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Inputting history of heavy metals into the inland lake recorded in sediment profiles: Poyang Lake in China

Guo-Li Yuan*, Chen Liu, Long Chen, Zhongfang Yang

School of the Earth Sciences and Resources, China University of Geosciences, No. 29 Xueyuanlu Haidianqu, Beijing 100083, China

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ABSTRACT

The temporal and spatial distribution of heavy metals (Cd, Hg, Pb, As and Cr) in Poyang Lake, the largest freshwater lake (3050 km^2) in China, were studied based on the sedimentary profiles. For this purpose, eight sedimentary cores were selected which located at lake area, outfall of lake and the main branch rivers, respectively. High-resolution profiles with interval 2 cm were used for analyzing the concentration of metals, and the ages of them were determined by ^{210}Pb and ^{137}Cs isotopic dating. While studying the change of metals concentration with the age in profile, it is found that the concentration of them in sediments was influenced not only by the sources in history but also by the sediment types. Based on this detailed work, the inventory and burden of heavy metals per decade were estimated in lake area during the past 50 years. Significantly, rivers-contribution ratio per decade was estimated to distinguish each river's contribution of heavy metals into lake while river-flux in history and metals concentration in profiles were considered as calculating factors. So, our research provides a proof to well understand the sedimentary history and the inputting history of heavy metals from main rivers into an inland lake.

1. Introduction

Because of long time residence for contaminant in sediment, the study of sediments plays an important role in proof of contamination, especially metals contamination [1,2]. It is reported that metals concentration in sediments usually exceeds those in overlying water by three to five orders of magnitude [3]. So, the sedimentary metals could well reflect the metals contamination in aquatic system at depositing times. The vertical concentration profile of metals in sediment cores can be used to reveal the degree of metal pollution in recent decades [4–6]. In order to reveal detailed information on historical inputs and trends of heavy metals pollution, it is essential to establish the depositional history of the sediments through vertical profiles [7]. Furthermore, analysis of heavy metal concentrations in dated profile helps to construct the chronologies of them. Among the contaminations, heavy metals (e.g. cadmium, mercury, lead, arsenic, and chromium) have adsorbed great attention in recent, which mainly result from the expanding industrial activities (e.g. metallurgy) and the related population growth. Thus, the results from the determination of heavy metals in sediments help to reflect the impacts of industrial and anthropogenic activities [1].

River sediment can accumulate and integrate the temporal variability of heavy metals in river water originating from anthropogenic activities into spatial river sediment. Moreover, the vertical metal concentration profile in river sediment can indicate not only the pollutants in sources but also the pollutants transported or contributed into reservoir through the river [1]. The history of heavy metals distribution can be assessed by taking vertical sediment core samples from river-beds, as the makeup of sediment cores reflects the geochemical and contamination history of source region, including any anthropogenic impact, and can act as a useful indicator of metal pollution flux [4,8,9].

At a regional scale, multiple terrestrial sources of natural (erosion, leaching) and anthropogenic origin (e.g. mining and smelting waste) lead to the presence of high levels of heavy metals in aqueous environments [10,11]. Sedimentation under favourable hydraulic conditions in natural reservoir may allow historical recording of fluvial trace metal inputs and evaluating long-term trends of particulate metals transport in the system [12,13]. In natural reservoir, the hydraulic condition in lake is more favourable than in estuary and coast. Moreover, the loading or burden of pollutants could be well calculated in one lake due to the deposition area is definite. So, it is more helpful to study the occurrence and history of deposited heavy metals in one given area. Profiles of sediment bound constituents such as metals and man-made organic compounds have been widely used to provide a record of contaminant inputs to lakes [14–18], reservoirs [19], and bay [20,21]. At the same time, sediment is an important sink and reservoir of per-

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* Corresponding author. Tel.: +86 10 82334657.
E-mail addresses: yuangl@cugb.edu.cn, yuanguoli@hotmail.com (G.-L. Yuan).

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Table 1
Sampling-core and corresponding data.

Sampling cores	Location	Core depth (cm)	Age
C1	Lake Outfall	168	1818–2006
C2	Xiushui	190	1925–2005
C3	Lake	132	1919–2005
C4	Lake	152	1948–2005
C5	Gangjiang	240	1939–2005
C6	Fuhe	220	1955–2005
C7	Xinjiang	180	1952–2005
C8	Raohe	198	1901–2005

sistent pollutants, and emission histories of them are preserved as a function of depth in sediment, especially in sediment [22].

Poyang Lake is located in the north of the Jiangxi Province and it lies on the southern bank of the Yangtze River in China. It is the biggest freshwater inland lake in China. Ganjiang River, Fuhe River, Raohe River, Xinjiang River and Xiushui River are its five main branches. Dexing and Yongping copper mines are at the side of the Poyang Lake. The metal contents are very high at the conjunction of the rivers and Poyang Lake, where the aquatic environment has been contaminated [23]. Recently, study of the heavy metals in sediments of Poyang Lake region has adsorbed great interests. Some reports have focused on studying the inputting main rivers [24,25], and the others focused on the lake and wetland area [26,27]. Nevertheless, almost all of them pay lots of interests in surface sediments and few reports [28] focus on studying the heavy metals in vertical profiles of the sediments. As mentioned above, study on concentration of heavy metals in sedimentary profiles helps to well understand the pollution history and emission potential in Poyang Lake region. On the other hand, the profiles in rivers and lake help to indicate not only the sedimentary history in lake area but also the inputting source originated from different rivers.

Herein, our report aims to systematically study the heavy metals sedimentary profiles in Poyang Lake region, including lakes and rivers, in order to well understand the spatial and temporal distribution in this region, as well as, study the heavy metals accumulation and the contribution history from each river into an inland lake.

2. Materials and methods

2.1. Study area

Poyang lake (28°4′–29°46′N, 115°49′–116°46′E) is located in the north of the Jiangxi Province and it lies on the southern bank of the Yangtze River (Fig. 1). It is the biggest fresh lake (3050 km^2) in China. Over 90% rainy water in Jiangxi Province area flows into the lake. Ganjiang River, Fuhe River, Raohe River, Xinjiang River and Xiushui River are its main branches, and 86% water flux of lake is inpouring from these rivers. There is just one outfall from Poyang Lake to Yangtze River in the north of the lake. Dexing and Yongping copper mines are located at the side of Poyang Lake. So, the majority of sediments in lake, including deposited heavy metals, are undoubted transported from mentioned rivers. The rainy season from April to September, and the arid season is from October to February.

