

CHAPTER - VIIIR E S U M E

- (1) The present thesis comprises the first ever succinct micro-palaeontological study of the Holocene coastal sediments of Saurashtra and Mainland Gujarat.
- (2) The coastal deposits of Saurashtra and Mainland Gujarat have preserved within them a fascinating record of the various Neogene and Quaternary episodes, and the diversity which marks the various segments of the coastline is typically reflected in the shoreline geomorphology, sediment types and the microfauna. In this thesis, the author has presented an analytical account of the diversity in

the microfaunal assemblages encountered in the various coastal segments, bringing out the close relationship that exists between the geological processes and the coastal environments. She has investigated the present-day microfaunal content of the beach and mud deposits vis-a-vis the various geo-environmental parameters prevailing along the coastline, viz. the morphology of the offshore and onshore areas, nature of coastal sediments, energy conditions, currents and climatic factors. Her studies comprised the following :

1. A critical evaluation of the geology and geomorphology of the coastline, including backshore and foreshore features, and features of the inner offshore continental shelf zone.
2. Investigations of the beach sediments occurring along the different coastal segments in respect of their bulk lithology and heavy mineral content.
3. Appraisal of the Meteorological conditions (rainfall, temperature, wind directions and velocities etc.) and nature of shoreline currents.
4. Detailed microfaunal studies of the beach and tidal mud deposits including those of the estuarine river mouths.

- (3) Though the Gujarat region as a whole comprises rocks ranging from the Precambrian to the Quaternary, the coastal geology is characterized only by post-trappean rocks, the coastline showing Tertiary and Quaternary sequences deposited over basaltic Deccan Trap. It has been observed that the coastline configuration, drainage pattern and Cenozoic depositional history are all manifestations of a number of bounding major faults on all sides of Saurashtra and the coastline of Mainland Gujarat. The coastline also shows numerous evidences of at least four strandline positions in Saurashtra and three in the Mainland Gujarat. Quaternary tectonism along various major bounding faults and associated fractures, in combination with eustatic sea level fluctuations have been the major factors responsible for the evolution of the coastline, and its diversity.
- (4) The entire coastline, on the basis of its geomorphic diversity, can be divided into following distinct segments each segment characterized by its own coastal environments:

I.	Jamnagar coast	V. Saurashtra coast
II.	Okha coast	(Gulf of Kutch)
III.	Dwarka coast	West and South Saurashtra
IV.	Porbandar coast	coast
V.	Devvada coast	

VI.	Bhavnagar coast	
VII.	Cambay-Dahej coast	Gulf of Cambay coast
VIII.	Hansot-Hajira coast	
IX.	Dumas-Tithal coast	
X.	Tithal-Umbargaon coast	S. Mainland coast

The varying effects of tidal action, wave action and shoreline currents have contributed to the coastal diversity and the differing coastal environmental conditions have, in turn, controlled the nature of the marine fauna.

- (5) The microfaunal diversity in terms of relative abundance or otherwise of certain genera and species, as also the degree of abrasion, have been found to be almost entirely dependent on the coastal marine environments. The segment-wise variations in the coastal ecological conditions have been spelt out in terms of the following environmental parameters directly related to the coastline processes :

1. Shoreline configuration
2. Shoreline morphology
3. Coastal drainage
4. Substrate
5. Nature of the littoral zone:
 - a. Slope, gradient and surface features
 - b. Material
 - c. Width

6. Energy conditions:
 - a. Wave action
 - b. Tidal action
 - c. Nature of currents.
7. Climatic conditions:
 - a. Rainfall - Humidity etc.
 - b. Temperature variations.
 - c. Wind direction.
8. Salinity
9. Turbidity

- (6) Sediments show a conspicuous correlation with the associated microfauna. The sediments of Saurashtra and Mainland Gujarat are strikingly different from each other while those of Saurashtra are dominantly calcareous, the Mainland coastal sediments are rich in terrigenous non-carbonate constituents. The sediment study has provided valuable information on the coastal environments and the processes operating in the various coastal segments.
- (7) It is observed that though the microfauna broadly comprises assemblages typical of nearshore environments, in several details, especially in respect of their sizes, robustness, amount of abrasion and relative proportions, it shows considerable variations. Detailed accounts of the microfaunal

characteristics of the different segments have been given in the thesis (Chapter VI), from which it is observed that geomorphic and environmental diversity is appropriately reflected in the microfauna of the coastal sands and tidal muds.

- (8) In all 95 species belonging to 34 genera and 10 families of foraminifers have been identified. Three of them are planktonic and the rest are benthonic forms.
- (9) The north coast of Saurashtra comprising a gulf environment and characterized by coral reef - mangrove ecosystem, is seen to have been influenced by (i) a hard subsiding substrate, (ii) almost normal to hyposaline waters, (iii) low turbidity, and (iv) not so pronounced wave action. Marked by a relative scarcity of beach sediments, the foreshore is mostly seen to form a veneer of tidal mud. In contrast the west and south coast facing the Arabian sea is marked by (i) high wave energy, (ii) clear water of normal salinity, (iii) pronounced surf action acting over a fairly broad miliolitic irregular substrate. This coast has been generating vast quantities of tests of foraminifers as well as tiny shells of gastropods and lamellibranchs. The environmental conditions in the gulf of Cambay are different from either of the two earlier described blocks. The various environmental parameters like (i) muddy substrate, (ii) high tidal energy but low

wave action and (iii) relative decrease in salinity and increase in turbidity, are reflected in the microfauna of the gulf coast. On going southward, the southern part of the Mainland Gujarat coast, which again provides open-sea conditions, shows increasing effect of salinity and waves. But in this coastal part, the shoreline environment is considerably modified by the factor of (i) influx of river sediments, (ii) longshore drift of the gulf sediments and (iii) variations in the salinity conditions dependent on the amount of river water received. Though the overall effects of variations in salinity are not so well marked, the normal saline, hyposaline and brackish conditions along with the nature of associated sediments, do seem to have influenced the microfaunal characteristics to some extent.

- (10) An interesting aspect of the coastal foraminiferal fauna pertains to the degree of abrasion, several forms, characteristics of nearshore open marine conditions have been found to comprise two populations - abraded and unabraded, abraded ones could be representing organisms that grew further offshore and were subsequently transported to the beach, the unabraded ones might have originated not very far from the low water line. Alternatively, the abraded tests could be representing earlier formed organisms subjected to a longer period of wave action as compared to the fresh ones.

- (11) It could be finally concluded that though the Gujarat coastline may not in terms of macro-level observations, reveal the complex intricacies of the various coastline processes and the coastal environments, but when it is examined in detail, it provides a fairly precise picture of the control exercised by the micro-environmental conditions prevailing in the different parts of the coastline^{and} respective foraminiferal assemblages. It should however be noted that the conclusions beyond a certain point, have to be taken as arbitrary and preliminary, because the studies are based on the present day accumulations of the beach and mud between the intertidal zone that consist of a combination of both indigenous and non-indigenous populations. What one finds today along the coast is an odd mixture of sediments with foraminiferal tests showing fairly wide ranges of variations in space and time. What the present author has ~~been~~ examined and described in the thesis could belong to more recent as well as ancient (Early Holocene) animal remains; also they might be representing organisms transported several kilometers from offshore and alongshore parts by wave currents, surf and littoral drifts.
- (12) The present study certainly does not provide answers to all questions; it only marks a beginning, and perhaps raises many more questions for which, detailed and in-depth future studies may provide the answers.