Petrologic characteristics of the Sumisu caldera, Izu-Bonin arc

Hiroshi Shukuno[1], Yoshihiko Tamura[1], Jirou Naka[1], Kenichiro Tani[1], Naoko Irino[2], Richard S. Fiske[3]

[1] IFREE, JAMSTEC, [2] IFREE

JAMSTEC, [3] Smithsonian Institution

The Izu-Bonin arc is a typical intra-oceanic island arc and its volcanic arc is characterized by bimodal, basaltic and dacitic-rhyolitic volcanism. The genesis of andesitic magmas is an important problem and must be resolved if we are to better understand arc magmatism and the genesis of continental crust. Contrary to popular belief, however, the curious lack of andesites in the Izu-Bonin arc could also provide some constraints on the genesis of andesite and of arc magmatism in general. The sampling reported here was carried out with DSRV Shinkai 2000 and ROV Dolphin 3K on the NT02-10 cruise of Japan Marine Science and Technology Center (JAMSTEC). Attention was focussed on Sumisu caldera in order to understand intra-oceanic arc magmatism. Sumisu caldera has a diameter of about 9 km and is one of the well-developed calderas along the front of the Izu-Bonin arc. Rocks of the pre-caldera volcanic complex are the products of bimodal, basalt-rhyolite magmatism, although a small volume of andesitic lava is present. Rocks having 60-66 wt% SiO2 are, however, completely absent. The felsic components (dacite to rhyolite) of the Sumisu area can be divided into two types based on occurrence and chemistry: 1) dacite-rhyolite (66-74 wt% SiO2), located in the caldera wall, and 2) dacite (68-70 wt% SiO2), making up the central cones on the caldera floor. Petrographic interpretations suggest the andesite (56-60 wt% SiO2), the dacite-rhyolite from the caldera wall, and the dacite from caldera floor could not be produced by crystal fractionation from the basaltic (50-55 wt% SiO2) and andesitic magmas, respectively. The andesite from the caldera wall and the dacite from the caldera floor have similar Y/Zr and Zr/B ratios. Thus, it is likely that the source of the andesites would be similar to that of the dacite from the caldera floor. Magmatic temperatures inferred by the two-pyroxene thermometer show unambiguous differences between the andesites and the dacites. Generally, temperatures of 1000-1100 C are obtained from the andesites, whereas 900-1000 C is indicated for the dacites. The SiO2 content correlates with the morphology of plagioclase phenocrysts in the caldera-floor dacites. Brownish glass inclusions are abundant in plagioclase phenocrysts in the caldera-floor dacites having SiO2 contents of 68-69 wt% but are rare in those with higher SiO2. Moreover, pyroxene phenocrysts in the dacite often have reverse zoning in terms of Mg# and temperature. It is possible that the dacite and rhyolite were produced by various degrees of melting of andesite in the upper- to middle-crust due to influx of hot basalt magmas from greater depth.