CHAPTER III

GEOMORPHOLOGY OF THE SHORELINE

The area investigated is the coastal tract that is developed mainly on the basalts of the Deccan Trap Province. Along the coast, development of various geomorphic features has been observed. As it is a transitional zone, features of both fluvial and marine origin have been observed.

GEOMORPHOLOGICAL CHARACTERISTICS OF THE SHORELINE

The geomorphological characters of the shoreline have been studied from the Malvan area. The geomorphic features are of both fluvial and marine origin. The geomorphic features of fluvial origin are both - erosional and depositional.

A. Fluvial geomorphic feature :

Erosional :

Estuary

Depositional :

Mud flats

The shoreline geomorphic features of marine origin are also both erosional as well as depositional and they are :

B. Shoreline geomorphic features :

Erosional :

1. Headland
2. Sea cliffs and sea caves
3. Island
4. Pocket beach

Depositional :

5. Tidal inlet
6. Sandbar
7. Raised beach
8. Beach dune (eolian)

These geomorphic features are described in detail in the following paragraphs :

A. Fluvial geomorphic features :

Erosional :

Estuary

Estuary generally marks the transition between fluvial and marine environments. In geomorphic terms, an estuary is an inlet of the sea, reaching into a river valley upto an upper limit of tidal rise (Fairbridge, 1980). Fairbridge has classified estuary into seven different types, depending upon

its physiographic location. Devis (1985) has classified estuary in three different types, which are based on transport and accumulation mechanism of sediments in an estuary.

In the present area of investigation, the estuary has developed along the mouths of the Gad and Karli rivers. Development of sandbars at the mouths of these estuaries has been observed (Plate III, Photo 2). Therefore, these estuaries can be termed as bar-built estuary, according to the classification suggested by Fairbridge (op.cit.). From their geomorphological expression and on the basis of the occurrence of sediment deposits in them, these have an appearance of flask.

In Karli river, the landward transport and effect of tidal range were observed in terms of settling lag and scour lag sediment deposits.

The estuaries are usually subjected to tidal action. During high tides, much finer sediments of silt and clay grade deposit on either banks, giving rise to mud flats. However, in low tide environment, estuary supports growth of vegetation. The vegetation observed in case of the present estuaries are shrubs and mangrove plants.

Depositional :

Mud flats

Mud flats are the deposits of fine sand, silt and clay grade sediments. Their deposition is in the lower reaches of the river mouth and estuary, mainly at low tides, where river meets the sea.

Mud flat deposits have been traced in the Kolamb creek (Plate III, Photo 1), Achra creek and Karli creek. These deposits support vegetation of mangrove plants. The mud flats are generally traced in the estuaries and tidal inlets, as these places are generally sheltered from strong wave action. The extensive mud flat at the Achra creek appears to be due to the protection of the estuary by headland, on its northern front and growth of sandbar towards the south. This sandbar extends to almost 8 to 10 km. in length, parallelling the coast.

B. Shoreline geomorphic features :

Erosional :

1. Headland

The extrusion of land composed of hard, massive and compact rocks into the sea is referred to as headland. It

slightly tapers towards sea, having varied length, width and height. The headland follows the general topographic extension of mainland. The headlands have been located due north of Achra creek, Malvan and Sarjekot. The elevation of each headland has been noted and it is about 120 m. above msl, at north of Achra and of about 80 m. above msl, at Malvan, while the headland near Sarjekot is about 80 m. above msl.

2. Sea cliffs and sea caves

Sea cliffs are developed along the shoreline due to erosional activity of sea waves. Vertical cliffs of about 20 m. above high water line have been traced at Kolamb (Plate IV, Photo 1). The sea caves are few in extension at Kolamb. The sea cliffs have developed at weaker zones, due to collapse of the rock along the coast.

Large boulders of laterite have been found at the base of sea cliffs. The rocks, constituting sea cliffs are lateritised, showing the presence of lithomarge at the base and brown coloured laterite at the top. The lithomarge is slightly yellowish to brown in colour.

