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A Characteristics of the Approximate Equation for Gravity Analysis

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There is a technique by which basement structure are analyzed by using the method of least squares from the gravity anomaly distribution in the basement depth already-known points obtained by bore data etc. In this technique, the polynomial of the regional gravity trend and gravity-depth (or, highly) conversion coefficient are obtained. Inoue et al. (1998) obtained a good result through this technique in northern part of Osaka Plain, Central Kinki, Southwest Japan. On the other hand, Ryoki (1999) calculated a distribution of the regional gravity anomaly in central part of Osaka Plain from the deep subsurface structure of Southwest Japan. When the trend obtained by Inoue et al. is compared with regional gravity anomaly calculated by Ryoki, the latter have a monotonous gradual curved surface as the former have a rugged surface with positive maxima and negative minima. However, the former has a local anomaly, which value is high in and around Mt. Kongo or Is. Awaji, low in the Osaka Basin, in addition to the gentle gravity change which the latter shows in reality. It is thought that the trend involves the local gravity anomaly, that is a non-linear element which cannot finish being shown by gravity-depth (Or, highly) conversion coefficient when the trend and gravity-depth (Or, highly) conversion coefficient is calculated by the method of least squares by using the gravity measurement value of the basement depth already-known points. Then, the characteristic of the trend polynomial was examined as an example of a two dimensional model.

Now, it is assumed that one of averages of the fault in depth observes. And gravity anomaly, which the two dimension vertical fault of head 1 made, was observed. Two or more gravity measurement points of depth already-known are assumed in the direction of distance x which made standard by depth z0 of the average of the fault. It is assumed g=f(x) + bz and requests f(x) coefficient to the fifth power, a5-a0, and b evaluated in the method of least squares. Here, g : measured gravity value in depth already-known point, z : normalized depth with z0 from surface of the earth. Next, trend f(x) is excluded from the gravity distribution by using a5-a0 and b. This result is divided by the conversion coefficient b and basement structure z(x) is presumed.

A estimated result considerably looks like a true structure (former vertical fault structure) when 11 gravity measurement points of depth already-known assumed at each distance 1. But, some vibrations appear to try to pass a depth already-known point by the method of least squares as much as possible. This vibration is due to Gibbs phenomenon according to the signal analysis theory. It appears when the shape like the fault structure which changes rapidly is presumed from an already-known point of several points. To avoid Gibbs phenomenon as much as possible, depth already-known points may not be arranged in the fault neighborhood. Then, analyzing similarly, a good result was obtained with the enough control of vibration when the points distance from -1 to 1 were excluded. This comes almost satisfactorily. In this estimated result was gently changeable between from distances -1 to 1 of the vicinity of the fault, the reason for this is that the trend f(x) was expressed by 5th powered function. In addition, if the polynomial of higher-power is used, steeper shape can be decided.

On the other hand, Gibbs phenomenon stands out even if there are a lot of depth already-known points. For instance, the maximum amplitude of the damped oscillation is 5-6 times in the result analyzed with 101 depth already-known gravity measured points. However, steeper shape is shown at the highest, maximum position.

Therefore, the trend is decided in detail when there are many already-known points to a certain degree, but it has been understood that Gibbs phenomenon is emphasized for a lot of already-known points to be arranged in the fault neighborhood.