The chemistry of hydrothermally derived iron in the deep ocean: a particle perspective

BRANDY M. TONER[1], CHRISTOPHER R. GERMAN[2], GREGORY J. DICK[3], AND JOHN A. BREIER[4]

[1]University of Minnesota-Twin Cities; toner@umn.edu
[2]Woods Hole Oceanographic Institution; cgerman@whoi.edu
[3]University of Michigan-Ann Arbor; gdick@umich.edu
[4]University of Texas-Rio Grande Valley; John.Breier@utrgv.edu

Hydrothermal venting occurs in every ocean basin on the planet. The physical and chemical gradients created by the mixing of ocean water with vent fluids creates dynamic changes in the chemistry of many elements, especially iron (Fe). Whether vents are net sources or sinks of elements in ocean budgets depends in large part on particle formation, reactivity, and transport properties. Hydrothermal vent particles have been shown to host microbial communities, and exhibit complex size distributions, aggregation behavior, and composition. In this talk, I will describe how a suite of complementary synchrotron radiation instruments with nano- and micro-meter focusing, X-ray absorption spectroscopy (XAS), and X-ray diffraction (XRD) capabilities are changing our understanding of deep ocean biogochemistry. Hydrothermally derived particles are now known to comprise a stunning array of inorganic and organic phases, from single-crystal Fe-sulfides to poorly-ordered nanophase Fe-oxyhydroxides, and polymeric organic matrices to microbial cells (Toner et al. 2016). X-ray microscopes and X-ray microprobes with elemental imaging, XAS, and XRD capabilities are ideal for investigating these complex materials because they can: (1) measure the chemistry of organic and inorganic constituents in complex matrices, usually within the same particle or aggregate; (2) provide strong signal-to-noise data with exceedingly small amounts of material; (3) simplify the chemical complexity of particles or sets of particles with a focused-beam, providing spatial resolution over six orders of magnitude (nm to mm); (4) provide elemental specificity for elements in the soft-, tender- and hard-X-ray energies; (5) switch rapidly among elements of interest; and (6) function in the presence of water and gases. Synchrotron derived data sets will be discussed in the context of important advances in deep-ocean technology, sample handling and preservation, molecular microbiology, and coupled physical-chemical-biological modeling.

Toner, B. M., German, C. R., Dick, G. J., and Breier, J. A., 2016. *Accounts of Chemical Research* 49, 128-137.

This abstract is too long to be accepted for publication. Please revise it so that it fits into the column on one page.