Characteristics of Diatom Assemblages in Surface Sediments of the new Yongding River and Haihe River Estuaries, Tianjin

Jing Fang*, Yufei Liu, Tianjiao Wang, Xia Yan, Yang Shuo, Liping Zhang
1School of Geography and Environmental Science, Tianjin Normal University, Tianjin 300387, China

Abstract. Diatom analysis was conducted on the surface sediments from the estuaries of the new Yongding River and Haihe River in Tianjin. The results showed that the main diatom assemblages in the new Yongding River was Navicula marina-Auliscus caelatus-Coscinodiscus hirosakiensis-Coscinodiscusoculus-iridis and Auliscus caelatus-Coscinodiscusoculus-iridis-Cyclotella meneghiniana-Cyclotella stylorum in the Haihe River. There was saprophilous taxa, Cyclotella meneghiniana, in both estuaries indicating that the two estuaries were polluted to a certain degree.

1 Introduction

The Tianjin plain is bounded by the Haihe River, and there are many oyster reefs in NEE direction to the north of the Haihe River. Most of the oysters that make up the reef grow vertically and develop in layers. Meanwhile, there are many horizontal layers in the upper half of the reef[1]. Oyster reefs grow in the environment from subtidal to intertidal, which is of great significance to restore the position of the ancient estuarine shoreline location, restore the paleogeography, paleoecology and the ancient sea surface. There are five cheniers to the south of the Haihe River, which represent the position of the ancient coastline during the stagnant period of the five regressions since the middle Holocene. Estuaries between land and sea are affected by river and tidal current. It is an important place to study sea level and ancient coast change. Based on the diatom analysis of modern estuarine sediments in Tianjin plain, the characteristics of diatom assemblage in the estuary area were found out, which provides basic data for the judgment and restoration of estuarine paleoenvironment.

2 Geological setting and methods

Tianjin plain is located on the west coast of Bohai Bay, where the terrain is low and flat, and the surface elevation is only 1-2m. Many rivers, such as the new Yongding River and the Haihe River, which are developed in Yanshan Mountains and Taihang Mountains, flow into the Bohai Sea in Tianjin (Fig. 1). The tidal range in this area is large (the average tidal range in Tanggu is 3.02 m), and the intertidal shoal is developed. There are 11 buried oyster reefs in the north of the Haihe River and 5 cheniers in the south of the Haihe River.

The surface mud samples were taken from the estuaries of the two main rivers, the new Yongding River (117°57′21″E, 39°12′58″N) and the Haihe River (117°42′53″E, 38°59′22″N). Diatom slices were made in the laboratory and identified under 400 times optical microscope. More than 200 diatoms were counted in each sample, and the percentages of diatoms of different species and genera were calculated.

3 Results and discussion

Xiaoshan (1988) investigated diatoms from 110 sites in 16 different areas of Japan. According to the living environment of diatoms, the paleoecology of diatom fossils in sediments was divided. According to the classification scheme of Xiaoshan, diatom environmental indicators (Tab. 1 and Fig. 2) in the new Yongding River and the Haihe River in Tianjin were classified as follows;

A: indicators of outer bay
B: indicators of an inner bay
D1: indicators of a sand flat in saline water
E1: indicators of a mud flat in saline water
F: benthic diatoms in fresh water
H: indicators of a river mouth
### Tab. 1 Statistics of diatoms in surface sediments of the new Yongding River and the Haihe River

