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Seismological character of the incoming plate to the Japan Trench and its implication for seismogenic processes

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An interaction between seismological processes in a subduction zone and an incoming lithosphere has been debated; e.g., hydrous minerals and fluid brought to a subduction zone by an incoming lithosphere has been considered as primary factors to control plate coupling, and a large normal fault earthquake in an incoming lithosphere occurred following a great megathrust earthquake in a shallow portion of a subductioin zone. The 1933 Showa-Sanriku earthquake and the 1896 Meiji-Sanriku earthquake are well-known as one of those doublets. Although there have been many geophysical and geological studies in subduction zones to understand an interaction between a subduction zone and an incoming lithosphere, little is known about structures and earthquake activities of an incoming lithosphere. In order to investigate structural characters of the incoming lithosphere to the Japan Trench where the 2011 Tohoku-oki earthquake occurred, JAMSTEC started a new seismological project in which active-source seismic data were acquired along profiles from the ocean basin to the trench through the outer-rise. Results from the active-source seismic profiles to the northern and the middle of the Japan Trench show that reduction of Vp and increase of Vp/Vs in the crust and the uppermost mantle from $\sim$150 km seaward of the trench where bend-related normal faults are well developed. In addition to the active-source seismic study, we have been conducting earthquake monitoring in an area from the trench to the outer rise by using OBS network including an ultra-deep OBS deployed at the trench axis. Aftershock activities observed in the incoming lithosphere at the seaward of the fault zone of the 2011 Tohoku-oki earthquake show that some of aftershock clusters extend down to $\sim$40 km deep through an area where the Moho reflection is obscure, and most of those earthquakes show normal fault mechanisms. Those observations suggest that bend-related normal faults can be a primal mechanism to bring water deeper into the oceanic lithosphere and this process may be enhanced by stress change in the incoming oceanic lithosphere after a large megathrust earthquake occurred. In this presentation, we summarize the results of the project and present a future plan.