PART-II

ONSHORE STUDIES

CHAPTER

IV

COASTAL GEOLOGY

GENERAL
SAURASHTRA BLOCK
BHAL BLOCK
MAINLAND BLOCK

CHAPTER IV

COASTAL GEOLOGY

GENERAL

The present day Gulf coastline mainly consists of Quaternary sediments, but the existing coastline configu-ration and coastal geology however have been controlled by the tectonic and depositional processes, marine as well as fluvial, that were initiated much earlier, almost at the beginning of Cenozoic Era. The Tertiary geology has provided the basic frame-work which has been acted upon and influenced by the subsequent fluvial and coastal marine processes. Though not exposed anywhere along the coastline the Tertiary rocks are very much present in the subsurface.

The various faults delineating the Cambay Basin cutting across it have not only imparted diversity of depositional environments but have also given rise to equally diverse rock types and landforms. With these geological processes have combined the effects of sea level fluctuations. Thus geology in combination with sea level fluctuations has provided an important factor towards the development of depositional and erosional landforms along the coast.

Not only the onshore features but also some of the offshore phenomena have direct relevance to geology.

The author has already given the details of the broad geological framework within which the Gulf is situated and has also alluded to the striking geomorphic features of the coastline. In this chapter he proposes to describe the relevant geological details of the different parts of the Gulf coast.

The geological details are based on his own field work, supported by the recent studies by previous workers (Ganapathi, 1981; Patel & Merh, 1982; and Patel et al, 1985). The phenomenon of sea level changes and related landforms and sediments recorded by the author is also based on the observations of the above workers.

The coastline can be broadly divided into three blocks namely (i) Saurashtra block (ii) Bhal block and

(iii) Mainland block. These divisions are based mainly on geology, physiography and terrain characteristics.

The three blocks have been further subdivided into numerous segments as under:

1. Saurashtra block
   a) Methla-Gopnath segment.
   b) Gopnath-Ghogha-Bhavnagar segment.
   c) Bhavnagar-Dholera segment.
2. Bhal block
   Dholera-Khambhat segment
3. Mainland block
   a) Khambhat-Dahej segment
   b) Hansot-Hazira segment

SAURASHTRA BLOCK

The Saurashtra coastal plains show a well developed Cenozoic sequence comprising of Deccan Trap and laterites overlain by Tertiary and Quaternary sediments (Ganapathi, 1981). The rocks of different stratigraphic ages occur quite close to the shoreline. Ganapathi (1981) has shown a NW-SE fault along the Shetrunji river and a E-W fault along the Kalubhar river. These two faults are of considerable significance and appear to have controlled the Quaternary depositional history and geomorphic

characteristics of the Saurashtra coastal block. The three segments into which the Saurashtra block has been divided are seen delineated by the two above mentioned faults. Whereas the Shetrunji fault separates Mehtla-Gopnath segment from the Gopnath-Ghogha-Bhavnagar segment, the Kalubhar fault demarcates the Gopnath-Ghogha-Bhavnagar segment from the Bhavnagar-Dholera segment. These faults as well as the extension of Narmada fault and Ghogha-Sanand fault (= WCBBF) have controlled the depositional history of the coastal area since the advent of the Miocene. Differential uplifts and subsidences along these faults are typically reflected in the stratigraphic differences of the three coastal segment.

In the Gopnath-Methla segment the Tertiary-Quaternary rocks show a width of about 10 km and following stratigraphy:

Alluvium & Mudflats	-	Holocene (Recent to sub-Recent)
Miliolite Formation	-	Pleistocene
Gaj Formation	-	Lower Miocene
Laterites	-	Paleocene
Deccan Trap	-	Cretaceo-Eocene

On crossing the Shetrunji river north-eastward the Gopnath-Ghogha-Bhavnagar segment reveals a striking change in the stratigraphy. The trap comes quite close to the shoreline almost 2 to 3 km only. Laterites and Gaj rocks are exposed along the coast itself; miliolites change

over to a non-carbonate facies, referred to as Lakhanka Formation by Ganapathi (1981). This coastal segment shows the following stratigraphy:

