Coupling platform dolomitization with basinal evaporative deposition: A new approach for tackling the Messinian salinity crisis

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Abstract

Studies based on stratigraphy and geochemistry suggest that basinal gypsum deposits and platform dolomites in Nijar Basin, adjacent to the Western Mediterranean, were formed in hypersaline brines during the Messinian salinity event (ca. 5.9–5.3MA). A working model proposes that the same brine that formed from seawater evaporation in the Nijar Basin, precipitated gypsum in the basin center and dolomitized the carbonates on the platform. Gypsum fabrics and lithofacies plus elevated $\delta^{34}S$ and $\delta^{18}O$ suggest that gypsum was precipitated from a redox stratified brine in a water body ranging from a few tens to > 100 meters deep. The proposed research is to test this model by measuring $\delta^{15}N$ and $\delta^{18}O$ and $\delta^{34}S$ and $\delta^{18}O$ values from dolomite-associated NO_3 and SO_4, respectively. The samples to be analyzed have already been collected from the field. The idea being tested is that if the platform dolomites precipitated from the same brine, they would have similar $\delta^{34}S$ and $\delta^{18}O$ values to the basinal gypsum. The incorporated NO_3 in dolomites may have $\delta^{15}N$ and $\delta^{18}O$ characterized by a stratified environment, i.e., elevated values. The research will be applied to other marginal and deep basins in the Mediterranean region, as the proposed research results in publishable datasets from the carbonates and evaporates, and potentially provides a new approach for tackling the Messinian salinity crisis. For instance, if basinal brines in the region were able to reach the platform and dolomitized Ca carbonates, then the Mediterranean Sea might have maintained a relatively deep-water body during the Messinian salinity crisis, rather than repeated desiccation. If so, a global sea level change alone could have caused the isolation and evaporative event in the Mediterranean. The analytical methods to be developed for measuring $\delta^{15}N$ and $\delta^{18}O$ from carbonate-associated NO_3 in the Stable Isotope Laboratory can be applied to future research on other carbonates, and could benefit other research projects at Lamont-Doherty.