Coseismic slip and afterslip of the Sumatra earthquake detected by continuous GPS observations and their tectonic implications

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1. Introduction

The 2004 Sumatra-Andaman earthquake is the first M9 event after the implementation of the global continuous GPS observation networks. Many groups have been conducting researches using data from IGS and other networks established in the surrounding regions. I would like to discuss coseismic and afterslip distributions and their tectonic implications on the basis of some representative studies.

2. Coseismic Slip

Coseismic displacements were presented by several authors. Vigny et al.(2005), Hashimoto et al.(2006a), Kreemer et al.(2005) and Banerjee et al.(2005) presented coseismic displacements in Asia and Australia using IGS and other available continuous GPS sites. They found a more than 25cm SW-ward displacement at Phuket which is about 600km away from the source region. Jade et al.(2006) presented coseismic displacements in Andaman and Nicobar Islands using the campaign GPS data. They showed these islands shifted by 5˜6m to southwest. Suito et al.(2005) obtained vertical displacements in Andaman and Nicobar Islands comparing satellite images before and after the earthquake and revealed large eastward tilt of Andaman Islands. Their results are consistent with the results of field surveys by Subarya et al. (2006). Their estimated moment magnitudes range from 9.1 to 9.2. It is important to note that the largest slip is observed SW off Sumatra and slip decreases along the strike of the trench axis. The largest slip is estimated ˜30m in some geodetic or seismological models.

3. Postseismic Displacements and Afterslip

Postseismic displacements are already as large as coseismic displacements (e.g. Hashimoto et al., 2006b; Katagi et al., 2007). Hashimoto et al.(2006b) and Katagi et al.(2007) pointed out that postseismic displacement at Sampari decayed faster than those at Thai sites. They imply rapid decay of afterslip on the segment west off Sumatra.

4. Tectonic Implications

Coseismic slip on the plate interface is the largest SW off Sumatra and rapid decay of afterslip is obtained in its vicinity. These results suggest that lateral variation in frictional properties on the plate interface along the trench may exist. On the other hand, distance between the trench and the pivot line along which is the boundary between coseismic uplift and subsidence is almost constant (Suito et al., 2005). Therefore strain/stress must have large spatial variation along the strike before the mainshock and we must pay more attention to the cause of slip of about 30m. These speculations may result in importance of ’hard’ asperities on plate interfaces for possible M9 earthquakes along subduction zones.