Imaging the 1995 Kobe earthquake area using double-difference tomography with discontinuities

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Recently double-difference earthquake location method and double-difference tomography method have been proposed by Waldhauser and Ellsworth (2000) and Zhang and Thurber (2003), respectively. Referring to their studies, in this work we have modified the tomography computer program (Tomog3d) of Zhao et al (1992) and made it applicable to both absolute arrival times and differential travel times. A favorable feature of the new version of the code (tomo-D3) is that it can deal with complex-shaped velocity discontinuities in the study area (such as the Conrad and Moho discontinuities). The aim of using double-difference data is to improve the resolution of the earthquake source area. We carried out many synthetic tests to confirm the feasibility and stability of tomo-D3. We found that when we use both absolute and double-difference arrival times, the resolution of seismic tomography can be improved. We have determined the P- and S-wave velocity structures of the entire crust (0-33 km depth) under the 1995 Kobe earthquake area using this new method (tomo-D3). Our tomographic results are similar to that obtained by Zhao et al (1996). The images show that the Kobe mainshock hypocenter is located in a distinctive zone characterized by low P and S wave velocities and high Poisson ’s ratio. This anomaly exists in the depth range of 16-25 km, which is interpreted as a fluid-filled, fractured rock matrix that contributed to the initiation of the Kobe earthquake.

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