Estimate of the serpentinization process in the northern Fizh block, the Oman ophiolite

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The mantle section of the Oman ophiolite is composed of partially-serpentinized harzburgite, dunite and lherzolite. These peridotites are likely to have been suffered from hydrothermal circulation on ocean floor because Oman ophiolite formed at mid-ocean ridge with fast spreading axis. In addition, peridotites above the basal thrust may have reacted with a fluid liverated from metamorphic sole during oceanic thrusting. Thus the study of serpentinization of the Oman peridotites is important to understand fluid-peridotite reactions in the upper mantle. In this study, we examine serpentinization processes in the Oman ophiolite on the basis of microscopic observation and chemical composition of serpentines in the northern Fizh mantle section. Lizardite is ubiquitously present in the Fizh mantle section and develops typical mesh texture associated with lizardite veins. Some clinopyroxenes are partially replaced by tremolite indicating possible fluid supply. Because no antigolite has been found in the Fizh mantle section the reaction of clinopyroxene with hydrothermal fluid must have occurred at temperature between 600 and 900 degreeC. It suggests that seawater can infiltrate the upper mantle at such high temperature beneath fast spreading mid-ocean ridge.

One of the important observations in our study is that the peridotites in the basal part of the mantle section contain abundant magnetites within the meshes and veins of serpentine. Moreover, some talc replaces the rim of orthopyroxenes. Previous studies proposed two-stage processes for serpentinization where magnetite formed at later stage. In addition, talc and forstelite can be produced from enstatite and flluid at 650-750 degreeC (>6kbar). We consider that the fluid was liberated from metamorphic sole and infiltrated the basal part of the mantle section during oceanic thrusting.

On the other hand, in the peridotites inside the mantle section and near the Moho Transition Zone no magnetite occur in meshed serpentine and only small amounts of magnetite occur in some veins that cut earlier meshed serpentine. The compositions of veined serpentines with magnetite are higher in Si+Al and lower in Fe+Mg relative to meshed and veined serpentines without magnetite. It is consistent with the model in which serpentine and magnetite formed from brucite under high silica activity [Bach et al., 2006]. The Mg# [=Mg/[Mg+Fe] atomic ratio] of serpentines associated with magnetite in the basal peridotite are slightly lower than those of veined serpentines associated with magnetite inside of the mantle section. This may indicate that Fe difussivity was faster due to higher temperature during magnetite formation in the basal part of the mantle section. Because the amount of serpentine is uniform inside the mantle section and has no correlation with the distance from the Moho Transition Zone lizardite formed at relatively low temperature, probably less than 300 °C, by infiltration of surface water since obduction of the ophiolite.

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