Status of Geological Disasters in Jiaozuo City and Countermeasures for Prevention and Control

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Abstract:*Due to the large-scale exploitation of mineral resources and the unreasonable human activities, the geological disasters in Jiaozuo City have become increasingly prominent and the degree of harm increased. This leds to a tremendous threat to human life and property safety. Jiaozuo City, the main types of geological disasters, landslides, ground subsidence, debris flow and ground fissures. It has great significance to the development of the city and the protection of people's life and property to explore the hidden dangers of geological disasters and actively take preventive and control measures. The establishment of geological hazard group measurement system of prevention and control to achieve the timely detection of geological disasters, rapid early warning and effective avoidance.*

Key words: *geological disasters, types of geological disasters, prevention and control measures, group measurement and prevention system, Jiaozuo City*

I. Introduction

Geological disasters refer to the geo-environment of the surface layer of the Earth's lithospheric crust, which is aggravated by natural action, man-made action or both, which endangers human life and property safety or destroys the ecological environment, and is referred to as geological disasters event [1] .Geological changes in the environment is the key cause of geological disasters. In recent years, as the economy continues to develop, the number of population increases, the human engineering activities become more and more violent, mankind's transformation of nature is also more frequent, and the change of geological environment is therefore accelerated. The impact of geological environment changes on the human threat is more and more intense, the prevention and control of geological disasters has become an urgent task [2] .

1 Jiaozuo Overview

Jiaozuo City is located in the northwestern part of Henan Province, bordering Taihang Mountain to the north and Shanxi Province to the north and the Yellow River to the south.The geographical coordinates are between 35º10'-35º21'N and 113º4'-113º26'E. The east-west length is about 32.5km and the north-south width is 19.7km.Jiaozuo mineral resources more varieties, larger reserves, better quality, after census of mineral resources have more than 40 species, accounting for 25% of Henan Province has been found in minerals, proven reserves of coal,limestone,bauxite,fire-resistant clay, more than 20 kinds of pyrite [3] . Due to the large-scale development of mineral resources and unreasonable human of

harm has also increased. This leds to a tremendous threat to people's lives and property.activities, the geological

disasters in Jiaozuo City have become increasingly prominent and the degree The main types of geological disasters in Jiaozuo are avalanches, landslides, ground subsidence, debris flow and

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ground fissures (Table 1). Among them, the major geological types are collapse and ground subsidence.

Geological disaster types	Quantity	Occurrence and impact
Collapse	20	In the northern mountains, Mengzhou City, Zhongzhan District and other places endanger traffic safety, resulting in economic losses
Landslide	3	Landslide caused by Mengzhou casualties, Landslide Qinglongxia, fraternity caused economic losses
Ground collapse	2	Jiefang District, Ma Cun area collapse of the ground endanger the lives of residents and underground construction
Debris flow	5	Shanmen River, Mengzhou City, landslides and other places endanger the farmland, resulting in economic losses
Ground fissures	2	Liberated areas, Macun area with the ground collapse, endangering the safety of mining personnel and residents of property

Table 1 Geohazards occurrences and impacts in various geological disasters in Jiaozuo City during 2012-2016

II. Spatial distribution of geological disasters in Jiaozuo City

2.1 Collapse and its distribution

Collapse geological disasters are widely distributed in the city. Among them, there are more coal mines and more goafs in Macun district, Sizhuang and Zhongzhan district, and the collapse is serious. The population density in the northern part of Jiaozuo is very small and collapsed Little impact; urban collapse in Jiaozuo City and the eastern part of a hundred rooms and other areas developed a small amount of collapse, but these areas have a large population density, as the main living area, so a greater impact [4].

2.2 Landslides and their distribution

The landslide phenomenon in Jiaozuo city mainly appeared in the middle and low mountains in the northern part of Taihang Mountain, mostly in rainstorms. There are also open mining mines and surrounding landslides prone.

2.3 Ground subsidence and its distribution

The ground subsidence is widely distributed and developed in hilly and piedmont plain areas in Zhongzhan District, Jiefang District, Shanyang District, Macun District, Xiuwu County, Qinyang City and northern Boai County in Jiaozuo City (Table 2). The impact is more extensive.

