Biogeosciences Discuss., 12, C1811–C1812, 2015
www.biogeosciences-discuss.net/12/C1811/2015/

Biogeosciences
Discussions
Open Access

Interactive comment on "Redox regime shifts in microbially-mediated biogeochemical cycles" *by* T. Bush et al.

T. Bush et al.

t.bush@sms.ed.ac.uk

Received and published: 29 April 2015

We appreciate the thoughtful comments of Professor Algar.

We agree that the example of redox regime shifts in the nitrogen cycle is worth some further discussion. It is true that in the environment nitrate is often in the range of the half saturation constants for the nitrogen cycle (∼10 micromolar nitrate), and that this may actually make redox regime shifts unlikely in these environments. Our reason for suggesting that the nitrogen cycle may be susceptible to redox regime shifts is that there are many examples of environments where anthropogenic influences such as agricultural run-off can lead to very high concentrations of nitrate – for example, eutrophic lakes or potentially aquifers impacted by nitrate. We refer to the following EU report.

http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Groundwater_nitrate_concen
27,_EFTA,_Candidate_and_Potential_Candidate_Countries_.png

The limit of 50mg/L nitrate set in the report represents ∼800 micromolar nitrate, and there appear to be a good number of drinking water aquifers above this level in Europe. In such ecosystems, redox regime shifts in the nitrogen cycle may be likely (given that the half saturation constant with respect to nitrate is ∼10 micromolar nitrate). We suggest including some extra discussion in the paper, explaining that we would expect redox regime shifts in the nitrogen cycle to occur in eutrophic terrestrial ecosystems, such as lakes or groundwater aquifers, and not necessarily the ocean.

With regards to redox regime shifts in response to rising oxygen and early Earth iron cycling, we are pleased that Professor Algar finds this idea interesting, and believe that this is worthy of a detailed exploration. However, such a detailed discussion may be beyond the scope of the present publication. The literature on the topic is extensive and discussing this point in detail may require a separate paper. For example, a future model could demonstrate whether a redox regime shift is possible within the range of published values for atmospheric oxygen, and oceanic Fe and sulfate on the early Earth taking into account the evidence for the progressive changes in these parameters through geologic time, from the Palaeoproterozoic to the Phanerozoic.

Interactive comment on Biogeosciences Discuss., 12, 3283, 2015.