Press Releases

JAMSTEC
Japan Agency for Marine-Earth Science and Technology

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Identifying the Source Location of the Giant Tsunami Generated by the 2011 Tohoku Earthquake

1. Overview

Using a measuring device (ocean-bottom electro-magnetometer) emplaced near the Japan trench, a team of scientists from the Institute for Research on Earth Evolution (Hiroshi Ichihara, Research Scientist (II); Yozo Hamano, Principal Scientist; Takafumi Kasaya, Senior Research Scientist) of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC; Asahiko Taira, President) and the Earthquake Research Institute, University of Tokyo (Kiyoshi Baba, Assistant Professor) have successfully interpreted the magnetic field variations at the time of the tsunami generated by the 2011 Tohoku earthquake. The data were analyzed and the results were successfully used to identify the location where a tsunami with short-period waves occurred. Focus had been placed on this zone as the source of the massive tsunami that was produced following the 2011 Tohoku earthquake.

These findings will prove useful in clarifying the origins of the massive tsunami generated during the 2011 Tohoku earthquake, and are expected to contribute to tsunami prediction in future large earthquakes.

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Title: Tsunami source of the 2011 Tohoku earthquake detected by an ocean-bottom magnetometer
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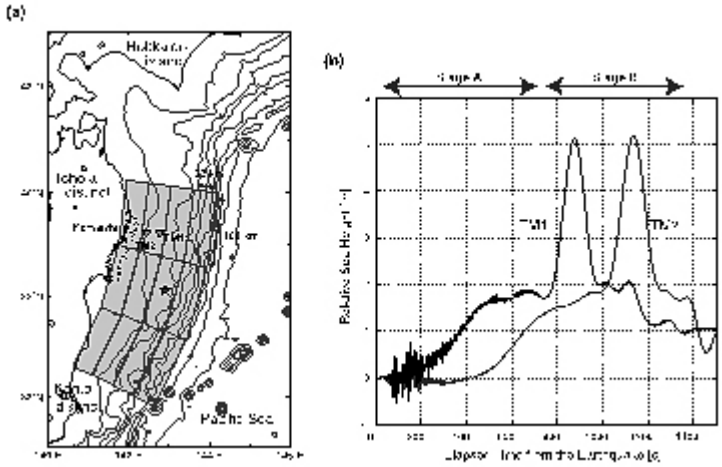

Figure 1: Taken from Maeda et al. (2011)

(a): The star denotes the epicenter of the main shock in the 2011 Tohoku earthquake. TM1 and TM2 denote the ocean bottom pressure gauge stations for the Kamaishi cable. (b): A graph of the tsunami waveforms obtained from TM1 and TM2.

