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THE EFFECT OF DRAINAGE ON CHEMICAL ELEMENTS CONTENT OF MARSH

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ABSTRACT: This paper takes marsh in the Sanjiang Plain as an example in order to research the effect of draining on the chemical elements in marsh. The Sanjiang Ecological Test Station of Mire and Uetland serves as the resarch base. The authors selected soil samples in the Sanjiang Plain (the top and the end of the drain, marsh soil and degeneration marsh soil), mainly analyzed contents of main ions (HCO_3^-, Cl^-, SO_4^{2-} and NO_3^-), main heavy metals (Fe, Mn, Zn and Cu), nutritive elements (N, P, K), organic matter and pH value. By testing these samples as above, the paper initially researches the effect on chemical elements content by draining by the means of the contrast of chemical elements contents between marsh soil and degenerative marsh soil and different characteristics of marsh soil elements. Results show that a lot of chemical elements had been lost because of draining.

KEY WORDS: Drain; marsh degeneration; chemical elements; different characteristics

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1 INTRODUCTION

Wetland has very important effect on retaining water and against drought, regulating climate, controlling soil erosion and so on①. Today men often attach importance to economic effect of wetland reclamation, but neglect and destroy other functions and effects which result in blind wetland development, a lot of wetland degeneration. The area of freshwater wetland in the 1950s was 134×10^5ha, but in the 1970s 70% had changed into farmland (MITSCH, 1993). The area of wetland in developing countries has reduced more than that of wetland in developed countries. The area of wetland in the Sanjiang Plain was 543. 5ha in China in 1949, but in 1995 had reduced to 197. 7ha(MA, 1997). Wetland degeneration destroys ecology and the sustainable development of local economy. So the research on wetland degeneration has important theoretical and applied value. And wetland degeneration is a universal fact in the Sanjiang Plain, which results from drainage. The paper discusses the effect of drainage on

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wetland degeneration.

2 STUDIED AREA AND METHOD

The Sanjiang Ecological Test Station of Marshes and Wetlands serves as a research base. Sampling is along two directions, one is horizontal direction, along the drain from the top of drain (site 1) to the middle (site 2) then to the end of drain (site 3) in order to analyze the effect on soil elements from streams. The other is vertical direction, from the middle of the drain to the middle of the marsh. There are two sites in the marsh, which are named site 4, site 5. Besides these sites, degenerative marsh sample was selected; the sampling sites is degenerative marsh (site 6), which was formed by draining for several years. Today marsh landscape had changed into meadow landscape. *Calamgrostis augustifolia* is the main vegetation. There are 6 sampling sites and 28 samples in common (Fig. 1). These samples were tested pH value, organic matter content, main ions contents (HCO_3^-, Cl^-, SO_4^{2-} and NO_3^-) by titration and colorimeter, main heavy metals (Fe, Mn, Zn and Cu) and nutritive elements (N, P, K) by Kjeldahl method, spectrophotometer and atomic absorption spectroscopy, respectively. By testing these above samples, the paper initially researches the effect on marsh degeneration caused by drainage by means of comparing chemical elements contents between marsh soil and degenerative marsh soil and different characteristics of marsh soil elements.

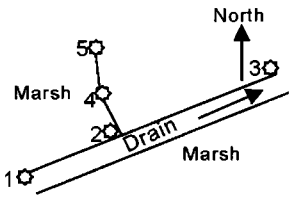

Fig. 1 Skeptic map of sampling sites

3 ANALYSIS AND RESULT

3.1 The Comparison of Elements Contents between Degenerative Marsh Soil and Marsh Soil

Degenerative marsh has been formed by drainage for several years; soil elements of drained marsh were migrated and changed. Form Table 1 we can draw a conclusion as follows: 1) pH value: pH value of marsh surface soil is generally 5.6 – 5.9, but that of degenerative marsh is over 6.0, and increase form the up to

