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TBL, RBL, and CBL vs LAB: physics vs semantics

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It is hardly possible to define the "base of the lithosphere", or the "lithosphere-asthenosphere boundary", without defining first what is the lithosphere. The multiplicity of the existing practical definitions of LAB is related to: (i) highly heterogeneous (both laterally and vertically) lithosphere structure; (ii) the multiplicity of (geo)physical and (geo)chemical parameters by which it can be defined; (iii) the multiplicity of methods that can measure these parameters; (iv) the transitional (diffuse) nature of the lithospheric base; (v) the dualism in the LAB nature with respect to (a) deep mantle processes and planetary differentiation and (b) shallow plate tectonic processes. The existing "lithospheric base" definitions differ significantly, depending on the parameter in consideration. Even for the same parameter (for example, seismic velocity), a significantly different resolution provided by different seismic techniques as well as physical assumptions and mathematical simplifications used in data interpretations often lead to significantly different practical "definitions" of the LAB. For example, the choice of a 1% or 2% velocity perturbation in a seismic model as the lithospheric base may lead to a $\sim$50-100 km difference in the LAB depth. Depending on the geophysical techniques (and physical properties of mantle rocks indirectly measured in geophysical surveys), the lithospheric base has different practical definitions. The definition of the thermal lithosphere (or TBL - the layer with dominating conductive heat transfer above the convecting mantle) is the most straightforward, while most of other definitions (i.e. seismic, electrical, elastic) are based on a sharp change in temperature-dependent physical properties at the transition from conductive and rheologically strong to convecting and rheologically weak upper mantle, and thus crucially depend on the thermal regime of the upper mantle. Given that lithosphere definitions employed in geophysical studies are based on measurements of different physical properties of upper mantle rocks, they may (and, in general, do) refer to outer layers of the Earth with significantly different thicknesses. Further confusion arises from the fact that not only different "lithospheres" (seismic, thermal, electrical, petrologic, flexural) are distinguished, but the same very terms are used in approaches utilizing different techniques. Since these techniques often assess different physical properties of mantle rocks, they may refer to different phenomena and to different depth intervals in the upper mantle. Using examples from seismic tomography, RF, thermal, and gravity modeling, complemented by petrologic data from mantle-derived xenoliths, I argue that while the concept of the "lithosphere" (despite being confusing) is nonetheless very useful, the concept of the "lithosphere-asthenosphere boundary" is misleading. In contrast, the concepts of the boundary layers (thermal, rheological, and chemical) are physically specific and provide explicit grounds for studies of depth variations of physical and chemical properties of the upper mantle.