Paper presented at the 22nd Asian Conference on Remote Sensing, 5 - 9 November 2001, Singapore.

THE APPLYING APPRAISEMENT OF CHINA-BRAZIL EARTH RESOURCE SATELLITE 1 CCD DATA FOR RECONNAISSANCE OF METALLIC ORE IN ZHONGDIAN AREA, YUNNAN, CHINA

Xiaohong WANG , Ruijiang ZHANG,
Geologists, China Aero Geophysical Survey and Remote Sensing Center for Land and Resources
29 Xueyuan Road,Beijing 100083
Tel: (86)-10-82318492 Fax:(86)-10-82329028
E-mail: Xiaohong_wang@sohu.com
Hong HU
Geoligist, Shandong Provincial Bureau of Geo-mineral Exploration and Development
Xiaowei JIANG
Doctor, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences
CHINA

KEY WORDS: CBERS-1, CCD Data, Reconnaissance of Metallic Ore

ABSTRACT: CBERS-1 is a new satellite developed and made by China and Brazil. It has three sensors. One of them is CCD Multi-spectrum camera. The authors have appraised the quality of a scene CCD data and the effects applied in reconnaissance of metallic ore. The result shows that CCD data have great potentials in minerals exploration.

1. INTRUDUCTION

China-Brazil earth resource satellite 1 (CBERS-1), which was developed and made by China and Brazil, was successfully launched on the 14th of October 1999. The data have been obtained and put into use since the 2nd of March 2000. This means that there is one more data source in satellite remote sensing. In order to widely make good use of the data and improve the quality of subsequent satellites, it is necessary to appraise the applying effect of the CBERS-1 data in many fields. In this paper we will appraise a scene CCD data's quality and effects used in ore-searching in Zhongdian of Yunna, China.

2. QUALITY OF THE CCD DATA

The CBERS-1 is equipped with three sensors. One of them is CCD Multi-spectrum camera. It has 4 bands from visible light to near infrared and one panchromatic band, and its spatial resolution is 19.5 meters at off-nadir. The scanning width is 113 km. The camera has side-looking ability. The scope of side – looking is ±32°. There is an internal calibration system in the sensor (Wu Meirong, 2000b).
We selected 4, 3 and 2 bands of CCD data for testing. The spectrum range of the CCD's 1 – 4 bands is corresponding with the TM1 – 4 bands (table 1). Therefore, we take the TM data as the reference standard.

The orbit number of this scene CCD image is 20000480402. The received time is the 24th of November 1999. It is the level 2 data, which have been dealt with the atmospheric correction and system geometric correction. The TM data's orbit number is 132-41. Its received time is the 20th of November 1990 and spatial resolution is 29.5 m. Because two kinds of data were gotten in same season and the studying area is underpopulated, the result is acceptable.

	Range of spectrum (ì m)	
Band	CCD	TM
1	0.45 – 0.52	0.45 – 0.52
2	0.525 – 0.605	0.52 – 0.59
3	0.63 – 0.69	0.63 – 0.69
4	0.75 – 0.90	0.77 – 0.89

Table 1. The Wavelength's Contrast of Two Kinds of Data

2.1 The Grade of Geometric Distortion

The testing method is to select the corresponding points in CCD image and the 1:100 000 topographic map, in order to correct the geometric distortion of CCD image, and to test the image's RMS relative error to the topographic map. The average error is 6.5 pixels after we selected 30 pairs of points in one scene. The result shows that the geometric distortion of the CCD data is acceptable and the pose of the satellite is rather stable.

