to 200 mg/L with time and showed no corelation with those of the tracers. This is due to the high dilution rate with reservoir fluids. In this field experiment, we could not discuss the fixation rate of CO_2 as carbonate.