A modeling approach on Evaporites volume and water budget calculation during the Messinian Salinity Crisis: Case study of the Central Mallorca Depression

Fadl Raad [*1], Ronja Ebner [2], Paul Meijer [2], Johanna Lofi [1], Agnès Maillard [3], Hanneke Heida [4], Daniel Garcia-Castellanos [4]

[1] Géosciences Montpellier, CNRS, Université de Montpellier, Université des Antilles - Université de Montpellier 2 – France
[2] Department of Earth Sciences, Utrecht University, Princetonlaan 8A 3584 CB Utrecht, The Netherlands
[3] Géosciences Environnement Toulouse (GET), Observatoire Midi Pyrénées, Université de Toulouse - France
[4] Geosciences Barcelona (GEO3BCN-CSIC), Barcelona, Solé i Sabarís s/n, 08028 Barcelona, Spain.

The upper Miocene's Messinian Salinity Crisis (MSC) lead to the reduction of water exchange between the Atlantic and Mediterranean and consequently the deposition of an immense evaporitic body, also known as the Mediterranean Salt Giant (MSG), in a relatively short time interval of ~640kyrs. Today, the evaporites belonging to the Salt Giant are mostly conserved offshore (>90%) below a thick sedimentary unit which is Pliocene to Quaternary in age, and distributed in several basins lying at different water depths.
The Central Mallorca Depression (CMD) contains a very well preserved evaporitic sequence, including halite that has been studied and mapped recently by several authors. Most recently, Raad et al. (2021) showed that the MSC evaporitic sequence in the CMD could be a non-deformed analogue of the key MSC area represented by the Caltanissetta Basin in Sicily. This assumed congruity makes the CMD an interesting system to study, which could lead to new insight into MSC events.
Physics based box models, as simplified as they might look, help in examining some factors and observations related to the MSC. Those models have been widely used in the literature of the MSG in the past two decades. Those models so far have been either applied to the Mediterranean Sea as a whole focusing on the strait of Gibraltar, or focused on the influence of the strait of Sicily between the Western and Eastern Mediterranean Sea. In this study, for the first time we use scaled down versions as we apply box models only on a single sub-basin, the CMD, where a good, high- and low-resolution seismic reflection data coverage is available.
As a first step, we quantify the volumes of the present-day MSC units. We then use the reconstructed pre-MSC paleo-bathymetry to apply different box models approaches by changing the connection between the CMD and the rest of the Mediterranean. We show that a persistent connection between the CMD and the Mediterranean is needed during the Primary Lower Gypsum (PLG) stage in order to supply the basin with the needed ions to form the observed gypsum. For the halite, on the contrary, we show that the observed halite volume can be deposited from an 850m thick brine column at halite saturation. We conclude from our results that a drawdown of at least 850m (sill depth) is necessary, since all other tested scenarios would lead to an excess of deposited halite.

Mots-Clés : Messinian Salinity Crisis, Central Mallorca Depression, Box modeling, Evaporites.

This research is carried out under the SALTGIANT ETN, a European project funded by the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie grant agreement number 765256.

Merci de ne rien inscrire dans cette zone et ne pas modifier les marges des pieds de page et entêtes.

Merci de ne rien inscrire dans cette zone et ne pas modifier les marges des pieds de page et entêtes.