

## TOPOGRAPHIC FEATURES OVER THE CONTINENTAL SHELF OFF VISAKHAPATNAM

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### ABSTRACT

Continuous echosounding surveys have been carried out along sixteen profiles covering the entire continental shelf between Bheemulipatnam and Kutukonda. Over the inner shelf and mid-shelf the bottom topography is smooth and featureless. Between 70 m water depth and the continental shelfedge several interesting topographic features such as Terraces, Karstic structures associated with pinnacles and troughs and smooth dome shaped reef structures are recorded. The nature of these features and the composition of sediments of this area suggest that they represent the ancient beaches formed during the lower sea levels of pleistocene.

### INTRODUCTION

During the discussions held with the owners of the fishing trawlers based at Visakhapatnam the information has been gathered that at about 70 to 100 m water depth off Visakhapatnam, the fishing nets get entangled at the ocean bottom and many times the nets are torned, and are also cut off. At the same time it is also reported that the fish and prawn catch in these areas is very promising. Based on these information, continuous echosounder surveys were planned to record the ocean bottom topography over the entire continental shelf between Bheemulipatnam and Kutukonda, which extends about 50 km along the coast. Intensity of the total earth's magnetic field is also recorded along these profiles. In total 16 profiles each separated by about 2 to 4 km were run to cover the area. All the profiles were extended upto the continental shelfedge. Owing to some problems in the motor driving circuit of the echosounder, continuous echograms could be obtained only along 10 profiles.

The surveys were carried out on a hired mechanised fishing boat nearly 12 m in length. The boat is fitted with a navigational compass and a speedometer. During the surveys the heading of the boat was kept constant at about 120°N and maintained on a uniform speed of 10 km per hour. Position location fixes were obtained for every ten minutes by taking the sextant angles from the objects on the coastline. During the clear days the sextant angles could be obtained upto a distance of about 15 km from the coastline. From these fixes, the effective speed of the boat and the heading are computed and the positions for the rest of the profile are obtained by extrapolation. Simrad EY Echosounder with an outboard ceramic transducer which transmits the pulses of 70 kHz was used to record the bottom topography.

### RESULTS AND DISCUSSION

The width of the continental shelf in the area covered by the present surveys varied between 35 to 40 km. Over the inner shelf the topography of the area varies from south

to north. Between Kutukonda and Uppada, bottom topography upto a depth of 40 m, deepens at a fairly rapid rate with an average gradient of 1:14. To the north of Uppada, the ocean bottom dips gently with an average gradient of 1:24. Between 40 and 70m depth, the ocean bottom is fairly flat and featureless in almost all the profiles. From 70 m depth to the shelfedge which occurs at about 130 m depth, several interesting topographic features have been recorded and they appear to align almost parallel either to the coastline or to the shelfedge (Fig.1).

From the general characteristics of the echograms the ocean bottom features are broadly categorised as (i) Terraces, (ii) Karstic structures associated with pinnacles and (iii) Reef structures.

Terraces are located mostly in the southern half of the surveyed area and they are more prominent and well defined step like features with smooth surface topography in profile No. 4 off Lawsons Bay (Fig. 2). They are recorded in 6 of the 10 profiles and occur almost uniformly at about 70 m depth. Mahadevan and Rao (1954) reported a wide coverage of oolitic sands, shell zones and concretion zone between 56 and 120 m depth over the continental shelf off Visakhapatnam. The oolitic sands off Visakhapatnam are also found to contain shallow water forams. Occurrence of shallow water foraminifera at these depths over the continental shelves of the major oceans and seas suggest that they might have formed when the sea level stood at much shallower level (Shepard, 1969).

