Application of High Resolution Remote Sensing Image in The Exploration of Skarn-type Iron Deposit in Hutouya Area of East Kunlun

Shaopeng Zhang[1, 2, *], Hui Wang[2], Yuhai Fan[1, 2], Nan Hu[2], Huan Liu[2], Chen Yang[2] and Youyun Liao[2]

[1] School of Earth Science and Resources, Chang' an University, Xi'an, China
[2] China Geological Exploration Institute of Aerial Photogrammetry and Remote Sensing Bureau, Xi'an, China

*Corresponding author e-mail: zhangshaopeng911@163.com

Abstract. In this paper, carry out a comprehensive study of remote sensing for skarn-type iron deposit in the Yemaquan hutouya area of east Kunlun by the use of the high resolution remote sensing data as Worldview2 etc and Aster data. In the development characteristics of high resolution remote sensing images, remote sensing abnormal mineralization information comprehensive analysis and research, to establish the zone of skarn type polymetallic deposit in remote sensing prospecting ore model, and use the model of mineralization in the study area location of in-depth and meticulous research, delineating the preferable ore finding area, prospecting provides a valuable clues for further prospecting region.

1. Introduction

With the continuous development of aerospace remote sensing and satellite sensor technology at home and abroad in recent years, a variety of high resolution remote sensing data are emerging, the resolution of remote sensing satellite data has increased rapidly, worldview 2 and the Quick bird broke the meter level. The rapid development of high resolution remote sensing data, make the remote sensing technology and application to a new height [1, 2, 3]. The high resolution remote sensing technology can play a more powerful role in geological survey in the areas with poor natural conditions and inconvenient traffic conditions [4, 5].

In the study area, the ore-forming conditions of the Hutouya area are superior, the district has found many skarn iron polymetallic deposits.

In this paper, a comprehensive study of remote sensing for skarn-type iron deposit carried out in the Hutouya area of east Kunlun by the use of the high resolution remote sensing data as Worldview2 etc and Aster data, . In the development characteristics of high resolution remote sensing images, remote sensing abnormal mineralization information comprehensive analysis and research, to establish the zone of skarn type polymetallic deposit in remote sensing prospecting ore model, and use the model of mineralization in the study area location of in-depth and meticulous research, delineating the preferable ore finding area, prospecting provides a valuable clues for further prospecting region [6, 7].

2. The generality of the study region

2.1. Geological background of the study area

The study area is located in the western of the East Kunlun Quanta Mountains, north to the southwestern margin of the Qaidam Basin, adjacent to the northwest of Altun Mountains. The exposed strata in the study area are Langyashan group(Jxl), Tanjianshan group(OST), Maoniushan group(D$_3$$m$), Dagangou group (C$_1$$dg$), Diaosu group(C$_2$$d$) and Elashan group (T$_3$$e$), The Strata in the study area outcrops well, with complete strata exposed and complex rock types.

2.2. Remote sensing image processing

In this work, high-score data like Worldview-2 and Iknos are used as the main information sources. Image processing includes image preprocessing, geometric correction, image fusion processing, image enhancement and image mosaic. Band combination conversion, correlation analysis, principal component analysis method, the differential image stretching method enhanced processing method used in the interpretation process, to enhance all kinds of feature information in remote sensing image based on color and texture, improve the image interpretation effect(Fig1). ASTER data analysis was used to carry out aberrant extraction of alteration mineral information such as ironization, silicification, modification and carbonation [8, 9].
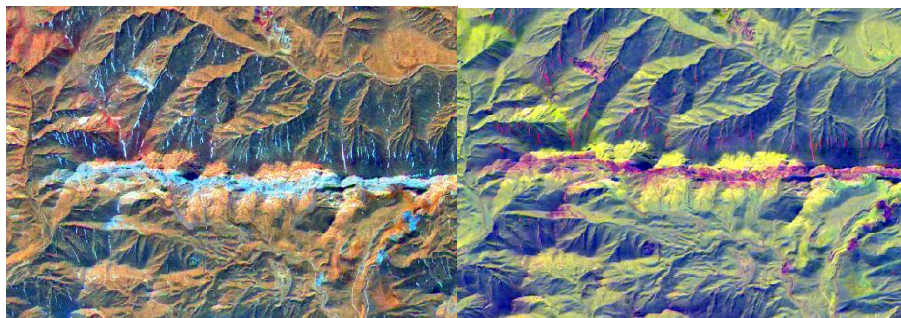

