Physical Models of a Basic Triangle Zone
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We present the results of clay and rock model experiments that investigate the kinematic development of triangle zones. A basic triangle zone (Jamison, 1993) consists of three elements, which are a roof (or back) thrust, a floor thrust and a hinterlandward thrust that breaches the erosional surface. Our experiments address the first two elements of triangle zone formation and assume that the hinterlandward thrust is "behind" the moving piston. The models illustrate the progressive development and propagation of the bounding backthrust during early stages of triangle zone formation, and the deactivation of this backthrust associated with the extension of imbricate thrusts or the floor thrust of the triangle zone. Aspects of these models compare favorably to the Moxa Arch (Wyoming) and Turner Valley structures.

All clay (pottery) models consist of two layers with a foreland directed precut ramp in the lower layer. Initial models with various layer thicknesses, stiffness, and lubrication between layers and along the precut show that a roof backthrust forms in the upper layer above the lower hinge of the precut. This geometry was used to determine the placement of a precut backthrust ramp in the upper layer of subsequent models and thus defines the initial geometry of the triangle zone in the undeformed state (Figure 1). At 14% total shortening (Figure 1), the displacement on the precut ramp of the roof thrust (b) is approximately twice the displacement on the precut ramp in the floor thrust (a). In addition, displacement on the precut of the roof thrust is one third of the total shortening. Much of the total shortening in the models is achieved by pure shear thickening of the clay, particularly at the moving piston (end effects). Displacement along the floor thrust is associated with forward translation of the core wedge between layers A and B and internal shortening of the backthrust wedge. Up to this stage the triangle zone is mechanically stable. With an additional 5% shortening, the triangle zone is deactivated as the ramp of the roof thrust begins to propagate down through layer A toward the lower precut hinge, and the floor thrust propagates upward from the leading edge of layer A in the hanging wall of the floor thrust.

Physical models using rock deformed under pressure consist of a lower precut layer of brittle sandstone overlain by alternating layers of limestone and weak and ductile lead (Figure 2). These models investigate the geometry and kinematics in the frontal region of the triangle zone for the condition where the hanging wall of the roof thrust is mechanically layered. These models display relatively minor thickening of the core wedge, but the geometry of the triangle zone is progressively modified by forward directed imbrication in the frontal portion of the core wedge. At early stages of shortening (Figure 2) more than half of the total shortening and translation of the core wedge are accommodated by displacement along the roof thrust. The remaining shortening is achieved by folding of the hanging wall above the roof thrust. At later stages of shortening, folding and translation along the roof thrust are deactivated and the floor thrust propagates in the foreland direction.

The rock and clay models illustrate possible geometric changes of the core and backthrust wedges during the evolution of triangle zones. These changes eventually lead to abandonment of the triangle zone through the extension of imbricate thrusts or the floor thrust of the triangle zone.

References:
