Geophysical Research Abstracts
Vol. 18, EGU2016-9285, 2016
EGU General Assembly 2016

Basement-driven strike-slip deformation involving a salt-stock canopy system

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NW-striking basement-involved strike-slip zones have been reported or inferred from the northern Gulf of Mexico (GoM). This interpretation is uncertain, because the effects of strike-slip deformation are commonly difficult to recognize in cross sections. Recognition is doubly difficult if the strike-slip zone passes through a diapir field that complicates deformation, and an associated salt canopy that partially decouples shallow deformation from deep deformation. We use physical models to explore the effects of strike-slip deformation above and below a salt-stock canopy system. Canopies of varying maturity grew from a series of 14 feeders/diapirs located on and off the axis of a dextral basement fault.

Strike-slip deformation styles in the overburden vary significantly depending on: (1) the location of the diapirs with respect to the basement fault trace, and; (2) the continuity of the canopy system. On-axis diapirs (where the diapirs lie directly above the basement fault) are typically strongly deformed and pinched shut at depth to form sharp S-shapes, whereas their shallow deformation style is that of a open-S-shaped pop-up structure in a restraining bend. The narrow diapir stem acts as a shear zone at depth. Pull-apart structures form between diapirs that are arranged in a right-stepping array tangental to the basement fault trace. These grade along strike into narrow negative flower structures. Off-axis diapirs (diapirs laterally offset from the basement fault but close enough to participate in the deformation) form zones of distributed deformation in the form of arrays of oblique faults (R shears) that converge along strike onto the narrower deformation zones associated with on-axis diapirs. Above an immature, or patchy, canopy system the strike-slip structures closely match sub canopy structures, with the exception of wrench fold formation where the supracanopy roof is thin. In contrast, the surface structures above a mature canopy system consist of a broad zone of PDZ-parallel faults and high-angle wrench folds, strongly decoupled from the subcanopy structure. The exception to this is where there are gaps (windows) in the canopy, allowing coupling to the deeper deformation field. In this mature canopy open-S planforms are muted as deformation is spread over a broader area of coalesced salt sheets, except at the canopy edge and where the supracanopy roof is thin. Supracanopy structures are also influenced by the sutures between the individual salt sheets. Results from this set of analog models are potentially useful as predictive tools to understand the origin and geometry of structures in areas where subsurface data is scarce or data quality is poor.