2.2. Sediment core samples

Sedimentary cores are taken from the five river estuary flowing into lake, the lake and the outfall to Yangtze River, total 8 cores (Fig. 1; Table 1). All core samples were taken from the deposition, which are covered by water in rainy season and exposed to surface in arid season. In order to take the sediment cores in lake area, the sampling work was carried out in December. Core-sampling works were carried out in polycarbonate tube (5.3 cm in inner diameter, 100 cm in height). The tube was vertically fixed into the deposition until the deposition cannot be penetrated by the tube. If needed, two or more tubes were linked for one core sampling. The core was taken out by digging the depositions around it. The sediment cores were held in ice boxes during transportation to the lab, after which they were cut into 2-cm core segments. Each sediment core segment was then dried in an oven at a temperature lower than 40 °C prior to chemical analysis.

2.3. Geochemical and radionuclide analysis

Of geochemical components, some major elements, Cr and Pb were analyzed by X-ray fluorescence spectrometry (RS-1818, HORNGJAAN). The major elements were expressed as percent of metal-oxides, while Cr and Pb were expressed as mg/kg. Cd (mg/kg) was analyzed by graphite atomic absorption spectrophotometer (AA6810 SONGPU). As and Hg (mg/kg) were analyzed using atomic fluorescence spectrophotometer (AFS-31001). Sediments age was estimated from available dates determined by ^{210}Pb and ^{137}Cs with the CRS model [29]. ^{210}Pb and ^{137}Cs were measured using EURISYS Gamma Spectrometry at the Institute of Geology and Geophysics, Chinese Academy of Sciences. ^{137}Cs was measured at 662 keV, while ^{210}Pb was obtained via gamma-emission at 46.5 keV and ^{226}Ra at 295 and 352 keV γ-rays emitted by its daughter isotope ^{214}Pb. Recovery (%) varied according to the metal but they were all in the range of 90–95%, and the precision was nearly 10% under the confidence level of 95%. The statistical analyses were carried out using SPSS 13.0 software.

3. Results

3.1. Chronology and mass accumulation rate

The age of sediment was determined based on ^{210}Pb and ^{137}Cs chronology with CRS model (Lab. of Geological Dating System, Institute of Geology and Geophysics), and the age of them in different depth of eight cores was shown in Fig. 2. Although it cannot be guaranteed that the sedimentary cores had not been disturbed by microbe, the continuous trend of concentration in profile suggested that the selected profile has not been defaulted and absent in large scale [30]. As shown in Fig. 2, the sedimentary rate in the site of outfall (C1) from Poyang River to Yangtze River is the lowest, and the sedimentary depth is just 24 cm during the past 51 years (1955–2006). C3 and C4 are the cores sited in lake area, and the sedimentary rates of them are almost similar but higher than that in outfall. The sedimentary rates in rivers (C2, C5, C6, C7, C8) are greatly higher than those in lake and outfall. Among them, sedimentary rate in Raohe is the highest, and the sedimentary depth was ca. 240 cm during the past 50 years. Generally, the sedimentary rate decreased as following order, Xiushui, Xinjiang, Gangjiang and Fuhe rivers. During the past 50 years, the sedimentary depth of Fuhe is not more than 100 cm, less than half of Raohe. Generally, the sedimentary rate is almost constant after 1980s in each river, which is slower than that it was before 1980s. In the case of Raohe, there are two inflexions in curves, which divide the curve at mid-1980s and mid-1960s. The trend of sedimentary rate between 1960s and 1980s is higher than that in former and latter stages. In summary, sedimentary rate in total 8 cores accords with the model of river–lake deposition. While the particles were transported by the water in river, major particles firstly deposited at river-bed with rapid and relatively coarse deposition. The left of the particles were taken into the lake and the lake serves as the reservoir for adsorbing the water and particles. At the same time, the lake provides wide space for oddment deposition. After the filtration of

