Estimation of wind erosion rates of Mongolian Plateau by using ^{137}Cs tracing technique

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Abstract: *Estimation of wind erosion rates of Mongolian Plateau by using ^{137}Cs tracing technique*. Wind erosion is one of the major environmental problems in semi-arid and arid regions. Here we established a transect from northwest (Tariat, Mongolia) to southeast (Xilingol, Inner Mongolia of China) across the Mongolian Plateau, and selected eight sampling sites along the transect. We then estimated the soil wind erosion rates by using the ^{137}Cs tracing technique and examined their spatial dynamics. In the Mongolia section (from Tariat to Sainshand), the wind erosion rate increased gradually with vegetation type and climatic regimes; the wind erosion process was controlled by physical factors such as annual precipitation and vegetation coverage, etc. While in the China section (Inner Mongolia), the wind erosion rates of Xilinhot, Zhengxiangbai Banner and Taipusi Banner were thrice as much as those of Bayannur of Mongolia, although these four sites were all dominated by typical steppe. Besides the physical factors, higher population density and livestock carrying level should be responsible for the higher wind erosion rates in these regions of Inner Mongolia.

Key words: Mongolian Plateau, wind erosion, ^{137}Cs tracing technique.

INTRODUCTION

As an important indicator of land desertification, wind erosion is one of the major environmental problems in semi-arid and arid regions worldwide (Lal 1994; Fryrear and Lyles 1997; Shao 2000), including the Mongolian Plateau. The main part of the Mongolian Plateau belongs to Mongolia in the north and Inner Mongolia Autonomous Region of China in the south and east. The plateau is an intracontinental region in East Asia, with the typical continental climate of rare annual precipitation and frequent drought and windy episodes during the whole winter-spring season. Wind erosion is an important geo-process that can result in regional land degradation and dust storms. And the dust storm is regarded as one of the most severe environmental problems in North China and East Asia (Husar et al. 2001; Natsagdorj et al. 2003). Moreover, the Mongolian Plateau is also a sensitive region of global climate change (Zhuang et al. 2003; Uno et al. 2006).

The traditional methods used to assess and monitor the wind erosion process are time-consuming, inefficient and costly. Moreover, it is difficult to obtain reliable estimates of wind erosion rates from short-term field studies (Lal 1994;

Fryrear and Lyles 1997; Shao 2000). The ^{137}Cs tracing technique has been improved during the last 40 years and is currently considered as one of the major techniques for estimating soil erosion rates. This technique was originally used for water erosion studies, but has been applied to estimate wind erosion rates since the 1990s (Harper and Gilkes 1994; Yan et al. 2001; Hu et al. 2005; Yuichi et al. 2007; Zhang et al. 2007).

We collected soil samples from a number of sites with different vegetation types along the Tariat-Xilingol transect across the Mongolian Plateau. The objectives of this study were to estimate the wind erosion rates of the sampling sites using the ^{137}Cs tracing technique and to assess the regional pattern of wind erosion along the study transect.

Study area

The Mongolian Plateau is a special morphologic zone on the Eurasia continent. As a closed continental upland, it is surrounded by high-mid mountains including Greater Hinggan, Sayan and Altay mountains and has a long distance to the ocean. The plains and the high mountains shape the main body of physiognomy feature of the Mongolian Plateau. The climate is of typical arid and semi-arid continental mode, with mean annual precipitation less than 400 mm, a long cold winter, and a drought windy spring. Severe wind erosion can cause heavy dust storms. The plateau is believed to be the major dust source of the North China and East Asia (Zhang et al. 2003; Uno et al. 2006).

