Journal of Global Change Data & Discovery. 2017, 1(3): 358-363
DOI:10.3974/geodp.2017.03.16
www.geodoi.ac.cn

Global Change Research Data Publishing & Repository

An Open-pit Mine Spatial Dataset for Guizhou Province (2015)

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Abstract: Guizhou province of China is rich in many minerals. The land used for mining accounts for a relatively large proportion of the total land area. Since 60% of the land in Guizhou are ecologically fragile karst topography, it is important to monitor the open-pit mines activities in order to maintain environmental sustainability. Based on Google Earth images from 2015, we established an open-pit mine database by visual interpretation. It was found that there were 1,084 strip mining and quarry mining areas, with a total area of approximately 90.96 km^2, accounting for about 0.05% of the whole area. The open-pit mining areas were mainly distributed in the west-central area of the region. Most open-pit mines in Guizhou were small and scattered. Mines over 0.5 km^2 accounted for only 2.5% of the total area of the open-pit mining area. This dataset can be an indicator to assess the potential impact of mining on local environment. The dataset files were archived in .kmz and .shp formats, with a data size of 4.97 MB.

Keywords: Guizhou province; open-pit mining area; 2015; mining region

1 Introduction

The mountainous region in Guizhou province accounts for 87% of the total area of the province and extends for about 0.17 million km^2. Majority of the land consists of fragile karst landforms. There are over 120 minerals identified from about 3,000 sites[1]. The mining economy accounts for about 50% of the gross domestic product (GDP) of Guizhou. Open-pit mining activities have a large impact on local environment; however, there have been few quantitative studies about the impact. Although overall distribution of mineral resources in Guizhou is relatively concentrated, the mining activities are small and scattered. In addition, mining may exist in "no-mining" zones[2]. Therefore, it is critical to monitor the extent of mining activities to ensure sustainable regional development and maintain the ecological balance.

With the development of satellite technology, advanced and high-quality free satellite data has become available. This technology has made the monitoring and management of mining

Received: 08-10-2016; **Accepted:** 20-11-2016; **Published:** 25-09-2017
Foundation(s): Ministry of Science and Technology of P. R. China (2016YFC05021003); National Natural Science Foundation of China (41571173)
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Article Citation: Liu, S. L., Cheng, F. Y., Hou, X. Y., *et al.* An open-pit mine spatial dataset for Guizhou province (2015) [J]. *Journal of Global Change Data & Discovery*, 2017, 1(3): 358–363. DOI: 10.3974/geodp.2017.03.16.
Dataset Citation: Liu, S. L., Cheng, F. Y., Hou, X. Y., *et al*. Mineral land cover dataset of Guizhou province in 2015 [DB/OL]. Global Change Research Data Publishing & Repository, 2016. DOI: 10.3974/geodb. 2016.09.08.V1.

areas much easier[3]. The effective monitoring of mining developments based on remote sensing images has been conducted in many mining areas in China[3]. It is more common to use a visual interpretation to extract the mining area because it is difficult to achieve the required accuracy using automatic classification methods alone. Therefore, we used visual interpretation as the main means of interpretation.

In this study, Google Earth remote sensing images from 2015 were used to identify the open-pit mining distribution points, including mining and quarry sites.

2 Metadata of Dataset

The full name, short name, corresponding author, other authors, geographic area, time that data was collected, resolution, data publication address, data sharing network service platform, dataset composition, and other information included in the "Open-pit mine spatial dataset of Guizhou province (2015)" are listed in Table 1[4].

Table 1 The metadata summary of the Dataset of open-pit mine land cover in Guizhou province by remote sensing interpretation (2015)

Items	Description			
Dataset full name	Mineral land cover dataset of Guizhou province in 2015			
Dataset short name	MineralLCDataGuizhou2015			
Authors	Liu, S. L. C-1377-2017, shiliangliu@bnu.edu.cn Cheng, F. Y. S-6509-2016, chengfangyan@mail.bnu.edu.cn Hou, X. Y. S-6962-2016, houxiaoyun526@126.com Yin, Y. J. S-8009-2016, 1505330249@qq.com Zhang, Y. Q. P-3944-2017, 13324103182@163.com			School of Environment, Beijing Normal University
Geographical region	The geographical range: 24°37′N–29°13′N, 103°36′E–109°35′E Administrative area: Guizhou province			
Year	2015	Spatial resolution	30 m	
Data format	.shp, .kmz	Data size	4.97 MB	
Foundation(s)	Ministry of Science and Technology of P. R. China (2016YFC05021003); National Natural Science Foundation of China (41571173)			
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn			
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China			
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[5]			

