

Ferruginous shelf conditions perturbed the nitrogen cycle during the Late Permian extinction event

METTAM C.*¹, ZERKLE AL.¹, CLAIRE MW.¹,
JUNIUUM CJ.², TWITCHETT RJ.³

¹School of Geog. & Geosci., University of
St Andrews, UK *correspondence: cwm2@st-
andrews.ac.uk

²Dept. of Earth Sci., Syracuse University, NY, USA

³Dept. of Earth Sci., Natural History Museum,
London, UK

High-resolution geochemical and ichnofacies records from two localities in East Greenland reveal diverse conditions on the margins of the Boreal Ocean during the latest-Permian transgression and extinction. At Fiskegrav, where sediments were deposited in a terrestrially-influenced shallow-shelf embayment, macrofossils disappear before the onset of anoxic and ferruginous conditions, as revealed by Fe-speciation and $\delta^{34}\text{S}_{\text{pyrite}}$ data. Intermittent recolonization of the sea bed by bioturbators - in slightly coarser-grained horizons - is ascribed to the delivery of relatively O_2 -rich water from near-shore settings by gravity-driven processes, a hypothesis supported by TOC:TN and TOC:Al data indicating fluctuating sediment provenance. Bulk $\delta^{13}\text{C}_{\text{org}}$ values decrease as macrofossils disappear followed by episodic fluctuations reflecting variations in terrestrial input. Recorded $\delta^{15}\text{N}_{\text{bulk}}$ values increase from the base of the section up to the extinction level, likely due to increasing input of inorganic NH_4^+ in terrigenous clays - as indicated by TOC:TN ratios that fall below Redfield minima for marine organic matter. Above the extinction horizon, $\delta^{15}\text{N}_{\text{bulk}}$ fluctuations are coupled to changes in TOC:TN ratios. Where TOC:TN ratios are > 4 we detect ^{15}N -depleted $\delta^{15}\text{N}_{\text{bulk}}$ values, implying increased N_2 fixation under nitrate-limited conditions. At Kap Stosch, some 100km further north and closer to open ocean depositional settings, Fe-speciation and $\delta^{34}\text{S}_{\text{pyrite}}$ data indicate consistently anoxic, ferruginous conditions. These geochemical data coupled with facies observations provide a fascinating insight into the Late Permian shelf environment of northern mid-latitudes, suggesting that ferruginous conditions were widespread except in the very shallowest settings, and that nitrate limitation may have been an additional environmental stressor impacting marine life.