

Os isotope of primitive magma of high-Mg andesite in the Setouchi volcanic belt: recycled Os vs shallow crustal assimilation

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High magnesian andesites (HMAs) can occur in subduction zone settings such as SW Japan and Aleutian Island. The high Mg/Fe ratios of HMAs strongly imply their equilibration with upper mantle peridotite. Geochemical modelling of HMA magma formation in the Setouchi volcanic belt (SVB) suggests its derivation by partial melting of subducted lithosphere, and subsequent melt-mantle interaction (Shimoda et al, 1998; Tatsumi & Hanyu, 2003). Osmium isotope is a sensitive tracer of crust and sediment, because of significant contrast between a high Os isotope ratio of crust and sediments ($^{187}\text{Os}/^{188}\text{Os}$ more than 0.5) and a low ratio of wedge mantle ($^{187}\text{Os}/^{188}\text{Os} = \text{ca. } 0.13$). Therefore, Os isotope provides information on slab component contribution to the mantle source of island arc lavas. We obtained the radiogenic Os isotope compositions ($^{187}\text{Os}/^{188}\text{Os} = 0.1718$ to 0.2041) for the HMAs in the SVB in bulk rock analyses, suggesting input of subducted components in the generation of such HMAs (Suzuki & Tatsumi, 2006). However, crustal assimilation possibly results in high Os isotope ratios during magma ascent, as pointed out for volcanic rocks in continental arcs (e.g., Woodhead & Brauns, 2004).

Olivine phenocrysts in the Setouchi HMAs contains several Cr-spinels with size ranging from a few micrometer to 30 micrometer. We extract these Cr-spinels from large amounts (approximately 30kg) of HMAs for determination of Os isotopic compositions of primitive magma because Cr-spinel is the early stage fractionating phase. Cr-spinels preserve the chemical and isotopic compositions of very primitive magma free from any later stage crustal contamination. We found that the Os isotope ratios of Cr-spinels of both Setouchi basalt and HMA possess less radiogenic than those of bulk compositions of boninites and that those Os isotopic compositions are still higher than that of DMM. These results indicate that slightly radiogenic Os isotope ratios of Cr-spinel of Setouchi basalt and HMA, exhibiting primitive arc magma, are resulted from slab contribution and that much radiogenic Os isotope ratios of bulk basalt and HMA are originated from crustal assimilation.

References

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