



## **Lower plate impact on earthquake rupture segmentation on the Sumatra margin**

H. Kopp (1), W. Weinrebe (1), S. Ladage (2), U. Barckhausen (2), D. Klaeschen (1), E. R. Flueh (1), C. Gaedicke (1), M. D. Yusuf (4) and the SeaCause and GITEWS Teams (1,2,3,4)

(1) IFM-GEOMAR Leibniz-Institute of Marine Sciences, Kiel, Germany  
(hkopp@ifm-geomar.de)

(2) BGR, Federal Institute for Geosciences and Natural Resources, Hannover, Germany

(3) GFZ, GeoForschungsZentrum, Potsdam, Germany

(4) BPPT, Agency for the Assessment and Application of Technology, Jakarta, Indonesia

The large-scale morphotectonic segmentation of the Sumatra trench system results from subduction of reactivated fracture zones and aseismic ridges of the Wharton Basin and is also reflected in its seismotectonic segmentation as most recently evidenced by the distinct rupture zones of the 2004-2005 earthquake couplet. The fracture zones and the aseismic Wharton Ridge represent tectonic segment boundaries and zones of anomalous crust with regards to density, crustal composition and thickness. The segmentation of the downthrusting plate is mirrored in the seismotectonics of the upper plate. The distinct rupture zones of the 1797/1833, 1861/2004 and 2005 megathrust events suggest that tectonic overprint of the margin by subduction of oceanic relief and lithosphere anomalies leads to the formation of first-order segment boundaries on the upper plate that exert a decisive impact on earthquake rupture dynamics. The extent of the 1797/1833, 1861/2004 and 2005 rupture zones shows an intriguing correlation to the segment boundaries. Though the scientific community is beginning to understand the role of segmentation on the extent and distribution of rupture during megathrust events, we still lack the full understanding of the weight and influence of the physical properties of a margin (i.e. pore pressure, material strength, stress distribution) on its seismic potential compared to its structural tectonic heterogeneity. Upper plate segmentation of the Sumatra trench system is manifested in varying

modes of mass transfer as revealed by high-resolution seafloor mapping. The margin segments to the northwest of the Investigator Fracture Zone, which were affected by the 2004 and 2005 megathrust earthquakes, are subject to extensive surface erosion of the margin wedge. Oversteepening of the lower slope in response to elevated pore pressures and the subduction of pronounced seafloor topography lead to mass wasting processes here. Conversely, neotectonic formation of nascent accretionary thrust folds is limited to the sections of the deformation front southeast of the Investigator Fracture Zone and documents the resumption of frontal sediment accretion in the wake of oceanic relief subduction. Further analysis of multidisciplinary studies will close the gap in our ability to assess the impact of different physical-geological parameters on seismotectonic segmentation.