SEISMIC VELOCITY STRUCTURE OF THE UPPER MANTLE BENEATH THE EAST AFRICAN RIFT SYSTEM: EVIDENCE FOR A MANTLE PLUME

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East Africa has long been regarded as a region of incipient continental breakup. The Archean Tanzania Craton lies within the center of the East African Plateau and is surrounded by several Proterozoic mobile belts. The Cenozoic rift valleys have developed primarily within the mobile belts. To examine upper mantle structure beneath the East African plateau, local, regional, and teleseismic earthquakes were recorded in Tanzania for one year (1994-1995 using 20 broadband seismographs. Tomographic inversion of teleseismic P and S wave travel times indicates that high-velocity lithosphere beneath the Tanzania Craton extends to a depth of at least 200 km and that low velocity regions beneath the East African rifts extend to depths below 400 km. The velocity contrast between upper mantle under the craton and the rifted mobile belts is about 5 to 6 percent. Results from stacking receiver functions indicate that the 410 km discontinuity is depressed by 20-30km beneath the Eastern rift. In contrast, the 660 km discontinuity shows little relief. The upper mantle seismic velocity variations coupled with the structure of the 410 and 660 km discontinuities reveal a 200-400 km wide thermal anomaly extending into but not necessarily through the transition zone. This finding is not easily explained with models of small-scale mantle convection induced by passive stretching of the lithosphere but is consistent with the presence of a mantle plume, provided that a plume head lies beneath the eastern margin of the Tanzania Craton.