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Coupling thermo-mecanical simulation and stratigraphic modelling: impact of lithosphere deformation on stratigraphic architecture of passive margin basins.

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The aim of this study is to revise the view of the long-term stratigraphic trends of the Atlantic-type passive margins to include the impact of the coupling between the lithosphere deformation and the surface processes. However, modeling coupling lithosphere deformation and surface processes usually address large-scale deformation processes, i.e. they cannot resolve the stratigraphic trend of the simulated basins. On the other hand, models dedicated to stratigraphic simulation do not include these feedbacks of erosion/sedimentation on deformation processes. The recent development of a numerical modeling tool, coupling the thermal and flexural evolution of the lithosphere and including the (un)loading effects of surface processes in 3D (Flex3D; J. Braun), allows us to propose a new procedure to investigate, in 3D, the evolution of passive margins, from the scale of the lithosphere to the detailed stratigraphic architecture, including syn- and post-rift phases and onshore and offshore domains.
To do this, we first simulate the syn-rift phase of lithosphere stretching by thermo-mechanical modeling (Sopal, R. Huismans). We use the resulting lithosphere geometry as input of the 3D flexural modeling to simulate the post-rift evolution of the margin. We then use the resulting accumulation and subsidence histories as input of the stratigraphic simulation (Dionisos, D. Granjeon) to model the detailed stratigraphic architecture of the basin. Using this procedure, we evaluate the signature of various boundary conditions (lithosphere geometries and thermal states, stretching distributions, surface processes efficiencies and drainage organization) in the uplift/subsidence and denudation histories as well as in the stratigraphic architectures of the associated sedimentary basins. We apply the procedure to the case study of the passive margins bounding the Southern Africa plateau, for which we have compiled data constraining the thermal history, the terrigeneous sediment accumulations, and the long term stratigraphic architectures.