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Diatomic remains in sediments of Le An River flowing into Po Yang Lake

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Abstract—This study has shown the concentration of diatomas and heavy metal ions (Cu, Pb, Zn and Cd) in the sediment samples from Le An River, a main tributary to Po Yang Lake. 38 diatom species in 19 genera were microscopically found on the sample slides prepared from the sediment of 4 ecologically characterized sites along this river. The occurrence of diatoms might be associated with the local water quality which was determined from the concentration of organic halogen-substances and heavy metal ions, particular Cu and Pb contained in the sediment samples.

Keywords: diatoms; heavy metal ions; sediments; Le An River; Po Yang Lake.

1 Introduction

In order to study ecological problems in Po Yang Lake and its tributaries in Jiangxi Province, many sediment samples were obtained in the lake and its inlets either. For this study, only four samples derived from Le An River, one main tributary, were used (A01, A04, A07, and A13, Fig. 1), because they came from the sites where are more or less ecologically characterized. For example, a copper mine is located between the first sampling site Haikou (a town with 25000 inhabitants) and 29 km downwards Gukou (a harbor town with 45000 inhabitants). The second sampling site is at the inlet of a small stream, Da Wu River. From Gukou farther is the third sampling site Daicun (a small town with 3000 inhabitants), located just at the inlet of Ji Shui River, a longer stream from Da Mao San Region. The last one is chosen at Caijiawan (with 50000 inhabitants) near to the wetland of Po Yang Lake. Diatomic remains in these sediment samples, as one bio-indicator for water quality (Round, 1981) and for river pollution (Watanabe, 1982), were microscopically observed and counted in this study and their occurrences could therefore be found to have associated with the amount of copper as well as other heavy metals (Takamura, 1989) and organic halogen-substances distributed in this catchment area with a high habitation population.

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2 Materials and methods

Sediment samples obtained from coring overboard were portionated or fractionated for various analyses in the laboratory. After sorting of sands /debris and air-drying in the darkness, the samples used for this study were filtered through a 200 μm pored net and only a small portion of these samples was taken out for chemical analysis (e. g. for heavy metal ions analyzed by Perkin-Elmer atomic emission spectrometer, Plasma-II, after DIN38406-E22 and for adsorptable organic halogenated substances AOX by DIN38409-H14 method with M2000C-Haberkorn+Braun). One gram from each sample was "cooked" with H_2O_2-solution (30%, Fluka) to get dehydrated and oxidized organic substances and residues were "washed" with distilled water per centrifugation. Only a tiny amount of these "clean" materials from each sample was prepared onto 4 slides (each has a 2.5 × 5 cm^2 observation field). Diatom fragments and frustules distributed among crystals and particles were observed using a Leitz microscope with interference contrast and micro-photographic connection (Vario-Ortholux).

3 Results and discussion

Among these 4 samples, shells of diatoms were mostly found in Haikou sediment in which Zn with a high concentration(0.34g/kg, Table 1) has not inhibited the growth of diatom. The concentration of other heavy metal ions and AOX is found rather low at Haikou than other sites, so that I suppose the first site where diatoms could grow quite well without any damage of above factors, as a reference for comparison with other sites e. g. Gukou , Daicun and Caijiawan.

Table 1 Chemical and biological analyses on sediments of Le An River

Parameter	Haikou-29km→Gukou-27km→Daicun-142km→Caijiawan			
mg/kgCu	30	2270	984	474
Zn	335	88	59	474
Pb	20	20	1180	38
Cd	1	1	4	2
AOX mg/kg	10	32	23	64
Diatoms				
No. of genera	13	5	13	11
No. of species	24	8	20	16
No. of valves	220	15	169	68

At Gukou, the diatom development is obviously inhibited not only by high concentration

of copper(>2g/kg, Table 1) but also by increasing AOX-contamination. The concentration of both inhibitors was still high at Daicun where diatoms could undergo a recovery (Haikou-vegetation, Table 1). The inhibitory potential of copper might be lowed by high concentration of lead (>1g/kg, Table 1) in Daicun sediment. Diatoms and other algae growing at this site might be adapted to high concentrations of both heavy metals (Takamura, 1989). The river in the following 142 km section has reduced Pb to "normal" concentration (20—38 mg/kg, Table 1) and carried more zinc towards Caijiawan. Combination of Zn and Cu might decrease diatoms growing at Caijiawan, but a potential inhibition should be derived from AOX and similar (herbicide-containing) substances.

