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Drilling the Messinian Salinity Crisis as a Model Analogue for Dolomite Deposition at the End of Massive Salt Deposition Events

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Sedimentologic and stratigraphic studies of the Lower Cretaceous sequence, deposited in the economically important Campos Basin, southeast Brazil, document the occurrence of ∼20-m-thick dolomite intervals overlying the "massive salt" megasequences of the Lagoa Feia Formation. This stratigaphic succession marks the Aptian/Albian transition from extreme evaporitic conditions of the Lagoa Feia Formation to shallow marine conditions of the Macaé Formation, related to the early opening of the South Atlantic. The facies change from evaporites to dolomite is interpreted as a product of dolomitization resulting from the refuxing of hypersaline fluids from shallow embayments with intense evaporation (Latgé, 2001).

Although the reflux model provides a mechanism to produce fluids with geochemical composition favorable for dolomite precipitation, it cannot account for all of the factors required to promote dolomite precipitation. In this study, we propose a different model to explain the post-evaporite deposition of massive dolomite based on the study of sequences deposited at the end Messinian Salinity Crisis, which were recovered from the deep basins of the Mediterranean Sea during DSDP/ODP drilling campaigns. At most of these deep-water sites, the cored interval contained unusual dolomite deposits overlying the uppermost evaporite sections. For example, the upper Messinian sedimentary sequence at DSDP Site 374 comprises non-fossiliferous dolomitic mudstone overlying dolomitic mudstone/gypsum cycles, which in turn overlie anhydrite and halite (Hsü, Montadert et al., 1978).

We postulate that the end Messinian dolomite is a product of microbial activity under extreme hypersaline conditions. In the last 20 years, research into the factors controlling dolomite precipitation under Earth surface conditions has led to the development of new models involving the metabolism of microorganisms and associated biofilms to overcome the kinetic inhibitions associated with primary dolomite precipitation. Furthermore, based on the limited pore-water geochemical data obtained during drilling at DSDP Site 374: Messina Abyssal Plain, the dolomitic mudstones of the uppermost Messinian evaporite complex represent an ideal candidate for such an extensive study in a "natural laboratory". In fact, the data suggest that microbial diagenesis and perhaps dolomite precipitation may still be occurring. Thus, to increase our understanding of the biogeochemical processes associated with ancient massive dolomite formation, a major new drilling campaign to study the sub-seafloor Messinian evaporite complex in the deep Mediterranean basins, using greatly enhanced drilling technology currently available within the new International Ocean Discovery Program (IODP), would be timely.

Hsü, K., Montadert, L. et al., 1978. Initial Reports of the Deep Sea Drilling Project, Volume 42, Part 1: Washington (U.S. Government Printing Office).
Latgé, M. A. R., 2001. O Albiano no Atlântico Sul: estratigrafia, Paleoceanografia e Relações Globais. PhD thesis, Universidade Federal do Rio Grande do Sul, pp. 257.