Source inversion of the 1997 Northwestern Kagoshima earthquakes with high resolution using a 3-D heterogeneous structure model

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The wave field is strongly affected by the underground structure through which the seismic waves propagate from source to observation stations. However, in the most of conventional source inversions, horizontally layered media (one-dimensional structure) has been used for calculation of the Green's functions. The purpose of this study is to obtain the high accuracy and high resolution image of source process using the 3-D Green's functions which include the wave propagation effects more realistically.

Application of this study is the two mainshocks of the 1997 Northwestern Kagoshima Earthquakes (the first mainshock:M6.5, the second mainshock:M6.3) which are well recorded at near-source strong motion sites. We developed a parallel finite-difference code to calculate the 3-D Green's functions using the reciprocity theorem, which effectively reduces the computation time. Also, we have constructed the realistic 3-D structure model of the northwestern Kagoshima region to obtain the 3-D Green's functions. A new inversion method (Takenaka and Fujii, 2003) by a grid model approach is applied to the 0.1-1Hz bandpass filtered velocity waveforms.

As the results, for the first mainshock, the rupture begins from the hypocenter and propagates mainly toward the shallower western part and the deeper eastern part. The maximum amplitude of slip velocity was more than about 4km/s. The locations of asperities are extremely consistent with the areas where the aftershocks are not abundant. The comparison of the inversion result with the velocity perturbation by the seismic tomography analysis (Miyamachi et al., 1999) indicates that the rupture propagated to the high velocity zone and stopped there. Also for the second mainshock, the slip distribution was obtained with high accuracy and high resolution, which considerably overlaps on the low activity zone of the aftershocks.

The inversion results inferred by using the conventional 1-D Green's functions can not explain the source aspects as described above, which suggest that the source inversion using 3-D Green's functions has a potential to effectively reveal the source process with high accuracy and high resolution.

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