Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.4701

Cu isotope variations in active hydrothermal chimneys along the ultra-slow spreading Arctic Mid Ocean Ridge

APOLLINE MARIA SAMIN[1], EOGHAN REEVES[1], ANDREAS BEINLICH[1], JAMIESON JOHN[2] AND DESIREE L. ROERDINK[1]

[1]University of Bergen
[2]Memorial University of Newfoundland
Presenting Author: apolline.samin@uib.no

Copper isotope ratios ($\delta^{65}Cu$) vary significantly in seafloor black smokers and could be used as potential tracers of ore-forming processes. However, the origin of these variations remains debated. Redox-related processes are the most likely cause of Cu isotope fractionation in low-temperature environments. In contrast, interactions between pre-altered sulfides and fluids are responsible for Cu isotope fractionation in high temperature hydrothermal chimneys [1]. Additionally, Cu isotope fractionation has been predicted between the chloride- and hydrosulfide-complexes of Cu in hydrothermal settings [2, 3]. Better characterizing the importance of each process on the $\delta^{65}Cu$ variations in black smokers is essential to estimate the conditions of sulfide ore formation.

Here, we examine the variations in Cu isotope ratios in active hydrothermal chimneys from the Arctic Mid Ocean Ridge (Norwegian-Greenland Sea), to systematically assess ridge segment-scale Cu isotope variations in a previously unexplored geological setting. Vent fields on this ultra-slow spreading ridge display substantial variation in depth and temperature. We present data from five locations: Seven Sisters (~190°C, 123 m depth) on the Northern Kolbeinsey Ridge; the Jan Mayen vent field Soria Moria (~279°C, 657-719 m) on the Southern Mohns Ridge; Ægir's vent (~280°C, 2313 m) and Fåvne (~265°C, 3026 m) on the Central Mohns Ridge; and Loki's Castle (~305-315°C, 2310 m) on the Mohns-Knipovich bend. The vent fields show a large variation in fluid chemistry and mineral compositions with bulk rock Cu concentrations ranging from 0.003 wt% to 12.7 wt%, likely related to differences in vent temperatures, host rock compositions and influence from sediments. Preliminary SEM data highlight a small scale phase differentiation which suggest the replacement of a chalcopyrite-pyrrhotite assemblage by a second generation of cubanite and Fe-rich sphalerite, which could be responsible for relatively high $\delta^{65}Cu$ compared to unaltered Cu sulfides. We discuss the mineralogy and the Cu isotope composition of these different vent fields.

[1] Rouxel, O. et al., Economic Geology, 2004. **99**(3): p. 585-600.

[2] Fujii, T., et al., Geochimica et Cosmochimica Acta, 2013. **110**: p. 29-44.

[3] Zhong, R., et al., Chemical Geology, 2015. **395**: p. 154-164.