Global ocean anoxia during ancient 'greenhouse' climates: Prospects for a warming world

M. O.CLARKSON[1], C. H.STIRLING[2], H. C.JENKYNS[3], I. R.COOKE[4], A. DICKSON[5] AND S. K. GANGL[6]

[1]matthew.clarkson@otago.ac.nz
[2]cstirling@chemistry.otago.ac.nz
[3]hughj@earth.ox.ac.uk
[4]irc5zb@virginia.edu
[5]alex.dickson@earth.ox.ac.uk
[6]ganso923@student.otago.ac.nz

Phanerozoic Oceanic Anoxic Events (OAEs) represent severe perturbations to the Earth climate system that result in extreme chemical changes in the oceans and are commonly associated with extinction events. Proxies indicate widespread de-oxygenation of the water column during these discrete intervals that may be global in extent, however the feedback processes involved in OAE development are not completely understood. In particular, the recent discovery of the Plenus Cold Event, defined by a short-term return to cooler climates and potentially more oxygenated conditions during OAE2 (Cenomanian–Turonian), raises questions on the stability of anoxic conditons.

Here we present new high-resolution $^{238}U/^{235}U$ ($\delta^{238}U$) data from classically defined OAE2 sections (Eastbourne, South Ferriby and Furlo) to gain an insight into the global development of anoxic conditions. The fractionation of U is strongly redox dependent, whereby the heavier phase is sequestered into organic-rich sediments under anoxic conditions, driving the water-column $\delta^{238}U$ signature toward lighter values. This water-column signature is incorporated into carbonates and can be analysed by MC-ICP-MS. Due to the long residence time of U in the oceans, $\delta^{238}U$ potentially provides a record of global deoxygenation.

We compare the new record of $\delta^{238}U$ with other redox-sensitive elements (Mo, Fe and S), that show different redox responses and oceanic residence times, in order to understand the chemical evolution of the global oceans. In combination with published records for temperature (Mg/Ca and TEX_{86}) and weathering (Li, Sr and Ca isotopes) we are better able to characterize the global carbon cycle during these extreme perturbations.