

High-temperature hydration processes in the oceanic mantle: evidence from peridotites of the Oman ophiolite

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The scientific drillings of the crust-mantle boundaries and mantle sections of the Oman ophiolite were operated during the Oman Drilling Project Phase 2. Three holes, BA1B, BA3A, and BA4A were recovered from the mantle sections. The Hole BA1B is composed of upper dunite and lower harzburgite associated with mafic dikes. The Hole BA3A is dominated mainly by harzburgite and also contains a minor amount of thin dunitic layers and mafic dikes. The Hole BA4A consists of an alternation of dunite and harzburgite with abundant mafic dikes. The mafic dikes observed in each hole are gabbro to olivine gabbro, and sometimes wehrlitic. Irregular veins sometimes cut harzburgite. The veins are composed mainly of tremolite and talc with a minor amount of zircon and rutile. The harzburgites collected from all holes have amphibole and talc. These hydrous minerals usually occur as pyroxene-rims and veins in pyroxene, indicating that they were formed as the reaction products of pyroxene. The amphibole compositionally changes from hornblende cores to tremolite rims.

The amphibole is depleted in TiO_2 and Na_2O contents and is similar to those of the Mariana serpentinites and mantle xenoliths from a frontal arc volcano. The trace-element composition of clinopyroxene in the harzburgites systematically changes in dependence on the distance from mafic veins: the LREEs become more enriched with the decreasing of the distance. The same chemical trend is also observed in the amphibole. This fact suggests that the amphibole replacement of pyroxene would have occurred after the intrusion of the mafic dikes. No significant enrichment in Cs and Rb is present in the amphibole in the Oman harzburgites in comparison with that of the Mariana serpentinites.

The amphibole in the Oman harzburgites probably formed through the reaction between peridotites and fluids. The involved fluids are different in composition from aqueous fluids released from the subducted slab, which are expected to be enriched in LILEs. The amphibole in the Oman harzburgites might be a vestige of hydration by hydrothermal fluids, which would have percolated into the uppermost mantle at a spreading axis.

Keywords: Oman ophiolite, Mantle, Peridotite, Hydration