1 Introduction

Jining iron ore in the Shandong province is the richest iron deposit areas in China. The iron ores discovered so far have been estimated to be more than 5 billion tons, although most deposits contain some iron ore bodies up to 1000m in depth. Jining iron deposits are primarily of Superior-type (Ni and Ma et al., 2010). The thickness of Iron ore strata drilled in Tuntou village is 85.53 m. The depth for iron ore is in the range of 1612.89–1796.54 m.

The corresponding analysis (CA) on profile of gravity and magnetic anomalies is a method that can be used to indicate that the moving-window application of Possion’s theorem allows rapid estimation of source magnetization-to-density ratios (MDR) from multisource data sets (Chandler et al., 1981). The intercept of CA in interpretations of regional gravity and magnetic anomalies should only be the contribution of remanence anomalies, which can be obtained by total anomalies subtracting induced magnetism background and gravity anomalies related parts (Zeng et al., 2006). Jining magnetic anomaly was caused of magnetite-bearing quartzite with strong remanent magnetization. Through an analysis of the intercept of CA, combined with the drilling data in this area, it is show that CA is an efficient method to delineate prospect areas for Jining iron ore.

2 Geological Setting

Jining iron ore was in Qianlong block, southwest of Shandong, which belong to Precambrian banding iron formation (BIF). The iron ore belt occurred in Jining rock group (Li et al., 2010). The main ore belt consists of a variety of magnetite-bearing quartzite with bands-dense infection structure which made from magnetite dark bands and quartz, sericite, chlorite light color bands. The wall rocks are composed of remaining sericitic phyllite, chlorite phyllite, calcite meta-dacite, and sandstone (Ni et al., 2010).

3. Geophysical Setting

3.1 Physical characteristics of rocks and ores

The susceptibilities of the ore-bearing layers and covers are in the range of (1–348) × 10⁻⁵SI, which can be generally regarded as non-magnetic or weakly magnetic. The densities show variation in the range of 1.7–2.9 g/cm³. The susceptibilities for iron ore are in the range of (37588–93854) × 10⁻⁵SI, residual magnetization of 40-65A/m which is the unique geological body that could cause strong magnetic anomaly in this area, with the densities in the range of 3.32–3.54 g/cm³, which might produce a high-gravity anomaly if the volume is large enough.

The density of the Quaternary formation in Jining area and surrounding areas is 1.75 g/cm³. The susceptibilities for Cambrian and Ordovician strata is (1–72) × 10⁻⁵SI and the density range is within 2.7–2.8 g/cm³. The density for Phyllite is in the range of 2.75–2.9 g/cm³.

The results show that the gravity and magnetic anomaly of Jining area was the cause of magnetite-bearing quartzite with bands-dense.

3.2 Characteristics of magnetic and gravity anomaly

On the 1:200,000 contour map of the aeromagnetic ΔT anomaly with an intensity greater than 1000 nT is identified in the Jining area. There are two center of the positive anomaly is located at Tuntou village and Bojiaxing village to the northeast of Jining area. The positive anomaly contours extent to NE with 15 km long and 8 km width along NE direction. The value of Tuntou anomaly is up to 3800 nT and the value of Bojiaxing...
The aeromagnetic anomalies of Jining have been found within 150 km$^2$ in the region (Fig. 1a). On the contour map of first vertical derivative of gravity, as same as aeromagnetic anomaly, there are also two centers of the positive anomaly. These centers match well with the aeromagnetic anomalies. The value of gravity anomaly at the Tuntou village is within $(15–35) \times 10^{-5}$ m/s$^2$·km. The value of the vertical derivative of gravity anomaly at the Bojiaxing village is within $(10–15) \times 10^{-5}$ m/s$^2$·km. The vertical derivative of gravity anomalies in Jining have been found within 100 km$^2$ in the region along NE direction (Fig. 1b).

4 Method and Discussion

Chandler et al. (1981) used Poisson’s theorem in a modified form to total field magnetic anomaly reduced to pole and the first vertical derivative of gravity:

$$\Delta T = A + (1/G) J (D \partial g/\partial z)$$

where $\Delta T$ is the total field anomaly reduced to pole, $\partial g/\partial z$ is the first vertical derivative of gravity, $A$ is an intercept term intended to approximate the effect of remanence anomalies (Zeng et al., 2006), $J$ is the source magnetization, $D$ is the source density, and $G$ is the universal gravitational constant.

It is obviously to show that there are four anomalies at Yandian in the intercept of CA map (Fig. 1c). We decline the iron ore prospect by the outline of -500 nT. The anomaly in Tuntou with the value smaller than $-500$ nT is verified to be the iron ore by well ZK8, ZK303 and ZK3506. It is proved that area of Yandian anomalies with the intensity smaller than $-500$ nT is iron ore by boreholes ZK402, ZK404 and ZK403. The well ZK701 and ZK702 at Hongfusi have found nothing with an intensity greater than 250 nT. The well ZK301 and ZK303 pinched out iron ore within intensity value of $-500$ nT underground.

All these drill holes infer the anomaly with an intensity smaller than $-500$ nT in Yandian has a good prospect.

5 Conclusion

We have presented a case study that used the intercept of CA to find the boundary of Jining iron ore and investigate evaluation of ore potential. This case has demonstrated the efficacy of combing magnetic and gravity anomalies with the exploration for magnetite in strong remanence environments. Therefore, this approach is likely to have broad applicability in other areas with similar exploration targets and challenges.

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References


