Characteristics, Challenges and Suggestions of Geological Disaster Prevention and Control in China

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Abstract. Geological disasters are prone, predominant and frequent in China; China has become one of the countries with the most sudden geological disasters in the world. China has initially established comprehensive prevention and control system which take investigation and evaluation, monitoring and early warning, treatment and disposal as its core by the end of 2018. There are still many challenges in the prevention and control of geological disasters in China, first, the accuracy of survey and evaluation is obviously insufficient, second, the professional level of group monitoring and prevention needs to be improved, third, the prevention and control of geological disaster and land spatial planning have not been planned as a whole. Four suggestions are put forward: the first is to improve the accuracy of geological survey and evaluation, the second is to improve the monitoring and early warning capacity, the third is to increase the control of land spatial planning, and the fourth is to improve the scientific and technological support capacity.

Keywords: geological disaster; prevention and control; characteristic; effect; suggestion.

1. Sudden Characteristic of Geological Disasters in China
Influenced by the complex and diverse topographic features, geological conditions, and climatic types, geological disasters are prone, predominant and frequent in China, with a large number, wide distribution and great harm, China has become one of the countries with the most sudden geological disasters in the world.

1.1. One of the most serious countries with sudden geological disasters in the world
The high-prone areas of collapse, landslides, and debris flow were 1.12 million square kilometers by the end of 2018, and the medium-prone areas were about 2.73 million square meters [1].

From 2008 to 2018, a total of about 152000 sudden geological disasters occurred in China, resulted in 7035 deaths (excluding earthquake-induced geological disasters and death toll) [2]. According to the death toll statistics, 92% are situated in highly prone areas. Among them, Zhouqu mountain flood and debris flow, Sichuan Dujiangyan Sanxi Village, Guizhou Guanling, Sichuan Xinmo Village and other high-level remote landslides and debris flow caused about 1/3 of the death toll.
1.2. Geological disasters have many hidden danger points and great harm
By the end of 2018, there were 288,000 hidden perils of geological disaster across the country, potentially threaten the safety of 16 million people [3], and a large number of hidden perils of geological disaster had not been identified due to the restriction of survey means and accuracy.

1.3. Slowly changing geological disasters seriously affect urban safety
Slowly changing geological disasters such as surface subsidence and ground fissures are important factors affecting the urban safety in China. Due to the continuous over-exploitation of groundwater, the area of severe surface subsidence in the Beijing-Tianjin-Hebei Plain (annual s subsidence rate ≥50 mm), the area reach 1.15 square kilometers, and the situation of surface subsidence prevention and control is severe. There are more than 275 ground fissures longer than 1 km, which are mainly distributed in the North China Plain, Fenwei Basin, and the Yangtze River Delta [4]. The area of mine gob throughout the country is about 34.3 square kilometers, and there are more than 3,300 karst collapse disasters recorded across the country.

2. Geological Disaster Prevention and Control Work Has Achieved Results in China
At present, China has initially established comprehensive geological disaster prevention and control system centered on survey and evaluation, monitoring and early warning, comprehensive treatment and emergency management, which has strongly supported economic and social development.

2.1. Geological disaster investigation and evaluation is gradually deepened
According to the statistics of China Geological Survey, from 1999 to 2008, the survey and division of general geological disasters in 2020 mountainous and hilly counties in China were completed, and the group monitoring and prevention system was established.

From 2005 to the end of 2018, a total of 1517 counties (cities) have completed more detailed geological disaster survey, which support the construction of survey and evaluation, monitoring and early warning, comprehensive treatment and emergency management four major systems.

Since 2014, the geological disaster survey and risk assessment of mountainous and hilly areas have been launched, at present, only 62,000 square kilometers of geological disaster survey and risk assessment are completed [5].

2.2. The geological disaster monitoring and early warning system has been established
The technical support system for geological disaster prevention and control has been preliminarily established, such as the national geological disaster information platform. Innovate service products and effectively serve the needs of urban construction, land use planning, disaster prevention and alleviation.

The geological disaster risk are for government use has been formed, and the land use planning map based on geological disaster risk zoning has been prepared in combination with the current situation of land use, the geological disaster monitoring and early warning system is established, the land use planning map based on geological disaster risk area is compiled. The geological disaster monitoring and early warning system is established, which consists of group monitoring and group prevention, meteorological early warning and professional monitoring and early warning.

