

Joint seismological/mineral physics modeling of the composition and state of the lower mantle

Guy Masters, Institute of Geophysics & Planetary Sciences, UCSD

abstract:

We revisit the question of the composition and thermal state of the lower mantle by matching 1D seismic velocity and density profiles between 30 and 120GPa. While this part of the mantle is thought to be mineralogically simple, the procedure is complicated by the lack of reliable mineral physics data for some of the phases (particularly the shear modulus of calcium silicate perovskite) and by the potential for significant seismological effects from spin crossover. In particular, it has been proposed that this latter effect can cause anomalous compressional velocity gradients throughout much of the lower mantle. It turns out that the compressional velocity in the lower mantle is extremely well-known and we review some of the literature describing the seismological constraints. These constraints potentially put significant limits on the effect of spin crossover on elasticity.

If we neglect potential effects of spin crossover, we find that we can match the seismological profiles with a composition which is slightly more silica rich than pyrolite ($X_{pv}=0.68$) and with a reasonable temperature at the top of the lower mantle. We use this composition to investigate the physical cause of 3D velocity anomalies in the lower mantle.