【Grant-in-Aid for Scientific Research (S)】

Broad Section B

Title of Project：　Head and tail of massive earthquakes: Mechanism arresting growth of interplate earthquakes

HINO, Ryota
(Tohoku University, Graduate School of Science, Professor)

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Keyword：megathrust earthquake, slow-slip, tsunami-earthquake, deep-sea paleoseismology

【Purpose and Background of the Research】

The behavior of the shallow part of the plate boundary fault, which is deeply involved in the growth of megathrust earthquakes, shows remarkable variations along the Japan Trench. This study will reveal the mechanism arresting growth of interplate earthquakes by clarifying the characteristics of the shallow plate boundary in the northern part of the Japan Trench, where no massive earthquake such as the 2011 Tohoku earthquake has occurred. In the northern part of the Japan Trench, slow-slips that occur repeatedly over several years and tsunami earthquakes, medium-sized slip events near the trench axis that occur at intervals of > 100 years, play major roles in releasing slip deficit. The occurrence history (especially frequency) of the tsunami earthquake, and the balance of the relative motion between the land and the oceanic plates in this region is modeled.

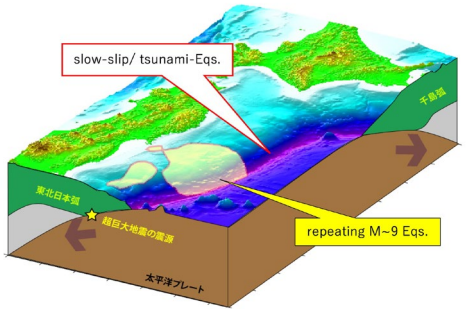

Figure 1　Along-trench variation of behaviors of megathrust

【Research Methods】

- Slip distribution of periodic slow-slip

We will clarify the spatiotemporal evolution of slow-slips by monitoring small repeating earthquakes. The slip distribution of slow-slips up to the shallowest part of the plate boundary will be imaged by seafloor broadband seismic and crustal deformation observations.

- Deep-sea paleoseismology of tsunami earthquake

The generation history of tsunami earthquakes is reconstructed by identifying and dating traces corresponding to tsunami earthquakes from deep-sea sediment cores around the Japan Trench. Analysis of physical property of the cores is key to identification of subtle traces of tsunami earthquakes as well as inspection of sediment cores from the landward slope.

- Modeling of slow-slip and tsunami earthquake

We build models of slow-slips and tsunami earthquakes based on observation results. We seek the mechanism prohibiting large-scale slips along the middle Japan Trench from propagating to the north, based on the topographic and geological structures delimiting the rupture zone. Combining these element models, we will simulate the process composed of repeating huge earthquakes in the middle and dominance of slow-slips/tsunami earthquakes in the north.

【Expected Research Achievements and Scientific Significance】

Identifying the conditions under which a large earthquake occurs is not only important in understanding the nature of earthquakes, but it is also effective to give reliable estimation of the size of future earthquakes. Through this study, focusing on the area where large-scale slips have never occurred while adjacent to the area where large-scale earthquakes occur, we unravel the conditions that large-scale earthquakes do not occur. Together with the features common to areas of past massive earthquakes, the results of this study deepen the understanding what make massive earthquakes of subduction thrusting events.

【Publications Relevant to the Project】

・Ikehara, K., K., Usami, T. Kanamatsu, et al., Spatial variability in sediment lithology and sedimentary processes along the Japan Trench: Use of deep-sea turbidite records to reconstruct past large earthquakes, Geological Society, London, Special Publications, 456, DOI: 10.1144/SP456.9, 2018.
・Uchida, N., T. Iinuma, R. M. Nadeau, R. Bürgmann, R. Hino, Periodic slow slip triggers megathrust zone earthquakes in northeastern Japan, Science, 351, 488-492, doi: 10.1126/science.aad3108, 2016.

【Term of Project】

FY2019-2023

【Budget Allocation】

154,900 Thousand Yen

【Homepage Address and Other Contact Information】

http://jdash.org
hino@tohoku.ac.jp