Active blind thrust structures beneath sedimentary basins in back-arc of the Northeast Japan revealed by seismic reflection profiles and their geomorphic signatures

*Tatsuya Ishiyama[1], Naoko Kato[1], Hiroshi Sato[1], Shin Koshiya[2], Taro Koike[3], Katsuya Noda[3]

1. Earthquake Research Institute, University of Tokyo, 2. Department of Civil and Environmental Engineering, Faculty of Science and Engineering, Iwate University, 3. Geosys, In.,

We collected and processed new high-resolution seismic reflection data across back-arc sedimentary basins in the Northeast Japan in order to define active blind thrust-related structures beneath alluvial plains. We carried out four seismic reflection profiling by use of portable offline seismic recorders and Vibroseis trucks as seismic sources; We deployed up to 725 portable offline seismic recorders (GSR and GSX) covering whole seismic lines at 10-m intervals and provided seismic shots using Vibroseis trucks (HEMI-50 and Y-2400) at all midpoints of nearby receivers. After standard seismic processing including common midpoint stacking, first break muting, bandpass filters, deconvolution, noise suppressing filters, near-surface statics and migration, we successfully created high-resolution depth-converted cross sections for all seismic lines. Preliminary structural interpretations of depth-converted sections to ca. 2 km depth commonly illuminate pairs of thrust-related folds that deformed Miocene to Pleistocene units in these sedimentary basins. Beneath Shonai plain, we defined previously unrecognized asymmetric anticlines that deform Pleistocene and Holocene basin-fill units. Axial surfaces of these anticlines identified in these seismic sections are apparently consistent with those recorded in Holocene fluvial terraces, which may suggest recent growth of these fault-related anticlines associated with activities of underlying east-dipping blind thrusts. It is of note that these active blind structures are structurally similar to that recognized where an enigmatic 1894 earthquake event (M7.0) caused devastating damages on local communities (Ishiyama et al., 2020) and possibly forms fault segments comprised by arrays of en-chelon blind thrusts beneath the alluvial plain. These results also emphasize upon important roles of back-arc failed rifts in strain accommodation at later post-rift stages as mechanically weak zones within the overriding plates. Moreover, rapid subsidence of back-arc sedimentary basins above densified lower crust due to mafic intrusion into rift axis may hindered inrabasin active blind thrusts, strongly suggesting active structures still unrecognized in other sedimentary basins likewise that should be taken into account as possible future earthquake sources. Our experiments undoubtedly show validity of the state-of-the-art seismic imaging techniques to resolve otherwise unidentified seismically active blind structures.

Keywords: Blind thrust, Northeast Japan, Seismic reflection profile, Fault-related fold