The Tariat-Xilingol transect spanned a 1,400 km spatial gradient from Tariat region (99°E and 49°N, in Mongolia) to Taipusi Banner region of Xilingol (116°E and 42°N, Inner Mongolia, China), and traversed the main wind erosion region of the central Mongolian Plateau (Fig. 1). We chose this transect because it constitutes dust sources and dust moving routes (Zhang et al. 2003) and a spatial gradient in both climate and vegetation types. From northwest to southeast, the
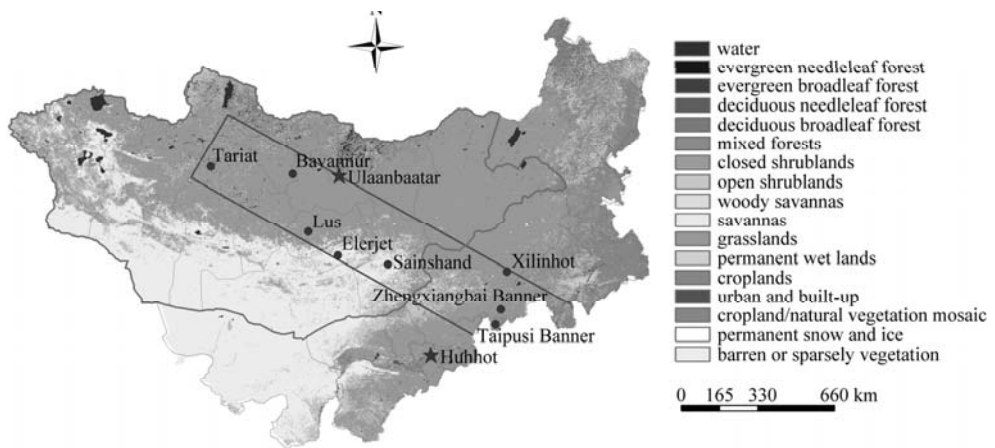

FIGURE 1. The Tariat-Xilingol transect and sampling sites with MODIS land cover background on the Mongolian Plateau

transect crosses Arkhangai, Bulgan, Ovorkhangai, Dundgovi and Dornogovi of Mongolia, and Xilingol of Inner Mongolia, China. Most previous studies focused on land use, soil carbon dynamics, and wind erosion rates in the Inner Mongolia region (Liu et al. 2003; Hu et al. 2003), and few studies were conducted in Mongolia (Yang et al. 2004; Dill et al. 2006;Yuichi et al. 2007). Along the transect from north to south, the vegetation type changes from forest steppe, typical steppe, desertification steppe, steppe desert, Gobi desert, typical steppe to farming-pastoral grassland. Thus, the transect covers the major vegetation and ecological types of the wind erosion region on the Mongolian Plateau (Yang et al. 2004; Dill et al. 2006).

Sample collection and analysis

The soil samples were collected three times. The first field trip was conducted in Tariat, Bayannur, Lus, Elerjet and Sainshand in the Mongolia section of the transect, the second and third field trips were conducted in Xilinhot, Zhengxiangbai Banner, and Taipusi Banner in Xilingol of Inner Mongolia, China (Fig. 1). We chose these 8 sample sites after we thoroughly considered the causing factors of wind erosion such as vegetation types and the intensity of human activities. Table 1 provides detailed descriptions for the sampling sites. The Tariat sampling site (RS1) with forest steppe is located in the north slope of Hangai Mountain where the dominant vegetation type is typical *Carex* meadow steppe on the taiga forest edge. Bayannur is located in the grazing zone of Tura River basin, with the typical steppe of the north Mongolian Plateau. RS2-1 is located on 3° slope pasture

which is far from Tura River, RS2-2 is located on flood plain pasture of Tura River, and RS2-3 is located on cutting grassland of terrace. The vegetation and land use types of these three sites cover the typical kinds of livestock grazing in the local area. The Lus sampling site (RS3) is located in the central area of Dundgovi Province of Mongolia which is the transitional region between Hangai Mountain and Gobi desert. Vegetation type is desertification steppe with typical high drought hardiness plants, like *Allium mongolicum* and *Caragana*, etc. Elerjet (RS4) is located in the south area of Dundgovi and closer to the Gobi desert. The dominant vegetation type is steppe desert with less annual precipitation than Lus. The Sainshand sampling site (RS5) is located in the typical Gobi desert region of the central Dornogovi, with rare persistent remains on the bare ground surface. The sampling sites of Xilinhot (RS6), Zhengxiangbai Banner (RS7) and Taipusi Banner (RS8) are located in the south section of this transect, Inner Mongolia, and the steppes are used as pastures those are under the different management and human disturbance modes. Generally, for the effective and reliable comparison on wind erosion at the transect scale, all of the sampling sites have similar topography (open and flat plain).

