Earth's lower mantle elasticity from mineral-physics constraints

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As the resolution of seismic tomography studies increases, seismic heterogeneities in the Earth's lower mantle are better constrained and solicit robust interpretations. Temperature and chemical perturbations are likely the cause of these heterogeneities and several studies, both theoretical and experimental, aimed at constraining the effect of these parameters on the elasticity of major lower mantle forming minerals. Mineral-physics-based velocity models calculated from the elasticity data sets can then be compared to seismic wave velocity models to constrain the chemical composition of the Earth's interior. To date, however, there is still no consensus on whether the composition of the upper and lower mantle is the same, or whether the 660 km discontinuity also represents a chemical boundary. This is due to both the experimental challanges in obtaining accurate elasticity data at high-pressures and temperatures and the complex cation substitution mechanism occurring in bridgmanite, the most abundant mineral of the lower mantle. In this study we will present a systematic framework describing the elasticity of bridgmanite as a function of pressure, temperature, Fe and Al substitution and oxygen vacancies. This framework has been constructed by analysing all the available data in addition to new elasticity measurements on bridgmanite solid solutions.