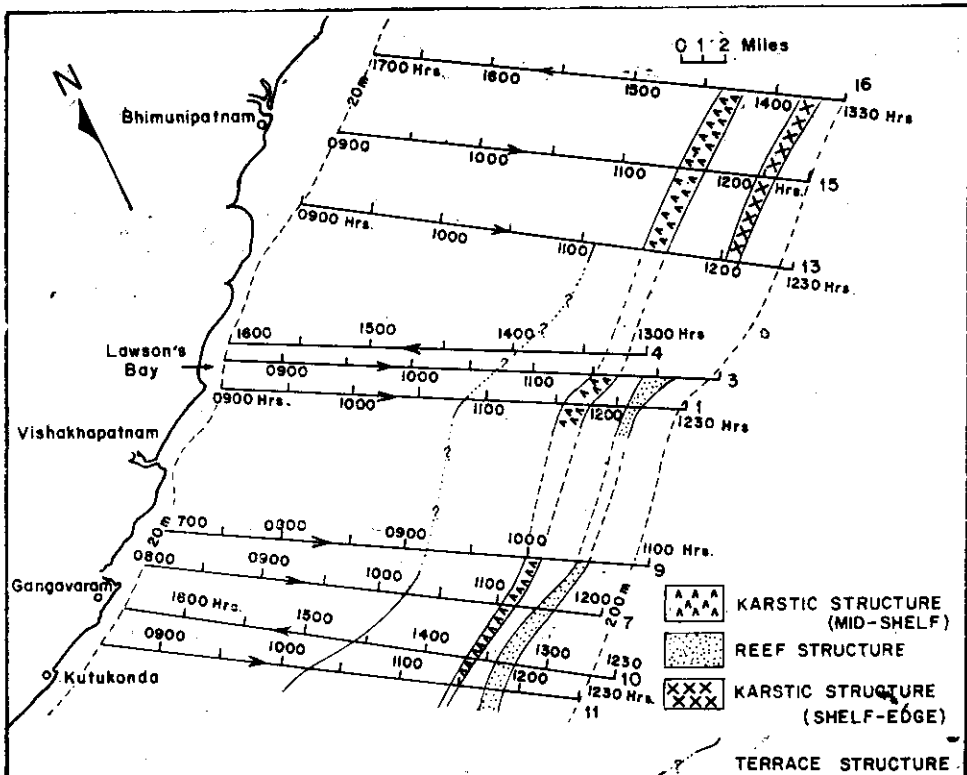


Fig. 1 Profile locations and lineations of topographic features.

The Karstic features are composed of series of pinnacles with and without troughs (Fig. 3a). At some places isolated single pinnacles which are fairly big in their horizontal and vertical dimensions are also recorded (Fig. 3b). The pinnacles are commonly 2 to 6 m in height, reaching a maximum height of 8m at some places. At some places, groups of these pinnacles extend upto 2 to 3 km in length. All of them occur over the outer shelf at the bottom depths varying from 80 to 100 m and they run almost parallel to the shelfedge. The troughs are usually 1 to 3 m deep and some of them are as much as 10 m deep and few hundred metres wide. They consist of more than one pinnacle neither of which projects over the top of the depression. They occur in the area where the bottom sediments are categorised as shell and concretion zone which are composed of oolitic sands. The pinnacles of this nature are reported by Nair off Bombay (1971) and off Goa and Ratnagiri (1973). These structures are believed to have come into existence in the limestone of the underlying sediments during pleistocene low sea level.

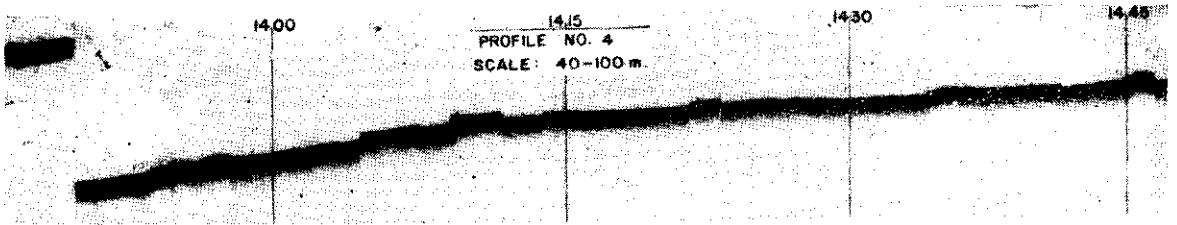


Fig. 2. Terraces/benches off Lawson's Bay along Profile No. 4.

