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Origins of the 520-km discontinuity

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The 520-km discontinuity is often explained by the phase transition from wadsleyite to ringwoodite, although the theoretical impedance of this transition is so small that the related converted and reflected seismic phases could hardly be seen in the seismograms. At the same time there are numerous reports on observations of a large discontinuity at this depth, especially in the data on SS precursors and P-wave wide-angle reflections. Revenaugh and Jordan (1991) argued that this discontinuity is related to the garnet/post-garnet transformation. Gu et al. (1998) preferred very deep continental roots extending into the transition zone. Deuss and Woodhouse proposed splitting of the 520-km discontinuity into two discontinuities, whilst Bock (1994) denied evidence of the 520-km discontinuity in the SS precursors. Our approach to this problem is based on the analysis of S and P receiver functions. Most of our data are related to hot-spots in and around the Atlantic where the appropriate converted phases are often comparable in amplitude with P410s and S410p. Both S and P receiver functions provide strong evidence of a low S velocity in a depth range from 450 km to 510 km at some locations. The 520-km discontinuity appears to be the base of this low-velocity layer. Our observations of the low S velocity in the upper transition zone are very consistent with the indications of a drop in the solidus temperature of carbonated peridotite in the same pressure range (Keshav et al. 2011), and this phenomenon provides a viable alternative to the other explanations of the 520-km discontinuity.