3D Inversion of Gravity Anomaly – An Application of Technology of Apparent Density Imagery

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Summary
A new method is used to invert the gravity anomaly into density distribution underground. The density obtained by this method is the approximate density contribution of the stratum at different depth and is called apparent density. This method do not need to solve linear algebraic equation system and overcomes the computation time bottleneck hindered the application of 3D inversion to practice. For a data set of 71 x 81 points, it takes 10 s for 3D inversion on a 1.73 GHz PC.

Methodology
The inversion steps are:

1) Continue the observed gravity anomaly on an undulate terrain to the mean horizontal plane (Xu, 2006a);
2) The gravity field on this plane is seperated by cutting method into several fields caused by strata at different depth (Wang et al., 1997);
3) Downward continue the gravity field due to the different stratum to the top of the stratum (Xu 2006b);
4) Invert the gravity anomaly at the top of the stratum into density of the stratum.

In process “from undulate terrain to horizontal plane” and downward continuation of gravity anomaly, a new continuation method-iteration approach is used. The process of continuation is more stable and has a greater depth of continuation.

Real case
A real case in a region in Xinjiang, China is presented to demonstrate the effect of inversion using this method. There are anomalies of Ni, Co in this area. Figure 1 is the contour map of the area, the difference of elevation is 130 m. The gravity anomaly appears as an ellipse (Figure 2), length –4 km and width –2 km and the amplitude of the anomaly is about 7 mGal. We invert this gravity anomaly using this new method. First, continue the gravity anomaly on the terrain to plane of 800m elevation. Then, invert the gravity anomaly into apparent density difference by following the steps 2, 3 and 4. The result is shown in Figure 3. The maximum difference of apparent density is 0.48 g/cm³, which is about at elevation of 600 m. The surrounding rocks are basalt and diorite, the mean density is 2.75g/cm³. The interpreted density of the anomalous body is about 2.9-3.2 g/cm³. The drill hole met gabbro, the density of which is 3.1 g/cm³ (Figure 4).
Figure 1. Topographic map.

Figure 2. Gravity anomaly.

Figure 3. Profiles of apparent density difference from inversion.
Figure 4. Profile 264: Comparison between the inverted density and the measured density in the bore hole.

Conclusions
This new approach to 3D inversion of gravity anomaly do not need to solve linear algebraic equation system and has high computation speed. Several examples show that the results of inversion are more stable.

References