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Re-Os Isotopic Systematics of Setouchi high-Mg Andesites, SW-Japan: Evidence for Slab Melting

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Melting of a subducting oceanic crust is a likely process of subduction in the Archean time, which is due to steep geothermal gradient. Such melting could have contributed to the formation of the continental crust (e.g., Kelemen, 1995). In most modern subduction zones, in contrast, melting of the oceanic crust does not occur (Peacock, 1990). Alternatively, aqueous fluids are released and trigger melting of the overlying mantle wedge to form a wide variety of arc magmas. (e.g., Tatsumi and Eggins, 1995).

High-Mg andesites (HMAs) are characterized by their high MgO contents and/or high Mg/Fe ratios. Isotope geochemistry of Setouchi volcanic rocks, sw Japan, documented a rather radiogenic signature for HMAs, suggesting a major role of an enriched subduction component, i.e., a melt from subducting sediments, in producing Setouchi HMA magmas (Shimoda et al., 1998). We here present the Re-Os isotopic data of Setouchi HMAs and basalts to constrain well the mechanism of transportation of such a subduction component, via aqueous fluids or slab melts.

Osmium concentrations and isotopes vary in Setouchi HMAs, with [Os] ranging from 10.9 to 14.5 ppt and $^{187}Os/^{188}Os$ from 0.172 to 0.217. The Setouchi basalts have lower Os isotopic compositions (0.156 - 0.177) and higher [Os] (33.4 - 56.2 ppt) than the HMAs. Inverse relationship between [Os] and $^{187}Os/^{188}Os$ was observed in Setouchi HMAs and basalts, in the same way as Alves et al. (1999). Higher $^{187}Os/^{188}Os$ ratios in the HMAs than those in the basalts indicate that HMAs were produced with higher amounts of the enriched components than the basalts. The mixing calculation using Sr-Nd-Os isotopic compositions also suggests that the production of Setouchi HMAs can be explained by mixing between mantle and sediment-derived components. The results of dehydration experiment (Suzuki et al., 2000) revealed that Os could not be significantly mobilized (less than 15%) during dehydration reaction of serpentine. Therefore, it is unlikely that Os in the subducted components was transported only via aqueous fluids, because unusually high amounts of dehydration products are required to produce the elevated $^{187}Os/^{188}Os$ in the Setouchi HMAs. The unusual tectonic setting, including subduction of a newly-borne and hence hot plate, might be responsible for melting of subducting sediments at the time of Setouchi HMA formation (ca. 13 Ma).

The $^{187}Os/^{188}Os$ ratios of the island arc basalts in Rei-zan and Tomari, nw Japan (0.138 and 0.141, respectively), are lower than those of the HMAs and basalts in the Setouchi area. Tectonic setting of nw Japan was that the old Pacific plate was subducting under the Eurasian plate. Therefore, the dehydration process is more responsible than slab melting for a little suprachondritic Os isotopic compositions of arc basalts in nwJapan.

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