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Copper isotope systematics in seafloor hydrothermal systems: A case study of TAG and Snake Pit fields, Mid-Atlantic Ridge

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Seafloor hydrothermal systems play a significant role in deep ocean metal budgets. Copper (Cu) is a metal of economic interest with potentially toxicity to deep sea biological organisms. Due to its non-conservative property during hydrothermal fluid - seawater mixing, it remains unclear whether hydrothermal vents represent an important local or global source of Cu to the deep ocean. Here we present a comprehensive dataset of Cu isotope composition of high-temperature vents (fluids and sulfide deposits), low-temperature diffuse vents, hydrothermal plume fall-out and metalliferous sediments. This work focuses on samples which were collected in the Mid-Atlantic Ridge, at the TAG and Snake Pit hydrothermal fields during BICOSE 1&2 cruises (Ifremer). At TAG, the combination of major and trace element geochemistry and Cu-isotope values of proximal oxidized sediments (δ^{65}Cu from 0.03 to 0.4‰) compared to high-temperature vent fluids (δ^{65}Cu -0.14 et 0.37 ‰), and plume fall-out materials collected in sediment traps (δ^{65}Cu -0.24 to 0.07 ‰) indicates that quantitative sulfide oxidation within sediments does not impact Cu isotope signatures. Sulfide-rich metalliferous sediments from Moose site (Snake Pit) display Cu isotopic values (δ^{65}Cu 0.50 to 0.85‰) in the range of both high temperature hydrothermal fluids (δ^{65}Cu 0.53 to 1.01 ‰), and chalcopyrite from chimneys (δ^{65}Cu 0.55 to 1.08 ‰). This suggests that Cu-isotpoes are not significantly fractionated from source to sink. However, two sediment cores from Beehive (Snake Pit) show variability of Cu isotopes (δ^{65}Cu -0.17 to 1.37 ‰ and 0.04 to 0.89 ‰) which is interpreted as rapid changes of Cu sources to the sediment rather than post-depositional modification. Study of sediment porewaters further suggest that diagenesis of hydrothermal sediments may represent a significant source of fractionated Cu to overlying seawater.