The evolution of burrowing fauna triggered a low-oxygen ocean and global warming

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Most of the present-day oxygenated seafloor is colonised by fauna. Animal movement and feeding has a major effect on the sedimentarey biogeochemical cycles. We are starting to understand the effect of burrowing on modern-day sediments, but it is still unclear what the long-term effects are for the global biogeochemical cycles of carbon, oxygen, sulphur and phosphorus.

Here we present a combination of *in situ* observations and diagenetic modelling results. Bioturbation stimulates the oxygen uptake of the sediment, decreases organic carbon burial and promotes phosphate burial. Furthermore, re-oxidation of reduced iron sulphides is stimulated, thereby promoting sulphur recycling. Modelling results indicate that these effects already occur at burrowing depths of the same magnitude that were present at the beginning of the Cambrian explosion.

We apply these present day observations to a long-term box model of the geochemical evolution of the early earth. Results show that animal colonisation of the seafloor in the Early Palaeozoic significantly affected the global cycles of carbon and oxygen. The evolution of shallow burrowing contributed to a global low-oxygen state, which prevailed for ~100 million years until the evolution of land plants caused a rise in atmospheric O_2 towards modern levels. Additionally, enhanced sedimentary phosphorus retention limited primary production, which led to an expansion in ocean anoxia, while decreased carbon burial allowed atmospheric CO_2 levels to rise, giving rise to global warming.

Keywords: modelling; bioturbation; global biogeochemical cycles; evolution