3. Island

The ditached landmass in the form of island has been traced near Malvan and Kolamb areas. The sediment deposit between the island and mainland gets exposed at the time of low tide. The prominent island of an area of about 1.5 sq.km. has been observed near Malvan. It has an average elevation of about 20 m. above msl. The rock constituting the island are sandstones and quartzites, which are hard, massive and compact and strike N 25° W - S 25° E dipping by about 65° due south - west (Plate IX, Photo 1). The island rocks are found to be highly jointed and sheared.

Few more small islands have also been observed in the areas around Malvan, which are accessible on foot at the time of low tide.

4. Pocket beach

Pocket beach is arcuate shaped and developed in between two adjacent headlands. The slope of the beach is found to be gentle as observed between low water line and high water line. The pocket beach is sandy. The concave sandy pocket beach has been traced from Tarkarli to Malvan with a length of about 3 km. and a width of about 40 - 50 m. Similarly, the sandy

pocket beach has also been traced due north of Malvan. It has a limited lateral extension along the coast, which is about 800 m.

Various sedimentary structures have been recorded along the pocket beach. These are ripple marks (Plate V, Photo 2), obstacle marks, cuspate ripple marks (Plate VI, Photo 1). These features, being temporary, are called as washout structures.

The molluscan shells act as obstacles to receding tide water, giving rise to obstacle marks and rill marks (Plate V, Photo 1).

Depositional :

5. Tidal inlet

Tides may be diurnal (one high and one low per day), semidiurnal (two high and two low per day) or mixed (combination of diurnal and semidiurnal). Tides due to semidiurnal or mixed origin generally predominante in most areas. For the study of tidal inlets, the amplitude difference between spring (full and new moon) and neep (first and third quarter moon) tides is important. Increase in amplitude during spring tide leads to the tidal prism, which, in turn, increases the tidal current velocity resulting in movement of

greater volume of water in and out of the inlet.

In the area in and around Kolamb Creek and Achra Creek, the tidal inlets are predominantly characterised by large sand bodies deposited by tidal current and waves. The deposits are in the form of sandbar that grow from the headland paralleling the coast (Plate III, Photo 2). These deposits are characterised by carbonate sediments, which are white in colour, medium to fine grained and contain varying proportion of molluscan shell fragments. These sediment deposits are moulded into different shapes, thereby influencing the tidal current action.

6. Sandbar

Sandbars are the depositional features developed at the mouth of the river. The sediments are being supplied from the river, which are reworked by sea waves. Sandbars mould their shapes, according to the intensity and direction of approach of the sea waves.

In the present area, two major sandbar have developed, that extend away from the headland in the south direction. The sandbar at the mouth of Gad river was traced for about 3 to 4 km. in length, which runs almost parallel to the coast, having the width of about 350 m. to 400 m.(Plate III, Photo 2).

In the central part of the area near Kolamb creek, the sandbar extends also from the headland towards south with a length of about 15 m. and about 22 m. in width. In the interior part of the sandbar, an estuary is enclosed.

7. Raised beach

Adjacent to the high water line are the raised beach sections. These sections of raised beaches have been traced all along the northern coast of the area studied (Fig. 3.1 a). However, the raised beach has been traced only in the southern part near Karli river. In the central part of the area near Kolamb (Fig. 3.1 b), the raised beaches are composed of slightly consolidated carbonate sediments. The elevation of raised beach sections varies between 0.60 m. to 1 metre (Plate VII, Photo 1 and 2, Plate VIII, Photo 1 and 2).

