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Establishment of environmental specimen bank in Shanghai

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Abstract: The program of the Shanghai Environmental Specimen Bank (SESB) has been established recently and its current status is briefly described. Typical specimen such as water and sediment of Suzhou creek, city particulate matter are collected and some results which have been obtained during the long term permanent operation of this project since 1998 are presented. Moreover, further aspects of environmental data evaluation and assessment are discussed.

Key words: specimen bank; environment; ecology

Introduction

An environmental specimen bank (ESB) represents a major part of the national system for environmental control. It means the collection of parts of plants, animal organs, soil and sediment samples, their processing, partial characterization and long-term storage under conditions which prevent any change of their chemical composition (Emons, 1997). On this way a systematic repository of environmental samples is created which provides information about current levels of environmental pollution with respect to selected substances and also provides a unique storage archive of selected material containing environmental information for future generations.

With the rapid development of economy, people pay even more attention to their ecosystem. The banking activities are focused on the preparation, characterization and storage of representative samples from different ecosystems in Shanghai. This repository allows the retrospective analysis of known pollutants, the future determination of ecotoxic chemicals unknown at the time of sampling, the redetermination of compounds with improved analytical methods and check of the efficiency of legislative regulations. The further extension of the ESB implies the permanent development and optimization of methods and procedures for sampling, processing, characterization and storage of environmental samples. This results in the preparation of standard operating procedure and contributes to the progress of environmental science in general (Rossbach, 1997).

Under the co-operation of Shanghai Academy of Environmental Sciences, the ESB of Shanghai City is developed at Shanghai Institute of Nuclear Research (SINR) in 1998. Until now, some typical environmental samples such as the water and sediment of Suzhou creek, city dust are collected, characterized and stored at low temperature for a long time.

1 Specimen collection

The representative specimens should be selected which reflect in particular anthropogenesis (man-made) influences on the input, distribution and fate of environmental pollutants. It is not possible to collect and store all pollutants in a whole country, but it should be an adequate approach to consider typical ecosystems from creek, land and atmospheric environment. Thus appropriate components from such systems for the creation of an environmental repository have to be selected.

Shanghai is an international open city, with the urban construction and economic development, the government plans on a long-term basis to harness Suzhou creek, which passes through the urban district and was polluted in past years. Therefore, in June of every year, the

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creek sediment (~10kg) is collected using bucket grab under the bridge of Zhejiang Road. At the same time, the creek water located at three positions (distance from bank 18m, 30m and 42m) at four tide times (flood, high, ebb and low) is also collected. Some information such as the rate and velocity of flow, the whole volume of tide are also measured. Fig.1 shows a water level curve of Suzhou Creek, which means a complete process of tide and four collecting times are expressed by arrows. According to the characteristic distribution over years of Shanghai urban air pollution, a monitoring network of six air quality measuring stations is set up in Shanghai urban area. The particulate matter is collected by a streaker sampler operated at the flow of 150 L/min, which allows a continuous sampling over three days period.

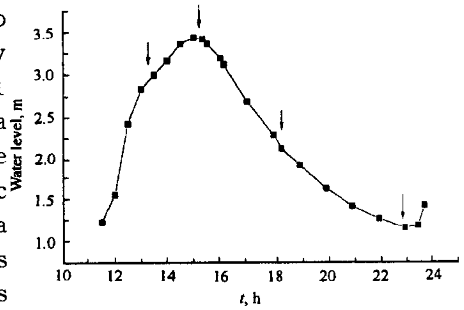

Fig.1 The water level curve of Suzhou Creek (under the bridge of Zhejiang Road)

2 Sample processing and storage

Under normal conditions, according to the varieties and characteristics, some samples should be processed and prepared before storage. The creek water at four times and three positions was mixed in definite proportion, then put into a low temperature refrigerator for storage. The creek sediment samples should be pretreated before analysis and storage. First the sediment was dried in a cleaning room with good ventilation, then the grinding was accomplished by using a gate ball mill pulverizer. The homogeneity can be achieved by a thorough mixing of the powdered material. Moreover, particle size distribution and water content are determined. The whole ESB process from sampling to long-term storage and characterization is performed according to standard reference operating procedures (Zhang, 1998).