Figure 1. Local enhancement effect of study area (Decorrelation, MNF transform)

2.3. Remote sensing anomaly extraction

In the study area, polymetalmetallogenic on the surface is often accompanied by obvious alteration such as skarnization, epidotization, carbonatization, silicification, limonitization, malachite, lead - zinc mineralization, chalcopyrite mineralization , etc [10].
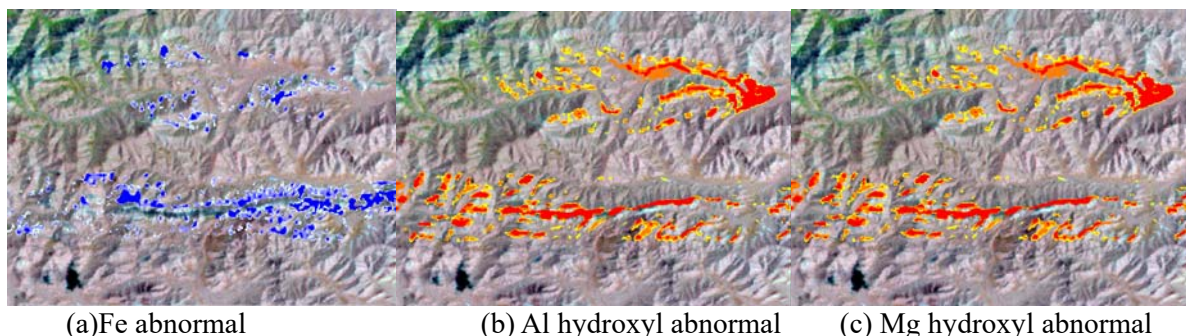

(a)Fe abnormal   (b) Al hydroxyl abnormal   (c) Mg hydroxyl abnormal

Figure 2. Aster anomaly intensity map of the study area

In this work, the Aster data were used to extract the anomaly information of the alteration minerals from the metallogenic belt of the study area by principal component transformation method. The extraction includes data preprocessing, interference elimination, multivariate data analysis, anomaly

detection, exception handling, exception selection and so on. In the study area, the anomalies of Fe^{2+} and Fe^{3+} were extracted from the B1, B2, B3 and B4 bands of Aster data, and Al-OH was extracted from the B1, B3, B4, B7 (or B8), using B1, B3, B4, B5 (or B6) principal component transform to extract Mg-OH anomaly,then classification of remote sensing anomalies based on abnormal extraction results and geological contents(Fig2).

2.4. Establishment of remote sensing prospecting model and Remote sensing prospecting prediction
Based on the analysis of metallogenetic geological features and high resolution image features of ore-controlling factors in the area, a skarn-type iron-polymetallic ore prospecting model based on high-resolution remote sensing images is established(Table 1), two favorable area as the east Yingqinggou and West Hutouya for prospecting.

Table 1. The study area polymetalmetallogenic remote sensing prospecting model

Ore - controlling factor		Remote sensing prospecting
Geological conditions	Tectonic position	The main body is located in the east Kunlun (Qimantag) Early Palaeozoic back-arc basin of the East Kunlun orogenic belt. The NWW-trending fault is extremely developed on the south side of the Kunbei fault and the Qimantag Ophiolitic tectonic melange zone
	Ore-controlling strata	Langyashan group(Jxl), Tanjianshan group(OST) and Diaosu group(C2d)
	Orogenic lithology	The ore-controlling strata are in contact with the middle-acid intrusive rocks in the skarn belt
	Ore-controlling structure	Near-east-west fault is the main ore-controlling fault, controlling the distribution of rock mass and the distribution of mineralized zone. The small-scale northeast fault provides the ore-bearing space for ore-bearing hydrothermal fluid
Remote sensing alteration anomaly condition	Wall rock alteration	The mineralization zone is characterized by intense skarnization, such as pyrite, limonitization, malachite, lead-zinc mineralization, and yellow-shale petrochemical, carbonate and silicification in the ore belt and surrounding rocks. Copper mineralization and so on
	Mineralization alteration zone	The mineralized bodies are distributed in the east-west direction, and no significant difference in hue between the high-resolution image and the cover image. The gray band in the north can be interpreted as an interpretation sign. Mineralization zone around the iron staining anomalies and strong hydroxyl anomalies, is in the east-west strip-like distribution, and the characteristics of the band is almost parallel to the distribution, mineralization zone through the Department for the shallow cover, the color is light gray; Mineralized form of the same distribution.