8. Beach dune

It is observed that the raised beach section have been overlain by dunes (Plate VII, Photo 1 and 2). The dunes are either stabilised or unstabilised. The dunes are stabilised due to growth of vegetation (Plate IV, Photo 2). In the northern part of the area, there are two series of dunes that run parallel to the coast (Fig. 3.1 a). The height of the

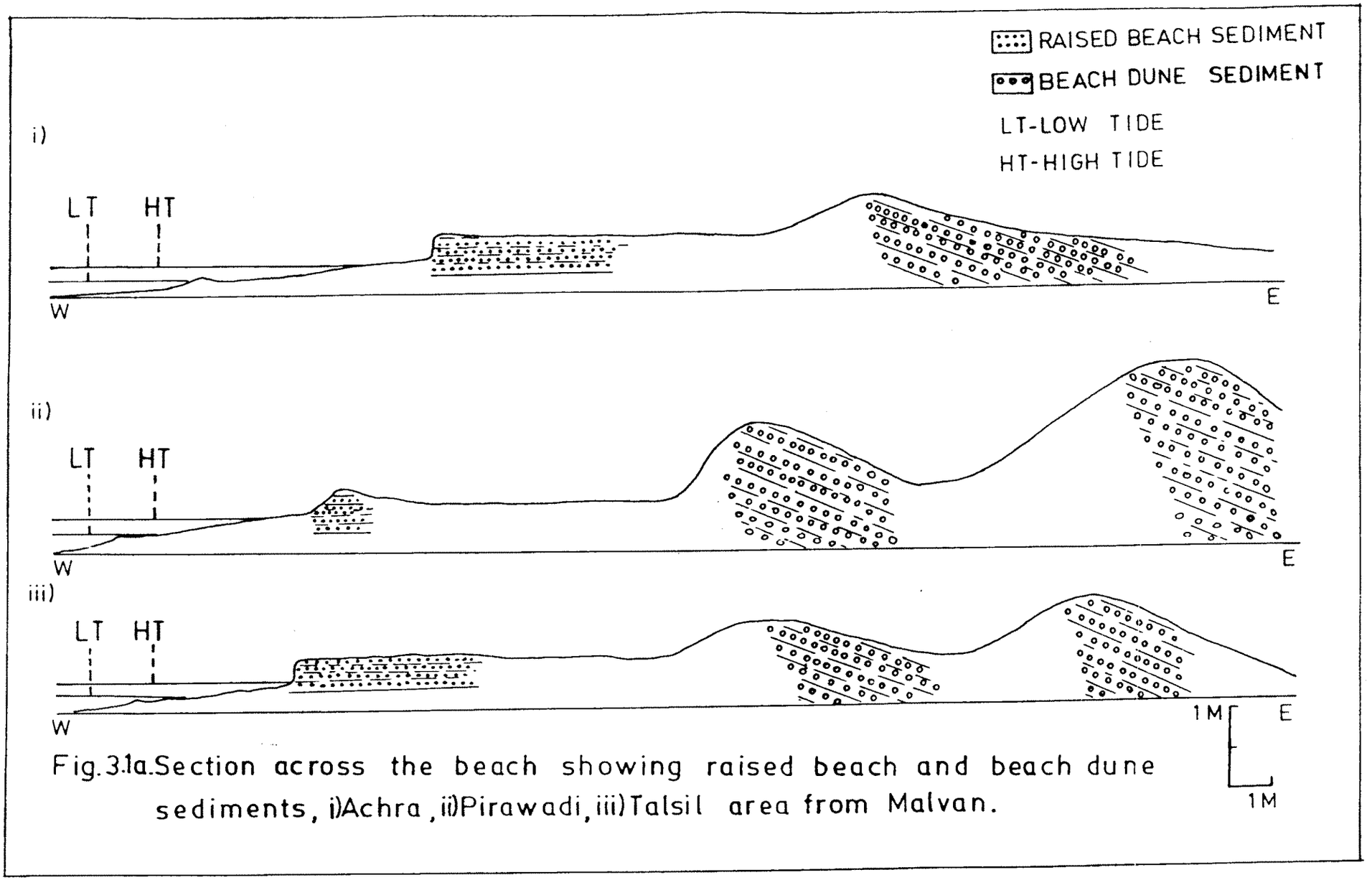

Fig.3.1a.Section across the beach showing raised beach and beach dune sediments, i)Achra, ii)Pirawadi, iii)Talsil area from Malvan.