Except those used in analysis, the remained environmental specimens are immediately deep-frozen in the low temperature to avoid any chemical alterations.

3 Sample characterization

3.1 Radioactivity determination

In order to improve the measurement's sensitivity, the creek water was concentrated by boiling, then was reduced to ashes at the temperature of 450℃ for 0.5h. The determination of total α and β radioactivity was performed by a low background radioactive measuring instrument. Table 1 shows the total α and β radioactive levels of Suzhou creek at different times. We can see that the different ash weight from the same volume water changes with the tides. The total α level at low tide increased 2—4 times than that at high tide, and the total β level at low tide is double

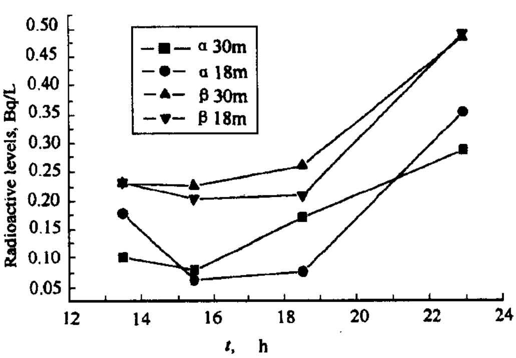

Fig.2 Total α, β radioactive levels in Suzhou Creek

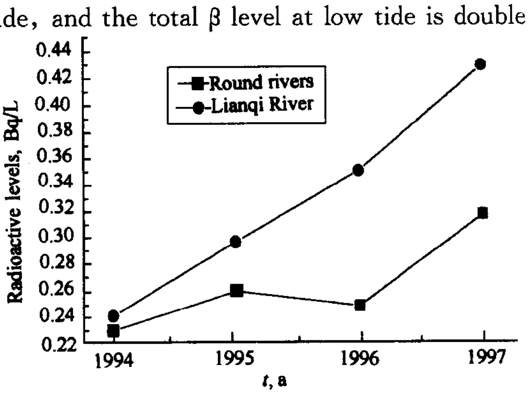

Fig.3 The results of β radioactive levels in water of the creeks around SINR

more than that of high tide. Moreover, the water sample contained many suspended materials at low tide was turbid seriously and resulted in the increase of radioactive levels. From Fig. 2, the change trend of radioactive levels both 18m and 30m from bank is the same to the change of ash weight. The total β data obtained in this work were similar to those of the creeks around SINR during 1994—1997 (Fig. 3).

Table 1 Total α, β radioactive levels at different time from Suzhou Creek, Bq/L

Sampling site	Time	Volume, L	Ash weight, g	Total α	Total β
Creek center	Flood tide	2.5	0.7763	0.103 ± 0.017	0.230 ± 0.008
	High tide	2.5	0.7371	0.079 ± 0.018	0.225 ± 0.006
	Ebb tide	2.5	0.7795	0.169 ± 0.024	0.258 ± 0.007
	Low tide	2.5	2.0658	0.284 ± 0.024	0.481 ± 0.011
18m from creek bank	Flood tide	2.5	0.7966	0.177 ± 0.021	0.231 ± 0.008
	High tide	2.5	0.7265	0.062 ± 0.013	0.202 ± 0.007
	Ebb tide	2.5	0.7400	0.076 ± 0.015	0.207 ± 0.007
	Low tide	2.5	2.0283	0.351 ± 0.045	0.487 ± 0.019

The results of sediment showed that the total α level is 459 ± 91 Bq/kg and total β level is 592 ± 30 Bq/kg. Compared with the total β (756.7 ± 86.4 Bq/kg) of Huangpu River and total β (595.7 ± 72.0 Bq/kg) of Wusong River (Hu, 1993), all of these results are under normal background levels, not very remarkable difference.

For reason of quality control, the method was checked by the standard radioactive powder sources of pure uranium GBW04301 and potassium-40 GBW04326. The experimental values were found is good agreement with the certified ones (Zhi, 1999).