The soil samples were collected by using a column cylinder drill (90 mm internal diameter). 3–5 samples were collected at each sampling site, including one section sample and 2–4 bulk samples. The section sample was collected from the top 30 cm of the soil profile with 3 cm increment from 0 to12 cm and 6 cm increment from 12 to 30 cm. The

TABLE 1. Locality and physical characteristics of the ^{137}Cs sampling sites

Sampling site	Location	Longitude and latitude	Elevation (m)	Annual precipitation (mm·a^{-1})	Soil type	Vegetation type and coverage	Land use
RS1	Tariat	N48°11′47.3″ E99°41′19.0″	2042	263	meadow chestnut soil	Carex meadow steppe, accompany with *Potentilla, Leymus chinensis* (Trin.) *Tzvel* and *Willd frigida*, 70% coverage	pasture
RS2-1	Bayannur	N47°48′12.3″ E104°27′54.0″	1039	279	chestnut soil	*Caragana – Stipa* steppe, accompany with *Chenopodium* and *Allium mongolicum*, 50% ~ 60% coverage	pasture
RS2-2	Bayannur	N47°51′29.8″ E104°26′50.0″	959	279	meadow chestnut soil	*Achnatherum splendens* (Trin.) *Nevski* meadow steppe, accompany with *Leymus chinensis* (Trin.) *Tzvel* and *Allium mongolicum*, 70% ~ 80% coverage	pasture
RS2-3	Bayannur	N47°54′56.2″ E104°29′2.6″	1011	279	chestnut soil	*Stipa – Caragana* steppe, accompany with *Allium mongolicum* and *Cleistogenes squarrosa* (Trin.) *Keng*, 70% ~ 80% coverage	cutting grassland
RS3	Lus	N45°44′36.6″ E105°19′2.2″	1397	162	calcic brown soil	*Allium mongolicum-Caragana microphylla Lam* desertification steppe, 30% coverage	no
RS4	Elerjet	N44°43′55.5″ E106°55′46.0″	1083	144	desert grey soil	*Nitraria tangutorum Bobr* steppe desert, accompany with *Allium mongolicum* and *Cleistogenes*, 20% coverage	no
RS5	Sainshand	N44°24′22.7″ E109°39′20.0″	991	132	desert grey brown soil	Typical Gobi desert with *Nitraria tangutorum Bobr* and *Allium mongolicum* remains, coverage < 5%	no
RS6	Xilinhot	N43°45′52.4″ E116°5′51.9″	1100	350	chestnut soil	*Leymus chinensis* (Trin.) *Tzvel* steppe, accompany with *Stipa, Caragana, Potentilla* and *Willd frigida*, 60% ~ 80% coverage	pasture
RS7	Zhengxiangbai Banner	N42°19′48.5″ E115°32′53.0″	1317	352	chestnut soil	*Stipa – Leymus chinensis* (Trin.) *Tzvel* steppe, accompany with *Caragana, Potentilla* and *Willd frigida*, 80% coverage	pasture
RS8-1	Taipusi Banner	N42°6′49.5″ E115°29′6.4″	1374	394	chestnut soil	*Stipa krylovii* steppe, 80% coverage	enclosed pasture
RS8-2	Taipusi Banner	N41°47′21.0″ E115°08′08.1″	1429	394	chestnut soil	*Stipa – Serratula centauroides* (Linn.) steppe, 80% coverage	cutting grassland
RS8-3	Taipusi Banner	N41°45′29.1″ E115°09′58.1″	1406	394	chestnut soil	*Stipa krylovii* steppe, accompany with *Potentilla* and *Cleistogenes squarrosa* (Trin.) *Keng*, 60% coverage	pasture
RS8-4	Taipusi Banner	N41°57′39.8″ E115°20′31.8″	1579	394	chestnut soil	*Carex – Stipa krylovii* steppe, accompany with *Potentilla* and *Willd frigida*, 60–80% coverage	pasture

bulk samples (0–30 cm) were radially distributed around the section sample point with 10–20 m away from the section sample. All the samples were oven-dried, disaggregated and passed through a 2 mm sieve prior to the ^{137}Cs activity analysis. The samples were tested in the Nuclear Physics Laboratory of Sichuan University. The ^{137}Cs activities in soil samples were determined by gamma-ray spectrometry equipped with hyperpure germanium (HPGe) detector. The sample testing weight of about 400 g and the counting time of $\geq$ 25,000s provided the results with an analytical precision of the 95% level confidence. The ^{137}Cs activities in the samples were obtained from the peak area in the spectrum associated with 662 keV.

