# Defining the lithospheric base: semantics versus physics

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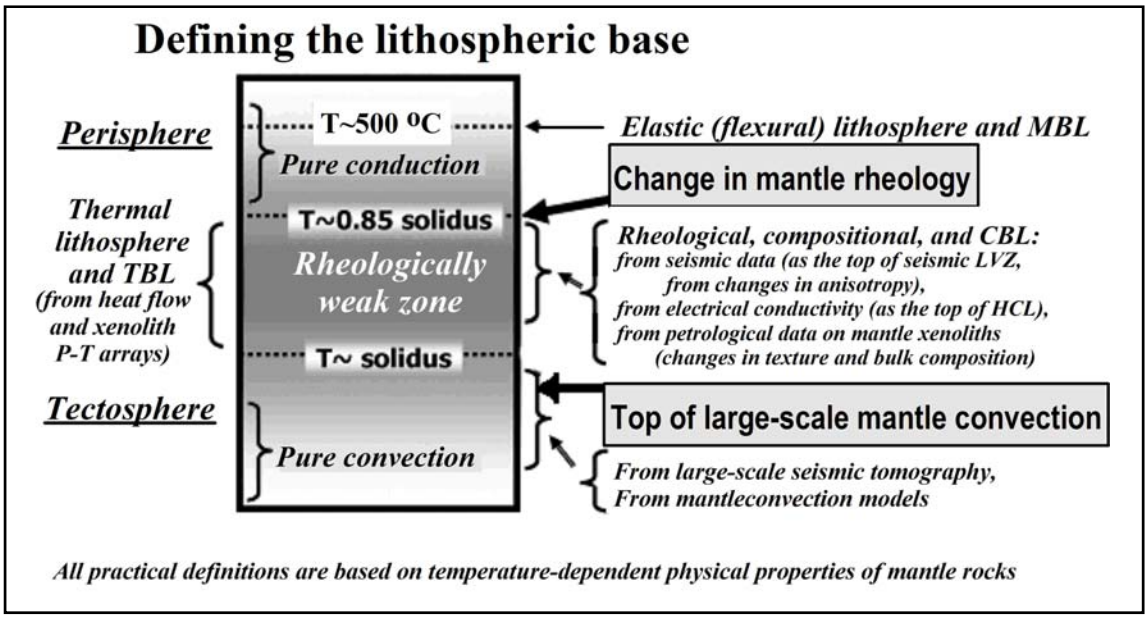
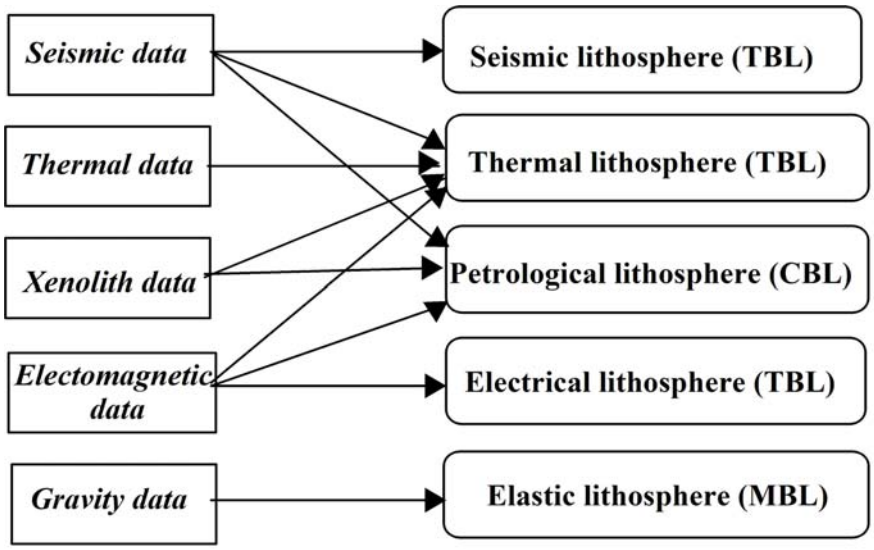
It is hardly possible to define the "base of the lithosphere", or the "lithosphere-asthenosphere boundary", without defining first what is the lithosphere. The definition of the thermal lithosphere (or TBL - the layer with dominating conductive heat transfer above the convecting mantle) is the most straightforward. Depending on the geophysical techniques (and physical properties of mantle rocks indirectly measured in geophysical surveys), the lithospheric base has different practical definitions. Most of them (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 (see top figure). The approaches are supported by laboratory measurements of density, elastic moduli, and electrical conductivity of mantle rocks, parameters that have a strong temperature-dependence and a sharp change in properties at temperatures close to solidus. Several examples are used to illustrate the practical approaches to determine the base of elastic, thermal, electrical, and seismic lithospheres. Since these lithosphere definitions, widely used in geophysical studies, are based on measurements of different properties of upper mantle rocks, they may (and often do) refer to outer layers of the Earth with a significantly different thickness.

The existence of an excessive number of the "lithosphere" definitions explains why the term "lithosphere", which became a convenient and widely used concept in geosciences, is considered by Don Anderson (1995) to "become an unnecessarily confusing concept". Alternatively, one may argue that because of the complexity of the concept and because of its multi-disciplinary nature, the concept of the lithosphere is "necessarily confusing". A great deal of confusion arises not only from the fact that different “lithospheres” (seismic, thermal, electrical, petrologic, flexural) are distinguished, but also from the fact that the same very terms are used in approaches utilizing different techniques (see bottom figure). 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.




The text is cited with some modifications from Artemieva, 2009. Both of the figures are reproduced from the same paper:

Artemieva I.M., 2009. The continental lithosphere: Reconciling thermal, seismic, and petrologic data. Lithos, 109 (1-2), 23-46, doi /10.1016/j.lithos.2008.09.015.