Extreme initial Os and PGE fractionation in Philippine Sea Plate basalts: Evidence for recycled crust?

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The Philippine Sea Plate (PSP) consists of lavas emplaced from 60 Ma to the present day. During the early part of its history, palaeo-reconstructions suggest that the nascent plate lay to the SE of its current position, probably in the area of the present day Manus Basin, under which a waning mantle plume has been postulated. Trace elements and radiogenic lithophile isotopes for PSP basalts suggest various possible geochemical inputs including MORB source, a back-arc MORB-like source or a source which contains recycled crustal material.

To further constrain the input from recycled materials in PSP magmatism, 29 alkalic and tholeitic basalts, obtained from DSDP/ODP drill cores in the West Philippine Basin and the adjacent back-arc basins (BAB - Shikoku and Parece-Vela), have been analysed for Re-Os isotopes and platinum group element (PGE) abundances.

This study also provides a rare opportunity to investigate PGE systematics in OIB-like and back-arc basin samples. Many of the BAB samples and basalts which are thought to partially sample recycled components display marked negative Pd anomalies (typically Pd/Pt = 0.01-0.3) in comparison with MORB-like samples from the area and published data for MORB (Pd/Pt = 0.25-7.0). Similarly, Pd/Pt ratios are commonly lower than published arc-related data (Pd/Pt <0.35). Distinguishable positive Ru anomalies also exist (Ru/Pt = 0.3-2.2, compared to MORB-like samples from the region Ru/Pt <0.3, and published arc data < 0.17). These anomalies must either reflect source heterogeneity or suggest the influence of a different melting or fractionation process.

Age-corrected initial $^{187}Os/^{188}Os$ ratios range from ~0.130 (consistent with MORB) to highly radiogenic values of 0.300. While some of the radiogenic samples contain very little Os (<10 ppt), and could therefore be susceptible to contamination during emplacement, some samples with Os concentrations up to 150 ppt give initial $^{187}Os/^{188}Os$ ratios greater than 0.150. Furthermore, the lack of old (and therefore radiogenic) crustal material into/through which the melts have been emplaced limits the possibility of significant contamination. Therefore it is likely that at least some of these radiogenic initial ratios are derived from an enriched mantle source containing recycled crustal material. This may lend support to the proposed recycled origin for the recently documented extreme Os isotope variations in MORB.