Evidence of Partial Melt in the Northern Appalachian Anomaly

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Asthenospheric upwellings, hotspots, can create partial melt either by decompression of the material or heat transfer to the surroundings. They will also cause P and S waves to slow down as they pass through the hotspot creating a travel time delay. If heat is the only variable that is slowing down these waves, then the ratio of S to P wave travel time delays should be ~3.24 (1 second P wave delay = 3.24 second S wave delay). If there is partial melt present in a hotspot this ratio should increase to ~5 (in the same scenario as above, there would be a 5 second S wave delay). The hotspot that is the focus of this study is the Northern Appalachian Anomaly and many aspects of it have been studied, yet there has not been sufficient evidence for the presence of partial melt thus far, however it has been predicted to be a modern asthenospheric upwelling and to have areas where the flow direction is vertical. This study uses 7 large earthquake events (Mw>=6.5) along with ~4000 P and S wave travel time delay data with the ratio of S to P wave travel time delays of ~5 as the metric for evidence of partial melt. What this study finds is that on the edges of the Northern Appalachian Anomaly there are areas where the S wave delay is significantly higher than the P wave delay at the same station. This coincides with areas that have been determined to have vertical flow (based on null shear wave splitting values). The Central Appalachian Anomaly was also a part of this study and has been predicted to be at much greater depths than previously predicted (this is based off of the parallax seen in this study). Combining this study with the others mentioned could be used as a starting point in looking for recent (~40-20 ma) magmatic events in the area of the Northern Appalachian Anomaly.