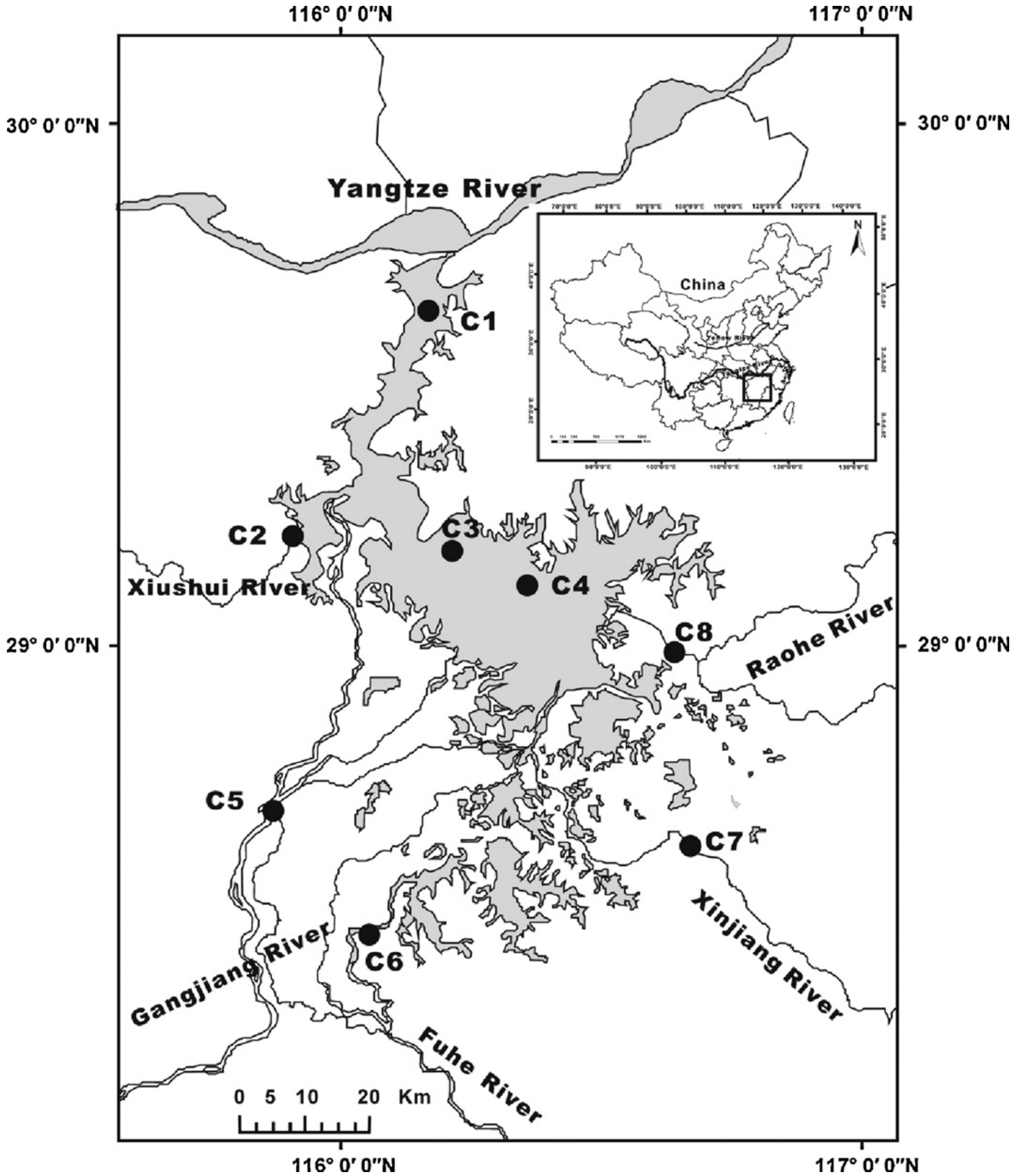

Fig. 1. Sketch map of the study area with location of sampling sites shown as black points.

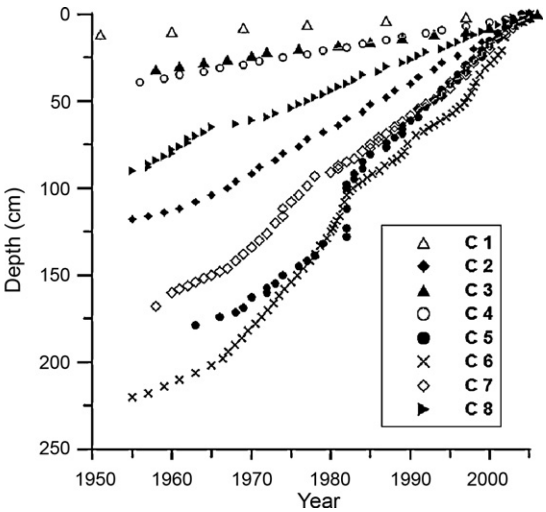

Fig. 2. The curves of depth and age for sedimentary cores based on isotopic dating.

the lake, the suspended particles in water are very few and thus the deposition in outfall of the lake is very thin. Reflection in sedimentary cores for such a change is that, the deposition thickness in river is higher than that in lake, and lake is higher than outfall. Such a result is confirmed by the core depth–age curves in Fig. 2.

3.2. Vertical distribution of heavy metals in sedimentary cores

Mainly adsorbed in particles, heavy metals were transported and accumulated in sediments. To some degree, the concentrations of heavy metals in sediments stand for the level of heavy metals during transportation and deposition. The concentration of Cd, Hg, Pb, As and Cr in profiles of 8 cores are shown in Fig. 3, where the sedimentary depth is related to 50–60 years deposition. C1 sites at outfall of the lake, C3 and C4 at lake area, and C2, C5, C6, C7 and C8 at Xiushui, Gangjiang, Fuhe, Xinjiang and Raohe. Therefore, the concentrations of heavy metals in river sediments stand for the input concentration into lake. The concentrations in lake area stand for the accumulation and depositional concentration, and concentra-

