Canopy-margin thrust systems: Understanding-imbricate wedge shortening and its implication for pore pressure along the Sigsbee Escarpment, Mad Dog area, deepwater Gulf of Mexico

By

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Abstract:

Imbricate wedges along the margins of advancing salt canopies offer a unique opportunity to calculate tectonic compaction, because the length of the base-salt flat at the rear of the wedge provides a bed-length-independent estimate of total shortening in the system. Comparing these estimates with shortening calculated from deformed bed lengths in the wedge provides an estimate of tectonic compaction.

We studied imbricate wedges near Mad Dog field, along the Sigsbee Escarpment in the deepwater Gulf of Mexico. Geometries in this area were imaged on two overlapping 3D seismic datasets – a prestack-depth-migrated exploration survey and a depth-stretched, time-migrated high-resolution shallow-hazards survey. Shortening calculations indicate that 1-5% of bed lengths were lost to tectonic compaction during imbricate-wedge formation. This is very low relative to other estimates of tectonic compaction such as the 68% calculated in the Nankai accretionary prism. We suggest that this is due to extremely rapid formation of the Mad Dog imbricate wedges, which did not give fluids a chance to escape. The Mad Dog imbricate wedges lack any significant synkinematic sediments, indicating they developed over 10,000–20,000 years. The lack of tectonic compaction suggests these imbricate wedges were (and may currently still be) overpressured.

The magnitude of overpressure potentially found in these imbricate wedges was approximated using calculated tectonic compaction values and a simplified soil mechanics model. The modeled wedge yielded a pore pressure ratio ($\lambda) = 0.90$ at the onset of deformation and, assuming deformation ceased 84,000 years ago, presently $\lambda = 0.85$.