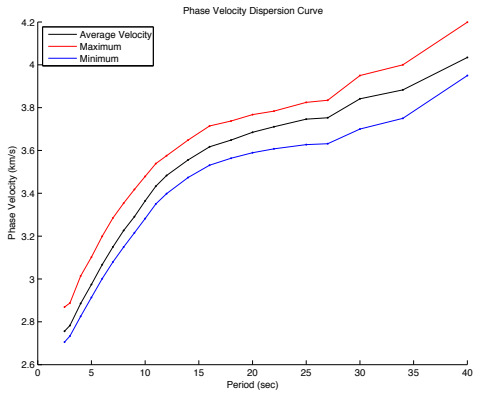
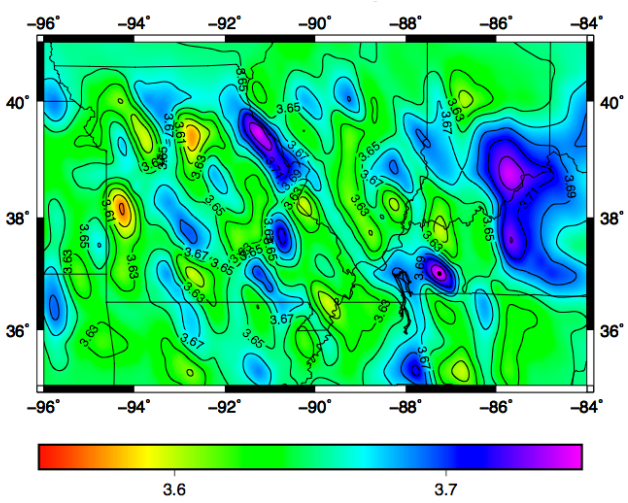
The North American craton within the United States is almost entirely a cratonic platform, where a coating of Phanerozoic sedimentary strata buries the Precambrian basement by up to 7 km. At-depth structure of this region remains poorly understood in large part because of the sediment cover and low topographic relief. Lithospheric structure is of particular interest because over a half-billion years of tectonic forces have resulted in the formation of epeirogenic provinces such as the Illinois Basin and surrounding structures. The OIINK flexible seismic array was deployed in 2011 to collect seismic data from the Ozark Plateau, New Madrid Seismic Zone, and the Illinois Basin from Missouri to Kentucky. Together with stations of the Earthscope Transportable Array, we use ambient noise tomography to investigate the crustal structure of the region and produce high-resolution models of the lithosphere. The use of ambient noise provides both denser and more azimuthally uniform surface wave path coverage than that afforded by earthquake generated surface waves. For our analysis we used vertical component seismograms recorded between January 2011 and December 2013, filtering out earthquakes and other similar signals to obtain records of the background seismic noise of the region. Following the work of Besen *et al.* (2007), we computed cross correlations of 600s long time segments from over 29,000 station pairs to obtain the dispersion measurements of Rayleigh wave propagating across the region. We are then able to measure the phase velocities and gain insight into subsurface structures. We observed that the average phase velocity measurements range from ~2.8 km/s at 4 seconds to ~4.1 km/s at 40 seconds across the area of study. These measurements are slightly faster than those observed by regional studies for this area, but are in close agreement with the range of phase velocities measured using earthquake surface waves recorded by the OIINK array. The relatively high phase velocities of ~4 km/s at periods between 30 and 40 s likely result from the cratonic nature of crust and upper mantle in this area.





Phase Velocity (km/s) at 18 seconds

The distribution of high and low phase velocities at periods between 4 and 18 s possess a northwest-southeast oriented pattern of velocities that appear to follow the trends of mapped faults within the Ozark Plateau. The 20s phase velocity map strongly correlates with large-scale regional tectonic structures. The Illinois Basin and the Reelfoot Rift are associated with low velocity zones, while a marked zone of high velocities define the Cincinnati Arch. At periods greater than 12 s we observed a zone where phase velocities are reduced by ~0.15 km/s in southern Illinois. This location corresponds to the deepest part of the basin. Relatively high phase velocities surround this area, which highlight the oval shaped nature of the basin. There are also abrupt changes in the orientation of the phase velocity anomalies from the areas to the west and east of the Illinois Basin compared to the basin itself. The orientation and position of the velocity zones highlight the complex relationship between the Illinois Basin and other regional structures.