RE-OS ISOTOPIC COMPOSITION OF HOROMAN PERIDOTITE: IMPLICATIONS FOR THE GENESIS OF THE PLAGIOCLASE-LHERZOLITE AND THE LAYERED STRUCTURE

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ABSTRACT

The Horoman peridotite is a fault-bounded massif, 8 x 10 x 3 km, emplaced in the southern end of the high temperature low pressure Hidaka Metamorphic belt in Hokkaido, Japan (Niida, 1984). It consists of cyclically layered sequences of plagioclase lherzolite, lherzolite and harzburgite with subordinate amounts of dunites, mafic granulites and pyroxenites. Although the Horoman massif is geochemically well characterized, the process (or processes) responsible for the formation of the layering, as well as the origin of the fertile plagioclase lherzolite still remain controversial (Niida, 1984; Obata and Nagahara, 1987; Takahashi, 1992; Takazawa et al., 1998a; Yoshikawa and Nakamura, 1998).

We report the Re-Os isotopic composition of twenty samples, eighteen peridotites from the an extremely well characterized 140-m section across the layered sequence from plagioclase lherzolite to lherzolite to harzburgite (the Bozu section), (Takazawa et al. , 1998a), and two mafic layers (Type I of Takazawa et al., 1998b). The $^{187}Os/^{188}Os$ ratios observed in 140-m section of the peridotitic massif range from 0.11577 to 0.12829, similar to the isotopic range observed in other peridotitic massifs. The correlation between Re content and Os isotopic composition indicates that the Os isotopic composition in Horoman peridotite is controlled by the Re concentration through ingrowth. Also, the Re contents are correlated positively with Al_2O_3, CaO, Sc and Yb and negatively with MgO and Mg#, suggesting that the Re variation is controlled by a "basaltic component".

Two main ideas have been proposed to explain the origin of the fertile plagioclase-lherzolite:

1) it exemplify an unmelted fertile peridotite (Takahashi, 1992; Takazawa et al., 1998a; Yoshikawa and Nakamura, 1998)
2) it represents a region of melt impregnation (Obata and Nagahara, 1987).

Results such as supra-chondritic Re/Os ratios in the plagioclase-lherzolite, as well as successful modeling of major and trace element content of the fertile plagioclase-lherzolite by simple mixing between mafic layers (Type I of Takazawa et al., 1998b) and the lherzolite, strongly suggest the late addition of a "basaltic component", supporting the hypothesis originally proposed by Obata and Nagahara (1987).

Re-depletion model ages indicate that the melting event in Horoman peridotites is ≥ 1.8 Ga, much older than the range of ages from 0.9 to 1.3 Ga (depending whether is clinopyroxene or whole rock isochron) previously estimated based on Nd isotopes (Takazawa, 1996; Yoshikawa and Nakamura, 1998). As an alternative hypothesis to previous works, we propose that melting of the mantle ≥ 1.8 Ga. produced depleted peridotite which were infiltrated by basaltic melts (Type I mafic layers of Takazawa et al., 1998b) at approximately 0.9 to 1.3 Ga. forming the plagioclase-lherzolite. This inferred age for Type I mafic layers is much older than the one obtained by Takazawa et al. (1998b) from the Nd isotopic systematics. The generation of the plagioclase-lherzolite by infiltration of basaltic melts gives a viable mechanism for generating the layered structure in the Horoman massif.

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