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Reactions of Foraminiferal Assemblages on Tropical Coastal Beachrocks to Hydrodynamic and Sedimentary Processes

Yanli Lei*

Department of Marine Organism Taxonomy & Phylogeny, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, 266071, China

Abstract

The interaction between sedimentary processes and hydrodynamics has a significant impact on coastal habitats. Given the sensitivity and specificity of living populations or the presence of dead specimens, the assemblages of benthic foraminifera are structured by environmental factors, making them excellent indicators of the main processes in coastal settings. The present study evaluated environmental variables in beachrocks of Brazilian tropical sandy beaches using benthic foraminifera as a proxy. In order to describe foraminiferal assemblages (27 samples), as well as to conduct grain size analysis and CaCO content determination, samples were collected at the base of coastal beachrocks on the beaches Pina, Enseada, and Toquinho (northeastern, Brazil) (27 samples). Medium to coarse sand of terrestrial origin, fairly sorted and roughly symmetrical, made up the majority of the deposits. Rip currents, littoral drift and the primary forces behind the size, sorting, and redistribution of the sediments are littoral drift, rip currents, and waves. A total of 6829 foraminifera from 42 genera and 76 species were found.

Keywords: Foraminiferal • Assemblages • Hydrodynamic

Introduction

Amphistegina lessonii, Archaias angulatus, Massilina pernambucensis, Quinqueloculina lamarckiana, Textularia agglutinans, and Triloculina laevigata were the dominant species in the assemblages, which were primarily made up of relict samples that most likely originated and were deposited during the last marine static period of sea level. Foraminiferal assemblage structure greatly varied between beaches and was connected to the main sedimentary and hydrodynamic processes. In contrast, more intensive hydrodynamics tended to hinder the deposition of fine sediments and foraminifera, leading to increased deterioration. This was especially true in places with lower hydrodynamics and finer sediments, like Pina.

Due to their exposure to wind, rain, river flow, waves, coastal currents, and changes in sea level, coastal zones are dynamic regions that are vulnerable to significant environmental adjustments. In the intertidal zone of northern Brazil, beachrocks, reefs with 20–80% quartz content, biogenic grains made of algae and mollusks, and cement made of carbonate compounds are all widespread. These reefs provide a variety of ecosystem services for the local human populations, such as coastal protection, recreational areas, and income from fishing and tourism. They also play a significant role in the maintenance of the marine biodiversity [1].

Literature Review

Charles Darwin originally characterised the beachrocks of the Brazilian coast in 1841; they run parallel to the beach and mark old shorelines, these reefs are either alternately exposed and submerged at high and low tide, or they are constantly exposed and/or submerged (at depths of 5–10 m). With a thickness of 3-5 m, a breadth of up to 60 m, and a maximum stretch of 10 km, beachrocks' morphology varies greatl. From shallow coastal waters to the deep sea, benthic foraminifera (protists) create carbonate tests and are exceedingly diverse and prolific in sediments or in combination with other creatures. Given their sensitivity and specificity to environmental conditions, these organisms are crucial instruments for oceanographic investigations because of their potential as bioindicators. Even deceased foraminiferal assemblages can shed light on the predominate environmental conditions at the time of sedimentation, either directly or indirectly. Prior research has demonstrated that the establishment and growth of benthic foraminifera is influenced by salinity, depth, current activity, sedimentary processes (erosion, input, transport, and deposition), and biological interactions [2].

Given the ongoing buildup of debris, depositional environments encourage the development of rich and diverse foraminiferal assemblages, making them crucial sources of data for studying the relationships between environmental factors and the structure of foraminiferal assemblages. The majority of foraminiferal studies differentiate between living and dead assemblages and employ descriptors including taxonomic makeup and richness, abundance, and morphological and taphonomic traits as proxies for environmental analyses. Foraminifera from northeastern Brazil's continental shelf have a well-established taxonomy. Yet, the connections between the assemblages' structure and the traits of the present study focused on the taxonomic composition, richness, and abundance of the benthic foraminiferal assemblages as well as their response to the hydrodynamics and sedimentary processes in areas affected by beachrocks along the tropical Brazilian coast as a proxy for environmental characteristics. The premise under test was that the benthic foraminiferal assemblages, who make up the bottom sediments, are reliable indicators of how the primary environmental conditions around coastal beachrocks affect the sediment properties [3].

Discussion

The availability of light has a direct impact on primary output. Recently, the idea of a photic zonation in the water column based on distinctive microboring assemblages in Jurassic materials and light intensity was put up. The shallow euphotic zone is the well-lit area of the subtidal zone inside the euphotic zone, where light levels are greater than 10% of water surface light, whereas light levels in the deep euphotic zone are between 10% and 1% of superficial light. The boundary between these two zones would be positioned at a depth of about 50 metres (m) in water with good translucency, whereas

***Address for Correspondence:** Yanli Lei, Department of Marine Organism Taxonomy & Phylogeny, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, 266071, China; E-mail: Leiyanli88@qdio.ac.cn*

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the boundary between the lower euphotic zone (deep euphotic zone) and the aphotic zone would be situated at a depth of about 100 metres (m). However, since turbidity is another factor-higher on the sea floor and connected to the type of sediment and productivity-there is no direct correlation between light intensity and bathymetry? Moreover, the photic zone's bottom limit is affected by latitude, being shallower on high-latitude shelves. Primary photosynthetic production can occur in the water column by phytoplankton or on the seafloor by phytobenfhos. Whereas primary production in the water column is mostly based on shallow euphotic zone depth, production in the bottom is dependent on light intensity (linked to depth and turbidity degree) (limited by local sea depth and turbidity degree). Under the shallow euphotic zone's lower boundary, the primary production is sparse [4].

Hence, where planktic and benthic primary production exists, shallow settings of the shelf have higher primary production and consequently higher foraminiferal nutrition availability. These regions frequently overlap with the inner shelf's greatest carbonate production area, or "carbonate factory". Lower primary production is found in remote portions of the shelf where the seafloor is below the lower limit of the shallow euphotic zone and phytobenthic species are rare or nonexistent. The organic matter intake is correlated with influx from emergent and more proximal portions (inner shelf), and it declines with increasing distance from shore in the distant areas of the platform, which correspond to the midand outer shelf (in a ramp model), with decreased primary production. The phytodetritus inputs are one way that organic matter is distributed away from the euphotic zone. When transported through the water column, the phytodetritus may reach at the ocean floor as an aggregate that has been partially degraded by bacteria. In Upper Jurassic epicontinental platforms, a relationship between siliciclastic and nutrient inputs that decrease offshore has recently been demonstrated [5,6].

Conclusion

Content of organic matter: Foraminifera and microbes (bacteria and fungi) could directly devour organic matter, and the latter are also a food source for foraminifera. This would make the sediment organic matter crucial in the management of benthic foraminiferal assemblages, Claims that when foraminifera apparently related to the eating of dense bacterial populations are involved, both bacteria and foraminifera respond to organic matter input by increasing biomass and activity. The growth of "phytodetritus-exploiters" and other foraminifera that employ labile components or bacterial populations that proliferate in relation to phytodetritic deposits is caused by the increase of phytodetritus in the sediment.

Acknowledgement

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Conflict of Interest

None.

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