Table 2 Jiaozuo main ground collapse disaster list

Distribution location	Collapse pit (a)	Subsidence area (km^2)	Collapse range (m)	Remarks
Zhongzhan District, Jiefang District	6	20.8	Maximum 5m	Coal mine
Shanyang District, Macun District, Xiuwu County	8	30.8	Maximum 6m	Coal mine
Qinyang City	3	2.6	0.3~1.2m	Kaolin ore
Boai County	1	1.2	Maximum 1.4m	Kaolin ore
total	18	55.4		

2.4 Debris flow and its distribution

The debris flow disasters in Jiaozuo City are mainly distributed in the northern Taihang Mountains. The main inducement is that a large amount of mining mineral resources and unreasonable deforestation and land reclamation have made the original geo-ecological environment more fragile, and the debris flow cycle has been continuously shortened and the scale has been continuously expanded .

2.5Ground fissures and their distribution

Ground fissures are mainly distributed in Zhongzhan District, Jiefang District, Shanyang District, Macun District and Xicun Township and Fangzhuang Town of Xiuwu County in Jiaozuo City in the northern foreland belt.They are usually associated with ground fissures.Long-term underground mining activities, resulting in a certain area ofgoaf, making cracks more likely to occur.

III. Main causes of geological disasters and their conditions of pregnancy

3.1 Topography

Terrain and topography is an important factor in the occurrence of geological disasters.Jiaozuo City is located in the Taihang Mountains and the plains of the Yubei transition zone, the northern Taihang Mountains, the southern Qinhe, the Yellow River impact plain.The terrain, high in the northwest, low in the southeast, complete with topography.The region can be divided into two first levels, two second level and nine landscape units.

3.2 Lithology

Lithological characteristics determine the strength and stress distribution of rock and soil, destroy the deformation characteristics of the foundation, but also its occurrence and development of the material basis. The strata exposed in the study area are mainly Archean metamorphic rocks, Sinian quartz sandstone, Ordovician system on the central part of the Majiagou lithology limestone, bioclastic rock, maculosus limestone, clip algae limestone and muddy dolomite and Carboniferous rocks. The bottom of the rocks is characterized by iron-rich clay rocks, aluminum-rich clay rocks, kaolin mines and clay minerals. The upper part is composed of gray-white dark-gray flint limestone, local quartz sandstone and clayey rocks, clay rock, gray cryptocrystalline limestone interbedded. The Quaternary sporadic scattered in the low-lying hillside and bottom of the valley. It is mainly composed of residual loess loess [5] .

3.3 Geological structure

Geological structure is the product of the crustal changes. Different tectonic units have different morphological characteristics and stress states, and different degrees of geological disasters. Different types of tectonics control the distribution of geological disasters [6]. The main faults in the area are the Fenghuangling fault and Pangesi fault. The northern part is located in the contact zone between North China Plain and uplift of Taihang Mountain. It has simple structure, no folds and faults, and some laughed flexures, mainly showing monoclinic structures with frequent tectonic activities. According to historical records, there have been many earthquakes in history in Jiaozuo and nearby areas.

3.4 Hydrogeological conditions

The main water-bearing rocks in the area are carbonate fractured karst water distributed in the Fenghuangling fault and Jiaozuo mining areas. The lithology of the aquifer is mainly Ordovician middle-lower limestone. The aquifer is located below the local erosion datum and is permeable to water. Among them, the structural fissures and karsts are developed and the water conductivity is good. Jiaozuo City, the overall over-exploitation of groundwater, local landing funnel [7].

3.5 Human activities

The continuous development of cities, the continuous enhancement of various human engineering activities and the worsening of the natural environment have caused many geological disasters [8]. Jiaozuo is a resource-based city dominated by coal mines, clay mines and construction raw materials. In recent years, open mining and distribution in the region have increased in area. Long-term uncontrolled exploitation of resources has triggered geological disasters such as ground subsidence, ground fissures, landslides, landslides and debris flows, aggravating the destruction of land resources and aquifers in Jiaozuo City, resulting in many geological Environmental issues such as water and soil pollution [9].

IV. Geological disaster prevention and control measures

4.1 Prevention and control goals and requirements

For the prevention and control of geological disasters, the principle of prevention first, combination of avoidance and governance and overall planning should be adhered to, and the principle of stressing priorities should be adhered to. The comprehensive prevention and control measures of geological disasters are the combination of administrative measures and engineering measures.