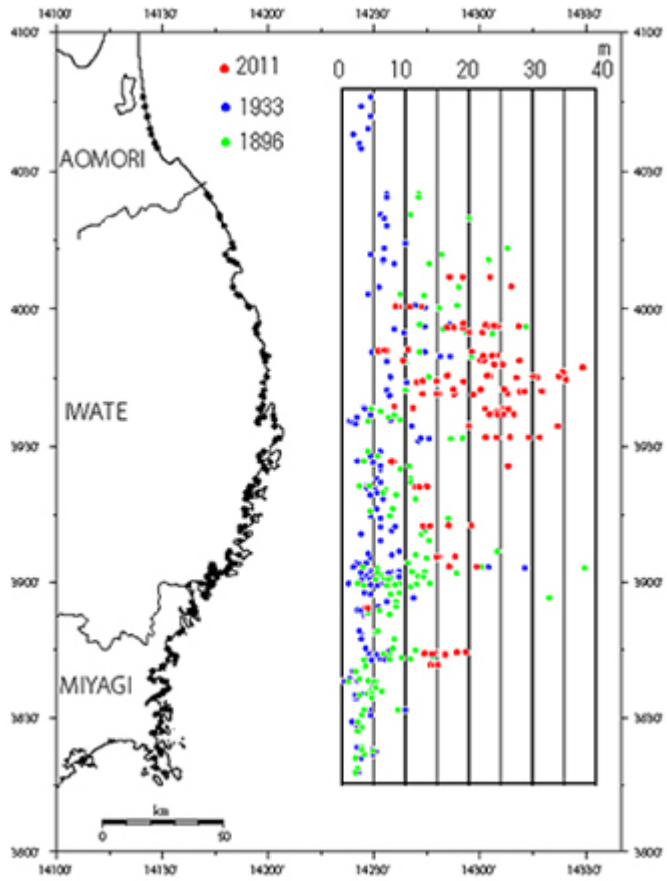

Figure 2: Tsunami height distribution based on the results of tsunami surveys at northern Sanriku by Yoshinobu Tsuji (ERI), Prof. B. H. Choi (Sungkyunkwan University), Dr. Kyeong Ok Kim (KORDI), and Mr. Hyun Woo Kim (Marine Info Tech Co.), in which the tsunami wave heights of the 2011 Tohoku earthquake (red dots), 1896 Meiji Sanriku earthquake (green dots), and 1933 Showa Sanriku earthquake (blue dots) were compared (Reproduced from the special site for the 2011 Tohoku earthquake provided by the Earthquake Research Institute, University of Tokyo).

Figure 3: Emplacing the ocean-bottom electro-magnetometer (OBEM) used for this research (left), provided by the University of Tokyo (ERI). An OBEM of the same model type shown near the ocean floor (right).

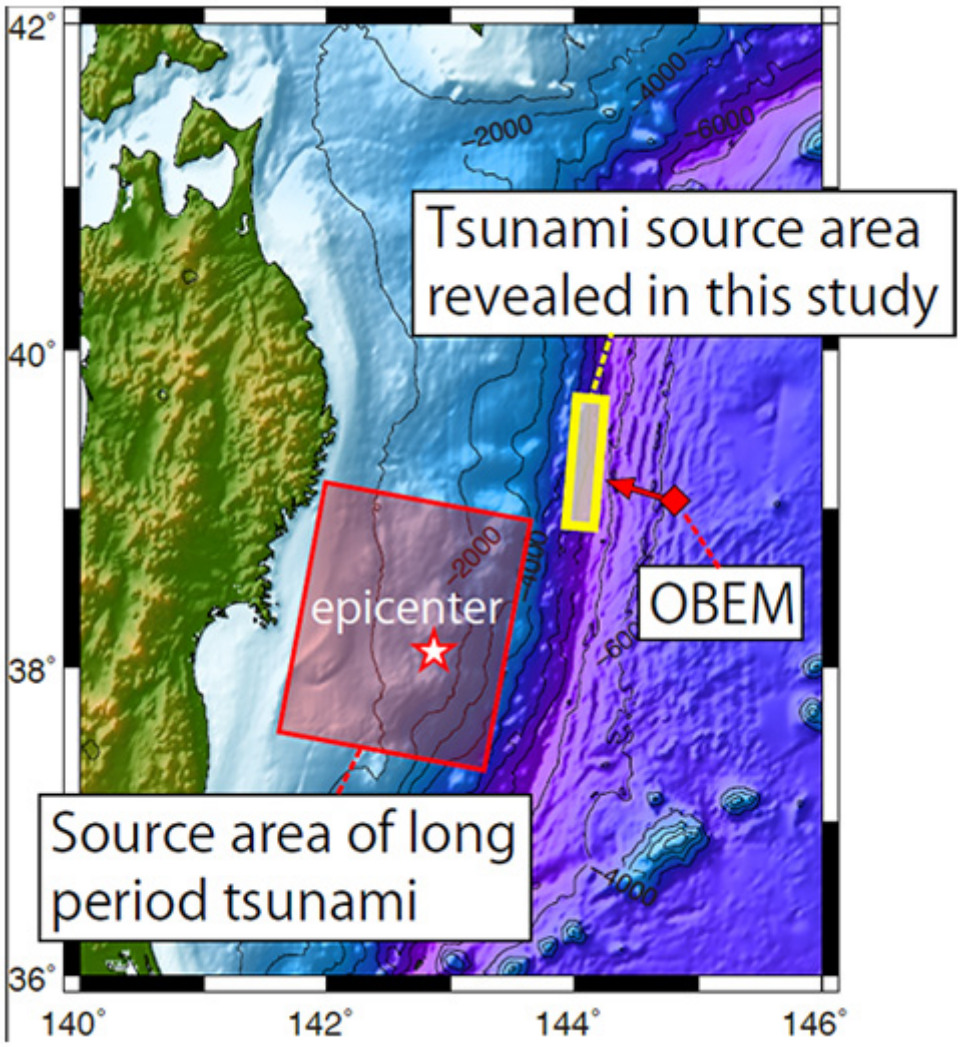

Figure 4: The locations of the tsunami source (yellow rectangle) revealed in this study and the monitoring station. The arrow extending from the monitoring station denotes the direction of the tsunami source as revealed by the magnetic field data.

