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Trace element behaviors in ultramafic rocks through contact metamorphism and implications for elemental cycling in subduction zones: A case of the Tari–Misaka Complex in the Inner Zone of SW Japan

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Dehydration of serpentinized mantle peridotite modifies the composition of the mantle wedge, especially fluid mobile elements (FME) and light rare earth elements (LREE), and is an important factor controlling elemental cycling in subduction zones. The release of FME through deserpentinization has been proposed by studies of metaperidotites from HP-UHP metamorphic belts [1], although the protolith composition and retrogressive modification remain poorly understood. In contrast, metaperidotites formed by contact metamorphism allow us to evaluate chemical variations across metamorphic grades and provide rigorous insights into elemental behaviors at sub-arc depths. The Tari–Misaka complex, located in the Inner Zone of southwest Japan, is a mantle peridotite member of an Early Paleozoic ophiolite that experienced contact metamorphism (up to 780°C) associated with the intrusion of Cretaceous granitoids [2]. In this complex, antigorite, metamorphic olivine, tremolite, talc, anthophyllite, and metamorphic orthopyroxene are progressively formed in metaperidotites toward higher grades. In this study, we determined the major and trace element compositions of minerals and whole rocks from different metamorphic grades, to elucidate elemental behaviors through deserpentinization. Independent component analysis of whole-rock trace element compositions of the metaperidotites identifies the component characterized by enrichment in LREE and FME. This component gradually increases toward higher grades and correlates with modal and mineral compositions of metamorphic minerals, suggesting a genetic link to contact metamorphism. Isocon analysis also yields the gradual increase of Li, La, and Ce toward higher grades. These compositional changes were likely caused by the influx of crustal components mediated by aqueous fluids derived from the intrusion. The trace element compositions of whole rocks and minerals in this study are similar to those of HP-UHP deserpentinized metaperidotites, implying that the composition of metaperidotites metasomatized by a crustal component-rich fluids is independent of pressures. Deserpentinizaed metaperidotites possibly play a crucial role as carriers of FME and LREE into the mantle wedge and deep mantle.

Reference

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