In-situ Stress and Origin of Overpressures in the West Alboran Basin

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Data from the deep well Andalucía G-1 drilled in the West Alboran Basin (WAB) are analyzed to constrain the magnitude of the in-situ stress and pore pressure. The magnitude of the vertical stress is derived from density data. Pore pressure profile is defined by means of direct measurements in permeable formations, and normal compaction trend lines in shale-prone sediments. Leak-off tests are used to constrain the magnitude of the minimum stress. The magnitude and orientation of the maximum horizontal stress is modeled using observations of wellbore failure.

The interpreted pore pressure profile shows a hydrostatic column that extends down to 2000 mbsl where the top of the pore pressure ramp is located. Undercompaction seems the dominant mechanism generating overpressures in shale-rich sediments (of probable Early Miocene age) that feed the prominent diapirs in the WAB. We also evaluate the contribution of other mechanisms to the observed overpressures. We argue the potential for thermally generated pressures as a contributing mechanism to overpressure in deeper domains of the basin.

The modeled stress tensor suggests that Andalucia G-1 was drilled in an area under a normal faulting stress regime, where the orientation of the maximum horizontal stress is parallel to the coast. We propose that this orientation most likely tracks the coastal trend along the WAB, and it is the consequence of the presence of a large prograding sedimentary wedge that exerts a strong control on the stress regime in the proximal basin domain.

The full stress tensor is ultimately used to make inferences on the potential mechanisms behind the triggering of mud diapirs. Increasing pressures in deep confined units can cause shear failure of the cap rock or reactivation of pre-existing sealing faults, which in turn, would develop major pathways for vertical pressure and mass transfer toward shallower levels of the basin.