RESULTS AND DISCUSSION

[137]Cs reference inventory

The determination of the reliable fallout ^{137}Cs reference inventory is the key premise of the successful calculation of the soil erosion rates by using the [137]Cs

tracing technique (Walling and He 1999; Zapata 2002). Consequently, how to get the reliable fallout ^{137}Cs reference sample is usually regarded as a limited factor when the ^{137}Cs tracing technique is applied to estimate the wind erosion rate (Chappell 1999). For the Sites of Tariat, Bayannur, Xilinhot, Zhengxiangbai Banner and Taipusi Banner, we confirmed the reliable ^{137}Cs reference sites by analyzing the vegetation type and coverage, human activity, characters of soil profile and other wind erosion related factors. Each ^{137}Cs reference site was disturbed slightly with 90% ~ 100% vegetation coverage and complete litter layer above soil surface. For the Site Lus, Elerjet and Sainshand located in the desertification and desert region; however, it is impossible to confirm the reliable ^{137}Cs reference site.

Walling and He (2000) established ^{137}Cs fallout inventory simulation model in global scale by incorporating the relationship of ^{137}Cs fallout inventory with annual precipitation and latitude distribution pattern. Qi et al. (2006) validated the

TABLE 2. [137]Cs reference inventories and simulating ^{137}Cs fallout inventories of the sampling sites

Location	Reference sampling sites	Longitude and latitude	Elevation (m)	[137]Cs reference inventories (Bq·m⁻²)	Simulating ^{137}Cs fallout inventories by model (Bq·m⁻²)
Tariat	RF1	N49°11′26.2″ E99°40′51.4″	2042	1630.68 ±185.82	1724.05
Bayannur	RF2	N47°59′41.4″ E104°25′11.0″	951	1602.79 ±169.41	1630.58
Lus	–			–	1456.00
Elerjet	–			–	1522.77
Sainshand	–			–	1530.80
Xilinhot	RF3	N43°26′46.7″ E116°6′2.0″	1447	2035.67 ±78.65	1863.70
Zhengxiangbai Banner	–			–	2016.65
Taipusi Banner	RF4	N41º45′4.6″ E115º07′15.3″	1373	2391.75 ±77.89	2236.14

model by using measured data of ^{137}Cs fallout inventory in China and pointed out its main defect and potential application value. Using model simulations, the ^{137}Cs fallout inventories of all sampling sites were simulated and compared with their corresponding measured values of the ^{137}Cs reference sites (Tab. 2).

The simulated ^{137}Cs fallout inventories agreed with measured value well (Tab. 2). Since the model performed well in predicting ^{137}Cs fallout inventories, the simulation results could also be used as the substitutes of ^{137}Cs reference inventories in the Site Lus, Elerjet and Sainshand without reliable reference sites. Since the Site RS7 in Zhengxiangbai Banner was located closely to RF3 and the annual precipitation was also about 350 mm, the reference inventory of RF3, 2035.67 Bq·m^{-2}, was used to estimate wind erosion rates in sites of RS6 (Xilinhot) and RS7.

Wind erosion rates at the sampling sites

The mathematic models using the ^{137}Cs tracing technique could be classified into two types based on disturbance types and the intensity of their impacts on soil surface: one for cultivated soils and one for uncultivated soils. All sampling sites in the transect are uncultivated soils, and the profile-distribution model developed by Zhang et al. (1990) was used to estimate the wind erosion rates in this study.

$$X = X_0 \cdot e^{-\lambda \cdot h \cdot (T-1963)} \qquad (1)$$

where X is ^{137}Cs inventory of sampling site (Bq·m^{-2}) in the year T, X_0 is ^{137}Cs

reference inventory (Bq·m^{-2}), h is average annual soil erosion depth (cm·a^{-1}), T is the year of sample collection, λ is the coefficient describing the shape of the ^{137}Cs depth distribution in the soil that can be confirmed by the least squares fit using every layer ^{137}Cs contents of the section sample. The ^{137}Cs redistribution in the soil can be affected by rainfall and wind erosion characteristics in the Mongolian Plateau. Therefore, we induced k (0.95), a coefficient of ^{137}Cs redistribution caused by snow-blow (Hu et al. 2005), into the equation in order to improve the confidence level of the estimated wind erosion. The modified profile-distribution model is described by the following equation:

