Crustal seismic velocity structure in the Japanese Islands from receiver function analysis using similar earthquakes

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The stress and strain changes due to the recurrence process on the inter-plate great earthquakes of the subducting plate should have a significant effect on shallow inland seismicity and velocity structure in the overriding plate. In this study, we applied receiver function analysis using similar earthquakes, which repeatedly occurred at almost the same location, to investigate the spatiotemporal change of the crustal seismic velocity structure beneath the Japanese Islands. Similar earthquakes used as data were extracted from the seismograms of medium-sized earthquakes, which observed in the seismic network of Japan and occurred in the epicentral distances between 30 degrees and 90 degrees in the periods from September 1989 to February 2016. We estimated temporal changes of crustal seismic velocity structure by receiver function analysis from the selection of pairs of similar earthquakes occurred before and after the 2011 Tohoku-Oki earthquake (M9.0). In this analysis, we assumed that the depths of the Moho discontinuity, which estimated using all available data for the above period, do not change within the analysis period. As a result, we detected areas of decreased crustal velocity to the west of the source region of the Tohoku-Oki earthquake. We suggest that the stress change by a great inter-plate earthquake affected the velocity reduction or velocity polarization. On the other hand, the crustal velocity increased to the north of the source region. This change may be caused by the effect of the postseismic deformation after the 2003 Tokachi-Oki earthquake (M8.0). However, it is difficult to specify the accurate timing of the change because of long-term data stack. The impact of the great earthquakes has been widespread for a long time. The further studies of the seismic velocity structure in arbitrary period will clarify the cause of changes.