2.3. A number of large-scale geological disaster management projects have been implemented
From 2008 to 2018, the central and local governments allocated a total of 61.9 billion Yuan of special funds, implemented 1425 project treatment project of major geological disaster, and completed the relocation of more than 2.1 million people. In addition, the Three Gorges Reservoir area has invested 14.16 billion Yuan of special funds, completed 689 project management projects, and relocated about 90,000 people [6].
3. The Challenge of Geological Disaster Prevention and Control in China

China's geological disaster prevention and control work started late in comparison with developed countries, and faces many problems and challenges.

3.1. The accuracy of survey and evaluation is obviously not enough

Compared with developed countries, the survey and evaluation accuracy and land coverage are obviously not enough in China. For example, the United States, Italy and other developed countries have mostly carried out 1:10000-1:24000 scale high-precision geological disaster survey and risk assessment, while China has only carried out 1:200000 scale rough and 1:50000 scale preliminary survey, and the survey quality is uneven[7]. The basic theory of geological disaster, such as the disaster study, early identification of hidden dangers and accurate early warning and prediction, China still faces technical challenges.

3.2. The professional level of group monitoring and group prevention needs to be improved

The coverage of geological disaster monitoring is not professional and early warning accuracy is not enough in China, and the capacity of information, standardization and scientific and technological support is not enough. In general, the means of group monitoring and group prevention are backward, the application of new technology is not enough, and the uncertainty is large. The monitoring and early warning system based on group monitoring and group prevention is difficult to meet the needs of complex geological disaster prevention and control with high position, long distance and concealment, etc.

3.3. Geological disaster prevention and control and land spatial planning need to be planned as a whole

The geological disaster risk assessment work depth in some urban planning and construction, major projects is not enough, risk prevention and control measures are not enough; to strengthen ecological protection, control debris flow, land subsidence and other geological disasters need to take systematic measures, geological disaster prevention and control and land spatial planning, use control and ecological protection and restoration need to be planned as a whole, as special area of land spatial planning and use control, the high-risk areas of geological disasters are strictly controlled [8].

4. Suggestions on Strengthening the Prevention and Control of Geological Disasters

In order to build a solid foundation for geological disaster prevention and control, it is necessary to strengthen geological disaster survey and evaluation, monitoring and early warning, project management and control, strengthen land spatial planning and control, and improve the scientific and technological support capacity, so as to minimize casualties and the impact on economic and social development.

4.1. Improve the accuracy of geological survey and evaluation

Carrying out large-scale risk assessment of urban geological disasters, and complete the survey and assessment of hidden dangers in key geological disaster prevention and control areas as soon as possible. To further explore the existing potential geological disaster points and put forward classified management suggestions.

In order to improve the survey accuracy, the synthetic aperture radar measurement, high-resolution satellite image, UAV remote sensing, airborne laser radar and other technical means are comprehensively used.

To improve the degree and depth of project geological survey work and study the foundation of research principle, especially the project geological mapping of slope structure types and formation lithology that affect the distribution and development of regional geological disasters.
4.2. Improve the monitoring, early warning and prediction capacity
To improve the accuracy of regional geological disaster meteorological early warning, make early
warning and prediction for possible landslides and debris flows, and provide technical support for risk
avoidance decision-making.
To enhance the real-time monitoring and perception capacity of multi-source sky ground integration
of geological disasters, and focus on the integrated research and development of Beidou navigation
system, radar measurement and deformation sensor.
To improve the multi-source data acquisition, integration and comprehensive analysis capacity,
strengthen the interconnection and data comprehensive analysis of geological disaster information
system, and promote cross departmental coordination and linkage.
To improve the real-time and quasi real-time warning capacity of geological disaster accuracy, strive
to improve the accuracy of early warning and prediction and the amount of time in advance, and strive
for more time for the threatened people.
To build monitoring and early warning system with group and specialty, strengthen the emergency
drill of disaster prevention and avoidance, and improve the evacuation and avoidance capacity.

4.3. Strengthen the management and control of land spatial planning
The high risk area of geological disaster is regarded as a special area of land spatial planning and use
control; the areas that need to be moved and avoided strictly follow the requirements of spatial planning
and control, and the areas that are not suitable for construction should be strictly controlled, strengthen
engineering construction, avoid the rigid constraints of geological hazards, and reduce disaster risk from
the source.

4.4. Improve the support capacity of science and technology
To strengthen the basic theoretical research on disaster mechanism, monitoring and early warning and
prediction, and risk assessment, and the technical principles are combined with the needs of disaster
prevention administrative command. The integrated research and development such as Beidou
navigation system, radar measurement and deformation sensor are strengthened. Strengthening green
governance technology and promoting ecological governance. Promoting practical technology and
products, the talent teams are built and strengthen the building of expert teams and international
cooperation.

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