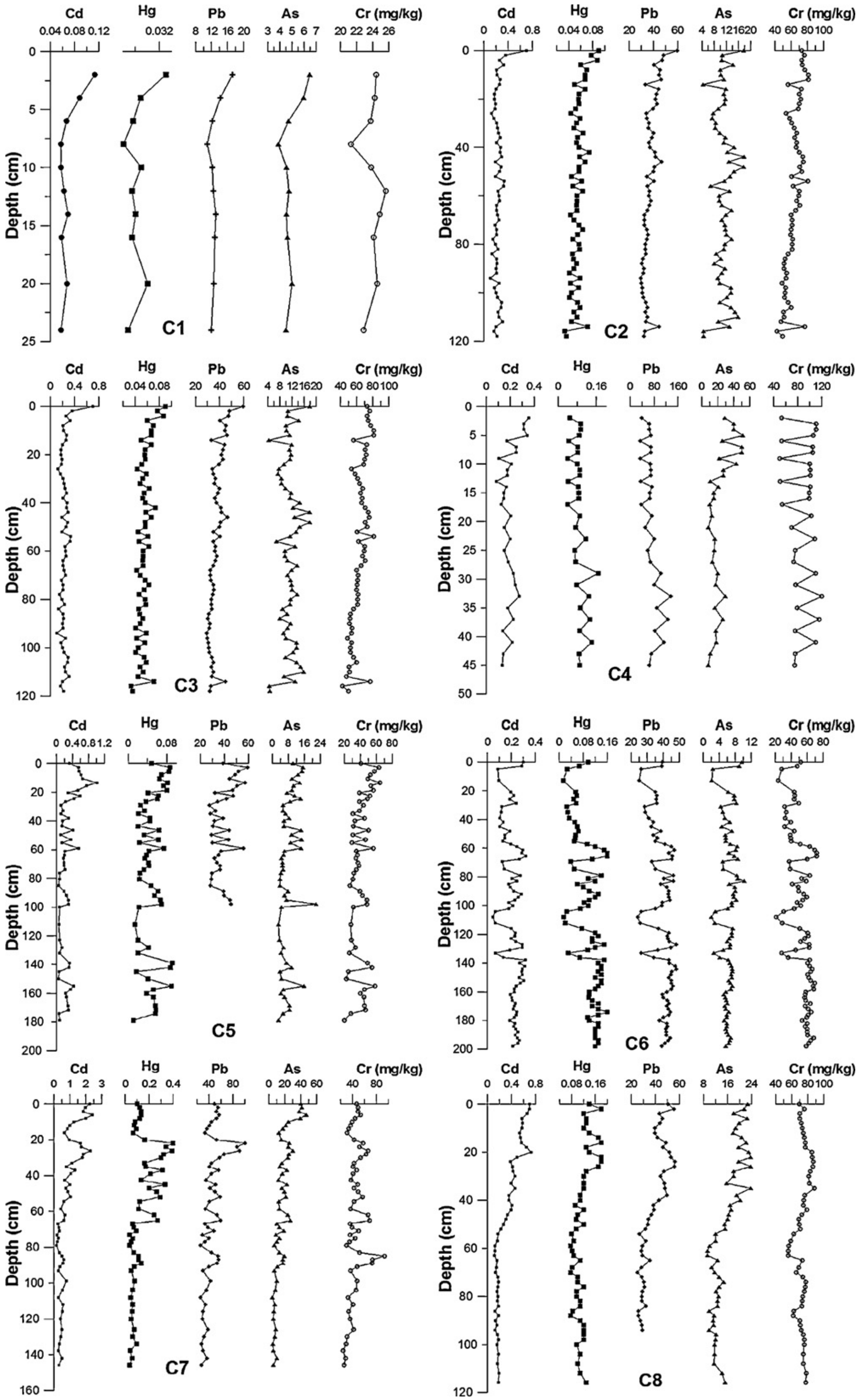

Fig. 3. Concentration profile of heavy metals in eight sedimentary profiles.

tion in C1 stands for that of heavy metals in suspended particles running out from lake into Yangtze River.

At the location of outfall (C1), heavy metals concentration in down-section of profile is rather constant while it shows an increasing trend at up-section till to surface. Such a trend is clearly observed for Cd, Pb and As elements, and, respectively, increasing from 0.06 to 0.11 mg/kg, 12.38 to 17.20 mg/kg, and 4.73 to 6.44 mg/kg.

In lake area, two profiles (C3 and C4) show almost similar characters with stable concentration in profile for most of elements. Generally, the concentration of Cd and Hg in C3 is generally higher than that in C4 while As and Cr in C3 are lower than that in C4. Nev-

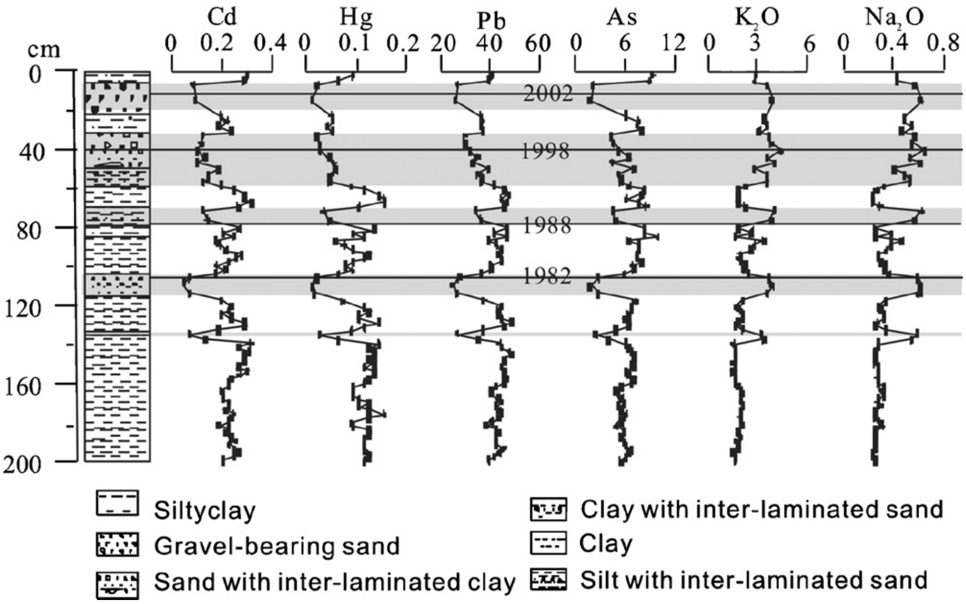

Fig. 4. The sedimentary core of C6 with the corresponding concentration of Cd, Hg, Pb, As, K, and Na elements.

ertheless, the concentration of five heavy metals in two profiles is in same order gratitude. By comparing, it is found that the concentration of these metals in lake is ca. 2–4 times of that in the profile sited at outfall. The concentration of heavy metals in Poyang Lake is lower than that in Taihu Lake in east China [31], and corresponds with that in Chaohu Lake [32]. Comparing with other reports in worldwide, it is close to that in Wadi Al-Arab Dam [33], and lower than that in the reservoir in central Taiwan [34]. From this point, it seems that heavy metals pollution in Poyang Lake sediments is very slight in surface and not serious as reported [23].

Each river presents the different input sources around the lake, thus each profile even metal in it, possibly shows completely different characters comparing with others. In Fuhe River (C6), the concentrations of Cd, Hg, Pb, As and Cr are almost no obvious change through the whole profile. In most river profiles, the concentration of Cd in surface sediments is high, especially in Xinjiang (C7) and Raohe (C8). The values in Xinjiang (C7) reach 1–2 mg/kg, and 0.5–0.6 mg/kg in Raohe (C8). Except surface, the concentration of Cd in five profiles is constant at ca. 0.2–0.4 mg/kg. The concentration of Hg in these profiles occurs at the range of 0.05–0.15 mg/kg except that of Xinjiang with high value more than 0.3 mg/kg in 1980s. The concentrations of Pb in these profiles are almost close and distributed at limited range between 20 and 60 mg/kg, but focused on 30–50 mg/kg. It is reasonable to understand that river pollution could directly reflect the pollution condition in one region because it is the closest reservoir from the pollution source. So, heavy metals in sediment of rivers could serve as a direct indication for pollution in one given time and region. Based on the data in Fig. 3, the sedimentary concentration of heavy metals in profile in Poyang Lake five rivers, especially Cd, is obviously lower than that in west-four Pearl Rivers [35] and main rivers in southern Taiwan [36], even lower in one order gratitude. Although large copper mines are located at upstream of these rivers, it seems no obvious influence on heavy metals pollution in Poyang Lake area.

