Solid Earth Physics Seminar, Harvard University

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Geological Museum Room 310, 24 Oxford Street

Constraints on the evolution of oceanic lithosphere from surface wave tomography

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Abstract:

Plate tectonic manifests itself most simply in ocean basins. A plate-cooling model has been used extensively to describe the evolution of oceanic lithosphere and is able to predict the observed age-dependent trend of seafloor topography. Various global and basin-wide seismic models also suggest that the seismic properties of oceanic lithosphere vary as a function of age. However, there is a lack of consensus between different seismic studies, and higher-resolution tomographic models are needed to investigate oceanic regions whose seismic properties depart from simple age dependence.

In the first part of the talk, I will describe a novel and efficient way to measure the phase and group velocity of fundamental mode surface waves that takes advantage of waveform similarities, which enables me to generate global tomographic models with improved constraints in the oceanic upper mantle. I will also demonstrate that not accounting for azimuthal anisotropy can produce significant artifacts in models of isotropic velocity, especially in the Pacific.

The second part of the talk focuses on Indian Ocean. I will show that high-quality Rayleigh waves traversing the entire Indian Ocean can be extracted from ambient seismic noise, and adding dispersion information extracted from ambient noise to my global earthquake dataset can indeed improve the resolution of phase velocity maps. In the northeastern region, where there is little evidence of thermal perturbations in the form of plateaus and hotspots, I use a forward modeling technique based on experimental mineral physics data to show that a simple plate-cooling model can predict the observed phase velocity and seafloor topography simultaneously. Key findings from this work include thickened crust beneath the Seychelles-Mascarene Plateau and asymmetric velocity along the Central Indian Ridge, with slower velocity on the western side, which I hypothesize is due to interaction between the ridge and nearby hotspots.