Table 2 Diatoms in sediments of Le An River

Diatom species author	Haikou	Gukou	Daicun	Caijiawan
Melosira varians C. A. Ag.			c	r
Stephanodiscus astraea (EHR.) Grun.			r	
Achnanthesis affinis Grun.			r	
A. biasolettiana Kütz.	r	r	c	
A. minutissima Kütz.	a	r	a	
A. linearis W. Smith	c	r		
Amphora sp.				r
A. ovalis Kütz	r			
Cocconeis pediculus EHR.	r			
C. placentula EHR.	c		r	r
Cymbella cistula (E.) Kirchner		r	c	
C. turgidula Grun.	r		r	r
C. ventricosa KTZ.	a		a	a
Epithemia turgida (E.) Kütz	r			r
Eunotia lunaris (E) Grun.			r	
E. pectinalis (KTZ) Rabh.	r			r
Fragilaria capucina Desmazieres var.	c	r		
F. construens (EHR.) Grun			r	c
Hantschia amphioxys (EHR.) Grun		r	r	
Gomphonema intricatum Kütz			c	
G. gracile EHR.	c			c
G. sphaerophorum EHR.				c
Gyrosigma accuminatum (Kütz) Rabh.				r
Navicula plicata Donkin			r	r
N. menisculus Schumann	c		c	
N. halophila (Grun.) Cleve	c			

Table 2 (continued)

Caloneis silicula (EHR.) Cleve				r
Nitzschia linearis W. Sm.	r	r		
N. palea W. Smith	c			
Pinnularia divergens W. Sm.	r	r		
P. interrupta W. Smith+P. *mesolpta*(E.) W. Sm.	r		c	
Rhopalodia gibba(E.) O. Müller			r	
Surirella ovalis Bréb.			r	
S. linearis W. Sm.	r		r	
Synedra gracile Kütz.				r
S. rumpens Kütz	r		r	
S. ulna(Nitzsch) EHR.	a		a	a
∑ Number of species	24	8	20	16

Abundance: a(abundant, >20 per sample); c(common, 8—20) and r (rare, 1—7)Diatom identification after Hustedt (1930), Patrick & Peimer (1966; 1975),Watanabe *et al.* (1982)

In these sediment samples, only few valves of Melosira and *Stephanodiscus* were observed (No. 1—2, Table 2). Among small cristals and sand particles, in fact, most diatoms found were pennate species(Patrick, 1966; 1975);larger sized diatoms were always in fragmentation and small epiphytic or epilithic species appeared intact. But both groups could deliver ecological information, when they were exactly identified (Cox, 1991; Round, 1991). With one valve attached Cocconeis diatoms on water plants like small scales, but with one polar end clustered *Synedra* cells in a colony on a substratum. *Cymbella ventricosa* and *C. prostrata* have set on the branchings of gelatinous stalks which have started from the surface of a substratum. The presence of these species can indicate that some macrophytes as their hosts have also developed along the river (Round, 1981). Some phytoplanktonic species, such as *Fragilaria capucina* and *F. crotuensis* are commonly found; they could grow on the bank of this slow flowing river. But the development of epiphyses (incl. phytoplankton) and host plants could be inhibited by the inlet of AOX and similar herbicides. In the Gukou section, only a few species of *Achnanthes* and *Nitzschia* (benthic or epilithic) were found and that too, very rarely (Table 2). This poor vegetation of water plants should be caused by the pollution of copper and organic halogen substances.

Among the metal ions tested in this study(Table 1), cadmium is not important due to its presence in low amount. The most important element is copper; its evidenced inhibiting firstly photosystems II(Shioi , 1978) and other functions in respiration, pigment formation or cell division(Stauber, 1987) and consequently the growth of diatoms. The outlet from De Xin Copper Factory before the second sampling site has strongly polluted Le An River and finally Po Yang Lake. The high appearance of diatoms at Daicun with ca. 1g Cu per kg sediment could indicate that diatoms could adapt to high concentration of both Cu and Pb (Table

1, Takamura, 1989). Lead and zinc are less important, but their combination with other substances could be synergistic or antagonistic effects not only on the growth of diatoms and algae but also finally on human being. The water quality is strongly influenced by both presence of heavy metal ions and organic substances, particularly with respect to civil pollution and agricultural application. Therefore, all of these pollutants derived from Le An River and other tributaries can determine the vegetation of water plants, diatoms and algae in the river as well as in Po Yang Lake.

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References

Cox EJ. Use of algae for monitoring rivers(Ed. by Whitton BA). Innsbruck; Inst Botanik Univ. 1991;33

Hustedt F. Subwasser-flora mitteleuropas heft 10; Bacillariophyta (diatomeae), Koeltz Reprint. 1976;566

Patrickk R, Reimer CW. The diatoms of the United States-I, II. Monograph-13, Philadelphia; Academy of Natural Sciences. 1966,1975

Round FE. The ecology of algae. Cambridge University Press. 1981;653

Round FE. Use of algae for monitoring rivers(Ed. by Whitton BA). Innsbruck; Inst Botanik Univ. 1991;25

Shioi Y. Phycologia Plantarum, 1978; 44;434

Stauber JL, Florence TM. Mar Biol, 1987; 94;511

Takamura N. J Appl Phycol, 1989; 1;39

Watanabe T. Bio-indication of benthos for river pollution. Environmental Sciences-B121/R12/10. 1982;95

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