Uplifting Africa: Why is it so high and how and when did it get up there?

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The topography of southern Africa is unusual and important in a global context because it is anomalously elevated (large areas over 1000 m) relative to other continents (e.g. Nyblade and Robinson, 1994), and because understanding its evolution would advance knowledge about the coupling between deep mantle flow and dynamic topography. The Earth's largest low seismic velocity anomaly occurs in the mid-lower mantle beneath southern Africa and its discovery has catalysed interest in the role mantle convection plays in generating large scale dynamic topography (e.g. Lithgow-Bertelloni and Silver, 1998; Al-Hajri et al. 2009; Forte et al. 2010).

While there is clear evidence that low seismic velocities exist within the deep mantle beneath Africa there is still debate about the relative contributions to the cause of the anomalous velocities from competing chemical and thermal effects and the consequent net vertical buoyancy and flow (e.g. Forte et al. 2010). Also, the rate of convection in theoretical models is a strong function of the viscosity structure prescribed for the mantle and this in turn is strongly linked to the rates of surface uplift predicted by them, and the magnitude of uplift is strongly linked to the density structure as well as viscosity. Uncertainty about these variables and their dependence on temperature and pressure remains a problem (e.g. Conrad and Gurnis, 2003). These issues all lead to uncertainty in both the timing, and critically, the amplitude and even sign of predicted uplift.

In this seminar the implications of a large thermochronology data set (AFT and U-Th/He analysis) for understanding the timing and amount of erosion and uplift across southern Africa, with emphasis on how these data may be reconciled with geodynamic studies discussed above and with other studies of the morphotectonic history (e.g. Burke and Gunnell, 2008; Moore et al., 2009), will be discussed. The African data indicate at least two major periods of erosion affecting the continental margins and interior; one associated with continental break-up in the early Cretaceous (c. 120-130 Ma) and a later period during the mid-Cretaceous (c. 100-90 Ma) which is thought to relate to deep mantle and/or lithospheric processes. The complete uplift history clearly contains interacting elements of several different driving mechanisms, operating at different spatial scales and possibly at different times producing discrete localized uplift as well as regional uplift and some thoughts on how these might be distinguished will be presented.

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