Does the redox cascade apply to permeable sediments?

PERRAN L.M. COOK[1]*, VICTOR EVRARD[1], MICHAEL BOURKE[1] AND RONNIE N. GLUD[2]

[1]Water Studies Group, School of Chemistry, Monash University, Melbourne, Australia (*perran.cook@monash.edu)
[2]Nordic Center for Earth Evolution, University of Southern Denmark, Odense, Denmark.

The redox cascade is a well-established paradigm that allows us to describe the sequential use of electron acceptors by microbial communities to oxidise organic matter. Sediment redox environments can be highly variable ranging from aerobic to anaerobic and back to aerobic on the timescale of minutes. The redox environment in permeable sediments is likely to be particularly variable, driven by sediment movement (re-suspension) and varying currents which can oscillate redox conditions on the timescale of minutes, hours and days. There have been no studies on the latent capacity of microbial communities or their short-term (hours –days) shifts in metabolism as the redox environment changes.

Understanding this dynamic is particularly important because it has implications for key redox reactions of global importance such as denitrification. In this talk we present the results of flow through reactor experiments on the ability of microbial communities to mineralize carbon and use electron acceptors other than oxygen over time scales of hours to days. Of key interest, our results have shown that microbial communities are able to rapidly switch to denitrification on times scales < 1 h, however this pathway can only account for a small fraction of the electron sink required for the observed rates of carbon mineralisation, pointing to the importance of the simultaneous use of other electron acceptors.

The role of natural organic matter in membrane perturbation: A model biomembrane system approach

R.L. COOK[1]* AND L.M. OJWANG'[1]

[1]Department of Chemistry, Louisiana State University, Baton Rouge, LA, 70803, USA
(*correspondence: rlcook@lsu.edu)

Natural organic matter (NOM) is an important component of earth's ecosystems. It is known to play a major role in biogeochemical (including redox) processes and pollutant bioavailability (and subsequent toxicity), to name just two. There are conflicting reports in regards to the ability of NOM to either lower or raise the bioavailaibility of pollutants. To understand these conflicting findings a mechanistic understading is needed in terms of how NOM interacts with biomembranes. In order to make the system as simple as possible, only passive processes will be studied using of phospholipid vesicles. Our initial studies focused on the effects of pH, NOM concentration, and temperature on the ability of different humic acids to perturb the model biomembrane systems by utilizing fluorescence leakage experiments. Subsequently, wideline ^{31}P NMR was employed to investigate how the model biomembrane was being perturbed [1]. From these studies a two-step adsorption/absorption mechansim was proposed by which NOM induced biomembrane perturbation. This proposed mechanism was then further tested by kinetic studies which, in addition to supporting the proposed adsorption/absorption mechanism, also indicated two distinct components of the absorption step. Finally, the chemical components within the humic acids responsible for the perturbation of the model biomembrane system were investigated with the aid of chemically modified humic acids.

[1] Elayan *et al*. (2008) *Environ. Sci. Technol.* **42**, 1531-1536.

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