BSR distribution in the Nankai Accretionary Prism from US-JPN Nankai 3D seismics

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US-Japan 3D seismic survey (EW9907/08) was performed in the western Nankai Accretionary Prism in Jun-Aug, 1999. Compiled 2D data show clear images of BSR and geologic structures. Distribution of BSR within the survey area is strongly dependent on topography and geologic structure. Depth of BSR from seafloor indicates seaward increasing down to foot of slope of the large thrust zone, but rapidly changes to shallower in the frontal imbricated thrust zone. Heat flow values calculated from BSR is well related to the actually measured on seafloor (NGH99). This indicates a high fluid convection around the toe of the Nankai prism. BSR shows typical occurrence especially in the large thrust zone, where a hanging wall has BSR contacting the thrust, while a footwall does not have clear BSR.

Bottom Simulating Reflector (BSR) is commonly interpreted to coincide with base of gas hydrate stability field with free gas deposits underneath. It has been known from the previous studies that BSR occurs widely within the Nankai Accretionary Prism off SW Japan.

US-Japan cooperative 3-D seismic investigation using R/V Ewing (EW9907/08 cruises) was carried out in the western Nankai Accretionary Prism from June to August in 1999, deploying 14 air guns (4276 cubic in total), a 6,000 m long 240 channel streamer cable, and a double GPS system. The surveyed area covered an 80 km by 8 km box from the trench to the older accretionary prism, consisting of 81 2-D lines. 3 dimensional analysis will be completed in a year, but compiled 2-D processed data show detailed distribution of BSR and clear images of geologic structures, particularly down to a formerly unresolved deep structure in large thrust zone at 40 km landward from the Nankai Trough axis. This makes it possible to have a discussion about correlation between geologic structure and a process of BSR formation. Besides, comprehensive heat flow measurements were performed in September the same year (Dai-5 Kaiko-maru: NGH99 cruise). We obtained new data at 67 points along the same survey line as the above 3-D seismics. Acquired data is available for comparison with heat flow values calculated from BSRs on seismic profile.

Distribution of BSR within the survey area is strongly dependent on topography and geologic structure. Especially, depth of BSR obviously changes at out-of-sequence thrusts, which make an efficient contribution to formation of the accretionary prism. General depth of BSR from seafloor indicates seaward increasing down to foot of slope of the large thrust zone (from 0.4 to 0.8 sec), but rapidly changes to shallower in the frontal imbricated thrust zone (more than 0.2 sec). The heat flow values calculated from BSRs have good correlation with actually measured heat flow values. These facts indicate that there should be higher fluid convection around the toe of the Nankai prism.

In the large thrust zone, BSR shows typical occurrence related to geologic structure. Generally, a hanging wall has BSR contacting the thrust, while a footwall does not have clear BSR. This feature may suggest 1) difference in volume of fluid resources while migrating along strata, and/or 2) fluid diffusion from thrust planes in lower pressure portions near the seafloor. Therefore, this feature of distribution of BSR can be considered as a typical occurrence in a large thrust zone of an accretionary prism.

Although the study will last further (e.g. amplitude analysis on BSR planes) along with 3-D analysis, these observations give rise to more speculation related to an interaction among geologic structure, fluid migration, and development of gas hydrate layer and BSR.