GEOLOGICAL HISTORY OF INNER SHELF QUATERNARY SUCCESSIONS FROM THE SOUTHEASTERN MEDITERRANEAN, ISRAEL

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Abstract

The southeastern Mediterranean shelf located in the distal part of the Nile Delta was subjected to sea level oscillations during the Upper Quaternary. To study the history of this key area, two cores drilled offshore Ashqelon, southern Mediterranean coast of Israel in water depths of 9.5 and 25 m, were analyzed. TL, U-Th and ^{14}C dating techniques and some foraminiferal biomarkers enabled for the first time to correlate shallow water sedimentary successions representing the last 330,000 y with their deep-sea equivalents. Facies and faunal analyses indicate that most of the sediments were deposited in near-shore environments with only short intervals of continental episodes.

Key words: Southeastern Mediterranean, Nile delta, Upper Quaternary, Chronostratigraphy, Foraminifera

Introduction

The present-day sedimentological regime of the SE Mediterranean was established during the Pliocene. Clastic sediments derived from the delta of the Nile River have been accumulated on the inner shelf of southeastern Mediterranean, transforming it from a carbonate platform in the Miocene to a series of protruding deltas in the Plio-Pleistocene-Holocene. Late Quaternary climatic conditions severely altered both marine and coastal environments. Repeated shifts of the shoreline, caused by interglacial/glacial transgressions and regressions, were responsible for considerable facies oscillations. Lateral and horizontal discontinuities in inner shelf records were encountered, hampering an accurate regional correlation and environmental reconstruction. The aim of this study is to establish a multiple stratigraphic framework and to reconstruct the regional paleoenvironments during the last 330 kyr using continuous 83-100 m long cores from the SE Mediterranean shelf.

Material and methods

The region selected for this study is the off Ashqelon inner shelf area, southern Israel, which seems to represent more accurately the variability of the Nilotic cell. Two boreholes, 83 and 100 m long, taken 0.5 and 2.5 km off Ashqelon, at 9.5 and 25 m water depths, respectively were selected for this study. Data collected consists of sedimentology (grain size analysis, carbonate content, petrography of indurated horizons), and quantitative foraminiferal studies for reconstruction of the marine environments and correlation. Dating techniques included AMS ^{14}C, (TIMS) U-Th, and luminescence (1), enabling correlation to marine isotope stages (MIS) chronostratigraphy (2) and sea level oscillations (3).

Results and discussion

The inner shelf of the distal, easternmost end of the Nile River delta records in great detail the history of past climates and sea level changes. The Upper Quaternary sequence begins with carbonate-rich ~20 m thick silicicalstic unit, dated at ~335±24 to 231±9 kyr, which records the interglacial marine isotope stage (MIS) 9 and 7.3 and the intervening glacial MIS 8. Most of this period was arid. Low sedimentation rates of ~13 cm/ky and high carbonate content of up to 81% are accompanied by oligotrophy of the seafloor. Benthic foraminifera species richness is high (up to ~100 species, H(S) = ~3.6; Equitability = ~0.5) and the assemblages is composed of tropical-subtropical species including the symbiont bearing *Amphisorus hemprichii*, *Peneroplis* spp. and *Sorites orbiculus* (4). This indicates severe reduction or cut off of Nilotic input and establishment of a carbonate ramp on the southern continental shelf off Israel.

During the interval 223-175 kyr, silty-sandy marine sediments were deposited rapidly representing major increases in Nilotic input and near-shore marine productivity (5). Fresh water (6) and fluviatile input (7) into the eastern Mediterranean caused major changes. Sedimentation rates exceeding more than 50 cm/kyr, gradual reduction in carbonate content and the replacement of the symbiont-bearing larger foraminifera assemblage with opportunistic species responding to the increase in organic matter indicate transition to euotrohpy and that the carbonate ramp and its accompanying vegetation ceased to exist.

Sea level fell towards the end of the penultimate glacial, MIS 6.4-6.3, with the shoreline migrating westwards as demonstrated by intertidal beachrocks in the eastern core. Between 139±12 and 128 kyr continued cooling and sea level fall of ~-130 m is evidenced by the accumulation of loamy paleosol.

During the last interglacial MIS 5, between 128-70 kyr, resumption of Nile River activity is indicated by the accumulation of marine sands and silty sands. Sea levels were oscillated at a relatively high level, and the warm climate varied from humid to dry (6). During substages 5.5, 5.3 and 5.1 (~125, ~100, and ~80 kyr respectively) the shoreline was at least 5 km east of the present coastline (8). A break in the marine sedimentation occurred during MIS 5.4 (~110 kyr) when sand dunes formed 2 km west of the present coastline under arid conditions.

In the early part of the last glacial, ~70-~55 kyr, when sea level was at -60 to -55 m (3) marine sands and indurated sandstones accumulated in the west at a low rate, reflecting reduced Nile River contribution. Between ~50 and ~19 kyr, sea level gradually fell to –120 m. The entire shelf became exposed and a paleosol corresponding to the onshore Netanya Hamra developed (1). This paleosol formed under arid conditions; however intensive pedogenetic activity took place during the more humid interval, between 36-25 kyr (6), and subsequently during deglaciation.

As the early Holocene sea level rose, rates of sedimentation increased rapidly to ~400 cm/1000 y and sands and silty sands covered the entire pre-Holocene exposed shelf. Towards the east silty clays of a brackish/fresh water origin accumulated. This unit seems to be intimately linked to the rapid sea level rise, high rate of deposition, and humid climate conditions prevailing in the early part of the Holocene, and is known from various parts of the coastal plain.

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