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An assessment of the cause of the "Extension Discrepancy" with reference to the west Galicia margin

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A common observation at rifted margins is that the amount of extension measurable from faulting is too little to explain the observed crustal thinning and subsidence. This is the "extension discrepancy". Several causes have been proposed, including depth-dependent stretching or thinning, sequential faulting, subseismic faulting and polyphase faulting. In this contribution we explore the different possibilities, with specific reference to the West Galicia margin. If we take the observations at face value, then it seems unavoidable that the upper crust must be stretched and thinned less than the middle and lower crust, however is it unclear where the displaced lower crust has gone as there is no inverse discrepancy. Furthermore, there is independent evidence against large-scale DDS from seismic velocities and from the occurrence of upper crustal, lower crustal and mantle rocks in close proximity at the deep margin. We thus reject DDS as a sole cause of the extension discrepancy, although recognise that small-scale local DDS associated with asymmetric faulting is expected. Such small-scale DDS is an inherent part of models of sequential faulting, but these do not predict an overall extension discrepancy, so cannot alone explain one. Subseismic faulting also alone seems inadequate as it cannot explain the extreme thinning observed at the deep margin. However, as subseismic faulting is a requirement of the fractal distribution of fault sizes and the limited resolution of the seismic method, it most certainly does contribute to the extension discrepancy. Polyphase faulting, in which the thinnest crust has been affected by more than one phase of faulting, resulting in complex and poorly imaged structural architecture, is both predicted at deep margins, and in combination with subseismic faulting, capable of explaining the extension discrepancy. We demonstrate that the west Galicia margin has undergone more than one phase of faults, that these faults cross-cut each other, leading to complex geometries.