Analogue Modelling of Fold-and-Thrust Belts: Dynamic Interactions with Syn-tectonic Sedimentation and Erosion

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Thin-skinned fold and thrust belt systems generally develop as tapered wedges according to the critically-tapered Coulomb wedge theory. Syn-tectonic erosion and syn-tectonic sedimentation cause the removal of material from the from the rear of the wedge and its re-deposition in the foreland and at the front of the wedge. These processes both act to reduce the topographic slope of a thrust wedge causing a state of disequilibrium in the wedge thereby altering its evolution as it readjusts. In this poster, the effects of syn-tectonic sedimentation and erosion on simple, critically-tapered Coulomb wedges were evaluated by conducting twelve 2D analog model sandbox experiments.

At the thrust belt-scale, syn-tectonic sedimentation produced longer wedges composed of fewer major forward-vergent thrusts with lowered thrust activities in the foreland. Syn-tectonic erosion inhibited forward propagation of the deformation front, decreased the number of major thrusts, and increased thrust activities in the hinterland. Where combined, the effects of syn-tectonic sedimentation and erosion were complementary. At the scale of individual folds, syn-tectonic sedimentation altered fold evolution by producing limb rotation and a front-limb trishear zone formed by tip-line thrust splays.

Examples of natural thrust wedges including the deepwater Niger Delta fold belt, the Makran accretionary prism, offshore Iran, and subaerial thrust wedges in Taiwan and the sub-Andes show strong similarities to the physical models. The comparisons indicate that fold belts with little or no syn-tectonic sedimentation or erosion would tend to form well-ordered arrays of closely-spaced thrusts such as those found in accretionary prisms. In contrast, high syn-tectonic sedimentation would produce buried, widely-spaced thrusts in the foreland whereas high syn-tectonic erosion would produce very active hinterland thrusts. The changes in thrust wedge dynamics due to increased syn-tectonic erosion in the model wedges may indicate that sub-aerial fold and thrust belts, with higher erosion, would possibly evolve differently than their submarine counterparts. The results of these physical models have direct application to the interpretation of and understanding of thrust systems in hydrocarbon-bearing fold and thrust belts.