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P-T-deformation history of the northern part of the Horoman Peridotite Complex, Hokkaido, Japan

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It is important to know the chemical composition of the bulk silicate earth (BSE) for understanding the formation and evolution of the earth and other planet of the solar system. There have been many studies to estimate the BSE composition on the basis of chemical models, such as Pyrolite model (e.g., Ringwood, 1962) and CI chondrite model (e.g., MacDonough & Sun, 1995). However, each model is based on critical assumptions. In the pyrolite model, the BSE is assumed to be a mixture of the current upper mantle and a basalt with an appropriate ratio. In the CI chondrite model, the chemical diversity of the upper mantle represents that due to the BSE differentiation. Moreover, in the CI chondrite model, the estimated chemical composition has a large uncertainty due to the large scatter in chemical compositions of the upper mantle peridotites. In order to critically evaluate the assumptions and to resolve the last issue, we adopt a strategy searching for a mantle fragment having the deeper and older information of the upper mantle. The Horoman peridotite complex, Hokkaido, Japan is known to be as old as ˜830 Ma in its formation of one of the chemical diversities (Yoshikawa and Nakamura, 2000) and derived from the depth of ˜70km as a solid state (Ozawa, 2004) and is suited for the purpose of this study.

The Horoman peridotite complex is located in the northern end of the Hidaka belt, which is a low P and high T type metamorphic belt. The complex occurs in the highest-grade region of the metamorphic belt mostly consisting of pelitic rocks and mafic rocks and is divided to Upper Zone and Lower Zone based on features of deformation microstructures. It is composed mostly of plagioclase lherzolite, spinel lherzolite, and harzburgite, which show layering on various scales. The layering is dipping to the north in the southern part and to the south in the northern part, thus the structurally lower Lower Zone appears in the northern and southern ends of the complex. On the basis of the study in the southern part, Ozawa (2004) shows that the Lower Zone ascent from the depth of ˜60km and temperature of 950?C almost adiabatically. We focused on the northern part of the complex, the pressure-temperature history of which has never been scrutinized yet.

Studied samples were collected along Chiyanbetsu-zawa running nearly perpendicular to the layered structure in the northern part of the Horoman complex. Mineral compositions were measured with EPMA, and three-dimensional morphology of fine-grained seams consisting of pyroxenes and spinel was quantified. By applying a geothermobarometer based on Lindsley (1983), Gasparik (1987), Nickel and Green (1985), and Ozawa (2004) to the core of orthopyroxene, the deepest P-T conditions were estimated. The result shows that the northern part tends to give lower temperature and similar depth to the southern part studied by Ozawa and Takahashi (1995). The seams contain orthopyroxene and clinopyroxene as inclusions and contain many islands of very fine-grained pyroxene-spinel symplectite. Along the margin of the seam, plagioclase grains, as large as several tenths of microns occur. The aspect ratio of seams in symplectite-bearing spinel lherzolite was found to be ˜5:2:1, indicating very weak deformation as compared with those measured by Sawaguchi (2001). These features suggest that the northern part of the Horoman complex is a suitable for the search of the mantle fragments for constraining the BSE composition. The difference in temperature between the northern and southern Lower Zone may be explained by the lateral variation in lithospheric geotherm.

Keywords: Horoman, Peridotite, P-T-deformation history