Progressive mixed-magma recharging of Izu-Oshima volcano, Japan: Implications for crustal development in island arcs

O. ISHIZUKA[12*], N. GESHI[1], R. N. TAYLOR[3], T. OIKAWA[1], Y. KAWANABE[1] AND I. OGITSU[1]

[1]Geological Survey of Japan/AIST, *correspondense:o-ishizuka@aist.go.jp
[2]JAMSTEC, Kanagawa, 237-0061, Japan
[3]University of Southampton, Southampton, SO14 3ZH, UK

Understanding the magma flux received by volcanoes is required to evaluate the growth of arc crust. However, much of the input from the magma source may not emerge as erupted material but can be transported laterally and retained in the crust. Magmatism can also occur across a region from the frontal arc into the backarc without significant lateral magma movement, and this magmatism reflects progressive changes in the slab-derived material away from the trench. Together, these characteristics imply that movement of melts from the sub-arc mantle through the crust to the volcanic edifice involves a complex magma plumbing system.

To discover how magmas move and interact beneath an arc we have examined the temporal and spatial evolution of the Izu-Bonin frontal arc volcano Izu-Oshima and the adjacent Izu-Tobu backarc volcanoes. Extensive ^{14}C ages and geochemical analysis of Izu-Oshim magma has enabled us to construct a well-constrained ~14 ka record of Izu-Oshima volcanism.

The geochemistry of Izu-Oshima is found to change systematically through the last 10,000 years. Ba/La, Pb/Ce, $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$ and $^{206}Pb/^{204}Pb$ all decrease between 10 ka and 5 ka before increasing between 5 ka and the present, while La/Yb and Nb/Zr show the reverse. These changes in composition match the addition of Izu-Tobu (backarc) magma to the Izu-Oshima plumbing system with a maximum of a 40% Izu-Tobu at around 5 ka. Progressive but asymptotically declining changes in composition through the 10-5 ka period are found to fit a model where pre-mixed magma is episodically added to, and mixed with, a chamber beneath Izu-Oshima. The 5-0 ka period reverses this trend, suggesting a switch to a progressive influx of pure Izu-Oshima frontal arc magma. Interaction and pre-mixing between the fluid-dominated frontal arc melt and the sediment-bearing backarc magmas must occur at deeper levels within the arc crust. These deep reservoirs receive a continuous feed of one magma type from the mantle, but may experience periodic connection and mixing events followed by episodes of isolation on timescales of ~5000 years.