Mudflats, Beaches & Dunes	-	Holocene (Recent to sub-Recent)
Lakhanka Formation	-	Pleistocne to Holocene
Piram Beds	-	Mid Pliocene
Gaj formation	-	Lower Miocene
Laterites	-	Paleocene
Deccan Trap	-	Cretaceo-Eocene

The Bhavnagar-Dholera segment is very much different from the earlier two segments. Here the coast for several kilometers inland consists of unconsolidated Late Quaternary sediments, alluvial as well as tidal marine. Nowhere Tertiary rocks are exposed, and the Recent sediments are seen to abut against the Deccan Trap. In subsurface however, Tertiary rocks have been reported by the ONGC workers (Raju, 1968). The stratigraphic succession for this segment thus works out as under:

Alluvium & present day Mudflats	-	Holocene (Recent to Sub-Recent)
Raised mudflats	-	Early Holocene
Older Alluvium	-	Middle to Upper Pleistocene

BHAL BLOCK

The block which comprises a linear NNW-SSE trending depressed zone separates the Gujarat Mainland from the Saurashtra peninsula. Tectonically, in a broad sense, it forms a part of the western flank of the Cambay Basin lying to the immediate west of the Western Cambay Basin Bounding Fault. Surface exposures comprise only the Late Quaternary sediments. However in the subsurface, Tertiary rocks have been reported in the works of ONGC (Raju, 1968). Although, the main graben to the east of this fault (mostly falling within the Mainland of Gujarat) shows a very pronounced downthrow, the western flank of the basin also points to a distinct subsidence. This phenomenon coupled with Late Quaternary sea level changes (regression-transgression-regression) has given rise to the Bhal sedimentary sequence.

The major bulk of the sediments of this block consists of an older alluvial accumulation overlain by tidal mud deposits formed during the last sea level rise

(Flandrian transgression). During the course of the last few thousand years the sea has regressed to its present level. As a result, the Late Quaternary exposed stratigraphy could best be described as under:

Present day Mudflats	-	Late Holocene (Recent)
Raised Mudflats	-	Early Holocene (Flandrian)
Older Alluvium	-	? Late Pliestocene

As seen today, elevated relicts of older alluvium peep out as 'bets' or 'islands' above the saline wasteland.

MAINLAND BLOCK

The coastal Mainland falling within the limit of the study area i.e. between Khambhat (Cambay) and Hazira (Between the Mahi and Tapi rivers) geologically comprises the Broach and Narmada blocks of the Cambay Basin structure. From north to south it shows a very conspicuous tectonic control in the deposition of the Quaternary sediments, as a result of which the exposed geology of the various segments shows some well defined differences. Nowhere the Tertiaries are exposed. The Narmada geofracture marks the most significant tectonic lineament, on the basis of which the Mainland coastal block is divisible into two geologically diverse segments viz. Cambay-Dahej and Hansot-Hazira. These two segments are not only geomorphically distinct from each other but from the point of view of Quaternary-Tertiary

stratigraphy, one differs from the other. Whereas the northern segment consists of a huge pile of about 150 m thick of Quaternary alluvium, the southern segment has a somewhat reduced alluvial-thickness, less than 100 m; in both cases the alluvial sediments are resting over the Tertiary rocks (Agarwal,1984). The sequence to the south of Narmada (Narmada block) is different in the sense that here the alluvium is reported to overlie directly on Jhagadia formation, the Jambusar Formation and Broach formation is being absent.

So far as the coastline proper is concerned the Quaternary deposits in both the segments show the following depositional sequence

Present day Mudflats, Beaches dunes etc.	-	Late Holocene (Recent)
Raised mudflats, paleodunes and coastal ridges	-	Early Holocene
Older Alluvium	-	? Mid to Upper Pleistocene

The Late Quaternary stratigraphy of the Mainland Gujarat is obviously controlled by the factors of sea-level changes and neotectonism along ENE-WSW fractures.