Geophysical Research Abstracts,
Vol. 11, EGU2009-6209, 2009
EGU General Assembly 2009

Structure of the Sumatra wedge affected by the 26th December 2004 :Effects of the lower plate volcanic ridges.

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Detailed swath-bathymetry, coupled with echo-sounder data were collected offshore the northern tip of Sumatra over the rupture area of the 26th December 2004 Mw=9.2 earthquake during the Sumatra aftershock cruise. 20 ocean bottom seismometers were also deployed in the northern Sumatra area., and more than 1000 events were identified during the 12 days recording period.

We mapped recently active steeply dipping thrust fault zone within the western
termination of the Sunda accreted wedge. Main N10°W trending out of sequence thrust fault zones with a discrete westward vergency and some component of dextral strike-slip motion were continuously mapped within the wedge, on the basis of bathymetry and low frequency sounder profiles. The interplate boundary does not appear to extend into the frontal part of the wedge but most probably merges in its central part along these major faults, the Lower and Upper Splay Faults.

After relocation, the seismicity shows different pattern in each side of this Upper Splay Fault. East of this boundary, beneath the Aceh basin, the earthquake depths ranged from 30 to 60 km allow us to illustrate the subducted plate. In the western part, the aftershock distribution is strongly influenced by the N-S orientated oceanic fracture zones. Two clusters of earthquakes between 10 and 50 km in depth trending along N-S direction are observed in the lower wedge that we interpret to be reactive fracture zones.

The lower wedge is interpreted as the northern prolongation below the wedge of the lower plate NS oceanic fracture zone ridges affected by NS trending left lateral strike-slip faults. This wedge outer ridge is in the process of being transferred to the upper plate. On the other hand the central ridge is interpreted as possible stacked volcanic ridge slivers already incorporated into the upper plate along the subduction buttress (the inner ridge of the wedge). We propose that the tectonic interaction of the volcanic Indian Ocean fracture ridges of the subducted plate with the leading edge of the upper Sunda plate subduction zone is an active tectonic transfer process of oceanic material to the upper plate.

The proposed emergence of the interplate boundary into the middle part of the wedge along the Lower Splay Fault, could have favoured the formation of the giant Sumatra tsunami at moderate water depth. This docking and temporary stacking of these volcanic ridges before their subduction at depth, is favoured by the strong oblique convergence that prevails up to the Bengal basin into the north.