Sedimentary phosphorus cycling along an oxygen gradient in the Arabian Sea: Insights from sequential extractions and X-ray spectroscopy

PETER KRAAL[1]*, CAROLINE P. SLOMP[1], GERT-JAN REICHART[1] AND BENJAMIN C. BOSTICK[2]

[1]Department of Earth Sciences – Geochemistry, Utrecht University, Budapestlaan 4, 3508 TA, Utrecht, The Netherlands (*correspondence: p.kraal@geo.uu.nl) (slomp@geo.uu.nl, reichart@geo.uu.nl)

[2]Lamont-Doherty Earth Observatory, Columbia University, Palisades NY 10964, USA (bostick@ldeo.columbia.edu)

Benthic phosphorus (P) cycling was studied along a water depth and oxygen gradient on the flanks of the Murray Ridge in the northern Arabian Sea. The transect covers sites from within to well below the oxygen minimum zone (OMZ), which is located between 150 – 1200 m. Sedimentary P speciation was determined both with sequential extractions and spectroscopy (X-ray Absorption Near Edge Structure). Elevated organic C/P ratios in sediments from within the OMZ compared to oxygenated sediments at greater water depth suggest enhanced regeneration of P from organic matter under low oxygen conditions. Porewater and sediment chemistry demonstrate a strong sink-switching from organic and Fe-bound P to authigenic Ca-P phases in low oxygen settings within and directly below the OMZ. At oxygenated deep water sites, low pore water phosphate concentrations do not allow for formation of authigenic apatite. The results show that organic-rich sediments overlain by dysoxic bottom waters can effectively sequester P through authigenic apatite formation. Hence, these sediments can constitute an important long-term sink for P despite the enhanced recycling of P from organic matter under low-oxygen conditions. Insight into the mechanisms and dynamics of P authigenesis in low oxygen settings is of importance for an accurate understanding of the global marine P cycle.

Mapping Mercury vulnerability of aquatic ecosystems across the contiguous United States

DAVID KRABBENHOFT, NATHAN BOOTH, MICHAEL N. FIENEN AND MICHELLE LUTZ

Wisconsin Water Science Center, U.S. Geological Survey, 8505 Research Way, Middleton, WI 53562 (dpkrabbe@usgs.gov, nlbooth@usgs.gov, mnfienen@usgs.gov, malutz@usgs.gov)

About 20 years ago, researchers at a few locations across the globe discovered high levels of mercury in fish from remote settings lacking any obvious mercury source. We now know that for most locations atmospheric deposition is the dominant mercury source, and that mercury methylation is the key process that translates low mercury loading rates into relatively high bioaccumulation levels in aquatic food webs. Presently, almost all US states have advisories for elevated levels of mercury in sport fish, and as a result there is considerable public awareness and concern for this nearly ubiquitous contaminant issue. In some states, 'statewide' advisories have been issued because elevated fish mercury levels are so common, or the state has no effective way to monitor tens of thousands of lakes, reservoirs and wetlands. As such, resource managers and public health officials have limited options for informing the public on of where elevated mercury concentrations in sport fish are more likely to occur than others. This project provides, for the first time, a national map of predicted (modeled) methylmercury concentrations, which is the most toxic and bioaccumulative form of mercury in the environment. The map is the result of over two decades of research that resulted in the formulation of conceptual models of the mercury methylation process, which is strongly governed by environmental conditions – specifically hydrologic landscapes and water quality. National-scale trends are clearly apparnet from the modeling results, with the Gulf and Atlantic coastal plains, the northeast, lower Mississippi Valley, and the upper Midwest lakes region having the greatest predicted methylmercury concentrations.