The deformation of upper mantle rocks creates systematic mineralogical fabrics that are the cause of anisotropy in seismic properties. Here we combined over 900 observations of core-refracted shear waves (SKS, SKKS, and PKS) that had been recorded between 2012-2017 by 35 long-running stations operating in the Northern Appalachians.

The characterization of regional anisotropic patterns often involves generalized assessment of station-averaged splitting parameters. While this approach allows associations with large-scale tectonic features, the details that are potentially beneficial for interpreting the smaller-scale features like orogenic terranes may be neglected. To identify additional characteristics within the datasets of individual stations more effectively, and to utilize them for comparisons between neighboring stations, we created a template event set. It maximized back azimuthal coverage and homogenized the data sets, making comparisons more meaningful. The station-averaged splitting parameters were obtained using Splitting Intensity technique (Chevrot 2000), which considers both the null and split measurements with respect to their back azimuths.

The preliminary visual assessment suggests similar appearance of splitting patterns between neighboring stations, enough for them to be grouped into tentative anisotropic “domains”. We seek to further verify the notion of anisotropic domains by producing quantitative descriptions, including the null-to-split ratios, the degree of null dispersions, and the systematic comparison of periodic splitting patterns expected from the complex anisotropic structures. Together with the existing knowledge of factors that influence the variations of splitting parameters, we will assess the effectiveness of anisotropic domains as a tool for organizing the regional anisotropic properties and evaluate whether they may serve as a viable stepping stone for extending the observations into tectonic and geodynamic interpretations.

Figure (below): Examples of representative split bubbles from different anisotropic domains, showing varying splitting patterns with respect to back azimuths and inclination angles. Based on visual assessments, the differences between each domain may be characterized by criteria like the relative abundances of null and split measurements, and the back azimuthal distributions of null measurements. The overall geometries of anisotropic domains do not resemble the elongate, NE-trending Appalachian terranes evident on the surface.