Development of disaster analysis and rescue treatment standard in plateau and ultra cold area of China

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Abstract

This paper compares the different definitions of plateau and ultra cold area by various institutions and gives the geographical definition of plateau and ultra cold area in China. On the basis of what has been down above, the types, frequency, effects and rescue situation of the disaster in the plateau and ultra cold area of China are described. This paper analyzes the site placement and equipment allocation requirements of disaster rescue in plateau and ultra cold area, combs out the standard formulation and patent authorization of disaster rescue in plateau and ultra cold area, and points out the direction of the disaster rescue equipment system and standard system construction in plateau and ultra cold area in China.

Keywords: plateau and ultra cold area, emergency rescue, equipment system, standard system ,disaster rescue site placement

Introduction

China's plateau and alpine region has a vast area and is the country with the largest plateau population in the world. Among them, the Qinghai-Tibet Plateau covers an area of more than 2.4 million square kilometers, accounting for about 1/4 of the national land area and has a permanent population of about 10 million. The Qinghai-Tibet Plateau is a region with strong earthquake activity and frequent occurrence of large earthquakes. The number of large earthquakes above 7.0 ranks first in the country's earthquake regions. It is also a region with high occurrence of natural disasters such as landslides and mudslides, causing huge casualties and property losses. Due to the special terrain and climate characteristics in high altitude and cold regions, higher requirements are put forward for disaster emergency rescue and on-site resettlement support capabilities. More and more attention has been paid to disaster rescue and disposal in high altitude and cold regions. China has developed a number of rescue equipment suitable for high altitude and cold environments and promulgated a number of equipment-related standards for high altitude and cold regions, providing better equipment support and technical guidance for disaster rescue in high altitude and cold regions.

1 The definition of plateau and ultra cold area

The definition of plateau and ultra cold area "Plateau alpine region" is a relatively vague definition, which usually refers to the plateau region in western China and the cold region in high latitude.

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1.1 Definition of Plateau Region in China

The definition of plateau range is different in different documents and standards. According to teaching materials such as "Fundamentals of Geology", geography defines a plateau as a vast area with an altitude of more than 1,000 meters and relatively flat or undulating terrain. In medicine, 3000 meters is defined as the critical height of human response, so the plateau above 3000 meters is called "medical plateau" in medicine. The national standard "Environmental and Technical Requirements for Mechanical Products-Plateau Environment" (GB/T14093.3-2009) divides plateau areas into five grades according to altitude: 1000m, 2000m, 3000m, 4000m and 5000m m. According to the provisions of the national standard "plateau machinery under special environmental conditions part I: requirements for plateau internal combustion power machinery" (GB/T 20969.1-2007), plateau environmental conditions refer to the environmental conditions in areas above 2,000 m altitude. The reason for these different definitions is that different data have different concerns. Although the height of 1,000 m is a geographical plateau, it has little impact on internal combustion power machinery and other equipment, and there is no need for special specifications. However, the formulation of this annotation mainly focuses on two aspects: one is the impact of plateau environment on emergency rescue equipment; The second is the impact of plateau environment on human body. The definition of plateau environment is also based on these two perspectives. Therefore, plateau environmental conditions are defined as the environmental conditions in areas above 3,000 m in altitude according to relevant national standards.

1.2 Definition of ultra cold area in China

In fact, this is only a common statement, not a standard statement, for the definition of alpine range. According to the national standard "Temperature and Humidity in Natural Environmental Conditions of Electrical and Electronic Products" (GB/T4797.1-2005), the usual cold environment mainly includes "cold", "cold temperature I" and "cold temperature II". Among them, the average value of annual extreme value of daily average temperature in "cold" climate region is the lowest -40℃, the highest 25℃, the average value of annual extreme value is the lowest -50℃, the highest 32℃, the absolute extreme value is the lowest -60℃, the highest 40℃; The average value of the annual extreme value of the daily average temperature in the "cold temperature I" climate zone is the lowest -29℃, the highest 29℃, the average value of the annual extreme value is the lowest -33℃, the highest 37℃, and the absolute extreme value is the lowest -40℃ and the highest 40℃; The average value of the annual extreme value of the daily average temperature in the "cold temperature ii" climate zone is the lowest -26℃ and the highest 22℃, the average value of the annual extreme value is the lowest -33℃ and the highest 31℃, and the absolute extreme value is the lowest -45℃ and the highest 34℃. The climatic regional distribution map given by this standard is shown in the figure. It can be seen that "cold" climate areas are mainly distributed in the high latitudes of northeast, inner Mongolia and Xinjiang, and "cold temperature I" and "cold temperature ii" are mainly located in northeast, inner Mongolia, Xinjiang and Qinghai-Tibet plateau.

