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Seismic constraints on thermo-chemical nature of the lower mantle and on $S-to-P$ heterogeneity ratio

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We analyse our joint V_P-V_S model *SPani* and the data that went into it to assess the thermochemical nature of the lower mantle. Robust structural variations between V_P and V_S and an increase of decorrellation with depth between δlnV_S and δlnV_P in the two Large Low Shear Velocity Provinces (LLSVPs) indicate the presence of compositional heterogeneity inside the LLSVPs and compositional layering. The morphology of subducting slabs confirms the complexities recently imaged by V_P models (e.g. Fukao and Obayashi 2013) and the comparison between V_P and V_S suggests the presence of chemical variations also in the transition zone and mid-mantle. A quantitative interpretation of chemical heterogeneity is hampered by the difficulty to provide precise estimates of the heterogeneity ratio $\delta lnV_S/\delta lnV_P$ ($R_{S/P}$). For instance, the global median value of $R_{S/P}$ ($< R_{S/P} >$) drops from ∼2.8 to ∼1.9, at 2500km depth when the V_P component of *SPani* is replaced by a V_P model resulting from a differently regularized inversion. Boosting the V_P anomalies of 20% also drastically reduces $< R_{S/P} >$ without significantly degrading the data fit. In spite of robust decorrelations between V_P and V_S structure, we found that high values of $R_{S/P}$ associated with both positive and negative velocity anomalies in the lower mantle, including the two LLSVPs, are affected by noise in the model parameters and can be overestimated. Additional uncertainties in compositional effects on $R_{S/P}$ from mineral physics and in the conversion of δlnV_S or δlnV_P into density contributes to further complicate a quantitative thermo-chemical interpretation.