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Bouguer gravity anomaly of Japan's adjacent seas

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The Japan Coast Guard (JCG) conducted bathymetric, marine gravity and magnetic, and seismic surveys for Continental Shelf Survey Project between 1983-2008. The survey area extends over 350 nautical miles from the coastline in the southern region of Japan. Since the project has been settled temporarily, we can now report the precise Bouguer gravity anomaly map of Japan's adjacent seas which has been newly compiled based on these survey results.

The drift correction, Eotvos correction and the up-to-date normal gravity formula were applied to the raw gravity data then the freeair gravity anomaly was obtained. Atmospheric correction was not applied. The gravity grid data was made in 1 km mesh. Bouguer gravity anomaly was calculated by applying a terrain correction under the assumption that the average density of oceanic crust was 2.67 g/cm3. For the terrain correction, the square pillar model of topography griddized 1 km x 1 km was made and the gravity effect of the model within 40 km radius was calculated by using half-infinite integral.

A topography model was made by using mainly bathymetric data which was collected by multibeam echo sounder on JCG's Continental Shelf Survey Project. Blank areas with no bathymetric data were complemented with ETOPO1. The effect of sediment layers was not entered into calculations. The new Bouguer gravity anomaly map took more exact terrain correction into account and covered wider areas; the southern part of Kyushu-Palau ridge, the surrounding of Minami-torishima island, the northern part of Izu-Ogasawara ridge, the surrounding of Amami Plateau, etc. compared to the previous map (Oikawa and Kaneda, 2007).

Seismic structure of oceanic crust such as its thickness is obtained by seismic survey and gives information on its creation process. However, it is not a practical way to conduct seismic surveys in all regions. The thickness of oceanic crust is generally one of the key factors in Bouguer gravity anomaly, and Bouguer gravity anomaly tends to increase when the thickness of oceanic crust gets thinner, if the density structure below the mantle is assumed to be constant. According to this relationship, it might be possible to estimate the thickness of oceanic crust for sea areas where seismic surveys have not been conducted. Therefore, we have reported the regional relationship between the thickness of oceanic crust and Bouguer gravity anomaly. We set conditions to choose areas: The effect of sediment layers is small and its structure is comparatively homogeneous, in order to make it easy to compare the relationships. As a result, the comparison was conducted in the areas constituted of oceanic crust.

The thickness of oceanic crust was extracted from the velocity structure model resulted from analysis of seismic refraction survey at sea areas where lineation of geomagnetism was observed. Sea areas were divided into three groups whose formation process of oceanic crust were different in order to compare them; the areas of Shikoku Basin and western part of Parece Vela Basin, the area of northern and eastern parts of West-Philippine basin, and the area of Minami torishima island's adjacent seas. Then datasets of the thickness of oceanic crust with Bouguer gravity anomaly were plotted. Each thickness of oceanic crust with Bouguer gravity anomaly shows the regional characteristic.

In the areas of Shikoku Basin and western part of Parece Vela Basin, the thickness of oceanic crust tends to decrease depending on the increase in Bouguer gravity anomaly. In the area of Minami torishima island's adjacent seas, on the other hand, Bouguer gravity anomaly changes between 340-440 mGal regardless of the thickness of oceanic crust is almost constant.

Keywords: Bouguer gravity anomaly