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The influence of partial melt on mantle convection in a spherical shell

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Partial melting plays an important role in the thermal evolution of terrestrial planets, being present during some period of planetary evolution but has been neglected so far in most global 2D or 3D convection models.
When modelling partial melt it is important to consider the effects of this process on mantle viscosity and melting temperatures. The influence of partial melt on viscosity and melting temperature depends on whether we have a dry or a wet planetary interior: viscosity decreases with partial melt upon the evolution of a dry mantle and increases with depletion of water due to partial melting assuming a wet planetary interior. Mantle viscosity and melting temperatures are also influenced by the different styles of mantle melting: batch melting where the melt remains in contact with the residual material all the time, and fractional melting where the melt leaves the system as soon as it is formed.
In this study, we investigate both, i.e. change in viscosity and melting temperature due to partial melting on the mantle dynamics using 2-3D spherical convection models [2, 3]. In particular, we investigate the influence of partial melt on a dry and wet planetary interior. Depending on the melting style, we also consider variations in the melting temperatures with the degree of depletion. For the models we consider different activation energy and viscosity profiles for dry and wet olivine and a planetary interior with cooling boundary conditions and decaying radioactive elements.

References:
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