The Variance Character of Heavy Metal's Content in Yellow River Estuary Water

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Abstract: In the high water and low water period, water sample of the Yellow River delta were gathered to determine the concentration of Cu, Pb, Zn, Cd, Cr, As, Hg. The average concentration of heavy metals in the high water period was higher than that in the low water period, and the content of heavy metals in bottom was higher than that in surface layer. From river to sea, the variance of heavy metals content is obvious. At low water period, the heavy metals content decreased from river to sea, but at the site that was at 12.5km apart from A03, there was a obvious low value area, and then increased, the main reason was resuspension of sediment; In high water period, at the site that was at 11.5 to 15km apart A03, the content of heavy metals decreased obviously, and then appeared a peak value, the site of peak value in high water period was at about 1.3km apart from that in low water period. The factor analysis showed that the resuspension of mud and sand and salinity conduced from the river runoff and the mixture of fresh and salt water was the main reasons of the variance of heavy metals content in Huanghe estuary water.

Key words: Yellow river Estuary, water; heavy metals; variance character

1 Introduction

The pollution of Yellow River system increased heavily in recent years. Water quality of 66% river systems was lower than the surface water quality III in 2005. New large reservoirs changed the hydrographic characters of the river. Yellow river is a high-turbidity river, which affects the transport of metal more than other rivers. These factors all affected the transport flux of heavy metal from the river to the sea. The objective of the research was to learn the content of metal in Yellow River estuary in different water period, and the variance of metal in water in the process of mixture of river water and sea water. The change of trace heavy metal concentration was compared the historical data.

2 Material and method

The surveys were carried out in May and September in 2005(Fig. 1), which covered low and high water period. Surface water and bottom water were sampled. The samples were filtered by precleaned Nuclepore filters(0.45μm). In the laboratory, suspended sediments were digested with $HF\text{-}HNO_3\text{-}HClO_4$ in close Teflon systems. The solutions were analyzed by atomic absorption spectrophotometry (AA6800) to determine heavy metal concentrations (Cu, Pb, Zn, Cd, Cr). Hg and As were analyzed by atomic fluorescence spectrophotometry (AFS930). The accuracy and precision of heavy metal determinations were monitored through repeated analyses of standard samples. Other environment parameters (Salinity, Temperature, Depth, SS, DOC, N, P, et al.) were determined. Suspended sediment content decreased and salinity increased from the river to the sea(Fig.2). Fluctuation of SS and salinity in low water period was much clear than that in high water period.

