Blind thrust faults beneath the western Ishikari plain revealed by high-resolution shallow seismic reflection profiling, Hokkaido

*Tatsuya Ishiyama[1], Naoko Kato[1], Hiroshi Sato[1], Shin Koshiya[2], Shigeru Toda[3], Susumu Abe[4]

1. Earthquake Research Institute, University of Tokyo, 2. Faculty of Science and Engineering, Iwate University, 3. Department of Earth Sciences, Faculty of Education, Aichi University of Education, 4. Japan Petroleum Exploration Co., Ltd.

We show newly collected onshore high-resolution two dimensional (2D) seismic reflection and refraction data with a total length of ca. 12 km across the western Ishikari plain in order to define the shallow subsurface geometry of underlying blind thrust faults. Seismic lines were designed to obtain subsurface images to depth of ca. 2 km across the western Ishikari plain and underlying blind thrusts that deform the basin-fill sediments. The shallow seismic lines are tied with a simultaneously obtained new deep seismic reflection profile (Sato et al., 2018) which can be correlated with deep boreholes so that we could tie seismic reflectors with geologic units to trace horizons throughout the seismic section. Along the seismic lines, we deployed a dense array of ca. 1200, 10 Hz vertical component geophones at 10 m interval with common depth point (CDP) bin sizes of 5 m. A vibrating source truck (Hemi 50) manufactured by IVI was used as the seismic source for a total of 1177 shot points set adjacent to nearly all the receivers along the ca. 12 km long seismic array. On average, 2 to 10 times sweeps with frequencies of 8 to 100 Hz were acquired at each shot point. The locations of all shot and receiver points were accurately determined using the differential Real-Time Kinematic (RTK) Global Navigation Satellite System (GNSS). The processing of the seismic reflection data
Data processing using Super X, a commercial software package from JGI Inc., generate depth-converted seismic sections. Data processing included the compilation of field data, coherent noise reduction to suppress surface waves, direct waves and ground roll, 2D binning, deconvolution, static corrections, CDP stacking, 2D migration and depth conversion (e.g., Yilmaz, 2001). Applying deconvolution, bandpass filter, and static correction to the seismic data successfully improved the quality of the seismic imaging and enhanced the seismic reflections. We also carried out refraction analysis on first arrivals to estimate the weathering layers to explain space-variant delays in every seismic trace. As a result, the quality of the shallow portions of the stacked seismic profiles was significantly improved.
The seismic sections illuminate the detailed subsurface structure to depth of ca. 3 km beneath the western Ishikari plain. The preliminary interpreted depth-converted sections correlated with nearby Neogene stratigraphy indicates shallowly to moderately east-dipping blind thrust faults and pairs of overlying fault-related anticlines that deform Plesitocene to Pliocene sedimentary units. We will mainly discuss (1) the shallow structural characteristics of the active blind thrust based on our interpretation of the 2D seismic data in combination with the Neogene stratigraphy, (2) structural relations to deeper structures obtained by the new deep seismic profile (Sato et al., 2018), and (3) and structural relations to southerly plunging active anticlines located north of the seismic lines that deform late Pleistocene marine terrace deposits (Komatsubara and Anzai, 1998).

Keywords: active fault, Blind thrust, Active fold, Ishikari plain, Hokkaido, Seismic reflection profiling

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