Seismic stratigraphy of Late Quaternary sediments on the continental shelf of Antalya Bay

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Abstract- On the basis of the interpretation of high-resolution seismic records collected from the continental shelf of the Antalya Bay, four distinct depositional sequences on the acoustic basement were identified. Last three of these sequences are believed to be deposit during the "Holocene Transgression".

Keywords- Antalya, Stratigraphy, Holocene

Introduction

The purpose of the study is to investigate the present bathymetry (Fig. 1) and Late Quaternary stratigraphy of the continental shelf of the Antalya Bay using echo-sounding and high-resolution shallow seismic profiling methods. The data used in this study were collected during the cruise of TÜBİTAK Project (199Y074) in 1999, using R/V Bilim of the Institute of Marine Sciences / METU. The depth values were taken by JMC F-830 echo sounder system that is mounted to the research vessel. To investigate the sub-bottom geology of the study area, an EG&G Uniboom high-resolution reflection-profiling system was used.

Bathymetry

In general, the isobath lines, representing the sea floor topography, lie conformably with the coastline of the Antalya Bay. Gently sloping (< 2°) wide shelf areas are the important characteristics of the western and northern regions of the Antalya Bay (Fig. 1). This peculiarity indicates high sediment supply to these shelf areas from the rivers on the land. In contrast to this, the eastern region of the Antalya Bay is marked by steeply sloping (>2°) shelf (Fig. 1). This configuration of bathymetry is basically controlled by sedimentation and tectonics of the Antalya Bay. The detailed interpretations of the echo-sounding records have revealed the presence of some irregular bottom features in the western shelf region that are possibly caused by the occurrences of barrier or ridge-like features. Submarine canyons and topographic irregularities appear to be other prominent features of the sea floor in the Antalya Bay. Off the Hurmaköy and north of Göynük in northern region and off the Duden River mouth in the western region the shelf and slope are deeply dissected by submarine canyons (Fig. 1).

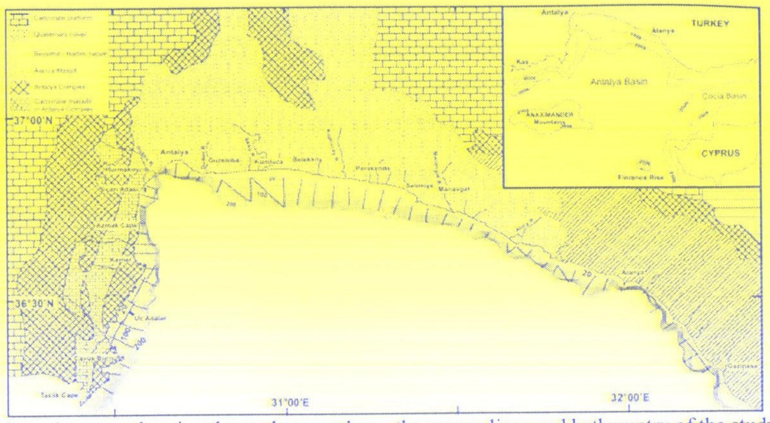

Fig. 1: Location map showing the onshore geology, the survey lines and bathymetry of the study area (contour intervals are 20 m)

Sub-bottom Stratigraphy

In the study area, based on the seismic stratigraphic approach, four distinct depositional sequences (1, 2, 3, and 4) above the acoustic basement (AB) have been identified in the sub sea-floor of the continental shelf of Antalya Bay (Fig. 2). Additionally, a basal reflector-R that forms the boundary between the pre-Holocene and the Holocene sequences was interpreted. It is believed that the depositional sequences 2, 3 and 4 have been deposited during the Holocene or "Flandrian" transgression.

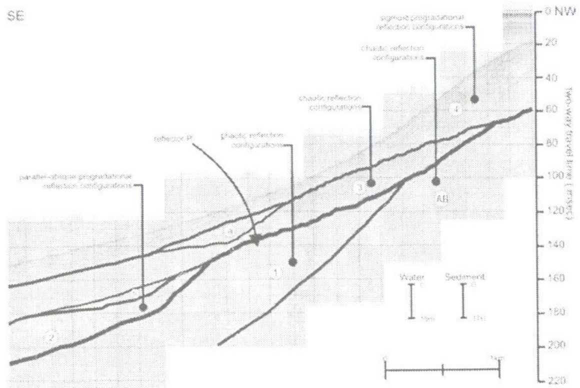

Fig. 2. High resolution seismic profile showing the depositional sequences

The acoustic basement

The acoustic basement, exhibiting chaotic reflection configurations, consists of the seaward extension of onshore sequences (Fig. 2). Based on the surficial sediment lithology and age of onshore formations, it can be concluded that the composition of the acoustic basement changes with places. It is composed of ophiolite series of Antalya Complex in the western region; Pliocene-Pleistocene aged clastics of Aksu Basin in the northern region, and metamorphic rock series of Alanya Massif in the eastern regions. In some areas, acoustic basement has been faulted.

