Shale tectonics in the Alboran Sea (Western Mediterranean)

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The Alboran Sea in the Western Mediterranean was formed during the Neogene by large-scale extension in a plateconvergence setting between the African and Eurasian plates. In this tectonic scenario with diversely (in azimuth and platemotion rate) but continuous oblique convergence, basin subsidence started abruptly by the Early Miocene accompanying westward migration of the Gibraltar Arc, the orogenic loop formed by the Betic (in South Iberia) and Rif (in North Africa) belts. Behind this Alpine arc, the Alboran basin is characterized by a thick sedimentary depocenter (> 8 km) that mimics the orogenic front. One of the key features of the West Alboran Basin (WAB) is the development of a significant diapir province, feed by the lowermost sediments (early to middle Miocene) that are formed of under-compacted shale and olistostromes.

Using the 2D seismic survey of ConocoPhillips, and completing with previous commercial and scientific seismics, we have analyzed the shale diapirism in the northern WAB. The 3D geometry of the shale diapirs and their evolution during the Neogene, accompanying sedimentation and basin subsidence, have been characterized.

Shale diapirs show two orthogonal orientations, probably controlled by deep structures in the basement, like halfgrabens and oblique, transfer structures. Diapirs develop isolated and elongated shapes with sub-vertical walls, both parallel and perpendicular to the dip of the basement surface. In the interference region between both trends diapirs tend to have a long-lived evolution, develop piercing structures and associated mud volcanoes in the seafloor. Allocthonous shale tongues are common in the areas with maximum sedimentary accumulations, where they advanced basinward during the middle-to-late Miocene. We conclude that shale diapirism in the WAB depocenter is linked to deformation in the basin margins, because pulses of shale diapir ascent and lateral advance follow immediately major episodes of extension in marginal syn-sedimentary faults.