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Nd and Pb isotopic Mediterranean overflow water signature in the Gulf of Cadiz over the Mio-Pliocene boundary.

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Marine gateways play a major role in ocean circulation and therefore climate. Currently, it is thought that there was no significant Mediterranean Overflow Water (MOW) in the Gulf of Cadiz during the Messinian Salinity Crisis (MSC) in the Late Miocene. However, a connection has supplied the Mediterranean with enough salt to precipitate the extensive evaporates preserved across the basin. After the MSC, the Mediterranean overflow was re-established through the Straits of Gibraltar. Today, MOW follows the continental slope of the Iberian Peninsula at a depth of 500-800 m in the Gulf of Cadiz northwards. In this study, lead and neodymium isotopes are used as water mass tracers for Mio-Pliocene MOW and NE Atlantic water in the Gulf of Cadiz. Complementary biostratigraphic data, carbon and oxygen isotopes and trace elements are presented alongside to corroborate our findings.
Here we present a detailed authigenic Fe-Mn oxyhydroxide-derived Pb and Nd isotope records extracted from ∼5.85 - 4.0 million year old bulk sediments recovered in IODP Core U1387C in the Gulf of Cadiz (current water depth 559 m). MOW and NE Atlantic waters have different Nd and Pb isotopic characteristics allowing for the identification of bottom water mass provenance changes and mixing proportions at the core site. The properties of the water bodies during the given time period are defined by Fe-Mn crust and marine sediment signatures. We also examine the natural variability within a single precession cycle. In order to confirm that the bulk sediment data indeed reliably reflects the primary composition of the bottom water masses, several bulk sediment samples are compared to foraminifera-derived Nd isotopic compositions.
Results from the Messinian show a trend from isotope compositions that are more typical for MOW towards compositions more typical for the NE Atlantic. Subsequently, this trend reverses. After this, around 5.6 Ma an abrupt shift from MOW to more NE Atlantic characteristics is visible. The last abrupt switch is mainly visible in the lead isotopic record. The first trend may bear evidence for the presence of Mediterranean water in the Gulf of Cadiz at the same time of the deposition of the Lower Evaporites precipitation in the Mediterranean basin. The abrupt change to more Atlantic values around 5.6 Ma, during the deposition of the Upper Evaporites in the Mediterranean, could reflect a change from a two-layer flow gateway system with a MOW to a one layer inflow of Atlantic water in the Mediterranean.
Mediterranean-Atlantic exchange through the Straits of Gibraltar, is thought to have been established after the MSC. No geochemical record of MOW is known immediately after the opening of the Straits. The radiogenic records may reveal the timing of Pliocene MOW and a strengthening at ∼4.2-4.5 Ma at the same time of the onset of the contourite depositional system in the Gulf of Cadiz.