Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37255

Near-ridge seamount nitrogen and noble gases derived from diverse mantle sources along the East Pacific Rise

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To assess the origins of volatiles in the mantle beneath the East Pacific Rise (EPR), we present unpublished nitrogen (n = 23) and noble gas (n = 15) abundance and isotope data from near-EPR seamount basalt glasses (of the 8°20’ N seamount chain and Rano Rahi seamount group). Seamount nitrogen isotopes are consistently enriched ($\delta^{15}N$ between -2.68 ± 0.24 and +2.85 ± 0.70‰), relative to depleted MORB mantle (DMM; -5‰ ± 2), indicating pervasive nitrogen enrichment in the sub-EPR mantle. Lavas that are incompatible element enriched (EMORB) were previously shown to have Pb, Sr, and Nd isotopes consistent with recycling. These same samples all yield $\delta^{15}N$ > -0.57 ± 0.85‰, suggesting nitrogen enrichment is related to recycling of subducted materials (oceanic lithosphere and/or sediments). $^{40}Ar/^{36}Ar$ values are only slightly above atmospheric values for all EMORB (≤ 577), indicating EMORB are either largely influenced by post-eruptive atmospheric contamination, or the mantle source for EMORB contains a significant atmospheric argon component, presumably from recycling. By contrast, the more incompatible element depleted lavas (DMORB and NMORB) have a wide range of $^{40}Ar/^{36}Ar$ (327 – 17,500), consistent with mantle-atmosphere mixing. Light noble gas isotopes from northern seamount lavas are more radiogenic (lower $^{3}He/^{4}He$ (5.76 to 9.02 R_A) and higher $^{21}Ne/^{22}Ne_{ex}$ (0.0541 to 0.0623)) than southern seamount lavas (8.17 to 10.51 R_A and 0.0425 to 0.0532, respectively), consistent with published on-axis data, suggesting the southern EPR is influenced by a more primordial mantle than the northern EPR. When combined, these results suggest that recycled volatiles exist along the EPR, and geodynamic processes responsible for sub-ridge mantle heterogeneity differ between the northern and southern EPR. We attribute widespread geochemical variability to the presence of a mantle-wide, deeply-sourced upwelling beneath much of the EPR, the primary difference between north and south being the proximity of the sub-ridge upwelling to the south Pacific LLSVP (which is absent to the north). This large-scale mantle upwelling may draw primordial volatiles from the LLSVP, suggesting that the southern EPR on- and off-axis lavas are being rejuvenated by sources derived from a primitive region of the lowermost mantle, unlike the northern EPR.