Seafloor sulfide mineral deposition and remobilization

Amy Gartman
U.S. Geological Survey
Pacific Coastal and Marine Science Center
2885 Mission St.
Santa Cruz, California 95060
U.S.A.
agartman@usgs.gov
https://www.usgs.gov/centers/pcmsc/science/global-ocean-mineral-resources

Abstract

Element mobility is the defining feature of seafloor hydrothermal deposits, occurring from the onset of high temperature water-rock interactions, through eventual inactivity and burial. Metals that are mobilized by high temperature fluids at hydrothermal vents may precipitate in the subseafloor, at the seafloor surface as sulfide deposits, or be transported with ocean water in hydrothermal plumes, eventually being deposited in sediments or dissolving into the larger ocean basins. Factors controlling the location of sulfide mineral precipitation include the heat source, the initial chemistry of the fluids, as well as the rate of cooling and mixing with seawater. Although models for mineral saturation exist, recent research demonstrates that poorly understood processes, such as nanoparticle precipitation and colloidal transport can influence the location and timing of metal precipitation[1] and thus predictions of local element enrichment.

Even after deposition from hydrothermal fluids, element mobility within hydrothermal systems continues as sulfide minerals are unstable in contact with oxygen, which permeates deep-ocean water in varied concentrations. Whether the oxidation that occurs as a result of sulfide mineral aging remobilizes the metals within the sulfide minerals, or just changes their mineralogical environment, depends on the mineral in question and the oxidative process it undergoes. An understanding of metal remobilization and loss from oxidizing

sulfide deposits can be gained through integrating experimental results with studies of modern and ancient seafloor deposits. I will discuss element transport in hydrothermal sulfide environments as it leads to mineral formation, local deposition, and transport, as well as element mobility in aging hydrothermal deposits.

[1]Gartman A., Hannington M., Jamieson J.W., Peterkin B., Garbe-Schönberg D., Findlay A.J., Fuchs S. and Kwasnitschka T. (2018) Boiling-induced formation of colloidal gold in black smoker hydrothermal fluids. *Geology* **46**, 39-42.

Keywords: Seafloor massive sulfides, hydrothermal, oxidation, metal mobility

Amy Gartman

Amy is a Research Oceanographer studying marine minerals at the USGS Pacific Coastal and Marine Science Center, where she began as a Mendenhall postdoctoral fellow in 2015. Prior to that she was a postdoctoral researcher at Harvard University's Department of Organismic and Evolutionary Biology, where she studied interactions between microorganisms and metal sulfides. She holds a B.S. in Chemistry from New York University and a PhD in Oceanography from the University of Delaware. Her current research focuses on the formation and dissolution of seafloor minerals with an emphasis on metal sulfides and the role of nano-scale processes contributing to element fluxes. She has been a member of the U.S. delegation to the ISA as a scientific advisor since 2016.