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変換波 sP から推定した 2004 年９月 5 日の紀伊半島南東沖地震(M7.4)の余震の深度の分布

°白玲（京大防災研）、川崎一朗（京大防災研）、石川有三（気象庁精密地震）

Focal depth distribution of aftershocks of Sept. 5, 2004, off-shore southeast of Kii peninsula earthquake (M7.4) estimated from sP phase

°Ling BAI (DPRI, Kyoto University),
Ichiro KAWASAKI (DPRI, Kyoto University)
Yuzo ISHIKAWA (Matsushiro, JMA)

(1) Off-shore southeast of Kii peninsula earthquake

A major earthquake with a magnitude of 7.4 occurred at 23:57:16 (local time) on September 5, 2004 at the off-shore southeast of Kii peninsular, Japan. This earthquake shocked much of southwestern Japan and as far north as Tokyo. However, the seismic activity was estimated to have quite different focal mechanisms. The foreshock (M6.9), the main shock and the largest aftershock (M6.5) showed reverse fault with a N-S compression, whereas aftershocks in the area extending to the northwest were estimated to have strike-slip faults.

Seismic stations are mostly located in continental areas. The poor azimuthal coverage can easily induce earthquake mislocations when using routine location method and basic seismic phases. Five OBS (Ocean Bottom Seismometers) were deployed at the center area of the earthquake cluster. The errors in focal depth for earthquakes outside the OBS net are remarkable uncertain.

(2) Relocations and velocity inversion

Distinct later phases were observed at small epicentral distance of about 150km. We interpret this phase as sP phase, an upgoing S phase from the focus which is then reflected and converted to a P wave at the Earth’s phase at a point relatively near the hypocenter. This phase is sensitive to focal depth for its travel time changes slowly with distance but rapidly with depth. The sP follows the P wave by a time interval (sP-P) has been studied to constrain the focal depth. The goal of this procedure is to eliminate the effect of original time on location determination. However, it does not take the advantage of recent development of accurate location. Many of those developments are aimed at improving relative and/or absolute location accuracy.

We attempted to develop DD to include sP phase to restrict focal depth. The calculations of travel time difference, derivative, and angle of incidence are a critical central part of the relative earthquake location method. Then we investigated velocity structure by using relocations as original input.

(3) Results and discussion

We verified the relocations by using green function. There is significant topographic irregularity on the subduction zone where would have impacts on the initiation and rupture process of the earthquakes.