Effects of structural heterogeneities of fault zone on source process of the 2004 mid-Niigata Prefecture Earthquake

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The velocity structure on the mainshock fault plane for the 2004 mid-Niigata prefecture earthquake is elucidated by inverting arrival times from 708 aftershocks observed by extremely dense temporary seismic stations, using double-difference tomography.

Following the mainshock, several research groups in Japan deployed temporary seismic stations. Intensive researches such as hypocenter relocations, focal mechanism, seismic tomography and imaging of reflection planes or scatterings in the crust, have been conducted using seismic data recorded by each group. Seismic data (arrival times and waveforms) for 708 aftershocks commonly observed at temporary stations were merged into a data set by the recent work of Kato et al (preprint, 2006). Total number of the temporary seismic stations within the data set reaches into 145 in the source region (within a 30 km squared). To the best of our knowledge, such dense aftershock observations have been barely conducted to date.

High-velocity zone is clearly imaged at the shallow northeast side of the hypocenter. Most of aftershocks near fault plane are distributed at the periphery of this high-velocity zone. The high-velocity zone on the mainshock fault plane roughly coincides with the asperity area where both coseismic slip and static stress drop show larger values than the surrounding areas. The high-velocity zone is enclosed by low velocity zones, which correspond to sediments at shallow depths and weak lower crust. Inelastic deformations of those low velocity zones can concentrate elastic energy on the high-velocity zone during tectonic loading.