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Interior structure of the Moon – constraints from seismic tomography, gravity and topography

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Seismic tomography can be combined with constraints from geoid, topography and other surface observations to gain information about mantle structure and dynamics. This approach has been taken with much success for the Earth mantle, and here it is, for the first time, applied to the Moon. Lunar tomography has much lower resolution as for the Earth and is mostly restricted to the near side, nevertheless we can assess under what assumptions the fit between predicted geoid (based on a tomography model) and observed geoid is best: Among the models tested, we find the most similar pattern (correlation about 0.5) if we only consider tomography below 225 km depth, if density anomalies cause little or no dynamic topography and if we compare to the geoid with the flattening ($l = 2, m = 0$) term removed. This could mean that (a) like for the Earth, seismic anomalies shallower than 225 km are caused by a combination of thermal and compositional effects and therefore cannot be simply converted to density anomalies; (b) the lithosphere is sufficiently thick to prevent dynamic topography more than a small fraction of total topography; and (c) flattening is a "fossil" bulge unrelated to present-day mantle anomalies. However, we have to be cautious with interpreting our results, because the amplitude of the predicted geoid is much lower than observed for models with high correlation: This could either mean that the tomography model is strongly damped, or that the geoid is mostly due to shallow causes such as crustal thickness variations, with only a small part coming from the deeper mantle.