DISSOLUTION OF MESSINIAN EVAPORITES AND ITS EFFECT ON THE SLUMPING OF PLIO-QUATERNARY SEDIMENTS ALONG THE LEVANT MARGIN, EASTERN MEDITERRANEAN

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Abstract

Series of reverse faults in the upper part of the sedimentary sequence in the Levant Basin deform only the Plio-Quaternary series and the upper part of the Messinian evaporites. The faults suggest that the Messinian salt flows basinwards, carrying along the overlying sediments. The flow pulled the salt away from the edge of the Levant Basin, where it pinches out and the overlying sediments slumped. Seawater penetrated along the normal detachment faults of these slumps, dissolved the salt, and enhanced the collapse of the overlying Plio-Quaternary sequence.

Keywords : Messinian, Salinity.

Reverse faults that dip to the SE, that were discovered in seismic surveys of the Levant Basin off Israel presented evidence of basinwards flow of the Messinian salt. The faults offset the upper part of the Messinian evaporites and the Plio-Quaternary sequence while the lower part was not deformed. The basinward flow of the Messinian salt was probably initiated by the subsidence of the Levant Basin due to sedimentary load. The faults suggest the structural evolution of a series of complex and enigmatic structural features in the subsurface at the base of the continental slope of the Levant, which were described by Neev [1] off Israel and by Tapponnier et al. [2] off Lebanon. Neev [1] presumed that the structures are a part of a global shear zone, and Tapponnier et al. [2] correlated the feature with possible eastward subduction. Comprehensive and systematic multichannel seismic surveys (e.g. [3]) enabled us to shed new light on these structures.

Already the early explorations of the eastern Mediterranean found out that the lower part of the continental slope of the Levant is characterized by extensive slumps and landslides, and Plio-Quaternary sedimentary strata that overlie enigmatic structural features of Messinian evaporites proved unstable. Complex structural features of the Messinian series were traced along a strip 20 km wide that stretches along some 250 km parallel to the coast of Israel and Lebanon. Although these structures have been known for more than 30 years, their origin was considered unresolved.

Recent discovery of numerous reverse faults that offset only the Messinian evaporites and the overlying strata in the Levant Basin seems to illuminate the process that formed the enigmatic structures. We show that the complex structures are associated with the wedging out of the Messinian evaporites. The initial deposition of the Messinian evaporitic sequence took place in a hypersaline lake that covered the deeper parts of the Mediterranean Sea, where the configuration of the bottom of the lake is represented by seismic reflector N. The top of the evaporitic sequence, reflector M, was deposited in the proximity of the lake level. The shoaling of that lake is represented by the wedging out of the evaporites and the merging of reflectors M and N, which can be discerned at reflection time of 2.5 seconds, or 2 km. It seems that slight basinal subsidence during the late Pliocene due to sedimentary loading initiated westwards flow of the Messinian salt, as indicated by numerous southeastwards-dipping reverse faults. This flow tapered off at the eastern edge of the salt deposit, where the flow of the salt was compensated by subsidence of the overlying strata. This subsidence generated geotechnical faulting that enabled the penetration of water into the evaporitic layer and partially dissolved it. The dissolution removed additional portions of the evaporites, and left behind irregular relicts of the evaporitic layer, further enhancing the subsidence of the overlying strata. Thus the dissolution of the edge of the salt layer dropped the basis of the Plio-Quaternary series further and led to its slumping and collapse along the distal slope.

References

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