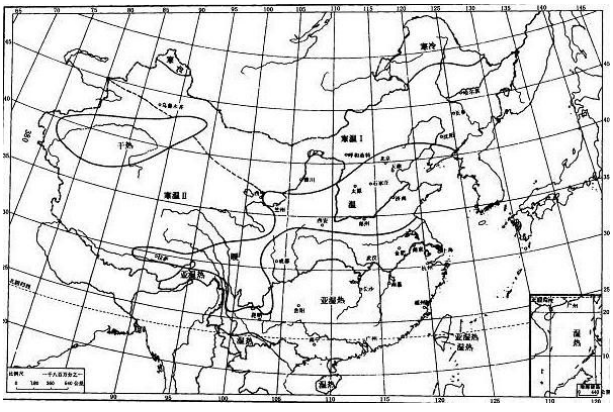

Figure 1: Regional distribution of climate in China

2 The types and general situation of disasters in plateau and ultra cold area

Different types of disasters have different requirements for emergency rescue equipment and methods, so the formulation of standards should first clarify the types of disasters. The following natural disasters are common in China's high altitude and cold regions.

2.1 Earthquake

Earthquakes are the most destructive natural disasters in high altitude and cold regions. Qinghai-Tibet Plateau is located at the edge of Indo-sub-plate. Affected by plate movement and compression, earthquake disasters are very intensive. It is the largest earthquake area in China, with the number of earthquakes with magnitude 7 or above ranking first in the country (as shown in Figure 2).

2.2 Snow Disaster

Snow disaster refers to a kind of meteorological disaster that occurs after a heavy snowfall or continuous snowfall weather process, with large-scale snow accumulation, strong cooling and strong wind weather, causing serious harm to animal husbandry production and daily life. Qinghai-Tibet Plateau is a snow disaster-prone area in China, which occurs almost every year. Due to the influence of topography and climate characteristics, the frequency of snow disasters varies in different regions. Meteorology generally regards snow depth $\geqslant$5cm and continuous snow days $\geqslant$7 days as a snow disaster process in grassland pastoral areas. Snow disasters occur mainly from October to March of the following year, and there are also snow disasters from individual years to May or even June of the following year. From October 2003 to February 2004, 69 heavy snows lasting four months reduced the grassland in northern Tibet to a piece of Xue Hai. Ice and snow covered 380,000 square kilometers of grassland in Naqu region, with an area equivalent to the total area of Shandong, Jiangsu and Anhui provinces in eastern China.

2.3 Drought

Precipitation in the Qinghai-Tibet Plateau mainly comes from the southwest monsoon of the Indian Ocean. May-September is the wet season, and October-April is the dry season. More than 80% of the precipitation is concentrated in the wet season. Therefore, large-scale droughts often occur in the Qinghai-Tibet Plateau, with varying degrees of drought almost every year. There are two drought-prone areas on the Qinghai-Tibet Plateau. One is the southern part of Tibet's Naqu region, the northern part of Xigaze region and the surrounding area of Lhasa city. The other is the northeast of Qamdo and the border between Qinghai, Sichuan and Tibet. The average annual drought frequency in these two regions is above 50%, i.e. drought occurs once in less than two years on average. In the periphery of these two drought centers and the vast areas in the south, the drought frequency is also above 40%.

