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What controlled the Mediterranean Sea level during the Lago-Mare stage of the Messinian salinity crisis?

Daniel Garcia-Castellanos[1], Hanneke Heida[1], Dan Palcu[2], and Vanni Aloisi[3]
[1]CSIC - Geo3BCN, Barcelona, Spain (danielgc@geo3bcn.csic.es)
[2]Utrecht University
[3]Institut de Physique du Globe de Paris

Stratigraphic and geochemical evidence suggests that the Mediterranean Sea underwent widespread salinization and a kilometer-scale evaporative drawdown between 5.97 to 5.33 million years ago, during the period known as the Messinian salinity crisis (MSC). The mechanisms responsible for the accumulation of one million cubic kilometers of salt on the sea floor and the impact on terrestrial and marine fauna and on climate are being better understood in the last decades. However, the presence of relatively fresh water sediment containing fossil fauna of eastern (Paratethyan) provenance in the last stages of the MSC poses severe problems to understand the ending of the crisis. These brackish-water deposits, known as the Lago-Mare unit, are sometimes found at elevations close to the present sea level, in apparent contradiction with the coetaneous evaporitic sediment found in deeper, central parts of the Mediterranean.

We make use of landscape evolution models calibrated with sediment transport and river incision data to explore plausible scenarios of climate and sea level changes during the MSC. The results show that, upon full isolation, the large initial evaporative sea level fall of the Mediterranean leads to a progressive capture of the waters from nearby lacustrine basins such as the Black Sea or the Pannonian Basin. This drainage area expansion triggers a gradual sea level rise in the Mediterranean. Milankovic climate oscillations superimposed to this trend lead to large-amplitude (500-1000 m) harmonic sea level variations reaching ever-higher levels. This is consistent with the salt precipitation in deeper areas during lowstands and Lago-Mare deposition during highstands in marginal areas. This model may also explain the seemingly contradiction between the high-level Lago-Mare deposits and the km-scale sea level drop estimated from erosion markers and implicit in the Zanclean cataclysmic reflooding model.