Petrogenesis of Low-Si Boninites Drilled from IBM Fore-arc by IODP Expedition352: implications from LA-ICP-MS study

*Tetsuya Sakuyama[1], Jun-Ichi Kimura[4], Yoshihiko Tamura[4], Eiichi TAKAZAWA[2], Toshiro Takahashi[2], IODP Expedition 352 Scientists[3]

1. Faculty of Science, Osaka City University, 2. Department of Geology, Niigata University, 3. IODP, 4. JAMSTEC

We discuss petrogenesis of Low-Si boninites with high Cr content (500-1500 ppm) obtained from IODP Holes U1439C and U1442A in terms of whole-rock major and trace element compositions, trace element compositions of minerals, and Pb isotopic compositions ($^{208}Pb/^{206}Pb$ and $^{207}Pb/^{206}Pb$) of groundmass. We conducted electron probe micro-analyzer (EPMA) and laser-ablation multiple collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS) analyses as well as X-ray fluorescence spectrometer (XRF) and ICP-MS analyses on low-Si boninites and FABs in order to reveal the petrogenesis of these rocks.

Many low-Si boninites with high Cr content (500-1500 ppm) contain reversely-zoned olivine and clinopyroxene phenocrysts: Fo# [$=Mg/(Mg+Fe^{2+})_{mol}$] of olivine varies from ~87 at core to >90 at rim, and Mg# [$=Mg/(Mg+Fe^{2+})_{mol}$] of clinopyroxene varies from < 83 at core to >89 at rim. Measured $^{207}Pb/^{206}Pb$ (0.823–0.842) and $^{208}Pb/^{206}Pb$ (2.02–2.06) of boninites' groundmass from Expedition 352 are similar to the reported $^{207}Pb/^{206}Pb$ (0.814–0.839) and $^{208}Pb/^{206}Pb$ (2.021–2.063) of boninites from Izu-Bonin and Mariana (IBM) fore-arcs. Low-Si boninites with intermediate Cr content (500-800 ppm) show higher $^{207}Pb/^{206}Pb$ (0.828–0.842) and $^{208}Pb/^{206}Pb$ (2.035–2.063) than those with the highest Cr content (~1400 ppm) ($^{207}Pb/^{206}Pb$ ~ 0.827–0.831 and $^{208}Pb/^{206}Pb$ ~ 2.042) but lower than the reported $^{207}Pb/^{206}Pb$ (0.830–0.856) and $^{208}Pb/^{206}Pb$ (2.055–2.097) of FABs from IBM.

Low-Si boninites with high Cr content show positive correlation between Zr/Ti and Cr content, which is hard to reproduce simply by differences in the degree of melting, fractional crystallization or crystal accumulation. One plausible mechanism to reproduce the geochemical variations observed for low-Si boninites with high Cr content is mixing between low-Si boninite with the highest Cr content and FAB. The intermediate $^{207}Pb/^{206}Pb$ and $^{208}Pb/^{206}Pb$ of low-Si boninites with intermediate Cr content as well as the presence of reversely-zoned clinopyroxene phenocrysts support mixing model, which can also reproduce variations in published whole-rock trace elements and isotope compositions of boninites and FABs.

Keywords: boninite, forearc basalt, Izu-Bonin-Mariana

