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Critically Tapered Wedges Above Viscous Detachments: Influence of Detachment Layer Geometry

This research models detachment folds using analog modeling and field observations to analyze the geometry and kinematics of folds and faults in fold complex with viscous detachments. A model composed of two layers is used to simulate the mechanical stratigraphy of a wedge. The lower layer is a ductile and viscous material that deforms at very low strain rates. This layer is used to recreate the behavior of an evaporitic detachment. The upper layer simulates the brittle deformation as it occurs in a sequence of sedimentary rocks. To scale properly the model I used as a real world example a fold complex in the front of the Monterrey Salient, northern Mexico. There a 3000 m thick sequence of carbonates and shale overlies an over 1000 m thick evaporitic unit. Serial cross-section and detailed mapping of this fold complex provided geometrical constraints such as regional angle, topographic slope, and thickness variations of the evaporite layer that affected the analog fold model final geometry. This combination of analog modeling and field structural analysis allowed the qualitative assessment of the amount and orientation of 3-D material migration in both the evaporite horizon and the sedimentary cover. The viscous behavior of the detachment layer produced folding on the sedimentary cover with foreland-verging structures. Where the evaporitic detachment pinches out the deformation regime changes and structures verge towards the hinterland. Thickness variations along the strike in the detachment horizon are interpreted to cause plunging of the fold complex and curvilinear fold axis.