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Relief evolution of Africa since 300 Ma: outcomes of the TopoAfrica project

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The goal of this project was to quantify the growth of long wavelength (x1000 km) topography over the last 300 My at the scale of a continent – Africa – and to understand (1) their relationship with the underlying mantle dynamics over such a time period and (2) their consequence over some Earth surface processes.
A direct inversion of the geological data into estimates of paleotopography is difficult. Quantification of past topographies of a continent requires coupling of geological data with a sediment production (erosion) and transport numerical model. The quantification of the Meso-Cenozoic topographies of the African continent is based on uplift (mean time interval 10 my) and paleoprecipitation maps (input of the model) and siliciclastic sedimentary fluxes and thermochronological data.
• No relief, older than Late Cretaceous (75-65 Ma), are preserved in Africa. This oldest relief corresponds to part of the present-day South African Plateau. Northward, no relief is older than the Middle Eocene (50-40 Ma).
• This implies that for past relief reconstruction, the geomorphological analysis is only efficient for the second half of the Cenozoic. For oldest periods, a model-based approach such as the one developed in the project is required.
• The mantle dynamic cannot explain all the long wavelength relief of Africa, even during Cenozoic times. The critical point was the movement of the African plate over the African superplume, perennial since at least the Early Cretaceous (110-100 Ma): this horizontal movement controlled the uplift of the South African Plateau during Late Cretaceous times (90-75 Ma). Other mechanisms have to be involved to explain the growth of the marginal bulges of the South Atlantic margins or the double bending of the Congo Cuvette during Neogene times.
• The weak point of the project is the palaeoclimate and mainly the paleoprecipitation quantifications, key information for the understanding of relief evolution. Few geological studies are available (paleosoils, wood and pollen analysis…) and difficult to quantify. On the other hand, most of the paleoclimate models are unable to predict the birth of the main desert of Africa at the right period and, then, cannot be used as an input for paleoprecipitation in our model of sediment production and transport.

Keywords: Africa, Relief, Mantle dynamics, Paleoclimate, Mesozoic, Cenozoic