[S-IT40_1PM1] Geofluids: their distribution and role in the Earth's dynamics

Convener:*Michihiko Nakamura(Division of Earth and Planetary Materials Science, Department of Earth Science, Graduate School of Science, Tohoku University), Hiroshi Sakuma(Department of Earth and Planetary Sciences, Graduate School of Science and Engineering, Tokyo Institute of Technology), Masahiro Ichiki(Graduate School of Science, Tohoku University), Tsutomu Takahashi(Institute for Research on Earth Evolution Japan Agency for Marine-Earth Science and Technology), Chair:Tetsuya Yokoyama(Department of Earth and Planetary Sciences, Graduate School of Science and Engineering, Tokyo Institute of Technology), Keika Horiguchi(Crustal Fluid Research Group, The Institute of Geology and Geoinformation, Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology)

Thu. May 1, 2014 2:15 PM - 4:00 PM 416 (4F)

Recent advances of magnetotelluric and seismic imaging of the Earth's interior have suggested "geofluids" distribute more ubiquitously than ever thought; this has accelerated the development of a new integrated discipline on the geofluids ranging from material sciences in molecular scale to geophysics and geochemistry in the island arcs and mid oceanic ridges. The scope of this session is to bring together multi-scale and interdisciplinary researches on distributions of aqueous fluids and silicate and other melts in the crust and mantle of a wide range of tectonic settings, and on the physical and chemical properties of these fluids. Topics on geodynamics related to the presence of fluids are also welcomed.

2:15 PM - 2:30 PM

Diffusive kinetic isotope fractionaion of water in silicate glasses

3-min talk in an oral session

*Minami KURODA1, Daiki YAMAMOTO1, Shogo TACHIBANA1, Michihiko NAKAMURA2, Satoshi OKUMURA2, Miho ASAKI2, Atsuko ISHIBASHI1, Naoya SAKAMOTO1, Hisayoshi YURIMOTO1 (1.Department of Natural History Science, Hokkaido University, 2.Department of Earth Science, Tohoku University)

Keywords:eruption dynamics, silicate glass, water, diffusion, hydrogen isotope, isotopic fractionation

Oversaturation of dissolved volatiles in an ascending magma leads to bubble nucleation and growth, which depend on volatile solubility and diffusivity, and drives explosive volcanic eruptions in the Earth. It is thus important to clarify the behaviors of volatiles in silicate melts in understanding the mechanism and dynamics of volcanic eruptions. Hydrogen isotopes record the degassing processes of hydrous magmas due to isotopic fractionation between dissolved and exsolved water. The degree of hydrogen isotopic fractionation is correlated with the water content in natural volcanic rock samples; Deuterium is more deficient in water-poor samples, and the degree of D-deficiency increases as the water content decreases. This trend has been interpreted to reflect the transition of degassing model from that in a closed-system to in an open-system. However, these two extreme degassing schemes do not take the diffusive transport of water in magmas into account, which should be included in a realistic degassing model, because the timescale of diffusion is not necessarily negligibly small compared to that of degassing during magma ascent. Moreover, diffusion of water in silicate melts may cause kinetic isotope fractionation between silicate melt and explosive fluid phases because H₂O is likely to diffuse faster than HDO, of which effect can be overprinted in the D/H ratios of natural samples. The hydrogen
isotopic fractionation during water diffusion in silicate melts, however, has not yet been fully
determined. In order to determine the isotopic fractionation factor of hydrogen due to water diffusion
in silicate melts, we performed diffusion experiments of water in SiO$_2$ and synthetic rhyolite glasses in a
D-enriched systems (H/D=10, 5 and 1). The experiments were performed for SiO$_2$ and rhyolite glasses at
850°C and water pressure of 50 bar in sealed silica tubes and at 650°C and water pressure of 500 and
1000 bar in a hydrothermal furnace developed at Tohoku University. Concentration profiles of H and D in
run products were measured with the ion microprobe (Cameca ims-6f at Hokkaido University) to evaluate
diffusion coefficients of water (including H$_2$O and HDO) in glasses. The obtained diffusivity (a diffusion
coefficient divided by a water content) in SiO$_2$ glass at 650 and 850°C were consistent with the values
reported in previous studies (Davis and Tomozawa, 1995; Berger and Tomozawa, 2003). The D/H ratios
along the diffusion profile were also analyzed for SiO$_2$ glasses with the ion microprobe. The D/H ratio
first decreases, but apparently increases along the profile. The decrease of D/H ratio may imply the
kinetic isotope fractionation during diffusion. However, the increase of D/H ratio cannot be explained
simply by diffusion and may reflect the change of instrumental mass fractionation with water content
(Hauri et al., 2006), which should be precisely determined to correct the profile of hydrogen isotopic
ratio.