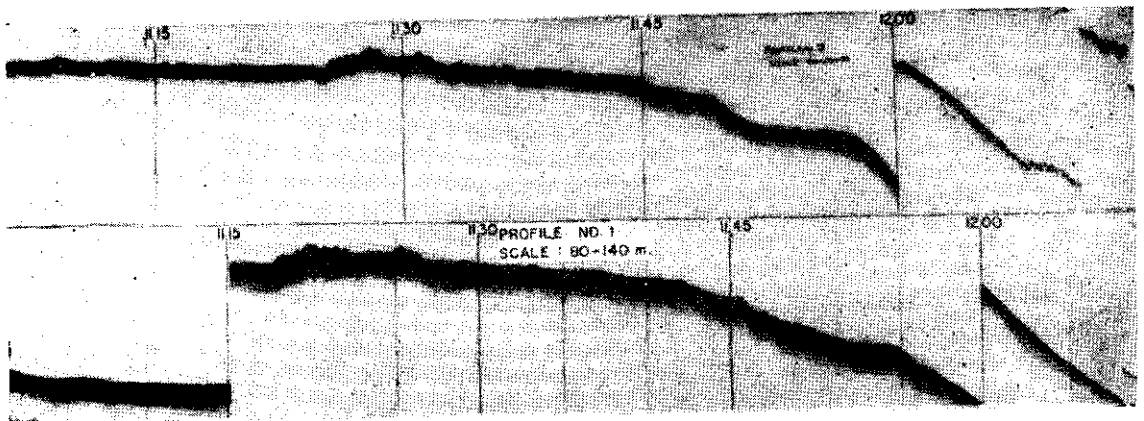


Fig. 3(a). Karstic structures with pinnacles.

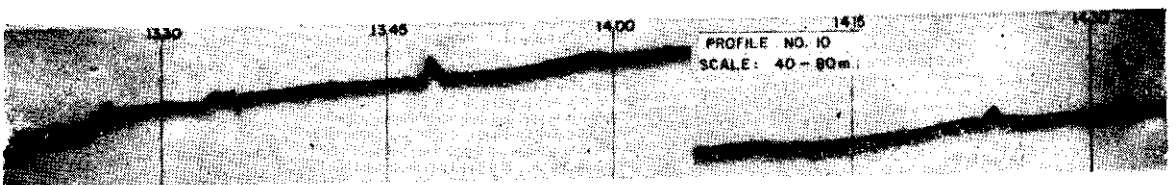


Fig. 3(b). Isolated pinnacles.

Near to the shelfedge, at the bottom depth of about 120 m, a dome shaped smooth topographic feature is recorded. It extends about 3 to 5 km in width with height varying from 4 to 10 m. This feature is very prominent and consistent in its shape in the southern portion of the area particularly between Kutukonda and Yarada hill (Fig. 4). At the first instance this feature is suspected as the rock exposer which is devoid of sediments. The magnetic surveys carried out along with the echosounding do not show any magnetic anomalies caused by this feature. On the other hand, the magnetic anomalies recorded in this area are of low amplitude and large period which arise mainly due to the basement layer underlying the sediments (Rao and Murthy). Therefore, the arguments that it may be the rock exposer can be ruled out. From the nature of the sediments reported in this area and also from the shape of the feature it is believed that it may represent the coral reef structure, that has formed during the pleistocene lower sea level and presently may be the dead reef structure. Dredging of bottom samples over these structures and their analysis in the laboratory are needed to study its nature and composition.

To the North of Visakhapatnam, particularly, near Bheemulipatnam, the dome like feature is replaced by rough topographic high composed of pinnacles (Fig. 5). It looks similar to the Karstic structures noticed earlier. Though they occur almost at the same depths where the dome like features are recorded, the relationship between these two features is not evident from the present studies. It is presumed that the Karstic topographic features recorded over the shelfedge off Bheemulipatnam may be the remnants of the dome shaped reef structures whose surface features have been deformed into the present rough topography due to the prolonged erosion partly by wave action and largely by bottom currents, mostly the turbidity currents.

From the available data it may not be possible to arrive at a conclusion regarding the origin and development of these features. However, by examining the characteristics of these topographic features in detail and by comparing them with the similar information available from the continental shelves of other oceans and seas the arguments that are put forward for their origin are discussed to make a qualitative assessment of these features.

