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Interaction between mantle-wedge lithosphere and plume-derived melt beneath the Japan arcs on the Japan-Sea opening

S. Arai (1), A. Tamura (1), S. Ishimaru (1), C. Ninomiya (1) and N. Abe (2)

(1) Department of Earth Science, Graduate School of Natural Science and Technology, Kanazawa University, Kanazawa 920-1192, Japan, (2) Department of Deep Sea Research, IFREE, JAMSTEC, 2-15 Natsushima-cho, Yokosuka 237-0061, Japan (ultrasa@kenroku.kanazawa-u.ac.jp / Fax: +81-76-264-6545 / Phone: +81-76-264-6521)

There are many localities of mantle xenoltihs captured by Cenozoic alkali basalts on the Southwest Japan arc, which enables us to construct a petrologic model of the upper mantle beneath an island arc. The Sea of Japan, one of the back-arc basins in the Western Pacific, quickly opened around the Miocene due to upwelling of a mantle plume through a slab window. Mantle diapirs related to the plume had produced magmas (from alkaline to tholeiitic in composition), including the host alkaline basalts, to modify the upper mantle to lower crust to various extents. The Cenozoic basalts make monogenetic volcanoes; some of them form volcano clusters and others are solitary (Takamura, 1973).

Pyroxenites of black-pyroxene series (= Group II; enriched with Fe, Al and Ti) are found as discrete xenoliths as well as parts of composite xenoliths with mantle peridotites and other peridotites/pyroxenites of green-pyroxene series. The melts that precipitated Group II pyroxenites and related megacrysts were released from the plume responsible for Japan-Sea opening. Group II xenoliths and related megacrysts are available characteristically from the monogenetic volcanoes forming clusters, and are rarely found from solitary volcanoes (Arai et al., 2000).

The Southwest Japan arc is thus an excellent field to know the interaction between the plume and the pre-existing mantle wedge peridotite. We examined mantle peridotites from various settings on the Southwest Japan arc to understand effects of the plume-derived melts on the sub-arc mantle. The mantle peridotite has been chemically

modified: the Fo content of olivine has decreased down to 74, and the Cr# of spinel has also decreased slightly. To be interesting, the mantle peridotite apparently has been intact in mode. The upper mantle beneath the Southwest Japan arc comprises the intact residual peridotite and the metasomatized peridotite with intervening Fe-rich pyroxenites (Group II). The latter may be anomalous mantle in terms of both chemical and physical properties.