IOP Conf. Series: Earth and Environmental Science **170** (2018) 022093 doi:10.1088/1755-1315/170/2/022093

# Characteristic analysis of the high resolution remote sensing in Heiqia –Sanshiliyingfang iron polymetallic mineralization zone

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**Abstract**. Wenquangou Group ore-bearing belt from Muji, Bulunkou, Tashikuergan to Heiqia is an important metallogenic belt of Western Kunlun area. Heiqia iron polymetallic metallogenic belt is located in its southeast section, having a good prospecting prospects. In this paper,high resolution remote sensing interpretation and mineralization anomaly information enhancement and extraction technology were used to delineation of Heiqiairon polymetallic mineralization zone in West Kunlun region. With the right amount of field sampling and verification test, we established remote sensing geology prospecting model, which will provide the basis for future remote sensing metallogenic belt in West Kunlun to find similar minerals. Survey results show that a copper-lead-zinc polymetallic mineralization with iron was found in Heiqia area. Survey results show that a copper-lead-zinc polymetallic mineralization with iron was found in Heiqia area. A great potential for prospecting siderite - copper zinc hematite mineralization belt was found, which extends in a length of about 60 kilometres, with width of 200 ~ 500 m, including a plurality of mineralized bodies. The mineralized bodies are located in the transition site that clastic rock to carbonate rock of the D segment in the Wenquangou Group, appearing in bedded, near bedded and lenticular. The occurrence of the mineralized bodies is generally 40° ~50° ∠68° ~81° , in accordance to the strata. The length of single body changes from several tens meters to hundred meters, the exposed thickness on the surface changes from ten centimetres to several meters. The surface ore minerals are mainly hematite and limonite, with a small amount of hematite and siderite. The Pb-Zn- Cu mineralization is commonly found in the carbonate rocks in the upper part of the iron ore body, which is also found in the upper part of the iron ore body. It is concluded that the type of deposit is Submarine sedimentary- Metamorphism-Hydrothermal modification.

## 1. Introduction

Less geological work has been conducted due to harsh natural and traffic in West Kunlun Mountains. The remote sensing technology has the advantage of macro-efficient and not restricted by terrain and traffic conditions in the sparse vegetation and exposed bedrock area[1-3].In order to delineation of Heiqiairon-Sanshiliyingfang iron Polymetallic mineralization zone in West Kunlun region, based on previous studies , by using high resolution remote sensing interpretation and mineralization anomaly information enhancement and extraction technology, with the right amount of field sampling and verification test, we established remote sensing geology prospecting model, which will provide the basis for future remote sensing metallogenic belt in West Kunlun to find similar minerals.

## 2. Overview of the study area

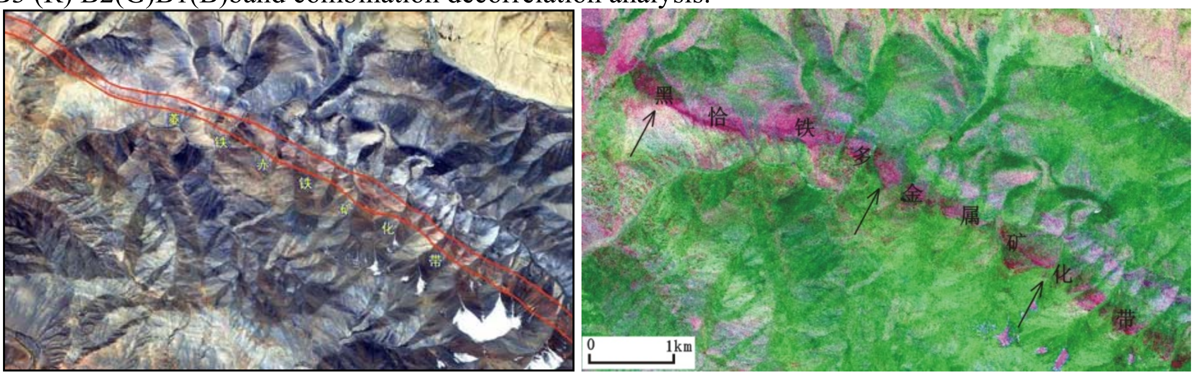
The study area is located in the joint area between the ancient Asian tectonic domain and the Tethyan tectonic domain (Kunnan - Qiangbei suture line). The geographical coordinates are E77° 15'~78° 00', N35° 50'~36° 30'. Heiqia－Sanshiliyingfang iron polymetallic mineralization zone is located in the northern edge of the North Qiangtang - Tanggula block and belongs to the late Paleozoic passive margin basin (Institute of geological survey of Shanxi provincial,2006). According to the latest mineralization zoning plan,Heiqia－Sanshiliyingfang iron polymetallic mineralization zone lies in the northern margin of the Fe-Cu-Au-Pb-Zn-RM ore belt (Ⅲ-1-①) in the Muztag-Aksa chin.

