Dense ocean floor network for mega thrust earthquakes and tsunamis around the Nankai Trough in Southwestern Japan

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Abstract: -Dense ocean floor network system will be deployed around the Nankai trough for mega thrust earthquakes and tsunamis.
This system will include twenty stations equipped with multi kinds of sensors such as broad band seismometers, accelerometers and precise pressure gauges.
This system (DONET) aims to understand mega thrust earthquake recurrence system around the Nankai trough and contribute to disaster mitigation.

Key-Words: - Nankai trough, DONET, mega thrust earthquake, Dense ocean floor network, Early warning system, Seismogenic zone, Multi kinds of sensors, Data assimilation, Recurrence cycle simulation, Monitoring

1 Introduction

The Nankai trough is well known as the mega-thrust earthquake seismogenic zone in the world. Recurrence intervals of these mega thrust earthquakes are about 100years-150years.

The recent mega-thrust earthquakes around the Nankai trough occurred in 1994 and 1946, therefore, many people are apprehensive of the recurrence of next mega-thrust earthquakes.

In many researches around the Nankai trough, the structural researches using refractions and reflections seismic has succeeded to image the key structures to understand recurrences of mega-thrust earthquakes around the Nankai trough. Moreover, results of mega thrust earthquake recurrence cycle simulation show that the first ruptures are occurring around the Tonankai earthquake rupture zone in each recurrence cycle, and the clear segment boundary between the Tonankai and Nankai earthquake rupture zones off the Kii peninsula by analyses using tsunami data. In 1854, 1944/46, actually, the initial rupture were starting from the Tonankai seismogenic zone ahead of the Nankai seismogenic zone with intervals of 32 hours and 2years in each event. In previous simulation researches, the result of recurrence cycle simulation indicates the difference patterns and intervals of mega-thrust earthquake recurrences in each cycle.

These results are consisted with recent historical earthequakes in 1854, 1944/46 around the Nankai trough. Therefore, based on these researches, we will deploy the dense ocean floor network to monitor the crustal activity such as seismicity and ocean floor deformation, improve the recurrence cycle model and provide the high quality early warning information for the next mega-thrust earthquakes.

This project is already starting from 2006, under the MEXT project, wihich is a kind of Japanese government. This dense ocean floor network system advances of previous ocean floor network system, because of high redundancy, extendable function and high quality data by multi kinds of sensors.

2 Previous researches in the Nankai trough

The 1944 Tonankai and the 1946 Nankai earthquakes, each hypocenter was located off the

Kii peninsula. So, the imaged irregular structure such as a key structure at the segment boundary between the Tonankai and Nankai earthquake rupture zone seems to be the controller of the Nankai Trough mega-thrust seismogenic zone system (Fig.1). Furthermore, there are significant structures such as the subducted seamount in the Nankai sesismogenic zone, subducting rigde system in the Tokai seismogenic zone and splay faults in the Tonankai seismogenic zone. These structures seem to affect the Nankai trough mega thrust earthquake seismogenic zone system.

In the fact, the results of recent simulation study of mega-thrust earthquakes recurrence cycles indicates that these irregular structures seem to act as a controller of recurrence cycle and pattern of mega-thrust earthquakes in the Nankak trough (Fig.2).

3 The dense ocean floor network

Based on these researches, we proposed and have been starting to deploy the dense ocean floor observatory network system equipped with multi kinds of sensors such as seismometers, pressure gauges etc., focusing on the understanding of crustal activities off Kii peninsula including the Tonankai/Nankai earthquake rupture zones (Fig.3). Especially, Precise multi pressure gauges will be most useful sensor to monitor ocean floor deformation with long term observation. These ocean floor deformation data will be applied to the data assimilation to improve recurrence cycle simulation.

This observatory system will be the one of most advanced scientific tools to understand the mega thrust earthquakes around the Nankai trough.

This advanced dense ocean floor observatory network system has useful functions and purposes as follows,

1) Redundancy, Extension and advanced maintenance system using the looped cable system, junction boxes and the ROV/AUV etc (Fig.4).

2) Multi kinds of sensors to observe wide range phenomena such as long period tremors, low frequency earthquakes and strong motion of mega thrust earthquakes over M8.(Fig.5)

3) Speedy evaluation and notification for earthquakes and tsunamis (Fig.6). This function is most important for disaster reduction /mitigation.

4) Provide observed data such as ocean floor deformation derived from pressure gauges to improve the simulation and modeling researches about the mega thrust earthquakes (Fig.7) These ocean floor deformation data are quiet necessary for the data assimilation to improve simulation models.

5) Understanding of the interaction between the crust and upper mantle around subduction zone.

Now, this project is scheduled from FY 2006 to FY 2009 as MEXT project which is a kind of Japanese government.

4 Conclusion

We will deploy the advanced ocean floor network off Kii peninsula as a local system(Fig.8) And, we have to apply the data from network to disaster mitigation and seismological researches.

In the second step, we would like to develop and deploy the advanced ocean floor network as a regional system and integrate ocean and land network data, and in next step, we would like to collaborate with international network systems as the global network to progress geosciences and contribute the early warning system for huge earthquakes and tsunamis (Fig. 9).