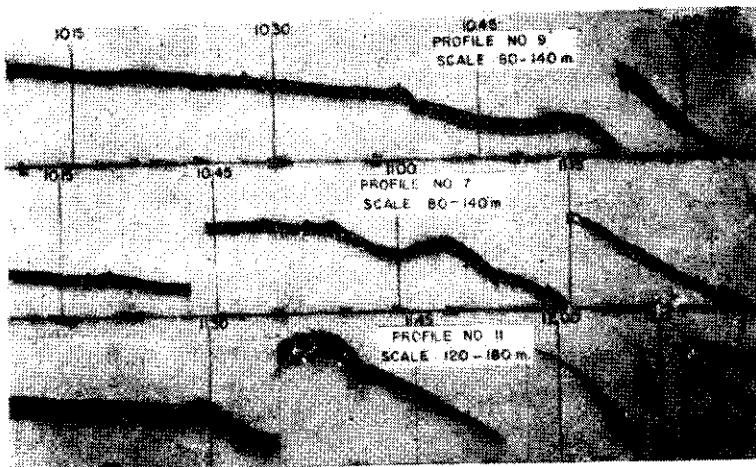


Fig. 4. Dome shaped reef structures near to shelfedge.

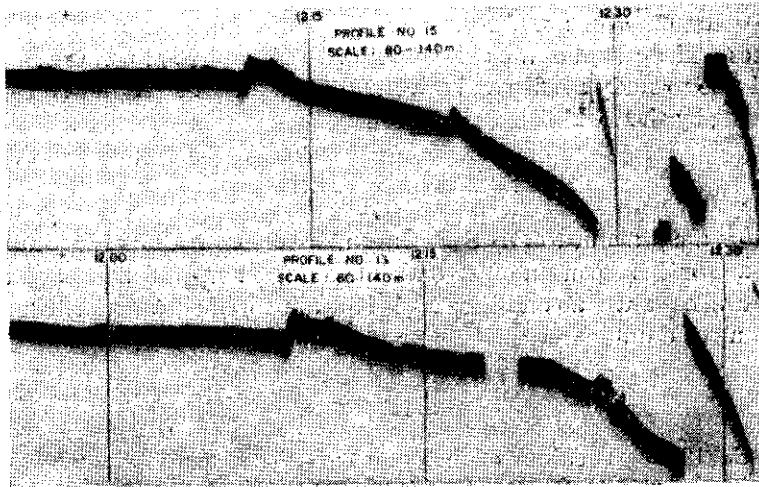


Fig. 5. Karstic structures near to shelfedge.

Many of these features have been traced for hundreds of kilometres over the continental shelf of Atlantic Ocean (Heezen, 1959). Among them, some are intermittent, others change in depth with distances along the shelf and still others are only locally developed. Four possible explanations are offered regarding the origin of these features: (1) Ancient shore features, (2) Structural or rock benching, (3) Block faulting and (4) Land slide or slump scars. The arguments offered and some of the evidences observed have all supported the first possibility and rule out the last three possibilities listed above. For example, the fact that these are found at the same levels along the coasts of diverse geology and tectonic developments, supports the eustatic origin of terraces between sea level and 50–100 fathoms. The gradients of the continental shelf are so low and these features are so persistent that block faulting and slump scars are excluded on general explanations. Again persistence of these features for many kilometres argues against a fault scarp or slump scars hypothesis. Therefore, it is felt that these submerged features that occur within a few hundred feet below the present sea level can probably be best explained as ancient beaches formed during the lower sea levels of the pleistocene. The origin of the shelfedge pinnacles can be explained in one of the two possible ways given below:

- (i) Organic capping of pre-existing structures which may be constructional or erosional.
- (ii) An organic reef (bioherms) origin has been suggested for the submerged reefs constructed during the lower stand of sea level.

In light of the above theories and also from the depths at which the present submerged features are recorded, from the nature of the sediments that occur in this region and also from the nature of the magnetic anomalies recorded in this area, it appears more probable that these features are of sedimentary origin and may represent the ancient beaches formed during the lower sea levels of pleistocene. It may also be suggested that the dome shaped reef structures as shown in Fig. 4 may be of organic reef origin while other features may be due to the organic capping of pre-existing structures. Collection of sediment samples and underwater photography over these features as well

the sub-bottom seismic profiling are to be carried out in these areas to elucidate the marine and other environmental conditions that are responsible for the formation of these features. These studies are also required to assess the mineral resources of these features and also to study the fish and prawn potential of these areas that is now believed to be promising by the local fishing community.

#### ACKNOWLEDGEMENTS

Authors are grateful to Dr. S. Z. Qasim, Director, National Institute of Oceanography, Goa, for his keen interest and encouragement. Thanks are also due to Shri M. M. Malleswara Rao and Shri N. S. N. Raju for their assistance in the collection and processing of data.

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