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Low-temperature venting and microbial iron deposit formation in the first observed active hydrothermal vent fields in the Red Sea rift

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Hydrothermal circulation of seawater through the crust takes place along all mid-ocean ridges[1] and often forms habitats for chemosynthetic life at locations of venting at the seafloor[2]. Since the discovery of hydrothermal vents[3], studies of active vent fields worldwide have increased our understanding of marine biodiversity and early life under extreme conditions[4]. The evolutionary aspects and colonization processes of hydrothermal vents, however, are still not fully understood[5]. Of particular interest in that respect are young, semi-enclosed oceans such as the Red Sea. Hydrothermal activity along the Red Sea Rift is, so far, only inferred by extinct chimney fields, metalliferous sediments, and a few high-temperature brine pools that are difficult to access. Active venting of hydrothermal fluids has never been directly observed from one of Earth's youngest ocean basins, despite ample evidence for hydrothermal activity[6].

Here, we present the first active hydrothermal vent fields and associated microbial communities ever reported from the Red Sea rift. High-resolution AUV hydroacoustic data revealed one of the largest active low-temperature hydrothermal areas worldwide, consisting of 45 fields, of which ROV seafloor observations confirmed 14. The vent fields consist of numerous Fe-Mn-oxyhydroxide mounds displaying shimmering fluids venting with temperatures up to 40°C. Interestingly, thriving microbial communities dominate the mound fields instead of specialized macrofauna. The composition and microtexture of the Fe-Mn crusts emphasizes the importance of the microbes in forming the hydrothermal mounds. The Red Sea's high saline and warm bottom water conditions together with the lack of specialized vent-fauna create a unique environment for the microbes, potentially analogue to conditions during the early history of Earth. Thus, the discovery of widespread low-temperature hydrothermal venting in the Red Sea opens a new frontier in understanding early life on Earth and the role of microbes in the formation of large Fe-deposits[7].

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