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Capturing a salt giant - riser drilling perspectives for the Levantine Basin

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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 exploration and production risk. Since 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. 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. 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. A complete core of the Messinian evaporites would open an outstanding archive of the extreme and fast environmental changes in 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, there is 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. Recent studies gave compelling evidences for fluid flow through and out of more than 1000 m thick evaporites. The accompanying flux of salinity, nutrients, dissolved organic matter, sulphate and sulphides strongly influence the biological habitat above and beneath the salt. Consecutive cycles of deposition and within-evaporite preservation (inclusions) of microbial life will produce an ice-core-like archive of microbial life captured during cycles of paleo-environmental change. Besides the microbial archives, active interfaces will stimulate active microbial life. Such interfaces can not only be found within and between evaporite cycles but also at the lower and upper evaporite boundaries. The high salt content leads to improved preservation of reactive organic matter not only between evaporite cycles, which themselves contain sulphate (e.g. gypsum/anhydrite), but also immediately above them where sulphate-depleted pore water within organic matter containing sediment occurs.At the interface between anhydrite and reactive OM, intense microbial activity is anticipated very much the same as has recently been discovered for some on-land gypsum deposits. Although no major methane accumulations are expected below the evaporites, some presence of methane is likely. This presents an attractive food source together with the anhydrate-sulphate, thus an active microbial interface. 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.