



Strained to breaking point – Extreme crustal stretching and mantle exhumation by successive detachment faults at the Porcupine Basin, west of Ireland.

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The Porcupine Basin shares many characteristics with magma-poor rifted margins (MPRMs) such as the West Iberian Margin and the Newfoundland Rifted Margin, and may be considered to be a Magma-Poor Aulacogen, a conjugate pair of failed MPRMs that are not separated by wide expanses of oceanic crust. Wide-Angle seismic experiments (RAPIDS4 & PIMS4) have shown that the crust beneath the basin is extremely thin, 2-3km thick in places, and that extensive serpentinisation of the subcontinental mantle has occurred. Since the Porcupine Basin is an aulacogen, both conjugate margins may be imaged on a single seismic profile and the basin is the perfect natural laboratory to study the onset of crustal rupture and break-up.

Here, we present a suite of 2D seismic profiles (time & depth migrated) that image the entire crustal thickness in the central part of the basin. These data clearly demonstrate increasing crustal stretching southwards. We show that, following crustal embrittlement, strain is strongly focused onto a westward dipping, low-angle structure known as the P-detachment, reducing crustal thickness from c. 10km to c. 2km beneath the basin. Strain is then transferred to a second generation “exhumation” detachment fault which cross-cuts the P-detachment unroofing a portion of the serpentinised mantle. In turn, the P-detachment and overlying crust in its hangingwall are uplifted and flexurally rotated in the footwall of the new exhumation detachment fault, forming part of the Porcupine Median Ridge.

The data suggest that after an initial phase of stretching had thinned the crust to c. 10 km, a throughgoing detachment system developed, probably active as a rolling-hinge, accompanied by serpentinisation of the mantle in the basin centre. The subsequent abandonment and dissection of the detachment system may be analogous to the faulting observed to postdate and cut the S and H detachments of the Iberia margin, resulting in the unroofing of mantle rocks.