Geometry and kinematics of inversion tectonics

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SUMMARY: Positive inversion tectonics involves the reversal of extensional fault movement during contractional tectonics. Basin stratigraphy developed before, during and after extensional fault movements may be described as pre-, syn- and postrift sequences. Growth fault activity may be graphically displayed using thickness changes in stratigraphic intervals from fault footwall to hanging wall. Alternatively, it may be recorded using a hanging wall displacement/distance plot. Contractional reactivation of extensional faults puts progressively older synrift markers into net contraction. The point of change from net extension to net contraction is the null point. Its position in the synrift stratigraphy may be used to quantify the inversion ratio, which is defined as the ratio of contractional to extensional movement. Negative inversion is the reactivation in extension of a significant portion of an existing contractional system. Stratigraphic separation diagrams constructed from geological maps may be used to define the null point of individual faults and to quantify their inversion ratio.

Basic nomenclature

Structural inversion occurs when basin-controlling extensional faults reverse their movement during compressional tectonics, and, to varying degrees, basins are turned inside out to become positive features. The result is that individual faults may retain net extension at depth and show net contraction associated with anticline growth in their upper portions (Fig. 1). The converse is also possible. Thus inversion can be considered in terms of both positive (uplift) and negative (subsidence) senses relative to the immediately preceeding history of a fault system (Glennie & Boegner 1981).

In this paper, a fault is considered to be of extensional mode if it involves the displacement of an approximately horizontal marker horizon in the fault hanging wall below its pre-deformational regional elevation, and is of contractional mode if a hanging wall marker is displaced above its regional elevation (Fig. 2). A marker horizon may consist of an originally horizontal or subhorizontal stratigraphic interface, a marker bed on a geological cross-section, or a sequence boundary on a seismic reflection section. This definition is simple; it does not involve discussions of net slip of the fault and closely resembles fault dip separation.

In our definition we consider apparent dip as portrayed in a cross-section or seismic section, rather than true fault dips. Cross-sections through a fault in any direction will reveal its extensional or contractional mode if our definition is applied. Only a perfectly bed-parallel fault (a flat on flat) and a perfectly strike-slip fault is neither extensional nor contractional and may be considered a neutral mode fault. A fault which appears vertical in the plane of a section cannot be classified in this scheme. Because net slip is not considered in this definition we may apply the contractional/extensional nomenclature to all faults including those

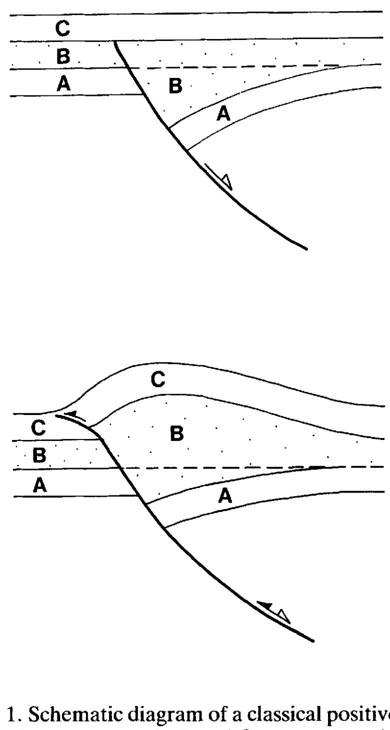

FIG. 1. Schematic diagram of a classical positive inversion structure. A, B and C are stratigraphic sequences. A, prerift; B, synrift; C, postrift sequence.

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