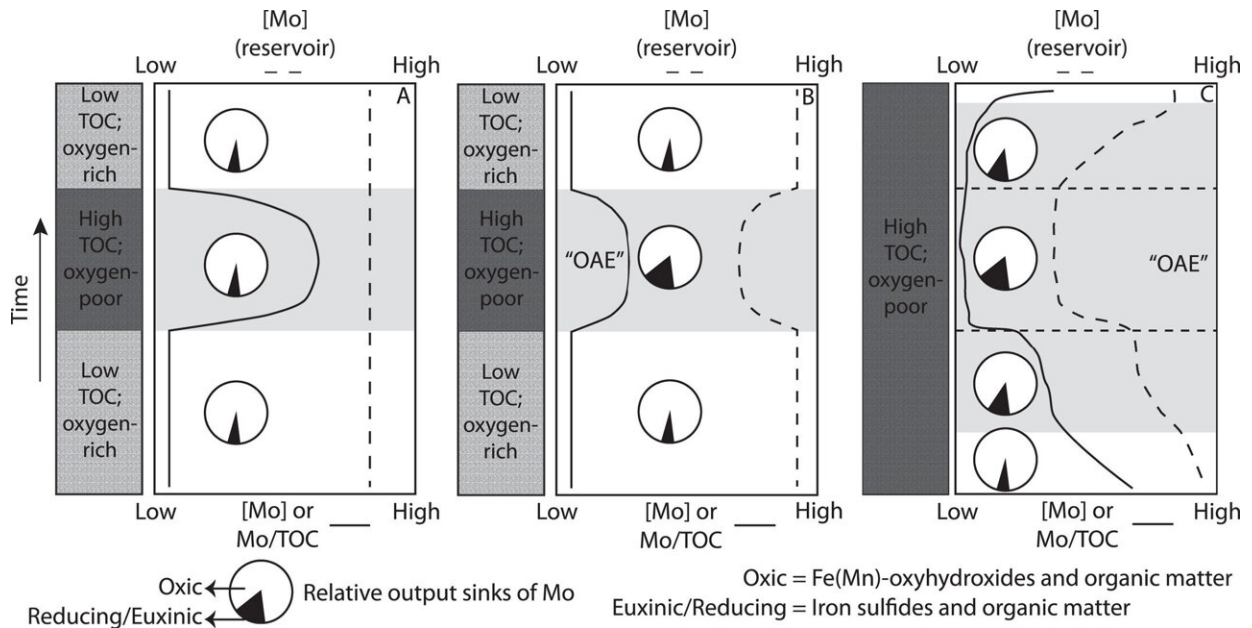


Researchers find decrease in crucial trace element preceded ancient mass extinction

November 22 2022, by Bill Wellock



Idealized molybdenum (Mo) and Mo/total organic carbon (TOC) systematics in the marine realm. The bottom panel (solid line) represents local Mo concentrations and Mo/TOC values measured from fine-grained, siliciclastic-dominated sedimentary succession. The top panel (dashed line) represents the global marine Mo reservoir. The pie chart represents the relative contribution of oxic and reducing environments with respect to burial of Mo within the global ocean. (a) In this non-Oceanic Anoxic Event (OAE) scenario, anoxic, organic matter-rich sediments are sandwiched between oxygenated, organic matter-poor sediments. Locally, sedimentary Mo values increase during anoxic sedimentation, but there is little to no change in the marine Mo reservoir because anoxia and organic carbon (OC) burial is not widespread. (b) In this OAE scenario, anoxic, organic matter-rich sediments are deposited between

oxygenated, organic matter-poor sediments. Locally, sedimentary Mo values increase only slightly during anoxic sedimentation, and there is a synchronous decrease in the global marine Mo reservoir size because anoxia and OC burial is widespread. (c) In this OAE scenario, anoxic, organic matter-rich sediments are deposited during the entire study interval in an open-ocean (Cariaco-like) basin. Locally sedimentary Mo values decrease as Mo and OC burial increases before the classic OAE interval. After the OAE interval, local sedimentary Mo values begin to increase and the global Mo reservoir begins to recover as widespread sedimentation under anoxic conditions decreases. *Note that these idealized TM records come from fine-grained, siliciclastic-dominated sediments as the proxy has not been calibrated for limestones. Furthermore, in these idealized records, low-TOC intervals are associated with oxygenated settings, whereas high-TOC intervals are associated with anoxic settings. In reality, both low- and high-TOC sediments can be deposited in either redox regime, and it is necessary to generate ancillary local redox proxies (e.g., iron speciation) to distinguish between them. It is also important to note that Mo chemostratigraphy from highly restricted depositional environments (e.g., T-OAE Yorkshire record) may be similar to Scenario C, thus constituting inappropriate evidence for interpreting global changes in marine chemistry. Credit: *AGU Advances* (2022). DOI: 10.1029/2022AV000671

A decline in the element molybdenum across the planet's oceans preceded a significant extinction event approximately 183 million years ago, new research from Florida State University shows.

The decrease may have contributed to the [mass extinction](#), in which up to 90% of species in the oceans perished, and it suggests that much more organic carbon was buried in the [extinction](#) event than had been previously estimated. The work is published in *AGU Advances*.

"This research tells us more about what was happening with molybdenum during this extinction event, but we also take it a step further," said Jeremy Owens, an associate professor in FSU's

Department of Earth, Ocean and Atmospheric Science and a paper co-author. "Our findings help us understand how much carbon was cycling through the system, and it's much larger than previously thought—potentially on the scale of modern atmospheric and oceanic increases due to human activities."

Previous research showed decreases in molybdenum during the main phase of the ancient mass extinction, but it was unclear how widespread the decrease was, how early it started or how long it lasted.

To answer those questions, the researchers analyzed rocks from three sites in Alberta, Canada, which had been part of a massive ocean that surrounded the ancient continent of Pangea. Because the site was connected to that global ocean, the researchers were able to infer conditions across the entire globe, instead of only a single basin.

They found new estimates for the start and duration of the molybdenum drawdown and the initial phase of deoxygenation. Their research showed that the decrease preceded the start of the extinction by about one million years, and it lasted about two million years in total, which is much longer than scientists had previously estimated.

The decrease in molybdenum also implies a massive increase in organic carbon burial in the ocean that may have been several times larger than previous calculations. Those calculations were based on estimations of carbon dioxide released from [volcanic activity](#), implying that [carbon dioxide release](#) from volcanoes was actually much higher, which would be necessary to balance global carbon reservoirs.

Just like 183 million years ago, more and more [carbon dioxide](#) is being added to the Earth system today, which could reduce marine trace metals such as molybdenum that many organisms rely on for survival as the oceans lose oxygen and bury more [organic carbon](#). After the ancient

[extinction event](#), global conditions gradually became more hospitable to life, but that process took hundreds of thousands of years.

"The uniqueness of the study sites has allowed us to take a deep look into how the chemistry of the [global ocean](#) changed across millions of years, which reconciles much of the current scientific debates that are focused on the local versus global aspects of this time interval," said Theodore Them, a former postdoctoral fellow at FSU who is now an assistant professor at the College of Charleston.

More information: T. R. Them et al, Reduced Marine Molybdenum Inventory Related to Enhanced Organic Carbon Burial and an Expansion of Reducing Environments in the Toarcian (Early Jurassic) Oceans, *AGU Advances* (2022). [DOI: 10.1029/2022AV000671](https://doi.org/10.1029/2022AV000671)

Provided by Florida State University

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