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A relationship between a steep horizontal gradient zone of gravity anomaly and active faults of the Japanese Islands

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'A steep horizontal gradient zone of gravity anomaly' (SHGZ-GA) appears, when a density structure changes radically in a surface layer. One of the causes, for such SHGZ-GA is an active fault. But, SHGZ-GA doesn't always correspond perfectly to an active fault. In the case of Tottori-ken Seibu earthquake (M7.3, November 6, 2000), the earthquake breaks out in the region where no active fault exists. It is important to presume the underground formation, which doesn't appear on the surface. So, the purpose of this study is to quantify the relationships between SHGZ-GA and active faults. Quantifying such relationships is helpful in the light of finding the active faults at the region, where the fault existence is suspectable.

The Bouguer anomaly data of Kanazawa University and Geological Survey Institute of Japan are compiled about 200,000 points data with assumed density of 2.67g/cc. The horizontal gradient of gravity anomaly is calculated in five regions. Band-pass filter(10~100km) is adopted to the small-scale density anomaly in a surface layer gravity to eliminate the gravity contribution of subducting slabs and undulation of Moho-discontinuity. The gravity anomaly data is divided to 15sec x 10sec grid (about 380m x 310m), and that is differentiated into the direction of latitude and longitude.

Kono (1988) defined the Steep Horizontal Gradient Zone of Gravity Anomaly as the zone where the gravity anomaly gradient is lager than 20mgal/10km over 10km length. We can expect that a fault longer than 20km length lineament is likely to correspond with SHGZ-GA. We, thus, select the faults longer than 20km-length lineament from the dataset of Active faults in Japan (The Research group for Active Faults of Japan, 1991). These faults are categorized into each active fault belt using the strike and the displacement of each fault and referring to Digital Active Fault Map of Japan (Takashi Nakata and Toshifumi IMAIZUMI, editors, 2002).

For each active fault belt, horizontal gradients are calculated along five normal to the strike of the fault belt. Considering a displacement of the fault and Bouguer Anomaly, the lengths from the point of the most steep gradient, from the point of 2.0mgal/km, and from the point of 1.5mgal/km are measured. Using the average value for five cross sections, the relationships between SHGZ-GA and active faults is quantified.

Clear contrast of SHGZ-GA's spatial distribution is shown between Northeast Japan and Southwest Japan bounded by Itoigawa-Shizuoka Tectonic Line. There are many SHGZ-GA in the Northeast Japan, while there are few SHGZ-GA in the Southwest Japan. 57 active fault belts can be quantified, while 15 can't be quantified. Most of those 15 active faults are strike-slip faults or compound faults. Calculated horizontal gradients are compared with each of the categorized faults in the point of view of those spatial relations. Dip-slip faults correspond best to SHGZ-GA, while strike-slip worst of all. This result means that the larger the vertical offset of basement is, the more obvious the SHGZ-GA's. In the western region from the Kinki region, active faults correspond to SHGZ-GA well, i.e. active faults exist just below SHGZ-GA in this region. Based on the result, the possibilities of existence of the active faults are quantified. The existence probability of active faults is 83.9% on the point to 1.5km away from 2.0mgal/km gradient, and 89.5% on the point to 1.5km away from 1.6mgal/km gradient. This result is very useful to reveal new active faults.