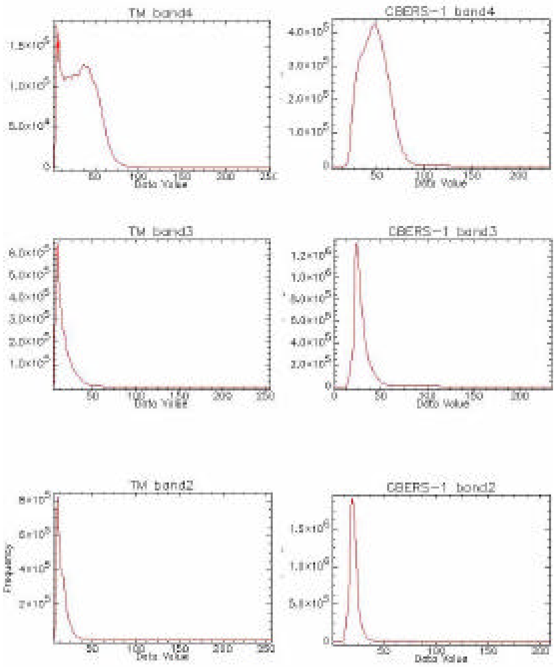


Figure 1. Histogram of Two Kinds of Data

2.2 Radiation Character

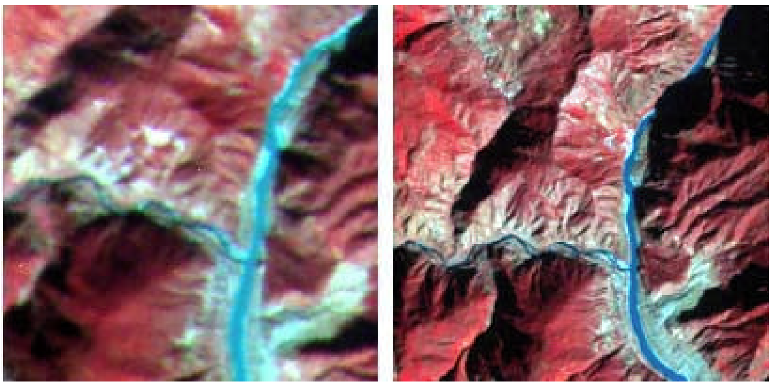
Figure 1 is the histogram of two kinds of original data. It shows that the distributing scope of TM4's gray scale is wider and its histogram has several peaks. This suggests that the CCD4's ability to distinguish the ground object styles is a little weaker than TM4's. The other two bands' radiation character is similar.

2.3 Noises

In order to statistic the noises' number of every single band's, we select 10 image subsections (512×512), and calculate noises/signals values. The result as follows: the ratios of the 4th, 3rd and 2nd band's are 0.02494812%, 0.02197266% and 0.02449036%. The noise level of the 4thband is similar to that of the 2nd band. The noises will be weakened when the data are processed by advanced software.

2.4 Definition

Figure 2 shows two color composite images of CCD and TM 4 3 2 bands in a same image subsection. It is obvious that the CCD image shows less information than the TM image does.



CCD Data TM Data

Figure 2. Definition Contrast of Two Kinds of Images

3. EVALUATION OF CCD DATA APPLIED IN RECONNAISSANCE OF METALLIC ORE

This image is located in Zhongdian region of Yunnan Province in southwest China. The region is rich in mineral resources, mostly multi-metal deposits. Strata outcrops are from Proterozoic to Quaternary. Intrusions belong to Hualixi Period, Yinzhi Period and Xishan Period. Main faults are the directions of South-North, North-North-East, North-North-West and West-East.

3.1 The Interpretation of Deposit-controlling Strata

According to the research, Carboniferous(C), Lower Permian (P_1), Upper Permian (T_3), are major deposit-controlling strata in the region. 83.7% deposits are located in the four sets of strata. Among them, basic, intermediate to basic volcanic rocks, debris strata should be the major minerals bearing layers of Au, Cu and Zn within the region. Acid acid to intermediate volcanic rocks are major bearing layers of Pb, Sn and Wu.

Deposit-controlling strata of C are basic igneous rocks, outcropped as interlayers with small thickness and different metamorphic rank. They are quite difficult to be distinguished from other strata of C. So, they are difficult to be interpreted and distinguished no matter on TM image or CCD image.

The other three sets of deposit-controlling strata are clearly showed in 4, 3, 2 (R, G, B) color composite image of TM and CCD data. The borderline between two layers are distinct, and can be easily interpreted. Figure 3 is CCD image feature of T_3 strata (gold deposit controlling layer). Obviously, it is quite different from that of adamellite of YINZHI period. Broadly speaking, two kinds of image have the same interpretation effect on deposit controlling strata.

