No evidence for seawater-derived crustal contamination at Loihi Seamount from trace metal abundances and oxygen isotope ratios

Carrie Welker

ABSTRACT

Loihi Seamount is the youngest Hawaiian volcano. It towers ~3 km above the seafloor to within ~1 km of sea level. A previous study found elevated ($^{234}U/^{238}U$) ratios in sixteen Loihi volcanic glass samples. The expected value of ($^{234}U/^{238}U$) in primary magmas derived from the mantle is 1.000, but seawater's expected value is 1.146. In the Loihi glasses, there were elevated ($^{234}U/^{238}U$) ratios with up to 1% excess ^{234}U. The elevated ($^{234}U/^{238}U$) values in the Loihi glasses were concluded to be from assimilation of hydrothermally altered, uranium-enriched rock within Loihi's volcanic edifice. The uranium must be derived from seawater to account for the ($^{234}U/^{238}U$) ratios > 1.000 in the Loihi glasses.

My research focused on analyses of trace metal abundances and oxygen isotope ratios in the same glass samples to further study the mechanisms of seawater-derived crustal contamination at this submarine volcano. Trace metal concentrations were analyzed using LA-ICP-MS, and $\delta^{18}O$ was analyzed using laser fluorination mass spectrometry. The $\delta^{18}O$ results are all ~5.5‰, which is typical of MORB. Since rocks altered at high temperature are generally expected to have low $\delta^{18}O$ values, this suggests that the process of assimilation did not lead to significant melting of hydrothermally-altered rocks. Trace metals (e.g., Cu, As, Cd, and Pb) become enriched in hydrothermal deposits at Loihi. Thus, elevated abundances of these trace metals in the Loihi glass samples might be a good tracer of crustal contamination. However, these elements are not enriched in the Loihi glasses, and ratios of these elements to Al do not plot on mixing lines towards Loihi hydrothermal deposits. In conclusion, the mechanism of contamination that affects ($^{234}U/^{238}U$) ratios of Loihi glasses is not modifying the $\delta^{18}O$ values or trace metal concentrations.