3. Conclusion

In this paper, remote sensing geologic survey of skarn-type iron polymetallic ores is carried out by using high-resolution remote sensing satellite data. A remote sensing model of skarn-type iron polymetallic deposit is established, and delineated two prospecting areas.

The development of remote sensing geological prospecting work by using high resolution satellite remote sensing data, can effectively reveal the ore controlling elements, assisted by remote sensing information, can play an effective role, especially in the difficult high altitude, obviously played a dominant role.

References

[1]   Gan Fuping, Wang Runsheng.2004. Remote sensing rock information extraction technology on the basis and methods.Beijing: Geological publishing house.

[2]   WANG Runsheng. 2008. ON THE DEVELOPMENT STRATEGY OF REMOTE SENSING TECHNOLOGY IN GEOLOGY. REMOTE SENSING FOR LAND & RESOURCES, (1): 1 ~ 12.

[3]   XIONG Sheng-qing. 2002. The Application Status and Development Trend Of Remote Sensing Technology In National Lad Resources. REMOTE SENSING FOR LAND & RESOURCES, (1): 1 ~ 5.

[4]   CHEN Ling, ZHANG Wei, ZHOU Yan, LIU Wei, CHEN Wei.2012. Application of High-resolution Remote Sensing Images to Searching for Sedimentary-metamorphic Type Iron Deposits in the Taxkorgan Area, Xinjiang. GEOLOGY AND EXPLORATION, 48 (5): 1039 ~ 1048.

[5]   ZHANG Wei, JIN Moushun, ZHANG Shaopeng, CHEN Ling, ZHONG Chang, DONG Lina.2016.Application of high resolution remote sensing data to ore-prospecting prediction in East Kunlun metallogenic belt. REMOTE SENSING FOR LAND & RESOURCES, 28(2): 112 ~ 119.

[6]   LI Wenyuan. 2010. The Geological Composition and Metallogenetic Prospect in the Qimantage Prospective Region, East Kunlun. NORTHWESTERN GEOLOGY, 43 (4): 1~9. CHEN Ling , ZHANG Wei, ZHOU Yan, LIU Wei, CHEN Wei.2012. Application of High-resolution Remote Sensing Images to Searching for Sedimentary-metamorphic Type Iron Deposits in the Taxkorgan Area, Xinjiang. GEOLOGY AND EXPLORATION, 48 (5): 1039~ 1048.

[7]   LIU JianNan, FENG ChengYou, ZHAO YiMing, LI DaXin, XIAO Ye, ZHOU JianHou, MA YongShou. 2013 Characteristics of intrusive rock, metasomatites, mineralization and atteration in Yemaquan skarn Fe Zn polymetallic deposit, Qinghai Province. MINERAL DEPOSITS, 32 (1): 77 ~ 93.

[8]   ZHANG Wei, YANG Jin-zhong, FANG Hong-bin, et al. 2010. Remote Sensing Interpretation and Metallogenic Prediction in the Metallogenic Belts of East Kunlun and Altun Mts. NORT HWES TERN GEOLOGY, 43 (4): 288 ~ 294.

[9]   ZHANG Ce, PENG Lihong, WANG Bing, ZHANG En1, FU Lihua, WEI Benzan, JIE Wen－hui. 2015. Application of WorldView-2 remote sensing image in the exploration of the volcano－sedimentary metamorphic type iron deposits in the Dimunalike area, Xinjiang. MINERAL EXPLORATION, 6 (5): 523 ~ 528.

[10]   GENG Xinxia, YANG Jianmin, ZHANG Yujun, YAO Fojun. The Application of ASTER Remote Sensing Data for Extraction of Alteration Anomalies Information in Shallow Overburden Area- a Case Study of the Baoguto Porphyry Copper Deposit Intrusion in Western Junggar, Xinjiang. GEOLOGICAL REVIEW, 2008, 54 (2) : 184 ~ 191.