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The Porcupine Basin: from rifting to continental breakup

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Southwest of Ireland, the Porcupine Basin is characterized by axial stretching factors that increase southward to values greater than six and typical of rifted margins. As such, the basin can be regarded as a natural laboratory to investigate the evolution and symmetry of rifting leading towards continental separation and breakup, and in particular the processes of mantle serpentinisation, and the onset of detachment faulting. We have processed through to prestack depth migration a series of E-W profiles crossing the basin at different axial stretching factors and linked by a N-S profile running close to the rift axis. Our results constrain the structure of the basin and have implications for the evolution of rifted margins. In the north at a latitude of 52.25N, no clear detachment is imaged, although faults do appear to cut down into the mantle, so that serpentinisation may have started. Further south (51.75N), a bright re[U+FB02]ection (here named P) cuts down to the west from the base of the sedimentary section, is overlain by small fault blocks and appears to represent a detachment fault. P may in part follow the top of partially serpentinized mantle: this interpretation is consistent with gravity modelling, with numerical models of crustal embrittlement and mantle serpentinization during extension and with wide-angle data (see posters of Prada and of Watremez). Furthermore, P closely resembles the S re[U+FB02]ection west of Iberia, where such serpentinites are well documented. P develops where the crust was thinned to less than 3 km during rifting, again similar to S. Although overall the basin remains symmetrical, the consistent westward structural dip of the detachment implies that, at high stretching factors, extension became asymmetric. Analysis of the depth sections suggests that the detachment may have been active as a rolling hinge rooting at low-angle beneath the Porcupine Bank, consistent with the presence of a footwall of serpentinites. This requires very weak fault rocks, such as serpentinites. Reconstructions suggest that the detachment developed after the onset of serpentinisation and thus represents late stage of faulting within a complex polyphase rift history.
Farther south still, a N-S running profile shows that P cuts up to form the top of the basement, and locally forms the top of what we interpret as exhumed mantle, since buried by postrift sediments. Thus detachment here appear to have been both responsible for the late-stage extension of the crust and the unroofing of the mantle. The same processes are likely to have occurred at magma poor rifted margins.