10.18686/gme.v2i2.4396

Risk and Response to Warm and Humidified Geological Disasters in China

Keshu Wang

College of Resources and Environment, Henan Polytechnic University, Jiaozuo Henan 454000

Abstract: Geological hazards caused by warming and humidification are particularly noticeable as the climate moves towards a warmer and more humid situation. Extreme temperatures and extreme rainfall events have led to an increase in the trend of landslides, avalanches and other geologic hazards. Strengthening the research and application of geohazard defense methods and technologies can reduce the occurrence of geohazards and the losses caused by them. This paper discusses the monitoring and prevention technology of geological disasters, analyzing the monitoring and prevention methods of geology.

Keywords: Warming and humidification; Geohazards; Monitoring; Extreme rainfall; Prevention

Introduction

The high temperature and extreme rainfall disaster events continuously triggered by global warming have caused great impacts on many aspects of China's economy, society, life safety and ecological environment [1]. The main types of geological disasters under the conditions of warm and humidified climate in China are glacial tundra geological disasters caused by high temperature and extreme rainfall and various secondary disasters caused by them. Therefore, it is more and more necessary to study the response to geological disasters caused by climate warming and humidification.

1. Geohazards and Risks of Warming and Humidification in China

1.1 Warming and humidifying geohazards in China

High-temperature and rainfall disasters caused by climate change are very different from those caused by earthquakes, typhoons and other disasters with strong short-term movements. Compared with sudden-onset natural disasters, disasters caused by climate change are characterized by long formation time, strong controllability, wide impact range, high disaster intensity and complex recovery process. Therefore, mastering the pattern of climate change can effectively predict the occurrence of geological disasters and carry out corresponding defense measures.

1.1.1 High-temperature geologic hazards

Increasing temperatures are often accompanied by the melting of glaciers and permafrost. As a large glacier resource country in the world, China has suffered serious losses in ecological environment and engineering stability in glacier-rich areas due to glacial geologic disasters triggered by glacier ablation. In addition to the impact of glacier ablation on water resources distribution, rising temperatures also have a negative impact on permafrost stability. Rising temperatures enhance the rate of glacier melting, so that the glacier body internal solid water into liquid water, reducing the shear strength of the glacier, the external flow of water convergence disaster glacier lake, elevating the surface of the glacier lake, increase the pressure of the lake with the lake shore, increase the possibility of glacier lake outburst.

1.1.2 Rainfall geohazards

Among the geohazard triggers, rainfall is one of the main causes that induce the occurrence of geohazards. The occurrence of geohazards such as avalanches and landslides is mostly related to the type of rainfall, the amount of rainfall, and the intensity of rainfall [2][3]. During the May-October flood season in China, the effect of long-term rainfall infiltration on the internal pore water pressure and soil pressure of the landslide body, the continuous rainfall infiltration increases the internal pore water pressure of the landslide body, so that the effective stress of the soil body decreases, thus reducing the shear strength of the entire slope body.

In the rainy season, when the intensity of rainfall is greater than the rate of rainwater infiltration, the excess rainwater is washed away downward along the gullies on the surface of the slope body. Loose rock and soil bodies, turbulent water flow formed by strong rainfall, and higher terrain differences are prone to form debris flow disasters in valley terrain. Landslides account for the vast majority of geological disas-

ters in China, but the casualties and property losses caused by a single mudslide disaster are more serious.

2. Warming and humidification disaster risk response

With the warming and humidification of China's climate, the geohazardous activities caused by extreme rainfall or extreme high temperature have gradually increased in the mountainous areas of southwest China and the yellow body of northwest China. Relevant literatures show [2][4] that the rainfall amount, rainfall duration and rainfall type have a significant effect on slope stability, especially in the pre-rainfall period and after rainfall.

2.1 Pre-geologic hazard monitoring

2.1.1 Pre-geological hazard monitoring content

The monitoring of geologic hazards mainly includes the measurement of ground deformation, groundwater, physical and chemical fields and triggering factors.

(1) Ground deformation monitoring mainly includes surface relative displacement monitoring, surface absolute displacement monitoring, deep displacement monitoring and macro-geological survey. This monitoring mainly monitors the displacement and deep displacement of the ground surface of the hidden geologic body during the formation of geologic disasters such as collapse, landslide, mudslide and ground subsidence. The ground monitoring data can be used as an important basis for the preliminary forecast and early warning of geologic disasters.

