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Causes for polarity reversals of PP precursor waves reflecting off the 410 km discontinuity beneath the Atlantic

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We investigate the velocity and density structure of the mantle beneath the Northern Atlantic at a depth of 410 km where the olivine to wadsleyite phase transformation occurs. Measuring polarities of precursor arrivals to PP seismic waves that reflect at this transition we analyze over 1700 teleseismic seismograms from 13 different source-receiver combinations using the advantages of high-resolution array seismology methods and crossing ray paths. The final dataset consists of 45 events with Mw $\geq$ 5.8 with a good coverage of reflection points beneath the investigation area. We find several events where the polarity of the precursor signal is opposite to that of the PP wave, however, events with same polarity of precursor and PP wave are also observed. We test several causes for changing polarity of reflections at the 410 km discontinuity and find out that there is a dependence of the polarity on epicentral distance. We computed the reflection coefficients of the precursor wave using the Zoeppritz equations with the initial values of density, VP and VS of a pyrolite model for the olivine-wadsleyite phase transition and varied the values by $\pm$10% above and below 410 km depth. More than 729 million combinations of density, compressional and shear wave velocities for olivine and wadsleyite layers were tested to find the combinations that can explain our polarity-distance observations. While the best-fitting models have a smaller positive contrast than pyrolite in density, a small negative contrast for P and S wave velocities is needed. Possibilities to explain these values include combination of a hydrous wadsleyite layer beneath, and anhydrous or Fe-enriched olivine above the boundary.