Subsurface Structure and Tectonic evolution of the Western Boundary Fault Zone of the Nagano Basin, Central Japan

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The Western Boundary Fault Zone of the Nagano Basin is a zone of NE-SW trending reverse faults, which border the eastern margin of the Northern Fossa Magna (NFM) and are traceable for about 52 km. The NFM is a half graben, which was developed in conjunction with the opening of the Japan Sea. Basin fill sediments in the NFM have been subjected to strong horizontal shortening since tectonic inversion occurred in Pliocene time (Sato et al., 2004). The Western Boundary Fault Zone of the Nagano Basin is considered as an active back thrust, that developed on the hanging wall side of the Itoigawa-Shizuoka Tectonic Line (Ikeda et al., 2002).

We revealed the subsurface structure of the Western Boundary Fault Zone from the result of shallow seismic profiling in September to October 2005 and gravity survey in September 2006. The seismic section and gravity anomalies indicate a reverse fault dipping about 45 degrees to the west (the Western Boundary Fault Zone of the Nagano Basin), which developed along a base of the Susobana tuff of Late Miocene age and scraped the NFM basin fills as an active back thrust. But, we need more consideration of deep subsurface structure of this Fault Zone.

To reveal the deeper geometry of the active fault and geologic structure, we reprocessed a deep seismic profiling data that were obtained by Japan National Oil Corporation (Now, Japan Oil, Gas and Metals National Corporation, JOGMEC) in 1996 (JNOC, 1998). Subsurface density structure of this Fault Zone was modeled by using gravity data that were acquired during the seismic profiling in 1998 (JNOC, 1998), with constraints from geological interpretation of the seismic section and surface geology.

Deep seismic line of NS96-A is located along Saigawa River, and is about 20 km long. This line trends east to west and transects the Western Boundary Fault Zone of the Nagano Basin. The source used in this survey is 4 vibrator trucks. Source spacing was 40 m, and receiver spacing was 20 m. 256 channels of geophone arrays ware used to record each shot. The deep seismic profiling data were reprocessed by conventional common mid-point (CMP) methods, using a digital seismic analysis software (JGI, SuperX-C).

In a density structure analysis, we used 96 gravity data that were selected from gravity data set along the 1996 the seismic line, and 50 gravity data we measured in September 2006 to compensate an insufficient data in the Nagano Basin. The obtained gravity data were reduced to Bouguer gravity anomalies. The effects of subducted Pacific plate and Philippine Sea plates were removed from the Bouguer anomalies, and then we obtained 'slub residual gravity anomalies' (Furuse and Kono, 2003). The density structure was estimated by 2-dimensional Taiwan's (1959) method.

The seismic section after careful processing shows the base of Miocene sediments, and this seismic section correspond to surface geology. Fairly flat Quaternary basin fills are shown in the eastern part of the seismic line. This basin fills were traceable from the east end of the line to the west, and terminate against the Western Boundary Fault Zone of the Nagano Basin, indicating that the basin-fill sediments are syntectonic. Subsurface structure obtained from deep seismic section is approximately consistent with observed Bouguer anomaly. Finally, we estimate an amount of late Neogene to Quaternary shortening across the Western Boundary Fault Zone of the Nagano Basin from seismic section and gravity anomalies. In this report, we will introduce these results.