(2) Groundwater monitoring mainly monitors the groundwater level, pore water pressure and groundwater quality. Groundwater is closely related to the formation of geologic disasters. Groundwater level and pore water pressure have serious influence on slope stability.

(3) Physical and chemical field monitoring mainly includes geological stress field monitoring, radioactive elements, geomagnetic field, and other physical and chemical variables of the geohazard hazard body. Physical and chemical quantity monitoring has good predictability for the occurrence of geologic hazards, and can effectively predict the occurrence of geologic hazards and predict their dangers.

(4) The monitoring of triggering factors mainly monitors meteorology, rainfall, reservoir level and earthquake. Through the comparison of factors such as the amount of rainfall, the duration of rainfall or high temperature, etc., it can effectively predict the occurrence of geologic hazards and carry out preliminary defense of hidden geological bodies. In addition to the monitoring of natural factors, the triggering factors of geologic hazards also include human factors, and the influence of human engineering activities is also one of the important factors of slope destruction.

2.1.2 Main Technical Methods for Pre-geological Hazard Monitoring

With the development of geohazard monitoring technology. Geological disaster monitoring technology from single to diversified; monitoring instruments from simple to precision development. Traditional monitoring instruments, such as level meter, total station and other simple optical measuring instruments, have played an important role in the long-term monitoring of geological disasters, and are suitable for the monitoring of single geologic disaster sites. With the influence of global climate change in recent years, geological disasters caused by rainfall and high temperature have increased in China, with a wide distribution area and complex triggering mechanism, optical monitoring instruments can no longer meet the needs of geological work.

With the interpenetration between geology and other disciplines. Optical, electrical, computer and communication technologies are combined with the field of geological monitoring, and have made great development in the monitoring of geological disasters. Interferometric Synthetic Aperture Radar (InSAR), Airborne Laser Detection and Ranging (LiDAR), Global Navigation Satellite System (GNSS), and other technologies have been developed in the field of geohazard monitoring. Satellite System (GNSS) and UAV remote sensing technology and other monitoring means, greatly improving China's geologic disaster monitoring and early warning capabilities.

China's geohazard defense has begun to geohazard pre-monitoring transition. Then the research and development of China's geohazard technology, especially the discovery of undiscovered geohazard hidden spots and the monitoring of the formation mechanism of geohazards, can prevent geohazards in the early stage of geohazards to a greater extent, and realize the purpose of geohazard monitoring in the early stage of geohazards, i.e., to reduce geohazard occurrences.

2.2 Engineering measures for geohazard defense

Geological hazards, in the final analysis, are threats to the survival and development of human beings caused by the violent movement of geological bodies (collapse, landslide, mudslide, ground subsidence, etc.) under the influence of external forces (natural and man-made factors) in the geological environment where we live. In recent years, under the influence of climate warming and humidification, geological disasters caused by rainfall and high temperature in China have increased, posing a serious threat to the development of many regions in China.

China's economic development has led to the rapid development of the engineering business, and the consequent increase in a variety of engineering projects, civil engineering construction, especially in geotechnical engineering. In the context of climate warming and humidifica-

tion, the use of effective geotechnical engineering measures and bio-engineering measures for the defense of geologic disaster potential sites, and strive to achieve the realization of geologic disaster pre-monitoring and pre-prevention at the same time, reduce the possibility of geologic disaster release, and to reduce losses from the root cause of the disaster.

2.3 Public geohazard prevention

Public geohazard prevention is a general term for mass monitoring and prevention of geohazards [5]. Public geohazard prevention utilizes the local people's familiarity with hidden hazards and long-term monitoring of geohazard zones through relatively simple means, which can effectively monitor and prevent geohazard pre-hazard activities. It is an effective method for the public to quickly save themselves and reduce casualties and property losses.

3. Conclusions

(1) Climate warming and humidification have caused an increase in various types of geological disasters in China, especially in recent years, when many atypical geological disasters have occurred under extreme rainfall and extreme high temperatures. Therefore, in the context of climate warming and humidification, it is necessary to strengthen the monitoring of geological disasters and self-investigation of geological disasters.

(2) The concept and method of combining engineering technology and plant ecological restoration has gradually become a new technology that needs to be researched in the management and restoration of geohazards. In ecological restoration, the investigation of plant planting conditions, plant selection, planting program, and post maintenance are all important conditions to improve plant restoration of slope instability.

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