3 Methodology

Using Google Earth images for 2015, we adopted an integrated method combining visual interpretation and historical data to describe distribution of open-pit mine land cover and its current operational situation in Guizhou. The scope of the investigation included the mining area, area of construction associated with mining, transit fields, waste dumps, and land used for disposal of tailings.

3.1 Major Steps in Data Processing

There were five data processing procedures (Figure 1).

(1) Data Acquisition: Satellite images, geographic and geological data, historical photos.

(2) Image Interpretation: The features in images were interpreted based on visual analysis, previous knowledge, and historical photographs. The selected mine features could include objects from a set of features and could be used for classification purposes.

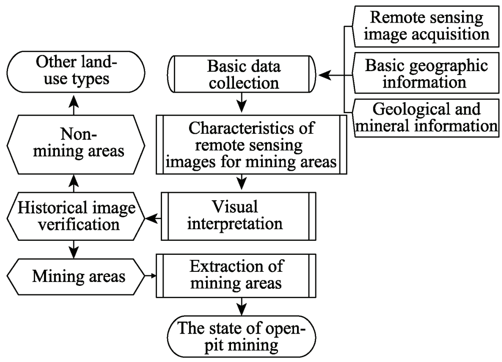

Figure 1 The data processing flowchart

(3) Preliminary delineation of mining sites in Google Earth: examine potential open-pit mining sites based on relevant geological and mineral data. This work was conducted at a fine scale to avoid missing individual locations.

(4) Refine mining site using auxiliary data: After the identification of possible open-pit mine locations, the obvious mining sites were recorded as open-pit mining, and for likely sites with lower confidence, multi-temporal images were used to decide whether it was mining site.

(5) Finalization of the dataset: delineate the boundary of open-pit mining sites using all data available.

3.2 Development of Interpretation Database

A mining interpretation database would help identify various features and ensure the consistency. The first step was to determine object element including shape, size, color, texture, etc. Based on the relationship between image and object, field information could be further determined. Since one image may include many objects, and some object features maybe obscure, therefore, we collected some basic research data, photographs, and image features from previous interpretations and compiled the mining interpretation database (Figure 2) [6–13].

Open-pit mining areas usually consist of the actual mining area, construction areas, transit yards, dumps (waste rock yard), and tailing ponds. There are typically many mining roads and a few mine buildings in mining areas.

(1) The mining area: usually has no vegetation and appears in a ladder form with different shades and dark colors. The mining section is often connected with mining roads and is sometimes accompanied by mining facilities

(2) The construction area: has a clear outline and its shape is more regular, being mostly in a rectangular or strip pattern. Buildings in large mines are arranged in a regular order, while those in small mines are smaller and loosely arranged, most are simple sheds or small independent houses. Buildings in the mining and construction areas are easily recognized due to their red, green, blue, white, and gray colors, exhibiting obvious differences with the color of the surrounding ground.

(3) A transit yard: is often accompanied by a long rail network or transport belt, and the track can reach the top of the transition stack. In the flat transit fields, there are usually open roads and visible traces of large trucks. The transit yard appears dark gray, with a conical or fan shape and a three-dimensional form. The edge of the ore heap has a specific arc, with a radial texture from the center. Transit yards in mountainous areas are mainly distributed along the slope.

