Lithospheric structure above the Northern Appalachian Anomaly: Constraints from the NEST experiment

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The Northern Appalachian Anomaly (NAA) is an estimated 400-km wide and ~200 km deep low-velocity region in the upper mantle centered beneath New Hampshire, extending beneath Vermont and Maine. The present-day geophysical anomaly is spatially correlated with an inferred pulse of accelerated erosion and uplift during the Late Cretaceous. The anomaly is also spatially correlated with Jurassic to Cretaceous magmatism that post-dates the breakup of Pangea; the Cretaceous magmatic activity is often inferred to be associated with the Great Meteor Hotspot (GMHS). It remains unclear whether, and to what extent, the anomaly, uplift, and GMHS are linked. Proposed conceptual models for the NAA include a remnant thermal anomaly resulting from the passage of the GMHS or asthenospheric upwelling associated with edge-driven convection.

The spatial coincidence of the geophysical anomaly, previous intraplate magmatism, and unusual topographic uplift in the geologic past stirs curiosity about whether there is an underlying set of processes that might explain both the surface and upper mantle processes. In an effort to better understand the structure and origin of the NAA and the extent to which it is related to past intraplate magmatism and topographic uplift, we have deployed an array of broadband seismometers across Vermont, New Hampshire and Maine, compromising the northern line of the New England Seismic Transects (NEST) array. Data from the ongoing NEST deployment will allow for detailed imaging of the crust, mantle, lithosphere, and asthenospheric upper mantle to address these questions.

We present initial results from P-to-S receiver function analysis of NEST data, which shed light on the present-day architecture of the crust and lithospheric mantle above the NAA. Receiver function analysis allows us to identify discontinuities such as the Moho and the lithosphere-asthenosphere boundary. In combination with other ongoing analyses of NEST data, our characterization of the present-day structure of the lithosphere above the NAA will allow us to understand whether and how dynamic processes in the upper mantle modify lithospheric structures inherited from earlier tectonic events.