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Depth imaging of detachment tectonics in the Porcupine Basin west of Ireland

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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. In the north, no clear detachment is imaged, although faults do appear to cut down into the mantle, so that serpentinisation may have started. Further south, a bright reflection (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 poster of G. Wagner et al.). Furthermore, P closely resembles the S reflection west of Iberia, where such serpentinites are well documented. P develops where the crust was thinned to about 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. This requires very weak fault rocks, possibly in combination with some fluid overpressure. 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, the ‘Porcupine Median High’, appearing lens-shaped in cross-section, overlies the tilted fault blocks and is onlapped by postrift sediment. Despite no evidence for synrift magmatism, this high has previously been interpreted as a basaltic

structure. However, the reflection from the top of the wedge is weak, not normally associated with basalts, and it develops above the line of intersection of the crust-mantle boundary with the P detachment, and hence may be a serpentinite structure, related to the spatial limit of serpentinization.