## 3. Methods

In this paper, with iron polymetallic mineralization zone as a case study in the Heiqia – Sanshiliyingfang area of West Kunlun Mountains, by using IKONOS remote sensing images as major data source, the authors made standard image map, adopted methods of image enhancement for protruding the information of ore-controlling factors and mineralization, and finally carried out an interpretation of remote sensing for mineral resources. On the basis of alteration anomaly information extraction for iron polymetallic mineralization zone by using ASTER data and right amount of field verification, its high-resolution remote sensing characteristics and metallogenic geological conditions were analyzed. Tt can provide the basis for future to find similar minerals in the West Kunlun metallogenic belt.

## 4. The high resolution remote sensing characteristic

The mineralization zone showed brown and regular stripe pattern with different shades after IKONOS B3 (R) B2(G)B1(B)band combination decorrelation analysis.




(a)Decorrelation **analysis** (b)Principal component analysis

**Figure 1.** The interpretation key of Heiqia –Sanshiliyingfang iron polymetallic mineralization zone after enhancement processing for Ikonos remote sensing data

Mineralized body was dark reddish brown, with a deeper color than the mineralized zone, and the mineralized zone was narrow striped, lenticular, beaded intermittent extension. Carbonates are light gray - white - light brown tone, striped image pattern(Fig.1(a)). The principal component analysis was carried out using IKONOS data B1, B3, B4, B2 and the third principal component is combined with the original 1,3-band to obtain a new image. Iron polymetallic mineralization zone of Heiqia–

Sanshiliyingfang is in pink color and stripe grain, which is obviously different from that of surrounding rock (Fig.1(b)), so it is easy to interpret directly.

The principal component analysis was used to extract the anomalies of iron mineralization (iron staining). PC3 is the characteristic principal component of iron staining anomaly. The anomaly lower limit was determined according to the mean + 3δ (standard deviation), and the anomalies of the iron stains extracted were banded (Fig.2).

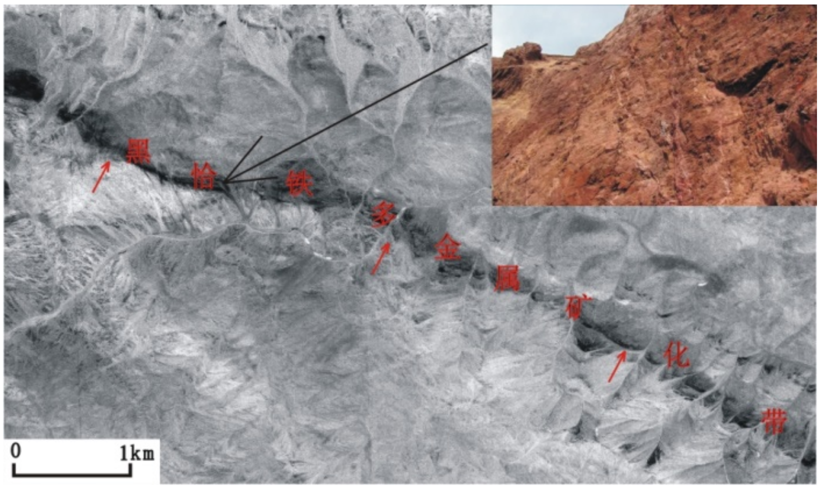



**Figure 2.** The ferric contamination anomaly of IKONOS remote sensing data (upper right corner for the iron ore field photos)

## 5. Organization of the Text

### *5.1. Geological characteristics of ore body*

The mineralized bodies are located in the transition site that clastic rock to carbonate rock of the D segment in the Wenquangou Group, appearing in bedded, near bedded and lenticular (Table 1). The occurrence of the mineralized bodies is generally 40° ~50° ∠68° ~81° , in accordance to the strata. The length of single body changes from several tens meters to hundred meters, the exposed thickness on the surface changes from ten centimeters to several meters. The boundary between the ore body and the upper and lower footwall is clear. The surrounding rock is mainly iron (iron containing) dolomite, and the second is dolomitic limestone, silicified dolomite marble (mostly located in the ore body), and a small amount of other metamorphic clastic rocks (metamorphic sandstone and sandy slate).

