Carbonation of Mantle Peridotite: An Approach From Fluid Inclusion Analysis and Hydrothermal Experiments

*Tatsuhiko KAWAMOTO[1]

1. Shizuoka University

Carbonate rocks in serpentinites are called ophicarbonate. Two types of ophicarbonate are observed as carbonate veins in serpentinite and serpentinite breccias surrounded by carbonate matrix. At Shizuoka University, Japan, we have described and reported saline fluid inclusions in carbonate minerals in ophicarbonate at the localities as follows: (1) carbonate veins in serpentinites of the Oman ophiolite, formed at a fast spreading ridge; (2) carbonate veins and carbonate matrix in serpentinites in the Western Alps ophiolite, formed at a slow spreading ridge; (3) calcite in serpentinite mud volcanoes in the Izu Mariana Trench; and (4) carbonate veins in mantle-wedge serpentinite in the Sambagawa Belt, Chichibu, Japan. The results show that the studied fluid inclusions have salinity similar to that of seawater or slightly higher than seawater, except for the fresh water fluid inclusions found in the later veins of the Oman ophiolite serpentinite in (1), where fluid inclusions with salinity similar to seawater are present in veins formed below the seafloor before. This means that ophicarbonates formed by metamorphism beneath the seafloor seen in (1) and (2) involve saline fluids similar to seawater, and such saline fluids are also brought into the mantle wedge, where lithospheres sink seen in (3) and (4).

Hydrothermal experiments are also conducted to provide constraints on the carbonization of the Earth’s mantle. In addition to the hydrothermal experiments, we calculate phase diagrams by use of thermodynamic calculation such as Perple_X. If we will experimentally determine the equilibrium mineral assemblage in iron-bearing system, we can understand the effect of iron on the temperature and pressure conditions by comparing the calculated phase equilibrium in the CaO-MgO-SiO_2-H_2O-CO_2 system. The comparison between natural ophicarbonate and the calculated phase diagram also enables us to know the CO_2 /(H_2O+CO_2) molar ratio of the fluids in the carbonation. It will be also possible to constraint on the temperature and pressure conditions from the isochore of fluid inclusions. Combination of natural observation, experiments and calculation allows us to understand the conditions of mantle carbonation more precisely.

Keywords: fluid inclusions, serpentinite, seawater, carbon dioxide, mantle