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Influence of syncontractional sedimentation and inherited salt structures in the evolution of salt-detached fold-and-thrust belts: Insights from analog modeling

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The occurrence and distribution of inherited salt structures and syntectonic erosion-sedimentation processes highly impacts the structural style and kinematics in salt-detached fold-and-thrust belts. Since salt walls and diapirs represent weak discontinuities, deformation tends to concentrate there. On the other hand, syncontrational erosion-sedimentation may also localize deformation. Thus, the characteristic structural style and kinematics of salt-detached fold-and-thrust belts are defined by the combination of both factors.

Using an experimental approach based on analog (sandbox) models, the research we present herein investigates the influence of pre-existing salt structures in the development of salt-detached fold-and-thrust belts applying different syncontractional sedimentation rates. The experimental setup involved a regular pattern of minibasins developed by downbuilding surrounded by salt walls and diapirs that was subsequently deformed by contraction. The experimental program tested: i) the geometry of the source layer (either flat-lying and constant thickness or along-strike wedge-shaped) and ii) the syncontractional sedimentation rate (from null to high rate).

The experimental results show that the thickness of the source layer controls the shape of the sinking minibasins during downbuilding: if constant thickness, a symmetrical pattern of minibasins and salt walls occurred whereas if wedge shaped, an asymmetric pattern developed. Asymmetry is characterized by poorly developed minibasins and salt walls occurring where source layer is thinner and well-developed ones as source layer thickens.

The sequence of deformation during subsequent shortening includes contractional reactivation of salt walls and diapirs mimicking the inherited pattern at the end of the downbuilding, then progressive squeezing and secondary welding. Secondary welding of salt walls allowed forward propagation of deformation and minibasins deformation. Syncontrational sedimentation prevented for a rapid forward propagation of deformation and increased horizontal axis rotation of minibasins, effect which is countered by a higher sedimentary rate. In this latter scenario, minibasins which were already primary welded, rather than rotated, were detached and displaced forwards.