Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SCG65-P16 Room:Convention Hall Time:May 20 17:15-18:30

SYNTHETIC EXPERIMENTS OF AQUEOUS AND CARBONATE FLUID INCLUSIONS

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Deep aqueous fluids from subducted slab affect volcanic activity and seismicity in the subduction zone. (e.g., Schmidt and Poli, 1998) To reveal the chemistry of slab-derived fluids is crucial for understanding the material circulation in subduction zones, but as yet it is very difficult to experimentally constrain the chemical composition of these fluids. Diamond-trap experiments in combination with LA-ICP-MS analyses of frozen samples have been used to analyze chemical compositions of aqueous fluids in equilibrium with complex mineral assemblages (e.g., Kessel et al., 2004). However, in order to accurately determine fluid compositions experiments also need to be designed to account for modification of the fluid during quenching. Synthetic fluid inclusions trapped during high-pressure experiments can keep the composition of the fluids produced at run conditions. We have developed a method to trap fluids liberated during decomposition of hydrous and carbonate minerals as fluid inclusions in a quartz crystal.

The synthetic fluid inclusion tech-nique (Sterner and Bodnar, 1984) was employed in this study. Synthetic fluid inclusions were formed in synthetic quartz provided by Nihon Dempa Kogyo Co., LTD. Quartz single crystals were cut into about 1-2mm size, heated to 450 C, and then quenched in cold distilled water to make cracks within it. After drying in a vacuum oven at 150 C overnight, the quartz crystals with cracks were rapped in a piece of Pt foil (2.5um-thick) and sealed in Au or Pt capsules with various mineral assemblages, such as Mg(OH)2, CaCO3+SiO2, CaCO3+SiO2+H2O and mMgCO3Mg(OH)2nH2O+SiO2+Mg(OH)2. The capsule was placed in a solid-media piston-cylinder apparatus and kept at the pressure range 0.5-1 GPa and at the temperature range 800-1100 C for 3-192 hours.

After quenching, thin sections (200-500um-thick) were prepared to examine with an optical microscope, Raman spectroscopy and microthermometry. The analyses for microthermometry were performed by referring Diamond (2001) and using the computer program Loner AP (e.g., Bakker, 2009).

Fluids liberated from Mg(OH)2 were successfully trapped as fluid inclusions in all experiments. Microthermometry for a fluid inclusion in the sample synthesized at 800 C and 1 GPa for 3 hours showed the homogenization temperature of 251 C, molar volume of 22.8 cm3/mol. However, the calculated isochore shows that the temperature calculated for 1 GPa was 961 C, which was different from the run condition.

Fluid inclusions were not observed in experiments with CaCO3+SiO2, whereas were successfully synthesized in experiments with CaCO3+SiO2+H2O. The size and amount of fluid inclusions in these samples were smaller than those in the experiments with Mg(OH)2. Raman spectra showed the peaks of CO2 but the broad peaks of H2O were not observed clearly.

Fluids liberated from mMgCO3Mg(OH)2nH2O+SiO2+ Mg(OH)2 were successfully trapped as fluid inclusions in all experiments. Raman spectra showed that the fluid inclusions in these samples were composed of H2O and CO2. Microthermometry for the three fluid inclusions in the sample synthesized at 850 C and 1GPa for 18 hours showed that the homogenization temperatures from vapor-liquid carbon phase to liquid carbon phase were 24-29.5 C and total homogenization temperatures were 255-269 C, yielding molar volumes of 24.2-26.3 cm3/mol and total mole fractions CO2 of 12-18 mol%. The calculated isochores give 910-1033 C at 1GPa, which had wide distribution.

In the experiments of anhydrous systems, liberated fluid could not be trapped during crack healing or perhaps crack healing did not occur in the experimental conditions in present study. The tem-peratures estimated from microthermometry were different from run conditions.

To interpret the condition that fluid inclu-sions are produced, it is needed to figure out the reason of this discrepancy by more analyses with precise ob-servations of occurrence.

Keywords: synthetic fluid inclusion, hydrous mineral, carbonte mineral, piston-cylinder