4. Discussion

4.1. Influence of sediments on the concentration of heavy metals

Commonly, it is considered that heavy metals are mainly adsorbed in particles, and heavy metals are apt to be absorbed by the fine particles rather than coarse particles. As the result, the concentration of heavy metals in clay is often higher than that in sands while they were deposited in similar contaminated environment [37]. In order to study the influence of sedimentary type on heavy metals enrichment, Fuhe sedimentary core (C6) was selected for data analysis. As shown in Fig. 4, the concentration of Cd, Hg, Pb and As in clay and silty clay is obviously higher than that in sand. Besides the sedimentary section, the concentration of K and Na elements also helps to understand such results. It is well known that the content of K and Na decreased with weathering degree in natural particles, especially in clay [38]. In this case, the reflection in sediment is that the enrichment level of K and Na is opposite to that of heavy metals in same sedimentary section. As shown in Fig. 4, shadow section stands for the sandy sediments, in which the concentration of heavy metals is lower than that in clay section.

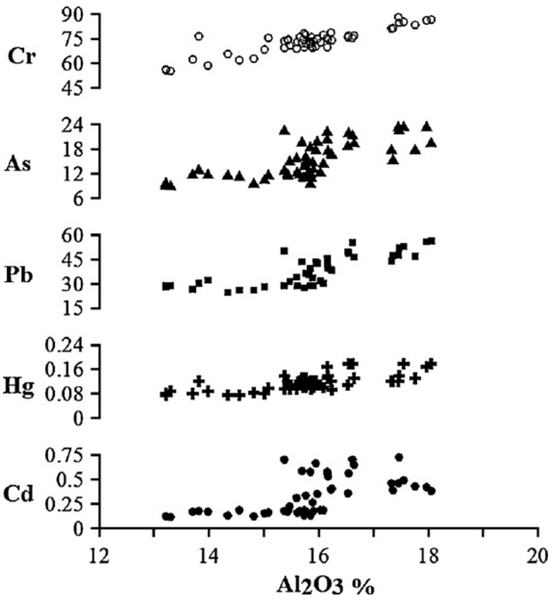

Fig. 5. The correlation between concentration of Al_2O_3 and Cd, Hg, Pb, As and Cr in C6 sediments.

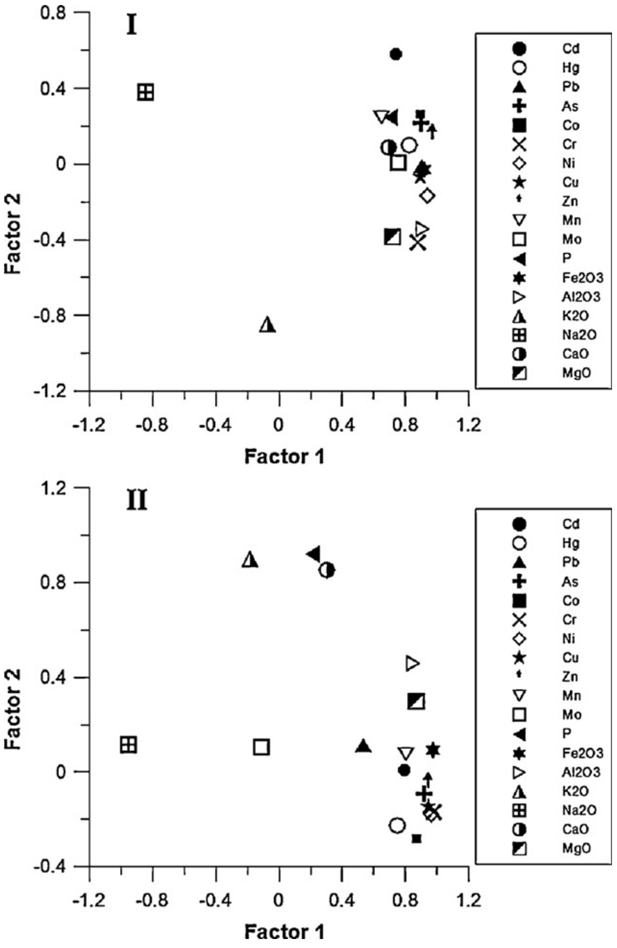

Fig. 6. Fuzzy cluster analysis for metal elements in sediment core C6, I: 29 samples (1972–2005); II: 14 samples (1957–1971).

On the other hand, Al_2O_3 is the main component of clay. So, the content of Al_2O_3 is positively related to that of clay in sediment. In other words, the content of Al_2O_3 in sediments could also be used to indicate the content of clay in it because content of Al_2O_3 could be quantified rather than clay. Fig. 5 presents the relationship between heavy metals and Al_2O_3 content in C6 sedimentary sections. All of heavy metals such as Cd, Hg, Pb, As and Cr show positive correlation to that of Al_2O_3 in sediments, which are consistent with the results in Fig. 4. That is, clay sediments adsorbed more heavy metals than sand or coarse particles. Such a result is also consistent with other reports [39].

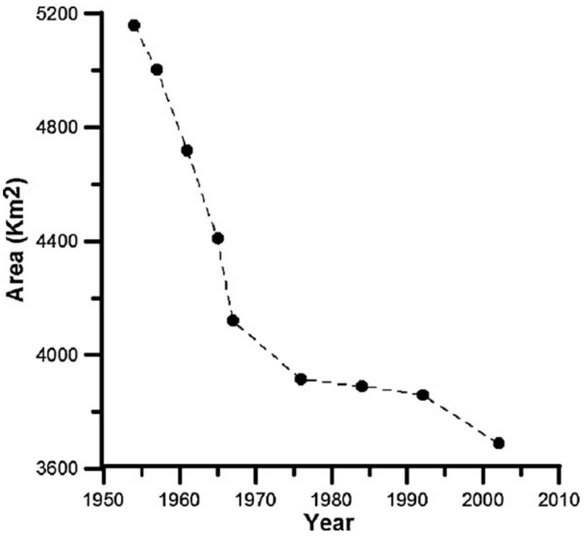

Fig. 7. The change of Poyang Lake area in past 5 decades.

