Microstructural development in a hydrated ductile shear zone across the crust-mantle boundary: an example from Moho Transition Zone in Oman ophiolite

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We studied a hydrous shear zone in Oman ophiolite in order to understand deformation processes in the deep root of fault zone within the oceanic lithosphere. Several ductile shear zones have been developed in Oman ophiolite associated with obduction onto the Arabian Peninsula [1]. One of the ductile shear zones crosscuts Moho Transition Zone (MTZ) in the Fizh massif, where hydrous minerals have been formed due to water infiltration during shearing [2]. We analyzed microstructural development with water-rock reaction in this shear zone along the Wadi Zabin.

We classified various fine-grained zones within the hydrated shear zone into five sub-zones: Amp-Pl sub-zone consisting of fine-grained amphibole and plagioclase matrix, Ol sub-zone consisting of fine-grained olivines, Amp sub-zone consisting of fine-grained amphiboles, and chlorite and/or serpentine in filling the interstices of amphiboles, Chl sub-zone consisting of fine-grained chlorites with strong foliation, and Cpx sub-zone consisting of fine-grained clinopyroxenes. Amphibole porphyroclasts in fine-grained plagioclase matrix in Amp-Pl sub-zone indicate that plagioclases were deformed stronger than amphiboles. Furthermore, relics of Amp-Pl sub-zone in Chl sub-zone suggest that Chl sub-zone had been formed after the formation of Amp-Pl sub-zone by localizing strains in chlorite aggregates at lower temperature.

A layer boudin and microfolds of Ol sub-zone layers were observed in Amp sub-zone, indicating that Amp sub-zone was not only formed from Ol sub-zone but was also deformed strongly than Ol sub-zone. Furthermore, chlorite and lizardite infillings at the interstices of fine-grained amphibole suggest that these minerals were taken place after amphibole occurrence. Considering the stability of the minerals [3], hydrous minerals would have been formed during retrogressive shearing. In addition, no antigorite was identified, indicating that the water-rock reaction ceased at antigorite stability field, although lizardite occured at the latest stage.

These results indicate that strain localization in the entire hydrated ductile shear zone has been shifted from plagioclase within mafic rocks to chlorite within ultramafic rocks. Such strain localizations may occur at deep root of fault zones along with water infiltration.

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