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Re-analysis of Gravity Anomaly aound the Kitakami district based on Conrad-Moho-Slab-residual gravity anomaly

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As a pasrt of the study of active faults in and around the Kitakami area, we performed the re-analysis of extisting gravity anomay data. A key point of this re-analysis was to extract the gravity anomaly component without the influence of the relief of conrad/moho discontinuities and the subduction of Pacific plate in order to realize more clearly the shallow-depth tectonic strucrures. This was done using the method proposed by Gennai and Kono (1999), who referred this componet as Conrad-Moho-Slab-residual gravity anomaly (CMSRG). Here, the method and results of this re-analysis were reported.

Method

Re-analysis of garvity data was intended for an area of 38.0-39.7N/139.8-141.5E, which included the almost whole are of the Tohoku district. Gravity data used was 1km-mesh gridded data of Bouguer anomaly (2.67g/cm^(3)) compiled in 'Gravity CD-ROM of Japan, Ver.2' (GSJ, 2004). Using this dataset, CMSRG was calculated by the following procedure.

1. Based on the published data concerning the depth distribution of Conrad and Moho discontinuities (Zhao et al.,1992), and that of upper surface of subducting Pacific plate (Nakajima and Hasegawa, 2006), 3D model was constructed, which was constituted by four layers, upper crust, lower crust, slab, and asenosphere. The thickness of slab was assumed to be 90km.

2. Assuming that each of these four layers area homogeneous with respect to density, average densities were assigned to these layers, so 3D density structure model was constructed. Average densities of upper crust, lower crust, asenosphere and slab were set to be 2.67, 2.90, 3.30 and 3.42 g/cm^(3)) respectively, which were determined with reference to the seismic tomography results.

3. Gravity anomaly due to above 3D density structure model was calculated, and was subtracted from observed Bouguer anomaly.

As pointed out by Gennai and Kono (1999), CMSRG calculated in this way, was considered to reflect the structure (density heterogeneity) in the upper crust.

In the step 2, the density contrast (0.12g/cm^(3)) between asenosphere and slab was determined to remove the monotonically westward-decreasing trend observed in the Bouguer anomay. This value was larger than that reported by Furuse and Kono (2003) (0.065g/cm^(3)). This difference may be attributed to the density increase during subduction due to mineral-phase transition, however, further study is needed about this point.

Result

CMSRG obtained was separated to several components based on wavelengths by means of FFT fitering, and then was compared with the geological information, eearthquake distributions, results of seismic reflection survey, and so on. These studies reveals the following characteristics.

1. CMSRG represents more clearly, the tectonic structures in the shallow-depth part of upper crust, such as caldera and active fault.

2. The Kitakami lowland is divided to several blocks by EW- or NNW-SSE-trending structures shown by high gravity anomalies, which patterns are consistent with seismic and geodetic observations.

3. The patterns and extents of low gravity anomalies within the Kitakami lowland well reflect rift structures.

4. Forward calculation based on the seismic reflection profiles (Kato et al., 2006) reproduced well the observed gravity profiles, and shows that almost of gravity anomaly at the lowland is responsible for the depth change of basements.

Keywords: Kitakami, gravity anomaly, upper crust, rift