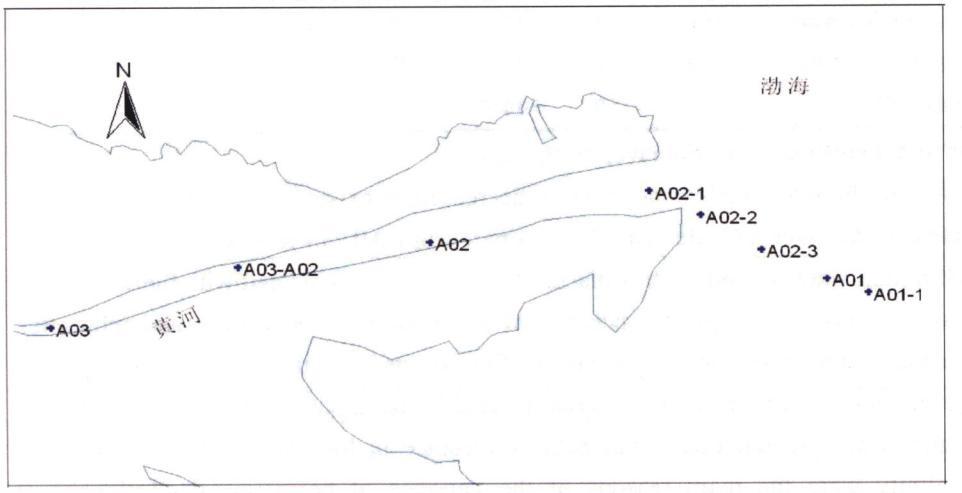

Fig.1 The sampling site in Yellow River Estuary

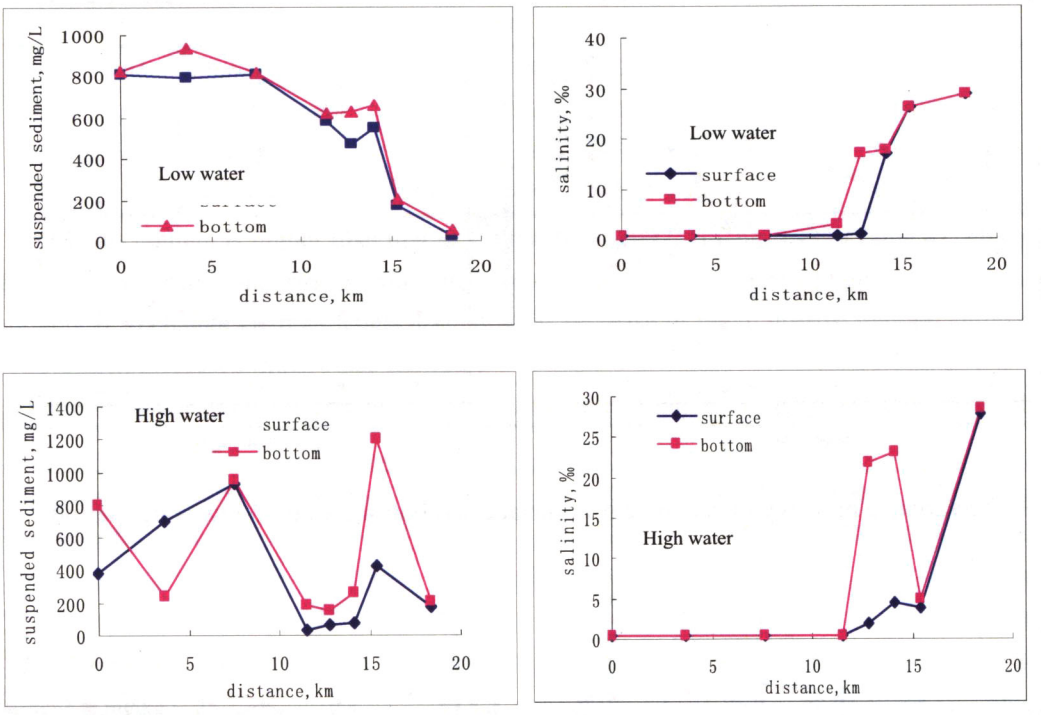

Fig. 2 Variance of salinity and suspended sediment in low and high water periods

3 Results and discussion

3.1 Heavy metal in Yellow river estuary

The most metals concentration was not high compared the Surface water standard III. High SS concentration caused the much high concentration compared the other big rivers. Metal in bottom water was higher than that in surface water. Metals content in high water period was higher than that in low water period, which was different from the most rivers in China. In high water period many sources could be input to the river with the flood. High suspended sediment in summer was another reason.

Table 1 Average content of total heavy metals content in water, μg /L

		Cu	Pb	Zn	Cd	Cr	Hg	As
Low water period	Surface water	32.7	26.3	51.0	0.42	21.4	0.12	2.68
	bottom water	39.0	30.4	55.5	0.45	26.0	0.10	2.55

High water period	Surface water	35.4	31.2	52.3	0.60	33.4	0.16	1.68
	bottom water	37.1	35.9	58. 9	0.65	36.4	0.16	2.23
Surface water standard III		1000	50	1000	5	50	0.1	50

3.2 Variance of metal content from the river to the sea

From the river to the sea, metals concentration decreased. It existed the great changes in the mixture part between the river and the sea 12.5km apart from A03 in low water period, 1.5 to 15km apart A03 in high water period. In this place, SS concentration changed with the water flow rate. Chemical characters changed greatly because of the mixture of freshwater and salt water. These factors change the transport of metal in this place. By the principal component analysis(PCA) of the metals concentration in water, F1 and F2 factors account for more than 90% of variance in high water period, more than 80% if variance in low water period. Suspended sediment and salinity were the main reasons of the variance of heavy metals. Influence of suspended sediment in high water period was higher than in low water period.

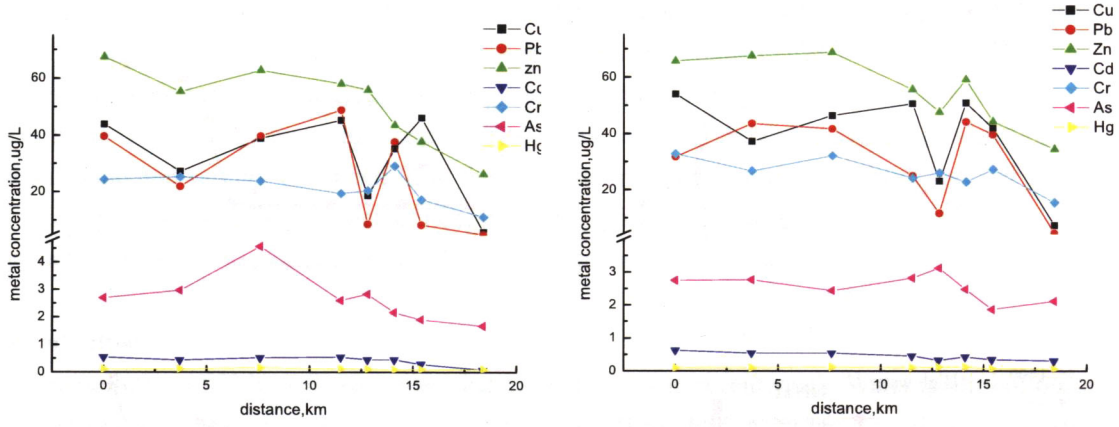

Fig 3 The variance of heavy metal content in surface and bottom water in low water period

