Metasomatism in the Early Paleozoic forearc mantle recorded in serpentinites in the Motai metamorphic rocks, South Kitakami Belt

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The Early Paleozoic Motai metamorphic rocks composed of high-P pelitic and basic schists, amphibolite, and serpentinite are distributed in the western margin of the South Kitakami Belt (e.g., Maekawa, 1981). Ozawa et al. (2015) suggested that the Miyamori-Hayachine ophiolite is derived from an Ordovician arc-backarc system and regarded the Motai metamorphic rocks as oceanic materials subducted into the arc. To reveal mantle processes beneath the Ordovician forearc, the petrology and geochemistry of the Motai serpentinites are studied. The protoliths of the serpentinites are estimated to be harzburgite to dunite based on the amount of bastite (orthopyroxene pseudomorph). Chromian spinel Cr# [= Cr / (Cr + Al)] increases from 0.4 to 0.9 with the decrease of the amount of bastite. The compositional range is similar to that of the Mariana forearc serpentinites. This suggests that the protoliths of the serpentinites are depleted mantle peridotite beneath forearc regions in a subduction zone. The Motai serpentinites are highly serpentinized and are generally composed of lizardite/chrysotile, antigorite, talc, chlorite, diopside, and Ca-amphibole. The Motai serpentinites are divided into two types based on their mineral assemblage, petrographic texture, and mineral chemistry. Type-1 serpentinites are lacking olivine, whereas type-2 serpentinites sometimes contain olivine. The type-1 serpentinites are characterized by fine-grained antigorite and phyric or vein-like Ca-amphibole and diopside. The type-2 serpentinites contain coarse-grained antigorite and euhedral, needle-shaped Ca-amphibole. The type-1 phyric Ca-amphibole has compositional zoning of hornblende core to tremolite rim. On the other hand, the type-2 Ca-amphibole is compositionally homogeneous. The Ca-amphibole and diopside of the type-1 serpentinites are more enriched in LILEs and LREEs than those of the type-2, suggesting the influence of hydrous fluids derived from slabs. The mineral assemblage and chemistry of the type-2 serpentinites indicate the thermal effect of contact metamorphism by the Cretaceous Hitokabe granite, which is situated about 2 km away from the type-2 localities. The Ca-amphibole of the type-1 serpentinites is different from that of the Hayachine-Miyamori ophiolite in terms of their origin: the latter was formed by the infiltration of melts produced in the arc-backarc system (Ozawa, 1988). The chemical characteristics of the Ca-amphibole in the ultramafic rocks in the South Kitakami Belt reflect the tectonics of the Early Paleozoic mantle wedge, and the Motai metamorphic rocks represent fragments of subduction-related slab and mantle materials beneath forearc regions.

