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The subsurface structure in northern Mino region, central Japan revealed by reflection method

Hiroshi Furuya^{1*}, Noriko Tsumura¹, Nozomi Komada¹, Joint observation group in the Nobi-earthquake source region²

¹Graduate School of Science, Chiba Uni., ²ERI, Uni. of Tokyo

The northwest of central Japan is a region on which the deformation is concentrated in Japan, and has a lot of folds and faults. One of those faults is Neodani fault as the earthquake source fault of the Nobi Earthquake in 1891. It is thought that Philippine Sea Plate (PSP) which is subducting under this region is closely related to the formation and the development of such faults, too. The upper surface of PSP under the study area is presumed to form a ridge shape that expands toward the northwestward from the result of the travel time tomography and the hypocentral distribution, but the spatial relationship between upper surface of PSP and the moho in the overriding plate or the mantle wedge are not clarified. In this study, the reflection method is applied to the shot records obtained in the study area and tried to clarify the subsurface structure under the region.

To reveal a subsurface structure, seismic array observation was conducted by Joint Observation group in the Nobi Earthquake source region. The seismic array consists of three lines which intersected at high angle with Neodani fault; hereafter we call these as line1, line2, line3 from the north. In each line, about 30 seismic stations were settled ever 1km interval from the southwest to the northeast. We analyzed 8 dynamite shots which were carried out by Chiba University, NIED and other universities on mid night of 9th and 10th October 2009. Applying a conventional reflection processing to the shot record obtained at each seismic line, we made zero offset gathers for all shots. From the careful check of the seismic profiles, we were able to find that distinctive reflections exist around two way travel time (TWT) 10s. These reflections were seen in most of the zero offset gathers and seem to form a reflective zone with 2-3direction. Furthermore the upper boundary of the distinctive reflective zone gradually inclined to the northeast in all seismic line. These were another clear and coherent reflections at around TWT 14s of seismic line1 profile, while the similar reflections were not seen in line2 and line3 profiles.

Some previous seismic profiles revealed a crustal structure in the Kinki district, central Japan. Dense reflective zones at TWT 8-10s were found in the seismic profiles and those were interpreted as a lower crustal lamination owing to their depths and reflection patterns. In this study we can confirm that the distinct reflective zone in our profile continues to the western part, because the western end of our line2 was overlapped on the eastern end of a seismic profile (1989 Fujihashi-Kamigori line). Thus the reflective zone of our seismic line also shows the lower crustal lamination. Reflectors of the event around TWT 14s is not clear, but a possible candidate is the upper surface of PSP because of its depth. If these events were reflected at the upper surface of PSP, the upper surface of PSP has a flat shape beneath the seismic array stations although the distinct reflective zone is dipping toward the northeast. It means that thickness of bounded layer between of PSP might affect the deformation such as folding and faulting of the crust in the study area.

Keywords: northern Mino region, lower crust, Neodani fault, reflection method, Philippine Sea Plate