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Finding Mohn's Treasure: evidence of deep hydrothermal activity at a supposedly extinct seafloor sulfide deposit

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Norway's interest in marine mineral resources, in particular seafloor massive sulfides (SMS), has increased rapidly in the last decade. In 2019, a new "Act on Mineral Activities on the (Norwegian) Continental Shelf" entered into force, steering commercial seabed mineral exploration toward inactive hydrothermal deposits. One such supposed site - Mohn's Treasure, was first discovered by dredging in 2002 at the depth of 2600 m on the flank of the axial rift valley of the Arctic Mid Oceanic Ridge, *ca.* 30 km southwest of the well-known Loki's Castle active hydrothermal field [1]. Since no visible seafloor hydrothermal activity or chemical anomalies were ever detected in multiple geophysical and biological (video) surveys of Mohn's Treasure, it has historically been described as an inactive, fossil, or extinct hydrothermal deposit [1-3]. Given its large areal extent (150x200 m), it is considered a SMS target for the potential opening of commercial mineral exploration in 2023.

In 2022, clear, focused venting of low temperature fluid (*ca.* 38°C) was serendipitously imaged and sampled from a small area at a depth of 2800 m at Mohn's Treasure. Relative to ambient seawater, duplicate samples of this fluid are consistently depleted in Mg (*ca.* 36 mmol/kg), as well as Na and SO_4, implying a mixed/cooled endmember hydrothermal fluid actively vents at the site. The fluid is also enriched in several elements (Cl, Ca, K, Li, B, Sr, Si), with mmolar levels of Alk and CH_4. These chemical characteristics indicate that, in contradiction to the presumed extinct nature of the Mohn's Treasure deposit [1-3], high temperature (>150°C) fluid-rock reactions are actively ongoing at depth beneath the seafloor there. Microbial community analysis also indicates this fluid supports active chemosynthesis at the vent seafloor. Our findings highlight the difficulty in demonstrating a vent field deposit to be truly inactive/extinct [4], in the absence of detailed, fine-scale seafloor exploration and monitoring.

[1] Pedersen *et al*. (2010), *AGU Monograph 188*

[2] Lim *et al*. (2019), *Geochemistry, Geophysics, Geosystems,* 20, 5691–5709.

[3] Ramirez-Llodra et al. (2020), *Frontiers in Marine Science*, 7, 490

[4] Jamieson & Gartman (2020), *Marine Policy,* 117