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Removal and supply of trace metals (Fe, Ni, Cu, Zn, Cd, and Pb) in seawater caused by hydrothermal activities of the Izu-Bonin-Mariana Arc

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Trace metals, such as Fe, Ni, Cu, Zn, Cd, and Pb, are nutrients or toxins for marine phytoplankton. In this study, we focus on supply and removal mechanisms of trace metals in seawater caused by hydrothermal activities of the Izu-Bonin-Mariana Arc. Some trace metals are dissolved from bedrock into hydrothermal fluid and subsequently supplied to seawater. On the other hand, some trace metals are removed from seawater by sulfides near hydrothermal vents and by Fe-Mn oxides in hydrothermal plumes. To understand the supply and removal mechanisms of trace metals, we utilized their isotopic composition, which is a powerful tool for estimating the sources and sinks of elements.

We determined concentrations and isotope ratios of Fe, Ni, Cu, Zn, Cd and Pb in hydrothermal fluid samples collected from hydrothermal vents near Higashi Aogashima (32.26° N, 139.55° E) and seawater samples collected near Myojin Knoll (32.06° N, 139.51° E) in the Izu-Bonin-Mariana Arc. In addition, we analyzed seawater samples collected from a station in the western North Pacific (22.50° N, 164.99° E) that is not affected by hydrothermal plumes for comparison. The concentrations and isotope ratios of Fe, Ni, Cu, Zn, Cd and Pb were determined using a novel multielemental isotopic analysis reported by Takano et al [1, 2]. A hydrothermal plume was found at a depth of 800 m above the Myojin Knoll with high concentrations of dissolved Fe and Pb and particulate Fe, Cu, Zn, Cd and Pb, suggesting that these elements were supplied by hydrothermal activities. Dissolved and particulate Ni did not show anomalies in the hydrothermal plume. The isotope ratios of Fe and Pb in the hydrothermal plume were not significantly different between dissolved and particulate phases, suggesting that isotopic fractionation was small during transformation processes between dissolved and particulate phases. In contrast, particulate Cu, Zn, and Cd were isotopically lighter than dissolved species, suggesting that lighter isotopes were preferentially removed as sulfides near hydrothermal vents. We will also report the results of hydrothermal fluid samples.

[1] Takano *et al* (2024), *ACS Earth Space Chem*, in press.

[2] Takano *et al* (2024), *ACS Earth Space Chem*, 8(3), 547-553.