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How syn-rift sedimentation promotes the formation of hyper-extended margins

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Seismic observations show that some rifted continental margins may have substantial amounts of offshore sediments. For example, sediment layers of several kilometres thick are found on the margins of Mid Norway, Namibia and Angola. Intriguingly, these margins are wide, being characterised by distances of several hundreds of kilometres from typical continental crustal thicknesses of 30-40 km to clearly identifiable oceanic crust. On the other hand, some margins that are sediment-starved, such as Goban Spur, Flemish Cap and Northern Norway, have short onshore-to-offshore transitions. Variations in the amount of sediments not only impact the development of offshore sedimentary basins, but the changes in mass balance by erosion and sedimentation can also interact with extensional tectonic processes. In convergent settings, such feedback relationships between erosion and tectonic deformation have long been highlighted: Erosion reduces the elevation and width of mountain belts and in turn tectonic activity and exhumation are focused at regions of enhanced erosion. But what is the role played by surface processes during formation of rifted continental margins?

I use geodynamic finite-element experiments to explore the response of continental rifts to erosion and sedimentation from initial rifting to continental break-up. The experiments predict that rifted margins with thick syn-rift sedimentary packages are more likely to form hyper-extended crust and require more stretching to achieve continental break-up than sediment-starved margins. These findings imply that surface processes can control the style of continental break-up and that the role of sedimentation in rifted margin evolution goes far beyond the simple exertion of a passive weight.