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Division of sedimentary environment in the southern coast of Laizhou Bay since the late Pleistocene

Zhaolin Wang
Shandong provincial territorial ecological restoration center, 250014, China

Abstract:
The information about the change of the sedimentary environment was recorded by the sediments. The southern coast of Laizhou Bay has experienced three transgressive and regressive events, forming a unique sedimentary environment since the late Pleistocene. This paper analyzes and discusses the evolution of the sedimentary environment based on the sediments in WB01 sedimentary columns. The strata of the study area have been characterized by land sea alternation. WB01 core can well divide 5 marine strata and 6 terrestrial strata. The marine strata and terrestrial strata show the characteristics of interphase distribution. The particle size of the sediment in the two deposition columns changes with the depth. Generally, the size of sediments in marine formations is smaller than that in continental formations.

Keywords: *Sedimentary environment;division; The south coast of Laizhou Bay*

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I. Introduction

The sedimentary environment is the natural geographical environment formed by sedimentation. The coastal zone is regarded as the hotspot in the field of sedimentology because of its unique evolution law of the sedimentary environment. It is very important for the study of sedimentary environment and sedimentation. the coastal zone has become a hot research area because of its unique geographical location[1,2]. Since the 1950s, many scholars have done a lot of research on coastal zone[3,4]. Among them, the study on the evolution of the sedimentary environments in the coastal zone was the hot spot. The main reasons for the evolution of the sedimentary environment in the coastal zone are the changes insea-level in history and tectonic movement and the reconstruction of paleogeomorphology caused by climate change.

China has a long continental coastline with a length of 18,000km. It extends to the Yalu River Estuary in the north and the BeilunEstuaryin the south. It crosses the three temperature zones of tropical, temperate, and cold zones. In addition, the unique monsoon climate and historical sea-level fluctuation have formed a unique sedimentary environment in the eastern coastal zone of China. Many scholars take the eastern coastal zone of China as the research area to carry out work [5,6]. The southern coast of Laizhou Bay has become one of the most important areas of modern sedimentology because of its unique sedimentary environment.

Therefore, it is of great value to study the evolution of the coastal sedimentary environment around the Bohai Sea since the late Pleistocene. Based on WB01 sedimentary columns, the sedimentary environment evolution of the southern coast of Laizhou Bay will be analyzed in detail.

II. Study Area

The southern coast of Laizhou Bay (118°29′E-119°56′, 36°43′N-37°19′N) is located in northern Shandong province, eastern China and covers an area of about 3500 km^2, including Hanting, Shouguang, and Changyi. The southern coast of Laizhou bay is the typical silt coast with flat terrain and widespread tidal flat. The main soil parent materials are alluvial and marine sediments whose distributions are from land to sea. Salinized moisture soils and seashore saline soils are also widespread. The study area is controlled by East Asian monsoons and its climate is warm temperate semi-humid monsoon climate, with a mean annual temperature of 11.9℃ and mean annual precipitation of 767 mm which concentrates on summer and autumn. The annual evaporation of this area is between 1200mm and 1500mm and the frost-free period is about 187 days. There are three rivers including Mi river, Bailang river, and Wei river and all the three rivers flow from south to north into the Bohai Sea. Cultivated land, residential land, and industrial area are the main land-use types on the southern coast of Laizhou Bay. Heavy metal pollution in the Laizhou Bay area is increasing because of human activities and natural factors, influencing social development.

III. Materials And Method

WB01 are selected for drilling based on the systematic analysis of the Yellow River strata. The Quaternary was directly penetrated to drillsedimentary core samples. After drilling, the basic process of indoor cataloging is as follows: The drilling core is divided into two parts, half of which are reserved for storage and the other half is reserved as working core. All cores are photographed and kept on file for subsequent core cataloging. Describe the lithology, grain size, color (color code determined by international standard shade guide), sedimentary structure, bedding structure, erosion interface and organisms. Combined with the test indexes (grain size of sediment, foraminiferal assemblage and trace elements), the sedimentary facies types were comprehensively judged. Most of the sedimentary facies in the core are tidal bedding, so it is necessary to judge the sedimentary facies type according to the facies combination. This step is the fine division of sedimentary facies.

IV. Results And Discussion

4.1. Division of sedimentary facies and construction of chronology scale

In this study, two sites were selected for drilling in the south coastal plain of Laizhou Bay,70.10m core was obtained respectively. According to theresults of ^{14}C dating and OSL dating,WB01 was divided into 5 marine strata and 6 continental strata from top to bottom.

The first continental layer: This layer is a modern sedimentary terrestrial layer, buried at 0-5m depth. This section of the stratum is obviously disturbed by human activities, mainly composed of silt. The color is mainly yellow-brown and gray, and the water content is medium or low.

