Inversely depleted forearc mantle section records the subduction zone infancy: Umigame Seamount, Bonin Trench

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The Izu-Bonin-Mariana arc is a typical intra-oceanic arc system. Forearc basalts erupted by magmatic activity during the initial stages of subduction found in Izu-Bonin-Mariana arc provide key information on the initiation of magmatic activity and process of subduction during island arc formation. In recent years, many explorations and research with a focus on volcanic rocks have been conducted, so that models for the development of crustal structure in island arc have been proposed in detail. Since outcrops of plutonic rocks including peridotites in the forearc section expose commonly deeper than 6000 meters on the landward trench slope, few research has considered the forearc mantle by analyzing ultramafic rocks, although structural and petrological studies of forearc peridotites obtained from the landward slope of Izu-Bonin Trench help to understand structural development of the Izu-Bonin arc in the early subduction. More recently, investigations for the landward slope of Izu-Bonin Trench were conducted using Shinkai6500 (Dive 6K1505, 6K1506 and 6K1507) as a part of YK17-14 cruise by R/V Yokosuka in 2017. Shinkai6500 collected serpentinized peridotite, gabbro and basalt in Umigame Seamount (Dive 6K1507). Peridotites have preserved their primary information in mantle despite of their heavy serpentinization. Peridotites show coarse-grain textures with various degrees of serpentinization. Olivine-spinel compositions are in a range of the Olivine-Spinel Mantle Array of Arai (1994), where spinel compositions in harzburgites showed high Cr#(=Cr/(Cr+Al)) of 0.69 to 0.78, indicating that they are forearc peridotites after melting by the addition of water. Cr# for spinel in harzburgites is slightly higher than Cr# of the peridotites (Cr#=0.64-0.73; Harigane et al., 2013) occurred at about 1000 meters shallower than those in this study, indicating that more depleted peridotites have been developed at deeper levels. Olivine crystal-fabrics of harzburgite samples are mostly E-type, suggesting that E-type could be developed due to an input of slab-derived hydrous fluid to the forearc mantle during the initial stages of subduction as discussed by Harigane et al. (2013). In addition, a few harzburgite samples have A-type fabrics, indicating that A-type olivine fabric could be developed where high temperature mantle flow occurred in the mantle wedge during the subduction zone infancy before the input of slab-derived hydrous fluid. Consequently, Umigame Seamount owns a rare ultramafic body preserving information during the initial stages of subduction.

Keywords: Bonin Trench, Umigame Seamount, Mantle, Peridotite

