# Variable occurrences of magnetite and iron mobility during serpentinization: insights from samples from CM1A of Oman Drilling Project

*Ryosuke Oyanagi[1], Kazuki Yoshida[2], Yasuhiro Niwa[3], Yasuo Takeichi[3], Masao Kimura[3], Kenta Yoshida[1], Atsushi Okamoto[2], Oman Drilling Project Phase 2 Science Party

1. Japan Agency for Marine-Earth Science and Technology (JAMSTEC), 2. Graduate school of environmental studies, Tohoku University, 3. High Energy Accelerator Research Organization (KEK)

Serpentinization of the oceanic lithosphere provides significant impacts on biological activities at seafloors, as oxidation of $Fe^{2+}$ in olivine results in a reduction of water to produce hydrogen and hydrocarbons. In serpentinized peridotites, $Fe^{3+}$ is mostly contained in magnetite. However, the distribution of magnetite is not always uniform but commonly concentrated along veins. In addition, serpentine, which is the main constituent mineral of serpentinized peridotite, also can be a host phase for $Fe^{3+}$. Therefore, the behaviors of iron such as partitioning, mobility, and redox conditions, and their relation to hydrogen production during serpentinization are still poorly constrained. In this contribution, we report the preliminary results of micro- to nano-scale observation of magnetite and iron distribution within wehrlite and dunite at the crust-mantle boundary of the Samail ophiolite, recovered from the Oman Drilling Project hole CM1A. The synchrotron-based multi-scale X-ray CT images were taken by the beamline NW2A, PF-AR at KEK, Japan.

The wehrlite sample (CM1A-144Z-4-66-68) is partly serpentinized and olivine grains show mesh texture composed of mesh rim and veins. Mesh rim is composed of serpentine (Mg#~94) with minor brucite and magnetite. The vein in mesh texture is composed of serpentine (Mg#~95) + magnetite. Magnetite shows two types of occurrence: the first type of magnetite with a size of 1-2 $\mu$m occurs as planar aggregate at the center of the mesh veins. The second type of magnetite occurs in the mesh rim. The CT image reveals that the second type of magnetite accompanies pore with a size of ~0.5 $\mu$m, and seems to align. Within unreacted olivine mesh core, magnetite accompanying pore is also observed, which is similar to the second type of magnetite. Such occurrence suggests that the second type of magnetite was formed within fluid inclusions of olivine, and micro- to nano-scale pores were not collapsed during serpentinization although it essentially involves volume-increasing reactions.

In contrast to wehrlite, dunite (CM1A-90z) is completely serpentinized and cut by the later serpentine veins, which is a common feature of dunite samples from CM1A. In the matrix, magnetite uniformly occurs in size less than 5 $\mu$m, and does not show the evidence of mesh texture. The detailed observation revealed that later veins are composed of Fe-poor serpentine (Mg#~98) with reaction zones with plenty amount of magnetite. In the reaction zone, the euhedral magnetite with size in 10-30 $\mu$m was concentrated within the reaction zone. These occurrences suggest that magnetite was formed during serpentinization, iron could move by dissolution and precipitation processes in response to the infiltration of external fluids.

Keywords: serpentinization, hydrothermal alteration, Ferric iron, Magnetite

 