Characterizing lithospheric anisotropy within the Superior and Wyoming cratons using Ps receiver functions

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Composed of stable proto-continents (cratons), the interior of the North American continent is, in most cases, significantly older than the tectonically active (or recently active) portions of continent. Despite the longevity, little is known about the structure, formation and evolution of this earliest lithosphere. Observations of a seismic discontinuity within the cratonic lithosphere, termed a mid-lithospheric discontinuity (MLD), have been documented in North America at depths of approximately 80-100km. Notably, it appears that the MLD may be a global feature with evidence for similar structure across, and within, cratons in Africa and Australia. Although the origin of the MLD is currently debated, it is hypothesized that it may be a relic of either the formation, or later evolution, of the continents (see Selway et al. (2014) for a review).

Work to characterize associated anisotropic structure of the MLD using Ps receiver functions has proven successful, with results indicating that rapid changes in the orientation of anisotropy occur at MLD depths beneath the Granite-Rhyolite Province of the central U.S. (Wirth and Long, 2014). Here, we expand this work to include an analysis of the anisotropic nature of the MLD across the Wyoming and Superior cratons. The goal of this work is to better understand the apparent ubiquity of the MLD across cratons, despite their many distinct origins and early tectonic histories.

For our preliminary analysis we have calculated radial and transverse component Ps receiver functions for seven stations in the north central United States, within the Superior and Wyoming cratons. For each station, events were selected from the USGS NEIC global event catalog and were restricted to an Mw>=5.8 and epicentral distances of 30 to 90 degrees. Preprocessing of the data, including data selection (culling) and P phase arrival selection were carried out using an automated MATLAB GUI script (described in Abt et al. (2010)). The deconvolution was preformed in the frequency domain using both a water-level stabilized deconvolution and an extended time multi-taper technique. Receiver functions were migrated to depth and binned as a function of back azimuth. Future work to model key features within the receiver functions will be needed in order to more completely characterize the anisotropic structure beneath the stations, and to place it within the broader tectonic framework.