4.2. *The correlation of metals in sediments*

Table 2 shows the factor load of principal factors by Cluster analysis [40] of some metals in sediment core C6, including heavy metals such as Cd, Hg, Pb, As and Cr. Fuzzy cluster analysis [41] is carried out based on the data in Table 2, and the results are shown in Fig. 6. In this case, the purpose is to find out the relationship among the heavy metals in sediment, whether they originate from same or different source. In C6 profile, the character of heavy metals concentration in the upper section is obviously different from that in lower section. As observed in Fig. 4, the concentration of heavy metals in lower section is almost constant without change with depth in profile. While in upper section, the character is different. So, the analysis was carried out by dividing the data into two sections, section I and section II. The time for such a dividing line could be dated between 1972 and 1971. In section I (1972–2005), elements of Hg, Pb and As could be considered in one cluster while Cd and Cr are independent from the cluster. In other words, Hg, Pb, and As may be originated from same source which are aggregated with Co–Ni–Cu–Zn–Mn elements. Pb and Cr are possibly from

Table 2
R2 type factor load of principal factors in profile of C6 core (section I: 29 samples, 1972–2005; section II: 14 samples, 1957–1971).

Section I	F1	F2	F3	Section II	F1	F2	F3
Cd	0.737	0.578	−0.095	Cd	0.795	0.008	−0.063
Hg	0.825	0.100	0.336	Hg	0.747	−0.225	0.506
Pb	0.905	−0.013	0.285	Pb	0.535	0.112	0.815
As	0.898	0.217	−0.016	As	0.918	−0.091	−0.078
Co	0.892	0.263	−0.175	Co	0.867	−0.283	−0.253
Cr	0.877	−0.415	−0.120	Cr	0.976	−0.170	−0.045
Ni	0.937	−0.167	−0.172	Ni	0.966	−0.179	−0.079
Cu	0.891	−0.068	0.371	Cu	0.944	−0.146	0.235
Zn	0.967	0.132	0.003	Zn	0.943	−0.066	0.000
Mn	0.646	0.246	−0.627	Mn	0.802	0.075	−0.393
Mo	0.755	0.009	0.454	Mo	−0.112	0.105	−0.033
P	0.706	0.246	0.439	P	0.214	0.920	0.107
Fe_2O_3	0.918	−0.029	−0.241	Fe_2O_3	0.973	0.092	−0.170
Al_2O_3	0.908	−0.343	−0.094	Al_2O_3	0.850	0.460	−0.143
K_2O	−0.075	−0.846	0.009	K_2O	−0.183	0.901	−0.114
Na_2O	−0.844	0.379	0.228	Na_2O	−0.955	0.116	−0.170
CaO	0.695	0.085	0.005	CaO	0.305	0.855	0.211
MgO	0.720	−0.386	−0.505	MgO	0.870	0.298	−0.285

Table 3
Average concentration of heavy metals (mg/kg) and thickness of sedimentary cores (C3 and C4) in 5–10 years interval.

Age	Cd	Hg	Pb	As	Cr	Thickness (cm)
C3						
2005–2000	0.56	0.09	48.30	14.25	58.36	8.00
1999–1990	0.59	0.10	51.20	11.25	54.62	5.50
1989–1980	0.55	0.10	54.53	11.47	61.44	4.70
1979–1970	0.28	0.09	48.37	10.73	66.12	5.80
1969–1960	0.24	0.09	51.50	12.17	74.54	5.34
1959–1950	0.23	0.08	48.67	10.67	70.77	6.66
C4						
2005–2000	0.34	0.07	50.26	35.02	77.37	5.00
1999–1990	0.17	0.06	48.84	29.47	73.03	7.34
1989–1980	0.13	0.06	50.48	12.16	72.57	8.00
1979–1971	0.17	0.08	62.20	12.52	77.73	7.64
1969–1960	0.20	0.10	88.03	17.65	82.48	8.00
1959–1950	0.16	0.10	83.80	15.28	80.81	8.34

