What controlled the redox landscapes and benthic ecosystems of the Ediacaran?

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The global Ediacaran landscape was highly variable and heterogeneous at a basin scale, but the controls on local redox and how this relates to the distribution and ecology of the oldest complex ecosystems is not clear.

We present schematic representations of redox zonation for key Ediacaran-early Cambrian basins based on compiled iron speciation and cerium anomaly data. We place data within shelf to basin transects, incorporating sequence stratigraphy and palaeodepth and then use palaeogeographic reconstructions to interogate local redox variations due to changes in relative sea level as well as longer-term trends potentially related to cratonic positioning.

Whilst neighbouring East European Platform and Western Avalonia share a similar transition to dominantly oxic, lower slope conditions after the Gaskiers Glaciation, all other regions indicate highly variable redox. Here, water column stratification in restricted and open shelf environments persisted up to, and in some cases beyond, the Precambrian-Cambrian boundary. Whilst anoxia at depth was usually characterised by ferruginous conditions, the variably restricted to open slope environments of the Yangtze platform, China, were frequently driven to euxinia.

Intermittent incursions of ferruginous anoxia triggered by marine transgressions likely proved detrimental to Ediacaran metazoan reef building, which is recorded only from mid-ramp positions in the Nama Group, Namibia, where oxygenated waters were otherwise long-lived.

We further show how the distribution and elemental chemistry of early carbonate cements may offer evidence for highly fluctuating redox over ecological timescales, which in turn may have structured the ecology of long-lived communities. We propose that the Cloudina reefs of the Nama Group grew by the colonisation of successive communities whose growth was terminated by the cyclic influx of dolomitising, anoxic waters during minor transgressions.