

The Nankai Trough Tectonic Compilation Map Project - an example of using the Frontier Database system-

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Abstract

Institute of Frontier Research for Earth Evolution (IFREE, recently re-modified from FRPSD) have been cooperative experiment with the explosive seismology group on land Shikoku and the northern Shikoku Basin using the R/V Kairei in 1997 through 2000 (Fig. 1). Along totally 5000km lines, 300 OBSs are deploying to reveal extensive crustal structure off Nankai trough to the underneath Shikoku. Figure 1 shows seafloor topography, bathymetry, and physiographic features of the Nankai Trough margin off Shikoku Island, SW Japan. We can combine all together and compile available data of multichannel seismic (MCS) reflection obtained by JAMSTEC, JAPEX, and JNOC. The purposes of these studies within a multi-purpose Frontier Database framework are: (1) to obtain geophysical and geological observations of subduction zones at the Nankai Trough and the northern Shikoku Basin region known as one of the most focus-on seismogenic zone around Japan; (2) to interpret for variations in sub-bottom topography, gravity, magnetics, thermal structure; (3) to reveal a fine scale shape of subducted seamounts and its vicinity area; (4) to identify geophysical features across the trough axis with intensity variations, heat flux and shape of decollement zone, accretionary prism, and oceanic layers, and deformational characteristics at a large earthquake; (5) to understand the northern edge of the Philippine plate kinematically. Figure 2 shows three-dimensional display obtained by 44 multi-channel seismic (MCS) profiles. Upon constructing crustal structure models by R/V Kairei, JNOC, and Japex from shallower to deeper part, baseline and mapping projection are defined as WGS84. Clear reflecting surfaces shown on several track lines were digitized to define the ocean bottom, BSR (bottom-simulating reflector), and the top of oceanic layer. The approach of three-dimensional view has been helpful to understand each layers horizontal distribution. There are almost same characteristic features with ocean bottom and BSR distribution. Figure 3 is an example of site judgement to decide exact drilling sites. We compiled whole track lines with each survey name, top of subducting slab depth, bathymetry (with thick line at 2,500 m), coseismic slip distribution from the inversion of tsunami waveforms by Tanioka and Satake (2001) and possible drilling target areas (red zones). Drilling target zone of Nankai trough are the area with shallower than 2,500 m of oceanic floor and up to 5,000 m depth of subducting slab from the ocean bottom. Red zones are available drilling sites. These kind of maps are useful to discuss and collaborate in between scientists, engineers, and crews to decide operating sites.

Frontier Database

This study is supported by Database system of Intitute of Frontier Research for Earth Evolution (IFREE) in JAMSTEC. Marine geophysical data of bathymetry, gravity, geomagnetics, heat flow measurements, crustal structure, seismicity, fault and bio-marker distribution have been

accumulated recently by JAMSTEC and other institutions for all the marine region. A universal marine geophysical Database system and interactive compilations and analyses system are constructed within the IFREE framework. Geophysical data sets obtained during cruises are entered into the main server of the JAMSTEC Database, which is maintained by JAMSTEC Computer and Information Office (JCIO). They are selected, edited and formatted to fit to the Frontier Database. Using two-and three-dimensional forward modeling of gravity and magnetic profiles, with seismic structural data in the Frontier Database, a qualitative interpretation of the geometry, densities and magnetization of subducting plates, marginal basins, and island arcs are discussed (after Kido *et al.*, 1999).

Outline

The Frontier geophysical database project is one component of the 1997 and subsequent fiscal years' Frontier Research Program and is designed specifically to help clarify the seismogenic mechanism of great subduction zone earthquakes and construct long-term earthquake recurrence models. It contains reflection and refraction seismic data, bathymetry and ship track locations, gravity, earth magnetism, heat flow and fluid seep distribution data acquired by deep-sea research vessels. In designing the Frontier database, it has been necessary to consider several operational requirements. In particular, the database must be capable of being added to in the future as new data are obtained. The data are used as input for crustal deformation models. Using the integrated datasets with inversion and forward modeling software, we are also able to perform verification of the models' results.

