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Geodynamic modelling of continental lithosphere thinning leading to sea-floor spreading: Implications for post-breakup rifted margin hinterland uplift

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Post-breakup uplift of the continental hinterland has been observed along many rifted margins, including the margins bordering the North Atlantic, Brazil, Africa, India and eastern Australia. Hinterland uplift is in contrast to the post-breakup subsidence experienced by thinned continental margin lithosphere adjacent to the ocean-continent transition. The observed uplift has a width of several hundred kilometres and amplitude of the order of 1 – 1.5 km. Evidence suggests that uplifted rifted margin hinterlands have experienced multiple phases of post-breakup uplift, with the initial event being coincident with continental breakup and later events significantly post-dating rifting. Post-breakup uplift of passive margin continental hinterlands is predicted by a geodynamic model of continental breakup and sea-floor spreading initiation incorporating lithosphere thinning by simultaneous pure-shear and buoyancy assisted upwelling. The resultant flow field within continental lithosphere and asthenosphere has an increased ratio of upwelling velocity to divergent velocity (Vz/Vx) compared to a simple passive pure-shear lithosphere thinning model. This produces an outward flow of asthenosphere material towards the young continental margin lithosphere, thickening the adjacent continental lithosphere at distances beyond the region of localised continental breakup thinning. The immediate response to lithosphere thickening in the continental hinterland is to decrease the lithosphere geothermal gradient. This is in contrast to the elevated geothermal gradient in oceanic and thinned continental margin lithosphere. Re-equilibration of the geotherm causes cooling and subsidence of oceanic and thinned continental margin lithosphere, and warming and uplift of the thickened continental lithosphere inward of the rifted margin. The uplift of the con-

tinental hinterland is further amplified by isostatic rebound in response to erosion. The model predicts post-breakup hinterland uplift of amplitude up to 1 km and wavelength 300 km, located inboard of the region of continental lithosphere thinning. Results show that the Vz/Vx ratio of upwelling material due to induced buoyancy during early sea-floor spreading is the dominant control on the predicted thermal uplift.