Contrasting Styles of Shale Tectonics in the Alboran Sea and the South Caspian Basin

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Basins with significant subsidence and sedimentation rates show usually mud-rich sediments at the lowermost levels preserving abnormal high-pressures with respect to the overburden. This configuration is gravitationally unstable and any subsequent tectonic process, or the occurrence of basin-floor tilting, may promote shale withdraw and ascent. Impelled by the singularity of shale tectonics, we use two mobile-shale basins as case study: the Alboran Sea in the Western Mediterranean and the South Caspian Basin, offshore Azerbaijan.

In the Alboran Basin we present a detailed reconstruction of the 3D geometry of the diapirs and associated minibasins in the northern margin of the western depocentre (offshore Spain). Basin formation began in the Early Miocene when rapid initial subsidence of the basin floor was accompanied by massive sedimentation and burial of fine-grained sediments. Gravity-driven tectonics and continuous basement subsidence during the Miocene led to downslope migration of mobile shales, while the basin margins were affected by syn-sedimentary extension and associated shale-cored thrusts advanced toward the basin depocentre. Punctuated diapir ascent and the advance of shale sheets were linked to the marginal thin-skinned extension.

In the Caspian Sea, using a depth-migrated seismic cube, we present different examples of shale structures within a complex anticline culmination. Detachment anticlines were developed in the youngest sedimentary sequence (the Productive Series) since the Pliocene, enhanced by the mobilization of overpressured muds. We reconstruct the folding history, evaluating its spatial-temporal distribution and comparing these results with the timing of the mud ascent episodes.

We document the contrasting styles of shale-involved deformations in both basins. In the Alboran Sea, shale downslope migration and ascent are clearly associated with the synchronous extension in basin margin. In the Caspian Basin similarly, tilting of the basin floor promoted shale tectonic processes forcing the upward migration of overpressured mud-rich sediments.