"Element transport and magnetite decomposition during alteration of the gabbroic vein in serpentinite body from the Bayankhongor ophiolite, Mongolia"

*Nomin Tumurkhuu[1], Otgonbayar Dandar[1], Masaoki Uno[1], Manzshir Bayarbold[1], Atsushi Okamoto[1]

1. Tohoku University

Hydration of mantle rocks is important for elucidating the dynamics of global water circulation, elemental transport, and geological processes. The crust-mantle interface constitutes a significant geological boundary where element transport occurs. However, research on the multi-stage hydration of mantle rocks within this zone, particularly in the oceanic lithosphere (mid-ocean ridge), is still lacking. Therefore, to understand element transport during the hydration of the crustal vein in the mantle at the crust-mantle transition zone, we investigate the mantle-crust section preserved in the Bayankhongor ophiolite (BO; mid-ocean ridge origin) Mongolia.The outcrop of the crust-mantle section (~30 m in diameter) in the BO is characterized by a brownish gabbroic body with a massive and sheared mantle body fully serpentinized. Mantle rock samples mainly consist of lizardite in two forms: mesh core (Mg# = 0.95-0.98) with fine magnetite (Mgt) and vein (Mg# = 0.94-0.98) with vein Mgt (<30 μm width), along with spinel (Mg# = 0.42-0.52 & Cr# = 0.46-0.48), and chlorite (Chl; Mg# = 0.87-0.96). The absence of brucite in the serpentinites suggests infiltration of Si-rich fluids. Green veins (80-95 cm in width; it mainly consists of clinopyroxene (Cpx; Mg# = 0.92) replaced by a mixture of Chl-serpentine (Srp) and cut by serpentine and epidote (Ep) veins), along with white veins (~15 cm in width; ~40 cm long; it is mostly consisted of Ep and Cpx with a minor amount of Chl) cut through the mantle rocks. Additionally, black veins (~2 cm in width; it is composed of Chl patches (Mg# = 0.83-0.93) and Chl-Srp patches with clear cleavages and fine Ti-rich minerals) intersect the serpentinite. The reaction zone (~3 mm) between host serpentinite and black vein shows that Mgt disappeared and Mgt is replaced by Al-rich (1.1-6.9 wt%) Srp. Mass balance on black vein (assuming protoliths: Cpx for Chl-Srp and plagioclase for Chl patch shows gain of Fe and Mg, and loss of Si, Al, and Ca whereas that on the reaction zone shows loss of Fe and gain of Si, and Al. This implies that Mg-rich fluid and chl formation cause Mgt disappearance and mobility of Fe, Si, and Al. Reaction zone and mass balance result imply that local mobility of Si, Al, Fe, Mg, and Ca could occur at the crust-mantle section in the oceanic lithosphere during multi-stage hydration.

Keywords: Element transport, Serpentine, Gabbroic vein

Element transport and magnetite decomposition during alteration of gabbroic vein in serpentinite body from the Bayankhongor ophiolite, Mongolia.

Nomin TUMURKHUU, Otgonbayar DANDAR, Masaoki UNO, Manzshir BAYARBOLD, Atsushi OKAMOTO

Graduate School of Environmental Studies, Tohoku University

Hydration of mantle rocks is important for elucidating the dynamics of global water circulation, elemental transport, and geological processes. The crust-mantle interface constitutes a significant geological boundary where element transport occurs. However, research on the multi-stage hydration of mantle rocks within this zone, particularly in the oceanic lithosphere (mid-ocean ridge), is still lacking. Therefore, to understand element transport during the hydration of the crustal vein in the mantle at the crust-mantle transition zone, we investigate the mantle-crust section preserved in the Bayankhongor ophiolite (BO; mid-ocean ridge origin) Mongolia.

The outcrop of the crust-mantle section (~30 m in diameter) in the BO is characterized by a brownish gabbroic body with a massive and sheared mantle body fully serpentinized. Mantle rock samples mainly consist of lizardite in two forms: mesh core (Mg# = 0.95-0.98) with fine magnetite (Mgt) and vein (Mg# = 0.94-0.98) with vein Mgt (<30 μm width), along with spinel (Mg# = 0.42-0.52 & Cr# = 0.46-0.48), and chlorite (Chl; Mg# = 0.87-0.96). The absence of brucite in the serpentinites suggests infiltration of Si-rich fluids. Green veins (80-95 cm in width; it mainly consists of clinopyroxene (Cpx; Mg# = 0.92) replaced by a mixture of Chl-serpentine (Srp) and cut by serpentine and epidote (Ep) veins), along with white veins (~15 cm in width; ~40 cm long; it is mostly consisted of Ep and Cpx with a minor amount of Chl) cut through the mantle rocks. Additionally, black veins (~2 cm in width; it is composed of Chl patches (Mg# = 0.83-0.93) and Chl-Srp patches with clear cleavages and fine Ti-rich minerals) intersect the serpentinite.

The reaction zone (~3 mm) between host serpentinite and black vein shows that Mgt disappeared and Mgt is replaced by Al-rich (1.1-6.9 wt%) Srp. Mass balance on black vein (assuming protoliths: Cpx for Chl-Srp and plagioclase for Chl patch shows gain of Fe and Mg, and loss of Si, Al, and Ca whereas that on the reaction zone shows loss of Fe and gain of Si, and Al. This implies that Mg-rich fluid and chl formation cause Mgt disappearance and mobility of Fe, Si, and Al. Reaction zone and mass balance result imply that local mobility of Si, Al, Fe, Mg, and Ca could occur at the crust-mantle section in the oceanic lithosphere during multi-stage hydration.