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On the effect of the Post-perovskite phase change on global mantle flow, geoid and dynamic topography

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In the lowermost parts of mantle, the D" layer is a profoundly important layer as it involves the process of heat and mass transfer between core and mantle. However, the physical nature of this layer is an issue of active debate. The seismic data represent a rapid increase and decrease of the shear velocity, especially beneath Circum-Pacific margins, in the D" layer. Indeed, such abrupt velocity discontinuity is not expected for this hot layer.
The discovery of the perovskite (pv) to Post-perovskite (pPv) phase transformation has led to dramatic increase in our understanding of the structure of the D" layer, since it is thought to produce such seismic discontinuity. Here, we have investigate the influence of the phase transformation of pv to pPv on the geoid undulation as one of the most important geophysical observable, using 3D spherical shell mantle circulation models based on a seismic tomography model (S40RTS) and strongly lateral viscosity variations in the D" layer and the mantle above.
We demonstrate that the geoid anomalies are strongly affected by the presence of pPv in the lowermost mantle. While the geoid heights over subduction zones are increased by considering a strong pPv compared to then surrounding mantle, a weak pPv reduces the geoid height, and a better fit to the observed geoid is obtained. We show that, applying a weak pPv viscosity of at least three orders of magnitude any higher viscosity contrast does not affect the geoid any further. We also investigate the effects of weak pPv combined with a different tomography model, a different pPv density contrast, the presence or absence of a global thermal-boundary-layer (TBL) and the presence or absence of lateral viscosity variations in the lower mantle.

Keywords: Post-perovskite, phase transitions, geoid, dynamic topography