Table 1 Chemical characteristic change of surface layer of marsh soil of different sites

Items	Sampling sites number					
	1	2	3	4	5	6
HCO_3^- (mg/kg)	2342	2196	3074	3513	3074	719
Cl^- (mg/kg)	319.5	416.5	497.0	639.0	461.5	25.0
NO_3^- (mg/kg)	35.0	50.0	15.0	30.0	35.0	5.4
SO_4^{2-} (mg/kg)	52.8	15.2	8.8	40.8	64.8	12.3
Ca^{2+} (mg/kg)	400.8	320.6	601.2	320.6	601.2	125.0
Mg^{2+} (mg/kg)	48.6	243.2	72.9	194.5	72.9	58.8
$K^+ + Na^+$ (mg/kg)	576.9	325.4	663.2	1033.8	674.7	107.0
Cu (mg/kg)	8.52	5.86	7.07	10.1	6.1	19.0
Zn (mg/kg)	231.0	366.8	361.9	312.4	206.8	201.0
Fe (mg/kg)	225.2	2149.2	79136.4	14148.0	1052.3	52680.2
Mn (mg/kg)	1376.0	5189.5	2642.5	77.7	443.0	166.2
Organic matter(%)	0.72	0.72	0.71	0.62	0.799	
Soil pH	5.6	5.7	5.9	5.9	5.8	6.06
Total N (%)	1.36	0.56	0.11	1.53	0.89	0.41
Total P (%)	0.910	0.639	0.921	0.995	0.786	0.697
Total K (%)	0.12	0.043	0.07	0.15	0.17	1.31
Rapidly available N(mg/kg)	974.4	739.2	772.8	940.8	672.0	331.0
Rapidly available P(mg/kg)	84.8	42.3	48.1	61.9	52.2	12.2
Rapidly available K (mg/kg)	790.3	433.4	490.4	1171	1285	455

Note: Number 6 is sampled from degenerative soil.

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the bottom. 2) Main ion contents: Negative ion contents (HCO_3^-, Cl^-, SO_4^{2-} and NO_3^-) of degenerative marsh are lower than those of marsh soil. Positive ions of degenerative marsh are few than that of marsh soil. But the content of Mg^{2+} is higher than that of marsh soil. 3) Main heavy metals: In degenerative marsh soil contents of Cu, Fe, are higher than those in marsh soil, but the contents of Zn, and Mn in degenerative marsh soil is lower than in marsh soil. 4) Nutritive elements: the content of total N, total P in degenerative marsh soil are lower than those of marsh soil, but that of total K is higher than that in marsh soil.

3.2 Differential Characteristics of Chemical Elements in Marsh Soil

There are two different characteristics of chemical elements in marsh soil. One is vertical different characteristic, that is, vertical chemical characteristics of chemical elements, the other is horizontal different characteristic, that is, from the top to the end of drain, or from the middle of marsh to drain.

3.2.1 Vertical characteristic of chemical elements in marsh soil

There are four different layers in marsh soil profile from top to bottom in the region. Surface layer is a wither grass layer. Peat layer is low than surface layer Humid acid layer is the third. Because there are any differences in matter composition and physical, chemical conditions, such as temperature, water depth, and pH value in different layers, there are different vertical characteristics (Table 2). 1) Main ions composition: Contents of main ions (HCO_3^-, Cl^-, NO_3^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, K^+, Na^+) reduced distinctly from top to bottom. At bottom layer the content of SO_4^{2-} is 0.2). Main heavy metals: Contents of heavy metals in grass layer or peat layer are higher than that in surface soil. From this layer to downward their contents reduced distinctly. 3) Nutritive elements: Contents of total N and total P in grass layer or peat layer are higher than those in surface layer or bottom layer. 4) pH value: pH value of marsh soil is gradually increase from surface to downward. Surface soil is 5.6 – 5.9. Contents of organic matter of marsh surface soil are 799 g/kg, but that of the bottom is 23 g/kg.

