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Aeromagnetic Exploration of Deep Iron Ore in Daye, China

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1 Introduction

Daye iron mining area is located at the Tieshan district of Huangshi City, Hubei province of central China. It is a well-known large iron (copper) deposit in China and has been worked for more than 1700 years. The exploration depth is usually less than -400 m a.s.l., with a known cumulative iron ore reserve of 16 647 380 00 t. The main orebodies are above -200 m a.s.l.. Only a few boreholes were drilled below -400 m a.s.l (i.e., deep) rarely detecting any iron orebody. However, Wang (1990) proposed the ‘Multi-Steps’ contact-mineralization model; Liu et al. (2006) summarized the deposit model comprised of first step ($+160$ to -160 m a.s.l.), second step (-250 to -430 m a.s.l) and third step (-600 to -850 a.s.l) (Fig. 1). What would be the future picture of the deep iron ore deposits? In this paper, we will look at the airborne magnetic anomalies and study the deep ore deposits of the Daye area, in the hope of providing useful information for deep iron deposits exploration.

2 Geological Setting

The main outcropping formation in the Daye area is the Lower Triassic Daye Group composed of limestone and marble. The outcropping intrusive rocks are the Tieshan Mixtite, formed at the early Yanshan era, composed mainly of granodiorites, diorites, quartz diorites, pyroxene diorites and biotitic diopsidic diorites. Daye iron deposit is a hydrothermal contact-metasomatic skarn type deposit. The orebodies occur in the contact zone of a diorite and marble or dolomite marble of the Lower Triassic Daye Group (Fig. 1). The orebodies occur as lenses, stratiform-like layers and veins; the form is controlled by the structure of the contact zone. The ores are comprised of mainly magnetite, some hematite, chalcopyrite, siderite and pyrite. The vein-form minerals are mainly chlorite, baikalite, garnet, calcite, dolomite and quartz.

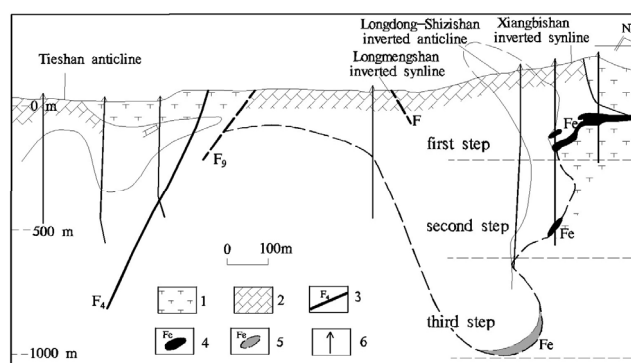


Fig. 1. Geologic Section (line # 18) of Daye Iron (Copper) Deposit (from Liu, 2006).

1, Diorite; 2, Marble; 3, Faults; 4, known orebodies; 5, Speculated orebodies; 6, Drill-hole.

3 Geophysical Setting

3.1 Physical properties of rocks and ores

The magnetic properties of the rocks and ores in the Daye area (Yu et al., 2006) are as follows, the mean magnetic susceptibility of the magnetite is $85805 \times 10^{-5} \text{SI}$, and the mean remnant magnetization J_r is $69460 \times 10^{-3} \text{A/m}$; the mean magnetic susceptibility for granodiorite, diorite, quartz diorite, pyroxene diorite and biotitic diopsidic diorite are, respectively, $959 \times 10^{-5} \text{SI}$, $1874 \times 10^{-5} \text{SI}$, $1900 \times 10^{-5} \text{SI}$, $5009 \times 10^{-5} \text{SI}$ and $6856 \times 10^{-5} \text{SI}$, and the mean remnant magnetization are, respectively, $3300 \times 10^{-3} \text{A/m}$, $8200 \times 10^{-3} \text{A/m}$, $10200 \times 10^{-3} \text{A/m}$, $15200 \times 10^{-3} \text{A/m}$ and $22300 \times 10^{-3} \text{A/m}$. Other rocks are no or weakly magnetic.