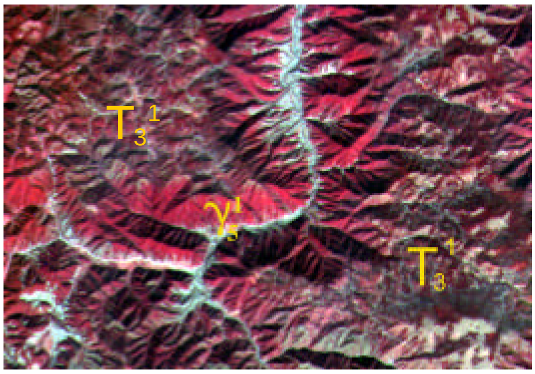
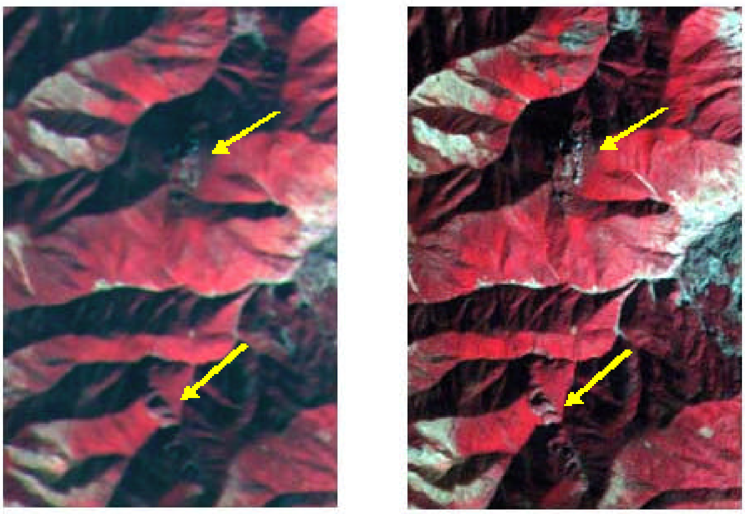


Figure 3. CCD Image Feature of T_3 Strata and adamellite of YINZHI period

3.2 Interpretation of Deposit-controlling Bodies

The deposit-controlling intrusive bodies can be divided into two types of shallow and super-shallow intrusive rocks. The shallow one is small in scale. Most of them are small rock stack, rock vein. Some of them can be interpreted in the CCD and TM images. Because of the definition, the borderlines of deposit-controlling intrusive bodies are a little clearer in TM image, but we can still distinguish them in CCD image (Figure 4). Super-shallow intrusive rock masses are large in scale. Most of them are changed gradually. So, it's difficult to be interpreted from the two



CCD Data TM Data

Figure 4. The Image Feature of Deposit-controlling Bodies

types of remote sensing images.

3.3 Interpretation of Deposit Controlling Structure

3.3.1 Deposit Controlling Faults: The faults related to mineralization in this area are mainly two groups, oriented west-east and north-south. The west-east oriented faults are important leader rock and leader deposit structure. North-south oriented faults are major faults in this area. They mainly control borderlines of strata or rocks. Most faults are extensional and to be important rock bearing and deposit bearing structure. In these two types of image, deposit-controlling faults are clearly showed. Figure 5 shows the tint abnormal of the two sides of a north-south oriented fault in CCD image.