3.2.2 Horizontal different characteristic of chemical elements in marsh soil

Table 1 shows horizontal characteristics of surface soil in the drain (from site 1 to site 3): 1) Main ions contents: Except SO_4^{2-}, NO_3^-, contents of HCO_3^-, Cl^-, Na^+, Mg^{2+}, K^+ in the end of the drain are higher than those in the top of the drain. 2) Main heavy met-

Table 2 Comparison between chemical characteristic of every layer in marsh soil profile at site 5

Items	Soil depth (cm)			
	0 – 10	10 – 20	20 – 40	40 – 50
HCO_3^- (mg/kg)	3074	386	293	146
Cl^- (mg/kg)	461.5	124.2	44.3	35.5
NO_3^- (mg/kg)	35.0	3.5	1.5	2.5
SO_4^{2-} (mg/kg)	64.8	8.8	0.0	0.0
Ca^{2+} (mg/kg)	601.2	120.4	30.0	20.0
Mg^{2+} (mg/kg)	7.29	6.0	1.21	1.21
$K^+ + Na^+$ (mg/kg)	674.7	157.3	82.2	33.1
Cu (mg/kg)	6.17	1.49	1.39	1.37
Zn (mg/kg)	206.8	522.3	161.4	30.1
Fe (mg/kg)	1052.0	4606.2	20102.0	2369.0
Mn (mg/kg)	442.9	210.8	166.1	153.3
Organic matter(%)	0.799	0.24	0.051	0.023
Soil pH	5.8	5.5	6.3	6.4
Total N (%)	0.89	0.99	0.30	0.18
Total P (%)	0.786	0.954	0.640	0.483
Total K (%)	0.17	1.22	2.41	1.83
Rapidly available N(mg/kg)	672.0	638.4	235.2	142.8
Rapidly available P(mg/kg)	52.2	8.4	9.0	15.2
Rapidly available K (mg/kg)	1285	220	163	138

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als: Except Cu, contents of Zn, Mn and Fe are higher from the top of the drain to the end of drain. (3) Nutritive elements: From the top of the drain to the end of drain contents of total N is high, but total P, K haven't changed. 4) The content of organic matter in the end of the drain is higher than in the top of the drain. pH value in the end of the drain is higher than the top of the drain.

Table 1 shows horizontal different characteristics from site 5 to site 4 to site 3. 1) Main ions contents: Except K^+, Na^+ and SO_4^{2-}, contents of other ions increase from site 5 to site 4 to site 3. 2) Main heavy metals: Except of Cu, contents of Mn and Fe are high from site 5 to site 4 to site 3, but the content of Zn has little changed. 3) From site 5 to site 4 to site 3 total N, P and K reduced. 4) The content of organic matter decreases from site 5 to site 4 to site 3.

4 CONCLUSION

Chemical elements have distinct different characteristics. One is vertical different characteristic. These elements such as HCO_3^-, NO_3^-, Ca^{2+}, Mg^{2+}, K^+, Na^+ etc. gradually decrease from surface layers downward. Contents of total N, total P, total K, Cu, Fe, Mn and Fe begin to reduce in the underlayer. The other is a horizontal different characteristic. There are two horizontal differences. One is from the top through the middle to the end of the drain. The other is from site 5 to site 4 to site 3. Horizontal difference in chemical elements of marsh soil from the top to the end of drain is caused by surface water flow in the drain. Horizontal difference in chemical elements from site 5 to site 4 to site 3 is caused by waterside seep of grass layer or peat layer The element composition and content of the end of the drain is the result of two water movements. No matter surface water flow or waterside seep of grass layer or peat layer, some elements of marsh soil lost, such as Fe, Mn. On the other hand, contents of total N, total P and total K are low in degenerative marsh soil and marsh soil after draining because of they had divorced from marsh original condition.

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