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The Interplay of Double-Diffusive Layers with Phase Transitions and its Impact on the Long-Term Evolution of Mantle Structure

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The evolution of the Earth and the chemical differentiation are largely dominated by internal convective processes within the mantle. So understanding how the accessible observations are linked to these underlying processes is a key question in determining the thermal history of the Earth.
Ever since it has been realized that the mantle material behaves like a viscous fluid the style of convection has been debated. One big question is whether the mantle is or at least has been layered to some degree. There are two fundamental feature that can lead to layered flow structures.
On the one hand the presence of an endothermic phase transition which is strong enough can separate upper and lower mantle convection. On the other hand compositional heterogeneities, originating from the crystallisation of a magma ocean, give rise to self-organised double-diffusive layering.

In order to determine the interaction of double-diffusive layers with the known phase transitions and the impact on mantle structure we performed numerical experiments ranging from strongly exothermic, representing the transition from perovskite to post-perovskite, the 410 and 520 discontinuity, to endothermic conditions.