



Lithosphere detachment below rift margins: implications for depth dependent extension and recycling of lithosphere material

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Many passive rifted margins are characterized by depth dependent thinning whereby the mantle lithosphere seems to have been thinned more than the crust. Examples include the Exmouth Plateau and North Atlantic margins. Here we propose an explanation for this observation that is supported by numerical models. Instabilities of the lithosphere develop during the late syn-rift stage below the margins of the rift zone. The instabilities develop preferably around heterogeneities in the lithosphere such as rift margins, where lateral thermal variations promote the development of small-scale convection cells. Our models show that the drips (the instabilities) that are formed consist of lower lithosphere material. When the drips detach and sink into the upper mantle, they actually remove base lithosphere material from the lithosphere. The lithosphere thus experiences additional thinning. Because the drips do not develop until the rift zone is well developed (late syn-rift to early post breakup), continental rifts such as the North Sea Basin did not experience depth dependent thinning.

Another consequence of this process is that the detachment of the drips provides a way to recycle lithosphere material into the upper mantle below passive rifted margins. This could help explain the chemistry of some melts that have a lithospheric component.