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Characteristics of hydrothermally derived particles from globally distributed deep-sea vent fields

BRANDY M TONER[1], ADRIAN A WACKETT[1], BRANDI R KAMERMANS[1,2], SARICK L MATZEN[1], TUCKER ELY[1,3], ERIC P. ACHTERBERG[4] AND CHRISTOPHER R GERMAN[5]

[1]University of Minnesota-Twin Cities
[2]Northwest Indian College
[3]39Alpha Research
[4]GEOMAR Helmholtz Centre for Ocean Research Kiel
[5]Wood Hole Oceanographic Institution

Presenting Author: toner@umn.edu

Hydrothermal venting occurs in every ocean basin on the planet. The physical and chemical gradients created by the mixing of deep ocean water with vent fluids and near-vent materials generate populations of particles with complex compositions. A subset of these particles have characteristics that promote long-range transport, making them of interest for the delivery of micronutrients - such as iron - to locations where they limit productivity. In this contribution, the past decade of sample-return studies of deep-sea hydrothermal particles will be summarized and data from three new sites will be reported (Figure 1). Particles were collected by in situ filtration, shipboard filtration, and sediment traps from buoyant and neutrally buoyant plumes at differing distances from vents (1 m to 4300 km). The primary data types for this meta-analysis are synchrotron microprobe iron X-ray absorption spectroscopy and diffraction, as well as X-ray and electron microscopy. Together these observations inform the size and morphology of hydrothermal plume particles, the mineralogy of crystalline phases, and phase identification for poorly crystalline iron-bearing phases. Previous findings for three vent fields (East Pacific Rise 9N, East Pacific Rise 15S, and Eastern Lau Spreading Center) will be interpreted within the context of new iron speciation and mineralogical data from Earth's deepest explored hydrothermal field (Beebe Vents, Piccard hydrothermal field), as well as ultramafic-hosted vents of the Mid-Cayman Rise (Von Damm) and Mid-Atlantic Ridge (Rainbow). Common and unique features of plume particles that arise from gradients in water depth, vent fluid temperature, and lithology (basaltic-, ultramafic-, and andesite-hosted) will be discussed. The strengths and weaknesses of the analytical approaches will be evaluated and knowledge gaps will be highlighted.

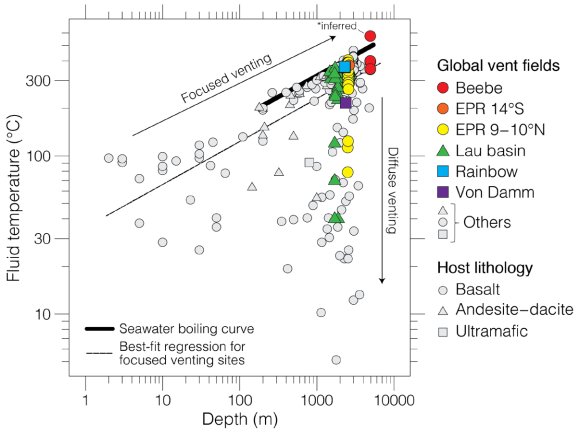

Figure 1. Summary of 304 datasets for sites of deep-sea hydrothermal venting. Vent fields discussed in this contribution are displayed in symbols with color while the host lithology is indicated by symbol shape (circle, triangle, square). Primary data source: InterRidge (accessed Feb 27, 2022).