The noble gas anatomy of a depleted MORB popping glass

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Noble gases in mantle-derived basalts provide a rich portrait of mantle structure, evolution and surface-interior volatile exchange. However, the ubiquitous presence of shallow-level air contamination frequently obscures the mantle Ne, Ar and Xe signal. In a majority of the samples, shallow air contamination dominates Ar and Xe budget. For example, in the unusually gas-rich popping rock 2ΠD43, an E-MORB that has been a cornerstone of noble gas geochemsitry (e.g., [1]), $^{40}Ar/^{36}Ar$ and $^{129}Xe/^{130}Xe$ ratios reach 24,500±1500 and 7.7±0.23, respectively, in individual step-crushes [1]. However, the bulk composition of the sample is close to air ($^{40}Ar/^{36}Ar$ of ~2000 and $^{129}Xe/^{130}Xe$ of 6.7). In some samples, air-mantle mixing can be modeled to estimate the composition of the mantle source; however, most samples do not present favorable mixing systematics. Thus, the extent of variability in mantle source Ar and Xe composition is not well-constrained. Here we present results from a set of experiments designed to understand when and how shallow-level air contamination is added to MORBs.

The KN207-2 sampling expedition between the Kane and Atlantis Fracture Zones in May 2012 recovered a depleted popping glass sample from the Mid-Atlantic Ridge. After cataloguing the sample on board the ship, chunks of fresh glass were sealed in ultrapure N_2 at 5 psi over an interval from 15 minutes to 2 hours after dredge retrieval. We analyzed carbon and noble gases in an aliquot of glass that was sealed 2 hours after dredge retrieval. Ten step-crushes were obtained with 9 yielding $^{129}Xe/^{130}Xe$ of 7.50-7.67 and one yielding 7.3. The bulk $^{129}Xe/^{130}Xe$ of the sample is 7.6, nearly identical to the estimated mantle source value of 7.7 for the sample. We are not aware of measurements on other samples where the bulk Xe isotopic composition of the sample is virtually identical to the mantle source value. Our simple experiment therefore suggests a path forward for dramatically reducing shallow-level air contamination in MORBs. Additional implications of the noble gas data will be presented.

[1] Moreira et al., *Science* **279**, 1998.