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Mantle exhumation at magma-poor rifted margin: a competition between frictional shear zones and thermally weakened necking domains. Consequences on time of breakup at Galicia/Newfoundland margins.

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Here we present a new analysis and interpretation of basement topography of the transitional domain from continental to oceanic crust along the conjugate margin sections SCREETCH-1 (Newfoundland) and WE-1/ISE-1 (Galicia Bank). The absence of significant syn-rift magmatism in this area allows using 2-D thermo-mechanical modelling to understand the formation of the distal margin and exhumed mantle. We show that plastic strain weakening of the exhumed mantle is required to explain observations on basement morphology, and detachment faulting. Our models predict that the evolution of detachment faulting within the transitional domain depends on the degree of frictional-plastic strain-weakening and varies from a single unique steady state asymmetric low angle detachment fault for large degree of strain weakening to multiple out-of-sequence forming detachments with or without dip reversal for lower amounts of strain-weakening. The model behaviour is a consequence of the competition between weak frictional-plastic shear zones and the thermally weakened necking domain in the footwall. The forward models reproduce elevations, wavelength of exhumed mantle ridges for a narrow range of rift velocities between 10 and 15 mm/yr and considering the increasing thermal conductivity of peridotites at shallow depth. This causes an efficient cooling of the footwall that has then enough strength to support high topography. The forward models also predict that the peridotite ridge is the breakaway of a second detachment fault that dates the crustal breakup and that rocks on top of the peridotite ridge have experimented a fast cooling (< 2 Ma). We use predictions from these forward models to discuss time of breakup and the position of the first steady state oceanic ridge at Galicia/Newfounland conjugate margins.