| number | species                          | living environment | New Yongding River | Haihe River                        |
|--------|----------------------------------|--------------------|--------------------|------------------------------------|
|        |                                  |                    | Total identification/pcs | percentage/% | Total identification/pcs | percentage/% |
| 1      | Thalassionema nizschioides       | A                  | 21                 | 10.3          | 5                         | 2.4          |
| 2      | Coscinodiscus hirosakienensis    |                    | 40                 | 19.6          | 35                        | 16.9         |
| 3      | Coscinodiscus oculus-iridis      |                    | 27                 | 13.2          | 17                        | 8.2          |
| 4      | Coscinodiscus spp.               |                    |                    |               | 6                         | 2.9          |
| 5      | Achtiocyclus spp.                |                    | 4                  | 2.0           |                           |              |
| 6      | Cyclotella stylosum              | B                  | 10                 | 4.9           | 19                        | 9.2          |
| 7      | Paralia sulcata                  |                    | 10                 | 4.9           | 10                        | 4.8          |
| 8      | Grammatophora macilenta          |                    | 1                  | 0.5           | 2                         | 1.0          |
| 9      | Auliscus caelatus                | D1                 | 22                 | 10.8          | 86                        | 41.5         |
| 10     | Raphoneis surirella              |                    | 1                  | 0.5           |                           |              |
| 11     | Diploneis bombus                 |                    | 4                  | 2.0           |                           |              |
| 12     | Actinoptychus senarius           |                    | 1                  | 0.5           |                           |              |
| 13     | Navicula marina                  | E1                 | 40                 | 19.6          |                           |              |
| 14     | Diploneis smithii                |                    | 1                  | 0.5           |                           |              |
| 15     | Tryblioptychus cocconeiformi     |                    | 1                  | 0.5           |                           |              |
| 16     | Navicula capitariadiata          |                    | 5                  | 2.5           |                           |              |
| 17     | surirella fluminensis            |                    | 3                  | 1.5           |                           |              |
| 18     | Stauroneis phoenicenteron        | F                  | 1                  | 0.5           |                           |              |
| 19     | Gomphonema intricatum            |                    | 5                  | 2.4           |                           |              |
| 20     | Cyclotella meneghiniana kwetz    | H                  | 12                 | 5.9           | 22                        | 10.6         |
The main diatoms in the new Yongding River and Haihe River estuaries are as follows. Indicators of outer bay (A): it includes Coscinodiscus hiroshakensis, Coscinodiscus oculus-iridis, Coscinodiscus spp., Actinocyclus spp. and Thalassionema nitzschioides, which are planktonic in the ocean with salinity above 35 %; indicators of an inner bay (B): it includes Cyclotella stylonium, Paralia sulcate and Grammatophora macilentia, which are planktonic in the inner bay with salinity of 35-26 %; indicators of a sand flat in saline water (D1): it includes Auliscus caelatus and Rhaphoneis surirella, which live in a state of attachment at the bottom of the sand (between the surface of the sand and the sand particles) in the waters with salinity above 26 %; indicators of a mud flat in saline water (E1): it includes Diploneis bombus, Actinoptychus senarius, Navicula marina, Diploneis smithii, Tryblionocyclus cocconeiformis, Navicula capitariadiata, surirella fluminensis, etc., which live in a state of attachment at the bottom of the sediment in the waters with salinity above 12 %; benthic diatoms in fresh water (F): it includes Stauroeis phoenicenteron and Gomphonema intricatum, which are planktonic in waters with salinity below 2 %; indicators of a river mouth (H): it includes Cyclotella meneghiniana, etc., which live in waters with salinity between 2‰ and 20 ‰.

18 diatom species were found in sediments of the new Yongding River estuary, of which 55.4% were marine species (M), 44.1% were brackish water species (B), and 0.5% were freshwater species (F). The main diatoms were Navicula marina (19.6%) belonging to indicators of a mud flat in saline water (E1), Auliscus caelatus (10.8%) belonging to indicators of a sand flat in saline water, Coscinodiscus hiroshakensis (19.6%) and Coscinodiscus oculus-iridis (13.2%) belonging to indicators of outer bay, and Thalassionema nitzschioides (10.3%) living in inner bay. The content of freshwater species was low, and only one species of freshwater planktonic species, Stauroeis phoenicenteron, was found.

10 diatom species were found in sediments of the Haihe River estuary, of which 45.4% were marine species (M), 52.2% were brackish water species (B), and 2.4% were freshwater species (F). The main diatoms were Auliscus caelatus (41.5%) belonging to (D1) indicators of a sand flat in saline water, Coscinodiscus oculus-iridis (8.2%) living in outer bay, Cyclotella meneghiniana (10.6%) belonging to indicators of a river mouth (H) and Cyclotella stylonium (9.2%) living in inner bay. The content of freshwater species was low, and only one species of freshwater planktonic species, Stauroeis phoenicenteron, was found. Freshwater diatom, Gomphonema intricatum (2.4%), was found, which belongs to benthic diatoms in freshwater (F).

In addition, Cyclotella meneghiniana (H) accounted for 5.9% and 10.6% respectively in the sediments of the new Yongding River and the Haihe River estuaries. Cyclotella meneghiniana is a kind of turbid species, which mainly lives in alkaline water, indicating that there were different degrees of pollution in the estuary of the new Yongding River and the Haihe River, and the pollution degree of the Haihe River was greater than that of the new Yongding River.

4. Conclusion

Based on the analysis of diatoms in the sediments of the new Yongding River and the Haihe River estuaries, it was concluded that there were more species of diatom in the new Yongding River estuary than in the Haihe River estuary. Navicula marina (19.6%) and Auliscus caelatus (10.8%) accounted for 19.6% and 10.8% respectively in the intertidal zone of the new Yongding River estuary, while the proportion of Auliscus caelatus in the Haihe River was 41.5%. The phytoplankton species Cyclotella meneghiniana accounted for 5.9% and 10.6% respectively in the sediments of the new Yongding River and the Haihe River. The pollution degree of the Haihe River estuary was higher than that of the new Yongding River.
Acknowledgements

This research was financially supported by the Tianjin Natural Science Foundation (18JCYBJC91100).

References

1. Masato Kosugi M.(1988)Classification of Living Diatom Assemblages as the Indicator of Environments, and Its Application to Reconstruction of Paleoenvironments, The Quaternary Research,27 (1):1-20.
2. Watanabe T, Ohtsuka T, Tuji A, Houki A, 2005. Picture book and ecology of the freshwater diatoms. Uchida Rokakuho Publishing Company, Tokyo. 666.