Seismic Evidence Supporting the Oceanic Plateau Origin of Northeastern Wyoming Lithosphere

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Recent tomographic models of the United States display a seismically fast region underneath northeastern Wyoming. Although beneath part of the Wyoming Craton, xenolith studies indicate this lithosphere is of Cretaceous rather than Precambrian age. Humphreys et. al. (2015) propose it is the mantle root of a Cretaceous oceanic plateau that was subducted beneath western North America. Additional geophysical evidence was assembled that corroborates the plateau root hypothesis by showing that the fast velocities are caused by chemical (Mg enrichment), not thermal, heterogeneities. The ratio of S to P wave differential travel time anomalies for the fast region was compared to that of the nearby Yellowstone hotspot, which is known to have a strong thermal component. This value is predicted to be ~1.8 for a chemical anomaly, in contrast to ~3.2 for a thermal anomaly. We estimated the ratio using a very high-quality dataset of P and S wave differential travel times from 15 teleseisms recorded by the Transportable Array. Seismograms were filtered so that P and S waves had similar wavelengths, and travel times were corrected for sediment thickness and Moho depth. The effect of the different ratios between Yellowstone and the fast region are plainly visible in the resulting delay time maps. Least squares regression yields ratios of 1.78 ±0.19 (95%) and 3.15±0.28 (95%), for the fast region and Yellowstone, respectively, and thus are in close agreement with predictions. We also use measurements of parallax to demonstrate that the anomaly extends to the unexpectedly deep depth of 300 km. These measurements and calculations are all consistent with the subducted mantle root hypothesis, which could have implications for large scale tectonics and subduction zone processes.