$$X = k \cdot X_0 \cdot e^{-\lambda \cdot h \cdot (T-1963)} \qquad (2)$$

The pattern of each ^{137}Cs profile is typically in uncultivated soils (Fig. 2). The ^{137}Cs content is highest at the surface layer, and declines exponentially with increasing depth. The reference section samples have higher ^{137}Cs contents in surface layer (0–3 cm) than the corresponding eroding samples commonly. The ^{137}Cs distribution depth along the transect is shallower than that of water-eroded areas (Fu et al. 2006) due to rare annual rainfall and thicker soil in the Mongolian Plateau.

The ^{137}Cs inventories of the sampling sites ranged from 265.63 ±44.91 to 2087.14 ±70.16 Bq·m^{-2}. The highest value was measured at Site RS8-2 of Taipusi Banner in the southern typical steppe zone and the lowest one was found at Site RS5 of Sainshand in the Gobi desert zone (Tab. 3). All of ^{137}Cs inventories of samples in Table 3 were substantially lower than the
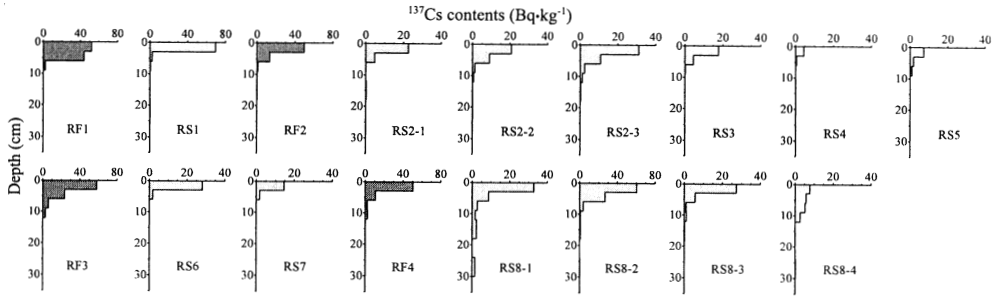
FIGURE 2. ^{137}Cs depth distributions of the section samples

TABLE 3. ^{137}Cs inventories and wind erosion rates of the sampling sites

Sampling sites	^{137}Cs inventory (Bq·m^{-2})	Soil bulk density (t·m^{-3})	Annual wind erosion depth (mm·a^{-1})	Annual wind erosion rate (t·km^{-2}·a^{-1})
RS1	788.91 ±98.89	1.10	0.16	172.37
RS2-1	1279.54 ±166.53	1.60	0.04	64.58
RS2-2	1070.90 ±138.49	1.26	0.08	103.46
RS2-3	846.45 ±100.89	1.24	0.14	169.07
RS3	796.47 ±128.38	1.57	0.13	206.34
RS4	733.70 ±122.30	1.75	0.16	276.24
RS5	265.63 ±44.91	1.04	0.40	419.63
RS6	661.15 ±101.34	1.29	0.28	360.02
RS7	886.86 ±83.79	1.67	0.21	351.33
RS8-1	1230.58 ±40.22	1.35	0.14	417.60
RS8-2	2087.14 ±70.16	1.24	0.02	53.12
RS8-3	1113.02 ±36.45	1.33	0.17	479.63
RS8-4	1412.76 ±75.43	1.29	0.11	309.74

values of reference inventories that are listed in Table 2, indicating that wind erosion process had occurred at these sites.

Table 3 shows the annual wind erosion depths and erosion rates, estimated by the modified profile-distribution model (2). Wind erosion depths ranged from 0.02 to 0.40 mm·a^{-1}. In the study transect, soil bulk densities of some sampling sites are higher because of high gravel contents and tight soils, and the wind erosion rate accordingly ranged from 53.12 to 479.63 t·km^{-2}·a^{-1}.