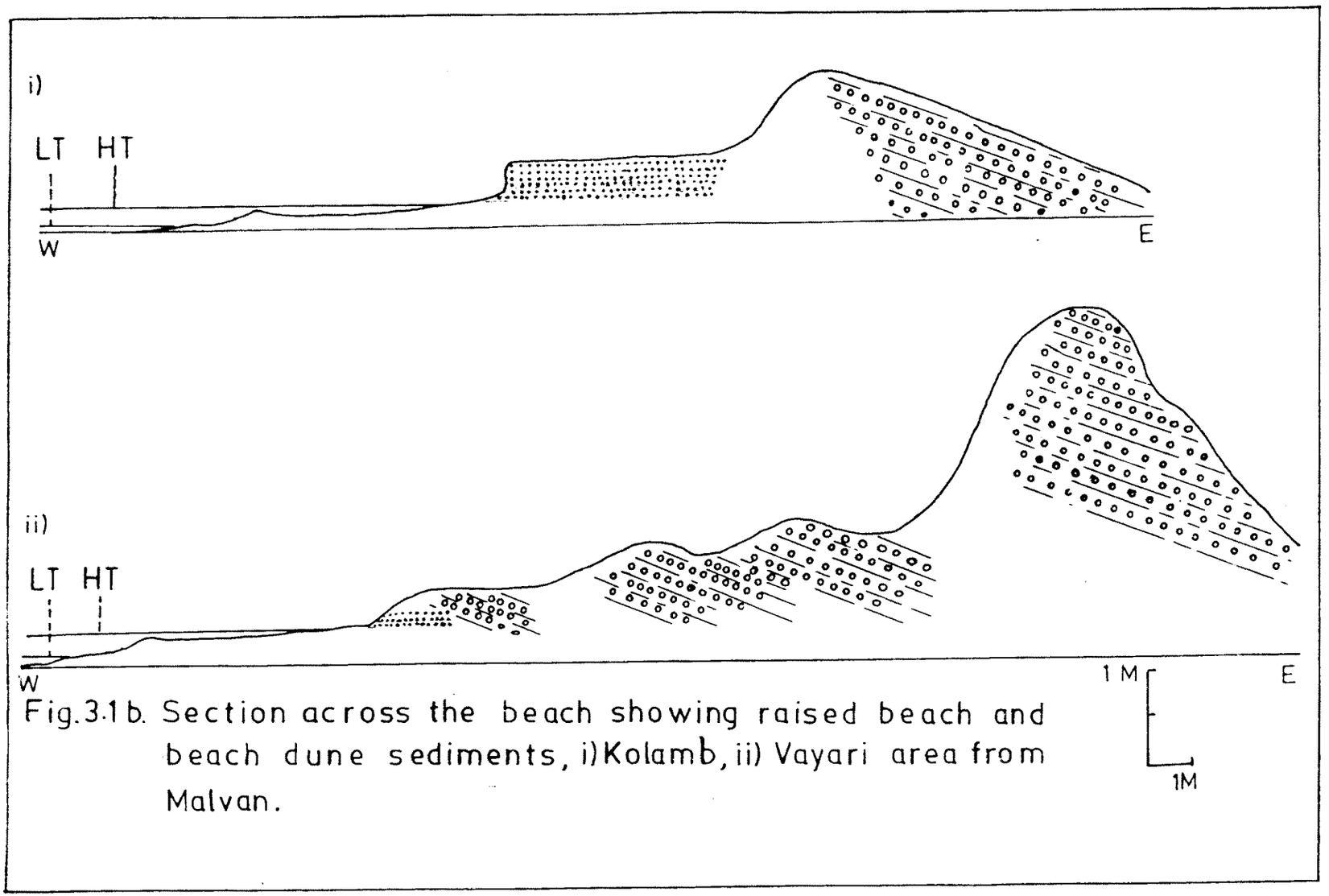

Fig.3.1b. Section across the beach showing raised beach and beach dune sediments, i) Kolamb, ii) Vayari area from Malvan.