4.2 Administrative Measures

The main administrative measures are as follows:

（1）The adoption of administrative decrees to standardize the behavior of the masses has effectively controlled the increasingly prominent trend of man-induced geological disasters and reduced the incidence and loss of geological disasters so as to avoid huge casualties caused by disasters.

（2）Strengthen the prevention and control of geological disasters, monitor the development of disasters, make long-term monitoring of key geological disasters and key geological disasters in a timely manner, timely predict and early warning, improve the success rate of prediction and ensure the safety of life and property.

（3）Prohibit the construction of the project in the affected areas of geological disasters, in the geological hazard zone should be prohibited any activities that may induce or exacerbate geological disasters, engineering measures to geological disasters that have occurred deformation and damage, and carry out remediation work in an orderly manner [10].

（4）Take the initiative to avoid and passive evacuation.

4.3 Engineering measures

The main engineering measures are as follows:Rock and Soil Improvement Project;Drainage works;Biological vegetation project;Structural measures reinforcement.

V. Conclusion

It has great significance to explore the hidden dangers of geological disasters and actively take preventive and control measures so as to develop the city and the protection of people's life and property. Duing to the great harm of geological disasters and the wide range of points, coupled with the economic conditions are not allowed, it is difficult to achieve a comprehensive governance. Therefore, the establishment of geohazard mass detection and prevention system is an effective measure to effectively protect people's lives and property, and to achieve stability and well-being. Under the guidance of the department in charge of land and resources and relevant professional and technical units, publicity and training and the establishment of a disaster prevention system shall be carried out so that the people's governments at the county and township levels and the village (neighborhood) committees in areas prone to geological disasters organize the area enterprises and institutions and the broad masses of the people to master the basic knowledge and skills to investigate, inspect and easily monitor the precursors and dynamics of sudden geological disasters such as landslides, landslides and ground subsidence, realize the timely detection, rapid warning and effective avoidance of geological disasters.

References:

[1] Guo Yue, Lin Xiao-song.Complexity Analysis of Geological Disaster System [J]. Journal of Chongqing Teachers College (Natural Science Edition), 2011,18 (4): 1-7.

[2] Liu Chuan-zheng, Liu Yan-hui.Prevention and Control of Geological Disasters and Geological Environment Utilization[J].Journal of Jilin University Science Edition（Earth Science Edition）, 2012,42 (5): 1469-1476.

[3] Geophysical Prospecting Institute of Henan Province. Jiaozuo Geological Disaster Prevention and Control Planning [R] .2003.

[4] Xing Yong-qiang, Zhang Yu. Geological Disaster Characteristics,Distribution and Countermeasures in Lingbao City, Henan Province [J]. Journal of Henan University of Science and Technology (Natural Science Edition), 2006, (5): 372-376.

[5] Zhang Sen-lin, Yang Shu-min, Zhang Da-zhi, et al.Geological hazard risk analysis and prevention and cure measures in the collapse area of typical coal mines in Jiaozuo [J].Chinese Journal of Geological

Hazards and Prevention, 2010,21 (1): 57-59.

[6] Sun Yue-ying, et al. Characteristics of Geological Disasters in Yuntaishan World Geopark in China and Countermeasures for Prevention and Control [J]. Geological Prospecting Group, 2005, (3): 218-219.

[7] Second Bureau of Geology and Mineral Resources of Henan Province. Jiaozuo Geological Environment Report [R] .2004.

[8] Feng You-li, Luo Qing-wei.An risk assessment of ground collapse in goaf based on Rough set [J]. Journal of Henan Polytechnic University (Natural Science Edition), 2016,35 (6): 759-764.

[9] Xiao Jiang-bo, Liu Fu-you, Zhang Tao.Environmental and Geological Problems in Mineral Resources Development in Jiaozuo City [J]. Geological Hazard and Environmental Protection, 2006,17 (2): 45-48.

[10] Wang Xin-yi, Li Ren-zheng, Li Jian-lin.Evaluation and Restoration of Geological Environment in Mining Area [J].Journal of Henan Polytechnic University (Natural Science Edition), 2014, (5): 681-685.