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Layer formation in the Early Earth

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The thermal history of the Earth and its chemical differentiation is largely determined by convective processes in the Earth's mantle. A simple model resembling the situation shortly after core formation consists of a compositionally stratified mantle, heated from below and cooled from above through the atmosphere. Under such conditions double-diffusive convection can lead to the generation of layered flow patterns, even without pre-existing jumps in their material properties. We have conducted 2D – and 3D numerical experiments to study layer formation under mantle-realistic conditions. We taken into account a strong dependence of the viscosity on temperature, and on pressure. Further a pressure dependence of the thermal expansivity has been included. The experiments show that distinct layers do evolve, they control largely the heat loss of the planet and also control the onset of plate like motions at the surface. We also observe intermittent breakdowns of layers and changes from multi- to single layer flow.

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