



## **Mantle exhumation at non-volcanic rifted margins due to melt suppression during continental break-up and seafloor spreading initiation.**

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Rifted continental margins exhibit large variations in magmatic activity associated with continental break-up. Non-volcanic margins may display a broad region, up to 150 km wide, of exhumed mantle separating oceanic crust from thinned continental crust, whilst voluminous volcanism accompanies break-up at volcanic margins. We have combined a decompression melting model with a model of continental rupture leading to seafloor spreading initiation. For a normal mantle potential temperature and slow extension/half-spreading rates ( $<10\text{mm/yr}$ ) we predict that broad regions of primitive mantle may be exhumed prior to melt production. Previous studies have shown the importance of asthenospheric temperature (White and McKenzie, 1989) the rate of thinning (Bown and White, 1995; Perez-Gussinye et al., 2006) and initial geotherm (Reston and Morgan, 2004) on melt production at rifted margins, assuming that continental break-up occurred by pure-shear stretching of the lithosphere. We model the onset and development of melt production during basin formation and rifted margin development using a model of depth-dependent lithospheric thinning and extension during continental break-up. In this model the thinning of continental lithosphere leading to break-up and sea-floor spreading initiation occurs in response to an upwelling and divergent flow-field which propagates from the base of the continental lithosphere to the surface. Existing melt parameterisations are used to calculate the fraction of melt produced as a function of temperature and pressure in the model space. Melt production reaches a steady state as the model reaches thermal equilibrium as seafloor spreading proceeds. By comparing our modelled margins to observations of crustal thickness, volcanic addition and/or mantle exhumation, stratigraphic history and geochemistry at volcanic and non-volcanic margins in the North Atlantic, we ex-

plote potential factors governing the structure and variability of rifted margins. We are able to account for a wide range of rifted margin structures by varying the upwelling and divergence velocities of the propagating flow-field at the site of continental break-up. When break-up is rapid, voluminous melt production occurs prior to break-up and the initiation of seafloor spreading, whereas at a slow half spreading rate of 5mm/yr, melt production is suppressed during the break-up process, and 90km of mantle is exhumed prior to melt initiation. We show that it is possible to exhume subcontinental or asthenospheric mantle without the requirement of large detachment faults. Similar to ultraslow spreading ridges, mantle exhumation at non-volcanic margins appears to be due to melt suppression during the break-up process.