Research into the Development Status of Mineral Resources by Remote Sensing Dynamic Monitoring Testing

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Abstract: The research is based on remote sensing technology with typical testing areas and suitable data sources. After establishment of proper technical process, information, such as tailings, mining location, mine geological disaster, etc., is abstracted. With a series of testing, valuable experiences have been obtained, which can act as effective technical preparation for large scale monitoring.

Key words: remote sensing, mineral resources, monitoring.

1. Introduction

In China, remote sensing, as a high scientific and technological method, has successfully been used in dynamic monitoring of land-use, city environment and geological disaster survey, geological exploration, etc. However, large scale dynamic monitoring of mining status has not been started for monitoring of mining status and environment of mine. The reason for this is very complicated. Firstly, mines have many types and various mining methods and the modes of damage to environment are various too. The interpretation keys of different mine and their surrounding environment are multifarious. Secondly, there are many data sources that have different spectral resolution, spatial resolution and prices. So, how to select a suitable data source to achieve a low cost, high quality monitoring results is also an important consideration. Thirdly, a practical technical plan has to been worked out to implement large scale monitoring. Hence, it is very important to be prepared technically for large scale monitoring by selecting some typical mines to test. With this idea, some typical areas such as Jincheng, shanxi and Chongyi, jiangxi have been chosen.

2. Monitoring Content and Process

In this study, the dynamic monitoring methods with remote sensing are mainly included the items as follow:

1) Some information such as types of mine, distribution, location, number and relative scale of mines should be collected.

2)The different mining status are determined

3)Damage to farmland and vegetation, water pollution and soil erosion due to mining and geological disaster such as ground fissure, self-combustion of coal mines, land slide, collapse, mudflow ,tailings should be investigated.

The integrated ideas are as follows:

Selecting appropriate monitoring areas and suitable data sources, using effective data processing method and relevant information extraction methods, good map expression form, etc(Fig. 1).