ANALYSIS AND DISCUSSION

The T value, the soil loss tolerance factor, is a discriminatory standard to determine whether obvious and harmful soil erosion had occurred. The Soil Conservation Service of USDA defined the T value as "the maximum level of soil erosion that will permit a high level of crop productivity to be sustained economically and infinitely" and established the zoning standard for the US (Wishmeier and Smith 1978). In China, the Ministry of Water

Resources (1997) established the standard for Classification and Gradation of Soil Erosion (No SL190-96), and defined the T value as "the maximum level of soil erosion that will maintain soil fertility and permit the crop productivity to be sustained in a long-time period" but the T value of wind erosion is not directly provided. For the Mongolian Plateau and neighboring region, the present T value of wind erosion (340 t·km^{-2}·a^{-1}) was obtained from a field experiment conducted at Northwestern Shanxi Province on the south margin of the Mongolian Plateau (Qin 1996). The determination of a reliable T value of wind erosion is important for assessing the damaging level in wind-eroded regions, especially in the light wind erosion region of the north Mongolian Plateau. Lacking reliable T values, we referred to the gradation of wind erosion in SL190-96 and the data of T values of water erosion in neighboring regions (the black soil region of Northeast China and Rocky Mountain area of North China), and define 200 t·km^{-2}·a^{-1} as the acceptable T value of wind erosion estimation in the Mongolian Plateau region.

Figure 3 shows the wind erosion trends along the Tariat-Xilingol transect, from north to south. In the north section, the wind erosion rates of Tariat and Bayannur are less than 200 t·km^{-2}·a^{-1}, suggesting that these sites were slightly eroded. The wind erosion process had no obvious effects on soil fertility, and steppe productivity and the structure & service of steppe ecosystem were maintained. The wind erosion rates of other sites are all beyond 200 t·km^{-2}·a^{-1}, suggesting that these sites were more severely eroded. The wind erosion has degraded soil fertility level and the primary productivity of steppe, and hence damaged the structure and service of ecosystem to some degree.

In the Mongolia section, the wind erosion rate generally increased from north to south along the transect except for Tariat. The lowest wind erosion rate was found at Bayannur in the typical steppe zone, 112.37 t·km^{-2}·a^{-1}, and the highest value was found at Sainshand in Gobi desert, 419.63 t·km^{-2}·a^{-1}. There is rare rainfall and obviously interannual variability in the Gobi desert zone, the ^{137}Cs
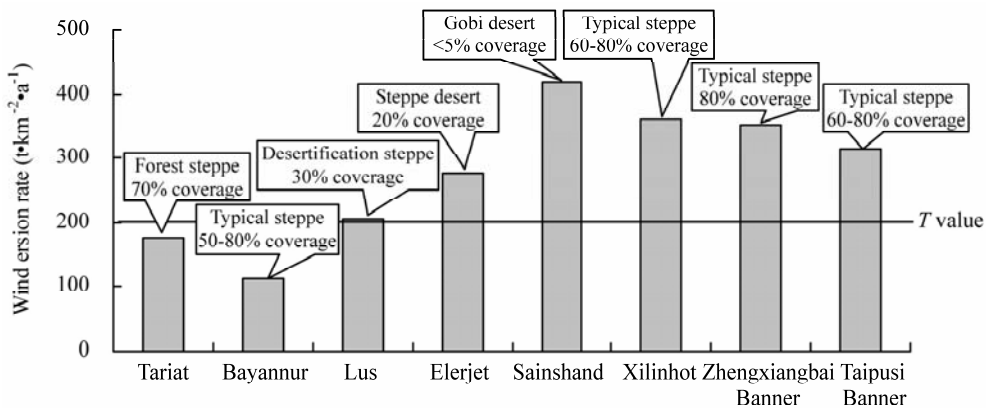

FIGURE 3. The wind erosion rates of the sampling sites of the Tariat-Xilingol transect

aerosols amount in atmosphere changed accordingly with the testing variability as a result of nuclear weapon tests (Zapata 2002), and the majority of ^{137}Cs fallout is combined with rainfall process. With all the above factors considered, the ^{137}Cs actual fallout inventory in the Gobi desert zone did not agree well with the model simulations by Walling & He's model (2000), and the accuracy of the estimated wind erosion rate of Sainshand in Gobi desert is not satisfactory. In general, the trend of the wind erosion rates in the Mongolia section can be summarized as follows: from north to south, wind erosion increased with decreasing annual precipitation and decreasing vegetation coverage; wind erosion increased and biodiversity decreased when ecosystem structure was simplified from typical steppe, desertification steppe, and steppe desert to Gobi desert. The wind erosion process was mainly affected and controlled by physical factors, and the disturbance due to human activity is negligible.

