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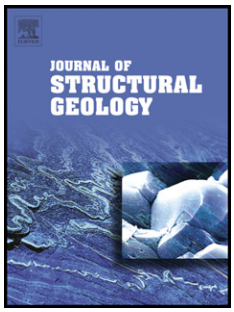

Area balancing as a test of models for the deep structure of mountain belts, with specific reference to the Alps

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Area balancing as a test of models for the deep structure of mountain belts, with specific reference to the Alps

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ABSTRACT

Basic concepts of structural restoration are applied to crustal cross-sections through mountain belts to explore large-scale tectonic models and deep structure. However, restored sections should account for variations in pre-orogenic crustal thicknesses. Crustal balancing approaches are reviewed and applied to two Alpine sections, coinciding with deep seismic experiments: NRP-20 East (Central Alps) and ECORS-CROP (Western Alps). Existing studies assume large (>300km) orogenic contraction and only moderately thinned pre-orogenic crust. The resulting restored sections contain more crust than is imaged beneath the present-day Alps, the missing crust generally assumed to be subducted. Two kinematic modifications reduce the requirement for subduction: thinning and buoyancy-driven return flow of ultra-high pressure metamorphic rocks during orogenesis; and pre-orogenic hyperextension. Using large stretching factors for the pre-orogenic crust negates crustal subduction on both Alpine transects. If the lower crust was approximately rigid, restorations of the Central Alps require strongly depth-heterogeneous stretching of upper and lower crust during Mesozoic rifting. Relaxing this requirement allows uniform lithospheric stretching, a corollary consistent with published subsidence estimates. Restorations make implicit statements on the form of pre-orogenic basins and the structure of continental margins incorporated into mountain belts that can in turn provide tests of tectonic models.

Highlights:

Workflows and methods are presented for crustal balancing through orogens.