Deep Seismic profiling across Lake Biwa, central Japan

Hiroshi Sato[1]; Kiyoshi Ito[2]; Susumu Abe[3]; Naoshi Hirata[1]; Naoko Kato[4]; Takaya Iwasaki[5]; Makoto MATSUBARA[6]; Hideo Saito[7]; Taku Kawanaka[7]; Takeshi Ikawa[7]

[1] ERI, Univ. Tokyo; [2] DPRI, Kyoto Univ.; [3] JGI, Inc.; [4] ERI; [5] ERI, Tokyo Univ.; [6] NIED; [7] JGI

The special project for Seismic hazard mitigation in urban areas started in 2002 as a five-years project. As one of the main part of this project, deep seismic profiling was undertaken in the Kanto and Kinki areas. In October 2006, deep seismic profiling across the Tanba Mts., Lake Biwa to the Nobi plain was performed as a final seismic survey of this five-years project. The purpose of this survey is to obtain deep geometry of active faults in the northern part of the Kinki triangle zone and to reveal the velocity structure of the upper crust.Seismic data was acquired by the common-mid point reflection method.Total length of the seismic line is 100 km. Across the major active faults, such as the Hanaore, Katata, and Yoro faults, seismic reflection data was corrected by dense shooting. Along the other part of the seismic line, low-fold reflection data was acquired. Seismic sources were four vibroseis trucks, dynamites (100-200 kg) and air-guns (1500 cu, inch) in Lake Biwa. Receiver interval was 50 m. Seismic signals were recorded by digital telemetry recorder (G-daps 4a:JGI), and off-line recorders (MS 2000: JGI). At Lake Biwa, ocean bottom cables were deployed. High-energy shots such as explosive sources and sets of 100 stationary vibroseis sweeps, were recorded by maximum 2756 channels. Beneath the Tanba Mts., west dipping reflectors are dominated down to 10 km. The deeper extension of the Katata fault can be traced down to 8 km in depth as west-dipping reflectors at 30 degrees further west of the surface trace of the Hanaore fault. Under the assumption that the Hanaore fault is vertical, deeper extension of the Hanaore fault is cut by the Katata fault or merged to the Katata fault

Both the Eastern and Western boundary fault of the Suzuka Mts.show 50 degree dipping fault surface and can be traced down to 5 km in depth. The fault surface of the Yoro fault also shows 50 to 40 degrees down to five km in depth and is interpreted to be connect to a reflector dipping 30 degrees from 6 to 15 km in depth. Based on the depth to the upper surface of pre-Neogene beneath the Nobi plain, the minimum vertical separation by the Yoro fault is 3 km.

Lithosheric image along the seismic line was obtained by low-fold seismic section using high-energy shots. The outstanding feature of the section is clear reflectors at 11 sec (TWT: Two-way travel time) beneath the Suzuka and Yoro Mts. The reflection waves concentrate within 1 to 1.5 sec and differ from the reflection from the lower crust. Base on the similarity of the reflection from the upper part of the Philippine Sea plate (PHS), we interpreted that these reflections are from the upper suface of the PHS. According to the unified hypocenter data of the JMA, hypocenters are distributed forming a gently westward dipping zone at 33 to 40 km in depth beneath Yoro and Suzuka Mts. and Ohmi basin, suggesting the slab geometry accords well to the reflectors. Lower crust of this seismic profile is reflective. Beneath the Tanba Mts., clear reflectors at 9 sec (TWT) shows gentle eastward dipping. Judging from the result of the Shingu-Maizuru seismic survey of 2004, the Moho depth beneath the Tanba Mts. is about 35 km in depth. Based on the pattern of the reflectors in the lower crust, the Moho depth increases beneath Lake Biwa up to probably 40 km. The crustal thickening beneath Lake Biwa also presented by earthquake tomography. The overall lithospheric structure across Lake Biwa suggests the existence of shallow PHS slab and increasing its dip angle beneath Lake Biwa associated with the crustal thickening. The shallow PHS slab implyes that it has a potential of possible source of damaging earthquakes, suggested by Ishibashi (1999).