Mode of seismic moment release in the source region of the 2004 Sumatra-Andaman earthquake.

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The 2004 Sumatra earthquake of Mw 9.3 ruptured 1200 km-long segments along the plate boundary between the Eurasian and Indo-Australian plates where the obliquity of plate convergence to the trench-normal varies from 22 degrees off the Sumatra to 78 degrees off the Andaman islands. In this paper, we investigated the balance of the moment release between the trench-parallel and trench-normal components using events for the last 30 years including the main shock and aftershocks of the Sumatra earthquake.

We applied the inversion method by Angelier (2002) to sets of fault plane solutions in several sub-divided areas for determining each principal stress fields. The maximum principal stresses for the areas with dominant thrust-type events direct normal to the strike of the plate boundary, deviating from the direction of the plate convergence, especially largely at northerly segments close to the Nicobar and Andaman islands. However, the principal stresses for the areas on the back-arc side of the Nicobar-Andaman islands show the strike-slip types whose slip directions are parallel to the trench-parallel component of the plate convergence. The seismic moment released by these strike-slip events for the last 30 years was estimated to be about $1.2*10\hat{}20$ Nm. Based on the results that the maximum principal stresses for the set of minor thrust-type events including the aftershocks direct normal to the trench, we might well assume that the slip of the 2004 Sumatra main-shock also directed trench-normal along the entire segments of its rupture zone. Then the seismic moment of trench-normal component released by the Sumatra earthquake is estimated at $6.5*10\hat{}22$ Nm. Since the ratio of trench-parallel to trench-normal component calculated using the average obliquity of plate convergence along the entire rupture zone is 1.5, the seismic moment of trench-parallel component corresponding to the above trench-normal component is $9.4*10\hat{}22$ Nm. Assuming that the recurrence time interval of an event like the Sumatra earthquake is 1000 years and that the moment release rate of trench-parallel component in the areas on the back-arc side of the Nikobar-Andaman islands is constant, being equal to that estimated for the last 30 years, we obtain $3.9*10\hat{}21$ Nm as an estimate of the seismic moment release for the recurrence interval, which is only 4% of the seismic moment of trench-parallel component that might have been stored for the recurrence interval. We infer that some other processes may operate for releasing the extra seismic moment of trench parallel component in the Sumatra-Andaman convergence zone.