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A Tectonic Model of Faulting during Rifting and the Development of the Asymmetry of Conjugate Non-volcanic Margins.

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The processes that form the structure of non-volcanic rifted margins are still extensively debated. A first widely recognized apparent paradox is that one margin displays gradual crustal thinning and pervasive faulting, whereas the conjugate displays far abrupter thinning but little faulting. Attempts to explain this structural asymmetry have invoked simple shear extension during much of the rifting along crustal- or lithospheric- scale detachment faults. However, seismic data have only convincingly imaged potential detachment faults near the continent-ocean transition, where the crust is extremely thinned to less than $\sim$6 km thick. Thus, those potential detachments could not explain the large-scale asymmetry of conjugate margins. A second often cited apparent paradox, for both conjugate margins, is the discrepancy between a seemingly small extension created by faulting (measured as horizontal stretching) compared to a greater crustal thinning (measured thinning factor). Invoked explanations range from rheologically-controlled depth dependent stretching to superposition of hypothesized multiple phases of extension. New depth migrated seismic images West-Iberia/Newfoundland conjugate margins used accurately calculate fault extension and compare it to measured crustal thinning resolve both paradoxes. The observations support a new model of faulting during rifting that produces a fault-controlled crustal thinning that naturally leads to the asymmetric structure of non-volcanic rifted margins.