Crustal structure around the source area of the 1952 Tokachi-oki earthquake, off Hokkaido, by an airgun-OBS seismic experiment

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We conducted an airgun-OBS (Ocean Bottom Seismometer) seismic experiment between the Tokachi-oki and the Nemuro-oki seismogenic segments in August 2010. Airgun shooting was operated along two lines; one is parallel to the Kuril Trench axis and runs ~50 km landward from the trench axis, and another crosses the trench axis at the Nemuro-oki segment. The seismic lines stride the source area of the 1952 Tokachi-oki interplate earthquake (M8.2), where the largest amount of coseismic slip of 7 m occurred at the eastern central part of the line. The corresponding area didn't slip during the 2003 Tokachi-oki earthquake (M8.0) which is thought as a repeater of the former event. This slip difference in each event can be caused by a physical condition on the plate boundary, such as the topography of the slab surface, the existence of the low velocity layer on the subducting plate. The object of this experiment is to investigate the relation between the seismic structure and the interplate rupture area.

OBSs recorded clear airgun signals and imply a structural difference bounded on the central part of the line. All OBSs observed clear fast arrivals; ~4.0 km/s within the offset 25 km, ~5.2 km/s between the offset 20 to 40 km, rapidly increase to > 7.2 km/s around the offset 40 km. The fast arrivals of most OBSs image a shadow zone around the offset 40 km, which is more definite at the western OBSs. Several later phases were observed within the offset 40 km but not so clear to pick at the western OBSs.

We run a first arrival travel time inversion method, after detecting the Vp in the sedimentary layer by a forward approach. Obtained Vp model showed the along-arc variation of Vp in the island arc crust which faces on the subducted Pacific Plate. In addition the along-arc difference in discontinuity of fast arrivals, those differences correspond to a structural difference between the 1952 rupture area and its surrounding area. We expect that further analyses using travel time and wave form data will extract lateral structural variation related to the extent of rupture area.