Depositional sequence 1

The depositional sequence 1 is characterized by chaotic (Fig. 2) and parallel-subparallel reflection configurations. The chaotic reflection configuration indicates coarse and heterogeneous sediments, which accumulated in high-energy environments (Sangree and Widmier, 1977) and the parallel-subparallel reflection configuration implies uniform rates of deposition on a uniformly subsiding shelf or stable basin plain setting (Mithcum *et al.,* 1977). It overlies the acoustic basement and pinches out landward at the depth of 75 m below the present sea level. Available sea level curve for the eastern Mediterranean Sea reveals (Arbouille and Stanley, 1991) that this level correspond to 22 000 yrs B.P. Therefore, depositional sequence 1 is interpreted to be pre-Holocene in age. The depositional sequence 1 is entirely absent between the offshore areas of Manavgat and Gazipaşa. This may imply strong erosion with paleocurrents (e.g. Flecker *et al.,* 1998), or alternatively uplift movements (e.g. Woodside, 1977; Özhan, 1988).

Depositional sequence 2

The depositional sequence 2, showing chaotic and oblique progradational reflection patterns (Fig. 2), pinches out at the depth of 110 m on the reflector-R. Oblique prograditional patterns imply depositional conditions with some combination of relatively high sediment supply slow to no basin subsidence, and a still stand sea level to allow rapid basin infill (Mitchum *et al.,*1977). This sequence has been deposited during the earlier stage of Holocene transgression between 22 000 and 18 000 yrs B.P., on the basis of the sea level curve (Arbouille and Stanley, 1991). The same transgressive deposit at the depth of the 110 m was identified on the seismic records collected from the Cilicia Basin (Ediger *et al.,*1999). This sequence is not observed in some areas where uplift and erosion processes are common. The thickness of depositional sequence 2 decreases landward and it disappears in the near shore areas. The maximum thickness of this sequence is measured to be as 40 meters.

Depositional sequence 3

The depositional sequence 3, underlying depositional sequence 4, represents chaotic and parallel-subparallel reflection configurations (Fig. 2). Within this sequence some occurrences of the fill seismic facies units are existed. These types of seismic facies are commonly interpreted as the result of topographic irregularities, which occur in response to erosion that are later filled or covered by the transgressive sediments (Brown and Fisher, 1980). The depositional sequence 3 pinches out at the depth of 50 m on reflector-R, which corresponds to approximately 11 500 yrs B.P. on available sea level curve (Arbouille and Stanley, 1991). This sequence has been formed during the period from about 18 000 yrs B.P. until 11500 yrs B.P. Depositional sequence is not observed in some areas due to similar processes of the other sequences. In general, the thickness of depositional sequence 3 begins to reduce towards the shore until disappear.

Depositional sequence 4

Depositional sequence 4, resembling seaward sedimentary wedge, is the youngest seismostratigraphic unit of the surveyed area. Its upper boundary forms the present sea floor. Depositional sequence 4 is characterized by sigmoid progradational and parallel reflection configurations (Fig. 2). As outlined before, parallel reflections patterns are indicative of the uniform rates of deposition on a uniformly subsiding shelf or stable basin plain setting (Mitchum *et al.,* 1977). Sigmoid progradational patterns indicate relatively low sediment supply, relatively rapid basin subsidence and/or rapid rise in sea level (Mitchum *et al.,* 1977). A relatively low energy regime is interpreted (Brown and Fisher, 1980). This sequence has been accumulating for the last 11 500 yrs B.P. according to available sea level curve (Arbouille and Stanley, 1991). Its thickness tends to increase ($\geq$ 40 m) in front of the fan-delta areas. It covers the whole sea floor area of the Antalya Bay. The basal reflector-R, forming the boundary between the pre-Holocene sequence (1) and the Holocene sequences (2, 3 and 4), is interpreted as pre-Holocene erosional surface produced by the subaerial fluvial erosion of the continental shelves.

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