



The species distributions of nitrogen and phosphorus in surface sediments of Datong lake

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ABSTRACT

In order to investigate the species distributions of nitrogen and phosphorus in Surface Sediments and the contents of multiple nitrogen and phosphorus forms in surface sediments and interstitial water, the test samples are collected from six representative sampling points of Datong Lake. The results show that the average contents of total nitrogen and phosphorus in sediment are 1912.9 mg/kg and 2144.5mg/kg respectively. The contents of nitrogen and phosphorus from different sampling point are different. The organic nitrogen, accounted for 93.50%-97.12%, is the main form of nitrogen and inorganic phosphorus accounts for 80% in phosphorus. The ratio of Ca-P to that of Fe-P and Al-P in inorganic phosphorus is about 1:1. Through the correlation relationship analysis of phosphorus species distributions in sediments and interstitial water, we can conclude that the phosphorus is hard to release from sediment to interstitial water and exogenous elements have a great influence on the contents increase of nitrogen and phosphorus.

Key words: Datong Lake, Sediments, Nitrogen, Phosphorus, correlation relationship analysis

INTRODUCTION

In recent years the lake eutrophication problem is becoming more and more serious, and become one of the environmental problems of great concern at home and abroad, most studies suggest that the nitrogen and the phosphorus in water is mainly caused the eutrophication of lakes nutrition. Nitrogen, phosphorus accumulation, excessive input, the lake sediments are the important reservoirs of lake nutrient and difficult to reduce the load of [1-7]. Therefore, the content and distribution of nitrogen, phosphorus in lake sediments on the control of eutrophication and research ecosystem status have an important guiding significance [8-11], and to understand the development of social economy in different periods of the lake, the evaluation of pollutant emission control measures, the success of [12-16] has important reference value.

In this paper, through field investigation, sampling points on lake surface sediments and interstitial water of N, P distribution and speciation were determined, analysis of the content and distribution of various forms of nitrogen, phosphorus in the sediments of Lake in the surface layer, the analysis of the current situation and relationship between different nitrogen, phosphorus and pollution, provide certain data the reference and scientific basis for pollution control and prevention of lake district.

EXPERIMENTAL SECTION

By using GPS mode, in 2013 May to select 6 representative sampling, analyze lake surface water and sediment sampling, specific sampling locations are shown in figure 1. The Disturbing Gravity Sampler sampling point 0-5cm surface sediments, sediment samples were collected immediately after polyethylene sealing bag package number, remove debris and shell, emptying air packaging process, packaged into frozen quickly and soon back to the lab for freezing treatment [18]. First sift sediments roughly and then remove debris from the fresh samples. In 50mL

centrifuge tube 4000r/min centrifugal 20min centrifuge tube, take supernatant collected in jars and number for the determination of nitrogen, phosphorus in interstitial water, and then from the mud flat heart after natural drying in the bag, the mud like natural air dry grinding and mixing, 100 mesh sieve, encapsulated in a plastic bag and cold standby [18]. Determination of the sample after drying, screening of more nitrogen, phosphorus forms.



Fig.1 Distribution of sediment sampling points in the Datong Lake

The main content of the determination are ammonia nitrogen in sediment, total nitrogen, nitrate nitrogen, inorganic nitrogen, total phosphorus, organic phosphorus, inorganic phosphorus, iron and aluminum bound phosphorus, calcium and phosphorus, simultaneous determination of surface pore water ammonia nitrogen and nitrate nitrogen, total nitrogen, phosphate and total phosphorus. The surface water depth (H), transparency (SD) was determined by the plug's disk method; pH, dissolved oxygen (DO), electrical conductivity were determined by a portable multi parameter water quality analyzer (WTW, Multi350i/SET, made in Germany), the determination of ^[8]total nitrogen in gap water and sediment ^[9-10]used potassium per sulfate oxidation UV spectrophotometry, nitrate nitrogen and ammonia nitrogen by KCl extraction and ultraviolet spectrophotometric method, or Nessler's Reagent Spectrophotometry.

