Tectonic Structure of East Antarctica from Full Waveform Ambient Noise Tomography

Ashish Kumar, Samantha E. Hansen, Erica L. Emry

The origins of tectonic structures in East Antarctica, such as the Gamburtsev Subglacial Mountains (GSMs), the Wilkes Subglacial Basin (WSB), the Aurora Subglacial Basin (ASB), and the Transantarctic Mountains (TAMs), are not clearly understood. Previous investigations have proposed multiple origin models to explain the formation of these structures; however, existing tomographic images lack resolution and consistency given the sparse seismic coverage in East Antarctica. We use full-waveform ambient noise tomography to model the shear-wave velocity structure beneath East Antarctica to further investigate these features. We extract Rayleigh-wave Empirical Green's Functions (EGFs) between periods of 15 and 340 secs from ambient seismic noise using a frequency time normalization technique. Synthetic waveforms are simulated through a 3-D heterogenous Earth model with a lateral grid spacing of 0.025º (~2.25 km) using a finite-difference wave propagation method. The synthetic seismograms are cross-correlated with the EGFs to measure the phase delays. The finite-frequency sensitivity kernels are calculated using the scattering-integral approach and the shear-wave velocity model is computed by inverting the phase delays using a sparse damped least-square inversion method. Preliminary results show fast seismic velocities beneath the WSB, which may be associated with thick and stable lithosphere, and slow velocities beneath the ASB, possibly reflecting old rift systems or other inherited tectonic structures. Slow upper mantle velocities are also observed beneath the TAMs, possibly associated with a thermal load that contributes to the uplift of the mountain range. Slow shear-wave velocities in the vicinity of the GSMs may be associated with rifting along the extended Lambert Rift System. Our final tomographic model and associated tectonic interpretations will be shared.