

EGU24-8313, updated on 15 May 2024

<https://doi.org/10.5194/egusphere-egu24-8313>

EGU General Assembly 2024

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Mantle Transition Zone (MTZ) beneath the contiguous US revealed by ambient noise cross-correlations

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Understanding the nature of the Mantle Transition Zone (MTZ) can foster our knowledge about the dynamics of the Earth, especially related to the vertical heat and mass exchange between the upper and the lower mantle. The MTZ, characterized by seismic-velocity discontinuities at depths of 410 km and 660 km, is conventionally studied using seismic waves emitted by earthquakes. However, this approach suffers from a typically uneven distribution of earthquakes, biases in earthquake location, and the complexity of earthquake processes.

In this study, we used body waves retrieved from ambient noise correlations to map the mantle transition zone beneath the US. We analyzed cross-correlation functions from more than 3500 seismic stations, including the EarthScope USArray stations during its deployment time frame between 2004 and 2013. We obtained clear short period (<10 s) P410P and P660P reflection phases by using a stacking strategy that considers global noise wave field data selection. This allows us to image the MTZ at an unprecedented high resolution, providing new constraints that can shed light on the tectonic history and the mantle dynamics in this area.