Importance of being salty: Elemental partitioning between melts and aqueous fluids and salinity of fluid inclusions from subduction channels and mantle wedges

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In order to understand seawater recycling in subduction zones, we determine the salinity of natural fluid inclusions in harzburgites from the mantle wedge (Kawamoto et al., 2013, PNAS, Kumagai et al., 2014 CMP) and jadeitites from serpentine mélanges of Southwest Japan and Dominican Republic.

High-pressure and high-temperature experiments suggest that saline fluids can effectively transport large-ion-lithophile elements (Kawamoto et al., 2014, Earth Planets and Space) and carbonate (Newton and Manning, 2002, American Mineralogist). In natural specimens, subduction-zone fluids contain more or less amounts of salt. The salinity of aqueous fluids in the mantle wedge seems to decrease from trench side to back-arc side: from 5.1 wt% NaCl equivalent in harzburgite xenoliths of the Pinatubo, a frontal volcano of the Luzon arc, the Philippines [Kawamoto et al., 2013 Proc Natl Acad Sci USA] to 3.7 wt% NaCl equivalent in lherzolite xenoliths of the Ichinomegeta, a rear-arc volcano of the Northeast Japan arc [Kumagai et al., Contrib Mineral Petrol 2014]. Abundances of chlorine and H_2O in olivine-hosted melt inclusions also suggest that frontal basalts have higher Cl/H_2O ratios than rear-arc basalts in the Guatemala arc [Walker et al., Contrib Mineral Petrol 2003]. In addition to these data, quartz-free jadeitites contain fluid inclusions composed of aqueous fluids with 7 ±0.3 wt% NaCl equivalent and quartz-bearing jadeitite with 4.6 ± 1.2 wt% NaCl equivalent in supra-subduction zones in the Southwest Japan arc [Mori et al., 2015, International Eclogite Conference] and quartz-bearing jadeitites contain fluid inclusions composed of aqueous fluids with 4.3 ±1.3 wt% NaCl equivalent in Rio San Juan Complex, Dominica Republic [Kawamoto et al., 2015, Goldschmidt Conference]. Aqueous fluids generated at pressures lower than conditions for albite=jadeite+quartz occurring at 1.5 GPa, 500 °C may contain aqueous fluids with higher salinity than at higher pressures. All of these salinity data in natural fluid inclusions have values similar to or slightly greater than the value of seawater (3.5 wt% NaCl equivalent) and show decreasing salinity from trench to back-arc side in the mantle wedge and subduction channels.

Keywords: saline fluids, aqueous fluids, subduction zone, fluid inclusions, mantle wedge, magma

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