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Modeling Rifting of the Iberian-Newfoundland Margin with Ellipsis

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Using the particle-in-cell software ELLIPSIS we examine the effects and relative importance of rheology, different initial weakness regimes and varying strain rates for rift geometry evolution. We apply our modeling strategy to investigate how a conjugate margin pair with geometry similar to that of the Iberian-Newfoundland margin may form by considering lateral changes in crustal thickness. The Gnu Public Licensed code ELLIPSIS is a finite element code in which Lagrangian integration points (or particles) capable of tracking time dependant variables are embedded in an Eulerian mesh allowing for the accurate tracking of surfaces and boundaries through time. We find that the degree of coupling/decoupling of the crust to the mantle controls the first order pattern of deformation. Decoupled models exhibit more uniform, homogeneous thinning of the crust over large regions with little localisation, while coupled models localise strain over discreet regions and produce a more typical rift basin structure. Including a single initial weakness in the model modulates both the wavelength and amplitude of the subsequent rift basin (and sympathetic rift basins) formed depending on the depth of the weakness in the crust. Shallower crustal weaknesses form smaller wavelength and smaller amplitude basins compared to models with a deeper crustal weakness. Crustal thickness is know to decrease from 40km over the Newfoundland margin to 30km over the Iberian margin, by including this lateral variation in crustal thickness in the model we find that without an imposed initial weakness a coupled model will produce a rift geometry temporally and spatially similar to that seen over the Iberian–Newfoundland conjugate margins where the Flemish Pass and Galicia Interior Basins opened initially and rifting and subsequent drifting started in the present location later. While crustal weaknesses can have a modulating effect on the geometry of rifts we find that the first order controls on rift geometry are the degree of coupling

between the crust and mantle and the strain rate.