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Re-Os Isotope Systematics of Indonesian Arc Lavas and Porphyry Intrusions

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Recently, there has been a great deal of interest in using the Re-Os isotopic system to investigate the petrogenesis of arc lavas. Some researchers have suggested that the radiogenic Os isotopic signatures observed in some arc lavas primarily represent the influence of subducted radiogenic crustal material in the mantle source (e.g. Alves et al., 1999), whereas other groups promote crustal contamination of the magmas en-route to the surface (e.g. Lassiter et al., 1999). If these enriched signatures do reflect primary crustal input into the mantle source, then arc lavas can potentially trace the flux of crustal material subducted into the mantle at subduction zones. However, if these signatures are simply the result of crustal contamination during transport and eruption, then the Os isotopic signatures of arc lavas tell little about their mantle source.

We present Os isotopic data from a series of Neogene Indonesian arc lavas and porphyry intrusions, including samples from the Sunda-Banda arc (West Java: Pongkor, Cirotan, Ciemas and Sumbawa: Batu Hijau) and Irian Jaya (Karume). All of the samples analysed contain low Os abundances (2 to 28 ppt) and have variable Re abundances (0.005 to 67 ppb), due to the heterogeneous distribution of molybdenite, resulting in a significant spread in $^{187}Re/^{188}Os$ ratios (15 to 22700).

Five samples from the West Java Ciemas quartz-diorite intrusion yield an imprecise isochron (MSWD = 15), giving an age of 15.2 ±2.7 Ma and an initial γOs = +75. The age obtained from this isochron, although imprecise, is geologically reasonable and within error of a previously measured K-Ar age. Initial Os isotopic compositions for all of the arc lavas and intrusions analysed are radiogenic, ranging from γOs_i = +20 to +150 for Sunda-Banda arc samples and up to γOs_i = +500 for quartz-monzodiorites from the Karume intrusion in Irian Jaya. These γOs_i values for the Sunda-Banda arc samples are at the low end of the range observed for other lavas from West Java (Alves et al., 1999; γOs_i = +20 to +3000), but are similar to arc lavas from Mexico (Lassiter et al., 1999; Righter et al., 2000). In contrast to analyses of West Java arc lavas by Alves et al. (1999), we observe no trend between [Os] and $^{187}Os/^{188}Os$, suggesting that there is no systematic crustal contamination of the samples. However, we do observe general positive trends in $^{187}Os/^{188}Os$ versus $^{187}Re/^{188}Os$, which are consistent with the age of the samples.

The Miocene Ciemas intrusion is only 60 km south of Pongkor and Cirotan, therefore any change between the Miocene and Pliocene in the volume and type of sediment input into the arc mantle as proposed by Alves et al. (1999) for this area should also be identifiable here. The Ciemas samples exhibit no trend with respect to [Os] versus γOs and the initial γOs of +75 is only slightly higher than that observed for arc mantle elsewhere (e.g. γOs = 0 to +40; McInnes et al., 1999). In addition, we observe no relationship between age (Miocene: Ciemas, Pongkor; Pliocene: Cirotan, Batu Hijau) and γOs_i as would be expected if the main control on the Os isotopic composition of the West Java magmas was changes in the sediment flux into the mantle. The γOs_i of the Miocene (+75 to +140) and Pliocene (+15 to 100) Sunda-Banda arc samples are within error of each other. The most marked change in Os isotopic composition is between the Sunda-Banda arc samples and Irian Jaya samples that have significantly more radiogenic γOs_i (+330 to 500). However, this most probably reflects the influence of the significantly older (Proterozoic; e.g., Vroon et al., 1996) and thicker crust in Irian Jaya, compared to the relatively young Sunda-Banda arc crust (Palaeozoic; e.g., Vukadinovic, 1989). These data suggest that the highly radiogenic Os isotopic compositions observed in some arc lavas are most probably the result of crustal contamination of low [Os] magmas, and do not reflect the primary Os isotopic character of the underlying mantle. This study was supported by ARC grant # C39927009 and AMIRA project P563.

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