2.4 Flooding

Compared with the eastern region of China, the frequency of floods on the Qinghai-Tibet Plateau is not very high, but due to the large slope and unstable geological conditions, the hazards are very great. From May to September of each year, the warm and humid air from the tropical ocean flowing northward from the Indian Ocean merges with the cold air flowing southward, which is easy to form heavy rain and causes floods on the plateau. Mountain torrents here generally occur in the gullies of mountain areas, mainly including high-altitude heavy precipitation mountain torrents, snowmelt mountain torrents and glacier melt mountain torrents. Due to the steep mountains and steep slopes in the Qinghai-Tibet Plateau, the flood convergence time caused by heavy precipitation is short. Although the flood formed is short, its intensity is high. Flash floods often occur, destroying buildings, flooding farmland and causing casualties to people and livestock.

From the above analysis, we can see that the earthquake is the natural disaster that has the widest influence, the strongest damage and the greatest threat to public safety in the Qinghai-Tibet Plateau region. Snow disasters occur to varying degrees almost every year, posing a great threat to the personal and property safety of local farmers and herdsmen. The border areas of Shannan in Tibet, southern Qinghai and northwestern Sichuan are the centers of high incidence of snow disasters. Drought mainly occurs in spring and summer, which has a great impact on crops and grassland pastures. It often causes large-scale diseases and insect pests. The southern part of Naqu, the northern part of Shigatse and the surrounding areas of Lhasa, the northeastern part of Qamdo and the border

areas of Qinghai, Sichuan and Tibet are two drought-prone areas. Although the frequency of flooding is not very high, it is very destructive because it often causes secondary disasters such as collapse, landslide and debris flow. Therefore, the types of disasters for which the equipment and technical standards are compiled are mainly earthquakes, taking into account snow disasters, droughts, floods and other disasters.

3 Demand Analysis of Disaster Rescue Equipment in Plateau and Alpine Areas

First, the equipment performance requirements are closely related to human physiological needs. The core function of survival support equipment is to guarantee people's basic survival or living conditions in different aspects, so the equipment performance requirements must meet the physiological needs of different aspects of the human body. Under different external environment and different guarantee time conditions, human physiological requirements have different requirements on equipment performance. For example, in extremely cold environments, accommodation support equipment must have good thermal insulation performance and sufficient warming capacity; When the ambient temperature is higher, pathogens and vectors will become more active, and the performance requirements for disinfection, disinfestation and garbage disposal of health protection equipment will be higher. Under short-term emergency conditions, the human body has lower requirements for drinking water quality, and the water purification performance requirements of catering equipment can be appropriately reduced.

Second, the safety and reliability requirements of equipment are higher than those of ordinary support equipment or facilities. After the disaster, the living environment of the disaster-stricken people is harsh, and they lack all-round normal guarantee conditions. They can only rely on survival guarantee equipment to provide basic survival or living guarantee. Therefore, survival support equipment is closely related to the life safety of disaster victims and must have higher safety. Survival support equipment generally works in the field. Natural conditions such as altitude, temperature, radiation, wind and sand have a significant impact on equipment performance, which puts forward higher requirements on equipment reliability and environmental adaptability. Similar to other emergency equipment, survival support equipment generally has the characteristics of strong mobility, easy deployment, repeated use, etc., which is higher than the requirements of ordinary life support equipment or facilities.

Third, the equipment has more similar functional components. Survival support equipment is to ensure the basic survival or living needs of people as the core function, with some similar functional modules, including internal combustion power system, hydraulic system, air pressure system, combustion system, electrical system, materials, etc., and these functional modules are vulnerable to environmental impact. Some parts or products of survival support equipment are in direct contact with human body, and their hygiene, human-computer interaction and human adaptability also have higher requirements. From the above analysis, it can be seen that it is not only necessary but also completely feasible to determine the type of equipment as survival support equipment to ensure the basic survival needs or living conditions of the disaster victims, such as accommodation, diet, energy, sanitation, etc., and to put forward general technical specifications or standards for survival support equipment in high altitude and cold environment.

