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A discussion of margin width in numerical models of rifted passive margins

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Geophysical observations of passive continental margins point to a large range in margin widths. The crustal taper, measured from the relatively undisturbed continent to the highly extended distal margin (taken as thinning of the crust to less than 10 km), varies from ca. 100 km to over 500 km. Sharply tapered margins, such as the Møre and Lofoten parts of the Norwegian margin, the Red Sea, and parts of the East Greenland margin, correlate with high onshore topography. Long crustal tapers, such as the margins of mid-Norway, Morocco, and South Australia, correlate with less-elevated continental topography.

Dynamic numerical models on the scale of the lithosphere to the upper mantle dominantly produce sharply tapered margins. In these models the crust tends to be relatively strong and crustal break-up occurs along large shear zones before or concurrent with break-up of the sub-crustal mantle. A weak lower crust can lead to extremely thinned crust over several hundreds of kilometres, with mantle break-up occurring before crustal break-up. However, even in these high beta-factor models, the crustal taper between 'unextended' continent and the first seaward location of high extension is still short.

I use thermo-mechanical models of continental rifting to illustrate that the transition between modes of strong crustal thinning along large shear zones and long domains of extremely thinned crust depends on rheological stratification, extension velocity, and surface processes. This transition is fairly abrupt and models do not achieve a long crustal taper. This begs the question what is required for dynamic models in order to produce long crustal tapers? I hope that this poster contribution may start a discussion on possible mechanisms for achieving gradual crustal thinning gradients in passive margin models.