Si stable isotope evidence for ecosystem engineering as driver for the Late Neoproterozoic ocean oxygenation

MICHAEL TATZEL[1*], FRIEDHELM VON BLANCKENBURG[1], MARCUS OELZE[1], JULIEN BOUCHEZ[2] AND DOROTHEE HIPPLER[3]

[1]Helmholtz-Centre Potsdam GFZ, German Research Center for Geosciences, Germany
[2]Institute de Physique du Globe Paris, France
[3]Institute of Applied Geosciences, Technische Universität Graz, Austria
*correspondence: mtatzel@gfz-potsdam.de

The oxygen content of the world's deep ocean basins increased significantly in the Late Neoproterozoic (e.g. [1]). The trigger of this fundamental change in sea water redox state [2], and its link to animal evolution [3], are subject to competing hypotheses. A common view holds that atmospheric oxygen initially built up through increased supply by photosynthesis accompanied by decreased rates of organic carbon oxidation (e.g. [4]). The alternative view suggests that the ocean was oxygenated through the introduction of 'filter-feeding' by sponges [2] [5] which reduced levels of dissolved and fine particulate organic matter.

In the well-preserved cherts and siliceous shales from the Ediacaran-Cambrian Lijiatuo section (South China) we used stable isotopes of silicon to distinguish between inorganic and biogenic Si precipitation in chert. The results indicate that the abundance of sponges increased over the Precambrian-Cambrian boundary. Cerium anomalies and the concentrations of phosphorus and barium further reveal that ocean oxygenation occurred simultaneously. The potential widespread colonisation of the continental slopes by siliceous sponges thus exhibit that 'ecosystem engineering' by sponges led to rising oxygen concentrations in deeper ocean basins and as a consequence to the foundation of the Phanerozoic marine ecosystem.

[1] Scott, C. et al. (2008), *Nature* **452**, 456–459. [2] Lenton, T. M. et al. (2014), *Nat. Geosci.* **7**, 257–265. [3] Mills, D.B. & Canfield, D.E. (2014), *BioEssays* **36**, 1145–1155. [4] Des Marais, D.J. et al. (1992), *Nature* **359**, 605–609. [5] Erwin, D.H. & Tweedt, S. (2012), *Evol. Ecol.* **26**, 417–433.