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Multiple uplift phases inferred from the Southwest African Atlantic margin

Magdalena Scheck-Wenderoth, Mauro Cacace, and Ingo Dressel
Helmholtz Centre Potsdam GFZ, Section 4.4 Basin Analysis, Potsdam, Germany (leni@gfz-potsdam.de)

The South Atlantic basins offshore Namibia and South Africa stored more than 10 km thick sedimentary successions that are separated by major unconformities into several sequences. These sedimentary units rest on a thinned continental crust of a magmatic passive margin. Using a 3D forward modelling approach considering flexural compensation of a rheologically differentiated lithosphere in response to sedimentary loading after stretching on one hand and the thermal feed-back between cooling of the stretched lithosphere and insulating sediments on the other hand we derive quantitative estimates on how vertical movements have influenced the margin after stretching. The approach combines the consideration of observations on sediment configuration as well as on crustal thickness (ß-factor) with the process of lithosphere thinning and subsequent thermal re-equilibration. These estimates are conservative estimates as they are based on the preserved sediments only whereas eroded sediments are not considered. Nevertheless, the approach considers thermo-mechanical coupling in 3D and both initial conditions as well as sedimentary history are constrained by observations. Specific effects include the delayed thermal re-equilibration of the thinned lithosphere due to deposition of insulating sediments and the related thermal feedback on lithosphere rheology and therefore on the flexural response to sediment loading. Our results indicate that in addition to predominantly continuous subsidence also phases of uplift have affected the southwestern African margin during the syn-rift and post-rift evolution. The spatio-temporal variation of vertical movements is controlled by the amount of initial thinning of the lithosphere, the variation of rheological characteristics (lithology and temperature) but also by the distribution of sediment supply (loading and thermal insulation).