

A novel marine phosphorus record from Jurassic belemnites

MS. AILSA C. ROPER¹, CLEMENS ULLMANN², CRISPIN
T.S. LITTLE¹, SIMON W. POULTON³, PAUL B. WIGNALL¹,
TIANCHEN HE³ AND ROBERT J NEWTON³

¹School of Earth and Environment, University of Leeds

²University of Exeter

³University of Leeds

Presenting Author: eacro@leeds.ac.uk

Determining changes in marine nutrient cycling throughout Earth's history is key to understanding periods of environmental change, as well as the functioning of Earth's systems. Phosphorus is considered to be the limiting marine nutrient over geological timescales and has also been identified as a potential driver of oxygen depletion in ancient oceans. Despite its importance, obtaining direct information on spatial and temporal variations in phosphorus concentration has proved challenging. Recent work has determined that analysis of phosphorus in biogenic carbonates can be used to investigate changes in water-column phosphorus concentration [1]. Building on this approach, we have explored using belemnites, an extinct group of nektonic molluscs with an internal calcite skeletal structure called the rostrum, as a monitor of water-column phosphorus concentration.

We have developed a method to quantify phosphorus in belemnite guards and applied this method to samples from multiple sites in the European Epicontinental Seaway (EES) from the upper Sinemurian to the Toarcian in the Lower Jurassic. Occurring in this time period were several major environmental events including an icehouse event in the Pliensbachian and a warming event in the Toarcian, the latter coinciding with widespread reduced oxygen conditions in the EES (the Toarcian Ocean Anoxic Event [TOAE]), as well as a second order mass extinction.

We will present carbonate-associated phosphorus records from three different locations in the EES. Records in belemnite calcite are indicative of changes in water-column phosphorus concentration, with high levels of phosphorus potentially a factor in driving dysoxic to anoxic conditions in the EES during the TOAE. Data from sections in Yorkshire and north Wales suggests that dissolved phosphorus concentrations were low in the latest Pliensbachian and just prior to the TOAE, followed by a sharp increase during the TOAE, with high concentrations sustained for several million years after the event. These trends will be compared to new data from south-eastern Europe sections from the margin of the Tethyan Ocean.

[1] Dodd, Zhang, Li, Algeo, Lyons, Hardisty, Loyd, Meyer, Gill, Shi & Wang (2021) *Geochimica et Cosmochimica Acta* 301, 48-69.