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Reconstructing the temperature and salinity of the Mediterranean Sea through the Late Miocene (13 Ma – 6 Ma) prior to the Messinian Salinity Crisis

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We present a unique, alkenone-based record of sea surface temperatures spanning 13 Ma to 6 Ma from the uplifted, pelagic, Mediterranean sequence at Monte dei Corvi. The thick salt layers resulting from the isolation of the Mediterranean have so far been an obstacle to conventional drilling in obtaining a high-resolution, continuous record of the basin's conditions prior to ∼6 Ma. This is especially important when reconstructing the climate conditions that preceded and contributed to the Messinian Salinity Crisis. Uplifted sections allow access to this otherwise unresolved time period. Planktonic d18O records from uplifted marine sections exist; however, they are hampered by the lack of independent temperature reconstruction in order to detangle the competing influence of both temperature and salinity on such data. Using alkenone paleothermometry we show that the Late Miocene Mediterranean Sea was notably warmer than present with SSTs equivalent and even higher than the warmest parts of the modern ocean. Between ∼ 12.9 Ma to ∼8.1 Ma temperatures hovered close to 28oC and possibly even higher. At ∼8.1 Ma, concurrent with notable changes in the vegetation pattern of the area as well as globally, sea surface temperatures show a distinct cooling trend punctuated with a cold episode at ∼7 Ma which coincides with the first appearance of desert conditions in the Sahara. The cooling trend continues up to the Messinian Salinity Crisis at which point marine sedimentation was interrupted at the site. Our dataset contains four high-resolution windows where we examine the precession scale SST changes that contributed to sapropel formation and comparing them with the regime established for the Plio-Pleistocene.
The reconstructed sea surface temperatures allow us to reconstruct the paleo-salinity of the Mediterranean leading up to the Messinian Salinity Crisis. The uncorrected the published d18O planktonic records show a sharp enrichment at ∼7.5 Ma. Once corrected for temperature the residual salinity component shows a much more gradual change. We suggest that the isolation of the basin was a gradual restriction. We show that even when the basin became restricted the mechanisms of sapropel formation remained the same with strong freshwater pulses and warmer temperatures leading up to the MSC.