Determination of total phosphorus in interstitial water used ^[7,11]potassium per sulfate for digestion, determined by Mo sbcolorimetry; phosphate (PO_4^{3-}) was determined by ^[12-13]and by Mo sb colorimetry; determination of total phosphorus in sediment were determined by high temperature calcination method, inorganic phosphorus, iron and aluminum bound phosphorus, calcium and phosphorus used sequential extraction method for the determination of ^[14-15], phosphorus forms in the sediments mainly by of fresh water sediment phosphorus separation method, which is under the framework of the European Committee for standardization under the framework of the development ^[16].

Sediment concentration distribution of nitrogen forms

The concentration distribution of nitrogen forms of each sample is shown in figure in Datong Lake Sediments. We can see from Figure 2, Datong Lake sediment total nitrogen concentration of each point is in the range of 1574.5~2186.0mg/kg, the average concentration of 1912.9mg/kg; NH_4^+ -N concentration is in the range of 43.83~138.02mg/kg, the average concentration of 88.56mg/kg; NO_3^- -N concentration is in the range of 0~8.589mg/kg, the average concentration is 4.04mg/kg. In the measured distribution of nitrogen forms in the content of organic nitrogen was the most, the total nitrogen content in 93.50%~97.12%, inorganic nitrogen in ammonia nitrogen is the main form of inorganic nitrogen, accounting for 87.35%~100%.

As can be seen from Figure 2, 4 point and 6 point has the highest content of total nitrogen, respectively 2095.8mg/kg, 2186.0mg/kg. According to the evaluation criteria of total nitrogen pollution in the sediments of the USA, EPA, The sediments of No. 4 and 6 point in Datong Lake have reached severe pollution, and the rest of the points are mild pollution. This may be the main reason 4, 6 sites near the South East Lake coast. The two sampling points close to residential and agricultural areas, of daily life and production generated a large amount of nitrogen source pollutants will cause a greater impact on the surrounding water, 6 point concentration is maximum, which is the main raw for 6 points close to the shore of fisheries, fisheries production and living activities of the sampling point caused by the point source pollution larger; Throughout the whole lake sediment total nitrogen content shows, Chase Lake sediment pollution is very serious, the endogenous load can't be ignored, the sediment nitrogen concentration is the main reason for the larger may is upstream to expand the scale of county city, the industrial economic development, increase agricultural planting and other non-point source pollution, increase the input of upstream pollution, pollution rebound to Datong Lake depression pollution with elongated, a large number of nutrient deposition caused by; In addition, Datong Lake is in Hunan Province is the largest inland lake aquaculture, species here and different, activities are more frequent, due to the biological metabolism of organic nitrogen source long-term accumulation in the sediment of the lake bottom, through long-term accumulation, causing the content of

organic nitrogen in the surface sediments of the gradually increased, leading to the main form of nitrogen in the sediments with organic nitrogen.

