Application of Remote Sensing in Investigation of Geological Environment of Iron Mine

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Abstract. Remote sensing technology plays an important role in mine production and management, and can provide comprehensive, accurate, rich and reliable information sources for geological prospecting, regional environmental monitoring, mine mapping and other basic work[1]. In particular, remote sensing technology has the advantages of macroscopic, rapid and dynamic technology, which can meet the requirements of mine geological environment survey and monitoring. With the improvement of satellite remote sensing in spatial resolution, temporal resolution and spectral resolution, remote sensing technology has developed rapidly in recent years; Remote sensing plays a more and more important role in mine geological environment investigation[2].

1. Introduction
The working method and technical process of mine environmental survey based on field work have been formed, but the survey results are still difficult to reflect the dynamic evolution of mine geological environment effectively, and the monitoring period is too long. Especially under the background of frequent occurrence of sudden geological disasters in mines, field investigation is difficult to meet the needs of mine geological environment monitoring. Using remote sensing technology and GIS technology to carry out environmental monitoring in mining areas has many advantages, such as rapid, low cost, wide monitoring range and effectively reflecting the evolution characteristics of geological environment in mines. At present, china still lack a systematic system of mine geological environment; remote sensing monitoring technology based on modern remote sensing technology and geographic information system of typical mine geological environment problem quick investigation and evaluation method, for the mine geological environment management to provide fast and efficient technology, promote the remote sensing technology in the mine geological environment monitoring play a greater advantage[3]. On the basis of collecting and sorting out the geological background data on Dalita coal mine in Shenmu, Shaanxi province, this paper summarizes the typical mine geological environment problems existing in Dalita coal mine in Shenmu, Shaanxi province by using high-resolution satellite and combining field exploration.

2. Research area overview
The working area is located in Daliuta Town, Shenmu County, Yulin City, Shaanxi Province, bordering Ijin Huoluo Banner, Inner Mongolia Autonomous Region to the north. The geographical coordinates are 110°05'00" ~ 110°20'00" E, 39°15'00" ~ 39°27'00" N, with an area of about 300km². The area has convenient transportation, including Xi'an - Baotou railway, Baotou - Shenmu railway,
Xi’an-Shenmu railway, Shenmu-Huanghua Port railway and Shenmu-DongSheng Highway runs through the mining area, fugu-Xinjie highway passes through the south of the mining area, and the mining area is connected with all towns and villages by roads (Figure 1).

3. Technical methods:
In this paper, On the basis of comprehensive collection and analysis of the existing data and field investigation, the principle of practicality and efficiency is followed. With high-resolution remote sensing technology as the main means of investigation, remote sensing data and multi-source data are comprehensively analysed, and on the basis of completing field survey and establishing interpretation marks correctly, and methods of human-computer interactive interpretation, indoor interpretation and field verification, in order to complete the investigation of soil and water loss, land desertification, ground collapse, ground cracks, surface water area reduction, groundwater level decline, soil and water pollution, spontaneous combustion of coal, collapse, landslide and debris flow in Daliuta mining area, Shenmu, Shaanxi

4. Field investigation and interpretation marking establishment

4.1.Field investigation
The high-resolution image map is adopted as the basis. Within the scope of coal mining, the distance between 200 and 500 meters is adopted. In gentle zone, the distance can be widened appropriately. The geographical location, area, shape, length, width and density of ground collapse and ground crack are investigated and delineated by route crossing method and tracking method. The objects and losses of ground collapse and ground crack disasters. The relation with the scope, mining depth and mining mode of goaf is analyzed.

4.2.Visit and investigation
Due to the fact that most of the surveyed areas are gaisha loess hilly areas, the ground fractures caused by coal mining are dense after a period of time due to rainfall and quicksand, so it is difficult to find ground fractures in the route. Based on such situations, local villagers are interviewed for investigation to learn about the historical collapse and ground fracture disasters.

4.3.Investigation means
Using 1:10000 or larger scale remote sensing, handheld GPS field fixed point, digital imaging technology, GIS mapping and other high-tech means, on the basis of ensuring the quality of the survey, quickly and efficiently complete the field subsidence area survey. The distribution and characteristics
of surface collapse and ground crack in the working area are found out by using the above comprehensive survey method.

4.4. Establishment of interpretation logo
In order to better and accurately extract ground features, different mineral species distribution areas are selected to carry out field exploration, and interpretation markers such as mineral resource mining sites, ground collapse, solid waste, water pollution, dust pollution and gangue spontaneous combustion are established in the working area.

4.5. Remote sensing data processing
In the course of work, according to the project purpose, we make full use of different spatial scales and spectral resolution remote sensing data, through the image synthesis and color correction, color space transform, image enhancement processing (such as ratio, principal component analysis), data fusion and multi-level filtering of remote sensing information technology, information comprehensive analysis and other methods, to carry on the mine geological environment problems information extraction, accurate discrimination mineral resources development and the mine environmental terrain types; in order to improve the accuracy and precision of mine geological environment information extraction, multi-factor comprehensive analysis and interpretation are carried out on the basis of ground spectrum test sampling, soil sampling and water sampling analysis.

