EGU25-18671, updated on 17 May 2025
https://doi.org/10.5194/egusphere-egu25-18671
EGU General Assembly 2025


# Variations of Earth's volume driven by intermittend mantle stratification

**Thorsten Nagel**[1] and Stéphane Bodin[2]
[1]TU Freiberg, Institut für Geologie, Freiberg, Germany (thorsten.nagel@geo.au.dk)
[2]Aarhus University, Department of Geoscience, Danmark

Through almost the entire mantle column, oceanic crust is denser than ambient mantle. In a ca. 100 kilometers thick channel below the lower-upper-mantle boundary, however, this relation is reversed. Hence, this channel constitutes a trap for oceanic crust and several recent studies have indeed proposed large ponds of crust at this depth. Accumulation of crust would be expected to be continuous, while sequestration into the lower mantle should be episodic due to the metastable nature of the gravitational trap. Non-steady-state concentration of crust in the channel would be associated with variations in Earths volume in the order of several millions of cubic kilometers. While transfer of crust from the upper mantle into the channel causes volume increase, the collapse of crust into the lower mantle would be associated with net volume decrease. We propose that collapse events could be associated with rising mantle plumes, hence, a net volume decrease of Earth would precede the eruption of large igneous provinces (LIP). A dramatic volume loss in 650 kilometers depth might be able to pull down the surface for a brief time. Such an event might be expressed in an outstanding sea-level-drop before the eruption of LIP. This hypothesis is confirmed by a review of eustatic sea-level changes accompanying late Paleozoic – Cenozoic LIPs activity showing that a majority of LIP emplacement are shortly (< 500 kyr) preceded by an episode of up to 50 meters (average of 25 meters) eustatic sea-level fall, with return to pre-perturbation levels at the onset of LIP eruption.