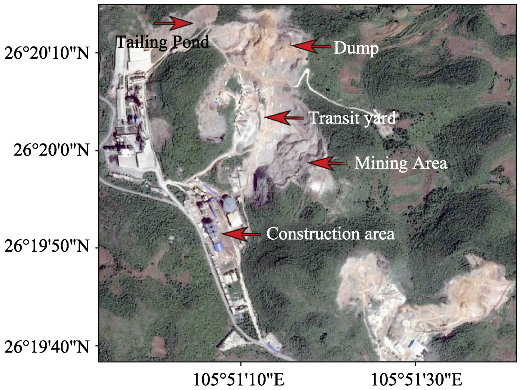

Figure 2 The characteristics of a typical remote sensing image of an open-pit mine

(4) Waste dumps: often include a pond, ore dam, roads, and other facilities with a regular shape, and can cover a large area with a round or banded form. They are mainly distributed in valleys or flat areas, with some building facilities in the vicinity, such as a concentrating mill. A few large tailing areas have adopted transportation to convey mine tailings, and usually appear as gray or black in images, and are therefore different from surrounding objects. Open-pit mine dumps are usually located near mining areas, and have a large area. The position of mine dumps can change over time.

(5) The tailing pond: is a signature feature of an open-pit mine, and usually has a large area and distinct color, with the surrounding vegetation being gray. Some tailing dams appear as a straight line on one side of the pond, and the dam acts as a dike that is higher than the surrounding ground[14]. In addition, when the tailing pond has a cascade dam form, it is usually covered by low vegetation, which stabilizes the dam.

4 Results and Validation

4.1 Results

Based on the Google Earth images from 2015, 1,084 open coal mines were identified in Guizhou (Figure 3). The results showed that the mining sites were mainly distributed in the west-central area. The area of open-pit mining totals 90.96 km^2, accounted for 0.05% of the total area, and with an average of 0.08 km^2 for each mining site. Individual mines of over 0.5 km^2 accounted for only 2.5% of the total area of the open-pit mining area, and were mainly located in the northeast.

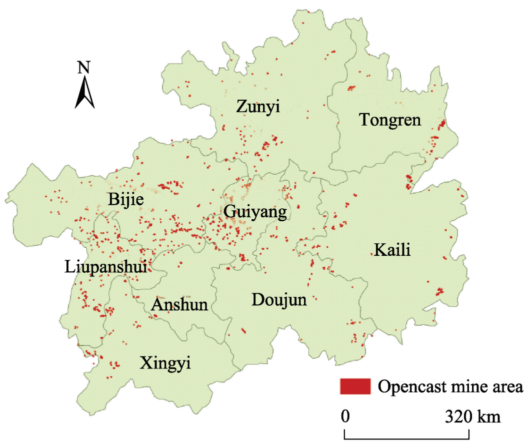

Figure 3 Data of open-pit mining areas in Guizhou province in 2015

4.2 Data Validation

To ensure data quality, we conducted a visual interpretation and in situ validation of the target area again after we obtained the location of mining areas through the selection process.

For areas where the image quality was affected because of the limited geographical area, we adjusted the timing of the remote sensing image again and identified the potential land use type according to the characteristics of the surrounding and target areas. It can be seen from Figure 4 that new mining sites were identified in the study area, including mining areas, transit yards, and buildings associated with the development of mining activities (red polygon in Figure 4). The presence of bare ground and significantly damaged vegetation was confirmed in the study area, which indicated that the area was a new open-pit mine.

5 Discussion

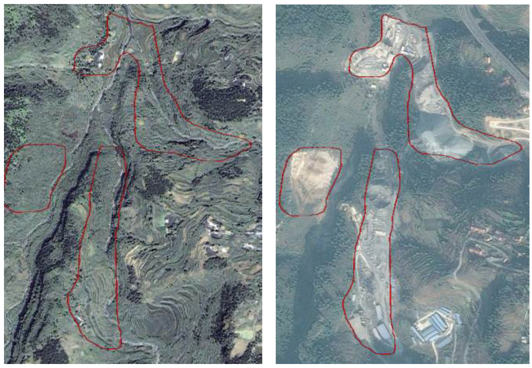

Figure 4 Comparison of the pre- and post-development periods of a new open-pit mine

The procedure used to develop the dataset in this paper mainly relied on visual interpretation to recognize objects and the interpretation process was simple, intuitive, and accurate. Objects included in the dataset were established by the spatial and temporal relationship between the objects and image features including shape, size, color, texture, position, and distribution. However, the workload involved in the visual interpretation is huge and there is a certain amount of human error involved in the depiction of the object edge. The human-computer interaction reduces the error in object depiction to a certain degree, but some downsides remain with regard to the operational workload. The computer-based classification usually cannot achieve the required levels of accuracy and precision without human interaction[15].