### *5.2. Ore characteristics*

The surface iron ore minerals are mainly limonite, followed by hematite and a small amount of siderite. Galena, blue-copper ore, malachite (Figure 3D), and few sphalerite, antimony lead ore, white lead ore and black lead ore are found in the lead (copper, zinc) associated with iron ore. Gangue minerals are quartz, muscovite, iron dolomite and barite, and occasionally graphite, tourmaline, apatite and so on. The structure of iron ore is mainly composed of two types: the shape half echinform fine grain and the self-form medium grain coarse-grained (variable crystal) structure. The main structure of the iron ore structure is four types. The first is the compact block structure (map 3A) and (hidden) lamellar structure formed during syndepositional period. The second is the banded and wrinkled structures formed during the post metamorphic stage. The third type is veins, cavities, clusters and breccia structures formed during hydrothermal superimposition in the late tectonic stage (Fig. 3B). The fourth type is honeycomb, earth like, colloidal and tuberculous structures formed after weathering and leaching of the earth's surface (Fig. 3C). Galena, which occurs in the cracked carbonate rocks of the roof of the iron ore body, is mainly in the semi ebony and fine-grained structure. Galena is filled with irregular structural fractures (Fig. 3E), showing interlocking veins and veins. The blue-copper mine is filled with structural fractures (Fig. 3F), showing disseminated and membranous structures. Pb Zn ore is closely related to iron (iron bearing) dolomite, while Cu mineralization is closely related to dolomitic marble.

The results of surface sampling and laboratory test show that the grade of TFe is 29.90% to 51.03%, the average grade is 36.94%, the grade of Pb+Zn in lead-zinc ore body is 0.24% ~ 2.37%, and the grade of Cu in copper ore body is 0.27% to 0.86%. When receiving the paper, we assume that the corresponding authors grant us the copyright to use the paper for the book or journal in question. Should authors use tables or figures from other Publications, they must ask the corresponding publishers to grant them the right to publish this material in their paper.

**Table 1.** Basic characteristics of main ore (chemical) points of HeiqiaPolymetallic Mineralization Zone

| Position | A newly discovered mineralized point | Number of ore bodies | Ore body shape | Surface scale long × width/m | Metallogenic element grade /% | Main ore mineral |
|---|---|---|---|---|---|---|
| Northwest paragraph | No. 1 lead (zinc) iron ore point | 1 | stratiform | 175× (4~8) | Fe (51.03), Pb(Zn) | Hematite, limonite, galena and pyrite |
| | No. 2 iron ore point | 1 | stratiform | 170× (2~3) | Fe (43.35) | Hematite, limonite |
| | No. 3 containing lead-zinc iron ore point | 1 | lentoid | 40× (0.5~8) | Fe (33.10) | Hematite, limonite, galena |
| | No. 4 lead (zinc) iron ore | 1 | stringer of penetrating layer | 30× (0.1~0.3) | Fe (32.65), Pb(Zn) | Hematite, limonite, galena |
| | No. 5 lead-zinc ore | 1 | stringer of bedding rock | 30×0. 4 | Pb+Zn(2.37) | Hematite, limonite, galena, sphalerite |
| | No. 6 containing lead-zinc iron ore point | 1 | stringer of bedding rock | 150×0.74 | Fe (31.10), Pb+Zn(2.35) | Hematite, limonite, galena, sphalerite |
| | No. 7 copper ore | 1 | stringer of bedding rock | 1700× (0.5~0.7) | Cu (0.86) | Malachite |
| Southeast paragraph | No. 8 iron lead mineralization point | 3 | stringer of bedding rock | ? × (2.0~20) | Fe (37.46), Pb (0.24~1.13) | |
| | No. 9 iron, copper and lead mineralization point | 5 | stringer of bedding rock | 200× (1~5)~900 ×(1~5) | Cu (0.27~0.49), Pb (0.69) | Malachite, Hematite, limonite, pyrite, chalcopyrite, galena |
| | No. 10 iron ore point | 1 | stringer of bedding rock | 300×6 | Fe (29.90) | Hematite, limonite |


**Figure 3.** Ore photograph of HeiqiaPolymetallic Mineralization Zone (A massive and honeycombed brown iron ore; B breccia brown iron ore; C concretion forms brown iron ore; D lead mineralization and malachite mineralization of ore; E vein lead zinc ore in roof of iron ore; F blue copper ore in marbleization dolomite of iron ore

## 6. Conclusion

The remote sensing characteristics is obvious and the ore prospecting potential is huge in Heiqia–Sanshiliyingfang polymetallic mineralization zone, which is worth further work. Multiple metallogenic clues were found in Heiqia Polymetallic Mineralization Zone. Through further mineral geology work, it is hopeful to realize a breakthrough of prospecting in iron polymetallic ore.

**Acknowledgments**

This research was supported by the National Basic Research Program of China (973 Program) (No. 2015CB453000), China Geologicai Survey projecs (No. 12120115011301 and 12120113046100).

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