

Halokinesis-Controlled Mud Volcanism in the Gulf of Cadiz

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The Gulf of Cadiz is characterized by pervasive mud volcanism. At least thirty mud volcanoes have been identified so far, and it is commonly believed that they result from sediment dewatering enhanced by tectonic forces within the accretionary prism. However, the geological processes that control the location of individual mud volcanoes are poorly understood, mainly because of the lack of high-quality seismic data in the area. Recently acquired high-resolution 3D seismic data and geochemical sediment cores indicate that halokinesis controls the location of some mud volcanoes. The 3D seismic data at the Mercator Mud Volcano indicate localized development of a slightly asymmetrical anticline that was continuously active for the past 800 ka assuming average sedimentation rates of 0.5 m/ka. The 3D seismic data show that the apex of the anticline is characterised by a rocky sea bed outcrop of unknown lithology, which is underlain by a chaotic seismic facies. The most plausible explanation for these observations is the presence of a salt diapir. This is corroborated by geochemical cores from the Mercator Mud Volcano which show very high chlorinity values of 4.5 mol/l and Na/Cl ratios of 1.0 indicating dissolution of evaporites (halite). Gypsum clasts within the mud volcano sediments are probably xenoliths transported to the surface from a deep source. Linear chlorinity gradients within hemipelagic sediments 220 m away and 50 m above the nearest mud flows indicate a salt source within 100 m suggesting that those particular mud flows have a high salt concentration. Together the seismic and geochemical observations imply that halokinesis is controlling the location of the Mercator Mud Volcano and that its fluid flow system is heavily influenced by the presence of ascending salt. Our observations imply that salt distribution on the northwest African margin extends at least 500 km further northward than previously known, and that petroleum plays for this area have to include the influence of salt. They also imply that halokinesis has to be considered as a driving force for other mud volcanoes in the area.