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Lithospheric structure of Africa: insights from its effective elastic thickness variations.

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Detailed images of lithospheric structure can help understand how surface deformation is related to Earth's deep structure. A proxy for lithospheric structure is its effective elastic thickness, Te, which mainly depends on its thermal state and composition. We present a new effective elastic thickness, Te, map of the African lithosphere estimated using the coherence function between topography and Bouguer anomaly. The Bouguer anomaly used in this study derives from the EGM 2008 model, which constitutes the highest resolution gravity database over Africa, allowing a significant improvement on lateral resolution in Te. Our map shows that Te is high > 100 km, in the West African, Congo, Kalahari and Tanzania cratons. Of these, the Kalahari presents the thinnest elastic thicknesses and, based on additional seismic and mineral physics studies, we suggest this may reflect modification of the lithosphere by anomalously hot mantle beneath the lithosphere. The effective elastic thickness is lowest beneath the Afar and Main Ethiopian rifts, where the maximum extension and thinnest lithosphere of Africa occur. The Tanzania craton appears as two rigid blocks separated by a relatively low Te area located southwest of lake Victoria. This coincides with the centre of seismic radial anisotropy beneath the craton, suggested to be the Victoria plume head by Weertrane et al. [2003]. Along the eastern branch of the East African rift Te is low and increases abruptly at 2 to 3 degrees South, coinciding with a deepening of earthquake depocenter and a change from narrow to wide rifting. These and other considerations suggest that the southern part of the eastern branch is underlain by thick, rigid cratonic lithosphere. Finally, the northern part of Africa is characterised by low Te on the Darfur, Tibesti, Hoggar and Cameroon line volcanic provinces, suggesting that the underlying lithospheric mantle has been thermally thinned. Corridors of low Te connect these volcanic provinces, supporting the idea that hot mantle flows between them. However, a thin corridor between these volcanic provinces and the Afar hot-spot is less obvious.