Geophysical Research Abstracts
Vol. 15, EGU2013-11419, 2013
EGU General Assembly 2013

Seismically deduced thermodynamic phase diagrams for the transition zone

Benoit Tauzin and Yanick Ricard
Laboratoire de Géologie de Lyon, Université de Lyon and ENS de Lyon, France (benoit.tauzin@univ-lyon1.fr)

Seismic discontinuities at 410 and 660 km depth are usually attributed to solid phase changes within the olivine component of the mantle. The Clapeyron slopes γ410 and γ660, i.e. the thermal dependence of the depths of reactions, have been shown experimentally to be of opposite signs. Yet, their values are not well constrained: laboratory ratios γ410/γ660 range between -8 and -0.4. Due to competing effects of wave-velocities and temperature on the topography of discontinuities, seismological observations have not been more precise.
In this study we present the "Z-γ stacking approach", a method using conversion/reflection imaging and separating the effects of velocity and temperature on discontinuity topography. The method makes not only possible the determination of γ410/γ660 but also can reveal any other phase transition in the mantle and its normalized Clapeyron slope γ/γ660. The construction of "seismic phase diagrams" allows the direct comparison with experimental phase diagrams.
From Z-γ stacking P-to-S receiver functions from USArray, we show that a ratio γ410/γ660 = -1.65 $\pm$ 0.50 satisfies the observations of the 410 and 660 below western US. Other minor discontinuities are suggested around 380, 590 and 630 km depth, with ratios γ380/γ660 = -1.4, γ590/γ660 = 0.7, and γ630/γ660 = -1.3. An asymmetry of waveforms in seismic phase diagrams suggests that phase transitions in the non-olivine component of the mantle have a visible seismic expression.