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Analog modeling and kinematic restoration of inverted hangingwall synclinal basins developed above syn-kinematic salt: Application to the Lusitanian and Parentis basins

Maria Roma (1), Oskar Vidal-Royo (2), Ken McClay (3), Oriol Ferrer (1), and Josep Anton Muñoz (1)

(1) Institut de Recerca GEOMODELS, Departament de Dinàmica de la Terra i de l'Oceà, Facultat de Ciències de la Terra, Universitat de Barcelona, Barcelona, Spain., (2) Terractiva Consulting SL, Barcelona, Spain., (3) Fault Dynamics Research Group, Earth Sciences Department. Royal Holloway University of London. TW20 0EX, Egham, United Kingdom.

The formation of hagingwall syncline basins is basically constrained by the geometry of the basement-involved fault, but also by salt distribution . The formation of such basins is common around the Iberian Peninsula (e.g. Lusitanian, Parentis, Basque-Cantabian, Cameros and Organyà basins) where Upper Triassic (Keuper) salt governed their polyphasic Mesozoic extension and their subsequent Alpine inversion. In this scenario, a precise interpretation of the sub-salt faults geometry and a reconstruction of the initial salt thickness are key to understand the kinematic evolution of such basins.

Using an experimental approach (sandbox models) and these Mesozoic basins as natural analogues, the aim of this work is to: 1) investigate the main parameters that controlled the formation and evolution of hagingwall syncline basins analyzing the role of syn-kinematic salt during extension and subsequent inversion; and 2) quantify the deformation and salt mobilization based on restoration of analog model cross sections.

The experimental results demonstrate that premature welds are developed by salt deflation with consequent upward propagation of the basal fault in salt-bearing rift systems with a large amount of extension,. In contrast, thicker salt inhibits the upward fault propagation, which results into a further salt migration and development of a hagingwall syncline basins flanked by salt walls. The inherited extensional architecture as well as salt continuity dramatically controlled subsequent inversion. Shortening initially produced the folding and the uplift of the synclinal basins. Minor reverse faults form as a consequence of overtightening of welded diapir stems. However, no trace of reverse faulting is found around diapirs stems, as ductile unit is still available for extrusion, squeezing and accommodation of shortening. Restoration of the sandbox models has demonstrated that this is a powerful tool to unravel the complex structures in the models and this may similarly be applied to the seismic interpretation of the natural complex salt structures.