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Evaluating the effects of diagenesis on the $\delta^{13}C$ and $\delta^{18}O$ compositions of carbonates in a mud-rich depositional environment: A case study from the Midland Basin, USA

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ABSTRACT

Marine carbonate $\delta^{13}C$ and $\delta^{18}O$ values are commonly utilized as indicators of past climate and are thought to record primary seawater conditions. However, these minerals can be altered following deposition and burial, overprinting the primary signal to reflect subsurface conditions. Whereas the influence of post-depositional alteration is widely understood in carbonate-dominated sediments (Swart, 2015), the influence has not been as widely studied in mud-rich settings. This study analyzed the carbonate $\delta^{13}C$ and $\delta^{18}O$ values from carbonate intervals in the Late Pennsylvanian Wolfcamp D shale unit in the Midland Basin to evaluate the impact of post-depositional alteration on the interpretation of stable isotope compositions of carbonates in a mud-rich depositional environment. Here we show the importance of using multiple indicators to fully evaluate the impact of post-depositional alteration on the interpretation of the marine carbonate $\delta^{13}C$ and $\delta^{18}O$ values in mud-rich environments. The extent of diagenesis in the Wolfcamp D was primarily controlled by fluctuations in benthic redox chemistry, which controlled sulfate reduction and the preservation of organic matter. These processes influenced the extent of carbonate cementation in the bacterial sulfate reduction zone and during deep-burial, making the carbonates unreliable for intra-basinal correlations. The results of this study were incorporated into a conceptual model that can likely be applied as a framework for other studies in mud-rich depositional environments.