

Imaging of deformation structure of Chuseki-so caused by Kakuda-Yahiko fault using Land Streamer reflection survey

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High-resolution shallow seismic reflection surveying by means of Land Streamer was conducted in Akatsuka district, Niigata City, to delineate the detailed structure recorded in the thick Holocene sediments deposited in the Niigata Plain, central Japan. Two survey lines were placed across the inferred flexure zone of Kakuda-Yahiko fault, which extends along the western edge of the Niigata Plain for over 25 km. Characteristic deformation patterns were clearly imaged on the CMP stacked sections down to 300 m in depth.

As well known, faulting structure recorded in the latest sediments is the key to clarify the recent behavior of each fault and evaluate the potential activity. Dense drilling has been adopted to clarify recent activities of active faults. However, we would have to note that it was still difficult to delineate the detailed faulting structure by such "pinpoint" surveying. Conventional seismic reflection surveying has been also utilized to delineate the 2-D deep structure of faulting. However the conventional technique was inadequate to image near-surface structure of faulting due to its insufficient spatial resolution. In contrast, high-resolution shallow seismic reflection surveying is capable to provide detailed information, surpassing that of drilling. To conduct the surveying even at paved areas, we developed a field tool named Land Streamer (Inazaki, 1992), and utilized it to high-resolution active fault survey (Inazaki & Nakanishi, 2007). A field surveying, the purpose of which was to image detailed structure of Kakuda-Yahiko fault, was conducted in the fall in 2009 making use of the Land Streamer.

Two types of newly developed Land Streamer tools were used for the field measurements; one was the P-wave type, having 144 active channels at 1 m intervals, and the other was the S-wave type on which 120 horizontal geophone units were placed at 50 cm intervals. A total of 1744 shot records were obtained during 10 days by 6 crew personnel. The data were processed on a PC using the VISTA processing package (Gedco, Inc.). CMP stacked time sections successfully profiled deformation structure not in the flexure zone of the major fault but also in the frontal zone or in the footwall side of the fault. High angle reverse faulting and related bulge structure at the hanging wall side was delineated in the near surface down to 300 m in depth. Increase in layer dipping with depth was also recognized in the flexure zone of the fault. In addition, we could identify small faults in the footwall side. One of which dislocated a horizon at 45 m in depth about 5 m in relative displacement. These deformation patterns were similar to those delineated at the Uchino-Ueshinmachi District, 4km north from the survey site, but were different to those at Matsuno-o District, 2.5 km south. This suggests a segmentation of the fault near the survey site.

Keywords: concealed fault, Niigata Plain, Kakuda-Yahiko fault, Land Streamer, seismic reflection surveying, Holocene sediments