

Aftershock distribution of the 2004 Niigata-Chuetsu Earthquake ($M_j = 6.8$) and heterogeneous structure in the source region

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The 2004 Niigata-Chuetsu Earthquake ($M_j = 6.8$) occurred on 23 October 2004 in the northeastern part of the Niigata-Kobe Tectonic Zone where large contraction rates were observed. The strong ground motion caused by the mainshock (1,722 gal was observed near the epicenter) severely destroyed ~5,000 houses and killed 40 people.

We deployed three temporary online seismic stations in the aftershock area, combined data from the temporary stations and from permanent stations located around the aftershock area, and determined the hypocenters of the mainshock and aftershocks with a joint hypocenter determination (JHD) technique. The resulting aftershock distribution showed that major events such as the mainshock, the largest aftershock ($M_j = 6.5$), the aftershock on 27 October ($M_j = 6.1$), etc. occurred on different fault planes that were located nearly parallel or perpendicular to each other. We also found that large differences in the travel time residuals (~1 s for P and ~2 s for S) between Niigata Basin to the west and Echigo Mountains to the east from the source area significantly affected the aftershock locations.

We carried out a tomographic inversion of the P- and S- travel times for 3-D V_p and V_s structures. The station corrections obtained in the JHD process were subtracted from the travel times beforehand. The result showed that the source area was highly heterogeneous. Low velocity anomalies to the west and high velocity anomalies to the east were clearly found down to ~10 km deep. One of the boundaries of the anomalies sloped downward to the west and corresponded well to the mainshock fault.

These features are probably a main cause that many larger aftershocks occurred in the sequence of the 2004 Niigata-Chuetsu Earthquake.