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Anomalies of rupture velocity in the mantle transition region

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The rupture process of deep earthquakes has remained one of the important issues in Earth Sciences, despite the development of global seismic networks let us estimate the detailed rupture process during large shallow events. Here we obtained the seismic rupture image during recent deep earthquakes (deeper than 300 km) using the back projection of teleseismic P-waves, observed by global and dense seismic networks. The obtained rupture models show that the rupture velocities are less than half of the shear wave velocity except for a depth range of 530 to 600 km, which are characterized by a relatively fast rupture propagation. The slow rupture earthquakes have over ten times larger stress drops compared to the fast rupture earthquakes. The large specific fracture energy for the deep earthquakes generally prevents the acceleration of dynamic rupture during earthquakes, while the small specific fracture energy in the exceptional depth range promotes dynamic rupture propagation.

Keywords: deep earthquake, back projection, rupture velocity, mantle transition region