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Plume convection models with realistic mantle mineralogy, and derivation of seismic velocities

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Starting from a representative primitive peridotite model of the chemistry and mineralogy of the uppermost 1000 km of the Earth's mantle and using experimental information on the position of several phase boundaries, proportions of mineral modes are computed for this depth range. From these, the thermoelastic parameters and an adiabat can be determined for the mantle. This serves as input for three-dimensional models of the ascent of a plume through the upper 1000 km of the mantle and its interaction with the different phase boundaries of olivine and pyroxene/garnet/majorite components of the mantle rock. Mineralogical changes due to melting in the plume and under a mid-oceanic ridge, if applicable, and their dynamical consequences are also included. The temperature and melt content distributions resulting from the convection models feed back into the mineralogy of the model and are also the basis for the determination of geophysical observables, in particular absolute seismic velocities and traveltime variations caused by thickness variations of the transition zone.