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‘SaltGiant’ drilling in the Sorbas Basin: Structural, Petrophysical and Geochemical characterization of the Messinian Salinity Crisis deposits

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The Late Miocene deposits in the Sorbas Basin (Spain) have been of an extreme importance in the understanding of the Messinian Salinity Crisis (MSC) events (5.97-5.33 Ma). They consist of four formations. The pre-crisis Abad marls topped by the evaporitic Yesares gypsum member, followed by two non-evaporitic units known as the Sorbas and Zorreras members. Those deposits have been widely explored and studied thanks to the numerous outcropping sections in the basin.

The ‘SaltGiant’ European Training Network held a training school in October 2021 in the Sorbas Basin, where four boreholes (named SG0, 1, 2 and 3) covering most of the Messinian Salinity Crisis sequence, were drilled, cored and logged in this context along an overall thickness of about 175 m. The drillings took place inside and in the vicinity of the Torralba gypsum mine. It allowed for the first time in the scientific non-industrial domain, access to a continuous and non-outcropping succession of the Messinian deposits in the Sorbas basin. In addition to the recovered cores, borehole geophysical data were obtained from the four holes and digital images of the area were collected with a drone. Prior to the drilling, an OBO (Outcrop / Behind Outcrop) workflow was followed, which will allow integrating the outcrop and subsurface data by combining the 3D geometry of geobodies with geophysical information.

Optical borehole wall images provide mm-scale images of the borehole walls, highlighting the sedimentological and structural characteristics of the deposits. Downhole geophysical measurements included acoustic velocity, electrical resistivity and natural spectral gamma ray, which allowed determining the petrophysical characteristics of the penetrated lithologies. In addition to the petrophysical logs, a Vertical Seismic Profiling was performed in holes SG2 and SG3, including a multi-offset VSP survey in hole SG3.

The petrophysical characterization of the Messinian deposits will provide a reference case study for the lithologic characterization of MSC deposits in the subsurface elsewhere. VSP analysis provided an in-field preliminary seismic velocity evaluation in the encountered formations. Preliminary results confirm the astronomical precession-driven cyclicity observed elsewhere in the Messinian gypsum. Further processing and analyses of the large amount of acquired data will lead to identifying the astronomical and possibly higher-frequency cyclicity in the post-evaporitic deposits in the Sorbas member.