The evolution of shallow bioturbation: An empirical study of the implications for enhanced phosphorus burial in marine sediments

KATHERINE A. DOYLE[1], SIMON W. POULTON[1], ROBERT J. NEWTON[1], VICTOR N. PODKOVYROV[2] AND ANDREY BEKKER[3]

[1] Earth Surface Science Institute, University of Leeds, LS2 9JT, UK
[2] Institute of Precambrian Geology and Geochronology, Russian Academy of Sciences, St. Petersburg 199034, Russia
[3] Department of Earth Sciences, University of California, Riverside, CA 92521, USA

Phosphorus (P) is generally considered the ultimate limiting nutrient for oxygen production via organic carbon burial over geological timescales. Modelling studies have suggested that the emergence of shallow bioturbation in the Ediacaran may have exerted a strong influence on organic P fixation in sediments. However, this hypothesis has not been empirically tested, and it is possible that geochemical feedbacks only became significant with the widespread development of deep burrowing in the Silurian. To address this, an adapted version of the P speciation "SEDEX" method for ancient sediments has been applied to a sedimentary succession spanning the Cryogenian-Ediacaran Periods (~850-542 Ma) from the southern Timan region of Northern Russia. The Kel'tminskaya-1 drillcore documents the evolution of ocean redox as well as the emergence of bilaterian animals during this period. Protistan assemblages are recorded in the ferruginous, anoxic waters of Tonian-Cryogenian age. A transitionary interval of fluctuating redox preserving ornamented microfossils occurs before the emergence of more stably oxygenated continental shelves and the advent of the Ediacaran biota *Kimberella*.

The current study provides enhanced insight to P cycling through the measurement of the individual pools of P which make up total P: Fe-bound P, authigenic P, detrital-bound P, magnetite-bound P, crystalline Fe-bound P and organic P. In this presentation, we will report data to evaluate the hypothesis that P burial was increased as a result of the evolution of shallow bioturbation, by assessing changes in the nature of P burial throughout the succession. Such a feedback would, in turn, promote enhanced stability of oxic water column conditions, with clear links to biological evolution.