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Post-rifting passive margins uplift induced by conductive 2D thermal evolution of the lithosphere

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Lots of passive margins have been uplifted during their post-rifting history, resulting in high topography. Topographic observations on passive continental margins show that volcanic passive margins stand 2 to 3 times higher than non-volcanic margins. The temperature of the passive margin lithosphere, that is higher in the volcanic case, may infer on the vertical motions observed. We have therefore investigated the post-breakup vertical motions of passive margins as a result of the post-rift 2D conductive thermal evolution. This thermal evolution is well known in 1D with the McKenzie model but remains however poorly constrained in 2D. A 2D finite element numerical model was so performed to evaluate both the vertical and horizontal conduction driven thermal evolution of continental passive margins, from breakup to post-breakup thermal equilibrium, as well as the resulting rheology modifications. Breakup temperature configurations of non-volcanic and volcanic margins are tested, and lead to different thermal evolution of the lithosphere. For both margins, a thermal cooling is observed in the stretched part resulting in thickening of the lithosphere. In the unstretched lithosphere, the thermal evolution leads first to a thermal heating resulting in lithosphere thinning, and secondly to a thermal cooling resulting in lithosphere thickening. In comparison with non-volcanic margins, volcanic margins show a slower thermal thickening and a greater thermal thinning in stretched and unstretched lithosphere respectively. The lithosphere thickness variations translated into isostatic vertical movements, reveal seaward thermal induced subsidence and landward thermal induced uplift. The estimated uplift reaches a few hundred meters in volcanic margins and only tens of meters in non-volcanic margins. These thermal induced vertical motions are small compared to the topographic observations made in nature. There-

fore, others mechanisms like flexural, erosional or tectonic motions must as well be considered to explain the margins topography differences.