Seismic structure of northwest of the Pacific Plate by applying seismic interferometry to airgun-OBS data

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Although it is considered that the seismic structure of the oceanic crust is relatively homogeneous, several previous studies reported the presence of evident deep reflectors in the lower crust or in the uppermost mantle, which can be related to the processes of formation and growth of the oceanic plate. For an example, the reflectors identified at the uppermost mantle of the Pacific Plate off Kuril Trench were interpreted as riedel shears which are formed during the plate motion. In this study, we investigate the crustal structure in the NW Pacific east of the Japan Trench by analyzing an airgun-ocean bottom seismometer (OBS) survey to discuss the development process of the Pacific Plate in this area.Traveltime analyses are popular to obtain seismic structures from wide-angle seismic experiment using OBSs data. Recently several studies have shown that OBS data processes usually applied to reflection-survey data can provide detailed structure images of deep into the crust. Seismic Interferometry (SI) provides waveforms from a virtually arranged receivers dataset denser than the actual OBS spacing, and we expect that seismic profiles from OBS data can be improved by applying the SI to OBS data before they are processed for the reflection processing.In this study, we applied an SI technique to the OBS data collected by the seismic refraction survey made in the northwest of the Pacific Plate in 2010. 23 OBSs were deployed along survey line (239 km, in total) at 6 km spacing. Airgun was fired every 0.2 km. We expect that the SI provides virtual receiver gathers with spacing of 0.2 km, the shot interval.Here, we calculated cross-correlation functions for all the observed trace pairs to obtain seismic traces, virtually recorded at the sea surface with both the shot and receiver intervals are equivalent to the actual shot interval, 0.2 km. By using the obtained virtual traces, we prepared CMP ensembles by arranging the traces according to the order of common midpoints, and we stacked all the traces having common mid points (CMP ensembles). Stacking with using velocity of 1.5 km/sec, the water wave velocity, gave coherent signals at ~7.3 sec in two-way travel time, corresponding to the reflections of the seafloor at depth of ~5,500 m, proofing that seismic reflection image can be obtained by the present data processing scheme. We searched optimum stacking velocity for the sub-seafloor structure in the range of 1.75–3.75 km/sec. We found a continuous reflector, corresponding to the Moho of the oceanic crust, was coherently imaged on the stacked section with RMS velocity of 3.50 km/sec. The S/N ratio of the Moho reflection phase is somewhat low on the present section, and we attempt to improve the quality by applying appropriate filters such as band-pass filter or inner mute to OBS data before applying SI, so that we discuss detailed structure in the crust and uppermost mantle in the Pacific Plate off the Japan Trench.

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