Density Structure beneath the Eastern Boundary Fault Zone of the Shonai Plain

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The Eastern Boundary Fault Zone of the Shonai Plain (EBFZSP), distributed along the boundary between the Shonai plain and Dewa hill, is located in the northwestern part of the Yamagata Prefecture. The NS striking EBFZSP is an active fault zone, which entire length of about 38 km. The east side of the fault zone is relatively up-lifting against the west side. The EBFZSP is divided into north and south based on the difference of the fault distribution type and activities. The shallow structure of the Matsuyama fault, the southern part of the EBFZSP, is clarified by seismic explorations. In this study, we report the gravity survey and the density structure analyses to explicate the subsurface structure and the forming history of the EBFZSP.

Gravity measurement was executed during 4-12 of August 2014 and 5-6 of March 2015 in and around the EBFZSP. The employed gravimeter is Scintrex CG-3M relative gravimeter. The exploration was also carried out along two seismic exploration lines. The total number of newly acquired gravity data are 177. All the existing gravity data available was also referred in the analyses.

After the traditional reduction process with reduction density as 2400 kg/m^3, the terrain correction with 10m-DEM and the slab correction for the long wavelength component was adopted. The horizontal and vertical 1st derivatives were calculated for the extraction of the geological discontinuities. We conducted the 2D talwani's method for the density structure analysis, and additionally the Tilt-Depth method was examined.

The Bouguer anomaly distribution in the study area is consistent with the geology, which shows low anomalies in the Shonai Plain and shows 50 to 60 higher values in the mountainous region. High horizontal gradient zone around 4 to 5 mGal/km and zero contour of the 1st vertical derivative lies in the Dewa hills, which develops at the eastern part of the fault zone. This gravitational characteristics are proved to be the Aosawa fault zone after the 2 dimensional density analysis. Compared with the distribution of the EBFZSP, the zero contour and the high horizontal gradient zone lies near (at most 3.5 km) the fault zone at the southern part. On the other hand, it is away (at most 9 km) at the northern part, where the fault zone is branching multiply.

The EBFZSP is thrust inclining eastward, which derived from the Aosawa Fault and migrating toward the plain. For the northern part, the complex derivation of the faults are shown in the surface topography and the faults are migrating more than southern part. On the contrary, the EBFZSP is directly derived from the Aosawa Fault and the subsurface structure is relatively simple for the southern part. Distance between the EBFZSP and the alignment of the gravity gradient characteristics is consistent with those structural difference between the northern and the southern part of the EBFZSP.

Keywords: Gravity Anomaly, Density Structure, Active Fault

