The eastern North American margin (ENAM) includes contractional, rifted, and ancient oceanic lithosphere. Despite being a passive margin since the breakup of Pangea (~200 Ma), ENAM is characterized by complex mantle flow indicated by Eocene intraplate volcanics, short-wavelength seismic velocity heterogeneity in the mantle, seismic anisotropy (a proxy for mantle flow) that deviates from modern plate motion and paleo-spreading, and complex lithosphere-asthenosphere boundary (LAB) topography. The mantle lithosphere is an important imaging target since LAB topography can influence asthenospheric dynamics and may preserve rift-drift transitional structures. We conducted joint anisotropy/velocity tomography across the continent-ocean transition to infer mantle flow and structure. We observe significant anisotropic layering across the margin. The oceanic lithosphere has frozen-in anisotropy that is fast parallel to paleo-spreading. The offshore asthenosphere has margin-parallel fast anisotropy indicative of keel-deflected or density-driven mantle flow. We also find short-wavelength velocity anomalies which can be largely explained by edge-driven convection or shear-driven upwelling. To improve constraints on the lithospheric structure, we jointly invert receiver functions with surface wave data for shear velocity profiles. Preliminary results show the shallowing LAB profile from the craton through the Appalachians and coastal plain. This work demonstrates the complex and dynamic nature of a margin which is traditionally considered tectonically inactive.