# Shallow crustal structure in and around the central focal area of the Iwate-Miyagi Nairiku Earthquake in 2008, northeast Japan

# Shin Koshiya[1]; Hiroshi Sato[2]; Naoko Kato[3]; Eiji Kurashimo[2]; Fumiko Watahiki[4]; Taro Mogi[5]; Masaru Noda[6]; Tsuyoshi Sano[4]; Shigeru Toda[7]; Toshifumi Imaizumi[8]; Tatsuya Ishiyama[9]; Susumu Abe[10]; Motonori Higashinaka[11]; Taro Koike[12]

[1] Civil and Environmental Eng., Iwate Univ.; [2] ERI, Univ. Tokyo; [3] ERI, Univ. of Tokyo; [4] Iwate Univ.; [5] Iwate Univ; [6] Faculty of Engin., Iwate Univ.; [7] Earth Sci., AUE; [8] Geography Sci., Tohoku Univ.; [9] Tohoku University; [10] JGI, Inc.; [11] JGI; [12] Geosys

The Iwate-Miyagi Nairiku Earthquake in 2008 (Mj=7.2, depth=8km) occurred on June 14, 2008 in the eastern flank of the Ou backbone range, northeast Honshu, Japan. To reveal shallow crustal structure in and around the central focal area of the earthquake, we conducted gravity survey, together with seismic reflection / refraction experiments, along an E-W survey line 11 km long.

The gravity survey was conducted from September 17 to 20, 2008, with a G-type gravity meter (G497; LaCoste and Romberg Inc.). Each interval of observation sites is about 200 m. The location and elevation of observation sites were surveyed with a total station and an automatic level, respectively. Error for each elevation, except for the western marginal site, was less than $20S\hat{}(1/2)$ (mm), where $S$ (km) denotes the length of the survey line. Acquired gravity data was processed to obtain Bouguer anomaly mostly according to the methodology of Geological Survey of Japan, AIST (2004), though the Bouguer correction was carried out as an effect of bounded spherical crust to the spherical surface within the same distance range of 45km as those for the terrain correction. We assumed that the density for Bouguer and terrain corrections were 2200 kg/m$^3$.

The geology around the survey line consists of Paleozoic sedimentary rocks, Cretaceous granitic rocks, Miocene Oarasawa formation, Oidegawa formation, Maekawa formation, Orose formation, Mizuyama formation, Pliocene Kunimiyma andesite and Odaira formation, in ascending order. Among these formations, the Oidegawa and Maekawa formations were thought to be syn-rif sedimentary formations. The Paleozoic formation and Cretaceous granitic rocks crop out in the eastern part of the surveyed area. In the western part, from the Oarasawa to Orose formations are distributed with dipping east, whereas the Mizuyama formation, unconformably overlying these formations, is extensively distributed in the whole area.

The Bougeur anomaly around the exposure of the granitic rocks is as large as ca. 83 mGal. It decreases dramatically to ca. 60 mGal at the eastern end of the survey line. It also decreases gently to 72 mGal around 3km west to the granitic rocks, and in turn increases to ca. 76 mGal at the western end of the survey line.

Using a two-dimensional gravity field modeling software, 2MOD $^{TM}$ (FUGRO-LCT Inc.), which uses Talwani-type polygonal bodies to define a model, we modeled density structure along the survey line. Taking the geology and the results of the seismic reflection / refraction experiments, we assumed four layers in the model. The first layer is roughly corresponds to pre-rift rocks, the second layer (its density difference to the first layer is -200 kg/m$^3$) to syn-rift formations, and the third and fourth layers (their density differences to the first layer are -700 kg/m$^3$ and -1000 kg/m$^3$, respectively) to post-rift formations.

The model leads to conclusions as follows. (1) The basements of the Paleozoic rocks and Cretaceous granitic rocks form a horst bounded by normal faults on both western and eastern sides. The fault of the western side, corresponding to the northern part of the Mochikorobashi-Hosokura tectonic line, is now active as a reverse fault in turn and caused surface rupture when the Iwate-Miyagi Nairiku Earthquake in 2008 occurred. (2) The known range bounding fault inferred from seismic reflection profiling, which is the source fault of the earthquake, were formed as a normal fault during Miocene and have been reactivated as a reverse fault.

Reference

Geological Survey of Japan, AIST, 2004, Gravity CD-ROM of Japan, Ver. 2.