Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31122

Application of lithium, boron and strontium isotopes in hydrothermal vent fluids to identify the factors controlling metal mobilization, transport, and precipitation

SWASTIKA BHAUMIK[1], ANETTE MEIXNER[1], EVA MARIA MECKEL[2], ANDREA KOSCHINSKY[2] AND SIMONE A. KASEMANN[1]

[1]Faculty of Geosciences and MARUM – Center for Marine Environmental Sciences, University of Bremen
[2]Constructor University

Hydrothermal vent systems at the seafloor host large quantities of metal-rich sulphide deposits. A variety of factors influences the mobilization, transport, and deposition of metal sulphide in hydrothermal vents. These include the composition of the host-rock, pressure and temperature conditions, phase separation and magmatic degassing.

The hydrothermal vent fluids from key sites along the northern Mid-Atlantic Ridge (Rainbow, Broken Spur, Menez Gwen sampled during cruise M190) and the Mediterranean Sea (offshore Milos, cruise M192) were analysed for their lithium (Li), boron (B) and Sr (Strontium) signature. Initial results indicate significant variations in isotopic compositions, pointing to the differences in geological settings and fluid pathways. The vent fluids from Rainbow, Broken Spur, and Menez Gwen exhibit isotopic compositions consistent with interaction between seawater and mid-ocean ridge basalts (MORB), whereas those from Milos suggest extensive interaction between fluid and continental crust material.

Li concentration in all the end-member hydrothermal fluids is significantly higher than in seawater. The δ^{7}Li values are approximately 5‰ for vent fluids from Rainbow, Broken Spur, and Menez Gwen, while the vent fluids from Milos exhibit lower δ^{7}Li values. Sr is also enriched relative to seawater in the Rainbow, Menez Gwen, and Milos vent fluids but is depleted in the Broken Spur vent fluids. The $^{87}Sr/^{86}Sr$ ratio varies between 0.7039 and 0.7050, except for Milos, where a higher ratio of 0.7101 is observed. B enrichment differs across the vent sites. Milos vent fluids contain significantly higher B concentrations than seawater, whereas Broken Spur and Menez Gwen exhibit only moderate enrichment. In contrast, Rainbow vent fluids are depleted in B. The δ^{11}B values range between 15‰ and 23‰ for Rainbow, Broken Spur, and Menez Gwen, while Milos vent fluids show comparatively lower δ^{11}B values. While the isotopic systems generally indicate significant interaction between water and rock, we also observe variations between sites that could indicate other processes affecting the fluids, such as mineral precipitation, phase separation, and magmatic gas addition.