Geophysical Research Abstracts
Vol. 15, EGU2013-4378, 2013
EGU General Assembly 2013

LAB and other lithospheric discontinuities below Cratons

Forough Sodoudi (1,2)

(1) Deutsches GeoForschungsZentrum GFZ, Global Seismology, Potsdam, Germany (foroug@gfz-potsdam.de), (2) Freie Universität Berlin, Malteserstr. 74-100, 12249 Berlin, Germany

Cratons are extremely stable continental areas of the Earth's crust, which have been formed and remained largely unchanged since Precambrian. However, their formation and how they survived destruction over billions of years remains a subject of debate. Seismic properties of the cratonic lithosphere re[U+FB02]ect its composition and physical state and obtain basic constraints on processes of the formation and evolution of continents. Insight on these issues may be gained by determining the depth and the nature of the Lithosphere-Asthenosphere Boundary (LAB), which is a necessary element of the plate tectonic theory. However, It has proved quite "elusive" beneath the oldest continental areas. What is missing to date is a consensus on the feature that would correspond to the LAB and whether such a feature exists everywhere beneath cratons. The relatively recently developed S receiver function technique employing S-to-P conversions appears promising for detecting the LAB with a sufficiently high resolution and density. A growing number of regional observations obtained from S receiver function studies has detected discontinuities characterized by a significant negative velocity contrast in the upper mantle. However, challenges still remain in detecting the S-to-P conversions from the LAB beneath the Precambrian cratons. Some recent SRF studies observed a deep (> 160 km) negative velocity contrast beneath cratons and interpreted it as the LAB. For example, a deep LAB at about 250 km was reported beneath the Kalahari craton by different authors. Similar results were also obtained beneath some parts of the Canadian shield, East European Craton, Australia, the Arabian Shield and Tanzania craton. In contrast, other SRF studies found no evidence for negative discontinuities at these depths in the North American craton, in Kalahari craton or in Australia. Instead they revealed a very sharp negative velocity gradient at much shallower depth (60-150 km), leading some authors to infer that the cratonic lithosphere may be considerably thinner than expected, contradicting tomographic and other geophysical or geochemical studies. Moreover, this finding contrasts also with other cratonic regions where SRFs clearly found an observable LAB discontinuity at depths of more than 160 km. To solve this problem, a concept of a "Mid-Lithospheric Discontinuity" (MLD) has been developed. The MLD is proposed as a global characteristic of Precambrian lithosphere, which had been consistently found as the 8° discontinuity within the continental lithosphere in the analysis of long-range seismic profiles. The nature of the MLD remains, however, uncertain, and may be attributed to accumulated melts, presence of fluids, lithospheric stacking, remnants of fossil subduction interfaces or change in anisotropic properties. Such a feature would have implications for the formation and evolution of the continents. Indeed, issues related to the unambiguous detection of MLD and the controversial LAB beneath the cratonic regions of the globe still remain contentious and therefore further work is required to resolve this issue. I will concentrate on this topic and present some new results from Kalahari craton, Scandinavia and eastern Europe.