Newly Acquired Data

In JAMSTEC, 5 research vessels have been in operation for 200 days a year. A large amount of various data sets are accumulated every day by day. A list of data newly obtained by JAMSTEC is shown in Table. All cruise data have been stocked and registered in the JCIO database system. In the Frontier database, only inventory information list of the navigation data has been renewed after each cruise. The necessary data from the JCIO database is chosen and processed to grid data using whole data obtained so far. Finally, geophysical data (location, topography, gravity, geomagnetism, seismic, heat flow data) are registered in JCIO database and Frontier database.

Future prospect

In order to facilitate the study of past, contemporary and future changes in the deep sea environment Pan-pacific regions, we aim for an object-oriented approach to the collection of data from a variety of sources. The construction of a database containing

datasets of seismicity and potential field data, crustal and thermal structures, and other data will make it possible to carry out multi-faceted studies of the geophysical properties of particular oceanic regions. One of goals of such database system will be widely used and spread for not only geophysicists and geologists but public users, such as GEODAS (GEOphysical DATA System) developed by NGDC and JANUS providing from ODP (Ocean Drilling Program) office. JANUS includes huge volumes of dataset; e.g. paleontology, lithostratigraphy, chemistry, physics, sedimentology, and geophysical data for ocean sediments and hard rocks. We expect the flow of information through such a database to be bi-directional. That is, while data from the database are used as the basis for numerical simulation of plate behavior or seismic activity, the results of such analysis should be fed back into the database so that future geophysical surveys can be more reliably planned and executed. This iterative approach will enable us to firmly establish the reliability of the database and its

associated models.

References

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Tanioka, Y. and K. Satake (2001) Detailed coseismic slip distribution of the 1944 Tonankai earthquake estimated from tsunami waveforms, *Geophys. Res. Lett.*, vol. 28, no. 6, pp. 1075-1078.

Tanioka, Y. and K. Satake, Coseismic slip distribution of the 1946 Nankai earthquake and aseismic slips caused by the earthquake. *Earth Planets Space*, in press.

No.	Items.	Data description and management application
1.	Marine Geophys. Data	Logging data obtained by R/Vs Kairei, Kaiyo, Yokosuka, Natsushima, Mirai; Project name, Time, Time zone, Location, Temperature, Salinity, Water sounding profile, Ship Speed, Climate, etc.
2.	Bathymetry Data	Seabeam 2000, HS10, Gridded data through SeaView tool
3.	Gravity Data	Gravity data by KSS-31 Bodenseewer, S-63 LaCoste & Romberg
4.	Magnetic Data	Total magnetic field by Proton magnetometer, Three component magnetic data by Fluxgate magnetometer, Ship's roll, pitch and yaw data, Shipboard magnetization effects
5.	Reflection/Refraction Data	Multi-channel reflection data, OBS (Ocean Bottom Seismograph) refraction data
6.	Jamstec marine geophys. data	Terrestrial Heat Flow Data, Seismicity observed by array OBSs, Cold seep distribution data

