Metasomatic reactions at crust-mantle boundary in subduction zone: an example from Tomisato ultramafic body in the Tomisato area, central shikoku, Japan

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A large amont of element transfer could occur during the metamorphism along the subduction zone. Serpentinite, which was formed via hydration and/or metasomatic reaction of mantle peridotite, controls slab slip behavior (e.g., Peacock and Hyndman, 1999; Mizukami et al., 2014). Si-metasomatism of mantle peridotite is discussed in MgO-SiO_2-H_2O system (Manning, 1995, 1997). However, detailed analytical studies of on-land exposures of peridotites metasomatized by subduction-zone fluids are limited (e.g., Peacock, 1987; King et al., 2003). Therefore, the possible relationships between devolatilization reactions and related fluid and mass transfer are not clear.
In this study, we studied metasomatic reaction around a ultramafic body in the high pressure Sanbagwa metamorphic belt in Tomisato area, central Shikoku, Japan. Hereafter, we call this Tomisato ultramafic body. This ultramafic body is ~20m in size, and it is located at the garnet zone. The Tomisato ultramafic body is almost fully serpentinized (i.e., no olivine relict) and brucite is not observed. A lack of pyroxene relicts suggests the protolith of the Tomisato ultramafic body is dunite. Within the body, serpentinite has block-in-matrix or brecciated texture with fragments of fine-grained antigorite in coarse-grained matrix antigorite.
At north of the Tomisato ultramafic body, ultramafic rocks contact with basic rocks and veins of tremolite and talc was observed. On the other hand, at south of the Tomisato ultramafic body, ultramafic rocks contact with pelitic schist and vein of talc was observed. At the north boundary, reaction zone of Tremoite + Talc + Chlorite / Antigorite + Talc / Antigorite was observed. Tremolite and Talc zones were localized at ~80 cm and ~110cm from the contact, respectively. In contrast, at the south boundary, reaction zone of Antigorite + Talc / Antigorite was observed. Talc zone was observed ~80 cm from the boundary. Both boundaries are composed mainly of antigorite clasts embedded in a talc and/or tremolite veins, and matrix antigorite is not associated with these veins. These observations suggest that Si-metasomatic reaction occurred after block antigorite formation, and the mineralogy depends on the contact crustal rocks. We will discuss the timings of the Tomisato ultramafic body was taken in Sanbagawa metamorphic belt, metasomatic reaction, mass transport between crustal and mantle material, and possibility of hydrofracturing.

Keywords: crust-mantle boundary, metasomatism, serpentinite, Sanbagawa metamorphic belt, pelitic schist, basic schist

