GEOCHEMISTRY OF THE ULTRAMAFIC XENOLITHS FROM OKI-DOGO ISLAND: IMPLICATIONS FOR THE WEDGE MANTLE EVOLUTION

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ABSTRACT

There are some localities of residual peridotite xenoliths from western edge arcs of the Circum-Pacific Ocean. Abe (1997) and Abe et al. (1998; 1999) show that the peridotite xenoliths from those arcs underwent wedge mantle metasomatism with some influx from subducted slab. We report the petrological and geochemical characteristics of the ultramafic xenoliths in the Cenozoic alkali-olivine basalts of Oki-Dogo island, another locality reported by Abe (1997) and Abe et al. (1998; 1999) in the Japan Sea. Both Group I and II ultramafic xenoliths (classification by Frey and Prinz (1978), equivalent to Wilshire and Shervais (1975) Cr-diopside and Al-augite series, respectively) come from Oki-Dogo island. Preliminary data on the petrology of the ultramafite, and also mafic xenoliths are in Yamaguchi (1964), Aoki (1977) and Takahashi (1978). We present here their mineral chemistry, especially the abundance of trace-elements in clinopyroxenes of Group I peridotite and the metasomatism by Group II ultramafic xenoliths suite.

Oki-Dogo Island is located at the northern end of the Southwest Honshu Arc in the Japan Sea. Extensive alkalic volcanism (mugearite, hawaiite, trachy-andesite, trachyte and alkali rhyolite) took place from late Miocene to early Pliocene in this island. Alkali-olivine basalts with a subordinate amount of basanites were extruded from many vents situated inside of the supposed magma chamber. These basalts were monogenetic in most cases and their extrusion started at least 3.6 Ma and lasted at least until 0.8 Ma (Kaneoka et al., 1977). Most of these alkali basalts are fresh and contain 2 to 15 percent normative nepheline. Ultramafic and mafic inclusions are commonly found in most of the monogenetic lava flows. According to Takahashi (1978), those xenoliths are classified into five groups: spinel lherzolite, banded spinel peridotite, banded plagioclase peridotite, gabbro and granulite groups. The rocks of the banded spinel peridotite group are cumulates formed by fractional crystallization of basic magmas in a pressure range between about 10 and 20 kb, and recrystallized at the same depth. Some of the spinel lherzolite group are cumulates from basic magmas in the upper mantle during the partial melting of the preexisting lherzolite.

Group I peridotite, which was classified as spinel lherzolite group by Takahashi (1978), has very low-Cr spinel. The Cr# (=Cr/(Cr+Al) atomic ratio) of chromian spinel is less than 0.3. Their Fo content of olivine varies from 90 to 83, while their NiO content is rather constant (0.25 to 0.40 wt%). Clinopyroxene grains in polished thin sections were analyzed in situ for abundances of REE, Ti, Sr, Y, Zr with the secondary ion mass spectrometer (SIMS; Cameca IMS-3f) at Tokyo Institute of Technology. The chondrite normalized REE patterns of clinopyroxene in Oki-Dogo Group I xenoliths are flat to U-shaped LREE-depleted. HREE contents, however, almost same level, which suggests that those peridotites have the same degree of melt extraction. The evidence from their REE patterns and trace-element contents suggest that the Group I peridotites underwent Fe-rich mantle metasomatism by the alkaline magma. The continental type mantle metasomatism as well as arc type metasomatism suggested by Abe (1997) occurs in mantle wedge.

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