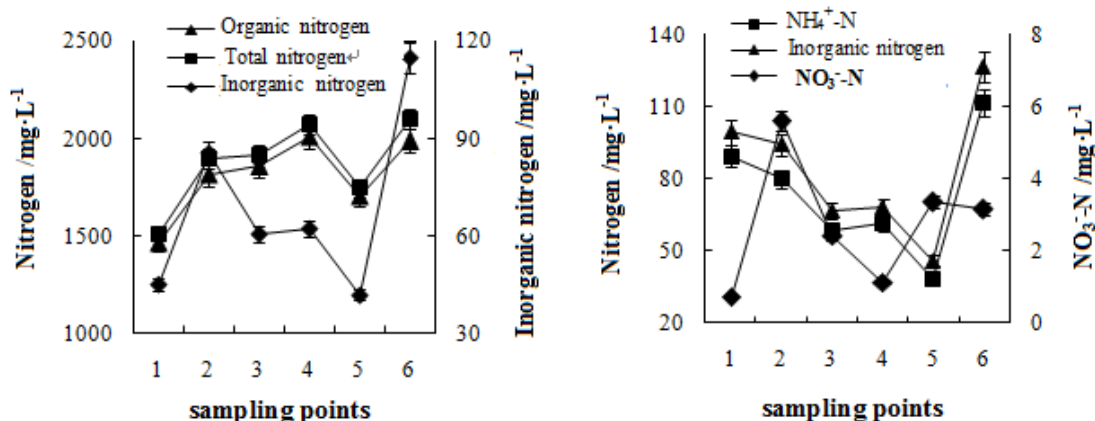


Fig.2 The Species Distributions of Nitrogen in Sediments of Datong Lake

The concentration distribution of phosphorus forms in the sediments

The phosphorus form concentration distribution of each point in Datong Lake sediments is in figure 3. Each point of Datong Lake total phosphorus concentration is in the range of 1697.7~3074.8mg/kg, the average concentration of 2144.5mg/kg; inorganic phosphorus concentration is in the range of 1446.4~2232.6mg/kg, the average concentration of 1731.0mg/kg; Fe /Al bound phosphorus concentration is in the range of 666.2~866.0mg/kg. the average concentration of 743.4mg/kg; calcium and phosphorus concentration is in the range of 705.4~1457.6mg/kg, the average concentration is 959.4mg/kg.

Fig. 3 shows the total phosphorus in sediments, lake surface, 6 points of the total phosphorus concentration is 3074.8mg/kg, the highest, the lowest was 1697.7mg/kg, No. 3, the other point is 1771.3~2212.8mg/kg. All the contents of inorganic phosphorus in the phosphorus content about 80%. The content of calcium and phosphorus and iron and aluminum phosphate is close to that of the main forms of inorganic phosphorus. The main source of calcium and phosphorus is detrital and authigenic apatite and insoluble calcium phosphate mineral, this part of phosphorus is the sediments of inert phosphorus, the activity in alkaline water is very low, only in the pH dips can dissolve part. Therefore, the calcium and phosphorus inert phosphorus has low activity, release little to the overlying water potential. Iron and aluminum phosphate is a part of phosphorus can release potential [7], its content can reflect the potential release of sediment phosphorus, Iron and aluminum, phosphorus content of inorganic phosphorus in Lake is close to 50%, which also shows that the lake has more internal phosphorus compared with others, iron and aluminum phosphate become the main storage library of the activity in the sediment. The whole lake TP accumulation is rather heavy, with the development of breeding technology in Datong Lake water are closely related. A lot of nutrients pour into the lake, for many years in the sediment deposition of nitrogen, phosphorus and other nutrient relation become the endogenous pollutant.

