A study of sulfur and carbon isotopes for understanding environmental changes in the Ordovician-Silurian extinction event

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The end-Ordovician mass extinction was the first of the “Big Five” mass extinctions in the Phanerozoic and the first that affected animal-based communities. This event was likely related to the glaciation of Gondwana; however, the exact mechanisms that led to widespread death are still unclear. The elevated extinction rates were accompanied by a positive carbon isotope excursion. Therefore, not only climatic cooling or a major sea level drop can be related to this mass extinction, both of which are directly connected to glaciation, but also a major perturbation of the global carbon cycle may have been involved. However, it is very difficult to draw conclusions about what actually happened in the oceans only from carbon isotope data. Therefore, a multi isotope approach should be applied in order to understand paleoenvironmental change in oceans around the end-Ordovician mass extinction event.
In this study, isotope ratios and concentrations of carbon and sulfur were analyzed for Upper Ordovician to Lower Silurian shale at the Langkawi Islands in Malaysia. The results revealed that the carbon/sulfur ratio (wt%/wt%) varied periodically from less than 1 to ~30. Such periodical variation was interrupted by the position of the positive carbon isotope excursion. Such excursion was accompanied by C/S ratios of less than 0.1, lower than the minimum values during the periodical variation. This means that the depositions of organic carbon and pyritic sulfur occurred in highly anoxic oceans that might have contained hydrogen sulfide in the water column. At the onset of the end-Ordovician mass extinction, which can be characterized by the carbon isotope excursion, highly anoxic waters containing hydrogen sulfide likely expanded to shallow oceans where sand deposition occurred.

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