2004年スマトラ島沖地震震源域付近の地質構造と変動地形に関する研究

その他のタイトル	The study on geological structure and tectonic relief around the epicenter of the 2004 Sumatra Earthquake
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論文の内容の要旨

論文題目　2004 年スマトラ島沖地震震源域付近の地質構造と変動地形に関する研究

(The study on geological structure and tectonic relief around the epicenter of the 2004 Sumatra Earthquake)

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On 26th December 2004, the Sumatra–Andaman Earthquake (Mw 9.1-9.3) occurred offshore northwestern Sumatra and subsequently northward ruptured the megathrust for over 1,300 to 1,500 km wide along the Sunda Trench. The great earthquake generated huge tsunami that struck many countries around the Indian Ocean. In particular, a huge tsunami of more than 20 m in height struck the west coast of Aceh in northern Sumatra. Since the earthquake, several international marine geological and geophysical surveys have been investigated morphologies, geological structures, and seismic activities in the Sumatra forearc region, including the Sunda Trench, trench slope, forearc high and the Aceh Basin. The generation mechanism of the huge tsunami during the 2004 great earthquake remains unsolved, yet several different fault models have been proposed by previous studies. Hirata et al. (2008, 2010) proposed that the secondary tsunami derived around the Middle Thrust in the forearc high region of the Sumatra forearc. However, a seismic reflection survey had not yet been conducted in the forearc high region. If the 2004 coseismic rupture reached the seafloor along the Middle Thrust, deformations of the seafloor contributing the great tsunamis would be recorded in the shallow parts of sedimentary sequences. In order to discuss the presence of deformations documented within sedimentary sequences, acquiring high-resolution reflection data in the forearc high region of the Sumatra is required.

The objective of this study includes elucidation of detailed geological structures and fault distributions around the Sunda Trench, trench slope, and forearc high regions offshore northwestern Sumatra, using the high-resolution seismic reflection images and swath bathymetric data. The data used in this study include the high-resolution multi-channel seismic (MCS) reflection data obtained during the KH-10-5 research cruise using *R/V Hakuho-Maru* in November 2010 and the swath bathymetric data compiled from NT05-02, KY09-09, and KH-10-5 research cruises. This study also demonstrates previously unrecognized deformational features such as the uppermost deformation within seafloor and sedimentary sequences in the forearc high region.

The high-resolution MCS profiles images clearly down to 1.6 sec. (TWT; Two-Way Travel Times) in the trench and the trench slope regions. Moreover, the MCS profiles also successfully obtained clear images down to 2.7 sec. (TWT) in the lower trench slope region and down to 2.0 sec. (TWT) in the forearc high region. These seismic profiles and bathymetric map clearly documented the system of faults and folds trending NW-SE or NNW-SSE direction in the Sumatra forearc region including the five major thrust faults systems defined by Sibuet et al. (2007) are confirmed: Deformation front, Main Thrust, Lower Thrust, Middle Thrust and Upper Thrust. Strikes of these thrusts are NNW-SSE direction, corresponding to the morphological trends. Based on interpretation of the seismic profiles and swath-bathymetric map, detailed distributions of fault and fold are elucidated in the Sumatra forearc region offshore northwestern Sumatra.

Distinct vergence is identified in the Sumatra forearc; the lower trench slope is characterized by landward vergence, while seaward vergence is dominantly developed in the forearc high region. In the lower trench slope region, the MCS profiles clearly showed seaward-dipping thrust faults and landward-vergent ramp anticlines. These faults and anticlines play major roles in the growth of the accretionary prism along the Sunda Trench. In the forearc high region, landward-dipping thrust faults are dominant and tend to strike NNW-SSE near the seaward rim of each ridge. Major thrusts defined by Sibuet et al. (2007) are also recognized on the high-resolution MCS profiles and bathymetric map. In addition, anticlinal ridges have been identfied in the forearc high region. Anticlinal ridges in the forearc high region are considered to have been formed due to the compressional stress generated by subducting Indo-Australia plate in the Sunda Trench.

In the forearc high region, a number of piggyback basins are recognized between anticlinal ridges. Thickness of the piggyback basins sediments can be imaged down to a maximum of 0.7-0.8 sec. (TWT) below the seafloor. Older and lower parts of this basin-fill consists of relatively continuous and landward tilted reflectors that onlap the flanks of the basin. On the other hand, the uppermost part of the basin-fill sediments is parallel and flat-lying in most of the piggyback basins of the forearc high region. In several of the piggyback basins, this study recognizes deformations in the uppermost part of basin-fill sediments. Many of them are distributed along the Middle Thrust. Therefore, this study suggests that the Middle Thrust had been recently active mostly among major thrust faults within the forearc high region.