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Impact of pre- and/or syn-tectonic salt layers in the hangingwall geometry of a kinked-planar extensional fault: insights from analogue modelling and comparison with the Parentis basin (bay of Biscay)

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Using sandbox analogue modelling we determine the role played by a pre-kinematic or a syn-kinematic viscous salt layer during rollover folding of the hangingwall of a normal fault with a variable kinked-planar geometry, as well as understand the origin and the mechanisms that control the formation, kinematic evolution and geometry of salt structures developed in the hangingwall of this fault.

The experiments we conducted consisted of nine models made of dry quartz-sand (35μm average grain size) simulating brittle rocks and a viscous silicone polymer (SMG 36 from Dow Corning) simulating salt in nature. The models were constructed between two end walls, one of which was fixed, whereas the other was moved by a motor-driven worm screw. The fixed wall was part of the rigid footwall of the model's master border fault**.** This fault was simulated using three different wood block configurations, which was overlain by a flexible (but not stretchable) sheet that was attached to the mobile endwall of the model. We applied three different infill hangingwall configurations to each fault geometry: (1) without silicone (sand only), (2) sand overlain by a pre-kinematic silicone layer deposited above the entire hanginwall, and (3) sand partly overlain by a syn-kinematic silicone layer that overlain only parts of the hangingwall. All models were subjected to a 14 cm of basement extension in a direction orthogonal to that of the border fault.

Results show that the presence of a viscous layer (silicone) clearly controls the deformation pattern of the hangingwall. Thus, regardless of the silicone layer's geometry (either pre- or syn-extensional) or the geometry of the extensional fault, the silicone layer acts as a very efficient detachment level separating two different structural styles in each unit. In particular, the silicone layer acts as an extensional ductile shear zone inhibiting upward propagation of normal faults and/or shears bands from the sub-silicone layers. Whereas the basement is affected by antithetic normal faults that are more or less complex depending on the geometry of the master fault, the lateral flow of the silicone produces salt-cored anticlines, walls and diapirs in the overburden of the hangingwall. The mechanical behavior of the silicone layer as an extensional shear zone, combined with the lateral changes in pressure gradients due to overburden thickness changes, triggered the silicone migration from the half-graben depocenter towards the rollover shoulder. As a result, the accumulation of silicone produces gentle silicone-cored anticlines and local diapirs with minor extensional faults. Upwards fault propagation from the sub-silicone "basement" to the supra-silicone unit only occurs either when the supra- and sub-silicone materials are welded, or when the amount of slip along the master fault is large enough so that the tip of the silicone reaches the junction between the upper and lower panels of the master faults.

Comparison between the results of these models with data from the western offshore Parentis Basin (Eastern Bay of Biscay) validates the structural interpretation of this region.