dune is 1.5 to 3 m. However, in the southern most part, there are four series of dunes,parallel to each other (Fig. 3.1 b). These dunes range in height between 1.5 to nearly 10 m., each separated by a distance varying between 10 m. and 15 m.

The surface of the unstabilised dunes are marked by wave ripples and are being reworked due to constant wind action (Plate VI, Photo 2). The longitudinal axis of dunes is nearly in the NS direction. The surface markings are wave ripples that keep migrating. The cross-stratified laminations in the dunes have also been observed in vertical sections, that strike S 45° W and dip with an angle of about 40° due N 45° E (Plate IX, Photo 2).

Thus, it is clear that the shoreline geomorphic features are of both fluvial and marine origin.

DISCUSSION

The preceding paragraphs suggest that the coastline under present study is marked by the geomorphic features of both fluvial and marine origin. Development of these features is mainly on the basaltic lavas of the Deccan volcanics. From the characteristics of geomorphic features, it is seen that the coastline is predominated by the marine geomorphic

features. It is intercepted in between by the Gad river.

From the association of the geomorphic features, it is seen that these features are of both marine erosional and marine depositional characters, The spatial distribution pattern, however, does not indicate any specific pattern and it is found that the features of marine origin have been intercalated by those of marine depositional characters. This seems to be therefore a mixed response of the coastline to the tectonic activity or to neotectonics.

The coastline under the present investigation constitutes a part of the West Coast of India. This is considered as a passive continental margin and developed due to rifting and faulting of the Indian subcontinent from South Africa under the Plate Tectonics concept. The rifting has been considered along north-northwest direction, as the Precambrian trend (Biswas, 1982). Ahmad (1972) has brought out the geomorphic evolutionary history of the Indian coastline and has classified the coastline under the present investigation as an evidence of submergence. Dixit (1976), while studying the geomorphology of the West Coast between Bombay and Goa suggested that this coastal tract has evolved due to submergence of land or the rise in sea level. Powar, et al. (1978), while studying the geomorphology and tectonics

of the Maharashtra coast, have suggested the presence of a hinge fault, axis of which ran in E-W direction along the Kundalika river (Lat. 18°, 58' N), which has given rise to geomorphic features of emergent character to the north of the hingeline, i.e. north of Bombay and the features of submergence to the south of the hingeline. Rajaguru and Marathe (1984), on the basis of geomorphological characters of primary and secondary laterites have suggested that the coastal tract around Ratnagiri has experienced neotectonic activity; whereas Kale and Rajaguru (1985) have brought out the evolutionary history on the basis of Neogene and Quaternary marine transgressional and regressional cycles. Brückner (1989) has classified the west coast of Maharashtra as a ria-type coast. On the basis of the geomorphic features, he has further suggested it as a submerged coast.

Presence of the geomorphic features of both marine erosional and depositional characters have been described for the Maharashtra coast by Powar et.al. (1978), Patil (1981). The detailed evolutionary history of the Konkan coast, including the shoreline, has been presented by Tiwari (1984), Brückner (1987, 1989). These papers, however, have suggested mainly the submergent character of the coastline and have also suggested the presence of the raised

beach sections as an indication of marine transgression, the coast being later subjected to marine regression. The transgression-regression history along the coast has been ascribed to the Holocene period.

The presence of headlands, sea cliffs and islands in the area under investigation suggests the submergence of the coast, while presence of raised marine terraces suggest marine transgression. The observation of the author, thus, seek support from the observations referred earlier in explaining the shoreline geomorphic features of the area investigated.