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# Influence of Mantle Rheology on Plume Dynamics and Periodicity

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## Résumé

Many hotspots worldwide display evidence of fluctuating magmatic activities and could be linked to time-dependent variations in melt production within mantle plumes. These periodicities are observed globally on Earth, ranging from 1 Myr to 20 Myr (Morrow and Mittelstaedt, 2021). Remarkably, the Réunion hotspot exhibits short magmatic pulsations with a periodicity of  $\sim 400$  kyr and given the  $\sim 230$  km separation between La Réunion and Mauritius, the synchronous short-period pulsation observed at the Réunion hotspot must arise from deeper plume dynamics (Famin et al., 2024, in rev.).

Understanding the physical controls behind these pulsations could establish links between mantle convection, plume dynamics, and surface volcanism. Previous studies suggest that plume behavior is sensitive to mantle rheology, including the balance between diffusion and dislocation creep, the effects of grain-size evolution, and yielding (Neuharth and Mittelstaedt, 2024).

Here, we investigate how mantle rheology influences plume dynamics using 3D regional convection models in spherical cap geometry with plate-like behavior at the surface, computed with StagYY (Tackley, 2000). We developed an automated algorithm to detect and track plumes in space and time, quantifying their morphology and dynamics (e.g., buoyancy flux, heat flux, tilt angle). Our study explores the effects of varying surface yield stress, the addition of dislocation creep, the effect of a viscosity jump at the transition zone, and the impact of latent heat in partial melting. We aim to understand how these parameters control the generation of short periodic magmatic pulses and to estimate melt production at the surface in order to compare it with geological observations.

**Mots-Clés:** Mantle plume, Mantle rheology, Réunion hotspot, Geodynamic modelling

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