Table Newly acquired data list

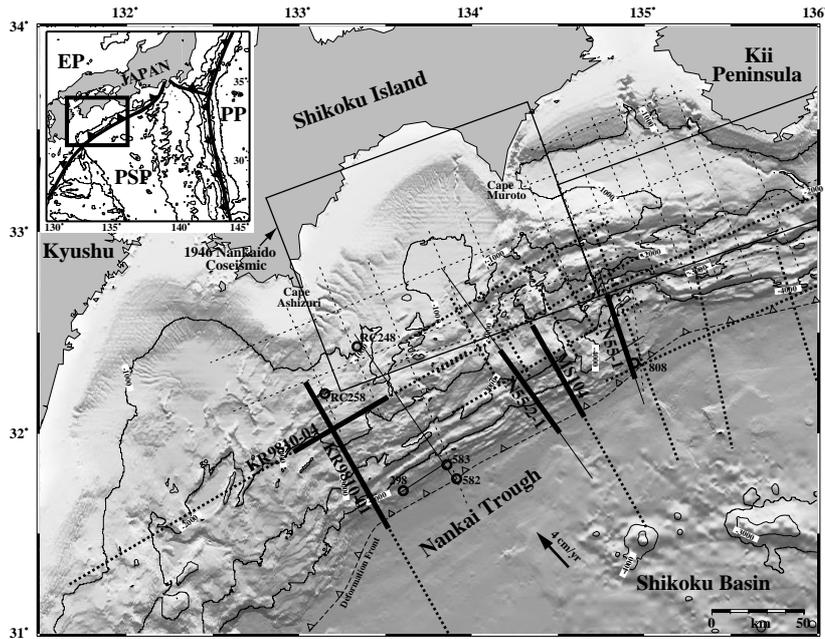


Fig. 1 Bathymetry and physiographic features of the Nankai Trough margin off Shikoku, SW Japan. Positions of multichannel seismic reflection lines are shown. The bold lines indicate the positions of profiles N55-1, MS104, N55-2-1, KR9810-01, and KR9810-04 displayed in Figures 2, 3, 4, 5, and 6, respectively. Site 808 of Ocean Drilling Program (ODP) Leg 131 is indicated as a circle. The thin-solid rectangle is the coseismic rupture area of the 1946 Nankai earthquake (Aida, 1981; Ando, 1982). The convergence rate of the Philippine Sea Plate under the Eurasia Plate is approximately 4 cm/yr (Seno et al., 1993). Water depth contours are in meters. EP=Eurasia Plate. PSP=Philippine Sea Plate. PP=Pacific Plate.

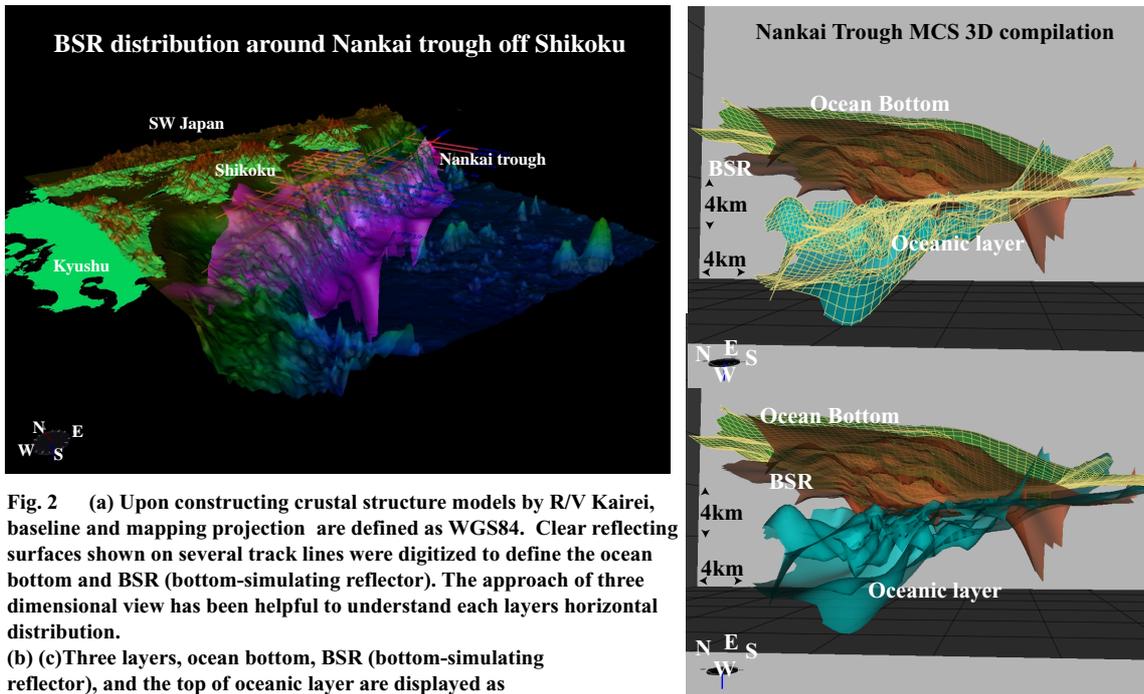


Fig. 2 (a) Upon constructing crustal structure models by R/V Kairei, baseline and mapping projection are defined as WGS84. Clear reflecting surfaces shown on several track lines were digitized to define the ocean bottom and BSR (bottom-simulating reflector). The approach of three dimensional view has been helpful to understand each layers horizontal distribution. (b) (c) Three layers, ocean bottom, BSR (bottom-simulating reflector), and the top of oceanic layer are displayed as three-dimensional view from the western direction.

