

Megathrust-inducing azimuthal seismic anisotropy in local and regional crusts

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Megathrust earthquakes produce large coseismic and postseismic lithospheric displacements. The 2011 M9.0 Tohoku-Oki megathrust earthquakes produced large displacements up to regional distances. The lithospheric displacements directing to the epicenter on the convergent plate boundary developed transient uniaxial tension field over the backarc lithospheres. The V_p/V_s changes display characteristic 2θ azimuthal variations in the upper crust of the Japanese islands, ranging between -0.0458 and 0.0422. Large lateral variations in V_p/V_s changes suggest medium-dependent perturbation. The lower crust of the Korean Peninsula in distances of ~ 1300 km displayed coseismic velocity changes of 3 % after the megathrust earthquake. The V_p/V_s ratios and seismic velocities recovered gradually over time. Peak V_p/V_s and seismic velocity changes were observed along paths subparallel or subperpendicular to the directions toward the megathrust earthquake. The azimuthal seismic anisotropy may have developed from preferential crack orientation and azimuthal lithostatic stress changes. It appears that recovery of the medium properties may take decades. A series of moderate-sized earthquakes occurred as a consequence of medium response to the temporal evolution of stress field in the Korean Peninsula.

Keywords: megathrust earthquake, crustal deformation, induced seismicity