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Tectonic Inheritance in Continental Rifts and Passive Margins

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Tectonic Inheritance in Continental Rifts and Passive Margins

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Contents

Abstract

Tectonic inheritance deals with the influence of pre-existing or pre-rift elements on the geometry, genesis and propagation of rift-related faults. Inheritance strongly controls the architecture of continental rifts and passive margins. Experimental results demonstrated the importance of layering and mineralogical anisotropy in extensional deformations. For low-to-intermediate angles of the anisotropy to the maximum compression direction, faults formed within anisotropic rocks parallel to the pre-existing weakness. For high angles, the faults breach the weak planes but follow them in segments. Rocks usually are anisotropic and respond to extension more easily than to compression. Shallow anisotropies at the brittle upper crust are either pervasive or discrete. While foliations and layers define 'pervasive' fabrics, widely spaced isolated zones of weakness such as faults and shear zones define the 'discrete' ones. Pervasive fabrics govern the overall trend of the rifts in passive margins. The discrete fabrics form oblique to rifts or as transfer zones between propagating rift segments. Rheology of the pre-rift lithosphere controls the architecture of rifts and passive margins predominantly for levels deeper than the upper crust. The parameters controlling the architecture of rifts and passive margins are strength, crustal and lithospheric thicknesses, thermal state and strain rate. The first three factors are soft-linked. For example, the strength of the lithosphere depends on its composition, thickness and temperature (van der Pluijm and Marshak 2004). The thickness of the lithosphere—thicker for mobile belts and thinner for cratons—depends on the thermal age (=age of last tectonothermal event). Lithospheric thickness thus influences its thermal state also. Generally, rifting in thicker lithosphere diminishes rift shoulder topographies, whereas rifting in colder and thinner lithosphere forms $\sim$3–5 km elevated rift shoulders. Warmer lithosphere produces rifts narrower and faster than those within colder lithosphere. In this work, we bring together the concepts of the inheritance of pre-rift shallow (pervasive and discrete fabrics) and deep (lithosphere rheology) elements. Citing examples from intra-continental and rifted passive margins, we show that the process of tectonic inheritance remains active throughout the rifting episode.

Keywords Tectonic inheritance · Pre-existing anisotropies · Pervasive fabrics · Discrete fabrics · Lithosphere rheology · Rifting

Highlights

1. Tectonic inheritance of pre-existing anisotropies in rifting is universal.
2. Pervasive fabrics have a mode of influence different than discrete/isolated fabrics.
3. Lithosphere rheology is important in controlling the geometry, genesis and architecture of rifted basins.

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