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

SCG60-06 Room:201A Time:May 25 12:15-12:30

Reconsideration of serpentinite in the shallow wedge mantle -Importance of brucite-

KAWAHARA, Hirokazu[1*] ; ENDO, Shunsuke[2] ; WALLIS, Simon[1] ; NAGAYA, Takayoshi[1] ; MORI, Hiroshi[2] ; YAMAMOTO, Koshi[1] ; ASAHARA, Yoshihiro[1]

[1]Earth & Planetary Sciences, Nagoya University, [2]National Institution of Advanced Industrial Science and Technology (AIST)

The flux of H_2O rich fluid is an important aspect of geological processes operating in the shallow wedge mantle. In the dunite-H_2O system, two of the most important hydration-dehydration reactions are as follows:

antigorite (Atg) = olivine (Ol) + orthopyroxene (Opx) + H_2O (1)

Atg + brucite (Brc) = Ol + H_2O (2)

Natural examples of the breakdown dehydration of Atg (reaction 1) have been closely studied (e.g. Padron-Navarta et al., 2011). However, there are relatively few well-documented studies describing the dehydration associated with reaction between Atg and Brc (reaction 2). Formation and breakdown of Brc (reaction 2) is potentially important when considering the H_2O flux in the shallow wedge mantle. It is also important to note that the product of Ol reacting with an SiO_2-bearing H_2O fluid is Atg and Brc is not formed. This can be expressed by the following reaction:

Ol + SiO_2 aq + H_2O = Atg (3)

This means that presence of Brc has the potential to be used as an indicator of the former action of an SiO_2-rich fluid. Brc is much weaker than Ol or Atg and its presence in sufficient quantities may have an important influence on the physical properties of the wedge mantle, for example development of shear zones. It is important therefore to obtain more information about the abundance and microstructure of Brc in serpentinite when considering a wide range of physical processes occurring in the shallow wedge mantle. However, Brc is not generally considered an important component of the shallow wedge mantle in previous studies.

Numerous ultramafic bodies that originated in the wedge mantle are distributed throughout the high-pressure/temperature subduction-type Sanbagawa metamorphic belt (Aoya et al., 2013). Here, we focus on the Shiraga (SG) body, which is a kilometer-scale ultramafic body located in the low-grade metamorphic region (corresponding to depths of about 30km). The SG body is a metaserpentinite, which originated as dunite. The body underwent metamorphism after serpentinization and metamorphic Ol (m-Ol) formed by reaction 2 is widely present (Kunugiza, 1980). This study shows that Brc was once widely distributed in the SG body. The major exception is the eastern margin of the body where a 100m thick serpentinite zone containing only Atg is found. Microstructural observations and compositional mapping show that Brc can be divided into two distinct types. Brc Ⅰ existed before peak metamorphism (within the Ol + Atg or Ol + Brc stability field), and Brc Ⅱ formed during the retrograde metamorphism. Brc Ⅰ occurs as inclusion in m-Ol and veins composed of coarse grains. Brc Ⅰ is separated from Atg by m-Ol. Brc Ⅱ occurs as veins and is in direct contact with Atg. Brc Ⅰ locally shows a clear zonal structure with a brown core containing significant amounts of magnetite (Mgt) exsolution lamellae surrounded by a colorless rim. Estimations of the initial composition of Brc before exsolution yield Mg# (= Mg / (Mg + Fe)) of Brc Ⅰ that increase from core to rim. In contrast, Mg# of Brc Ⅱ decreases from core to rim. m-Ol also shows a zonal structure with increasing Mg# from the core to the rim. In an Fe-bearing system, reaction 2 is a continuous reaction, which shows that the observed compositional changes of Brc Ⅰ and m-Ol are formed during the rising temperature period and those of Brc Ⅱ are formed in descending temperature period. Representative pseudosections of metaserpentinite in an Fe-bearing system were constructed to estimate the amount of Brc before peak metamorphic condition. The results suggest that the original rock contained about 20 vol% assuming weak Si metasomatism. If such large amounts of Brc are present in the shallow wedge mantle, they would significantly influence the physical property of the wedge mantle.

References: Aoya, M. et al. (2013) Geology, 41, 451-454; Kunugiza, K. (1980) J. Jpn. Assoc. Min. Petrol. Econ. Geol, 75, 14-20; Padron-Navarta, J. A. et al. (2011) J. Petrol, 52, 2047-2078.

Keywords: brucite, antigorite, wedge mantle, serpentinite, subduction zone