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Hydrothermal systems and mid-ocean ridge volcanism at East Pacific Rise 9°50'N export dissolved black carbon to the deep ocean

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Dissolved black carbon (DBC), the condensed aromatic fraction of dissolved organic matter, was thought to be formed on land and transported to the deep ocean by rivers. However, isotopic signatures of deep ocean DBC suggest hydrothermal vent systems to be a potential source of this refractory aromatic carbon to the deep ocean. In spring 2025, we traveled to East Pacific Rise 9°50'N to sample hydrothermal vents ranging in temperature, geochemistry, and biological activity. Hydrothermal fluids, rising plumes, and buoyant plumes were sampled using titanium majors, Niskin bottles via *Alvin*, and CTD casts, respectively. DBC was analyzed following the benzenepolycarboxylic acid method. Diffuse flow vents had higher concentrations of DBC (temperature < 50°C; mean DBC = 0.88 μM-C) than focused flow vents (temperature > 300°C; mean DBC = 0.34 μM-C). However, the DBC of rising plumes of hot, focused flow vents were (0.76 μM-C) higher than background seawater (~60 μM-C; *Wagner et al., 2019*) and similar to that of cooler diffuse flows. Low DBC observed for hot fluids suggests hydrothermal circulation either destroys DBC at high temperatures or may be further condensed and precipitated as graphite in vent chimneys. High DBC observed in rising plumes suggests that local biomass may be heated to produce condensed aromatic material at moderate temperatures as venting fluid mixes with background seawater. While on site, East Pacific Rise 9°50'N experienced a volcanic eruption, resulting in a massive megaplume with higher DBC concentrations than the ambient deep ocean (0.79 μM-C). Eruptions along this segment of the East Pacific Rise occur every ~20 years, thus these eruptive events have the potential to release large amounts of refractory DBC. Combined with a steady influx of DBC from diffuse vents and rising plumes, mid-ocean ridge hydrothermal vent systems are a viable source of DBC to the deep ocean and must be accounted for in the broader ocean carbon cycle.

Wagner, S., Brandes, J., Spencer, R. G. M., Ma, K. , Rozengard, S. Z., Maura, J. S., Stubbins, A. (2019) “Isotopic Composition of Oceanic Dissolved Black Carbon Reveals Non-Riverine Source.” *Nature Communications* https://doi.org/10.1038/s41467-019-13111-7.