Mg and Ca isotope signatures of authigenic dolomite

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Authigenic carbonates are capable of generating anomalous carbon isotope values in marine sediments, but their contributions to ancient sedimentary sections are difficult to assess. In this study of dolomite from the Monterey Formation of offshore California, Mg and Ca isotopes are shown to vary with stratigraphic depth as they respond to early diagenetic processes. The relationship of δ^{26}Mg and $\delta^{44/42}$Ca to traditional δ^{13}C and δ^{18}O measurements represents a new geochemical tool for identifying authigenic carbonates in the geological record.

The dolomite of the Miocene-age Monterey Formation occurs as beds and nodules throughout the organic-rich, predominantly siliceous sequence. The dolomite is an early diagenetic (pre-compaction) phase, with δ^{13}C ranging from –16 to +9‰. Light δ^{13}C values were likely acquired from the sedimentary zone of microbial sulfate reduction and heavy δ^{13}C from the zone of methanogenesis. Mg and Ca isotopes are roughly anti-correlated, with intervals of negative δ^{13}C associated with low δ^{26}Mg and high $\delta^{44/42}$Ca excursions that yield distinctly different values than primary marine carbonate.

The data can be explained either by variation in Mg and Ca isotope fractionation factors associated with changes in precipitation rate, or by changes in the depth distribution of dolomite formation within the sediment column. Regardless of the underlying mechanism, these data suggest that Mg and Ca isotopes can provide unique insights into the formation of authigenic carbonates which complement preexisting datasets of C and O isotope variability.