Petrology of mafic and ultramafic xenoliths in petit-spot volcanoes: Implications for the structure of the old oceanic plate

Natsue Abe[1]; Shoji Arai[2]; Junji Yamamoto[3]; Naoto Hirano[4]; Ayu Takahashi[5]

[1] IFREE, JAMSTEC; [2] Dept. Earth Sci., Kanazawa Univ.; [3] BGRL; [4] LEC., Univ. Tokyo; [5] Dept. Earth Planet. Sci., Univ Tokyo

A new type volcanism petit-spot was recently discovered in the NW Pacific plate (Hirano et al., 2006). The volcanoes erupted strong to moderate alkaline and highly vesicular basalt including mafic to ultramafic xenoliths. The eruption ages of the volcanoes are estimated younger than 8.5 Ma, whereas the Pacific plate of the area was formed in the Early Cretaceous (˜130 Ma). The volcanic fields during their activities are away from any spreading centers, hotspots and even island arcs (Hirano et al., 2006). To understand this petit-spot volcanism, we have been taking interdisciplinary surveys. The main results of these surveys using JAMSTEC R/V KAIREI and YOKOSUKA and shore-based research suggest that there are a lot of small knolls assumed young volcanoes. The arrangement and the size of the knolls imply that this volcanic field is a monogenic volcanic cluster, which are often observed in the intra-continental plate.

The xenoliths included in the volcanoes are deep-seated rocks composed the old Pacific plate; such as dolerite, micro-gabbro, gabbro, lherzolite, dunite, wehrlite, pyroxenite and harzburgite. The major element chemistry of the mafic xenoliths shows normal MORB composition, and the major mineral chemistry of the ultramafic xenoliths has a variation within the abyssal peridotite. The clinopyroxene in one of the ultramafic xenoliths has LREE-depleted trace element patterns which is similar to that in the abyssal peridotite from slow spreading ridges. The other samples have LREE-enriched patterns, and the one lherzolite shows highly HREE-depleted patterns, which imply those of the clinopyroxene in the garnet peridotite from subcontinental lithospheric mantle.

It is noteworthy that no serpentinite or highly altered mafic rocks discovered in the petit-spot volcanic field. The architecture of the oceanic lithosphere and the nature of asthenosphere are still enigmatic. The deep-seated rock xenoliths and its host alkaline basalt provide us much information about the geochemical, petrological and physical structure and the thermal state of the old oceanic plate.

Reference

Hirano, N., E. Takahashi, J. Yamamoto, N. Abe, S. P. Ingle, I. Kaneoka, T. Hirata, J. Kimura, T. Ishii, Y, Ogawa, S. Machida, K. Suyehiro (2006) Volcanism in response to plate flexure. Science. 313, 1426-1428.