Erosional Forcing on Basin Dynamics: New Aspects of Syn- and Post-Rift Evolution

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We propose a fully coupled 3-fold numerical model of basin evolution, which accounts for surface processes (erosion, transport sedimentation), brittle-elastic-ductile rheology, thermal transport and fault localisation. Fault distribution and evolution are important outputs of the model, allowing for better constraints on the results. We investigate thermo-mechanical consequences of surface processes on syn- and post-rift phases. Basically overlooked in the conventional models, surface processes modify the topography and sedimentary infill at rates of several 0.1 mm/y comparable with those of the tectonic uplift implying a strong coupling between the surface and tectonic processes. Sedimentation and erosion on the inward sides of the rift margins and inside the basin lead to localised inelastic weakening of the lithosphere that partly compensates the effects of thermal cooling, accelerates subsidence and increases by a factor of 1,5 - 2 the effective coefficients of extension. Erosional unloading of rift shoulders leads to local strengthening and flexural rebound. Pressure gradients induced by subsidence/rebound result in lower crustal flow, which may effect subsidence rates, stability of the rift shoulders and drive some post-rift extension or compression. It may also result in syn-rift uplift or delayed subsidence of the basement provoked by "switching" of the necking level from one competent lithospheric layer to another. Syn- and post-rift stagnation, upward and downward accelerations are naturally explained in our model without necessity to invoke external mechanisms such as phase transitions or post-rift compression. The effects revealed can significantly change the predictions of basin evolution inferred from the back-stripping models.