Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MIS31-12 Room:106 Time:May 24 14:00-14:15

Fabric and petrological characteristics of mafic and ultramafic rocks in the Tonga Trench

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The Tonga trench is one of the deepest oceanic regions in the world (10,866 m), so it may likely to be the closest location to the mantle. In the Tonga trench, various types of rocks have been dredged and drilled at several localities on the landward slopes of the trench. In particular, very pristine peridotites occur at the most deep landward trench slope. 100 samples of mafic and ultramafic rocks collected from several locations were analyzed in order to understand the characteristics and whole picture of the Tonga trench. Mineral composition of olivine and spinel in peridotites suggests that there are two types of regions: central region and northern region. The peridotites in the central regions have high-Cr# (0.46-0.83) which were typical of forearc peridotites. In contrast, the peridotites in the northern region have evidences of the reaction with magma during partial melting. Moreover, on the basis of H2O content (over 100 ppm) of olivine and TiO2 content (from 0.06 to 0.79 at northern region) of spinel, they remarkably reacted with melt and/or fluid. In addition to peridotites composition, mineral composition of plagioclase, clinopyroxene and amphibole in gabbroic rocks also suggest that there have been affected by water infiltration. Olivine fabrics are characterized by E-type and D-type. Although E-type and D-type are no clear relationship of mineral composition, grain size and equilibrium temperature, the only difference between E-type and D-type were fabric intensities. This difference suggests that pristine and serpentinized peridotites in the Tonga trench are deformed in the region where high strain field occurred due to the dragged flow. Eventually, they expose in a very neat condition (i.e. active tectonic erosion and fast ascent rate) resulting from an unique tectonic setting including fast subducting plate (24 cm/yr), fast spreading plate (15 cm/yr) and slab rollback.

Keywords: Tonga trench, mantle wedge, peridotite, serpentinite, gabbro