4.6. Remote sensing information extraction for geological environmental problems
Information extraction (remote sensing interpretation) is the process of obtaining the target feature information from the remote sensing image. It is mainly accomplished through two approaches: visual interpretation and automatic classification by computer. In practical work, the two methods are often combined. Visual interpretation requires more experience and expert knowledge, and the result is more relevant to the interpreter and less efficient. Computer automatic classification technology has the advantages of high efficiency and objective classification results. However, most commonly used computer classification techniques are based on pixel level and only rely on spectral information to complete pixel classification. However, although the structure, texture, shape and other information of high-resolution image data are very prominent, the spectral information is insufficient. Therefore, information extraction is carried out only by relying on the spectral feature space of pixels, focusing on local pixels and ignoring the texture and structure information near the whole image spot, which will inevitably result in the reduction of information extraction accuracy. Therefore, the traditional computer automatic classification technology of pixel level relying solely on spectral features is no longer suitable for information extraction of high-resolution images.

Different features have different features, and the different environmental features around the features determine the distribution characteristics of the features, which is also the indirect identification characteristics of the features. Based on the relationship between remote sensing image and feature, remote sensing image can be decomposed into various features of feature, so that interpretation of high-resolution remote sensing image becomes the analysis and judgment of multiple features of feature and image, instead of relying only on spectral features. By means of human-computer interactive interpretation and computer multi-feature information extraction, the high-resolution image information is accurately extracted by means of comprehensive analysis of spectral features, shape and texture features, terrain slope features and regional geological features.

5. The results of the survey

5.1. Sorting out the geological and environmental problems of coal mines in northern Shaanxi
Through data analysis, preliminary interpretation of remote sensing images and field exploration, the comprehensive sorting of geological environmental problems in Shenmu Coal Mine in Shaanxi province has been completed, and the following understandings have been obtained:
(1) Fragile ecological environment, serious soil erosion and land desertification;
(2) Land resources occupied and destroyed by mine development;
(3) Serious surface vegetation destruction, destruction of water resources, aggravated water resources;
(4) Environmental pollution caused by mineral exploitation activities;
(5) Geological disasters such as ground cracks and ground collapse caused by mineral exploitation.

5.2. Remote sensing survey results of geological environment elements of coal mines in northern Shaanxi

The exploration and research of human-computer interactive interpretation, three-dimensional landscape simulation technology and object-oriented automatic classification technology have been carried out for the problems of mine geological environment in northern Shaanxi coal mine. The geological environment element system of Shenmu coal mine in Shaanxi province was established through field exploration, classification and interpretation of surface features. On this basis, remote sensing interpretation of mine geological environment elements is carried out according to the corresponding relationship between interpretation object prototype and image features, which provides basic data for subsequent investigation method research and mine geological environment evaluation. Land desertification is one of the most important environmental geological problems in northern Shaanxi coal mine. Surface collapse and ground fissures in goaf directly destroy the structure of sand and soil on the surface, disturb the natural state of sand and soil, cause vegetation destruction, promote wind erosion and water erosion, and make land desertification. For the remote sensing extraction of desertification area in the working area, the traditional human-computer interactive interpretation method is difficult to be completed due to the large desertification area and the irregular and long boundary shape. However, due to the uniform color of sandy coverage, desertification and the surrounding non-covered areas form a strong spectral contrast, clear boundaries, easy to use object-oriented information extraction method. Not only can the desertification range be extracted quickly and effectively, but also the desertification degree can be graded.

The coal mining area in northern Shaanxi is located in the arid and semi-arid regions. The degree of desertification can be divided into four levels according to the vegetation coverage: mild desertification, moderate desertification, severe desertification and very severe desertification. As shown in Table 2-2 (referring to the technical specifications of the Fourth National Technical Regulations on Desertification and Desertification Monitoring):

| Table 1. Desertification classification Table |
|---------------------------------------------|
| Desertification classification | Vegetational cover |
| Mild desertification                | >40%             |
| Moderate desertification            | 25%-40%          |
| Severe desertification              | 10%-25%          |
| Extreme desertification             | ≤10%             |
Coal mine of shaanxi 1:50000 geological environment interpretation work is based on resources 1 02 c satellite data, at the same time auxiliary by June 2013 LandSat8 satellite data of spectral information, give priority to with object-oriented automatic information extraction, man-machine
interactive interpretation is complementary, comprehensive analysis of the study area feature of spectral information, shape, texture, and other characteristics, 9 were extracted feature type, extracting line map spot with a total area of 147042 hectares. It can be seen from the interpretation results and the statistical table (Table 2-4) that the grass irrigation land in the study area covers an area of 86,925 hectares. The desertification zone covers an area of 44,591 hectares. Urban and transportation land area is 5229 hectares; soil erosion area reached 3,328 hectares; the mine dump area reaches 2,205 hectares; the coal yard covers an area of 1,638 hectares. The water area is 856 hectares; the economic ecological forest area is 842 hectares. With an area of 428 hectares of arable land, desertification in the 1:50,000 working area is still widespread and serious.

Table 2. Statistical table of mine geological environment elements area.

| Elements of mine geological environment | floor area (ha) |
|----------------------------------------|-----------------|
| Grass land and shrub land              | 86925           |
| Desertification area                   | 45591           |
| Urban and transportation land          | 5229            |
| Soil and water loss                    | 3328            |
| Mine dump                              | 2205            |
| Coal yard                             | 1638            |
| The water                             | 856             |
| Economic ecological forest             | 842             |
| Arable land                           | 428             |
| Total                                 | 147042          |

6. Conclusion
(1) The application of high-resolution satellite remote sensing technology in mines is a higher-level application based on previous applications, which will be sustainable for mines. Continued development to provide modern space information technology support.
(2) The application of high-resolution satellite remote sensing in mines is a new system engineering, and a large number of key problems need to be studied in depth.
(3) Using high-resolution remote sensing satellite, the mine geological environment can be investigated 1:50000.

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