Results of a Teleseismic P-wave Tomography of the Superior Province with special focus on the Midcontinent Rift System

Bollmann, T.[1]; van der Lee, S.[1]; Frederiksen, A.[2], Wolin, E[1]., and the SPREE Investigators.
[1]Dept. of Earth & Planetary Sciences, Northwestern University; [2]Dept. of Earth Sciences, University of Manitoba

In the middle of the tectonically stable portion of the North American continent lie the remains of the massive 1.1 Ga Midcontinent Rift System (MRS). Previous and ongoing studies have imaged strong heterogeneity in the crust associated with the MRS, but have not imaged such heterogeneity in the mantle beneath the crust. We measured 46,374 teleseismic P delay times from seismograms recorded by the USArray Transportable Array (TA), the Superior Province Rifting EarthScope Experiment (SPREE), and surrounding permanent stations in the greater mid-continent region that surrounds the MRS. We included these and 54,147 delay times from a prior study in a tomographic inversion.

The inversion resulted in a number of conclusions. The first was that the majority of the region has a fast velocity with respect to *iasp91* but there are prominent low velocity anomalies as well. Two of them follow the rift, one in Iowa and another on the Minnesota/Wisconsin border coincident with one of the largest gravity anomalies along the rift. Others occur at the intersections of three terranes that collided in the mid to late Proterozoic. The first of which occurs at the intersection of the Superior Craton with the Penokean Province and the Marshfield Terrane west of the MRS in southern Minnesota. The other occurs at the intersection of the Penokean, Yavapai, and Mazatzal Terranes along the eastern edge of the Michigan arm of the MRS. A last low velocity anomaly of note lies beneath Lake Nipigon, north of Lake Superior. This anomaly lies outside the gravity anomaly of the MRS but crust above it is believed to be rift related due to age dating and chemical similarity to other rift rocks in the region. Although all of these anomalies occur in the lithosphere, their depth extent varies. The rift aligned anomalies reside at depths from 50-150 km, while the other anomalies reach depths near 300 km.

In the process of siting the SPREE stations we reached out to landowners, who graciously allowed us to place stations on their land. We have shared seismograms with them, and discussed research during service runs. We were also featured in a number of regional news outlets who distributed the message of our EarthScope research project to a greater audience.

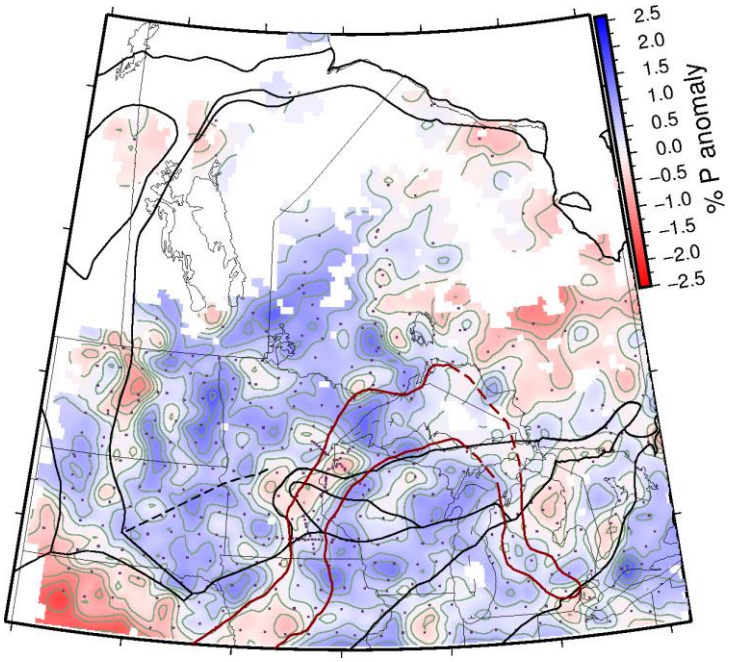

Figure 1*: 100 km depth slice with structural boundaries including an extracted outline of the MRS gravity anomaly (dark red line), tectonic boundaries from Whitmeyer and Karlstrom (2007) (solid black lines) and the surface expression of the Great Lakes Tectonic Zone, modeled after Holm et al. (2007) (dashed line).*