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Crustal structure off Aomori using a new approach for travel time analysis

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In June of 2000, we made a seismic experiment using an airgun-array and ocean bottom seismometers (OBS) in the fore-arc region of northeastern Japan to clarify seismic velocity structure in the aftershock regions of the 1968 Tokachi-oki earthquake and the 1994 Sanriku-oki earthquake. The airgun line was 200 km lengths and located at a latitude of approximately 40 degrees north and 46 OBSs were deployed along the line. At the ocean bottom seismograms, we observed clear first arrivals covered the whole of airgun profile and a lot of wide angle reflections from the deeper part of the NE Japan arc. The aftershock regions of these two large earthquakes are thought to be around the plate boundary in the deeper part of NE Japan arc, and it's necessary to use information derived from reflections from deeper part to discuss relationship between crustal structure and rupture area.

Although we have to make a special point of identification later phases on the records in the velocity analysis using wide-angle data, it would be difficult to identify correctly and uniformly between OBSs if we can treat enormous amounts of data as this case. In this study, we try to apply a new approach to identify later arrivals and to obtain deep crustal structure.

First, we estimated shallower part using MCS reflection cross section and an ordinary travel time analysis was applied to the first arrival data to determine the 2-D velocity structure. The resolutions of model parameters (Vp) shallower than 30 km depth are high values. The model shows the plate boundary subducted from the trench axis with low angle are located at 20 km depth at about 100 km landward from the axis.

Using the model thus estimated we are trying to map reflection (diffraction) points corresponding to picked travel times of evident later arrivals. This approach is at one with diffraction stacking method but have the added advantage that it will make us to obtain a structural image focused clearly on evident signals on the records by using picked travel time only. Applying this approach for picked data of all pairs of OBSs and shots can lead us to know the real reflection points and to identify these phases uniformly.

For the present, reflection points seem to converge at several areas - plate boundary shallower than 20 km depth, less than 10 km deeper than plate boundary, deeper part of island arc crust more than 30 km and island arc mantle which is correspond to the rupture areas of two large earthquakes. This suggests that we will be able to obtain detailed structure around the rupture areas using identified reflections and furthermore we can discuss relationship between crustal structure of rupture area and source process.