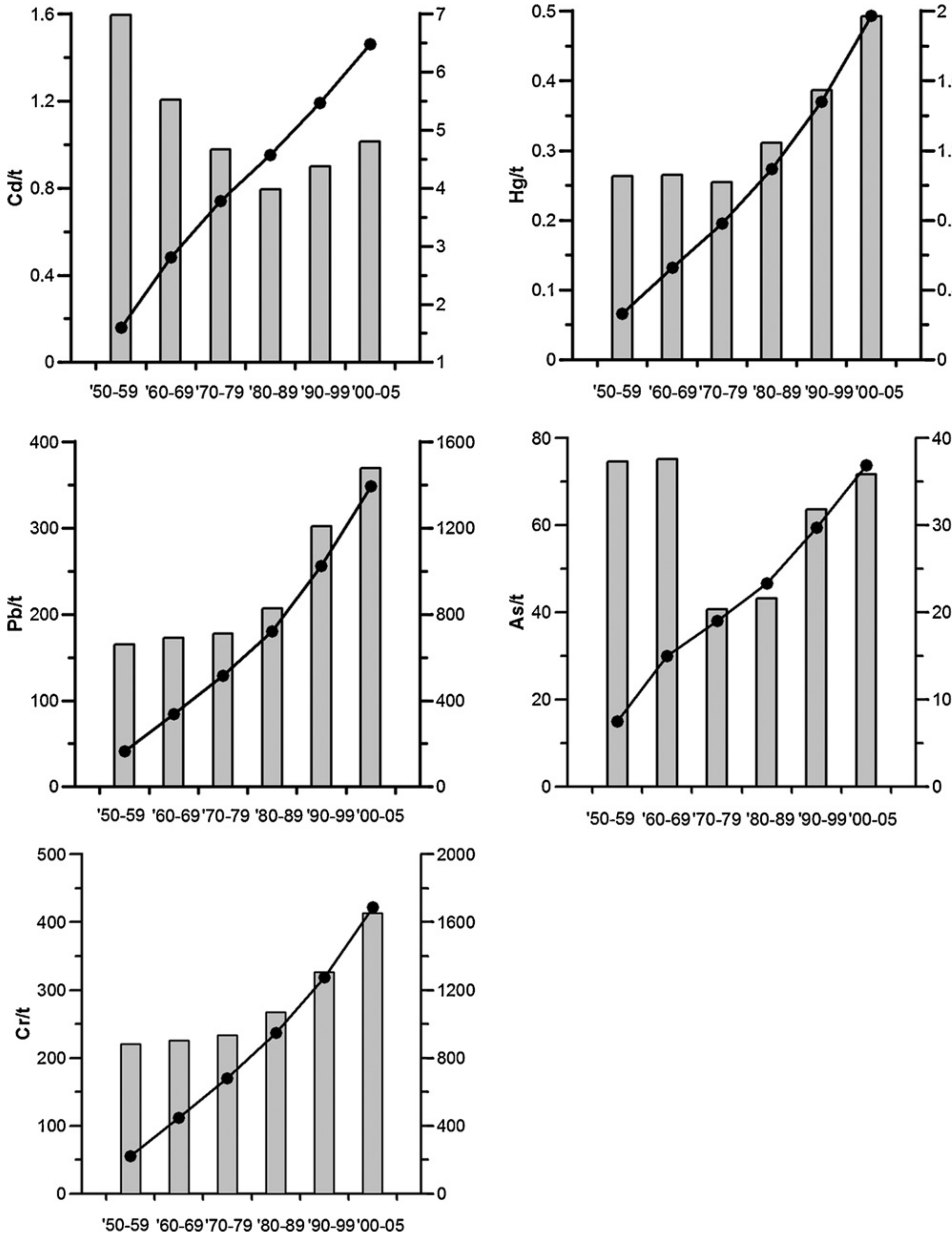

Fig. 8. Heavy metals burden (column) per decade in Poyang Lake and accumulating load from 1950 to 2005 (line).

other dependent sources. In section II (1957–1971), Pb and Hg are independent from the cluster of Cd–As–Cr which aggregated with Ni–Cu–Zn. Although the relationship of the metals could be clustered according to analysis, the sources of these metals seem difficult to be assigned because the pollution sources have been ceaselessly changed in history.

4.3. Inventories and burdens

The inventory (in mg/cm^2) of each target element represents the total integrated mass of this element per unit area during the given interval [15,21,22]. We estimate this sediment inventory using

$$\text{Inventory} = C_i \rho_i d_i \quad (1)$$

where C_i is the average concentration in sediment segment of given years interval (in mg/kg), ρ_i is the in situ density of this segment and assumed as average value 1.4 (in dry g/cm^3), d_i is the thickness of each increment of set years interval (in cm). In this case, the interval is set as 5 or 10 years. C3 and C4 are located in the lake area. So, it estimated that the average value of C3 and C4 stands for the average level in the lake for calculation. Although two cores are not enough to present the average level of whole lake, the calculation

