The Climate of Driving Force Analysis of the Permafrost Degradation in Daxinanling*

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Abstract: Human being have ignored the permafrost degeneration problem which results in the environment deterioration in Daxinganling. This article analyses the temperature, run off and snow depth data which were from 1971—1995 of local weather station and hydrology station in Daxinganling area and discloses the climate driving force and the main procedure of permafrost degeneration.
Keywords: daxinganling, permafrost, driving force

1 The problem of permafrost degradation in daxinganling

The permafrost can be divided into high altitude permafrost and high latitude permafrost. High latitude permafrost is distributed in the north side of the north-east of China, the area is about 38×10^4 km^2—39×10^4 km^2, and mostly distributed in Daxinganling, which is the south edge of Europe-Asia permafrost. Daxinganling is in the cool temperate-climate area. The average temperature is –1.5℃—4.3℃ in the south and –5℃— –7℃ in the north of the area. The minimum temperature is –52.3℃. The high latitude permafrost is divided into 3 types[1]—the large connective permafrost, the island-thawing permafrost and island permafrost by average atmosphere temperature, average soil temperature, the thickness of permafrost and its distribution.

Table 1 The fundamental characteristics of high latitude permafrost in the north east of China [2]

Type	Area (10^4km^2)	Average Atmosphere Temperature (℃)	Average soil Temperature (℃)	The connective degree (%)	The thickness of permanent frozen soil (m)
The large connective permafrost	6.16	<-5.0	-1—-2.5	70—80	50—100
The island-thawing permafrost	7.29	<-3.0	0.5—-1.5	50—60	20—50
The island permafrost	25.23	0—-3.0	0—-1.0	5—30	5—20

From the table, we can know that the connective degree and the thickness of the permafrost are increasing with the latitude increasing and temperature decreasing. This latitude distribution characteristic of permafrost is formed by climate, topography and water moisture.

The large permafrost and island –thawing permafrost are mostly distributed on the mountain area in the north of *Larix Gmelinii* virgin forest, where the *Larix Gmelinii* is the superior plant. The plant types

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are very complex in the island-thawing permanent frozen area. Between the edge of large area of permanent frozen soil and island-thawing permanent frozen soil, some places are needle forest superiorly habited by *Larix Gmelinii*, some places are needle forest habited by deciduous trees and needle trees, but mostly by *Larix Gmelinii*, the other places are forest grass land .The forest succession is related with permafrost very closely. From the history distribution of *Larix Gmelinii*, we know that the permafrost extinction or degeneration were in the same step with the withdrawing of *Larix Gmelinii*. Much research data shows that the high latitude permafrost in Daxinganling is withdrawing to north drastically. Comparing with the last ice age, the south edge of permafrost has withdrawn about 100 km—150 km[3]. The fundamental characteristic in permafrost is that the soil temperature is increasing, the thawing thickness is increasing in warmer season and the island thawing area is increasing.

When the average air temperature increase 4℃ and precipitation increase10%,the forest in the north-east of China will move 3—5 in latitude[1]. At that time, *Larix Gmelinii* will all move out of China and it will be replaced by the temperate grass land, the conifer and deciduous forest.[4-5] Without forest, the permanent frozen forest will degrade more quickly and even disappear from this place.

2 The climate driving force analysis of permafrost

The permafrost in this area is formed by climate and geography, and is affected very drastically by climate change.

2.1 The atmosphere temperature change analysis

The chart is the temperature data from Tulihe weather station (N50°30′,E121°28′) which is in the south edge of the permafrost and the Boketu weather station (N48°46′, E121°55′) which is in the center of the island-thawing permafrost from 1971—1995. From the data, we can see that the temperature is in a fluctuated status, and the main trend is in an increasing status.

From the temperature data of Tulihe weather station, the average temperature was –5.0℃ from 1971—1981 and –4℃ from 1982—1995, the average temperature had increased –0.4℃. From the temperature data of Boketu weather station, the average temperature was –0.8℃— –0.2℃ in the same stage. This result conforms to temperature increasing trend of all of the globe.1980s was the warmest in the past 100 years, and this trend would continue in the 1990s. From global scale, the average temperature got to the highest in1990. The average temperature was –2.7℃ and 0.9℃ in Tulihe and Boketu respectively in 1990 and was the warmest year from 1971—1995.

