High-resolution 3D Crustal Structure of the North American Midcontinent Rift from Ambient Noise Tomography

Ghassan Aleqabi

Continental rifts are large-scale laboratories that can be used to study the initiation and cessation of extensional plate boundaries. The Midcontinent Rift System (MCRS) of the North American continent is one of Earth's largest intra-continental rifts. Pleistocene glacial fill and Phanerozoic rocks cover much of the rift, concealing the evidence of its enigmatic history of inception and cessation. The joint deployment of the SPREE seismic Flexible Array experiment and the EarthScope USArray Transportable Array (TA), in Minnesota, Wisconsin, and Ontario, provides a unique opportunity to image buried structures associated with the MCRS. One of the seismic methods being applied is high-resolution ambient-noise tomography (ANT), utilizing Rayleigh waves determined by cross correlation of all available SPREE and TA station pairs. The ANT method allows us to overcome resolution limitations posed by teleseismic surface waves, particularly at shorter periods (10-40 s). The use of these shorter-period Rayleigh waves allow much better determination of shallow crust and upper mantle structure, which are crucial for understanding the history of the MCRS. In this study, we use the 3D models of MCRS shear-wave velocity structure to better understand the composition and thermal evolution of the MCRS, as well as the role the MCRS played in modifying the thermo-tectonic structure of the crust and upper mantle beneath it.

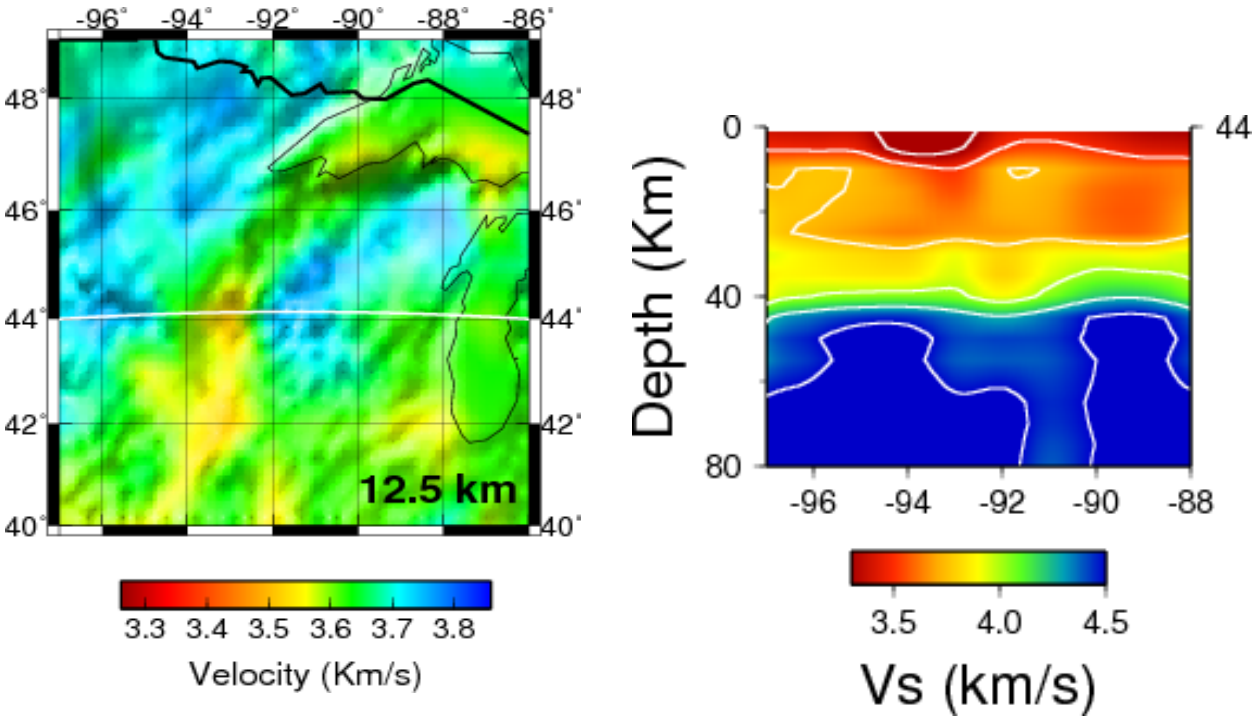

Figure 1. Images of the 3-D variation of shear-wave velocity (Vs) in the crust and upper mantle determined from ambient noise tomography. (a) Horizontal slice at 12.5 km depth. (b) Vertical profile underlying the white line at 44º N in (a).