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Mediterranean salt giants beyond the evaporite model: The Sicily perspective

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Mediterranean salt giants, occurring both in sub-seafloor and in onshore settings (the “Gessoso Solfifera Group”), are traditionally explained by repeated cycles of desiccation and replenishment of the entire basin. However, such hypotheses are strongly biased by mass balance calculations and geodynamic considerations. In addition, any hypothesis without full desiccation, still based on the evaporite model, should consider that seawater brines start to precipitate halite when 2/3 of the seawater has evaporated, and hence the level of the basin cannot be the same as the adjacent ocean.

On the other hand, hydrothermal venting of hot saline brines onto the seafloor can precipitate salt in a deep marine basin if a layer of heavy brine exists along the seafloor. This process, likely related to sub-surface boiling or supercritical out-salting (Hovland et al., 2006), is consistent with geological evidence in the Red Sea "Deeps" (Hovland et al., 2015).

Although supercritical out-salting and phase separation can sufficiently explain the formation of several marine salt deposits, even in deep marine settings, the Mediterranean salt giant formations can also be explained by the serpentinization model (Scribano et al., 2016). Serpentinization of abyssal peridotites does not involve seawater salts, and large quantities of saline brines accumulate in pores and fractures of the sub-seafloor serpentinites. If these rocks undergo thermal dehydration, for example, due to igneous intrusions, brines and salt slurries can migrate upwards as hydrothermal plumes, eventually venting at the seafloor, giving rise to giant salt deposits over time.

These hydrothermal processes can take place in a temporal sequence, as it occurred in the "Caltanissetta Basin" (Sicily). There, salt accumulation associated with serpentinization started during Triassic times (and even earlier), and venting of heavy brines onto the seafloor eventually occurred in the Messinian via the hydrothermal plume mechanism (Scribano et al, 2016).

This innovative model arises from the study of xenoliths in the Hyblean diatremes (southeastern Sicily), suggesting that a widely serpentinized Tethyan basement lies beneath the entire Sicily island and its offshore areas (Scribano et al., 2006; Manuella et al., 2015), according to geophysical, geological and petrological aspects.

In conclusion, our viewpoint represents a plausible explanation for the origin of giant salt deposits in the Mediterranean area and elsewhere, albeit this hypothesis should be constrained by further studies.

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