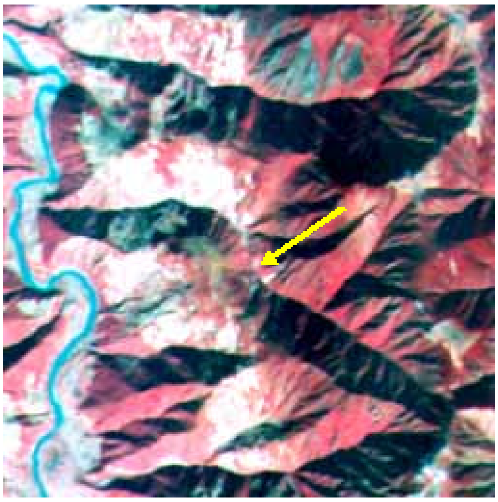


Figure 5. A North-South Oriented Fault in CCD Image

3.3.2 Deposit Controlling Ring Structure: Ring structure is the important deposit controlling structure in this area. It has two genetic types. One is super-shallow intrusive rocks. This type is one of the major deposit controlling structure within the region (Figure 6). The other is ancient volcanic structures, which broadly distribut in volcanic region. Most of them are ancient volcanic craters (Figure 7). They are related to gold and porphyry mineralization. Ring structures are clearly showed both on TM and CCD image. The interpretation results are the same.

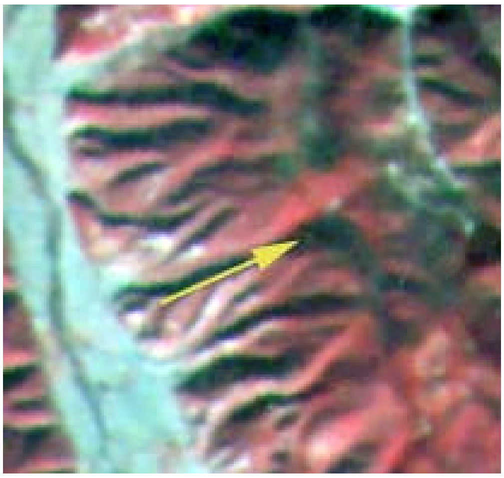


Figure 6. The Ring Structure Caused by Super-shallow Intrusive rock in CCD Image

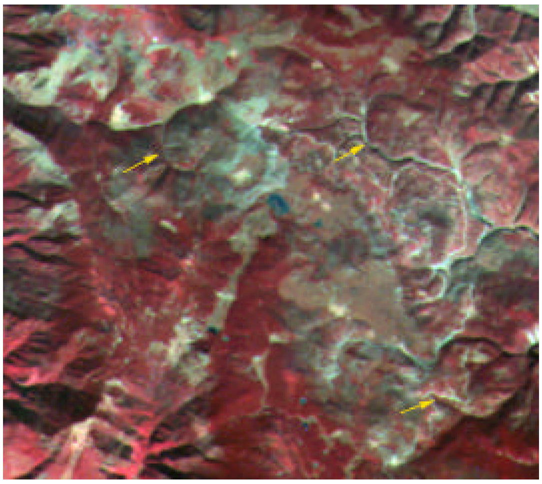


Figure 7. The Ring Structure caused by ancient volcanic craters in CCD image

4. CONCLUSION

After finishing the evaluation, we study the mineralization of each deposit within the area fully and interpreted entirely the deposit controlling strata, intrusive body and structure within the region using CCD color composite image. The 1:100000 and 1: 250000 interpretation map have been finished and four prospective targets have been trapped. Through comparison with existed geological material and field work, we are sure that the research result is of great reliability. After comparing interpretation result to existed 1:200000 regional geological map, we find the interpretation map has obvious improvement whatever in lithological classification or faults delineation, volcanic organ classification.

Owing to the strongly vegetation covered, the information of mineralization alteration can’t be interpreted. It can be conferred that CBERS-1data will have good applied effect on minerals exploration in bare land or vegetation half-cover area.

Because CCD data have good spatial resolution, we think it can meet the need of remote sensing basic geological survey and minerals exploration on scale less than 1:50000.

In a word, although the data quality needs to be improved, CCD data of CBERS-1 has great potentials in minerals exploration application.

References

Feng Maosen, 1992.The Data Processing of Remote Sensing Images, Geology Publishing Company, edited by Liu yajun, zhang rongchang, Beijing

Sichuan Provincial Bureau of Geology and Mineral Resources, 1990b.the geological structure and metallogenic prognosis of some main nonferrous metal and precious metal ores in baiyu-zhongdian area.

Wu meirong, 2000b. The System of Satellite Applying and Data Processing of the CBERS-1. In: The Corpus of Applying Appraisement of CBERS-1’s Data. Beijing, pp.7-25