Do uranium isotopes of marine limestones provide evidence for seawater anoxia as a common driver for Phanerozoic mass extinctions?

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Widespread marine anoxia has been implicated in 4 of the 'big 5' Phanerozoic mass extinction events. Evidence for anoxia as the main extinction driver has been based on lithologic, biologic, or geochemical tracers which record local redox conditions. To test the hypothesis that *global* marine anoxia coincided with mass extinction events, we analyzed U isotopes ($\delta^{238}U$) from marine limestones across 3 of the big 5 extinctions.

The Late Ordovician mass extinction was studied at Anticosti Island, Canada, the Late Devonian Kellwasser (KW) extinction events at Devil's Gate, Nevada, and the end-Permian extinction at Daxiakou, South China. $\delta^{238}U$ trends from the Late Ordovician signal a rapid negative shift (more reducing conditions) coincident with the onset of the second extinction pulse; these low values continue through the peak Hirnantian glaciation and into the early Silurian deglaciation. $\delta^{238}U$ trends from the Late Devonian record a gradual negative isotopic shift coincident with the lower KW event, and higher isotopic values (more oxic conditions) during the upper KW event. These trends suggest that anoxia as the driver for the upper KW extinction was limited to epeiric seas rather than global Late Devonian oceans. $\delta^{238}U$ trends during the Middle Permian through Early Trissic show a large, abrupt, negative shift coincident with the end-Permian extinction event and continuing into the Early Triassic supporting previous Tethyan $\delta^{238}U$ records.

These data, combined with recent results from the Triassic-Jurassic mass extinction[1], highlight the value of $\delta^{238}U$ in marine limestones as a globally integrated seawater redox proxy and that extensive seawater anoxia was a common factor for 4 of the big 5 Phanerozoic mass extinctions.

[1] Jost et al. (2017), G^3 18, 3093-3108.