Highly siderophile element mobility during serpentinization of forearc mantle peridotite

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Serpentinites formed by hydration of ultramafic rocks are attracting attention due to their possible effects on ecosystems via hydrothermal activities driven by fluid circulation. Thus, serpentinization of abyssal peridotites occurring on the sea floor has been studied intensively to understand the conditions and processes of serpentinization. These studies revealed that chemical exchange between peridotites and seawater results in the generation of hydrogen and methane and the uptake of sulfur and boron from seawater. Under such reducing conditions, highly siderophile element (HSE) mobility are considered to be minimal overall in agreement with several natural examples and experimental results. However, it remains unclear whether the observed processes are applicable to serpentinization apart from mid-ocean ridge settings such as hydration of subducting lithosphere via fractures at outer rise of subduction zone, and hydration of mantle wedge by slab-derived fluid.
Here we investigated uplifted mantle section of Timor-Tanimbar ophiolite in eastern Indonesia as a best example to characterize serpentinization in mantle wedge, since geological occurrence suggests this Miocene-aged ophiolite extends neighboring pre-emplaced forearc marginal basins. We performed whole-rock concentration analyses of major, trace and highly siderophile elements (HSEs) for extremely fresh peridotites and strongly altered serpentinites exposed in Moa island. Our results demonstrate that element mobility associated with infiltration of slab-derived fluids into peridotites in the mantle wedge are characterized by broad correlations between uptake of fluid mobile elements (e.g. Sr, Pb, LREE) and release of HSEs (up to 95%), which could be controlled by degree of fluid-peridotite reactions under oxidizing conditions. This result suggests that oxygen fugacities play an important roles on HSE mobility associated with sulfide breakdown, and serpentinization in different tectonic settings should be considered separately.

Keywords: highly sideophile element, mantle peridotite, serpentinization

