

Ambient Noise Tomography of the Wabash Valley Seismic Zone

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The Wabash Valley Seismic Zone is an intra-cratonic seismic zone running through the deepest part of the Illinois basin. Over the past several decades the seismic zone has produced a number of moderate sized earthquakes with more cumulative moment than the New Madrid Seismic Zone. The EarthScope Transportable Array offers a timely opportunity to study this enigmatic feature. We obtained one year of seismic data from 63 stations Transportable Array stations to create a surface wave velocity map of the region using ambient seismic noise. Data were first treated to diminish signal from earthquakes, and bandpass filtered between 7 and 16 s period, providing coverage of the seismogenic zone between 10 and 20 km depth, assuming a Rayleigh wave source. Daily station seismograms were cross-correlated amongst one another to determine the surface wave travel time between each station pair. The ambient seismic signal can be reasonably approximated as a uniform plane wave from a distant source, which varies over time to come from many directions. The travel times were used to constrain seismic velocity at discrete locations across the area of study. Additionally, we have obtained and stacked between six and twelve months of seismic data (depending on data availability) for each of these station pairs using 1 sps, 7-30 second period bandpassed data, potentially sampling to the base of the crust in the area. These correlogram stacks are used to measure surface wave dispersion in this period range. We find slower seismic velocity between stations on opposite sides of the valley than between stations on the same side. Group velocity increases in the deep crust except within the valley itself, where it often decreases in the lowermost crust. The 7-16s data show relatively low seismic velocity at seismogenic depths in the seismic zone, indicating the possible presence of anomalously thick sediment cover or more likely fluids within deep faults related to past rifting events.

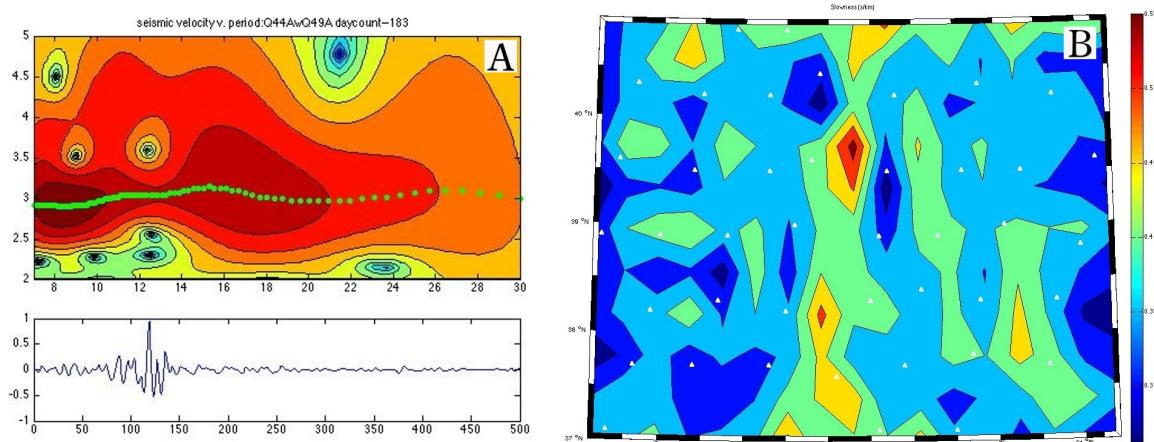


Figure 1: A) A surface wave dispersion curve between stations Q44A and Q49A obtained using a correlogram (shown below) with six months of stacked data. Seismic velocity in km/s on y-axis, period in seconds on x. B) A depiction of surface wave slowness, in the period range 7–16s, in the region of study.