Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS35-15 Room:201A Time:May 24 14:15-14:30

Carbon-bearing saline fluids in the subduction channel and mantle wedge

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We find C-bearing saline fluids in the subduction channel and mantle wedge. Saline fluids are found with or without methane in jadeitites of serpentinite melanges located in Southwest Japan [Mori, Shigeno, Kawamoto, Nishiyama, in progress]. Carbon dioxide-bearing saline fluid inclusions are also reported from sub-arc mantle peridotite xenoliths: 3.7 wt% NaCl in Ichinomegata lherzolites, Northeast Japan arc [Kumagai et al., 2014] and 5.1 wt% NaCl in Pinatubo harzburgites, Luzon arc [Kawamoto et al., 2013]. These findings indicate that aqueous fluids in the subduction channel and mantle wedge can contain certain amounts of C and Cl.

We suggested that separation of slab-derived supercritical fluids into aqueous fluids and melts plays an important role in elemental transfer from subducting slab to the mantle wedge [Kawamoto et al., 2012]. It is, therefore, important to determine the effect of Cl on the trace element partitioning between aqueous fluids and melts. Synchrotron radiation X-ray fluorescence (XRF) analysis is conducted to know Rb, Sr, and Pb partitioning between aqueous fluids and melts simultaneously at high-temperature and high-pressure conditions. There is a positive correlation between partition coefficients and pressure, as well as salinity [Kawamoto et al., 2014]. Two slab-derived components, melt and fluid components, are suggested to explain trace element characteristics of arc-basalts in the Mariana arc [Pearce et al., 2005]. The fluid component is characterized by enrichment of alkali, alkali earth elements, and Pb. Such features can be explained if the fluid component is a saline fluid, because alkali earth elements and Pb are much less mobile with Cl-free fluids than Cl-rich fluids [Kawamoto et al., 2014].

We suggest that slab-derived components have compositional features consistent with a saline fluid and a melt, which can be formed through a separation of a slab-derived supercritical fluid [Kawamoto et al., 2012, 2014]. Slab-derived supercritical fluids contain Cl, and separated aqueous fluids inherit much of the Cl and some of the large-ion lithophile elements. Dissolution of carbon materials into aqueous fluids is enhanced by the salinity [Newton and Manning 2002] and their species can be controlled by oxygen fugacity.

Reference

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Keywords: aqueous fluid, fluid inclusion, arc magma