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Origin of sinuous deformation patterns in hot, wide orogens

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Hot orogens are characterized by high crustal heat flow, pervasive felsic magmatism, large widths and distributed deformation. The Central Andes are a type example of an actively forming hot orogen. A prominent feature of this continental plateau and ancient hot orogens is the presence of anastomosing transpressive deformation zones. In the southern Central Andes, these zones form morphological ranges, which envelop elliptical to rhomb-shaped sedimentary basins. The cause of upper-crustal segmentation into rhomb-shaped, shear zone-bound domains associated with contractional sedimentary basins is not well understood. Here we use scaled multilayered analogue experiments to investigate the role of an orogen-parallel crustal-strength gradient on the formation of such structures. We show that the ellipticity and size of domains, the sinuous character and abundance of transpressional shear zones vary with the integrated mechanical strength of crust. Upper-crustal deformation patterns and the degree of strain localization in the experiments are controlled by the ratio between the brittle and ductile strength in the model crust as well as gradients in tectonic and buoyancy forces. The experimental results match the first-order kinematic and structural characteristics of the southern Central Andes and provide insight on the dynamics of underlying deformation patterns in hot, wide orogens.