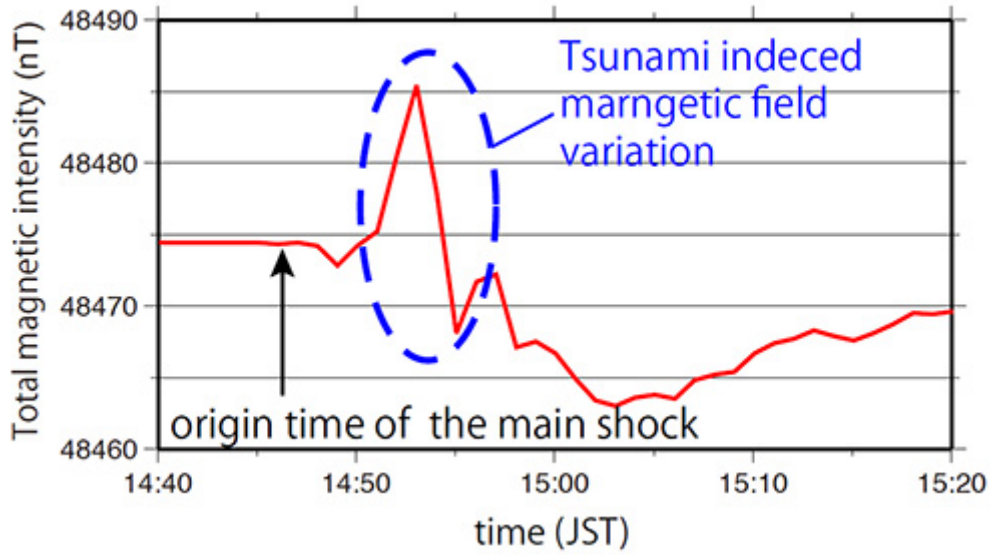

Figure 5: The magnetic field variation induced by the short period tsunami.

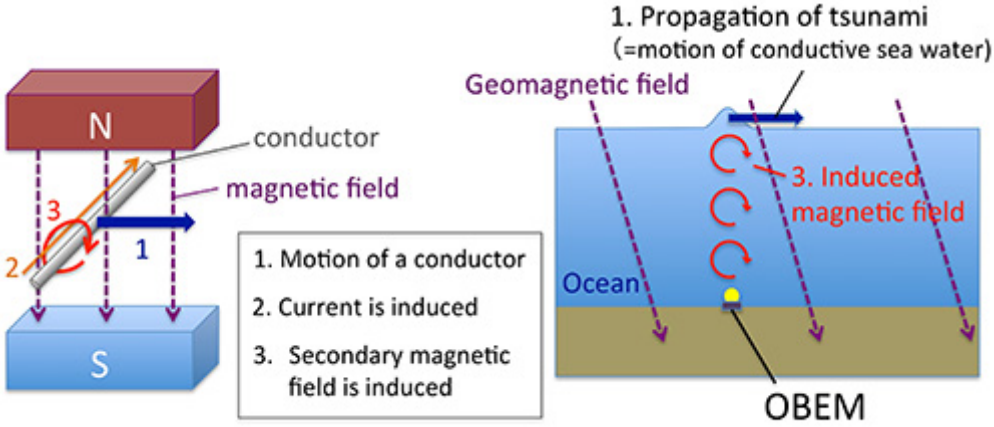

Figure 6: The diagram on the left is a simplification of the mechanism by which a tsunami generates a magnetic field. When a conductor moves through a magnetic field, an electrical current will be generated in the conductor (principle identical to that of a generator), and this current then creates secondary magnetic fields. The image on the right illustrates an example of an actual tsunami. The magnetic field and conductor in the figure on the left represent the geomagnetic field and seawater, respectively. Consequently, when a tsunami pushes seawater relative to the earth's magnetic field, small electrical currents (omitted in the right figure) flow through the seawater creating secondary magnetic fields which are then detected by the OBEM.

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