

Osmium isotopic and major element compositions of the fresh harzburgite from the Hayachine-Miyamori ophiolitic complex

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The Hayachine-Miyamori ophiolitic complex in the Kitakami Mountains, northeastern Japan is located in the Hayachine Tectonic Belt, which is one of the oldest geological terrane in Japan and consists of ultramafic tectonite and cumulate members corresponding to the lower ultramafic sections of ophiolites (e.g. Ozawa, 1984; Ehiro, 2000). Peridotites in this complex are extensively serpentinized (most of them consists of > 60 % serpentine; Ozawa, 1988). The tectonite member is divided into two suites on the basis of spinel Cr-number ($Cr\# = 100 \times Cr / (Cr + Al)$): aluminous spinel ultramafic suite (ASUS; $Cr\# < 40$) and chromite-bearing ultramafic suite (CSUS; $Cr\# > 40$; Ozawa, 1988). The Sm-Nd isotopic data with trace element compositions of clinopyroxenes of this complex suggest that the complex experienced partial melting events around 450 Ma ago with influx of three agents derived from the subducting slab (Ozawa and Shimizu, JGR, 1995; Ozawa, JGR, 2001; Yoshikawa & Ozawa, GR, 2007).

We found a least serpentinized boulder of spinel harzburgite (73003) belonging to CSUS and determined a bulk-rock major element compositions and $^{187}Re/^{188}Os - ^{187}Os/^{188}Os$ isotopic ratios. The sample 73003 is characterized by high CaO and low Al_2O_3 contents than other orogenic peridotites. Similar feature was observed from the Victoria peridotite xenoliths (Yaxley et al., 1991). Yaxley et al. (1991) proposed carbonatite metasomatism for the high CaO and low Al_2O_3 of the xenoliths from the following lines of evidence; (1) replacement of primary orthopyroxene by clinopyroxene and olivine, which may be attributed to the reaction between orthopyroxene and CO_2 -rich melt to produce clinopyroxene and olivine, (2) presence of accessory apatite, which can be produced by reaction from primary olivine + diopside + carbonatite melt to secondary orthopyroxene + haloapatite, (3) high bulk-rock CaO/Al_2O_3 value and extreme large ion lithophile element (LILE) enrichment without concomitant TiO_2 enrichment. CSUS peridotites have petrological and geochemical features consistent with (2) and (3), although the replacement of orthopyroxene by clinopyroxene + olivine has not been observed in CSUS peridotites. The modal abundances of clinopyroxene in CSUS peridotites, however, are as high as or even higher than in ASUS peridotites which have lower $Cr\#$ ratios indicating less degree of melting than CSUS peridotite. It suggests addition of clinopyroxene by influx of a CaO-rich agent. On the basis of the above observations, we infer that CSUS peridotites underwent influx of a silicate-carbonatite melt most probably from subducted slab.

The $^{187}Os/^{188}Os$ isotopic ratio (0.1235) of sample 73003 is consistent with those of present average abyssal peridotite (0.1238, $n=96$; Rudnick & Waker, Lithos, 2009) and the Izu-Bonin fore-arc mantle peridotites (0.1193 - 0.1273; Parkinson et al., Science, 1998). The Re-depletion age of this sample is around 500Ma. This age is consistent with the K-Ar amphibole ages (480 - 520 Ma) of the Matsugadaira-Motai metamorphic rocks which have been interpreted as formed at the subduction zone (Kanisawa et al., GKK, 1992). The Os isotopic results thus strongly support open-system melting at subduction zone as presented by the previous studies.

Keywords: Os isotopic composition, Hayachine-Miyamori ophiolitic complex, whole rock compositions, metasomatism by silicate-carbonatite melt