

Seismic Structural Differences across the Norumbega Fault, Maine

¹ P. Boody, ² W. Menke, ³ V. Levin, ⁴ F. Darbyshire

¹ University of Maine at Presque Isle, ² Lamont-Doherty Earth Observatory of Columbia University, ³ Rutgers University, ⁴ University of Quebec at Montreal

The Norumbega fault zone crosses Southern Maine in a Southwest direction and represents the boundary between cratonic North America (“Laurentia”) and an accreted microcontinent (“Avalonia”). The objective was to determine if a difference in the mantle or crust could be seismically detected on either side of the fault. Secondly, if there was a difference observed was this difference caused or contained by the fault zone? To study this question seismic data was assembled from existing stations in Maine and Canada and new seismic stations placed in Maine in 2012 as part of the QMIII Project. Large (magnitude >6) teleseismic earthquakes that occurred to the north west of the fault zone were selected from the USGS Preliminary Determination of Epicenters (PDE) database. Rayleigh waves from pairs of stations on the north and south side of the fault were analyzed. For each pair a dispersion curve of phase velocities was created using an initial hand tuning followed by the Monte Carlo method. Dispersion curves for paths north of and south of the fault were grouped and averaged to obtain mean dispersion curves for the two regions. A simple three layer earth model (upper-crust, lower crust, mantle) was determined for the mean dispersion curves by forward modeling. Excellent fits were achieved and an exploration of possible combinations of parameters gave a sense of which model features were unique. The two regions have significantly different dispersion curves, implying some difference in structure. The compressional velocities for waves in the mantle observed in the northern pairs are faster than those for the pair of stations in the south. Compressional velocities for the upper part of the crust, possibly the upper ~7.5km, are slower in the northern stations than those in the south. The stations in the south are near the fault zones, but there are not yet stations as close to the fault in north. These stations would help to constrain whether or not the observed differences could be linked to the presence of the fault. Priorities for future work would include more pairs of stations near the fault to the north to help establish if the fault is an actual boundary for these differences.