4 Formulation of disaster rescue and disposal standards in plateau and alpine regions

4.1 General Situation of Standards

At present, China has formulated some basic national standards for plateau environment and cold environment, but there are no technical standards for plateau environment and cold environment specifically for special equipment categories such as emergency resettlement support equipment. In terms of product standards for survival support equipment, there is a huge gap between military and civilian product standards, with only a few product standards. The construction of the standard system has a long way to go. Although there is still a long way to go, these existing standards can provide a very useful reference for the formulation of this standard, which is an important content to be studied for the formulation of rescue technology and equipment standards in high altitude and cold areas.

4.2 Technical Standards for Plateau Environment and Cold Environment In order to lay a much-needed standard foundation for the development and construction of China's western region, a special

national science and technology foundation project "Material Standards for Extreme (Special) Environmental Conditions" was launched at the beginning of the 21st century. Basic national standards were formulated through the research on special environmental conditions, major engineering foundation materials and mechanical and electrical products on the plateau. The content involves plateau electromechanical equipment standard system, special environmental terminology, classification of special environmental conditions, general principles of protection types, guidelines for high altitude artificial simulation tests, metal materials, polymer materials, main electromechanical equipment and requirements for plateau adaptability of engineering machinery and equipment. These standards put forward the most basic requirements for the environmental adaptability requirements, test and inspection methods of mechanical products and electrical and electronic products in plateau environment and cold environment, and are the basis for the formulation of subsequent standards.

4.3 Emergency Resettlement Support Equipment Product Standards China's emergency resettlement support equipment products have not yet formed a system, and the newly emerging products in the market in recent years, such as staple food processing vehicles, fuel delivery vehicles, shower vehicles and other catering, energy and health support equipment, lack corresponding standards and specifications. For accommodation support equipment, the Ministry of Civil Affairs has formulated a series of industry standards for relief tents, as shown in Table 1.

Table 1: standard for rescure tent in frigid plateau region

No.	Parameter	Value
1	MZ/T 011.1-2010	Relief Tent Part1:8m^2 Single tent
2	MZ/T 011.2-2010	Relief Tent Part2:12m^2 Single tent
3	MZ/T 011.3-2010	Relief Tent Part3:36m^2 Single tent
4	MZ/T 011.4-2010	Relief Tent Part4:12m^2 Cotton tent
5	MZ/T 011.5-2010	Relief Tent Part5:36m^2 Cotton tent
6	MZ/T 011.6-2010	Relief Tent Part6:Toilet tent
7	MZ/T 011.7-2010	Relief Tent Part7:Tent coating cloth
8	MZ/T 011.8-2013	Relief Tent Part8:Tent for frigid plateau

5 Research and Development Direction of Disaster Rescue Equipment in Plateau and Alpine Areas

In order to ensure the scientificity and authority of the standard formulation, it is necessary to carry out in-depth research on basic theories such as environmental parameters, equipment failure mechanism, human physiological effects and so on in high altitude and cold regions, so as to consolidate the theoretical basis of the standard. 5.1. Environmental Parameters in High Altitude and Cold Areas Environmental parameters in high altitude and cold regions are the basis for studying equipment failure mechanism and human physiological effects. At present, through literature research, we have preliminarily mastered the environmental parameters in high altitude regions of China, as shown in Table 2. However, these parameters are not specific enough and need further in-depth study.

Table 2 Table of Environmental Characteristics in Plateau Region

altitude/m		0	1000	2000	3000	4000	5000
atmospheric pressure/kpa	annual mean	101.3	90	79.5	70.7	61.3	53.9
	minimum	97	87.2	77.5	68	60	52.5
air density (kg/m^3)		1.282	1.112	1.006	0.892	0.802	0.719
oxygen content in air (g/m^3)		299.3	280.5	253.4	209.6	182.1	159.7
air temperature /℃	annual mean	20	20	15	10	5	0

	minimum	5	-5	-15	-25	-40	-45
average annual ultraviolet radiation intensity (w/m^2)		54	57.7	61	65	67.7	71
absolute humidity of air(g/m^3)	annual mean	11	7.6	5.3	3.7	2.7	1.7
	minimum	3.7	3.2	2.7	2.2	1.7	1.3
water boiling point /℃		100	96.9	93.8	90	87	84

5.2 Failure Mechanism of Equipment in High Altitude and Cold Environment In order to fully study the failure mechanism of equipment in high altitude and cold environment, the influence law of the characteristics of high altitude and cold climate environment on each system of equipment is preliminarily combed (see Table 3). Later, research will be carried out item by item according to the requirements of standard compilation to lay a theoretical foundation for proposing technical specifications for equipment in high altitude and cold environment.

