



Afterslip distribution corrected by the viscoelastic relaxation following the September 12, 2007 Southern Sumatra Earthquakes

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The great 2007 Southern Sumatra earthquakes (Mw 8.5 and Mw 7.9) occurred on September 12, 2007, at southern part of Sumatra Subduction zone on the region of the great earthquakes of 1797 and 1833. Studying afterslip distribution of large interplate earthquakes such as these earthquakes is very important because post seismic slip provides information of the stress changes, frictional characteristics and material property on subduction zones and it could affect the occurrence of future earthquakes. In general case, most studies on afterslip distribution considered only elastic properties. In fact, the effect of viscoelastic relaxation in the asthenosphere is included in observed post seismic surface deformation. Therefore, we should remove it in order to obtain the correct afterslip distribution.

We estimated time evolution of afterslip distribution using ABIC inversion method from 15 month GPS post seismic deformation for every 3 month time interval. We computed postseismic deformation using structure model of Maxwellian viscoelatic asthenosphere underlying on elastic lithosphere. For the calculation of afterslip in each interval, we considered not only viscoelastic responses to coseismic slip but also viscoelastic responses to afterslip in the preceding intervals.

The significant horizontal viscoelastic deformation was obtained at BSAT and PRKB sites close to the calculated coseismic rupture area with the trenchward motion direction. The majority of viscoelatic uplift pattern is obtained in area of Sumatra Island, which is anti-correlated with observed vertical postseismic GPS data. After removing displacements due to viscoelastic responses, then we try to explain them using afterslip model. We observed that the afterslip has maximum slip of 0.42 m during 15 months investigation. The moment release due to cumulative afterslip distribution is 0.86×10^{21} Nm (Mw 7.8), about 22 % smaller than the moment release due to afterlip using elastic properties only. The main area of afterslip distribution is located at about 100 km northeast of the epicenter of the first earthquake, where this area was not slipping during the main shock. The majority of afterslip area is extended to downdip of the coseismic rupture area, and it seems to be correlated with the aftershocks distribution.

We concluded that no single mechanism can explain the post seismic deformation associated with the 2007 southern Sumatra earthquakes. In the early stage of the post seismic deformation, afterslip can mainly explain the deformation. However, in the later stages, viscoelastic relaxation due coseismic and post seismic slip is dominant to explain the post seismic deformation. Our result shows that viscoelastic behavior in asthenosphere is very important and essential in order to obtain the true afterslip distribution.

Keywords: subduction zone, GPS, ABIC inversion, afterslip, viscoelastic