Observation of P-Wave Velocity Discontinuities in D’’ Beneath Southeast Asia Using Migration Techniques

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We utilize a simplified migration technique to image the P-wave velocity structure in D’’ beneath southeast Asia using records of earthquakes in the Philippines recorded at the KNET and GHENGIS arrays, obtained through the IRIS DMC. Traces are stacked according to the travel times from event to station via a 3D grid of hypothetical isotropic point scatterers in the lower mantle – if a point in the grid corresponds to a real reflection surface, the traces will sum coherently (Thomas et al., 2004).

We find strong evidence for one reflector at a height of 250 km above the CMB, and weaker evidence for a second reflector approximately 50 km above the CMB, which may correspond to a double crossing of the post-perovskite phase boundary (Hernlund et al., 2005).

Figure (a): Map showing events for which the P-wave velocity discontinuity in D’’ has been observed, along with great circle paths to station KZA, in the centre of the array. Open circles show CMB bounce points, and the red path segments show those segments of the ray path within 300 km of the CMB.

Figure (b): Plot of incident energy at the array as a function of slowness and back azimuth for an event on 17 June 1998. Great circle back-azimuth for this event was 120°; epicentral distance from event to array is 68°. Theoretical slowness for P is 6.22 sec/deg, and 4.20 sec/deg for PcP. The reflection from a velocity discontinuity in D’’, denoted PdP, can be recognized by its intermediate slowness between P and the reflection from the CMB. The fact that the majority of the energy in PdP appears ~10° off the great circle path may be an indication of topography in the reflecting surface.

Figure (c): Horizontal section through the grid of potential scattering points at a depth of 2635 km for the same event as figure (a), showing amplitude at the receiver following stacking. The reflection from a velocity discontinuity in D’’ can be clearly seen.

