



Rapid plate motion variations and continental uplift: a window on the history of asthenospheric flow

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Since the rifting of Gondwana \approx 150 Myrs ago the South Atlantic Ocean experienced two phases of fast spreading in Late Cretaceous and Oligocene-Miocene, separated by a period of slow spreading around the K-T boundary and concluded by the recent slowdown since the Messinian. At the same time, it is becoming clear that the topographic evolution of Africa is characterized by two main periods of widespread uplift. These periods of uplift are co-eval with the two phases of fast spreading. The present-day situation presents an oceanic basin characterized by a strong topographic gradient with Africa being elevated and South America being depressed by non-isostatic forcing. These observations — in particular the fast time-scale of plate motion variations — are difficult to explain via shallow tectonic forces acting in the lithosphere. However, they are completely consistent with the fluid dynamics of a thin and low-viscosity asthenosphere. In particular, they can be easily understood as the result of unsteady pressure-driven flow in such a low-viscosity sublithospheric layer. Moreover, the idea of a thin asthenosphere of low viscosity is corroborated by a number of observations and inferences, ranging from seismic tomography to glacial isostatic adjustment to mineral physics.