Guizhou province is rich in mineral resources and also has extensive Karst landforms. More than 60% of the area of Guizhou province is exposed karst, and therefore widespread open-pit mining will have a serious impact on the ecological environment[16]. The overall distribution of open-pit mining in the region was found to follow the pattern of “many, small, scattered,” which is consistent with previous studies[1,2,16]. In general, mineral exploration at small mines is inefficient and the exploration methods used are unsatisfactory, which has not only resulted in the waste of mineral resources but has also had a heavy burden on the regional ecological environment.

The dataset has digitized the entire open-pit mining area of Guizhou province and reflects the present status of regional mineral resource development. In addition, the dataset also reflects the impact of mineral resource development on the local ecosystem and provides data to support further studies in this field.

Author Contributions

Liu, S. L. completed the thesis design. Cheng, F. Y. wrote the paper. Hou, X. Y., Yin, Y. J. and Zhang, Y. Q. contributed to the data extraction and verification.

References

[1] Zhang, F., Teng, J. Z., Zhao, W. Q., *et al*. The major environmental problems caused by exploitation of mineral resources in Karst areas of Guizhou province [J]. *Guizhou Science*, 2011, 6: 65−71.

[2] Zeng, F., Sun ,Y. L., Jiang, J. J. Discussion on the development layout optimization of mineral resources in Guizhou [J]. *Guizhou Geology*, 2016, 2: 148−154.

[3] Yang, X. F. Research on dynamic monitoring method of remote sensing and application of mine environment change detection [D]. Beijing: China University of Geosciences, 2014.

[4] Liu, S. L., Cheng, F. Y., Hou, X. Y., *et al*. Mineral land cover dataset of Guizhou province in 2015 [DB/OL]. Global Change Research Data Publishing & Repository, 2016. DOI: 10.3974/geodb.2016.09.08.V1.

[5] GCdataPR Editorial Office. GCdataPR Data Sharing Policy [OL]. DOI: 10.3974/dp.policy.214.05 (Updated 2017).

[6] Ding, L. Research on monitoring and evaluation of mine environment based on remote sensing and GIS in Longnan gold mine area [D]. Changsha: Central South University, 2010.

[7] Ding, L., Zhu, G. C., Wang, J., *et al*. Application of IKONOS image with remote sensing technique in the monitoring of mine environment—An example in Baiyin coal mine region [J]. *Geomatics and Spatial Information Technology*, 2010, 1: 37−41.

[8] Li, H. Y. The research of remote sensing object-oriented information extraction in plateau mountain mine environment—Wuding ilmenite region as a case [D]. Kunming: Yunnan University, 2016.

[9] Liu, P. F., Shuai, S., Chen, A. Contrastive analysis of ZY-3 image and SPOT-5 image in mine remote sensing monitoring [J]. *Modern Mining*, 2015, 8: 127−129.

[10] Wang, J. F., Zeng, X. C. Application of high-resolution remote sensing images in mine environmental monitoring [J]. *Surveying and Mapping*, 2015, 5: 220−223, 224.

[11] Wang, Y. B., Luo, W., Li, M. Y., *et al*. Mine development monitoring based on high-resolution remote sensing images [J]. *Tropical Geography*, 2011, 4: 377−382.

[12] Wei, J. L., Zhou, Y. Z., Shao, H. Y., *et al*. Remote sensing monitoring of mine based on data of GF-1-In the case of Huili polymetallic mining area [J]. Non-ferrous Metals (mine), 2016, 4: 86−91.

[13] Zhu, Y. F. The research on extraction of rare earth mineral information based on high score image from satellite of Resource One [D]. Ganzhou: Jiangxi Polytechnic University, 2014.

[14] Zhang, D. Y. Application of high-resolution remote sensing technique to monitor mine activities [D]. Jiaozuo: Henan Polytechnic University, 2015.

[15] Liu, Y. L., Yan, S. Y., Wang, T. Discussion on human-computer interactive interpretation method of several practical remote sensing images [C]. 2002 Annual Conference on Environmental Remote Sensing, 2002.

[16] Li, R. F. The ecological compensation mechanism of mineral resources exploration in Guizhou province [D]. Guiyang: Guizhou College of Finance and Economics, 2011.