

Super-Deep seismic reflection profiling in the southern part of Hidaka Collision Zone, Hokkaido, Japan

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Introduction

The Kuril arc has been colliding against the northeast Japan arc around the Hidaka mountain range, Hokkaido, Japan. Furthermore, the Pacific plate is subducting north-northwestward beneath the Hidaka Collision Zone (HCZ). Recent seismic reflection experiments in this area (HIDAKA94-97) have revealed that the delamination-wedge structure is formed by the arc-arc collision beneath the HCZ (Ito et.al., 1998,2000,Tsumura,1999). However, the relationship between the delaminated lower portion of the lower crust and the subducting Pacific plate has remained unclear. In order to reveal the detailed 3D structure of the HCZ, a super-deep seismic reflection experiment was conducted in the southern part of the HCZ, Samani-cho, Hokkaido, in September 2000. Two seismic lines were deployed: Line1 is parallel to the subducting trend of the Pacific plate (NW-SE), and Line2 is nearly parallel to the trend of the arc-arc collision (NE-SW). Line1 is almost perpendicular to Line2. The length of Line1 and Line2 is about 16km and 8km, respectively. Five vibrators were operated, obtaining seismic data of the both lines simultaneously. In addition to 2D processing, we made 2.5D processing using all CMP scattered widely.

Results

The main features of seismic profiles can be summarized as follows:

For 2D profile in Line1:

1) At shallower portion, southeast-dipping reflections are truncating horizontal reflections, which are seen at 3 sec two-way travel time (TWT) in the northwestern half of the survey line.

2) A northwest-dipping strong reflection at 14 sec TWT descends down from the southeastern end of the survey line to the center, whereas gently southeastern-dipping reflection is seen at 14 sec TWT in the northwestern half.

3) Intermittent events are found at 7 sec to 8 sec, 9 sec, 11 sec, and 16 sec TWT.

For 2D profile in Line2:

4) Above 5 sec TWT, horizontal reflections are predominant but complicated.

5) There are nearly horizontal reflections at 11 sec TWT, gently southwest-dipping reflections at 13 sec to 14 sec TWT, however they are discontinuous and unclear.

For 2.5D profiles;

6) Very reflective events at 7 to 8 sec TWT, 10 sec to 11 sec TWT and 13 to 15 sec TWT were seen clearly in the eastern part of this survey area.

Discussion

At shallower portion (about 1 sec TWT), compared with geology, the southeast-dipping reflections from center to southeastern end of Line1 and horizontal reflection in Line2 are interpreted as the Hidaka Main Thrust (HMT) which is the boundary between the northeast Japan arc and the Kuril arc (Kikuchi et al.,2001; Ito et al., 1998). The northwest-dipping strong reflection between 13.5 sec and 14.5 sec TWT in the southeastern part of the survey Line1 are associated with the Pacific plate considering hypocentral distribution of earthquakes accompanied with the subducting Pacific plate.

In this survey, we have obtained the structure of the northeast Japan arc between the HMT and the Pacific plate. However no distinct reflectors corresponding to the descending lower crust occur. In comparison with HIDAKA94-97 profile, there is a possibility that the delaminated lower crust run up against the Pacific plate at about 14 sec TWT in this area. However this survey was not enough for our target structure to be interpreted the inside structure of the northeast Japan arc. This provides us good prospects that the detailed comparison with HIDAKA94-97 profile and further experiments are highly required to reveal the relationship between the delaminated lower portion of the lower crust and the subducting Pacific plate.