

Contrasting styles of shale-tectonics in the Alboran Sea and the South Caspian Basin

Juan I. SOTO¹, Idaira SANTOS BETANCOR², Asrar R. TALUKDER³, and Carlos E. MACELLARI⁴

¹Instituto Andaluz de Ciencias de la Tierra (CSIC-Univ. Granada) and Departamento de Geodinámica, Facultad de Ciencias, Campus Fuentenueva s/n, 18071 Granada, Spain.

jsoto@ugr.es

²Instituto Andaluz de Ciencias de la Tierra (CSIC-Univ. Granada) and Departamento de Geodinámica, Facultad de Ciencias, Campus Fuentenueva s/n, 18071 Granada, Spain.

idaira@correo.ugr.es

³Australian Resources Research Centre, Australian Commonwealth Scientific and Research Organization (CSIRO), 26 Dick Perry Av., Kensington, Western Australia 6151, Australia. Asrar.Talukder@csiro.au

⁴Director of Geology, Repsol Exploración S.A., Paseo de la Castellana 278-280, 28046 Madrid, Spain. cmacellari@repsol.com

Basins with significant subsidence and sedimentation rates show usually mud-rich sediments at the lowermost levels. These sequences tend to preserve abnormal high-pressures with respect to the overburden, leading to overpressure. This configuration is gravitationally unstable and any subsequent tectonic process, or even the occurrence of basin-floor tilting, may promote shale withdraw and ascent. Basins with examples of shale mobilization have commonly associated oil and gas reservoirs, reinforcing the interest in studying the controlling factors for shale tectonics and the evolution of shale-involved structures.

Impelled by the singularity of shale tectonics, and seeking out the differences with salt tectonics, we use two mobile-shale basins with examples of mud volcanoes, as case-study.

The Alboran Sea in the Western Mediterranean is a deep sedimentary basin formed during the Miocene by extension in a plate-convergence setting. Behind the orogenic arc formed by the Betics and Rif belts, this basin is floored by a thin continental crust; it contains an arcuate depocentre with important sedimentary accumulations and a complex shale-diapir province. We document a long-lived history of shale tectonics during the Early to Late Miocene, with continuous basement tilting and thin-skinned, syn-sedimentary extension in basin margins, which led to down-slope shale migration forming walls and finally allochthonous sheets.

The Caspian Sea resembles the Alboran Sea: it is also a Neogene basin associated with the Alpine collision and contains remarkable examples of shale-involved structures and active mud volcanoes. We present different examples of shale structures from the South Caspian Basin, offshore Azerbaijan. The source rock here for shale tectonics is the Maykop Series; of Oligocene to Early Miocene age. During the Pliocene-to-Recent, detachment anticlines are formed in the overlying sedimentary sequences (the Productive Series) enhanced by the low-viscosity material that feed fold cores. Shortening history has two major deformation pulses; one during the middle Pliocene (~3.5-3 Ma), toward the end of the deposition of the Upper Productive Series. Folding rates decreased afterwards during the Late Pliocene, and a second, syn-growth folding episode occurred during the early Pleistocene (~1.5-1 Ma). Mud diapir perforation and extrusion accompanied folding episodes, while a punctuated tilting history of the sedimentary sequence toward basin centre took place.