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Detailed crustal structure around northern Itoigawa-Shizuoka Tectonic Line derived from wide-angel reflection data

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1. Introduction

Itoigawa-Shizuoka Tectonic Line (ISTL) is a large scale structural boundary which divides northern east and southern west Japan arc. Geological distribution around ISTL reflects the history of Japan arc formation and looks so complex. In order to understand about island arc active tectonics, it is very important to obtain the detailed crustal structure around ISTL.

2. Observation

In 1991, Research Group for Explosion Seismology carried out a wide-angle reflection experiment around ISTL (RGES1991). The results indicate that low velocity zone is penetrating downward beneath ISTL. But the shape and the bottom depth is not made clear due to sparse observation intervals (more than 1km) and absence of shot point around ISTL. The resolution of shallow structure around ISTL is also extremely low.

In 2002, reflection survey was carried out along the Ohmachi-Komoro line. One of the shot points is located near ISTL and on the RGES1991 line. We designed deployment on the same RGES1991 line. Thereby we can treat the data in the same manner with RGES1991 data. As observation equipments, we used L-22D, seismometers made by Mark Products corp. and LS-8000SH, data logger made by Hakusan corp. The number of stations is 80. The interval of stations is about 500m in average. But we deployed more densely at intervals of 300m around ISTL.

3. Data analysis

Seeing the record sections, the apparent velocity of first arrivals indicates 3.7km/sec in the west side of ISTL. On the east side, it increases more than 5km/sec beyond Otari-Nakayama fault and reduces drastically beyond Saikawa fault. But there is not such a variation of apparent velocity of waves traveling from east to west. It follows that the difference would be caused from deep structure rather than shallow structure. Then we tried to obtain detailed velocity structure model from data combined with the new and the previous. We used the Finite difference Method made by Zelt and Barton (1998) so as to calculate stably travel time even under complex structure.

We state characters of our velocity structure model. At 5km west of ISTL, the basement rock of Hida mountains descends downward with east dipping. There is low velocity zone at 3.7-4.0km/sec between the basement and ISTL, which approaches at 7km depth. It is remarkable that matching surface velocity with geological distribution is so finely good. The variety of surface velocity from west to east is just corresponding with the Holocene, the Pliocene, the Miocene, the Pleistocene and the Miocene sediments.

4. Interpretation

At the east of ISTL, sedimentary rock since Miocene is thickly piled up. It is consistent with that the upper crustal structure was formed at the opening of Sea of Japan. The western boundary of the sedimentary rock is confined by ISTL. ISTL is east dipping fault, which is also supported by gravity data. Low velocity body (3.7-4.0km/sec) is sandwiched between east-dipping fault plane of ISTL and basement rock, which would be corresponding to the Quaternary sediments. Considering that the present ISTL is a reverse fault with east raise, it would appear that ISTL was formed as a normal fault in mid-Miocene and was reactivated as a reverse fault due to subsequent crustal shortening.