Geophysical Research Abstracts
Vol. 14, EGU2012-11738, 2012
EGU General Assembly 2012

Understanding the nature of the lithosphere, asthenosphere, and the boundary between them: Constraints from seismic anisotropy

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Despite decades of study, the nature and physical properties of the asthenosphere and the boundary between the asthenosphere and the overlying lithosphere remains a key unsolved problem in solid Earth geophysics. One of the defining properties of the asthenosphere is that it is relatively weak and thus tends to concentrate deformation. In contrast, the lithosphere is relatively strong and may preserve the signature of past deformation processes. Understanding the patterns and physical conditions of deformation in the lithosphere and asthenosphere through observations of seismic anisotropy may therefore shed light on the nature of the lithosphere, asthenosphere, and the boundary between them. I will discuss the different predictions about the geometry and strength of seismic anisotropy made by some of the recently proposed models for the asthenosphere and compare them to observational constraints on anisotropy. In particular, I will highlight recent work on the fate of the oceanic asthenosphere beneath subducting slabs and discuss how constraints on seismic anisotropy in the sub-slab mantle may illuminate the nature of the asthenosphere.