RE-CALIBRATING THE SR-ISOTOPE CURVE OF THE MESSINIAN SALINITY CRISIS IN THE MEDITERRANEAN

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Abstract
Based on the age model put forward by the CIESM in 2008 a new Strontium ($^{87}Sr/^{86}Sr$) isotope curve for the Messinian salinity crisis (interval 6.5 Ma to 5.2 Ma) has been obtained plotting the available data from the literature and new data obtained from various regions of the Mediterranean area during the last years.
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Isotope geochemistry based on $^{87}Sr/^{86}Sr$ ratio have been used during the last decades to reconstruct the hydrological changes affecting the Mediterranean Sea during the Messinian salinity crisis ([1], [2], [3], [4]).
Unfortunately, the age models adopted for the calibration of these data appear not sufficiently accurate and not well stratigraphically constrained.

Following the new age model put forward by the CIESM consensus report ([5], [6]) and its successive refinements ([7], [8]) the strontium isotope data ($^{87}Sr/^{86}Sr$) available from the literature have been re-plotted, from 6.5 Ma to 5.2 Ma, together with new data obtained from various regions of the Mediterranean area during the last years.

According to the two-steps/three stage stratigraphic model ([5], [6]) the Messinian salinity crisis can be split into three main hydrological stages sharing different isotope trends.

Stage 1 (5.96-5.6 Ma)
The first stage, dominated by $CaSO_4$ evaporites, corresponds to the deposition of Primary Lower Gypsum (PLG). Most of the samples yield non-oceanic Sr isotope ratios with several exceptions that plot within coeval oceanic waters suggesting an evaporite basin dominated by continental waters that received significant marine recharges ([9]).
This stage was characterized by selenite precipitation in small and moderately deep (< 200 m), periodically oxygenated basins, and deposition of organic-rich, barren shales and dolostones in larger, deeper basins characterized by oxygen-depleted seafloors. Evaporite facies and isotope characteristics suggest precipitation from a relatively homogenous Atlantic-fed water body with a partially reduced outflow with a significant contribution of continental waters.

Stage 2 (5.6-5.55 Ma)
The second stage, mainly characterized by $CaCo_3$-NaCl-K salts, is characterized by a maximum Sr isotope data dispersion ranging from the global ocean field to lower values.
This phase marks the MSC acme and was triggered by a combination of pan-Mediterranean tectonic and climatic factors which caused a drastic reduction of the Atlantic connections and a possible short-lived blockage of the Mediterranean outflow, leading to salt and evaporitic carbonate precipitation during the TG14-TG12 interval.

Stage 3 (5.55-5.33 Ma)
The third stage, characterized by $CaSO_4$ evaporites, saw the deposition of the Upper Gypsum (UG) and Lago Mare sediments and is characterized by overall lower values of strontium isotope ratio than the coeval oceanic waters. Furthermore, the lower portion of this interval (Stage 3.1) is characterized by a depletion-upward trend, whereas the upper portion (Stage 3.2) is characterized by lower and less dispersed values.
UG selenite precipitation occurred from a large, residual water body only partially connected with the Atlantic. Surface waters sporadically undergoing progressive dilution due to a change in the precipitation regime and periodic inflow of evaporated continental waters. Tectonic quiescence and more generalized subsidence, also comprising the delayed effects of salt loading, were responsible for the progressive reestablishment of full connections with the Atlantic and the final Zanclean flooding.

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