

Slab-sources for halogens (F, Cl, Br, I) in lavas across the Marianas arc

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The concentrations of F, Cl, Br and I were investigated in submarine volcanic glasses recovered from the Southeast Marianas forearc rift, and the Marianas arc and backarc, with the aim of tracking the evolution of slab-fluids across the arc. The glasses range from basaltic to dacitic in composition and contain 90-311 ppm F, 70-1555 ppm Cl, 130-1060 ppb Br and 4-65 ppb I. Halogen concentrations are broadly correlated with MgO (Figure 1, B), showing that much of the variation in halogen concentration is related to crystal fractionation. Therefore, we focus on ratios of elements with similar compatibility that are not altered by crystal fractionation including Br/Cl, I/Cl, Cl/Nb, F/Pr and Ba/Nb etc. Enrichment in fluid-mobile elements such as Ba show the subduction component in most samples is dominated by aqueous slab-fluids, however, two samples show a contribution from slab-melts (Figure 1, A). The forearc and arc glasses are enriched in halogens relative to Nb (Cl/Nb 100-1417; Br/Nb 0.32-369; I/Nb 0.004-0.069; Figure 1, C), indicating metasomatic enrichment of the mantle source by halogens introduced in slab-fluids. The backarc glasses show little enrichment and instead have halogen Nb ratios within the mantle range (Figure 1, C). The glasses have Br/Cl of 1.6×10^{-3} - 3.7×10^{-3} and I/Cl of 8.3×10^{-6} - 127×10^{-6} , that encompass a similar range of compositions as arc and backarc glasses from the SW Pacific [1]. The Br/Cl and I/Cl ratios of the subduction component overlaps altered ocean crust suggesting dehydration of altered ocean crust (\pm lithospheric serpentinites) as the main source of halogens and related slab-fluids (Figure 2). The Br/Cl and I/Cl ratios of the Marianas glasses are much lower than is typical of sedimentary marine pore-fluids and forearc serpentinites in the Marianas forearc (Figure 2). It is therefore unlikely that either pore-fluids or forearc serpentinites significantly contributed to subduction of halogens to sub-arc depths.

1. Kendrick, M.A., et al., *SW Pacific arc and backarc lavas and the role of slab-bend serpentinites in the global halogen cycle*. Earth and planetary science letters, 2020. **530**: p. 115921.

