Geophysical Research Abstracts
Vol. 15, EGU2013-5967, 2013
EGU General Assembly 2013

Intracratonic basin subsidence: a legacy of continental break-up?

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Intracratonic basins are enigmatic, large, and very long-lived sedimentary basins that exits across all the continental landmasses. After formation the subsidence history continues for hundreds of millions of years, providing a potential archive of change in climate and mantle dynamics. Subsidence within these basins initiates during periods of break-up and dispersal of super-continental assemblies. The long-lived subsidence history then contains episodic periods of uplift and subsidence at intervals of 20 to 50 Myr. We propose that intracontinental basins are formed by extension of the lithosphere, related to continental break-up. The subsequent episodic subsidence is driven by the lateral density contrast at the transition from oceanic to continental lithosphere at the passive margin.

Continental lithosphere is melt depleted, buoyant and thick. It will resist convective breakdown into the asthenosphere below, but will be prone to lateral flow due to horizontal density contrasts. Changes in lithosphere thickness at the transition between continent and ocean will nucleate convection cells. Using a numerical model of viscous upper mantle flow we show that stability or instability of the continental lithosphere at a passive margin is a function of the lithospheric rheology and composition. In model simulations, a continental lithosphere thought typical of the Phanerozoic continental platform experiences a topographic fluctuations due to an evolving array of convection cells in the mantle. The timing and magnitude of predicted changes in topography are similar to those observed at the eastern North American margin and the Congo Basin in Africa. The open question is if these small-scale instabilities will eventually lead to the onset of subduction and the destruction of the margin.