Depth-Dependent Lithosphere Stretching at Riftted Continental Margins

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Depth-dependent stretching of the continental lithosphere appears to be a consistent observation at the outer ~ 100 km of rifted margins. Extension estimates have been independently determined from faulting, crustal thickness and post-rift thermal subsidence for the Goban-Spur, Galicia, Vøring, Møre, South China Sea and NW Australian rifted margins. Upper-crustal extension (derived from faulting) is significantly lower than estimates of crustal extension (from crustal thinning) or whole-lithosphere thinning (from post-rift thermal subsidence). Paradoxically, in terms of a delamination model all margins appear to be 'upper plate'.

We do not attribute the observation of depth-dependent stretching to be solely a result of second generation faulting, aseismic extension, sub-seismic resolution faulting, or simple shear. We suggest that depth-dependent stretching of rifted margins occurs during early sea-floor spreading and is an inevitable consequence of the initiation of this process. Finite-element models of the early sea-floor spreading process generate depth-dependent stretching consistent with observations. The observations of depth-dependent stretching, that margins are ubiquitously 'upper plate', and the resulting mass-conservation paradox are best explained by a transitional 'continent-ocean boundary' that exposes continental mantle at the surface as indicated by wide-angle seismology.