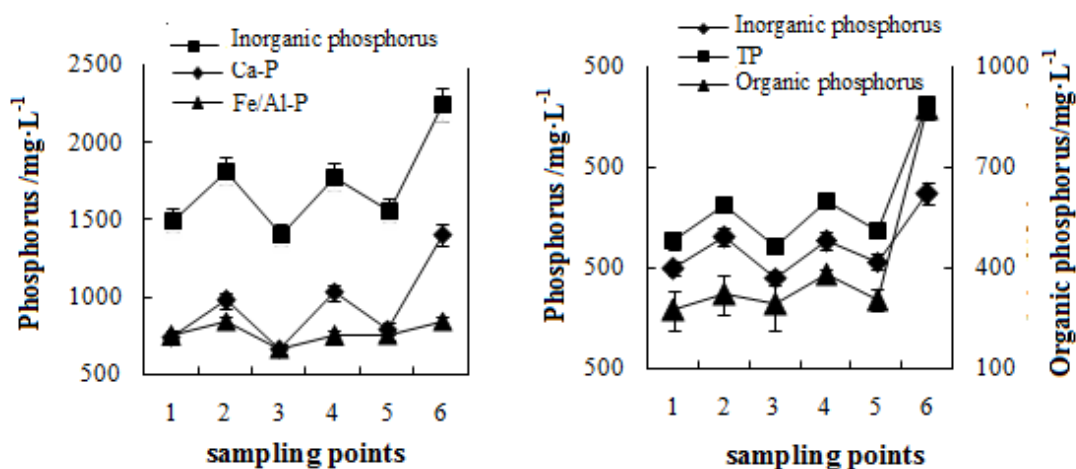


Fig.3 The Species Distributions of Phosphorus in Sediments of Datong Lake

The content of total phosphorus and inorganic phosphorus can be obtained by the difference of organic phosphorus, organic phosphorus content in sediments of Lake total phosphorus content of about 14.8%~27.4%. Organic phosphorus mainly from agriculture and human activities, can be used by organisms and can through organic matter mineralization so be released into the water to go, by the Datong Lake organic phosphorus, inorganic phosphorus accounted for the total phosphorus content, total phosphorus content in sediments of Lake increase is mainly due to the man-made feeding bait and expand the breeding density and so on factors.

The concentration distribution of nitrogen, phosphorus forms in sediment interstitial water.

For the exchange situation of nutrients in sediment and interstitial water, the content of ammonia nitrogen, total phosphorus, total nitrogen, phosphate in each sampling point in sediment and pore water was determined at the same time. The distribution of nitrogen, phosphorus content in each sampling point in picture 3, we can see from figure 3, the total Lake n in pore water concentration is in the range of 9.6~29.9mg/L, the average concentration of 21.3mg/L, $\text{NH}_4^+\text{-N}$ concentration is in the range of 7.7~24.8mg/L, the average concentration is 14.8mg/L, the total phosphorus concentration is in the range of 0.184~0.499mg/L, the average concentration of 0.349mg/L; phosphate concentration range is 0~0.126mg/L, the average concentration is 0.094mg/L.

The total nitrogen content in interstitial water, 5, 6, 4 concentration is relatively high and change little, were all in the range of 28~29mg/L, the concentration of 3, the lowest was 9.6mg/L; the concentration of ammonia nitrogen is 4, 6, significantly higher than other points, 22.9mg/L and 24.3mg/L, accounting for 81.6% and 83.8% of total nitrogen. 5, the proportion of total nitrogen ammonia nitrogen accounted for 25.8%. The total nitrogen content of the 6 points gap water compared with the total nitrogen content in surface sediments are very small, so it can be judged that the sediment nitrogen release to the overlying water have little potential. The total phosphorus content in interstitial water of 4, 6 was the highest point, 3 points was the lowest.

Phosphate is not the big proportion of TP, about 20% (except for 3 points), total phosphorus content in pore water is about 10 times of the overlying water, there is a larger concentration gradient between interstitial water and overlying water, shows that the sediment there are released to the overlying water. With the trend of distribution of phosphorus nitrogen, 3 points by the flow induced migration effect, release to the overlying water is slow. The 4, 6 points affected by the flow and exogenous input, the water and sediment accepted the heavy disturbance degree, the sediment release of P significantly increased. The concentration of total phosphorus and phosphate in interstitial water size which can explain the internal phosphorus loading of Datong Lake and lake eutrophication and algae blooms are closely related.

