Integration of seismic survey data for deep-sea drilling in Nankai Trough seismogenic zone

*Kazuya Shiraishi[1], Masataka Kinoshita[2], Yoshinori Sanada[1], KYAW MOE[1], Yasuhiro Yamada[1]

1.Japan Agency for Marine-Earth Science and Technology, 2.Earthquake Research Institute,The University of Tokyo

In Nankai trough region, various kinds of seismic surveys have been conducted in order to reveal detail subsurface structures of the seismogenic zone. In this study, we focus on the seismic surveys related to the NanTroSEIZE deep drilling, and discuss the integration studies of those seismic survey data.

Wide-angle reflection survey with ocean bottom seismographs (OBS) and airgun shooting is useful for exploration of regional deep structures by analyzing the refraction wave and wide-angle reflections. However, reflection imaging has not bee applied to the OBS data because of low illumination from the sparse receiver deployment. The recent progress of the seismic interferometry and the full waveform inversion contribute to the reflection imaging from the OBS data analysis. The seismic interferometry is useful to obtain the continuous reflection image by utilizing the multiple reflections of the OBS data. The OBS data is suitable for the FWI to estimate the fine-scale velocity structures, and the velocity model is used to improve the reflection imaging and to estimate of physical property distribution.

Vertical seismic profile (VSP) survey with vertical seismometer array in a borehole is carried out to investigate the detail structures and geophysical properties around the borehole. In walkaway and walkaround VSP data acquired at C0009 in 2009, information about structural features and geophysical properties such as attenuation and anisotropy are obtained. At C0002 site, new data will be acquired for imaging around the borehole and deep fault zone, and look-ahead for the safe deep drilling. We are doing feasibility studies by numerical simulation for optimum VSP survey design. The VSP survey with longer vertical receiver array is favorable, but we usually have some restrictions on the receiver deployment in the borehole. In such a situation, integrated analysis with simultaneous observation data of seismographs at sea floor or other seismic observatories in the borehole to expand the analysis area and improve the analysis accuracy. We have an opportunity not only to optimize the data acquisition but also to develop the new method for integration analysis.

Multi-channel seismic (MCS) survey with hydrophone streamers and airgun shooting is the most useful method to obtain subsurface information around the drilling site. Dense 2D MCS survey was conducted in 2003, and 3D MCS survey was also conducted in 2006. The 3D geometry of megasplay fault system and detail structures in the frontal accretionary prism were revealed in the Nankai trough subduction zone. However, any detail structures are not clarified in old accretionary prism between Kumano forearc basin and the megasplay fault, which are essential information for the successful deep drilling. For the success of the deep drilling in Nankai trough seismogenic zone, it is essential to know the detail of three-dimensional structures in the Nankai trough. It is expected that the quality of the 3D reflection image and velocity model are improved by applying the advanced technology. The updated results will contribute to the improvement of other data analysis and optimization of the new VSP data acquisition and processing.

In addition to the seismic data with OBS, MCS, and VSP, various kinds of scientific drilling data sets are available. Development of the integrated imaging and analyzing method is required to reveal new geophysical and geological aspect in the Nankai trough seismogenic zone.

Keywords: seismic survey, NanTroSEIZE drilling

