Structure of the U.S. Midcontinent inferred from Rayleigh Wave Phase Velocities

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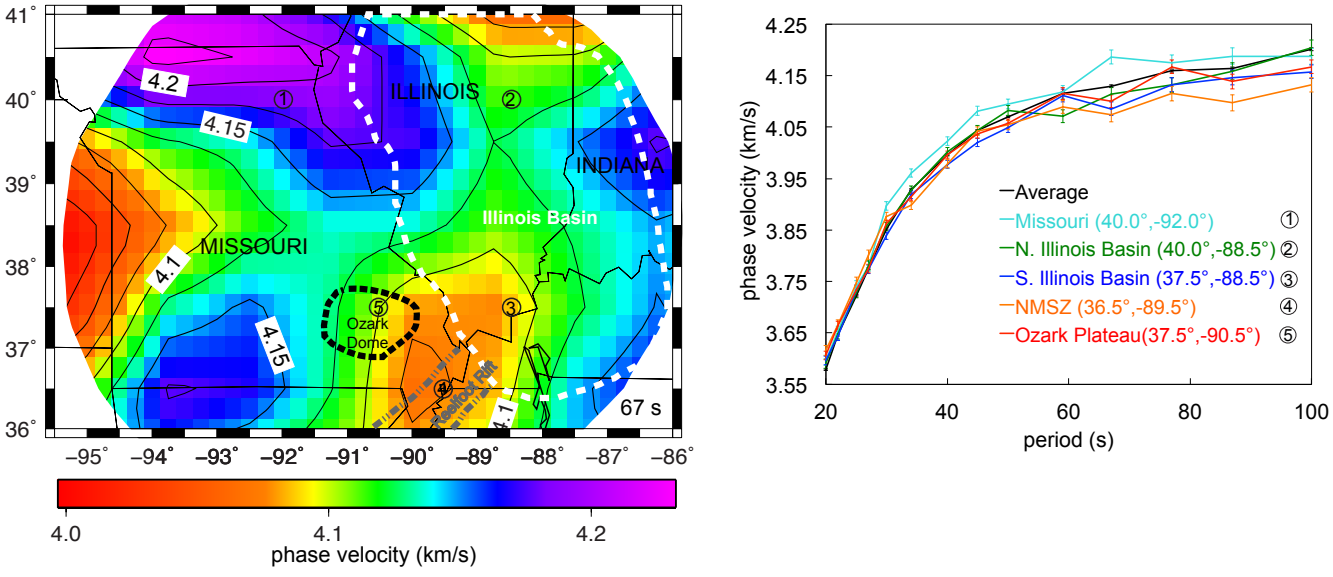
Improved understanding of the factors responsible for producing intraplate seismicity and driving the uplift and subsidence of epeirogenic structures remains a key EarthScope goal in the investigation of the central portion of North America. However, detailed knowledge of the continental interior is lacking because it has not been studied as intensely as tectonically active areas. Here we present a tomographic model of seismic wave velocities for the Midcontinent constructed by measuring phase velocities of Rayleigh waves recorded at EarthScope TransportableArray and OIINK FlexArray stations. The OIINK array specifically focuses on two epeirogenic structures in the Midwest, the Illinois Basin and the Ozark Plateau. Our initial results show that the average phase velocities in the area range between 3.58 km/s at 20 s and 4.20 km/s at 100 s, and are comparable to phase velocities identified within cratonic regions elsewhere. At individual periods between 20 and 34 s, which are sensitive to structures from the mid-crust to the Moho, phase velocities vary by < 0.05 km/s across the study area, and indicate only modest changes in crustal velocities. In contrast, at periods between 40 and 100 s, which are sensitive to the depths in the uppermost part of the mantle, phase velocities differ by ~ 0.1 km/s across the study area, and illustrate clear differences between the Illinos Basin, the New Madrid Seismic Zone (NMSZ), the Ozark Plateau and northern Missouri. The observed phase velocity variations at long periods suggest that structural heterogeneity that is absent in the crust exsits in the uppermost mantle. High phase velocities between 30 and 87 s characterize northern Missouri. The northern and southern portions of the Illinois Basin possess differing phase velocities over a range of longer periods, with the northern Illinois Basin generally exhibiting higher phase velocities. The Ozark Plateau does not stand out as a distinct feature. However, the NMSZ, which borders the southwestern edge of the study area, displays lower phase velocities at periods between 67 and 100 s, than those observed across the rest of the study area. These observations point to an important upper mantle contribution to the formation, and stability, of epeirogenic structures in the Midcontinent or that velocity changes do not accompany crustal contributions to the development of these features.



(**Left**) Map of phase velocities across the study area for a period of 67 s, which are sensitive to the uppermost mantle. Areas masked as white along the perimeter of the map lie outside the well resolved portion of the model. (**Right**) Dispersion curves for phase velocities and their standard errors for five locations (plotted as 1-5 on map).