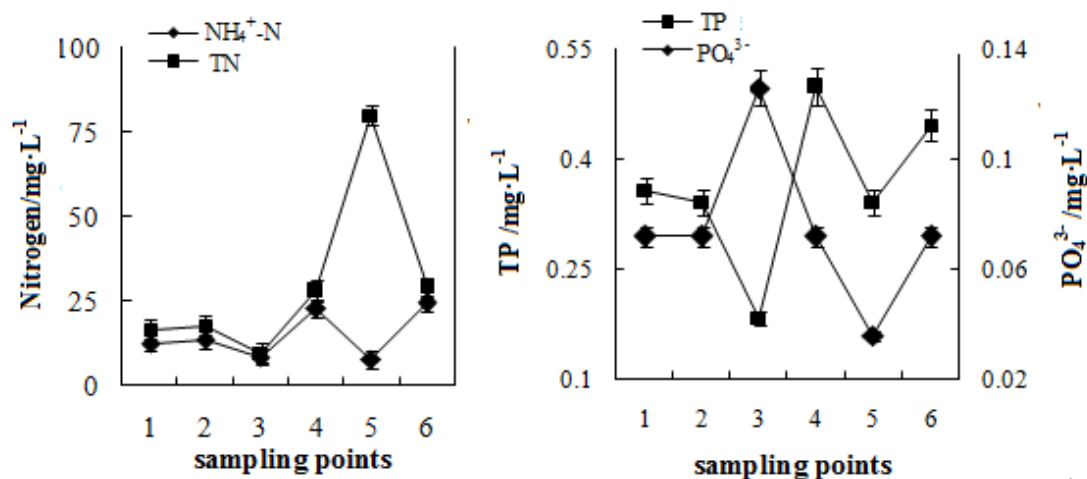


Fig.4 The Species Distributions of Nitrogen and Phosphorus in interstitial water of Datong Lake

Correlation analysis of surface sediments and interstitial water of nitrogen phosphorus forms

Using SPSS software to make the contents of different forms of nitrogen, phosphorus in sediment and interstitial water correlation analysis results are shown in table 2. The table 2 shows the total phosphorus and inorganic phosphorus, calcium and phosphorus in the sediments were significantly correlated, inorganic phosphorus was significantly correlated with calcium and phosphorus. The table 2 shows the increase of calcium phosphorus content may lead to the increase of inorganic phosphorus and total phosphorus content; inorganic phosphorus, calcium and phosphorus in sediments was significantly correlated with ammonia nitrogen in interstitial water, which can be inferred that they have good identity; but the correlation between total phosphorus and iron and aluminum phosphate in sediment and all forms of phosphorus nitrogen in interstitial water is not strong shows the ability that the lake sediments release phosphorus to the gap water is poor. Ammonia nitrogen and nitrate nitrogen did not shows

significant correlation, suggesting that there is diversity in origin; showed a significant correlation of total phosphorus, ammonia nitrogen and total nitrogen in pore water shows they have some homology, further explained the Datong Lake mainly depends on the rainfall and surface runoff, the homology is mainly affected by exogenous factors.

Table. 2 The correlation relationship analysis of phosphorus species distributions in sediments and interstitial water of Datong Lake

	TP	IP	Fe/Al-P	Ca-P	TN	NH ₄ ⁺ -N	TP _j	TN _j	NH ₄ ⁺ -N _j
TP	1								
IP	0.991**	1							
Fe/Al-P	0.278	0.367	1						
Ca-P	0.992**	0.988**	0.227	1					
TN	0.733	0.749	-0.035	0.773	1				
NH ₄ ⁺ -N	0.692	0.655	0.226	0.655	0.511	1			
TP _j	0.690	0.729	0.174	0.759	0.588	0.115	1		
TN _j	0.690	0.613	0.027	0.648	0.420	-0.139	0.840*	1	
NH ₄ ⁺ -N _j	0.798	0.812*	0.075	0.858*	0.746	0.556	0.850*	0.528	1

** indicates significant correlation; * correlation; the subscript j said in the interstitial water of nitrogen and phosphorus

CONCLUSION

Through the determination of various nitrogen, phosphorus determination of Datong Lake sediments, lake sediments of each point total N concentration is 1574.5~2186.0mg/kg, the average concentration is 1912.9mg/kg in the sediments, the main form of nitrogen is organic nitrogen, the content of 93.50%~ 97.12% for total nitrogen content, the ammonia nitrogen is the main form of inorganic nitrogen, total inorganic nitrogen concentration of phosphorus in lake sediments 87.35%~100%; for 1697.7~3074.8mg/kg, the average concentration is 2144.5mg/kg; all the contents of inorganic phosphorus in the phosphorus content is about 80%, the content of calcium and phosphorus and iron and aluminum phosphate was close to that of the main forms of inorganic phosphorus, the content of organic phosphorus, total phosphorus content of about 14.8%~27.4%. Correlation relationship analysis in different sampling points between sediments and interstitial water found that the increased nitrogen, phosphorus forms in sediments in Datong Lake were mainly affected by exogenous, and poor ability to release phosphorus to the overlying water in sediment.

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