Levant Basin as a key for Understanding the Messinian Salinity Crisis: Challenging the Desiccation Paradigm

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The Messinian salinity crisis (MSC) is an extreme event in Earth history during which a salt giant (>1×10\textsuperscript{6} km\textsuperscript{3}) accumulated on the Mediterranean seafloor within ~640 kyrs. The Messinian salt giant was formed about 6 million years ago when the restriction of water exchanges between the Atlantic Ocean and the Mediterranean Sea turned the Mediterranean into an enormous saline basin. After more than 40 years of research, the timing and the depositional environments of shallow (<200 m) and intermediate (200-1000 m) water-depth Messinian basins are known quite well from onshore outcrops. But what happened in the deepest portions of the Mediterranean Sea is still unclear, because the information about offshore successions is mainly based on geophysical data with no rock samples that can be dated.

The Levant Basin is the only deep Mediterranean basin where the entire Messinian section has been penetrated by wells tied to high resolution 3D seismic surveys. Here we present two studies challenging the desiccation paradigm dominating the MSC scientific literature for more than 40 years.

The first study focuses on the nearly flat top erosion surface (TES) that truncates a basinward-tilted Messinian evaporitic succession. This truncation is commonly interpreted to be the result of subaerial erosion at the end of the MSC. However, based on high resolution seismic surveys and wireline logs, we show that (1) the TES is actually an intra-Messinian truncation surface (IMTS) located ~100 m below the Messinian-Zanclean boundary; (2) the topmost, post-truncation, Messinian unit is very different from the underlying salt deposits and consists mostly of shale, sand, and anhydrite showing typical \textsuperscript{87}Sr/\textsuperscript{86}Sr values and fauna assemblages from stage 3; and (3) the flat IMTS is a dissolution surface related to significant dilution and stratification of the water column during the transition from stage 2 to stage 3. We suggest that dissolution occurred upslope where salt rocks at the seabed were exposed to the upper diluted brine, while downslope
the salt rocks were preserved because submerged in the deeper halite-saturated layer. The model, which requires a stratified water column, is inconsistent with a complete desiccation of the eastern Mediterranean Sea.

The second study focuses on the onset of the Messinian salinity crisis in the deep Eastern Mediterranean basin. Biostratigraphy and astronomical tuning of the Messinian pre-salt succession in the Levant Basin allows for the first time the reconstruction of a detailed chronology of the MSC events in deep setting and their correlation with marginal records that supports the CIESM (2008) 3-stage model. Our main conclusions are (1) MSC events were synchronous across marginal and deep basins, (2) MSC onset in deep basins occurred at 5.97 Ma, (3) only foraminifera-barren, evaporite-free shales accumulated in deep settings between 5.97 and 5.60 Ma, (4) deep evaporites (sulfate and halite) deposition started later, at 5.60 Ma. The wide synchrony of events implies inter-sub-basin connection during the whole salinity crisis and is not compatible with large sea-level fall that would have separated the eastern and western basins producing diachronic processes.