Geophysical Research Abstracts
Vol. 13, EGU2011-4755, 2011
EGU General Assembly 2011

A comparison of seismological and electromagnetic proxies for the LAB in southern Africa

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Seismic proxies for the locations of the lithosphere-asthenosphere boundary (LAB) from tomographic models included: maximum depth extent of a particular velocity perturbation (e.g. 2%) above a global reference model, depth to an absolute velocity, and depth to the maximum negative gradient in velocity. Tomographic velocity models have more recently been converted to temperatures in an attempt to obtain directly the depth of the thermal boundary layer (TBL). In contrast, magnetotelluric estimates of the LAB are normally based on a rapid increase in conductivity (rapid reduction in resistivity) often explained by the presence of water and/or partial melt, and as such should give complementary information to the seismic results.

We compare results from recent surface wave tomography and MT studies across southern Africa and produce new estimates of the depth to the LAB. Within the lithosphere the two datasets show broadly compatible features, and temperature is the dominant control on both resistivity and seismic velocity. To first order the LAB depth estimates are also similar and show reasonable agreement with petrological estimates from xenoliths in the extensive kimberlites. However, more insight into the nature, and uniformity, of the LAB can be obtained from a detailed comparison. Is there a systematic difference in depth between the two approaches – thus implying the same physical process throughout the region? Is a stronger electrical boundary observed in regions with hotter (upwelling?) asthenospheric mantle? Are there distinct seismic low velocity zones in regions that have rapid changes in resistivity? The comparison of these complementary data sets should also give additional insight into the likely cause of seismic discontinuities observed at about 150 km depth in receiver function analysis of the Kaapvaal Craton, which have previously been interpreted as either the LAB or an intracratonic discontinuity.