Slab behavior beneath Eastern Asia from full waveform tomography

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Full waveform seismic inversion for mantle structure has become feasible with the advent of accurate 3D wave propagation codes and the use of adjoint sources to compute the gradient of misfit functions between data and synthetics. The adjoint source, in this approach, depends on how a misfit is defined between data and synthetics. The best time shift between data and synthetic has been used in most full waveform inversions for mantle structure. Waves that sample the upper mantle, however, are almost always multi-pathed due to discontinuities, the low velocity zone as well as large amplitude lateral variations. Here we use the normalized correlation coefficient between data and synthetics as a misfit function and perform full waveform inversion on a large data set of three component seismic data from East Asia. Below the lithosphere, the inversion finds sharp images of the subducting Pacific and Philippine Sea plates with amplitudes greater than 4% for both P and S velocity. We see little deformation within the Pacific plate until near 600 km depth. The subducting Philippine plate, in the Ryukyu subduction zone, abruptly terminates near 450 km depth. This may be the total amount of Philippine plate that has subducted, or the plate may have been completely torn in the past (10-15 Ma) with previously subducted Philippine plate now displaced to the west. Below 600 km depth the Pacific Plate broadens and is less easily identifiable compared to shallower depths. We estimate ~20 Ma or less subducted Pacific plate is clearly visible beneath Northern China. Deformation and slab flattening occurs near the 660 km discontinuity but not much above it. The lack of visible Pacific Plate that subducted before 30 Ma may be due to younger plate subducting then or the plate is now in the lower mantle, deeper than what we can resolve. Deep anomalies beneath central and southern China are not connected to the surface. Beneath central China they are likely Pacific slab or, in part, detached Philippine Sea plate. An anomaly 600 km and deeper beneath southern China is more enigmatic.