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Evolution of bumpy boundary layers in planetary mantles

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There is much evidence that the core mantle boundary does not resemble the picture of a simple thermal boundary layer, as known from thermal convection at high Rayleigh number. Rather
it seems to be of complex structure, possibly induced by compositionally dense material. Present models of mantle convection, aiming at simulating the complex structure and
dynamics of the lower boundary layer require several ad hoc assumptions. Most of them
postulate the presence of a sufficiently dense layer at the transition from the magma ocean state to solid state mantle convection. Especially the density excess distinct material needs to be assumed. Both conditions are critical for the dynamics in a sense, that too much, too dense material results in a 'pancake-shaped ' flat layer without any topography while for having too little, not sufficiently dense material, thermal convection would simply sponge off the distinct material. Unfortunately the values of excess density and mass can hardly be constrained .Further it seems unlikely that conditions at the end of the magma ocean epoch resembled a chemically homogeneous mantle From a series of model calculations, starting out from an initial mantle as possibly evolve by fractional crystallization, all with realistic rheology, we find that chemical transport across the CMB plays a key role for the formation of a bumpy boundary..Parameterising the chemical transport by diffusion with an extreme low diffusivity, leads selfconsistently (without assuming any pre-exisiting dense material) to the formation of compositional piles with different degrees of complexity. Dense material, slowly entering the mantle is accumulated by thermal advection and thus piles are formed. At the same time the presence of the piles reduces further compositional influx. We find the presence of such piles to significantly influence the thermal – and compositional evolution of the mantle system
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