OCEAN AND EARTH SCIENCES

OLD DOMINION UNIVERSITY

Ph.D. Dissertation Defense

Thursday, May 2 @ 1:00 pm
Old Dominion University
Room: CAVE Auditorium (ECSB 1201)
Norfolk, Virginia
(In-person and Zoom)

HYDROGEN SULFIDE AS A STRONG LIGAND AFFECTING TRACE METAL CYCLING IN THE PACIFIC AND SOUTHERN OCEAN

Nicole Buckley

Chair: Gregory A. Cutter
Committee: Peter N. Sedwick, George W. Luther III

Historically, hydrogen sulfide was considered unimportant in the open ocean since it has primarily been associated with anoxic environments. Yet, in the late 1980s it was suggested that this sulfur gas is also being produced in the oxic, surface ocean through the hydrolysis of carbonyl sulfide (OCS). Since then, several studies have demonstrated that hydrogen sulfide is indeed found in oxic seawater at pico- to nanomolar concentrations due not only to carbonyl sulfide hydrolysis, but also assimilatory sulfate reduction by phytoplankton. Its importance in seawater is largely due to its high metal-ligand stability constants allowing it to affect the cycling of certain trace metals. Although 40 years have passed since its discovery in the oxic open ocean, our understanding of the speciation of dissolved and particulate metal-sulfides is still limited. Therefore, additional work is necessary to further our understanding of the processes affecting hydrogen sulfide speciation in the Pacific and Southern Oceans and the impact that hydrogen sulfide has on the biogeochemical cycling of certain transition metals like cadmium and zinc.
To explore hydrogen sulfide's role in metal cycling in the Pacific Ocean and processes affecting its abundance in the Southern Ocean, novel measurements of sulfide alongside transition metals were used to investigate the dissolved cadmium and zinc sinks observed oxygen minimum zones (OMZs) in previous studies, and a budget was constructed for the upper water column to quantify the extent of hydrogen sulfide complexation with key trace metals. My findings suggest that: (1) the removal of dissolved cadmium and zinc via metal-sulfide precipitation varies regionally within low-oxygen environments and instead plays a larger role in the loss of dissolved cadmium in the oxygenated subsurface, (2) aqueous metal-sulfide complexes, like CdS, ZnS, and PbS, dominate the speciation of dissolved sulfide in the open, Pacific Ocean, (3) phytoplankton production estimates can balance the open ocean sulfide budgets, but not the coastal Alaskan shelf, and (4) in the Southern Ocean, processes affecting hydrogen sulfide concentrations in the upper water column are largely controlled by the temperature dependance on the rate of OCS hydrolysis and the species-dependent nature of production by phytoplankton.

Zoom: For Zoom link email nbuckley@odu.edu