Major components and salinity of slab-derived fluids: insights from fluid inclusions in jadeitites and jadeite-quartz rocks

*Miki Shigeno[1], Yasushi Mori[1], Tatsuhiko Kawamoto[2], Tadao Nishiyama[3]

1. Kitakyushu Museum of Natural History and Human History, 2. Kyoto University, 3. Kumamoto University

Slab-derived fluids play important roles in mass transfer in subduction-zone channels between the subducting slab and the mantle wedge (e.g., Bebout, 2013). High salinity of the slab-fluids probably enhances the mobility of elements such as Pb in subduction-zone channels (Keppler, 1996). Salinity is important to affect solubility and fluid-rock partitioning of elements. Jadeitites and albitites occur as tectonic blocks in serpentinite mélanges intercalated to high-pressure and low-temperature metamorphic rocks. Therefore, fluid inclusions of them are expected to record information of the fluid composition in serpentinized mantle-wedge. Especially, jadeitites have index minerals of metamorphic conditions such as jadeite, quartz, albite and analcime. Jadeitites have been noted on relationships to fluids in subduction-zone channels; they are products of direct precipitation from aqueous fluids (P-type) and/or of fluid-induced metasomatism of a protolith (R-type) (e.g., Harlow et al., 2007, Tsujimori & Harlow, 2012). Albitite-rinds around quartz-bearing jadeitites are developed by metasomatism during retrogression (Shigeno et al., 2012b).

We investigated major components and salinity of fluid inclusions (liquid + gas bubble) in jadeite-quartz rocks (Kamuikotan, Yorii), quartz-bearing jadeitite with albitite rind (Nishisonogi), albite-jadeitites (Itoigawa, Oya) in Japan. The quartz-bearing jadeitite from Nishisonogi is a pale blue-green rock including quartz inclusions in the core of jadeite crystals (Shigeno et al., 2005). Investigation of mineral-inclusions of zircon revealed that the quartz-bearing jadeitite from Nishisonogi and the jadeite-quartz rock from Yorii were R-type (Mori et al., 2011, Yui & Fukuyama, 2015). The jadeite-quartz rocks show green-grey color and consist of subhedral jadeite and quartz. The albite-jadeitites are pale grey rocks, and show signature of P-type jadeitites such as euhedral jadeite crystals and interstice of albite.

Major components and salinity of fluid inclusions were examined by Raman spectrometry and by freezing point depression using heating/freezing stage. Raman spectrometry showed that primary fluid inclusions in jadeite-quartz rocks, quartz-bearing jadeitite and albitite rind of quartz-bearing jadeitite are H_2O liquid and vapor. In albite-jadeitite, primary fluid inclusions are H_2O liquid and vapor with CH_4. The modes of salinity of jadeite-quartz rocks, quartz-bearing jadeitite, albitite rind of quartz-bearing jadeitite are less than 6 wt% NaCl eq. The modes of salinity of fluid inclusions in albite-jadeitites are more than 6 wt% NaCl eq. Many secondary fluid inclusions are H_2O + CH_4 and tend to show higher or lower salinity than each mode.

These results and reaction curves are summarized in Fig.1. These results indicate that salinity distribution of slab-derived fluids and their difference depend on distance from surface of subducting slab. They are possible to explain different appearance, origin and metamorphic conditions (mineral assemblages) of two types of jadeitite as well as contents of fluid inclusions and salinity.

Fig. 1. Schematic model showing the major components and salinity of slab-derived fluids and the formation of jadeite-quartz rocks, quartz-bearing jadeitite with albitite rind, albite-jadeitites in forearc mantle wedge. The figures are not to scale. Modified from Harlow et al. (2015). Mineral abbreviations: Ab = albite, Anl = analcime, Jd = jadeite, Qz = quartz.

Keywords: Slab-derived fluid, Salinity, Fluid inclusion, Jadeitite, Albitite