From Fig.1, the temperature increasing was in different levels, the temperature increase more quickly in north area than in the south area. The temperature-increasing slope was becoming more drastically after 1988. This was the most important reason that the large connective permafrost is degeneration more drastically.

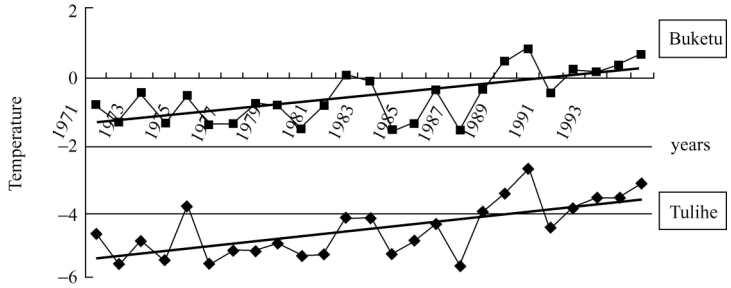

Fig.1 Curves of mean annual air temperature in Tulihe and Buketu (1971—1995)

2.2 The changes in snow depth

The Fig.2 shows the maximum snow depth in Tulihe weather station from 1980—1995. From

analysis, although the temperature was becoming warmer, the snow was increasing at the same time in the large permafrost area. With the snow depth increasing, the heat could not emit out, the ground temperature was becoming higher and higher. So the upper edge of the permafrost would decrease.

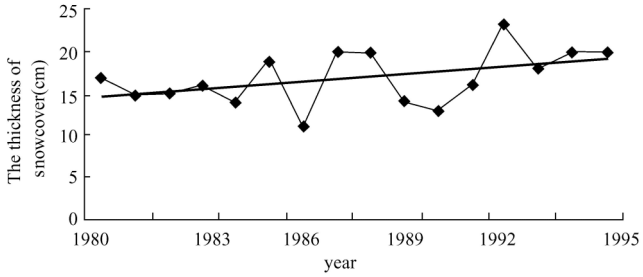

Fig.2 Curves of mean annual thickness of snowcover in Tulihe (1980–1995)

2.3 The changes in the surface run off

To analyses the permafrost degeneration in Daxinganling, especially in the large permafrost area, we had collected the hydrology data of this area. The hydrology stations are Jiliuhe river hydrology station (N52°09′,E121°45′), Genhe river hydrology station(N51 4′,E121°45′) and Niuerhe river hydrology station(N50 3′,E121°42′). The 3 stations are all in the large permafrost area and in the same longitude and different latitude. From the data selected from 1973—1988, the run off of the 3 rivers was increasing.(Fig.3) We cannot decide whether there is any direct relationship between permafrost degeneration and the run off increasing, but from the weather data the precipitation had not been increasing at the same time. Where the run off came from and how permafrost controlled the ground water time and space distribution need be researched in the future.

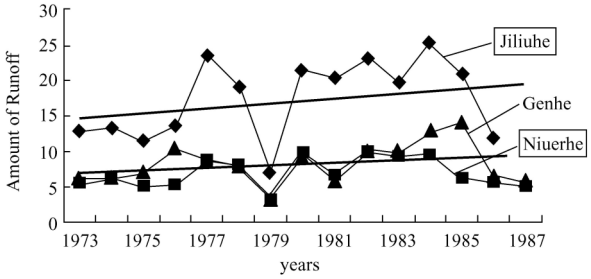

Fig.3 Curves of mean annual runoff in Jiliuhe, Niuerhe and Genhe (1973—1988)

3 Result and discussion

The most important driving force of the permafrost degradation in Daxinganling is global climate warming, and the degradation of permafrost will promote the extinction of Daxinganling virgin forest. The extinction of the forest will change the land use pattern.

Daxinganling permafrost is distributed in the south edge of Europe-Asia continent permafrost. The thickness of the permafrost is very thin, so it is very sensitive with the change of outer side. So Daxinganling permafrost degeneration should be monitored in the long term. The permafrost obviously has belt distribution characteristics, which is the distinguishing content in the forest ecosystem stand site monitoring. The permafrost degeneration in Daxinganling is affected by the global climate warming. The scientifically policy making is the foundation of sustainable development. The virgin forest conversion should be related with permafrost Conversion. The nation should support scientists to research in the field of how to conserve the fragile forest ecosystem.

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