Improved 3D seismic image in Nankai Trough off Kumano

*Kazuya Shiraishi[1], Gregory Moore[2], Yasuhiro Yamada[1], Masataka Kinoshita[3], Yoshinori Sanada[1], Gaku Kimura[4]

1. Japan Agency for Marine-Earth Science and Technology, 2. University of Hawaii, 3. ERI, The University of Tokyo, 4. Tokyo University of Marine Science and Technology

In Nankai Trough off Kumano, a 3D seismic survey was conducted in 2006 as a preliminary site survey of IODP NanTroSEIZE project. It has revealed three-dimensional structures of the magasplay fault system, details of deformation in frontal thrust zone, and development of forearc basin system in this area. However, it is still unclear about details in older accretionary sediments beneath Kumano forearc basin due to low signal-to-noise ratio and low resolution image in the complex structures after the initial data processing and depth imaging in 2006. In order to improve the seismic reflection image of dynamic deformation, we reprocessed the 3D seismic dataset from the original field records by applying new technologies advanced in a decade after the data acquisition and initial processing.

Big matters of the seismic data are effects of multiple reflections smearing the deep target signals in the deep-water and of the cable feathering due to high-speed Kuroshio current. The multiple reflections and the strong noise were better attenuated by applying advanced processing techniques in combination. Non-uniform fold distribution due to the cable feathering could be regularized by means of the optimized 4D trace interpolation, which is important to improve the data quality, too. The recent broadband processing with full deghosting and optimized zero phasing could enhance low frequency energy and improve the image quality with enhanced broadband signals. Then, velocity model building (VMB) and pre-stack depth migration (PSDM) considering tilted transversely isotropic (TTI) anisotropy media were carried out with a data-driven algorithm updating the velocity model based on a reflection tomography with Beam PSDM.

The final improved reflection images show new geological aspects, such as clear steep dip faults around the notch, and fine scale faults related to main thrusts in frontal thrust zone. It is expected that the anisotropic PSDM can image the complex structures at true locations with the steep dip or deformation. In the deeper part after multiple reflections were well attenuated, some dipping reflectors can be clearly observed above the megasplay faults. The mega-splay fault has curved surface with downward convex, and the new velocity model indicates the existence of high velocity zone above the mega splay fault with 1.5 - 2.0 km thickness and the maximum value more than 5,000 m/s. In further studies, we should investigate relationship of the reflection structures and the velocity profile using other seismic data in this area, because the depth is larger than the length of the streamer cables. In addition, the detail structure interpretation of the three-dimensional dynamic deformation and analysis of physical properties derived from the improved seismic data with velocity information will contribute to understanding the plate subduction system and success of the deep drilling towards seismogenic zone in the Nankai Trough.

Keywords: Nankai Trough seismogenic zone , 3D seismic survey