3.2 Characteristics of aeromagnetic anomalies

In the Daye area, four strong magnetic anomalies were discovered from a 1:10 000 airborne magnetic survey (Yu et al., 2006, 2007). The four anomalies correlate with 4 known iron deposits (Fig. 2) and shows (1) Strong magnetic anomaly coincides with thick section of the known iron ore body; (2) Gradient zone at the southern

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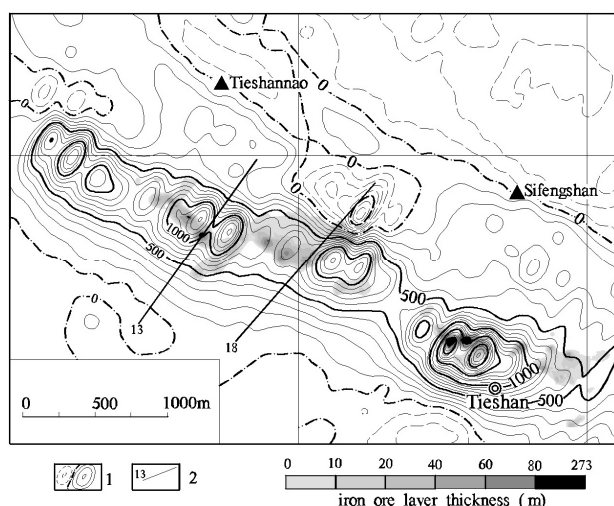


Fig. 2. Aeromagnetic anomalies superimposed on the thickness map of known ore bodies in the Daye area.
1, Magnetic contours; 2, Survey line and numbers.

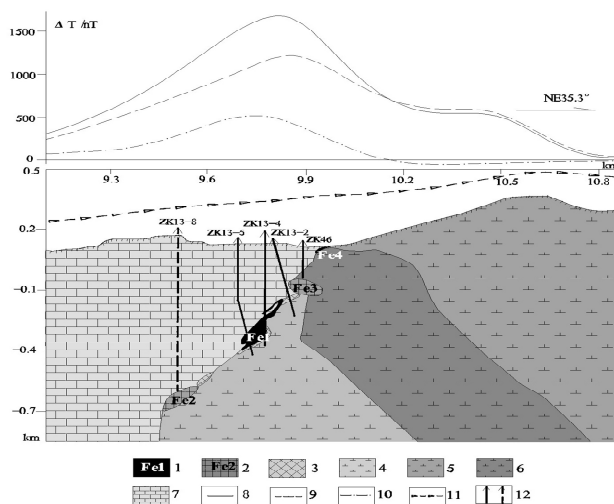


Fig. 3. Inversion results of aeromagnetic anomalies on surveying line No.13.

1, Known ore bodies; 2, Inferred ore bodies; 3, Skarn; 4, Quartz diorite; 5, Diorite; 6, Biotite pyroxene diorite; 7, Carbonate rocks; 8, Measured anomaly curve; 9, Calculated anomaly curve of the known ore and rock; 10, Residual anomaly curve; 11, Flight trajectory; 12, Drill Hole.

flank of the anomaly is fairly broad, over an area with no known deposits, which may indicate the existence of deeper iron ore bodies.

4 Results of Interactive Inversion

Figure 3 shows an inversion of aeromagnetic anomaly from line 13. In Figure 3 the Fe1 and Fe4 show the ore

bodies controlled with drill-holes, and the Fe2 and Fe3 show the predicted but unknown orebodies. As a result, ZK13-8 was drilled where the Fe2 iron orebody was interpreted and the drill encountered 3 layers of iron mineralization (total 11 m) between 703.49–732.66 m down the hole.

5 Conclusions

(1) Airborne magnetic surveys at line spacing of 50 to 100 m provides high resolution and accurate magnetic anomalies and is a major approach for deep iron ores exploration.

(2) The broad gradient located at the south of the airborne magnetic anomaly of the Daye iron deposits is caused by un-discovered, deep iron orebodies.

(3) Interactive inversion of the airborne magnetic anomalies can effectively predict the location of unknown iron orebodies.

(4) The 1:10 000 airborne magnetic survey in Daye iron mines confirms the validity of second and third step model for deep iron ore prospecting proposed by Wang (1990) and Liu et al. (2006).

Acknowledgements

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