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Authigenic barite as a proxy for past hydrocarbon outflow at the Carlos Ribeiro Mud Volcano, Gulf of Cadiz

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Mud volcanoes are dynamic features characterised by the expulsion of gas-charged fluids that lack sulphate but contain elevated concentrations of dissolved barium (Ba). During the ascent of these fluids through the sediment column, barite precipitates on contact with sulphate, either in the sediment pore-waters in the shallow sub-surface or at the sediment-seawater interface. In these settings, the pore-water suphate gradient is typically regulated by the methane flux from depth via the anaerobic oxidation of methane at the Sulphate-Methane Transition Zone (SMTZ). Consequently, high concentrations ('fronts') of authigenic barite in the sediments are found at the depth of the SMTZ, providing a record of the history of gas venting and mud volcano activity.
A high resolution geochemical data set has been collected from the Carlos Ribeiro mud volcano on the Portugese margin to study methane emissions both today and in the past. Piston, gravity and mega cores were obtained from five sites located on a 380 m long transect that extends from the apex of the mud volcano to mudflow pathways to the southeast of the crater. Concentrations of Ba in both the solid- and dissolved-phase have been determined to investigate hydrocarbon and sulphate cycling at Carlos Ribeiro MV. Our results show a strong geochemical coupling between these constituents. Barite fronts are absent in the centre of the crater while a single barite front at approximately 20 cm depth is present at two sites further away from the centre. Three barite fronts occur at 45, 85 and 130 cm depth within the mudflow, containing a Ba excess of 500 ppm on average. Past and current fluxes of methane will be estimated by application of a 1-D transport-reaction model to respectively Ba and sulphate pore-water profiles.