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# Diachronous flooding in the Mediterranean region at the end of the Messinian salinity crisis

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In the Mediterranean region, the early Pliocene marks the restoration of open marine conditions after the severe and prolonged Messinian salinity crisis. Recently, using well-known variations in the relative abundance of *Globigerinoides* spp. and the succession of early Pliocene bio-events recorded in several land sections in northern Italy, it was possible to establish a new stratigraphic framework for the late Miocene - early Pliocene. The obtained stratigraphy indicates that the re-establishment of marine conditions after the Messinian crisis was not synchronous over the Mediterranean basin and that the Lago-Mare environment continued to persist in some areas during the earliest Pliocene.

To compare the depositional record of the Mediterranean area with that of other locations (ODP Sites 846 and 1006), and to relate the early Pliocene history of the region to global environmental changes, samples from ODP Site 653, recovered in the Tyrrhenian basin, and from two land sections in southern and northern Italy (Roccella Jonica and Ricco', respectively) were investigated for stable oxygen and carbon isotope composition of planktonic and benthic foraminifers.

No hiatus has been observed between the Lago-Mare sediments and the marine deposits, implying that sedimentation was continuous at all studied sections. The $\Delta\delta^{18}$O and $\Delta\delta^{13}$C, calculated as the difference between planktonic and benthic foraminifer isotopic values, are here used as environmental proxies. $\Delta\delta^{18}$O and $\Delta\delta^{13}$C minima appear synchronously, but while $\Delta\delta^{18}$O minima appear at regular intervals, $\Delta\delta^{13}$C minima are less frequent. These isotopic minima events, related to periods of global

cooling, indicate a vigorous mixing of the water column. $\Delta\delta^{18}O$ maxima, on the other hand, represent periods of stratification of the water column and correlate with warm climate and global sea level rises. During some of these intervals, marine waters reached the sections where the Lago-Mare environment persisted at the beginning of the Pliocene, and in some regions of the basin, sapropel-like layers were deposited.

Based on these events, it was possible to identify 2 different flooding stages in the early Pliocene history of the Mediterranean region: during the first stage (5.33 to 5.15 Ma), right after a global sea level rise (TG5, 5.33 Ma), open marine conditions were re-established in the deepest areas of the basin but not all locations were reached by marine waters (i.e., sections in northern Italy). Stable oxygen isotopes indicate a trend towards warmer surface waters. The second stage, which is marked by a major flooding (T7 - T5, 5.15 - 5.1 Ma) and by the appearance of deep Atlantic benthic foraminifers, possibly represents the initiation of the 2-way communication between the Mediterranean basin and the Atlantic Ocean through the strait of Gibraltar, 230,000 years after the initial flooding at the Miocene/Pliocene boundary. As suggested by the oxygen and carbon isotope records, events of strong stratification of the water column became more frequent during this second stage.

Finally, even though tectonic causes cannot be ignored, the new isotopic records from the Mediterranean area indicate a causal link between early Pliocene paleoenvironmental events, which followed the end of the Messinian salinity crisis, and climate-driven eustatic changes, as recorded at other locations around the globe.