The first marine layer: This sedimentary layer is the Kenli transgressive marine layer in the early Holocene.Kenli Transgression is about 10-4ka B.P. The farthest transgression area is Huaguan-Shouguang-GuDi-Changyi-Xinhe-Tushan-Hutouya. This stage is in the post glacial period, the temperature gradually increases, and the sea level also rises. The transgression reached its maximum in the middle Holocene, and the sea water continued to subside. In the late Holocene, the sea level dropped and modern rivers developed. The burial depth of Kenli transgressive marine layer in WB01 is about 5-7m and 5-6m, which is mainly composed of silt. The average grain size of the sediments showed an upward trend, mainly dark gray yellow silt and black silt, with a small part of clay layer. There are a lot of shells in the marine strata with high water content.

The second continental layer: The continental layer is in the late Pleistocene, at the end of the Yumu glacial period, about 24-10 Ka B.P. At this stage, the climate is cold and dry, and the sea level is in the declining stage. In most areas of LaizhouBay, there are continental river deposits with small thickness, which indicates that the time interval between Kenli transgression and Guangraotransgression is relatively short, and the land has only a short exposure. The burial depth in WB01 is about 7-9m and 6-10m. The average grain size of the sediments increased and the content of sand increased, but the sediment was still mainly composed of silt, and the content of clay increased temporarily.

The second marine layer: This layer belongs to the late Pleistocene Guangrao transgressive marine layer. The transgression time of Guangrao is about 50-24ka B.P. ago, and the whole transgression time is long. The depth range of WB01 is about 9-18m and 10-15m, which is mainly composed of grayish yellow silt with a large number of shells and high water content. The transgression range of Guangrao is generally in the south of Guangrao-Shouguang-GuDi north-Changyi north-Xinhe-Tushan and Shahekou. This period is in the yumuya interglacial period, which is still within the glacial period, but the temperature is slightly higher than that of the main glacial period. Climate warming caused the sea level to rise, and the sea water invades the land again, forming marine strata. Compared with the Yangkou transgression, the climate in this stage is warm and wet, which is the transition period from dry and cold to warm and wet, so the sedimentary facies has the characteristics of land sea interaction.

The third continental layer:This is a continental layer of late Pleistocene, about 70-60 Ka B.P. The burial depth of WB01 and WB02 is about 18-25m and 15-20m, respectively. The color is grayish yellow, silt is the main component of sediment, and the content of clay is still low. This period was in the main glacial period of Yumu glacial period. The temperature was low, the weathering was weakened, and the coastline was retreating and the land area was increasing. Therefore, the sedimentary facies in this section of the two drill holes is continental.

The third marine layer: This layer is a transgressive marine layer of Yangkou in the early stage of late Pleistocene.Yangkou transgression occurred about 85~76ka B.P. The depth of drill holesWB01 is about 25-38m and 20-25m, respectively. It is mainly composed of sand, the proportion of silt content is decreased, the clay content is maintained at a low level, containing shells, and the whole core is yellow and grayish yellow. The time of the transgression corresponds to that of Cangzhou transgression on the west coast of BohaiSea. The transgressive ancient shoreline of this period was roughly located in Huaguan-south of Wopu-north of Shouguang-north of WeibeiZongchang-and north of Longchi. This stage belongs to the last interglacial period,

the climate is warm and humid, the chemical weathering is strong, and the transgression range is the smallest among the three transgressions.

The fourth continental layer: The burial depth of the continental layer in WB01 is about 38-46m, respectively. The color is mainly yellow-gray, and the particle size composition has a more obvious change than the upper stratum. Before the Yangkou invasion, the proportion of sand decreased rapidly, silt occupied the main position, and the content of clay also increased.

The fourth marine layer: The burial depth of this layer in WB01 is 46-50m, respectively. There is no shell debris in the marine layer, and there are calcareous nodules. Drilling hole WB01 is silt. The color is mainly gray-green. The marine layer is probably not caused by transgression, but may be due to the development of rivers. The climate shown in the element ratio below is a warm and humid feature.

The fifth continental layer: The silt content of this layer again occupied the main position, mainly brown red and gray green dense hard clay layer, containing large calcareous nodules and cements.

The sixth marine layer: The content of silt decreased again and the content of sand increased briefly. The color is mainly grayish green with hard texture and calcareous nodules. It is speculated that the area may be affected by the development of rivers, which brings large particles to deposit here.

Based on the information of core color and particle size distribution, 40m of WB01 is the change nodes of sedimentary facies. Due to the influence of transgressive regressive events, the clay content remained at a low level above this depth, and the content components of silt and sand increased alternately. The average grain size of the sediments in the transgressive layer is obviously higher than that in the continental strata. The whole material is relatively loose. There are shells in the transgressive layer and the water content is medium. Under these two depths, silt occupied the main part in most of the time, the clay content increased slightly, the content of sand decreased significantly, the color was mainly gray green, there were more calcareous nodules, and the texture was hard, indicating that the climate was relatively cold at this stage.

V. Conclusion

WB01 core can well divide 5 marine strata and 6 terrestrial strata. The marine strata and terrestrial strata show the characteristics of interphase distribution. The particle size of the sediment in the two deposition columns changes with the depth. Generally, the size of sediments in marine formations is smaller than that in continental formations.

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