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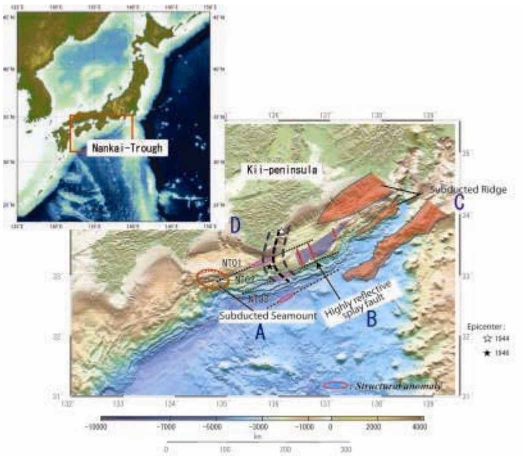

Fig.1 Imaged irregular structures around the Nankai trough

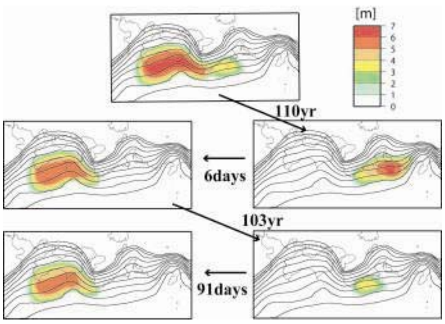

Fig.2 The result of recurrence cycle simulation

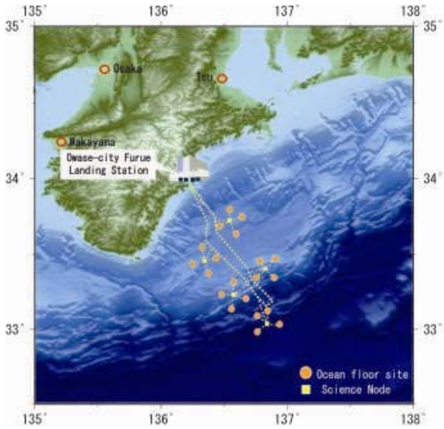

Fig.3 The outline of advanced ocean floor network around the Nankai Trough This ocean floor network is equipped with 20 observatories with seismometer and precise pressure gauge.

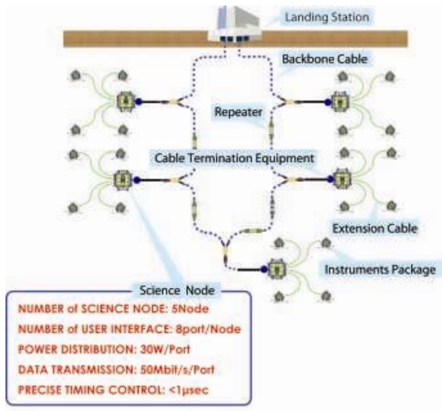

Fig.4 The concept of advanced ocean floor network system

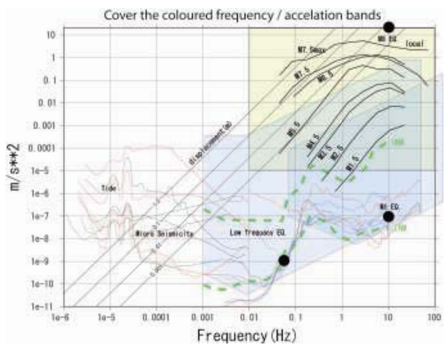

Fig.5 Seismometer evaluation based on the frequency bands

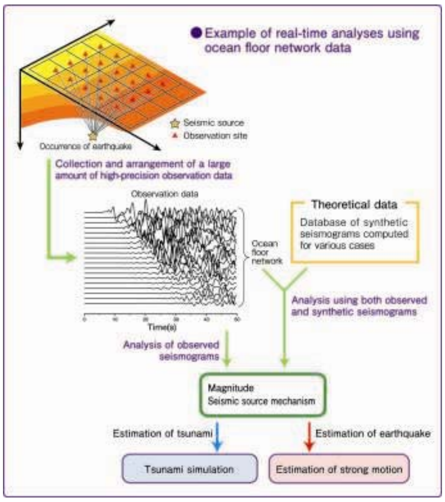

Fig.6. The outline of early warning system using the ocean floor network data

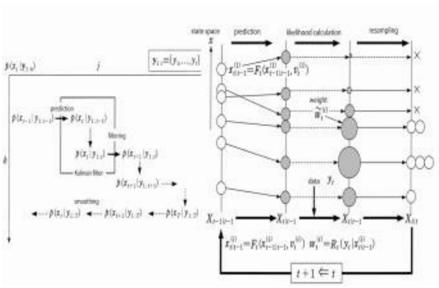

Fig.7 The image of data assimilation using ocean floor network data

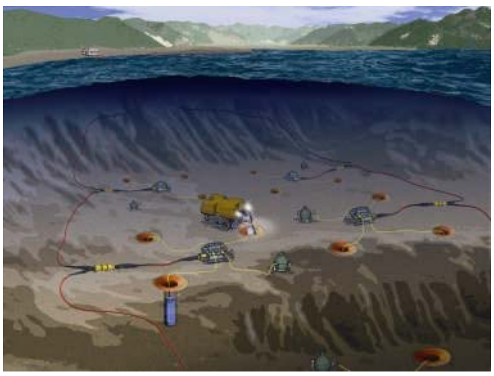

Fig.8 The image of ocean floor network system

Fig.9 Future plan of geosciences using the multi-sensors , multi scales and multi spheres network