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More than just sulfides... Assessing the global diversity of seafloor hydrothermal systems

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Since the discovery of black smoker-style hydrothermal venting at EPR 21°N in 1979, over 400 sites of high-temperature venting have been found on the seafloor. Venting is now known to occur in all major ocean basins and is associated with the full range of submarine tectonic plate boundary settings, from ultraslow-spreading mid-ocean ridges to continental backarc basins. Vent fields are typically characterized by the formation of metal-rich chimneys and mounds dominated by sulfide and sulfate minerals, and host unique ecosystems composed largely of vent obligate species. Although vent-associated ecosystems were a new discovery, the formation of metal-rich sulfide deposits on the seafloor had been predicted by economic geologists, based on the study of land-based volcanogenic massive sulfide deposits, which occur within ancient, but now exposed, oceanic crust, and are mined for their base and precious metal contents.

With the ever-increasing number of discovered deposits on the seafloor, and a growing body of literature that documents the results of mineralogical, geochemical, and isotopic analyses of rock and fluid samples collected from these sites, there is an emerging understanding of the range of compositional variability between different vent sites and the geological and tectonic controls on this variability. Despite these advances, recent discoveries continue to exceed the known limits of compositional variability. These new discoveries range from sulfur-poor, talc-rich deposits (e.g., Von Damm Vent Field on the Mid-Cayman Spreading Centre or Loki's Castle on the Mohns Ridge) to deposits dominated by primary oxidized mineral assemblages (e.g., the Suye field on the Southwest Indian Ridge). In this presentation, we will discuss this increasing variability of hydrothermal depositional styles and compositions, with a focus on the implications of this variability for our understanding of global submarine hydrothermal chemical budgets, and the mineral resource potential of hydrothermal deposits on the seafloor.