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Rift-flank uplift and rift dynamics, a new perspective

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In this contribution we present a new model of passive rifting and related rift-flank uplift. The numerical model is based on a lattice spring network coupled with a viscous particle model so that we can simulate visco-elasto-plastic behaviour with dynamic fault development. In our model we show that rift flank uplift can be achieved best when extension in the crust is localized and the lower crust is strong so that major rift faults transsect the whole crust. Uplift of rift flanks follows a smooth function whereas down-throw in the rift basin takes place in steps. The geometry of the developing faults has also an influence on the uplift, in this case displacement along major rift faults produces higher flanks than distributed displacement on many faults. Our model also shows that the relative elastic thickness of the crust has only a minor influence on the uplift since fault depth and elastic thickness are not independent. In addition we show with a second set of simulations and analytically that a strain misfit between the upper and lower boundaries of a stretched crust leads to an active uplift driven by elastic forces. We compare the numerical simulations, the analytical solution and real surface data from the Albertine rift in the East African Rift System and show that our new model can reproduce realistic features. Our two-layer beam model with strain misfit can also explain why a thick crust in the simulations can have an even higher rift flank than a thin crust even though the thin crust topography has a higher curvature. We discuss the implications of our simulations for real rift systems and for the current theory of rift flank uplift.