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Pulsations of a plume rising through a non-monothonic mantle

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Recent observations in seismic tomography and mineral physics of the spin transition at mid mantle depth suggest a non-monothonic viscosity radial patterns in the lower mantle. We investigate its effect to the upwelling of a mantle plume, explicitly modelling its rise. Models are performed to study the short or long term effect of the non-monotonicity to the fluxes in the plume tail. The numerical method is based on a Multipole-accelerated Boundary Element (FMM-BEM) implementation, for solving the momentum equation in spherical coordinates. We test several radial viscosity patterns, starting from the well-known hypothesis of a viscosity hill in the middle of the lower mantle and expanding it to more complex scenarios. In particular we test the combined contribution of viscous and density radial profiles. The constraints on the profile come only from first principle and laboratory mineral physics data. We test both the effect of the spin transition and/or of the chemical layering. We identify critical viscosity ratios and differential densities that enable the system to pulse, inducing a punctual manifestation at the earth surface. Such sharp transition between linear and pulsating plume pattern is relevant for identifying the origin of the punctuation of the islands in long oceanic hot-spot seamounts.