

Middelburg and Levin have done a very good job of reviewing what happens to sediment biogeochemistry as coastal hypoxia occurs over various temporal scales. They aptly demonstrate that the system is also not at steady state. Their review is well presented and discusses in a concise way their two main goals (1) to show how oxygen affects sediment biogeochemistry and organisms and (2) to explore the dynamics and response of biogeochemistry to hypoxic events.

Middelburg and Levin review the basic chemistry of reduced and oxidized species that are produced or consumed during organic matter decomposition as well as secondary redox reactions that occur in sediments. They also discuss the various microbes that affect these reactions and how these reactions affect the sedimentary community structure. They also discuss benthic – pelagic coupling as reduced waters with reduced metabolites such as hydrogen sulfide are brought to the surface by upwelling or storm events.

They also discuss the possible recycling of metals such as Fe and Mn in the sediments on controlling biogeochemical processes and the metals involvement with the oxidation of sulfide as well as the reaction of sulfide with Fe to form iron sulfide phases. I thought that they could have also mentioned the reaction of sulfide with organic matter which has been shown to be substantial in certain environments (e.g., the work of Bruchert, Ferdelman, Francois) but which has been studied less. Any process which can uptake sulfide is of interest in stabilizing the sedimentary environment. In fact, the preservation of sedimentary organic matter appears related to organo-sulfur formation which may be most important when sediments undergo alternating oxic-anoxic conditions as intermediates in sulfide oxidation (e.g., polysulfides, elemental sulfur and thiosulfate) can be more reactive with organic matter than hydrogen sulfide. I do appreciate that Middelburg and Levin recognize the importance of alternating oxic-anoxic conditions both in the form of physical events and of bioturbation in influencing sediment biogeochemistry and community structure. They do a very good job of discussing bio-irrigation and particle mixing.

Middelburg and Levin review the consequences of nutrients such as ammonium and phosphate and reduced materials such as Fe(II), Mn(II) and hydrogen sulfide getting into the overlying water column. It is here where hydrogen sulfide gets oxidized if there are no severe physical processes which transport it to the surface where it can affect fish and surface dwelling (micro)organisms. I thought that they could have been more explicit as they reviewed the work of others who have shown that catalytic Mn or Fe cycles (Konovalov et al, 2003; Ma et al, 2007) in suboxic zones are important to the oxidation of sulfide. These cycles usually prevent hydrogen sulfide from reaching the surface waters.

Middelburg and Levin discuss that secondary eutrophication also occurs when phosphate enters overlying waters. To date there are few studies that show the change in community structure of surface waters when nutrients are brought to the surface after upwelling or storm events. However, it seems that the predominance of harmful algal blooms in coastal and estuarine waters around the world are related to exactly this type of benthic –

pelagic coupling. This has been shown in a paper by Ma et al (2006) in Inland Bays. I think that such consideration or speculation is warranted in their review.

Overall I applaud the conclusions, which they provide in their review and which show that we need to worry about coastal hypoxia and sediment biogeochemistry as this relationship can affect the chemistry and the biology of shallow water columns as well. Long lasting hypoxia could have significant economic impacts as both the fishery and shellfishery industries may be negatively affected.