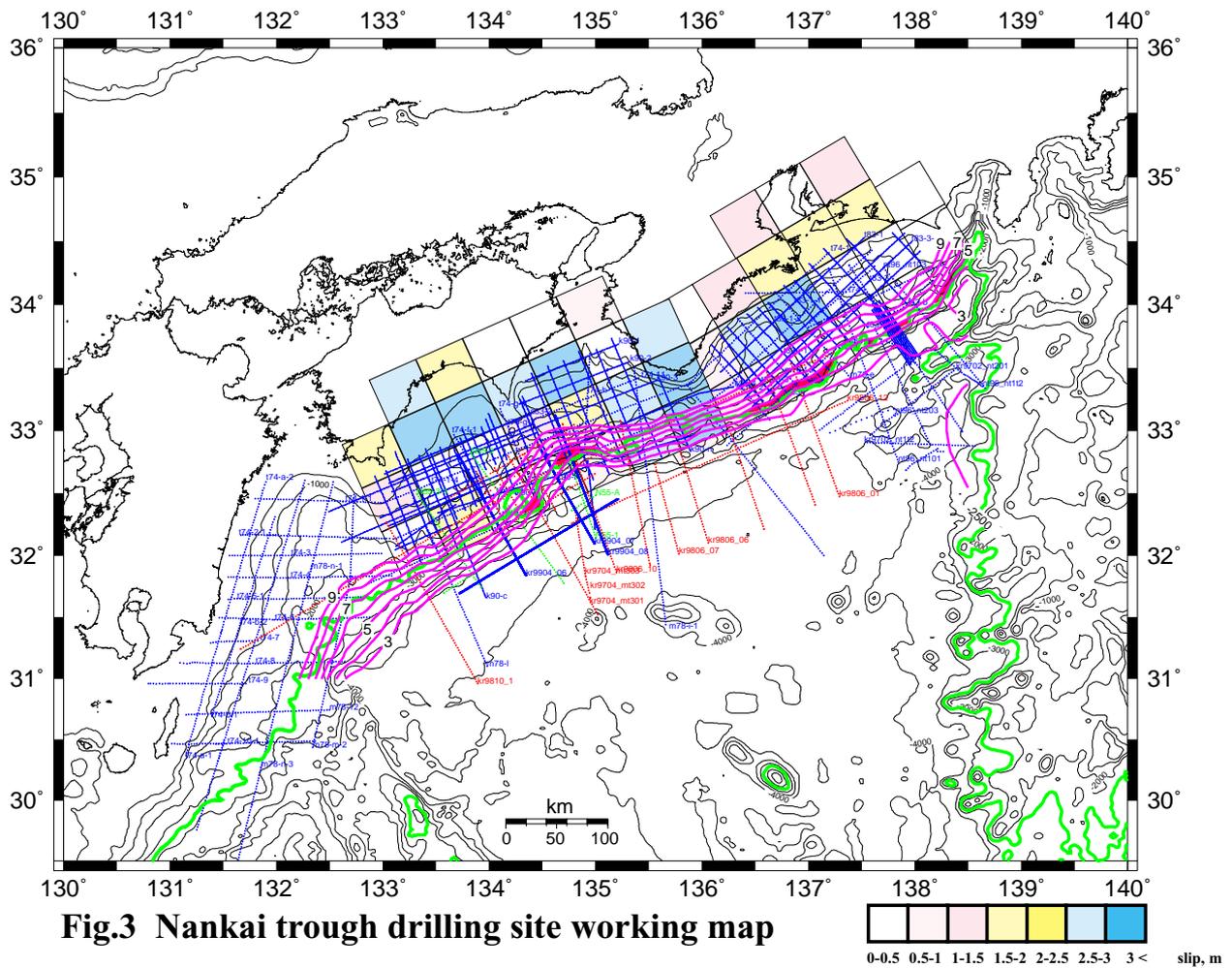


Fig.3 Nankai trough drilling site working map

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