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Seismic structures in the Earth's mantle

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In recent years, seismology has provided increasingly detailed images of the interior of the Earth, especially since the onset of the deployment of temporary seismic arrays: Seismic tomography has revealed that some slabs descend into the lower mantle while others seem to stagnate at the mantle transition zone; Topography of seismic discontinuities can provide information the dynamics of the mantle but also on the mineralogy of the Earth's mantle. Deeper in the Earth, the D" layer has been studied extensively, revealing more and more complex features for which several hypotheses to explain them have been brought forward. Other interesting observations include the topography of the core-mantle boundary, possible detections of hot upwellings in the deep mantle and depth, sharpness and other properties of the lithosphere-astenosphere boundary and other transition zones. In this presentation we will review some of these observations and their connection to dynamics and mineralogy of the Earth's mantle.
We will also present some interesting detailed images of mantle transition zone structure, as well as deeper mantle structures that could potentially be direct observations off deep subducted lithosphere and their connection to lowermost mantle structures in the D" region. Interpretations of these features can provide valuable information on dynamics and mineralogy of the Earth's mantle. These observations come from high-resolution seismic array analyses.
The observed structures in the D" region (the lowest 200-400 km of the Earth's mantle) for example could be due to the recently discovered post-perosvkite phase transition that should be visible mostly in cold (fast) regions of the lowermost mantle. However, other possibilities that could cause these structures are deep subducted lithosphere that may be sheared and/or folded, or thermo-chemical layering or convection at the base of the mantle. The different hypotheses will be discussed and their predictions will be compared to seismic observations including as much information of the seismic waves as possible.
New results on topography and sharpness of upper mantle discontinuities are presented and discussed in the light of mineralogy and dynamics of the mantle transition zone. For example through the depth and reflectivity of the 660 km discontinuity we find that the Kurile slab most likely stagnates near the transition zone. Using the information of amplitudes of the seismic waves that reflect off the 660 km discontinuity, we propose a possible mechanism for locally enhancing the increase of seismic velocities and/or densities across the base of the mantle transition zone.