Thallium isotopic evidence for widespread oceanic anoxia associated with the late Silurian Lau extinction event

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The late Ludlow Lau-*kozlowskii* extinction (LKE) is the largest biotic event in the Silurian with anachronistic facies and faunal turnovers reminiscent of the 'big five' Phanerozoic mass extinctions. The LKE is coincident with the beginning of a global carbon cycle perturbation, the Lau positive carbon isotope excursion (CIE). We propose that widespread anoxic conditions, including the expansion of euxinia (sulfidic water column), were a primary driver for the marine extinction event. Concurrent positive excursions in carbon and sulfur isotopes suggest an increase in the global burial of organic matter and pyrite likely due to an expansion of euxinic conditions. We present a multi-proxy data set (C, S, Tl isotopes & Fe speciation) detailing paleo-redox conditions before, during, and after the Lau CIE by examining both shallow-water carbonate platform strata and coeval deeper, basinal mudstones. From the mudstone facies, iron speciation data suggests that local redox conditions were reducing for some time prior to the onset of the Lau CIE.

Thallium isotopes have recently been recognized as a global proxy to track marine bottom-water oxygen conditions in the geologic record for short (~million year) climatic events. Organic-rich, reducing sediments faithfully record seawater thallium isotopes. Thus, isotopic excursions, for short-term events, are driven by changes in the magnitude of global manganese oxide burial which is closely linked to bottom water oxygen content. Preliminary data documents Tl isotopes are perturbed prior to the positive carbon and sulfur isotope excursions. This suggests deoxygenation of the global ocean coincident with the Lau-*kozlowskii* extinction event which is prior to widespread organic carbon burial and onset of sulfidic conditions. Thus, an expansion of oceanic deoxygenation prepared the Earth system for a cascade of environmental perturbations that included a major extinction event.