TOMOGRAPHY AND THE THERMAL EVOLUTION OF THE EAST AFRICAN RIFT SYSTEM

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We compare regional tomographic experiments in East Africa and the other major continental rift zones with thermo-tectonic histories. Lenardic and Kaula (1995) show that a continental plate that has cooled, and drifts over the mantle, carries its thermal structure with it. Having cooled, it is not in thermal equilibrium with the warmer mantle below. The temperature gradient limits the amount of heat conducted out of the mantle to a value lower than that need to rid the mantle of its heat. The extra heat from the mantle then must either flow laterally via convection, and escape through easier routes to the surface, or cause the mantle to heat up. We propose that part of this lateral escape has been achieved at the formation of new ocean floor around Africa associated with the breakup of Pangaea. However, as the plate has grown, the escape route has lengthened causing it to be less efficient, and so the mantle has heated up. The heating has caused the overall high elevation of the African continent. The associated departure from thermal equilibrium in the African mantle has given rise to vigorous convection, probably initiated at 30 my, whereby the base of the lithosphere is eroded by upwelling convection currents. Asthenospheric convection explains the pattern of domal uplifts and basins superposed on elevated topography across Africa and associated tomographic velocity anomalies.