Geophysical Research Abstracts
Vol. 15, EGU2013-1578, 2013
EGU General Assembly 2013

Evolution of Neogene Dynamic Topography in Africa

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The characteristic basins and swells of Africa's surface topography probably reflect patterns of convective circulation in the sub-lithospheric mantle. We have interrogated drainage networks to determine the spatial and temporal pattern of convectively driven uplift. ∼560 longitudinal river profiles were extracted from a digital elevation model of Africa. An inverse model is then used to minimise the misfit between observed and calculated river profiles as a function of uplift rate history. During inversion, the residual misfit decreases from ∼22 to ∼5. Our results suggest that Africa's topography began to grow most rapidly after ∼30 Ma at peak uplift rates of 0.1–0.15 mm/yr. The algorithm resolves distinct phases of uplift which generate localized swells of high topography and relief (e.g. the Angolan Dome). Uplift rate histories are shown to vary significantly from swell to swell. The calculated magnitudes, timing, and location of uplift agree well with local independent geological constraints, such as intense volcanism at Hoggar (42-39 Ma) and Afar (31–29 Ma), uplifted marine terraces, and warped peneplains. We have also calculated solid sediment flux histories for major African deltas which have persisted through time. This onshore record provides an important indirect constraint on the history of vertical motions at the surface, and agrees well with the offshore flux record, obtained from mapping isopachs of deltaic sediments. Our modelling and reconstructed sedimentary flux histories indicate that the evolution of drainage networks may contain useful information about mantle convective processes.