Structural and petrological features of peridotites derived from the landward trench slope of the southern Mariana Trench

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Structural and petrological studies have been carried out on serpentinized peridotites derived from the landward trench slope of the southern Mariana Trench, where is the deepest ocean in the world. Peridotite samples were collected from two area: West area (KH98-1-D3, 6K#1095, MARA20) and East area (KH98-1-D1, KH98-1-D2, MARA27). The samples showed dominantly coarse granular and elongated textures.

The olivine-spinel compositions within most of samples are in the olivine spinel mantle array (Arai 1994), indicating that they are residual peridotites. In West area, spinel compositions have both high-Cr# (more than 0.6) and low-Cr# (less than 0.6). In more detail, the Cr# tends to be lower at the shallower depth. The lowest Cr# peridotites would be compatible with those from Mariana Trough (backarc basin). These indicate that the peridotites outcropped at the southern Mariana Trench are of backarc origin, whereas deeper parts of peridotites appear to be affected by slab dehydration. In East area where is the vicinity of a slab tear, spinel Cr# shows in a range of 0.4-0.6. At the east of a slab tear, the dip of slab is less steep than at the west, suggesting that the mantle wedge at the east of the slab tear could be cooler than at the west. This suggests that the peridotites would be less depleted at East area.

Olivine CPOs show [100](010), [100](001), and a few [001](010) patterns. Although [001](010) patterns could be developed under hydrous condition, there were only a few examples in the Mariana Trench, suggesting that the peridotites of the Mariana Trench would not be modified to develop hydrous structures.

In East area, equilibrium temperature of the peridotites appears to decrease toward the deeper section where fine-grained textures were reported previously. Therefore, these suggest that grain sizes were reduced with temperature decreasing. Moreover olivine fabric intensity appears to decrease toward the deeper section, suggesting that the deformation mechanism may be changed from dislocation creep to diffusion creep in the deeper section.

Antigorite, which is serpentine mineral at high temperature, occurs within the peridotites derived from the deeper and the most western section, suggesting that the deeper and the most western section near the Challenger Deep are the areas where intense tectonic erosion is being taken place and that there might be fresh peridotites.