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SSS38-P34 Room:Convention Hall Time:May 24 15:30-17:00

Subbottom structures in the region causing the huge tsunami during the 2004 Sumatra-Andaman Earthquake

MISAWA, Ayanori[1*], HIRATA, Kenji[2], Leonard Seeber[3], Riza Rahardiawan[4], BABA, Hisatoshi[5], Katsura Kameo[1], ADACHI, Keita[1], SARUKAWA, Hiroshi[5], UDREKH, Udrekh[6], ARAI, Kohsaku[7], NAKAMURA, Yasuyuki[8], KINOSHITA, Masataka[8], FUJIWARA, Toshiya[8], ASHI, Juichiro[1], TOKUYAMA, Hidekazu[1], Haryadi Permana[9], Yusuf S. Djajadihardja[10]

[1]AORI, the University of Tokyo, [2]MRI, [3]LDEO, [4]MGI, [5]Tokai University, [6]BPPT, [7]GSJ, AIST, [8]JAMSTEC, [9]LIPI, [10]BAKOSURTANAL

On 26th December 2004, the Sumatra-Andaman Earthquake (Mw 9.2) nucleated offshore northwestern Sumatra Island and then ruptured the megathrust for over ~ 1,300 km mostly to the north along the Sunda Trench. The great tsunami spread over the Indian Ocean and more than the 220,000 people died. Several international marine geological and geophysical surveys have been conducted in this area, especially the Sunda Trench and the Aceh Basin areas. Based on the results from the surveys, five working hypotheses have been proposed for the tsunami source fault model. Among them, Hirata et al. (2008, 2010) suggested that the secondary tsunami source is located around the Middle Thrust of Sibuet et al. (2007). If the 2004 coseismic rupture reached the seafloor along the Middle Thrust, seafloor deformation contributing the great tsunamis would be recorded in the shallow part of the sediment layer.

To image the detailed shallow structure and to map distribution of active faults, we conducted a high-resolution Multi-Channel Seismic (MCS) survey with ship-board Subbottom Profiler (SBP) in the areas during KH-10-5 cruise (using R/V Hakuho-Maru). KH-10-5 MCS survey was carried out in November 2010. Total length of the survey lines was ~484.3 nautical miles. In this MCS survey, a GI gun with a total volume of 150 cubic inch (G: 45 cubic inch, I: 105 cubic inch) and 1200m-long, 48 ch streamer cable were used (steaming at 4 knots, 10 seconds shot interval).

The survey provided fine structural images down to 1.5 sec (TWT) in the trench and to a maximum of 2.0 sec (TWT) in the forearc high region. In the trench region, many landward-vergences (seaward-dipping) faults were identified. These faults reach the seafloor. In general, the trench region seems to suffer active deformation. Additionally, the landward-vergences uplift and deform the oceanic and trench-fill sediments of the Sunda trench. This deformation system has developed the kink folding systems and has also played the role of the accretionary process. In the forearc high area, many of faults and folds were also recognized. A number of ridges in this area are made by many thrust-anticlines. Between the anticline ridges, the syncline and the syncline (or piggyback) basins are also recognized. The sedimentary layers of syncline basins can be usually imaged down to a maximum of 0.5 sec (TWT) below the seafloor. In the deep part of these basins, sediment is often tilted landward. These tilted layers form a proto-deformation related to the shortening of the forearc and the development of the anticline ridges. In contrast, the shallow part of these basins is mostly flat-lying and laterally coherent. It indicates that the recently deformation activity of this area is relatively low. Along the Middle thrust, however, we found evidence in both MCS and SBP data of recent deformation in the near-surface layer. This active deformation area is almost coincident with the position of the predicted secondary tsunami source fault predicted by Hirata et al. (2008). However, only the high-resolution MCS and shipboard SBP data alone cannot decide if this deformation was activated coseismically during the 2004 event. Also, the deeper structure of the Middle Thrust could not be recovered by our MCS data. Additional survey will be required, such as the high-resolution deep-tow SBP and piston coring will be required in near future as well as a large-scale MCS survey with lager volume air-gun and much long streamer.

Keywords: 2004 Sumatra-Andaman Earthquake, Tsunami, Subbottom structure, High-resolution Multi-Channel Seismic survey