Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38100

Sediment Cover as a Fundamental Control on Trace Element Partitioning across Lateral Hydrothermal Sediment Zonation in Paleochori Bay, Milos, Greece

JONATHAN LUBIANTORO[1], FOTINI BOTSOU[2], ARISTOMENIS KARAGEORGIS[3] AND ROY E PRICE[1]

[1]SUNY Stony Brook/School of Marine and Atmospheric Sciences
[2]National and Kapodistrian University of Athens
[3]Hellenic Centre for Marine Research

Fluid-sediment interactions in hydrothermal systems exert strong controls on the mobility, sequestration, and speciation of many major and trace elements (Durán-Toro et al., 2019; Price & Giovannelli, 2017). Shallow-sea hydrothermal systems, which are typically nearshore vent systems occurring at water depths less than 200 m and are highly dynamic, often sediment-covered environments where mass exchange between vent fluids and sediments takes place. While hydrothermal fluids and mineral precipitates have been previously studied in several vent systems (Canet et al., 2005; Nestmeyer et al., 2021; Prol-Ledesma et al., 2010; Voudouris et al., 2021) comparatively little is known about the role of sediments in controlling element enrichments and mass budgets in sediments versus water column.

In Paleochori Bay, hydrothermal fluids discharge through unconsolidated sediments that produce well-defined sediment lateral zonation, from high-temperature (~100 ^{o}C) orange/yellow arsenic-rich sediments, intermediate-temperature (~60 ^{o}C) with white microbial mats, and lower-temperature (~40 ^{o}C) brown Fe-(oxyhydr)oxiderich sediments. Sediment cores were collected along a spatial transect spanning these zones. A multi-step sequential extraction procedure was employed to the sediments from all zones to quantify the acetic acid-soluble, pyrophosphate-extractable, citrate buffered dithionite(CBD)-extractable, and nitric acid-extractable fractions. Trace elements including As, Cu, Ni, Pb, Rb, Sr, Sn, and Zn were quantified using ICP-MS and ICP-OES in sediment extracts.

Results indicate systematic variations in trace element contents and mineral associations across sediment zones. High-temperature sediments are enriched with certain elements, such as As, and Zn, whereas intermediate and lower-temperature zones are enriched with, Ni, Pb, and Sn. Certain elements also show varying degrees of association with different solid-phase fractions, as the transect moves away from high-temperature sediments. Arsenic, Sn, and Zn are extracted in the acid-soluble or pyrophosphate steps and from the CBD or nitric-acid steps in intermediate to lower temperatures.

This study demonstrates that trace element mobility in shallow hydrothermal sediment is controlled by mineral-specific partitioning across different hydrothermal zones. By identifying the dominant solid-phase sinks regulating trace element sequestration, these results establish a framework for predicting trace element mobility and provide a better understanding of both the short-term element fluxes and potentially long-term sequestration in volcanically active coastal ecosystems.