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Cl-bearing CO2-H2O fluid-inclusions of peridotite xenoliths from Ichinomegata

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Hydrous minerals in a subducting slab carry OH- and H2O into the Earth's interior, and at points beyond their stability conditions they release H2O to the overriding mantle wedge (Tatsumi and Eggins 1995). The H2O fluids transport materials from the slab to the mantle wedge. Recently, analyses of halogen elements of high-pressure metamorphic rocks suggest that saline fluids are preserved in the subducting slab as marine pore-fluids until the depths of at least 100 km (Sumino et al., 2010, EPSL). Salinity of H2O fluids affects dissolution properties of metal ions (Keppler, 1996, Nature). It is, therefore, important to understand the salinity of the H2O fluids in the mantle wedge in terms of subduction system of metal.

Fluid inclusions in mantle xenoliths preserve direct information of the fluids in the mantle. Mantle xenoliths from the Ichinomegata volcano, located in back-arc side in the northeast Japan arc, have CO2-H2O fluid inclusions (Roedder, 1965, Am Mineral). In the present study, we report salinity of the CO2-H2O fluid inclusions in the mantle xenoliths from the Ichinomegata volcano.

All mantle xenoliths studied are porphyroclastic lherzolite, composed of olivine, orthopyroxene, clinopyroxene, spinel and hornblende. The CO2-H2O fluid inclusions are occasionally present in orthopyroxene porphyroclasts. The fluid inclusions have not reacted with host orthopyroxene crystals after the formation. We suppose, therefore, that the salinity of the fluid inclusions represents the original value in the mantle. Formation depths of the fluid inclusions are estimated by the following steps: (1) estimating the bulk mole volume of CO2-H2O fluid inclusion using homogenization temperatures of CO2 liquid-vapor and CO2-H2O (Bakker and Diamond, 2000, Geochem. Cosmochim. Acta), (2) calculating pressure of the formation of the fluid inclusion using equilibrium temperature estimated by a pyroxene geothermometer (Wells 1977, Contrib.Mineral. Petrol.) and isochore of CO2-H2O system (Loner AP, from Software Package FLUIDS, v.2, Bakker), (3) converting the pressure to depth by assuming densities of crust and mantle are 2.85 and 3.3 g/cm3, respectively, and Mohorovicic discontinuity is 27 km. Salinities of fluid inclusions are determined using melting temperature of clathrate (Darling, 1991, Geochim. Cosmochim. Acta). The depth is estimated to be about 30 km, which is consistent with the following petrographical feature. Some xenoliths have plagioclace and symplectites formed by reaction of plagioclace and olivine. This indicates that the xenoliths were from the boundary between plagioclace-peridotite and spinel-peridotite. The salinity of fluid inclusions is 3.93 +- 0.55 wt %. Using relationship between the molinity of Cl and the fluid/melt partition coefficients (Zajacz et al., 2008, Geochem. Cosmochim. Acta), for example, the fluid/melt partition coefficients of Pb and Zn under this salinity are 7.8 and 18.6, respectively (those of Cl-free hydrous fluid are almost 0 and 8.2, respectively).

Keywords: salinity, fluid inclusion, material transport, subduction zone, mantle xenolith, Ichinomegata