Trace Metal Dynamics in Shallow Hydrothermal Plumes at the Kermadec Arc

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Hydrothermal vents are a source of many trace metals to the oceans. Compared to mid-ocean ridges, hydrothermal vent systems at arcs occur in shallower water depth and are much more diverse in fluid composition, resulting in highly variable water column trace metal concentrations. During R/V Sonne cruise SO253 in 2016/2017, hydrothermal plumes from two hydrothermally active submarine volcanoes along the Kermadec arc in the Southwest Pacific Ocean were sampled: (1) Macauley, and (2) Brothers. At both volcanoes, results indicated strong plumes of dissolved trace metals, notably Mn, Fe, Co, Ni, Cu, Zn, Cd, La, and Pb, some of which are essential micronutrients. Dissolved metal concentrations commonly decreased with distance from the vents, as to be expected, however, certain element/Fe ratios increased, suggesting a higher solubility of these elements and/or their stronger stabilization. Our data indicate that at the magmatically influenced Macauley and Brothers cone sites, the transport of trace metals is strongly controlled by sulfide nanoparticles, while at the Brothers NW caldera wall site iron oxyhydroxides seem to dominate the trace metal transport over sulfides. Our study presents the first data on several dissolved trace metals in the Macauley system, and extends the existing plume dataset of Brothers volcano. Our data further indicate that chemical signatures and processes at arc volcanoes are highly diverse, even on small scales.