5.3.P04

Osmium in the Tonga subduction zone: Slab versus lithosphere

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Recent studies of Os in island arc volcanics revealed striking correlations between $^{187}Os/^{188}Os$ and Os (Ni, Mg) concentrations primarily reflecting assimilation and fractional crystallization (AFC). The Tonga arc is relatively young (<30 Ma), has a thin crust (12 km), and U-series disequilibria studies suggest aqueous solutions are the dominant agents for mass transport and minimal interaction with old lithosphere.It may be less affected by AFC processes than many other arcs. We examined Os concentrations and $^{187}Os/^{188}Os$ ratios for a transect across the Tonga subduction zone to characterize sources and determine fluxes of Os (and PGE).

The 70 m thick pile of pelagic and metalliferous sediments from DSDP Site 596 (1000 km E of the Tonga trench at 24º S) have a weighted Os concentration of 80±45 pg/g and $^{187}Os/^{188}Os$= 0.42±0.15. Pyroclastic sediments from Site 204 (100 km East of the Tonga trench at 25˚ S) have 110±20 pg/g Os and $^{187}Os/^{188}Os$=0.15±0.01. Cretaceous upper altered ocean crust from Site 595 (adjacent to Site 596) reveal 4±2 pg/g Os and $^{187}Os/^{188}Os$=1.6±0.8. Samples from the Tonga forearc are peridotites (~ 4 ng/g Os and $^{187}Os/^{188}Os$=0.128) and boninites (24 pg/g Os, $^{187}Os/^{188}Os$=0.146). Volcanics from the Tonga arc between Tafahi and Tofua range from 0.9 to 14.3 pg/g Os and $^{187}Os/^{188}Os$=0.178-0.506. Lau Basin basalts and andesites vary from 1 to 225 pg/g Os and $^{187}Os/^{188}Os$=0.136-0.699.

Both arc and back-arc samples form AFC-like trends in $^{187}Os/^{188}Os$ vs. 1/Os diagrams, very similar to relationships found in arc volcanics from Mexico, Java, and the Andes. However, Os is not correlated with Ni and Mg. The main arc (Late to Tofua) displays a positive correlation between $^{187}Os/^{188}Os$ and Ba/Nb (also U/Zr and Th/Nb). In contrast, rocks from Tafahi and Niuatoputapu as well as from the Valu Fa Ridge have constant Ba/Nb at variable $^{187}Os/^{188}Os$. The horizontal trend is best explained by crustal contamination, although the Os isotope variability (0.136-0.699) is surprising, given that the lithosphere is young and thin. The co-variation between Ba/Nb and $^{187}Os/^{188}Os$ may indicate that slab-derived Os flux is significant beneath the main arc, although such a model does not account for the systematic $^{187}Os/^{188}Os$ vs. 1/Os relationship without invoking additional fractionation processes. The forearc peridotites are likely affected by slab-derived fluids. If the initial $^{187}Os/^{188}Os$ of the mantle is between 0.120 and 0.125 and the slab-derived fluids have between 10 and 100 ppt Os of the composition of composite 595/596 crust ($^{187}Os/^{188}Os$= 0.76), small fluid fluxes (integrated water/rock ratios of 0.2 to 5) are sufficient to raise the $^{187}Os/^{188}Os$ to 0.128.

5.3.P05

Re-Os isotopes in mantle-derived pyroxenite xenoliths from Hannuoba North China

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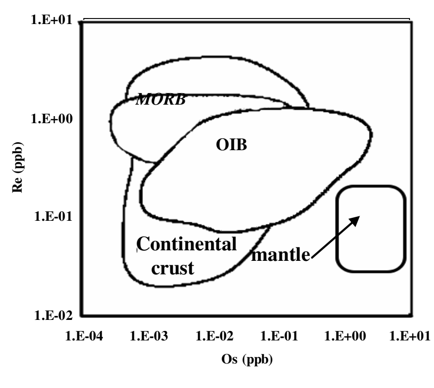
A set of very fresh pyroxenite xenoliths, composed of Al-augite±spinel pyroxenite, Cr-diopside spinel pyroxenite and garnet pyroxenite sampled from Cenozoic alkaline basalts in Hannuoba, North China displays fairly heterogeneous Re-Os isotopic compositions. The Re and Os contents of the samples range from 0.031 to 1.551ppb and 0.126 to 4.163ppb respectively. The $^{187}Os/^{188}Os$ and $^{187}Re/^{188}Os$ ratios vary from 0.1270 to 2.352 and 0.114 to 177.1 respectively. When compared with peridotite xenoliths from Hannuoba and orogenic pyroxenites from Beni Bousera, Ronda, Lanzo, and Lherz etc., the Cr-pyroxenites and three of four garnet pyroxenites have Re and Os contents and isotopic compositions clustering around those of the Hannuoba xenoliths. Almost half of Al-pyroxenites have Re and Os contents similar to those of orogenic pyroxenites, but much lower $^{187}Os/^{188}Os$ and $^{187}Re/^{188}Os$ ratios. However, the $^{187}Os/^{188}Os$ and $^{187}Re/^{188}Os$ ratios of these Al-pyroxenites are larger than those of peridotite xenoliths from the same location. The rest of the Al-pyroxenites have the same range of Re-Os contents as that of Cr-pyroxenites and mantle peridotite xenoliths.

The Cr-pyroxenites and three garnet pyroxenites were formed from asthenospheric melt in multiple stages. The Al-pyroxenites were derived from a mixture of asthenospheric melt and lower crust in various proportions during mantle melt underplating at the Moho boundary.



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