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Cyclicity and 87Sr/86Sr stratigraphy of the Primary Lower Gypsum of the Adriatic sub-basin (Italy): insight into oceanic-continental water mixing in the Mediterranean during the early stage of the Messinian salinity crisis

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During the Messinian stage, the Maiella area was part of the Adriatic foreland domain of the Apennine orogenic system. Westward of the present Maiella Mts (Queglia-Morrone-Alfedena) a W-dipping ramp characterized the connection between the Apennine foredeep basin (Marsica–Laga Mts basin), to the west, and the Adriatic foreland domain, to the east (Maiella Mts). The Maiella area was affected by the Apennine orogeny starting from the Early Pliocene.
The Messinian interval of the Maiella succession is characterized by deposits related to the Messinian salinity crisis (MSC), mainly Primary Lower Gypsum (PLG), which pass up-section, above a spectacular erosional surface (Messinian erosional surface, MES) to barren shales and carbonates. Above a younger erosional surface (MES2) marls with Paratethyan ostracofauna (late Messinian Lago-Mare event) predate the Early Pliocene flooding of the Mediterranean area, responsible for the deposition of bathyal clays just above oligohaline marls with Paratethyan ostracods.

In the Maiella area, the PLG rests conformably above Messinian shallow-water (40-50 m depth) marine clays and marls, sedimented in anoxic conditions. Down-section these anoxic deposits pass to open marine Turborotalia multiloba-bearing marls (Messinian p.p.), which lie on carbonate ramp deposits (Lithothamnium limestones, Tortonian p.p.-Messinian p.p.) containing a rich-Heterostegina level close to the base (middle Tortonian). From this Tortonian-Messinian 145 m-thick section, 69 samples have been collected for 87Sr/86Sr analysis. These include 6 samples from the pre-evaporitic deposits (Lithothamnium limestones, Turborotalia multiloba-bearing marls, and anoxic clays and marls) and 63 samples from the PLG, which are arranged in 19 precessional-forced sapropel/gypsum cycles. From the PLG, different facies have been sampled: selenite, banded-selenite, branching-selenite, gypsarenite, gypsum laminite, and microbial limestone. 87Sr/86Sr values, which range between 0.708674 to 0.709000, show cyclical variations even in the same precessional cycle. At the bottom of the section (9.5 Ma, middle Tortonian) 87Sr/86Sr values plot on the global ocean 87Sr/86Sr curve, whereas up-section in the late Tortonian-Messinian interval, they show departures from the 87Sr/86Sr seawater curve. The major shifts from the global ocean 87Sr/86Sr values are at about 6.0 Ma (just before the onset of the MSC), 5.93 Ma, and 5.86 Ma. Except for three gypsum/sapropel cycles (1st, 3rd, and 7th), which show values similar to the global ocean water, the rest of the PLG precessional-forced cycles are characterized by lower 87Sr/86Sr values.

The departure of the measured values from the 87Sr/86Sr global curve could be explained with frequent mixing of continental water with the seawater of the Adriatic sub-basin approaching the closure of the Gibraltar Strait and the onset of the MSC. Because drainage basins in the region encompass Mesozoic carbonates, in the Maiella area we could expect continental run-off with isotopic riverine input between 0.7076 to 0.7077. The major shifts from the 87Sr/86Sr global curve in the Maiella section, at about 6.00 and 5.93 Ma (0.708720 and 0.708674, respectively) could be linked either to riverine outflow increase or to minor inflow of oceanic water into the Mediterranean Basin during temporary closures of the global ocean gateway.