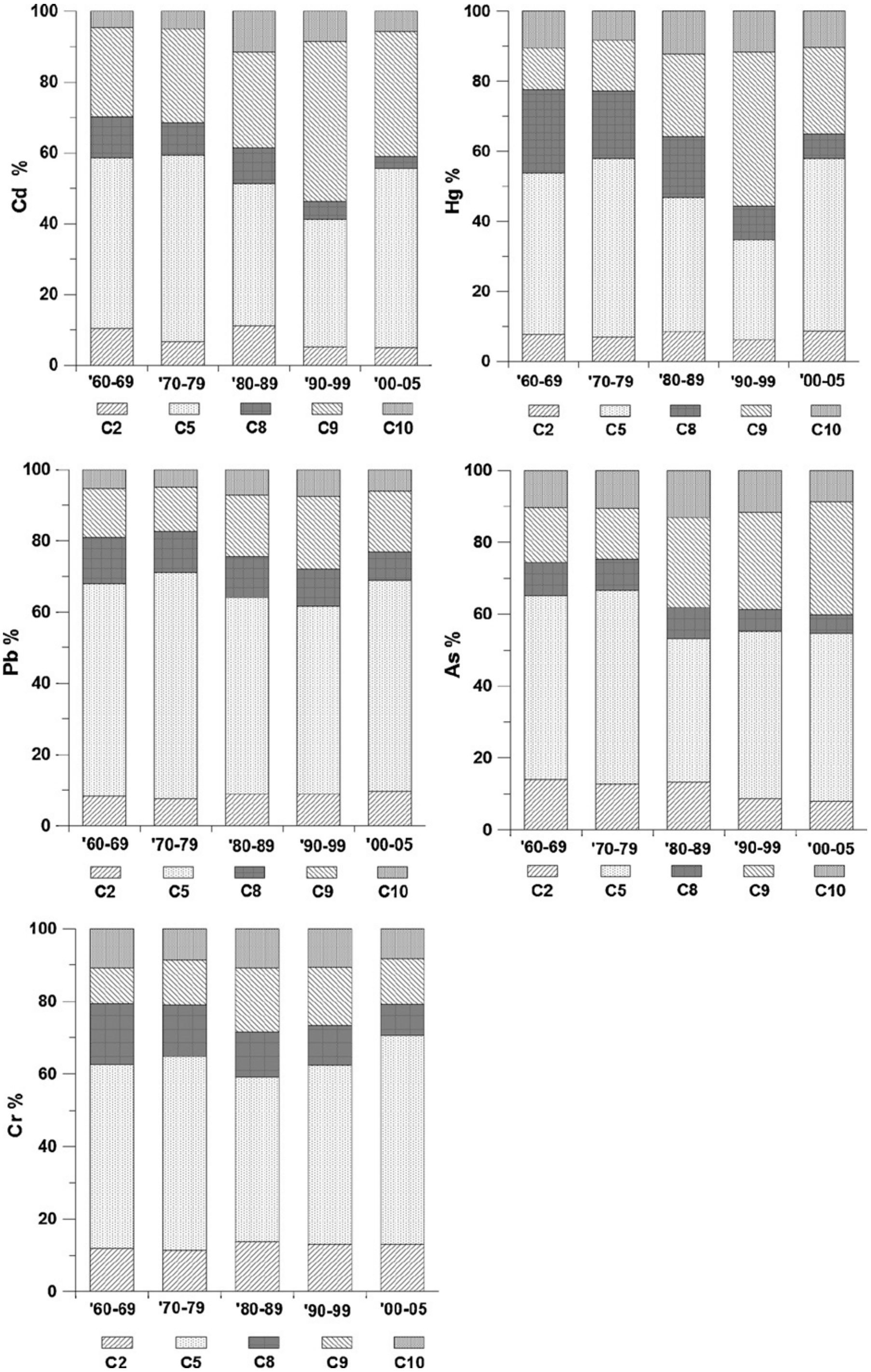

Fig. 9. Heavy metals contribution ratio of each river into Poyang Lake per decade from 1950 to 2005, C2, Xiushui River; C5, Gangjiang River; C6, Fuhe river; C7, Xinjiang river; C8, Raohe river.

Table 4
Flux and the ratio of five rivers into Poyang Lake during 1950–2005.

River (core)	Xiushui (C2)	Gangjiang (C5)	Fuhe (C8)	Xinjiang (C9)	Raohe (C10)
Flux ($\times 10^8$ m^3)	108.1	685.3	129.2	180.8	72.0
Ratio (%)	9.2	58.3	11.0	15.4	6.1

could provide us a whole impression of heavy metals deposition in Poyang lake basis on these authentic data. The decade average concentrations of Cd, Hg, Pb, As and Cr are shown in Table 3. Generally, the concentration of Cd in C3 is little higher than that in C4 while As and Cr in C3 are lower than that in C4.

The burden or load (in tons) is the inventory times the area of the lake [15]. As shown in Fig. 7, the area of Poyang lake is decreasing from 5160 km^2 in 1954 to 3690 km^2 in 2002 [[42,43] and China Lake Database]. So, the decade burden could be calculated by the method that average inventory times the average area of lake in that decade. Therefore, the burden of different heavy metals in responding decade could be calculated and results are shown in Fig. 8.

It could be observed that, burden per decade in Poyang Lake could be divided into two parts during 1950–2005s. The one occurred before 1980s and the other after that. Except Cd, the burdens of other heavy metals are almost no changes in earlier three decades. After that, the burdens of these metals increase per decade. Considering the real situation in China, it is not difficult to understand for such a result. After earlier 1980s, the industrialization and economic have developed and grown rapidly. Accompanying such a development, the environmental burdens are also becoming heavy, including the heavy metals pollutions. That is, the anthropogenic pollution, especially industrial pollution, made the environmental heavy metals higher and higher around Poyang Lake. Before early 1980s, the agricultural assarts and wood-cut are overrun. As the result, soil was lost into river and lake, which was evidenced by the rapid decrease of lake area before 1980s due to the large amount of depositions (Figs. 2 and 7). After that, such an appearance was controlled in some degree. Although the concentration of heavy metals is not high during 1950–1970s, the burdens of heavy metals are even higher than that of 1980s due to the high sedimentary thickness. For Cd, the higher burden in 1950s and 1960s may be resulted from lots of construction of irrigation works during these times. Unfortunately, the burdens during 2000–2005 exceeded those of previous decade, which suggests that the burden of heavy metals in Poyang Lake is increasing rather than decreasing nowadays.

4.4. Contribution of rivers

In Poyang lake area, the five main rivers provide absolutely most of the water and deposition into the lake and the flux are shown in Table 4 [44]. In this case, it is proposed that the same amount of water contributes to same amount of deposition into the lake through different rivers. It is also presumed that the ratio of water flux from one river into lake is constant in different times, and same water-flux took the same amount of particles to lake from each river. Basis on these presuppositions, the contribution of the heavy metals from one river to the lake is related to the water flux and the concentration of heavy metals in river-deposition. Thus, the contribution of heavy metals of each river into lake could be calculated by Eq. (2)

$$\text{contribution ratio} = R_{wi}C_{ij} \tag{2}$$

where R_{wi} is the water contribution ratio of each river into lake (table) during i period (5 or 10 years), and C_{ij} is the average concentration of one kind of heavy metal in number j river deposition during i period. Fig. 9 shows the results of contribution ratio of each river for Cd, Hg, Pb, As and Cr into lake in different decades. Obviously, Gangjiang river contributes almost 50% Cd to lake in past five decades, and the least is Raohe river although it contributed most amount of sediments to lake among rivers. For Cd element, the contribution ratio of Gangjiang decreased from 1960s till now, and that of Xinjiang increased as the times. The river contribution ratios for Hg and As elements also greatly changed as the times. For Pb and Cr, the contribution of each river is no obvious change as the times. That is, the concentration of Pb and Cr in deposition is almost no change since water flux ratio is supposed to be constant.

5. Conclusions

Eight sedimentary profiles were selected for studying the heavy metals distribution in Poyang Lake region, and the core sites located in lake, outfall of lake and the main branch rivers. Based on ^{210}Pb and ^{137}Cs isotopic dating, the relationship of depth-age for each profile was established. Combining the analysis of heavy metals concentration in these profiles, the temporal and spatial distribution of them in Poyang region was well constructed for well understanding pollution history. After distinguish the sedimentary type, it is found that the concentrations of heavy metals are influenced not only by the contaminant degree from the source but also by the sediment type. Such a result was confirmed by the positive correlation between content of Al_2O_3 and heavy metals in sediments. Cluster analysis represents that the source for heavy metals has changed as the times. Inventory and burden of heavy metals per decade were estimated for lake area. For most of them, the trend is decreasing till earlier 1980s then increasing as times. Unfortunately, the result suggests that the problem of heavy metals contamination has not been improved comparing to decade ago. Nevertheless, the pollution is not as serious as the imagination because the concentration of heavy metals is not higher than that of other lakes reported in worldwide. Through estimating river-contribution ratio to lake, it is found that Gangjiang river contributed almost half amount of heavy metals into Poyang Lake during the past 50 years although the sediment thickness is not so high as that in Fuhe river. In summary, our research provides a proof to well understand inputting history of inland lake, a close reservoir for heavy metals contamination.

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