Generation mechanism of the Nanzaki basanite in northern part of Izu Volcanic arc, Japan: petrological and geochemical constraints

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Petrological and geochemical studies were performed on the Nanzaki basanite (0.43 Ma) in the northern part of Izu-Bonin volcanic arc, Japan. The Nanzaki basanite is located 50 km off from the volcanic front, and covers Miocene volcaniclastic formations. Previous works have tried to study for this unique rocks (e.g., Goto and Arai, 1986; Aoki et al., 1987). The basanites are mostly composed of nepheline-bearing basanite lava and scoria. Phenocryst assemblage is olivine and clinopyroxene, and orthopyroxene is absent. Spinel, nepheline, and apatite are present in groundmass. Olivine Fo contents vary in 82-91 with a mean of 88, and clinopyroxenes are characterized by high TiO2 and low Cr2O3. Whole-rock major element contents are: SiO2 = 41.5-44.1, MgO = 10.2-13.1 , CaO = 11.9-13.3, K2O = 0.4-1.9. The low values of FeO*/MgO (0.81-1.09), and high Ni and Cr contents for the Nanzaki basanite represent primary (undifferentiated) magmas generated in the upper mantle. Tightly distributed REE patterns, displaying light rare earth element (LREE) enriched and heavy rare earth element (HREE) depleted, are consistent with the above primary chemical features. Incompatible trace element patterns for the basanites show some peculiar features distinct from those of basanites in the oceanic tectonic setting, like Hawaii. High Sr and Ba, and REE and low K, Rb, Zr, Hf, and Ti contents suggest that the basanite magmas were generated from an enriched mantle previously affected by metasomatism with incompatible element enriched components. A possible candidate for the components is carbonatite magma (or melt) which could have much influenced the trace element characteristics of the mantle (e.g., Ionov et al., 1993; Hoernle et al., 2002).. Beside these, slight enrichment in Pb and Cs and some other elements in the diagrams may also be indicative of fluids probably from subducting oceanic slab. The Sr-Nd isotope characteristics for the basanites (both low Sr and Nd isotope values rather than those of basaltic rocks in the volcanic front), however, is consistent with across arc isotopic variations of the Izu-Bonin volcanic arc.

These results conduct to the model that the basanite magmas were generated from some enriched parts of mantle (probably wehrlite-like rock or similar source, partly including carbonates) with contributions of melts/fluids from subducting oceanic slab in arc setting.

The only one clinopyroxinite nodule with vesicular texture is found within the basanite lava, and this much rare existence of the nodule probably means that the original magma for the basanite was generated from relatively shallower mantle (lower part of lithosphere or upper part of asthenosphere). Also vesicular texture of the nodule is indicative of existence of some volatile components (CO2, H2O) in the host basanite magma. These observations and results support the above model.

Key words: Nanzaki basanite, Izu-Bonin volcanic arc, carbonatite metasomatized mantle