

# Style Variations in Thrust-and-Fold Belts: Insights From Numerical Mechanical Models

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## ABSTRACT

Although the orogenic scale mechanics of thin-skinned thrust-and-fold belts is relatively well understood, the mechanics of deformation at the scale of individual thrust sheets is more difficult to address, due to complex feedback relationships among components of the orogenic wedge. Fully coupled numerical dynamic models allow for a deeper understanding of these relationships, especially those involving surface processes (erosion and sedimentation).

We describe numerical experiments of thin-skinned thrust-and-fold belt deformation using a 2-D finite-element continuum mechanics code (developed by Philippe Fullsack, Dalhousie University) capable of accommodating very large strain. In the undeformed state, each model is composed of layered frictional (Coulomb plastic) material. During deformation, the upper surface of the thickening wedge can be exposed to surface processes, allowing erosional removal and redistribution of material. Although faults are not modelled explicitly, narrow high-strain zones develop, forming structures very similar in style to those in thrust-and-fold belts.

Even with very simple initial geometries, the experiments produce a wide variety of deformation patterns that we group into three basic structural styles: (1) a quasi-pure shear style, with little vertical variation in horizontal shortening; (2) a detached-layer style, with an internal detachment localized along a weak layer, and greater advance of the thrust front at a high structural level; and (3) a bi-vergent style characterized by the absence of a strong sense of foreland structural vergence. Our efforts to date suggest that these styles may represent mechanical “modes” adopted in part by the complex feedback relationships between internal wedge deformation and surface processes.