3.2 Analysis of inorganic elements

The elemental determination of Suzhou creek water during a complete tide was performed using Slowpoke reactor and NAA set up in Shanghai Analysis Survey Center (Zhang, 1996; 1999). Samples were successively placed in a pneumatic transfer rabbit system and irradiated for 60s at a thermal neutron flux of 5×10^{11} $n/(cm^2 \cdot s)$ in the reactor. The radioactive activity was measured by using an Ortec Ge(Li) detector were coupled to a 8192 multichannel pulse height analyzer equipped with PC computer system. Some results such as net peak area, concentration and error were printed out automatically based on an NAA computer program.

The analysis results are shown in Fig. 4 and Fig. 5. The elemental contents of Mg, Na, Mn and Cl are at gradually decrease with the rising tide. The arrival of high tide, their contents are at minimum, then once again increase up on the ebb tide. A change trend of elemental concentrations both creek center and 18m from creek bank is not significantly different except Ca and Al, which reasons will be further demonstrated in the determination of next year.

The inorganic elemental contents of As, Se and Hg in Suzhou creek water and sediment are

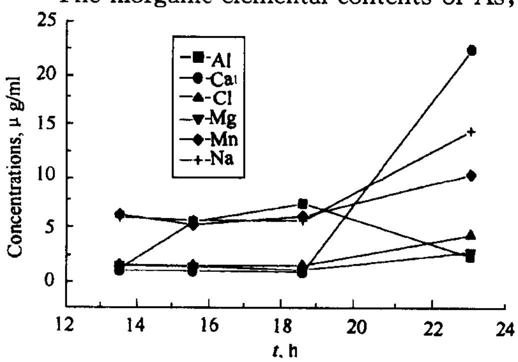

Fig. 4 Distribution of inorganic elemental concentrations in water of Suzhou Creek (Center, from bank 30m)

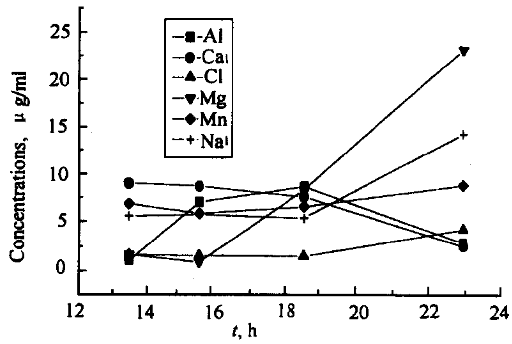

Fig. 5 Distribution of inorganic elemental concentration in water of Suzhou Creek (18m from both sides)

also determined using Atomic Fluorescence Spectrum (AFS). Analytical quality control is an essential part of the analytical procedure. The contents of all elements were quantified by using prepared chemical standard method and the procedure was checked by analyzing standard reference material NIST 1577a bovine liver and GBW08571 mussel. All results are listed in Table 2.

Table 2 AFS results of water and sediment from Suzhou creek

Sample	As	Se	Hg
Water, ng/ml	11.7 ± 0.4	0.81 ± 0.11	0.10 ± 0.01
Sediment, μg/g	2.71 ± 0.08	1.115 ± 0.005	1.24 ± 0.02
SRM1577a*, μg/g	4.81(6.1 ± 0.6)*	3.30(3.65 ± 0.09)*	0.065(0.067 ± 0.004)*
GBW08571*, μg/g	0.056(0.047 ± 0.006)*	0.61(0.71 ± 0.07)*	

* reference materials and certificate's data

4 Conclusions

Environmental specimen banking is an important tool to study environmental precaution and control systems, also it represents a major part of the national system for environmental control and prevention. The typical specimen such as plant, soil, water, atmospheric particulate matter and so on are collected. After processing and partial characterization, these samples are stored for a long-term without any change of their chemical composition. The prompt analysis of partial samples can provide information about current levels of environmental pollution with respect to selected substances, furthermore, the long time storage also provides a unique bank archive of selected material containing environmental information for future research.

The establishment and further development of Shanghai Environmental Specimen Bank are a permanent and long-term program and the work mentioned above will be continued yearly. Some related research projects of ESB should contributed to: a further validation of plant and animals as bioindicators for the pollution condition in the environment; a better evaluation of relations between contaminant concentrations and biological effects in living organisms; the elucidation of accumulation pathways of certain pollutants within food chains; the further development of analytical methods and procedures for samples of complex environmental matrices.

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