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Characteristics of the Eastern Boundary Fault Zone of the Niigata Plain as inferred from gravity anomalies

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Along the boundary range of the Niigata plain and the Echigo Mts., the Kushigata Mts. fault zone and the Tsukioka fault zone are distributed in the NNE-SSW direction, and Ikeda *et al.* [2002] call them for the Eastern Boundary Fault Zone of the Niigata Plain (EBFZNP). The EBFZNP is a part of the eastern margin of the northern Fossa Magna, and is distributed along the Shibata-Koide tectonic line proposed by Yamashita [1970]. The Niigata plain is a very thick sedimentary basin of which the thickness is over 6000 m. On the other hand, the basement rocks are exposed at the Echigo Mts. and the Niitsu hill (anticline) has been developed in the west of the Tsukioka fault zone. A high-resolution seismic reflection survey across the Tsukioka fault [Kato *et al.*, 2013] revealed that this fault is a bedding-slip fault which develops along the unconformity between the Miocene base and the basement rocks. Because the geological structure around this region has encountered heavily tectonic deformation, it has been uncertain that how active structures on the surface is related in the subsurface each other.

The purpose of this study is to reveal the characteristics of the EBFZNP through gravity anomalies. We report here the results of a dense gravity survey in and around the EBFZNP and the characteristics of the EBFZNP obtained from gravity analysis.

We conducted a gravity survey from 1st to 9th, September, 2014 in and around the EBFZNP. A Scintrex CG-3M gravimeter was used for the survey. We set the four gravity survey lines across the Tsukioka fault zone and/or the Niitsu hill. The total number of the measurement points was 181 points. The gravity data published by GSI [2006], Yamamoto *et al.* [2011] and Geological Survey of Japan (AIST) [2013] were also compiled in this study.

We applied a terrain correction [Honda and Kono, 2005] and a slab correction [Furuse and Kono, 2003] to the gravity data in addition to a normal correction procedure (the assuming density for Bouguer correction is 2,670 kg/m^3), then obtained a Bouguer anomaly map. The density structural analysis along the four survey lines was carried out by applying the 2-D Talwani method [Talwani *et al.*, 1959]. In order to illustrate discontinuous lines of the geological structures, the filtering processes of the horizontal and vertical first-order differential operation was applied to the Bouguer anomalies.

Bouguer anomalies show low anomalies in the plain side and 40 mGal more high ones than the plain side in the Echigo Mts. side. Both of the steep Bouguer gravity gradients and the zero isolines of vertical differentiation, which represent the tectonic discontinuities in the subsurface, are continuous and clearly extend along the EBFZNP. These features suggest that the subsurface structures of the EBFZNP form a single fault structure. Somewhat high Bouguer anomalies (30 to 40 mGal higher than the plain side) and both of the steep Bouguer gravity gradients and the zero isolines of vertical differentiation exist in the western part of the Niitsu hill.

The dense gravity survey on the seismic line suggests that the EBFZNP is estimated to be a highly west-dipping fault structure because the Bouguer anomalies continuously increase from the west to the east of the line and both the steep Bouguer gravity gradients and the zero isolines are located in the vicinity of the fault traces. This is coincident with the results of the seismic survey. From the density structural analysis, we also reveal that there are the west-dipping blind fault structure and the east-dipping half-graben between the Kushigata Mts. fault zone and the Tsukioka fault zone, and that the Niitsu anticline is an asymmetric structure with gentle western flank.

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Keywords: Kushigata Mts. fault zone, Tsukioka fault zone, gravity survey, density structural analysis