Seismic markers of the Messinian salinity crisis in the deep Ionian Basin

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We conduct the seismic signal analysis on vintage and recently collected multichannel seismic reflection profiles from the Ionian Basin to characterize the deep basin Messinian evaporites. These evaporites were deposited in deep and marginal Mediterranean sedimentary basins as a consequence of the “salinity crisis” between 5.97 and 5.33 Ma, a basin‐wide oceanographic and ecological crisis whose origin remains poorly understood. The seismic markers of the Messinian evaporites in the deep Mediterranean basins can be divided in two end‐members, one of which is the typical “trilogy” of gypsum and clastics (Lower Unit – LU), halite (Mobile Unit – MU) and upper anhydrite and marl layers (Upper Unit – UU) traced in the Western Mediterranean Basins. The other end‐member is a single MU unit subdivided in seven sub‐units by clastic interlayers located in the Levant Basin. The causes of these different seismic expressions of the Messinian salinity crisis (MSC) appear to be related to a morphological separation between the two basins by the structural regional sill of the Sicily Channel. With the aid of velocity analyses and seismic imaging via prestack migration in time and depth domains, we define for the first time the seismic signature of the Messinian evaporites in the deep Ionian Basin, which differs from the known end‐members. In addition, we identify different evaporitic depositional settings suggesting a laterally discontinuous deposition. With the information gathered we quantify the volume of evaporitic deposits in the deep Ionian Basin as 500,000 km3 Å} 10%. This figure allows us to speculate that the total volume of salts in the Mediterranean basin is larger than commonly assumed. Different depositional units in the Ionian Basin suggest that during the MSC it was separated from the Western Mediterranean by physical thresholds, from the Po Plain/Northern Adriatic Basin, and the Levant Basin, likely reflecting different hydrological and climatic conditions. Finally, the evidence of erosional surfaces and V‐shaped valleys at the top of the MSC unit, together with sharp evaporites pinch out on evaporite‐free pre‐ Messinian structural highs, suggest an extreme Messinian Stage 3 base level draw down in the Ionian Basin. Such evidence should be carefully evaluated in the light of Messinian and post‐Messinian vertical crustal movements in the area. The results of this study demonstrates the importance of extracting from
seismic data the Messinian paleotopography, the paleomorphology and the detailed stratal architecture in the in order to advance in the understanding of the deep basins Messinian depositional environments.