Paper Number: 4893

Imaging the lithosphere-asthenosphere boundary beneath continents using mineral physics and surface observational constraints

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The lithosphere-asthenosphere boundary is a fundamental yet elusive boundary defined through a number of physical and chemical proxies [1]. These disparate proxies are sometimes in agreement on the depth of the LAB, but most often appear to be in contradiction, even for very similar methods [e.g. 2].

The way forward is not to continue as we are with method-independent approaches that ignore, and are often inconsistent with, other observations, but with methods that combine geology, geochemistry and geophysics in a unified way. The approach of Afonso et al. [3,4] undertakes thermo-chemical modelling of the lithosphere in a self-consistent manner honouring bounded ranges of CFMAS oxide chemistry yielding surface observations of elevation, geoid, surface heat flow, seismic data and magnetotelluric data.

Examples of LAB depth estimates, and the chemical and physical characteristics of the lithospheres, will be shown from cratonic and active regions. These estimates come from posterior distributions of stochastic inversions testing many hundreds of thousands to millions of candidate models for acceptance against the observations.

References:

[1] Eaton et al. (2009) Lithos 109:1-22, doi: 10.1016/j.lithos.2008.05.009.

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[3] Afonso et al. (2013) Journal of Geophysical Research - Solid Earth 118:1-32, doi: 10.1002/jgrb.50124.

[4] Afonso et al. (2013) Journal of Geophysical Research - Solid Earth 118:1650-1676, doi: 10.1002/jgrb.50123.