Geochemical reconstruction of paleoceanographic conditions during Mississippian Limestone deposition

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To reconstruct the depositional environment of widespread carbonate formation during the Mississippian, it is crucial to understand the paleoceanographic conditions during deposition, that is the seawater composition and redox conditions of the water column. Carbonate associated sulfate (CAS), can be applied as a proxy for the isotope composition of seawater sulfate at the time of carbonate formation [1]. As proxies for productivity and paleoseawater conditions trace metal composition has previously been successfully applied in shales [2, and references therein], however, such data are, limited for carbonate deposits.

Here we investigate Mississippian limestone deposits from southwest Missouri, United States. Samples were taken along a horizontal, and three vertical transects from the St. Joe Group. We analyzed the samples for the isotope composition of CAS and their trace metal content. The trace metal analyses were carried out on the bulk rock fraction of the mudrock sample as well as the carbonate fraction, applying a modified leaching procedure [after 3], using inductively couple plasma-mass spectrometry. The trace metal data were calculated and compared as total content and on carbonate-free basis.

Our results show a good correlation of CAS sulfur isotope values and concentrations along a lateral transect over hundreds of meters (with sulfate average of 459 ppm and a mean $\delta^{34}S_{CAS}$ value of 20.39 ‰). Low contents of redox-sensitive trace metals concurrent with a good Al correlation point to deposition under oxic conditions. Cadmium values follow 3rd order stratigraphic trends and thus likely mirror changes in seawater composition related to sea-level fluctuations and consequently variations in productivity.

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