DEVELOPMENT OF DEEP BOREHOLE LONG TERM OBSERVATORY TO MONITOR THE EARTH'S INTERIOR

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ABSTRACT

The deep sea scientific drilling vessel *Chikyu* was developed to drill the sea floor, recover the core sample, and analyze these on board for realizing such important scientific targets of IODP (Integrated Ocean Drilling Program) as the studies on the sub surface biosphere, the material circulation beneath the sea floor, the past global environments, and the earth's dynamic. Borehole remained after drilled is not a mere relic after recovering the core sample from the sea floor, but is very important "scientific window" for monitoring the earth's interior. Here is mainly described the technological difficulties of the long term borehole observatories which were deployed at Nankai Trough and Japan Trench.

KEYWORDS

Borehole observatory, In-situ measurements, IODP.

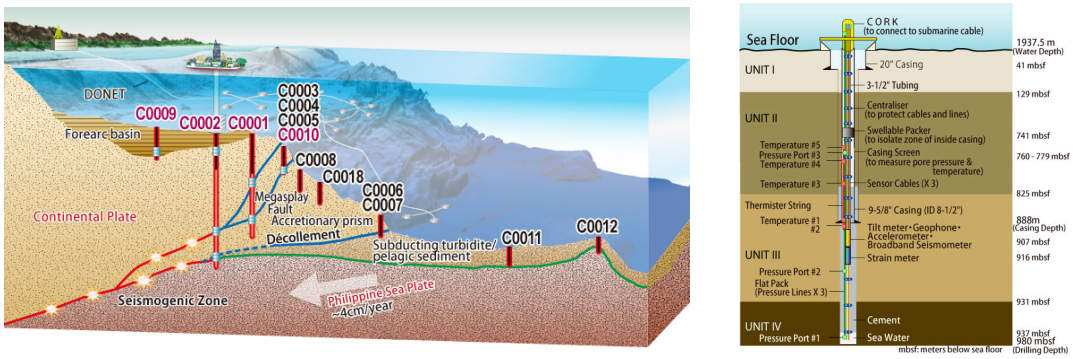
INTRODUCTION

Most of the large earthquakes (magnitude greater than 8.0) in Japan were observed at the subduction plate-boundary such as Nankai Trough and Japan Trench. The Mw 9.0 Tohoku earthquake and accompanying tsunami produced the largest slip ever recorded in an earthquake and devastated much of northern Japan on March 11, 2011. The IODP proposal for JFAST (Japan Trench Fast Drilling project) planned to drill into the Tohoku subduction zone using *Chikyu*, measure the fault zone physical properties, recover fault zone material, and install an observatory to directly record the temperature anomaly caused by frictional slip during the earthquake. Considering the significant technical and operational challenges related to the great water depth of ~7,000 meters, and timing constraints, the observatory needed to be both robust and simple, and we developed two different types of observatories, which were the autonomous MTL (Miniature Temperature Logger) observatory and the telemetered PT (Pressure and Temperature) observatory. The former one was successfully deployed in July, 2012.

Based on the results of previous Nankai Trough research efforts, further research opportunities were proposed as the IODP scientific drilling proposal NanTroSEIZE (Nankai Trough Seismogenic Zone Experiment) which proposes not only drilling, coring, geological analyzing, and geophysical logging, but also installing the borehole observatory into several drilling holes including deep riser holes at 7000 meters below sea floor (mbsf), where we expect to encounter the mega splay fault and the locked region of mega thrust fault. The figure shows the NanTroSEIZE proposed drill site (C0009, C0010 holes already exist), and also proposed observatory site (C0002 riserless observatory was successfully deployed in December, 2010).

EXPERIMENT

NanTroSEIZE C0002 riserless observatory, as shown in the figure, equips a broadband seismometer (resolution; 2.2 X 10^{-9} m/s), a geophone (10^{-9} m/s), a tilt meter (5 X 10^{-9} rad), a strain meter (10^{-9} strain), a accelerometer (3 X 10^{-6}G), pressure sensors, temperature sensors (< 2 X 10^{-3} K) to monitor the multiple parameters such as seismic, geodetic, and hydrogeology. [1] JFAST autonomous MTL observatory equips 55 of temperature sensors (5 X 10^{-5} ºC) and 10 of pressure sensors (10^{-3} %FS).



NanTroSEIZE proposed drill site and LTBMS site (in red letter)

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