Search for seismic discontinuities in the lower mantle

Lev Vinnik

vinnik@synapse.ru, vinnik@dubna-2.scgis.ru
Institute of physics of the Earth, Moscow, Russia

Mamoru Kato, Hitoshi Kawakatsu

mkato@eri.u-tokyo.ac.jp, hitosi@eri.u-tokyo.ac.jp
Earthquake Res. Inst. Univ. of Tokyo, Japan

Indications of lower mantle discontinuities are debated for decades, but still little is known about their properties, and their origins are enigmatic. In our study broad-band records of deep events are examined for the presence of signals from the lower-mantle discontinuities with a novel technique. We deconvolve vertical component of the P wave coda in the period range around 10 s by the S waveform and stack many deconvolved traces with moveout time corrections. In synthetic seismograms for the Earth's model without lower mantle discontinuities, the strongest signal thus detected in the time window of interest is often s'410'P phase (generated as S and reflected as P from '410 km' discontinuity above the source). In actual seismograms there are other phases that can be interpreted as converted from S to P at discontinuities in the lower mantle beneath the seismic source. We summarize the results of processing the seismograms (1) of deep events in Sunda arc at seismograph stations in east Asia, (2) deep Kermadec-Fiji-Tonga events at the J-array and FREESIA networks in Japan and stations in east Asia, and (3) deep events in the north-west Pacific region (Mariana, Izu-Bonin and the Japan arc) recorded at stations in north America. In our data there are strong indications of discontinuities near 860-880 km, 1010-1120 km, 1170-1250 km and 1670 - 1800 km depths. The clearest signals are obtained from the discontinuity at a depth of 1200 km. We argue that '900 km', '1200 km' and '1700 km' discontinuities are global, but laterally variable. Seismic stratification of the lower mantle may have bearings on the patterns of subduction, as revealed by tomographic models.