Table 3 Influence on equipment systems in frigid plateau environment

Equipment	Climate and environmental factors	Impact
power system	low air pressure, low oxygen content, low temperature, low air density, low boiling point, strong sandstorm	the air volume of the engine cylinder decreases, the combustion deteriorates, the fuel consumption rate increases, the output power decreases, the fuel viscosity increases, the output power of the storage battery decreases, the starting is difficult, the gas viscosity resistance is large, the matching between the internal combustion engine and the supercharger is misaligned, the cooling performance deteriorates, the water-cooled diesel engine is prone to the phenomenon of "boiling", the effect of the air filter deteriorates, and the wear of the engine cylinder piston intensifies.
electrical system	low air pressure, low temperature, large temperature differen-ce between day and night, dry, low air density	the insulation strength decreases, and the phenomenon of discharge and even breakdown is easy to occur. transistors and other devices are difficult to trigger; the system structure is easy to crack and generate static electricity. heat dissipation is difficult, temperature rise increases, and the on-off capability of switching devices using air medium to extinguish arc decreases.
hydraulic system	low air pressure, low air density,	the pressure of the hydraulic oil tank is insufficient, the oil absorption performance of the oil pump is reduced, the heat dissipation capability is deteriorated, the oil temperature is increased, the sealing performance is deteriorated, the hydraulic oil is easy to deteriorate, and the wear of various hydraulic components is accelerated。
pressure system	low temperature, strong sandstorm	the intake and exhaust volume of the air compressor are reduced, and the driving force of the air pressure system is reduced. the heat dissipation capacity of the air compressor is deteriorated.
combustion system	low air pressure, low oxygen content and low air density	the mixed gas becomes thicker and the burner is difficult to ignite. insufficient combustion and reduced heat production.
instruments	low pressure, low temperature, large temperature differen-ce between day and night	cause zero drift, lower precision, poor repeatability and measurement error.
mechanical system	low temperature, large temperature differen-ce between day and night, strong dust	the mechanical properties of the mechanical structure are deteriorated, and the movement link cannot move due to icing. friction piece shrinks, fit clearance changes, exacerbating mechanical wear.
material	strong ultraviolet radiation, low temperature, large temperature differen-	the mechanical properties of metal and polymer materials are reduced and the aging speed is accelerated. viscosity of various oils increases.

	ce between day and night strong sandstorm	

5.3 Human Physiological Effects in High Altitude and Cold Environment

The study of human physiological effects in high altitude and cold environment, on the one hand, is to find out the basic survival and living needs of disaster-stricken people and rescue workers under special environment. There are few systematic quantitative studies on the basic survival or living needs after disasters in China. There is no strict standard for disaster resettlement, which is generally implemented according to experience. In all previous disaster resettlement, especially in special environmental disaster resettlement, there are many life or health safety problems caused by inadequate protection. Therefore, a comprehensive and systematic grasp of the basic survival or living needs of various environmental personnel and the implementation of scientific and accurate protection in disaster resettlement are outstanding difficulties faced by disaster relief resettlement. On the other hand, in order to find out the occurrence mechanism, evolution and prevention laws of diseases related to high altitude and cold environment that occur to the affected people and rescue personnel, reasonable emergency rescue procedures and guidelines can be put forward accordingly, which is the theoretical basis of disaster rescue emergency management standards in high altitude and cold areas.

Conclusion

Severe environment, complex climate and geographical environment in high altitude and cold regions will have a great impact on emergency rescue equipment. On the basis of the existing standards, the establishment of a standard system and technical specifications for emergency rescue equipment in high altitude and cold areas plays an important role in improving rescue efficiency and protecting people's lives and property, and more human, material and financial resources should be invested for research.

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