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Low metal resource potential in seafloor hydrothermal fluids of the Norwegian-Greenland Sea

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Commercial interest in deep-sea mining of seafloor massive sulfide (SMS) deposits in Norway's large maritime jurisdiction is accelerating, as the Norwegian government considers opening *ca*. 592,500 km^2 of deep ocean - including ~1300 km of the ultraslow spreading Arctic Mid Ocean Ridges (AMOR), to mineral exploration in 2023. While ultraslow ridges are arguably promising for generating large Cu-rich SMS deposits [1], little baseline data exists about the ore-forming potential of vent fluids, or geochemical influences on metal mobility, in the many newly explored hydrothermal systems of the Arctic region.

Here we present an overview of abundances of economically relevant metals (*e.g.* Cu, Zn, Co *etc*.) in 16 active vents (38 hydrothermal fluid samples) along over 700 km of Norwegian AMOR jurisdiction collected in 2016–2022, in comparison to associated chimney sulfide deposits. These fluid-solid pairs were collected from 5 systems displaying diverse physicochemical conditions (temperature, depth, salinity, pH, crustal setting/influence): Loki's Castle (299–316°C, sediment-mafic), Fåvne (52–267°C, ultramafic) and Ægir (263–282°C, sediment-mafic), Jan Meyen (242–279°C, mafic) and Seven Sisters (126–190°C, mafic). Dissolved metals were processed to account for precipitate formation [2,3] and quantified using ICP-MS.

Overall, our data imply that the AMOR segments under consideration for mineral exploration, with few exceptions, constitute a province of predominantly Cu-, Zn- and Co-poor vent fluids and associated deposits relative to hydrothermal systems globally. Most fluid Cu concentrations are, for example, orders of magnitude lower than in fluids from well-characterized metal-rich systems (e.g. Manus basin). Cu concentrations in sulfides at most sites average <1 wt.%, with chalcopyrite rare or absent in most deposits. We attribute these low abundances to a combination of insufficiently high temperatures (limited by depth in some cases) and/or low enough pH for substantial metal mobility, the latter reflecting subsurface sediment alteration in several systems. Given the history of extensive sedimentation in this region (a glaciated margin) over the last several Ma, it is unclear if many fossil deposits could have encountered vastly different ore-forming conditions.

[1] German *et al*.(2016), *Chem. Geol.* 420, pp114–126.

[2] Craddock *et al*.(2010), *Geochim. Cosmochim. Acta*. 74, pp5494–5513

[3] McDermott *et al*.(2018), *Geochim. Cosmochim. Acta*. 228,