The south section, including Sites of Xilinhot, Zhengxiangbai Banner and Taipusi Banner, is located at Xilingol region of Inner Mongolia of China (Fig. 3). Apart from the Site of Sainshand in Gobi desert, the wind erosion rate increased gradually from north to south along the whole Tariat-Xilingol transect. The wind erosion rates of study sites in China are higher than those in Mongolia. The wind erosion rates at Xilinhot, Zhengxiangbai Banner and Taipusi Banner are thrice as much as that at Site Bayannur despite similar vegetation types. Higher wind erosion rates in Sites of Xilinhot, Zhengxiangbai Banner and Taipusi Banner could be explained

partially by more frequent dust storms due to stronger wind field in the windy season (Tang and Gao 1996; Uno et al. 2006). The average population density and stocking carry level is 10 per km^2 and is 0.6 per hm^2 for the sites in Inner Mongolia respectively (Inner Mongolia Yearbook 2004). The pasture natural condition in Site Bayannur is favorable, but the population density and stocking carry level, 3 per km^2 and 0.3 per hm^2 (Mongolian Statistical Yearbook 2001), are significantly lower than those of Sites in Xilingol, Inner Mongolia. Our results suggested that high intensity of human activity may be responsible for the more severe wind erosion in the Inner Mongolia section relative to the Mongolia section with similar natural conditions.

Except for Site Tariat and Site Bayannur, the wind erosion rate of each site is beyond the slight erosion level, the ecosystem stability and primary productivity were damaged to some extent. As an important component of the ecosystem, the steppe vegetation is in a continuous degenerate status.

CONCLUSIONS

In this study, we estimated the wind erosion rates at 8 sampling sites along the Tariat-Xilingol transect across the Mongolian Plateau using the ^{137}Cs tracing technique, and examined the patterns and causing factors of wind erosion along the transect.

The ^{137}Cs inventories of sampling sites ranged from 265.63 ±44.91 to 2087.14 ±70.16 Bq^{-2}, and the wind erosion rates ranged from 53.12 to 479.63 $t \cdot km^{-2} \cdot a^{-1}$. Most of the sites were only slightly affected by human activity. All the sampling sites

of the Mongolia section except Tariat, changing from typical steppe, desertification steppe, steppe desert to Gobi desert from north to south, with decreasing annual precipitation and vegetation coverage, and increasing wind erosion rates. Our results also showed that the wind erosion process was mainly controlled by physical factors in the Mongolia section of the study transect. In the typical steppe zones of the north and south section of the transect, the wind erosion rates at Sites of Xilingol are thrice as much as that at Site Bayannur. The contrast between these sites could be explained by their differences in physical factors, population density and stocking carry level. Our results also showed that intensive human activity may be responsible for the more severe wind erosion in the Inner Mongolia section. Given the acceptable T value of 200 t·km^{-2}·a^{-1} for the Mongolian Plateau, the wind erosion rate at each site is beyond the slight level except for Tariat and Bayannur. The ecosystem stability and primary productivity were damaged to some degree and the steppe vegetation was in a continuous degenerate status at these sites.

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Streszczenie: *Ocena intensywności erozji eolicznej Płaskowyżu Mongolskiego z wykorzystaniem techniki oznaczania [137]Cs*. W pracy przedstawiono wyniki badań intensywności erozji eolicznej Płaskowyżu Mongolskiego, określonej na podstawie ośmiu prób gruntu pobranego wzdłuż transektu o długości około 1400 km, przebiegającego przez teren Mongolii i Chin. Do oceny intensywności erozji wykorzystano technikę oznaczania [137]Cs w wierzchnich warstwach gruntu do głębokości 30 cm. Stwierdzono, że intensywność erozji w analizowanym transekcie od północnego-zachodu stopniowo wzrasta wraz ze zmianami reżimu klimatycznego (zmniejszania się rocznej wysokości opadów), a także zmianami pokrycia roślinnego. Chińska część Płaskowyżu o charakterze stepowym jest trzykrotnie bardziej intensywnie erodowana. Oprócz czynników fizycznych, na intensywność procesu erozji eolicznej wpływa większa gęstość zaludnienia Płaskowyżu na terenie Chin, a także większe pogłowie zwierząt hodowlanych.

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