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Development of olivine crystal-fabrics in the southern Marian forearc mantle wedge: insights from S. Chamorro Seamount.

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Large serpentinite mud volcanoes form on the overriding plate of the Mariana subduction zone, which extends for approximately 2,500 km in the N-S direction parallel to the Mariana Trench axis. Fluids from the descending plate serpentinize the forearc mantle and enable serpentine muds to rise along faults to the seafloor (Fryer, 2012 Ann. Rev. Marine. Sci.). The seamounts are direct windows into subduction processes at depths far too deep to be accessed by any known technology (Fryer, 2012 Ann. Rev. Marine. Sci.). In this study, we focused on serpentinized peridotites obtained from South Chamorro Seamount in order to understand the forearc mantle wedge structure of southern Mariana forearc. The South Chamorro Seamount is located at 100 km east of Guam island and 85 km west of the Mariana Trench axis. The peridotite samples consist mainly of harzburgites with a few dunite samples. We analyzed olivine crystallographic fabrics and chemical compositions of olivine and spinel grains. As a result, two types of olivine crystal fabrics were obtained: [010]-fiber type (or AG-type) and [100]{0kl} type (or D-type). The chemical compositions show that Cr# (Cr3+/Al3++Cr3+) of spinel is 0.4 to 0.8 and Mg# (Mg2+/Mg2++Fe2+) of olivine is 89 to 92, which are in the range of Olivine-Spinel Mantle Array (OSMA) of Arai (1994 Chem. Geol.). However, no other seamounts have been found to have as wide a range of Cr# in spinel composition as those of South Chamorro Seamount. The equilibrium temperatures induced by olivine and spinel compositions are 700 C for the [100]{0kl} type peridotites and 800 to 850 C for the [010]-fiber type peridotites. Since [010]-fiber olivine fabrics could be developed under melt-bearing high-temperature conditions, such as in the subsolidus regime (e.g., Kohlstedt & Holtzman, 2009 Ann. Rev. Earth Planet.), it is unlikely that they have been developed in the forearc region. Alternatively, the [010]-fiber type peridotites may be derived from the older lithospheric mantle before the formation of the Mariana arc system, whereas the {100}{0kl} type could be related to supra-subduction tectonics or the development of serpentine mud volcanoes.

Keywords: peridtite, serpentinite, crystal fabric, [010]-fiber type, [100]{0kl} type, subduction