

Mud volcanism and authigenic carbonates related to methane-rich fluids migration in the Tortonian-Messinian marls of the Huerca Overa basin (S.E. Spain)

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Methane-rich fluids that are generated at depth in organic-rich deposits migrate within the sediments to the seafloor where they are expelled to form mud volcanoes or pockmarks. These migrating fluids are generally involved in diagenetic processes as authigenic carbonate formation that is mediated by microbial activity and they may participate to gas hydrate formation. These features are well-known in the present-day continental margins but their fossil records are relatively scarce. In the Huerca Overa basin (South East Spain), there are chaotic to roughly layered structures intruding the Tortonian-Messinian marls that are interpreted as due to mud volcanism. Moreover, the surrounding marls contain abundant authigenic dolomite nodules. The oxygen and carbon isotopic compositions of these dolomites exhibit wide ranges ($-1.4 < \delta^{18}\text{O} < +3.9$; $-35.5 < \delta^{13}\text{C} < +5.1$). They indicate that authigenic carbonate precipitation occurred within the marly sediments due to circulation of deep fluids that might be relatively warm as shown by the low $\delta^{18}\text{O}$ values and where anaerobic oxidation of methane (low $\delta^{13}\text{C}$ values) and methanogenesis (high $\delta^{13}\text{C}$ values) were active. These two features, methane derived authigenic dolomites and mud volcanism, are testifying of the intense methane-rich fluid migration in the marly deposits of the western Mediterranean basins during the late Neogene, which was the time of major paleoenvironmental changes in the Mediterranean sea climaxing during the Messinian salinity crisis.