

Petrology on origin of the Mitsuishi ankaramite in greenstones from the accretionary complex, central-axial zone of Hokkaido

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A typical ankaramite contains a large amount of clinopyroxene phenocrysts, which are more abundant than those of olivine in picrites (Williams et al., 1982). Kushiro (1963, 1969) showed that the single phase crystallization of clinopyroxene occurs under a limited range of very high temperature at pressure range less than 20 kb in basalt systems. This means that the ankaramite is a representative rock sample with informations on early stage crystallization of primary basaltic magmas. Additionally, the phenocrystic cores of clinopyroxene with high Mg# (0.85-) and high Cr contents (0.025-), in equilibrium with those in upper mantle peridotites, are evidently informative on their magma source. In this paper we will discuss on the magma types and the possible source mantle signatures for the ankaramites.

The Mitsuishi ankaramites were sampled from tectonic slices of greenstones in the Cretaceous accretionary complex in the Mitsuishi area, central-axial zone of Hokkaido. The clinopyroxene phenocrysts are mega-size euhedral crystals up to 2.0 cm in diameter, ranging from 16 to 57 vol.%. Based on the color of clinopyroxenes and the vol.% of olivine phenocrysts, the Mitsuishi ankaramites are classified into the following sub-types; green clinopyroxene ankaramite (Type 1), green clinopyroxene-olivine ankaramite (Type 2), black clinopyroxene ankaramite (Type 3), and black clinopyroxene-olivine ankaramite (Type 4).

The phenocrystic cores of clinopyroxene in the types 1 and 2 ankaramites are characterized by a tholeiitic signature with low compositional ranges of Al₂O₃ (1.43-4.88 wt%) and TiO₂ (0.12-1.38 wt%), and high range of SiO₂ (49.55-53.43 wt%), whereas those in the types 3 and 4 ankaramites are alkaline one with high Al₂O₃ (2.25-8.25 wt%) and TiO₂ (0.62-3.71 wt%), and with low SiO₂ (45.10-52.48 wt%). The clinopyroxenes from the olivine phenocryst-poor types 1 and 3 clearly display a clinopyroxene-single phase fractionation trend on the Cr-Mg# correlation diagrams. The maximum content of Cr exceeds 0.025 in atomic number for all types 1 to 4 (0.034 for type 1, 0.037 for type 2, 0.033 for type 3, and 0.038 for type 4), attaining to the Cr range of upper mantle clinopyroxenes. The Mg# are less than 0.92 for all types 1 to 4 (0.91-0.86 for types 1 and 2, and 0.88-0.83 for types 3 and 4), suggesting a fertile mantle peridotite for their magma source. It can be estimated that the magma source peridotites for the alkaline types 3 and 4 are more fertile than those for the tholeiitic types 1 and 2.

In comparison with the clinopyroxene data published, the Mitsuishi ankaramite clinopyroxenes are far from those in island-arc type ankaramites (Barsdell, 1988). Tholeiitic types 1 and 2 ankaramite clinopyroxenes range from those in sub-oceanic mantle peridotites (MARK: Niida, 1997, AAR: Dick, 1989) to more fertile than those in sub-continental xenoliths (San Carlos: Frey, 1978). Alkaline types 3 and 4 ankaramite clinopyroxenes are more fertile than tholeiitic types 1 and 2 and rather close to those in the hot-spot type Hawaiian ankaramites (Frey et al., 1991).