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WINTERC-grav: a new upper mantle thermochemical model constrained coupled geophysical-petrological inversion of seismic waveforms, heat flow, surface elevation and gravity satellite data

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Conventional methods of seismic tomography, topography and gravity data analysis constrain distributions of seismic velocity and density at depth, all depending on temperature and composition of the rocks within the Earth. However, modelling and interpretation of multiple data sets provide a multifaceted image of the true thermochemical structure of the Earth that needs to be appropriately and consistently integrated. A simple combination of gravity, petrological and seismic models alone is insufficient due to the non-uniqueness and different sensitivities of these models, and the internal consistency relationships that must connect all the intermediate parameters describing the Earth involved. In fact, global Earth models based on different observables often lead to rather different, even contradictory images of the Earth.
Here we present a new global thermochemical model of the lithosphere-upper mantle (WINTERC-grav) constrained by state-of-the-art global waveform tomography, satellite gravity (geoid and gravity anomalies and gradiometric measurements from ESA's GOCE mission), surface elevation and heat flow data. WINTERC-grav is based upon an integrated geophysical-petrological approach where all relevant rock physical properties modelled (seismic velocities and density) are computed within a thermodynamically self-consistent framework allowing for a direct parameterization of the temperature and composition variables.

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