Geophysical Research Abstracts, Vol. 9, 08218, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08218

Analysis of Stresses Initiated Recent Near-Sumatra Earthquakes

Sh.A. Mukhamediev (1) and A.N. Galybin (2)

1. Institute of Physics of the Earth, Moscow, Russia (shamil@ifz.ru / Fax: +70952556040 / Phone: +70952541082)
2. Wessex Institute of Technology, UK (agalybin@wessex.ac.uk / Fax: +442380292853 / Phone: +442380293223)

The stress state is a key factor that affects the origin of the disastrous megathrust earthquakes occurred on 26/12/2004 and 28/03/2005 (hereafter, these are referred to as the Recent Near-Sumatra Earthquakes, RNSE). We have examined the region including the Sunda Trench, where the Indian and Australian plates (the Indo-Australia Plate, IAP) submerge under the Eurasia Plate (EAP) represented there by the Burma and Sunda peripheral plates. Experimental information on the stress state is represented by data on stress regimes and on orientations of horizontal principal stresses T1 and T2 (T1$<$T2; compressive stresses are positive); data are available in the world database WSM, Reinecker, et al. (2005) (The release 2005 of the World Stress Map, available online at www.world-stress-map.org). The data are spatially discrete and do not contain stress magnitudes.

We assume both IAP and EAP to be elastic (in general with different elastic moduli) and apply a direct approach, which uses experimental data on stress orientations as the only input and does not appeal to boundary conditions, for method detail see Galybin and Mukhamediev (2004). *Int. J. Solids Struct.*, 41. The stress field modelling involves fitting the calculated and experimental orientations at loci of stress measurements and imposing continuity of the stress vector across the Sunda Trench. The results show that in the vicinity of the trench, the T2 trajectories are subnormal and, hence, the T1 trajectories are tangential to its strike, maximum shear stress, Tmax, is low in an elongated area extending along the trench and crossing it near the epicentres of earthquakes of the RNSE, mean stress, P, for the island arc (northeast of the trench) is

lower than the corresponding characteristic value for the IAP, and Tmax and P reach minimum near epicentres of the RNSE along the trench (on both EAP and IAP sides).

Distinctive features of the stress field allow us to investigate the mechanics of initiation of the RNSE. Their epicentres are confined to a less stressed area characterized by lower T1 and T2 values (on both EAP and IAP sides); i.e., the initiation of earthquakes is affected not only by stress T2 normal to the trench strike, but also by the tangential stress T1. If the inclined seismogenic surface S of interaction between the obducting and subducting plates were smooth, then stress T1, parallel to this surface, would exert no influence on stresses affecting S. Hence, asperities of the surface S, which are extending parallel and perpendicular to the S strike, play a crucial role in the initiation of earthquake breakups. Such asperities emerge on the surface S due to subduction of topographic irregularities of the IAP under the EAP.

The Coulomb criterion is accepted as the condition of the breakage onset. The value of T2 is the most variable, it increases during a seismic cycle to a critical value T2c. Relationship between T2c and inclination of surface S to the horizon, f, shows that for the range of friction coefficient 0.1-0.2, the minimum of T2c is reached when f lies between 30-45 degrees. Asperities with such dip angles will provoke the initial displacement followed by an unstable dynamic lateral propagation of the fracture along the subduction surface S. The horizontal stress at the depth of the hypocenters (h=30 km) is estimated as 1000 MPa. It should be pointed out that the position of the minimum stress may change after the RNSE. Therefore, it is important to monitor the stress state to reveal the new position of this minimum stress and consider it in the tsunami early warning system planned for the Indian Ocean.

The work is supported by RFBR (grant 06-05-65245).