Tectonic structures at the Japan Trench off Sanriku from MCS reflection data

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KR97-07 cruise was conducted around the Japan Trench off Sanriku of northeast Japan in 1997. The consequent seismic profile shows erosion of sediments on the horst at the trench axis, deformation of horst structures 5 to 30 km landward from the trench axis. A flat reflector integrated as a stable slip plane was recognized 45 to 55 km landward from the axis 11 to 13 km in depth. The flat reflector becomes less obvious more than 60 km landward from the axis. At the same place, seismicity of the interplate earthquakes increases landward. It is concluded that a downdip (landward) end of the stable slip plane is also interpreted as an updip limit of seismogenic zone of interplate trust earthquakes in the study area.

JAMSTEC has conducted the MCS reflection survey (KR97-07 cruise) off Sanriku of northeastern Japan in October, 1997, to investigate deep tectonic structures. During the cruise we used the R/V "KAIREI" and acquired 280 km of MCS reflection data. The MCS data acquisition was curried out using four 1000 cubic inch air guns with shot-point distance of 50 m, a 120-channel streamer cable with receiver-point distance of 25 m. The maximum offset was 3200 m. Seismic reflection records of 13.5 sec were obtained for deep structure imaging with 4 msec sampling intervals. Prestack depth migration was applied after appropriate preprocessing including trace editing, multiple suppression, deconvolution and so on. The reflection image obtained by the prestack depth migration enabled us to understand interplate tectonic activities caused by subducting force of the oceanic plate.

We recognized deformation of horst structures 5 to 30 km landward from the trench axis 8 to 9 km in depth, a flat reflector interpreted as a stable slip plane along and above the plate boundary 45 to 55 km landward 11 to 13 km in depth. We also found an evidence of erosion of sediments on the horst at the trench axis.

Seismicity increases along the coupled plate boundary more than 60 km landward more than 12 km in depth, where any remarkable reflections are invisible. Deformed sediments overlie the slip plane (uncoupled plate boundary), whereas more rigid continental lower crust overlies the coupled plate boundary. The updip limit of the seismogenic zone of the interplate earthquake in the study area is inferred as a place where a flat reflector indicating the slip plane becomes less obvious.

The leading edge of the backstop was inferred by a remarkable landward-dipping reflector (interface). A possibility of relationship between this interface and the tsunami earthquake is suggested.