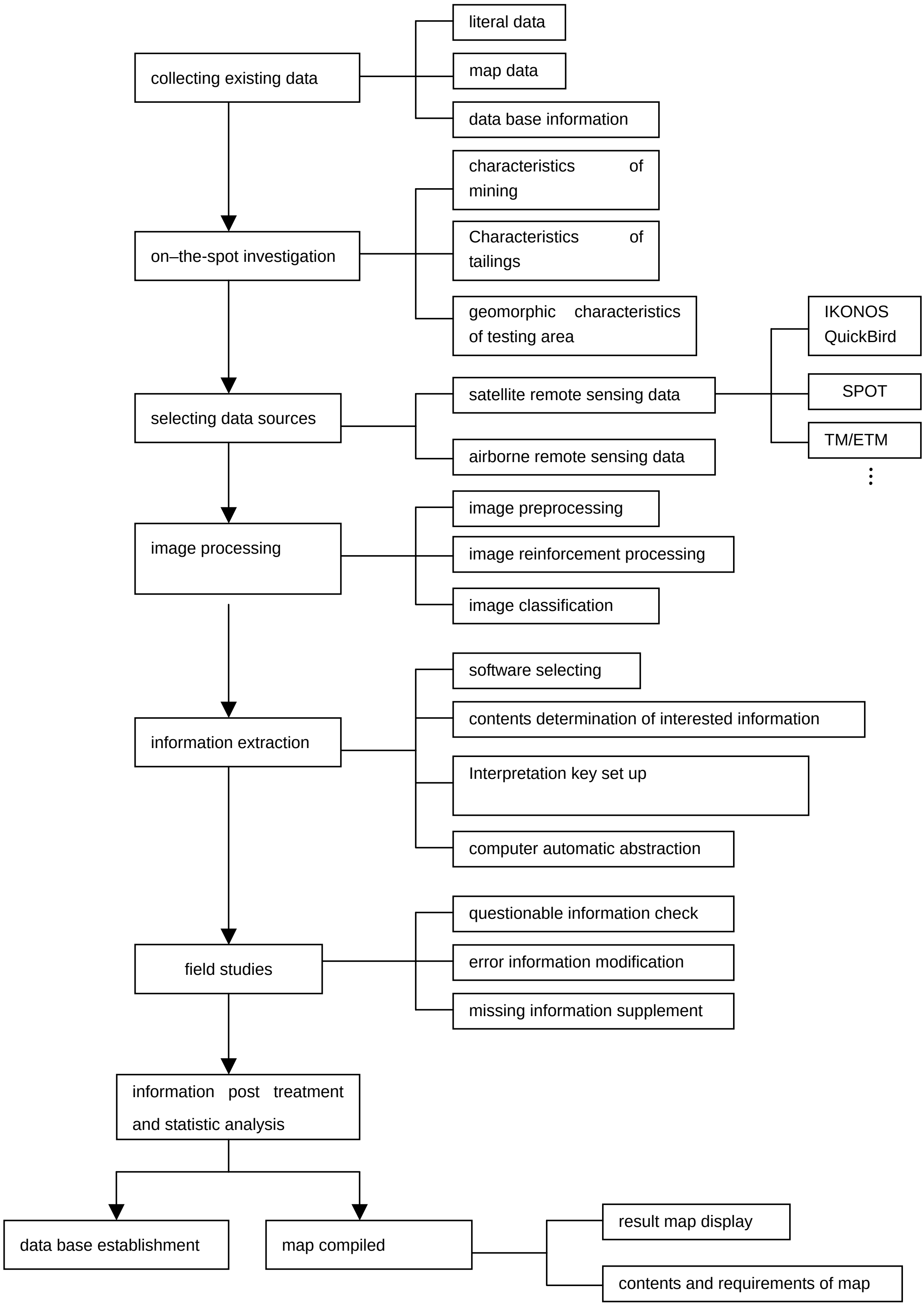

Fig. 1 study method flow chart

3. Monitoring Result

During 2001 to 2004, six areas have been selected as testing sites (See table 1). Each area is about 200 to 400km^2.

Table 1 Monitoring areas distribution

Areas	Deposit types	Characteristics of testing sites	data source
Tangshan, Hebei	Large-scale coal mines, limestone mines and bauxite mines	Situated in plain region. The depths of small coal mines are within 300m; state owned large scale coal mines are over 1000m. Bauxite mines are small, underground mining; Limestone mines are open-pits.	TM （ ETM+ ） (multi-spectral band);SPOT － 4(panchromatic band), IKONOS、aerial color infrared image(1:50000)
Huairou, Beijing	Small gold mines and iron mines	Located in the northern mountain area. Iron mines are opencast mining, which distribute mainly in relative high places of slope. Gold mines are underground mining, mainly located in ravines. They are all small mines	TM, SPOT － 4(panchromatic band), IRS(panchromatic band)、CBERS-1 CCD(multispectral band), aerial color infrared image (1:30000)
Jincheng, Shanxi	Large-scale coal mines, mini type iron mines, clay mines	Located in the hilly area in the north. Vegetation is scarce. Coal mines are various in size. Iron mines are very small. Mining cause severe geological disasters.	TM, QuickBird
Chongyi, Jiangxi	Tungsten, coal, limestone and other poly-metallic mines	It's one of the major production area of tungsten. Located in mountain area. Tungsten mines are medium sized while coal mines are small. Mines distribute relatively scattered. Except limestone mines which are open pits, the other mines are underground mining.	ETM, SPOT － 5、QuickBird, aerial color infrared image (1:70000)
Aletai, Xinjiang	Sapphire mines, muscovite mines, beryllium mines and lithium mines	Mountain is high and forest is dense; traffic is hard; difficult to reach. Mostly are strip mine, few are underground mining	IKONOS
Jingxi, Beijing	Coal mines	Located in northern mountain area; densely covered with vegetation. Mined multi-layered, boundaries of mines overlapped; scales various. The traffic is hard. There are geological disasters such as earth fissures and collapse.	QuickBird

The results are simply stated as follows:

1)With remote sensing method，illegal mining , mine tailings and gangue location, geological disaster information can be detected quickly and precisely.

For example, in Jincheng, Shanxi, there are 234 iron mines, 32 clay mines (brick factories) and 69 limestone mines are found to be mined without license. 393 surface collapse pits damage 5.74 hectares of farmland. 73 surface subsidence area are detected, covering an area of 143 hectares. 10 fissures due to mining are discovered with a total length of 3629.4m.

In Jingxi testing area, 10 collapses due to mining have been founded which damages 3.75 hectares of woodland. There are 17 fissures with a total length of 2243.5m.

The mining of tungsten in Chongyi mountain area has a history of more than 100 years. There are many old or new tailings scattered in the mountains. QuickBird images can show their locations, areas, numbers etc.

2)Different data source has different monitoring effects

The combination of medium-resolution data such as TM and SPOT-4 can reflects the information about mining surface of large-scale open pits, tailings bin and large-scale tailings piles. It can monitor the distribution of mines in large region and determine the general distribution status of mines.

Higher resolute data, such as SPOT-5 can reflect tailings pile, buildings in mines, large scale roads etc. It is suitable for monitoring of open pit and large scale underground mining.

With highest resolution data, such as QuickBird, IKONOS etc., the number of small mines, relative mining status, scale; the occupying areas of mines, temporary ore yard, tailings, factory buildings, temporary buildings and road etc. and the change of surrounding environment of mines; the distribution of geological disasters, such as collapse, fissures etc., can be monitored.

4. Conclusions

The monitoring test shows that it is feasible for dynamic monitoring of mining status and environmental problems due to mining to use remote sensing technology. The data provided are objective, real and reliable. Result is obvious. It is easy for management authorities to know and control the mining status. It benefits the supervision and management. Hence, it is of great importance. It is not achievable for conventional methods.

Series of testing studies can speed the course of standardization of remote sensing dynamic monitoring for mining status. It is also in favor of establishing national technological regulations, criteria, methods and technical flow of remote sensing dynamic monitoring.

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