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Hydrothermal activity in a young ocean – the discovery of six active hydrothermal vent field areas along the Red Sea Rift

FROUKJE M. VAN DER ZWAN[1], ISABEL DIERCKS[2], SVEN PETERSEN[2], SYLVIA G. SANDER[2] AND NICO AUGUSTIN[2]

[1]KAUST - King Abdullah University of Science and Technology
[2]GEOMAR Helmholtz Centre for Ocean Research Kiel

Presenting Author: froukje.vanderzwan@kaust.edu.sa

Seafloor hydrothermal venting occurs along all mid-ocean ridges and forms mineral resources and habitats for chemosynthetic life. Studies of active vents worldwide have increased our understanding of marine biodiversity and life under extreme conditions. The formation of hydrothermal vents in a young ocean, their geological and geochemical characteristics, and subsequent colonization of new hydrothermal vents are, however, still poorly understood. The Red Sea Rift is one of Earth's youngest ocean basins, but also a semi-enclosed and thus particularly interesting for understanding these processes. Despite ample evidence over the last 50 years for hydrothermal activity in the Red Sea based on rock chemistry, extinct chimneys, metalliferous sediments, and high-temperature brine pools[see overview in [1]], the first active hydrothermal vent fields were only discovered in 2022 at the axial Hatiba Mons volcano[2]. This area is one of the largest active hydrothermal areas worldwide, hosting 43 individual fields that surprised by consistently low-temperature venting and high microbes abundance, which seem to be involved in the formation of numerous Fe-Mn-oxyhydroxide mounds[2]. This environment, with high-saline and warm bottom water and the lack of specialized vent fauna, can be potential analog to early Earth's oceans, which opens new frontiers in understanding early life and Precambrian Fe-deposit formation.

In 2023, two more expeditions were carried out with the R/V Aegaeo (KRSE5-1) and R/V Meteor (M194)[3], to explore for other hydrothermal vents along the Red Sea Rift. Here, we present data on five more low-temperature venting areas, each with multiple active hydrothermal vent sites discovered during these expeditions. We compare the six hydrothermal fields distributed along the Red Sea Rift between 17°N and 25°N. The new discovery of active venting along the entire rift will help to understand regional differences and similarities in the vent fields and if this style of venting is typical for the Red Sea.

[1]F. M. van der Zwan et al. (2019) In: Geological Setting, Palaeoenvironment and Archaeology of the Red Sea. Springer

[2]F. M. Van der Zwan et al. (2023) Communications Earth & Environment 4 (1), 496

[3]N. Augustin (2023) METEOR Short Cruise report, M194. GEOMAR Helmholtz Centre for Ocean Research https://oceanrep.geomar.de/id/eprint/59591