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Roles of Strain Softening and Heterogeneity in Determining the Geometry of Rifts and Continental Margins

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Despite the large number of studies of continental rifts and rifted continental margins, many of which have produced high quality data, we still lack a unified understanding of the mechanical and thermal processes that control their extensional geometry. This problem is compounded by the wide range of styles that include both, non-volcanic and volcanic rifting. In addition, the relative importance of active versus passive rifting, that is whether rifting is driven by active mantle upwelling or whether mantle upwelling is a passive response to lithospheric extension remains to be determined

Previous work defined end-member styles of lithospheric extension and their associated geometries, pure shear, simple shear and combinations of these styles. These kinematic models served as templates for the interpretation of observations with the primary focus whether rifting is symmetric, or asymmetric as predicted by the simple shear template.

We use numerical modeling to investigate factors that are potentially important controls on the mode of lithospheric extension during non-volcanic passive rifting. We focus on processes that create shear zones and lead to mode selection, and the effects of noise in the context of 2D plane strain models of lithospheric rifting.

We assume that the lithosphere can be represented by a prototype uniform layered model comprising frictional-plastic and viscous layers and consider the effects of different factors or processes on the style of extension of this model lithosphere designed to answer the following particular questions. 1) What is the effect of strain-softening of the frictional-plastic parts of the system on the geometry during extension and does this feedback into mode selection? 2) Can mode selection be explained by a general

governing principle, in this case the minimum rate of dissipation of energy? 3) What is the effect of inherited inhomogeneity, ‘noise’, in the model crustal properties on the style of extension? Does mode selection still occur in the presence of noise, or does noise lead to incoherent extension that is merely an expression of the noise?