

80-3 - THE APPLICATION OF CALCIUM ISOTOPES TO UNDERSTAND
THE EFFECTS OF DIAGENESIS ON CARBON ISOTOPE TRENDS IN
ANCIENT CARBONATES: AN EXAMPLE FROM THE EARLY
MISSISSIPPIAN

Monday, 10 October 2022

8:35 AM - 8:50 AM

506 (Colorado Convention Center)

Abstract

A +5‰ to +7‰ $\delta^{13}\text{C}$ excursion is preserved globally in lower Mississippian strata (ca. 353 Ma). This is linked to a cooling interval as part of a long-term shift from greenhouse to icehouse conditions at the onset of the Late Paleozoic Ice Age. It is thought to represent increased primary productivity and organic carbon burial, possibly linked to the rise of land plants. However, investigating the burial of organic matter using the recorded $\delta^{13}\text{C}$ in carbonates remains unclear because of potential diagenetic alteration of marine bulk carbonate $\delta^{13}\text{C}$. Diagenesis can decouple shallow platform $\delta^{13}\text{C}_{\text{carb}}$ from the primary dissolved inorganic carbon (DIC) of the global ocean (or decouple $\delta^{13}\text{C}_{\text{carb}}$ from platform DIC, if different from the global ocean). This study pairs $\delta^{44/40}\text{Ca}$ data with Sr/Ca and $\delta^{13}\text{C}$ to examine the potential effects of fluid or sediment buffered diagenesis on $\delta^{13}\text{C}$ in bulk carbonate. The $\delta^{44/40}\text{Ca}$ and Sr/Ca measured in carbonates are also sensitive to the primary mineralogy (calcite or aragonite), thus influencing how we interpret these proxies.

We measured $\delta^{44/40}\text{Ca}$ and Sr/Ca of bulk carbonate across this stratigraphic interval in samples from the Confusion Range, Utah, Pahrangat Range, Nevada, and Dinant Basin, Belgium. Clumped isotopes were also measured for the Confusion Range section (conodont alteration index, CAI = ~1.5–2.0) but measured temperatures in the bulk carbonates were too high to indicate fluid or sediment buffered diagenesis, and instead indicate solid state reordering has occurred. Initial results show that the average $\delta^{44/40}\text{Ca}$ value from the excursion peak ($\delta^{13}\text{C}$ of +5‰ to +7‰) is -1.16‰ (relative to seawater; n=6, 2SD=0.06‰). The average $\delta^{44/40}\text{Ca}$ value for baseline $\delta^{13}\text{C}$ (0‰ to +1‰) is -1.14‰ (n=2, 2SD=0.04‰). Thus, preliminary data show no covariation between $\delta^{44/40}\text{Ca}$ and $\delta^{13}\text{C}$ or $\delta^{44/40}\text{Ca}$ and Sr/Ca. Using the Ahm et al. (2018) diagenetic model, our $\delta^{44/40}\text{Ca}$ and Sr/Ca data indicate predominantly sediment buffered diagenesis if aragonite was the primary mineral and seawater $\delta^{44/40}\text{Ca}=0$ ‰. These results suggest the $\delta^{13}\text{C}$ excursion of up to +7‰ is not an artifact of diagenesis. However, it is unclear if the $\delta^{13}\text{C}$ excursion represents global seawater DIC, changes in shallow shelf DIC, or a combination.

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