Geochemistry of Wadi Tayin mantle section in the southern Oman mantle section with special reference to suprasubduction zone magmatism

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The Oman ophiolite is the fragment of oceanic lithosphere that was produced by Neo-Tethyan oceanic spreading ridge systems. This oceanic mantle lithosphere has been modified by arc-related magmatism during oceanic thrusting prior to obduction onto the Arabian continent.
The northern Oman ophiolite contains a large amount of volcanic sequence and dykes that show signature of subduction zone setting. On the other hand, in the southern massifs most of volcanic sequence has been eroded out during emplacement. In fact volcanic rocks with arc signature has not been found from the southern massifs. So it is important to study geochemical features of peridotites from the mantle section to clarify whether arc signature is present in the southern massifs.
In this study, we report the mineral compositions of peridotites from the Wadi Tayin massif in the southern Oman ophiolite to investigate the influence of arc magmatism and modification of oceanic lithospheric during oceanic thrusting. We systematically corrected harzburgites and dunites along wadis to cover the mantle section from the boundary between lower crust and uppermost mantle (namely "Moho") to the basal thrust.
Spinel Cr# [=Cr/(Cr+Al) atomic ratio] of harzburgite varies from 0.22 to 0.58. It tends to elevate from the basal thrust to the Moho. Spinel Cr# of dunite has a peak of frequency at 0.55 - 0.60, and the number of spinels with Cr# greater than 0.6 decline significantly. In addition, the spinels with Cr# greater than 0.6 occur either in the basal part of the mantle section or along NW-SE striking shear zone. The relationship between concordant and discordant dunites (Arai et al., 2006) is often observed. Spinel Cr# of concordant dunites is in a range of 0.38-0.40 whereas that of discordant dunites is in a range of 0.52-0.54. Similar to the previous study the spinels in the discordant dunites are tend to have greater Cr# than those in the concordant dunites (Arai et al., 2006).
Abundances of trace elements in clinopyroxenes were analyzed by LA-ICP-MS and were normalized to those of C1 condrites (Sun and McDonough, 1989). The chondrite-normalized patterns show that clinopyroxenes are depleted in LREE relative to HREE although abundance of LREE is more variable than that of HREE. Harzburgite with lowest spinel Cr# of 0.28 is strongly depleted in LREE whereas harzburgite with moderate spinel Cr# of 0.45-0.55 is more enriched in LREE relative to the former. Clinopyroxenes in dunites (spinel Cr# 0.40-0.68) also tend to be more enriched in MREE to LREE with increase of spinel Cr#. Particularly dunite with the highest spinel Cr# of 0.68 from the shear zone is the most enriched in MREE to LREE relative to other dunites. The chondrite-normalized trace element patterns for clinopyroxenes from this dunite show negative anomaly in high field strength (HFS) elements such as Nb, Ta, Zr and Hf indicating affinity to arc magma.
A positive correlation is observed in the diagram of spinel Cr# vs Ce/Yb ratio for clinopyroxene from dunites thereby indicating a reaction trend formed by flux-melting of harzburgite. Because the dunite with the highest spinel Cr# shows negative anomaly in the HFS elements, fluid that caused flux-melting in the mantle section might be carried from metamorphic sole due to dehydration of oceanic crust during suprasubduction stage. According to the distribution of dunites that contain spinels with high Cr# (>0.6), the fluid might have been locally migrated both in the basal part and along shear zone. However, dunite

that contains spinel with high Cr# (>0.6) is rare and not abundant unlike Fizh and Salahi mantle section in the northern Oman ophiolite.

Keywords: ophiolite, mantle, mid-ocean ridge, suprasubduction zone, mantle-melt reaction

