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ORIGIN OF PLAGIOCLASE LHERZOLITE FROM THE NIKANBETSU PERIDOTITE COMPLEX, HOKKAIDO, NORTHERN JAPAN

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ABSTRACT

The Nikanbetsu complex, which is the neighbor complex of the Horoman peridotite complex, is located at the southern end of the Hidaka belt, which is characterized by a low-P and high-T type metamorphism in the Paleogene to early Miocene ages (e.g., Saeki et al., 1991; Arita et al., 1993). The complex is approximately 2 x 1 km in size and about 1300 m in thickness and is in fault contact with the surrounding metamorphic rocks. This complex is composed of mainly of plagioclase-bearing lherzolite with subordinate amounts of plagioclase-free lherzolite, harzburgite and two pyroxenes and olivine gabbro, minor amounts of clinopyroxenite and websterite (Takahashi, 1997). Harzburgite and lherzolite layers alternate with gabbro, and the layering is nearly parallel to the foliation. Plagioclase-rich veins are observed in plagioclase lherzolite and always have more than a few cm thick zone in which plagioclase is absent on the both sides. These veins are always parallel to the lineation and oblique to the foliation with 23~34° angle. The size of each vein is several tens centimeters to a few meter in length and a few centimeter in thickness. Several zones of abundant plagioclase-rich veins, that are several to a few hundred meters in thickness, occur in different lithology of gabbro layer-rich zones.

Plagioclase lherzolite from the southwestern part of the complex only contains a round symplectitic aggregate, which is composed of spinel and two pyroxenes without plagioclase and olivine. Plagioclase (6 to 9 % in modal composition) in plagioclase lherzolite from the Nikanbetsu complex is classified into three type (Takahashi, 1997). These are clinopyroxene-bearing seam type, isolated type and vein type by its mode of occurrence. Plagioclase of the seam type occurs as one of minerals forming a seam-like aggregate. It is partly a product of the decompression reaction among two pyroxenes and spinel which were derived from the reaction between garnet and olivine as observed in the Horoman complex (e.g., Takahashi, 1992), and partly a product from interstitial melt. Plagioclase of the isolated type occurs outside plagioclase-rich seams as an interstitial isolated grain in both of pyroxenes-rich part and olivine-rich part. The modal amount of the isolate type which occur in olivine grains, is slightly increases from the southwestern to the central part of the complex, and significantly increases from the central to northeastern part of the complex. Plagioclase-rich veins are composed mainly of plagioclase and coarse orthopyroxene.

Plagioclase from the Nikanbetsu complex shows also Na-Ca zoning, which has An-poor core (An 61~66) and An-rich rim (up to An 90). Large isolated plagioclase grains show a W-shaped Na-Ca zoning pattern; in the core region the An content slightly decreases from 70 to 65 followed by an increase up to An 85 at the rim. And they often have oscillatory zoning at their margin to rim. All plagioclase grains from plagioclase-rich veins have also compositional zoning similar to the other types. Olivine occurring in the vicinity of such the plagioclase-rich vein has Fo-poor (89~89.5) and NiO-poor (0.33~0.35 wt%) characters as compared with olivine far away from the vein (90~91 in Fo content, 0.36~0.38 in NiO wt%). Some olivine from the area where abundant plagioclase-rich veins and isolated plagioclase occur, shows also NiO-poor (0.34~0.35 wt%) character.

The existence of two pyroxene and spinel symplectite from the southwestern part of the complex indicates that the Nikanbetsu complex started to ascend from the garnet stability field as advocated from the Horoman complex (Ozawa and Takahashi, 1995). Calculated temperature for core-core pairs of coarse pyroxenes according to Wells (1977) indicates more than 1100°C at the southewestern part of the complex, to 1700°C at the northeastern part of the complex, which is similar to the highest value for the Upper Zone of the Horoman complex. The texture of isolated type of plagioclase interstitial to pyroxenes grains suggests that it was crystallized from a very small amount of partial melt formed in the vicinity of clinopyroxene and orthopyroxene grains. The W-shaped Na-Ca zoning pattern of large isolated plagioclase grains suggests that a rapid decompression, which caused the marginal Ca enrichment under above or below solidus conditions, took place after crystallized of a trapped partial melt. Mode of occurrence of oblique plagioclase-rich veins with plagioclase-free vein wall indicate that a crack suck partial melt from the surrounding partially molten peridotite (e.g., Nicolas, 1989). However, the Fe-rich and NiO-poor nature of the surrounding olivine indicates that the melt was not simply extracted from the host peridotite, because the simple melt extract will cause Mg and Ni enrichment of the surrounding olivine. The sharply decreasing trend for Ni content of the olivine in the surrounding zone of the vein can be explained by crystallization from a melt in equilibrium with the plagioclase lherzolite host away from the veins. Olivine is though to have been crystallized on the vein wall from the segregated melt. There may have been a modification by a reaction with an evolved melt derived by olivine fractionation from the segregated melt. This mechanism, however, requires some extent of olivine fractionation to produce less magnesian melt, however, requires olivine crystallization on the vein wall. The variation of the core composition of plagioclase within plagioclase-rich veins featuring Ca enrichment toward the vein wall indicates that plagioclase was crystallized on the vein wall at first, followed by filling up the center of the vein, because plagioclase at the center of the vein is more sodic. The existence of Na-Ca oscillatory zoning pattern of large isolated type of plagioclase from plagioclase lherzolite strongly indicate that the incipient melt was formed within several limited parts of the lherzolite, and each melt may have migrated independently.

REFERENCES

Arita K., Shingu H. and Itaya T., 1993. K-Ar geochronological constraints on tectonics and exhumation of the Hidaka metamorphic belt, Hokkaido, northern Japan. J. Min. Petr. Econ. Geol., 88: 101-113.

Nicolas A., 1989. Structures of ophiolites and dynamics of oceanic lithosphere. Kluwer Acadmic Publishers, Dordrecht, 367 pp.

Saeki K., Shiba M. and Itaya T., 1991. K-Ar ages of metamorphic and igneous rocks from the southern Hidaka metamorphic belt. J. Min. Petr. Econ. Geol., 86: 177-178.

Ozawa K. and Takahashi N., 1995. P-T History of a mantle diapir: the Horoman peridotite complex, Hokkaido, northern Japan. Contrib. Mineral. Petrol., 120: 223-248

Takahashi N., 1992. Evidence for melt segregation towards fractures in the Horoman mantle peridotite complex. Nature, 359: 52-55.

Takahashi N., 1997, Incipient melting of the mantle peridotites observed in the Horoman and Nikanbetsu peridotite complexes, Hokkaido, northern Japan. J. Min. Petr. Econ. Geol., 92:1-24.

Wells P.R.A., 1977. Pyroxene thermometry in simple and complex systems. Contrib. Mineral. Petrol., 62: 129-139.