CAPTURING A SALT GIANT - RISER DRILLING PERSPECTIVES FOR THE LEVANTINE BASIN

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Abstract

Riser-drilling of the Messinian evaporites is crucial to test the following hypothesis: Young salt giants are intrinsically highly dynamic in terms of structural, chemical and biogenic evolution, even without any external tectonic trigger. On a regional scale, we propose that the basinal Messinian evaporites represent the key archive for understanding of rapid environmental changes of the pan-Mediterranean realm in the Messinian.

Keywords : Evaporites, Levantine Basin, Messinian.

Salt giants are a global phenomenon and both indicators and generators for significant environmental changes. Salt layers of some kilometres thickness strongly affect the structural, chemical and biological evolution of sedimentary basins. Fluid inclusions within the salt represent ice-core-like microbial habitats of so far unknown importance. The world's most significant hydrocarbon traps are related to salt structures. Quantitative understanding of salt dynamics and associated fluid flow is further necessary in order to assess the geohazard exploration and production risk. Because evaporites may cause mass wasting and sink holes, they are an important source of geohazards. However, in spite of their global occurrence and general importance within the Earth system there is a significant lack in our knowledge about the early evolution of all salt giants on Earth.

The petroleum industry regularly drills through thick evaporite successions in the Gulf of Mexico, the North Sea and the South Atlantic, but always in positions where the evaporites have been massively remobilised by protracted phases of salt tectonics. There is no complete record of any major evaporite basin in a relatively young and undeformed state. Drilling through the complete Messinian succession represents perhaps the only opportunity to understand the stratigraphy, biosphere and fluid dynamics of a global salt giant in a state close to its original depositional configuration, because the present state of Earth system does not form salt giants. This is a novel concept for scientific drilling in sedimentary basins beyond the IOPD Initial Science Plan and one of the last scientific frontier challenges in sedimentary basin research.

In a global context, drilling a young salt giant is a unique chance to advance our understanding of gravity tectonics on basin evolution in the presence of a mobile layer. The specific role of a thick salt layer on basinal fluid dynamics and its interrelation with the deep biosphere adds further to the potential scientific implications of a future proposal. A single and preferable continuous core from the seafloor down to beneath the evaporitic layers will calibrate the extensive 2D-and 3D-reflection seismic data sets from the geometrically well defined Levantine Basin [1-2].

A complete core of the Messinian evaporites would open an outstanding archive of environmental changes since the Messinian. The discovery that the Mediterranean experienced a catastrophic desiccation phase during the Messinian has since proven to be one of the major achievements of the DSDP program. In the 35 years after completion of that leg, over 1000 papers have been published on the Messinian Salinity Crisis. In spite of all this research activity, one fact remains: we have no complete calibration of the stratigraphy of the most complete record of the MSC, because no scientific drilling has been able to venture into deep water and drill through the thickest succession of the deep basin. A huge amount of descriptive and analytical work has been conducted on the sequences preserved in marginal basins, producing elaborate and often conflicting correlation schemes aimed at a pan-Mediterranean synthesis based on these marginal stratigraphies. It has been estimated that 95/100 of the total volume of the Messinian evaporites is now preserved in the deep basins, and the lack of knowledge of deep basinal stratigraphy is thus fundamental to the entire field. Finally, unraveling the Pan-Mediterranean environment during the Messinian desiccation period is also a possible prospect on the future, since the closure of the gateway to the Atlantic is expected get closed due to the African-Eurasian convergence in some million years.

Riser-drilling of the Messinian evaporites in the Levantine Basin is crucial to test our hypothesis that in contrast to generally accepted models, emerging salt giants are intrinsically highly dynamic in terms of structural, chemical and biogenic evolution, even without any external tectonic trigger. On a regional scale, we hypothesise that the basinal Messinian evaporites represent the key archive for understanding of rapid environmental changes of the pan-Mediterranean realm in the Messinian.

References

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