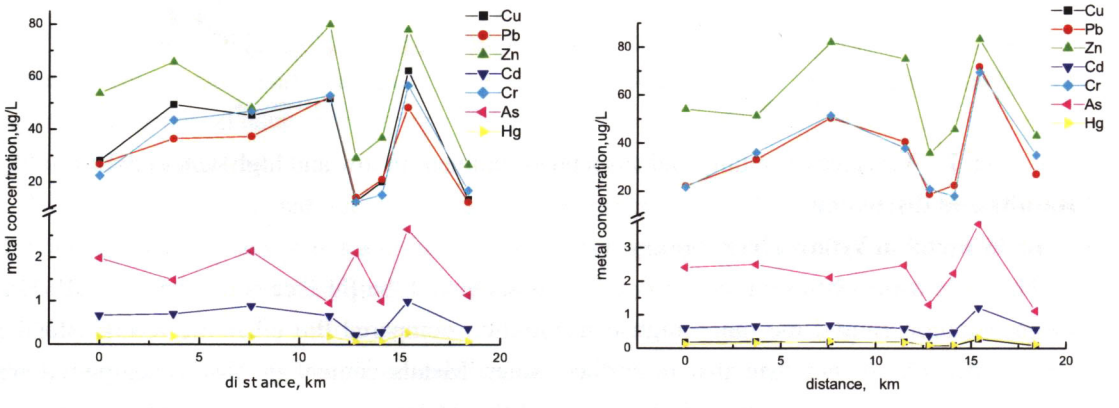

Fig 4 The variance of heavy metal content in surface and bottom water in high water period

Table 2 Factor analysis of heavy metals content in low and high water period

	Low water period				High water period			
	Surface water		Bottom water		Surface water		Bottom water	
Component	F1	F2	F1	F2	F1	F2	F1	F2
Cu	0.677	0.433	0.859	-0.250	0.987	0.094	0.978	

Pb	0.818	0.309	0.755	-0.516	0.952	-0.254	0.990	
Zn	0.920	-0.09	0.963	0.0177	0.931	-0.255	0.884	
Cd	0.951	0.175	0.867	-0.133	0.938	0.2	0.955	
Cr	0.723	0.4	0.846	-0.066	0.966	-0.134	0.960	
Hg	0.743	-0.627	0.637	0.591	0.406	0.903	0.813	
As	0.790	-0.574	0.418	0.872	0.977	0.151	0.997	
Eigenvalues	4.58	1.20	4.28	1.46	5.68	1.03	6.21	0.46
% of variance	65.4	17.2	61. 2	20.8	81.1	14.8	88.7	6.57
Cumulative %	65.4	82.6	61. 2	82	81.1	95.9	88.6	95.2

3.3 Dissolved and suspended metal concentration

Particulate metals are higher than the dissolved metals(Table 3). Most of metals were distributed in the suspended sediment. That's to say, metals were transported mainly by the SS.

Table 3 Dissolved and suspended metal concentration in water, μg /L

		Cu	Pb	Zn	Cd	Cr	Hg	As
Low water period	Dissolved metal	2.28	2.78	13.2	0.10	2.47	0.044	1.82
	Particulate metal	33.6	25.6	40.1	0.3	21.3	0.068	0.8
High water period	Dissolved metal	5.81	4.23	20.8	0.22	5.55	0.078	1.58
	Particulate metal	30.4	29.3	34.8	0.41	29.4	0.079	0.38

Metals content is higher than that in 1990s(zhang,1992; Huang, 1993)(Table 4). Zhang(1993) thought weathering and erosion controlled water chemistry, and anthropogenic contributions did not appear to change element levels dramatically. Increase of metal greatly implied anthropogenic contribution increased much since ten years

Table 4 Changes of dissolved and suspended metal concentration compared the historical data

	Cu	Pb	Zn	Cd	Cr	Hg	As	
Dissolved,μg/L	2.28	2.78	13.20	0.10	2.47	0.044	1.82	Low water
Dissolved,μg/L	5.81	4.23	20.79	0.22	5.55	0.078	1.58	High water
Dissolved,μg/L	0.95-1.53	0.01-0.04	0.065-0.33	0.001-0.006			2-2.1	Zhang,1993
Particulate,mg/kg	88.5	57.1	147.2	0.9	85.2	0.2	3.1	Low water
Particulate,mg/kg	163.3	172.3	209.2	2.0	164.6	0.41	1.1	High water
Particulate,mg/kg	26.7	16.4	69.8	0.18	76.9	0.02	13.1	Huang,1992

4 Conclusions

The concentration of heavy metals in the high water period was higher than that in the low water period, and the content of heavy metals in bottom was higher than that in surface layer. From river to sea, the heavy metals content decreased from river to sea, existing fluctuation before sand dam either in low water period or in high water period. The PCA showed that suspended sediment and salinity were the main reasons of the variance of heavy metals content in Yellow river estuary water. Most metal concentration increased clearly compared with the historical data. This change should be paid more attention

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