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Localisation of shortening in numerical models of basin inversion

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Extensional sedimentary basins form a lateral heterogeneity in the lithosphere that may localise deformation if the lithosphere is contracted. Shortening of basins may lead to reverse reactivation of normal faults and uplift and extrusion of basin fill sediments in a process which is referred to as basin inversion. Observations show that not only young, and weak, basins are inverted, but also older, and stronger, basins still localise shortening a long time after the thermal signature from extension has dissipated. We use a two-dimensional thermo-mechanical method to model extensional basin formation, post-rift cooling and subsequent shortening. The models are aimed at testing the ease of inversion and at investigating the sensitivity of inversion structures to mechanical and thermal variations.

Extension of our models leads to the formation of a sedimentary basin, or series of basins, with a generally symmetric geometry. These basins are easily inverted after a short post-rift cooling time, while long cooling and strengthening of the lithosphere tends to suppress basin inversion. Localisation of shortening in the model basin is promoted by: (1) strain-weakening of model shear zones in the extension phase, which helps their reactivation in contraction, (2) geometrical irregularities created in extension which focus later deformation, (3) lower density sediments which reduce the basin strength, and (4) sediment blanketing which may keep the basin warm, and thus weak, after a long post-rift cooling phase.