EGU26-7533, updated on 11 Nov 2026
https://doi.org/10.5194/egusphere-egu26-7533
EGU General Assembly 2026
© Author(s) 2026. This work is distributed under
the Creative Commons Attribution 4.0 License.

Spatial variations of the low-velocity layer above the 410-km discontinuity and their relationship to mantle dynamics

Tiente Rengneichuong Koireng and Pawan Bharadwaj
Indian Institute of Science, Centre for Earth Sciences, Bangalore, India (rengneichuongk@gmail.com)

Constraining seismic velocity discontinuities at depths of ~410 km (D410) and ~660 km (D660) is critical for understanding mantle dynamics. Receiver function (RF) studies have revealed the widespread presence of a low-velocity layer (LVL) immediately above D410, supporting the global water□filter model. Numerical experiments further predict the occurrence of double LVLs above D410 under specific conditions. However, the relationship between LVL occurrence and underlying mantle processes remains poorly understood. Conventional RF analyses rely on careful selection of high-quality traces from multiple teleseismic events at individual stations, followed by slant stacking within a time window around the P-to-S converted phase (P410S) from D410. This approach reduces data coverage and reproducibility and depends on reference Earth velocity models to align RFs. Because true mantle velocity structure and discontinuity depths deviate from these models, slant stacking is often ineffective, particularly for weak and complex converted phases associated with LVLs above D410. In this study, we apply an automated, data-driven machine learning approach to delineate LVLs above D410 using RFs from global seismic stations. Our method aligns the P410S phase without invoking theoretical travel times, instead relying on patterns inherent in the data. We demonstrate that the resulting alignment is physically meaningful and directly reflects velocitystructure near D410. This automated framework significantly improves efficiency, objectivity, and reproducibility in RF analysis. Our results reveal three global patterns of seismic velocity structure near D410: (1) a thick LVL associated with cold mantle regions and subducting slabs; (2) a double LVL, with variable inter-layer spacing, linked to hot mantle and fast upwelling; and (3) a thin LVL correlated with slower upwelling. These observations indicate that LVLs above D410 are a global feature consistent with the water□filter model, while their detailed characteristics reflect variations in mantle upwelling style beneath seismic stations.