Chapter _ II

Field and Laboratory Studies

CHAPTER - II

2.1 INTRODUCTION : A brief account of the process variables the physiography and coastal geomorphology of the area of investigation, methods used during field work and details of various methods adopted for the laboratory studies are presented in this chapter. Wave energy is the major factor controlling the development and changes in the beach. In broad terms beaches can be grouped into" High Energy Beaches" and "Low Energy Beaches" depending upon the strong and mild wave actions, respectively, at the coast. The incoming waves become steeper as the water depth decreases and therefore, ultimately they are oversteepened and break in breaker zone. The breaker zone is followed by surf zone,which at the shore line merges into the swash zone (Fig.2.1). The directions of the transport of sand in the beach region are strongly controlled by the movement of water which is dependent on the wave action, thereby, contributing towards the change in morphology of the beach. The following paragraphs deal with the different agents that control the coastal geomorphology and the deposition of heavy mineral bearing sediments.

2.2 PROCESS VARIABLES : The phenomena of variations in the characteristics of beaches and the beach sediments is time dependent and also on the nature and the effectiveness of the process variables which are directly or indirectly involved in. The commonly known process variables present

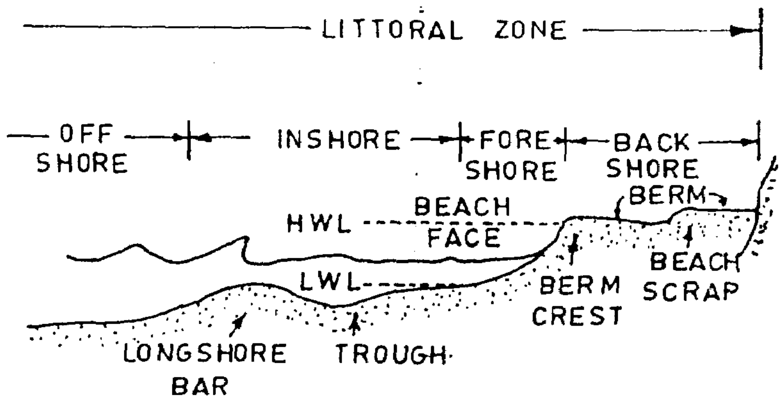


FIG.2·3 TERMINOLOGY USED TO DESCRIBE BEACH PROFILE (After KOMAR 1976)

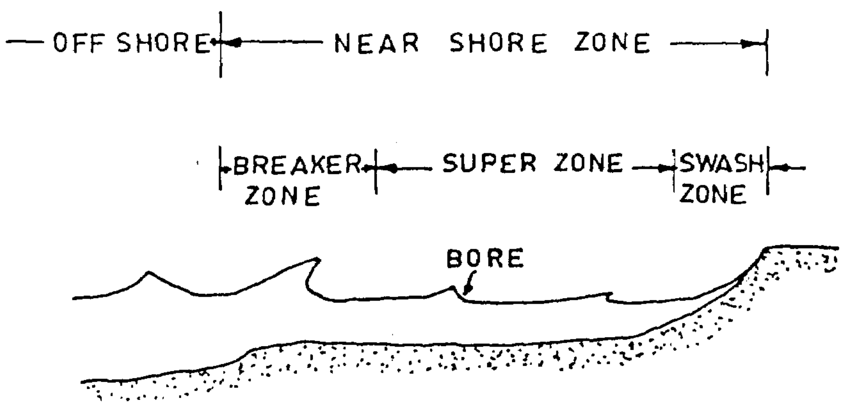


FIG.2·1 TERMINOLOGY TO DESCRIBE THE WAVE ACTION AND CURRENTS IN THE NEAR-SHORE REGION (After KOMAR 1976) along the coast are winds, waves, different oceanic currents including near shore currents, longshore currents, tides etc. Therefore, the account of these variables is essential in understanding shore line dynamics and the geomorphology of the coast for variation in the heavy mineral concentration.

2.2a **WIND** : Amongst all the process variables the predominent role of wind has been recognised in beach dynamics both actively as well as passively. Defund,1957 and Bretschneider 1968,stated that the wind generates waves and wind driven currents and transport the beach sediments from the subarial portion of the beach to the dunes. The pattern of wind distribution over the Arabian sea is the reversal of the wind system. A large scale reversal of atmospheric pressure and air flows occur annually resulting in the north-eastern monsoon and south-western monsoon. The role played locally by the land and the sea breezes also deserve emphasis as they have critical role in beach processes and developing local air circulations, thereby, indirectly in dispersion of heavy mineral bearing sediment (Murthy et.al 1982)

2.2b **WAVES** : A wave is a ridge or swell, moving along the surface of a large body of water, which may have generated by the action of gravity or wind. Wind generated surface waves both west and south-west - which are important contributors for the formation of littoral zone features due to the erosional and depositional activities. Hence,an understanding of wave action is essential for evaluation the processes that take place on the beaches. The waves are transient in nature and change from time to time. After originating, they move radially outwards from the focus in groups with varying periods, directions and intensities. During their shoreward propogation their characteristics change depending on the water depth. When the waves enter the shallow water, they slow down as the depth decreases and undergo transformations. The crest of the waves increases in height until they become unstable and break in the nearshore region, thereby, carrying and sorting the sediments. If the waves approach the crest at an angle, they will refract and become nearly parallel to the shore. Wave refraction can develop either a spreading out or a convergence of wave energy, (Reddy, 1976).

2.2c NEAR SHORE CURRENTS : The wave induced current systems in the near shore zones responsible for the water movements, as well as to and fro motions are 1. Long shore currents produced by an oblique wave approach to the shore line. 2. A cell circulation system of rip currents and associated long shore currents.

The long shore currents are well known, when waves approach a straight coast line at an oblique angle. Long shore currents always flow parallel to the coastline in the near shore zone. The velocity of the current quickly decreases to zero, outside the breaker zone (Fig.2.2). These currents are particularly important in transport of beach sand towards foreshore region. The formation of rips and narrow shore currents that flow seaward from surface zone are due to the nearshore cell circulation, (Fig.2.2). Shephard et.al (1941) from their study on rip currents concluded that the velocity of the rip currents and the distance they flow seaward are related to the height of incoming waves and the position of the rip currents as dependent on offshore topography.

2.2d TIDES : Tides are the daily rythmic rise and fall of sea-level, having a period of half lunar day . They are caused by the gravitational force of the sun and the moon on the earth. The tidal currents in the ocean are relatively weak but at near shore they can attain notable speed, thereby, proving their role in distributing and concentrating heavy mineral bearing sediments on beaches.

2.3 PHYSIOGRAPHY AND COASTAL GEOMORPHOLOGY OF THE NEWARA :

The Newara beach, lies in between the Western Ghats and the Arabian sea and bounded by two seaward projecting hillocks to the north and south. These hillocks rise to about 300 mts from M.S.L. The encroachment of northern promontory towards sea is comparatively more than that of the southern one, giving rise to a arcuate shape to the beach. The beach is plain with a small creek at the centre with few tidal inlets, bounded by flat topped hills. The high tide, which

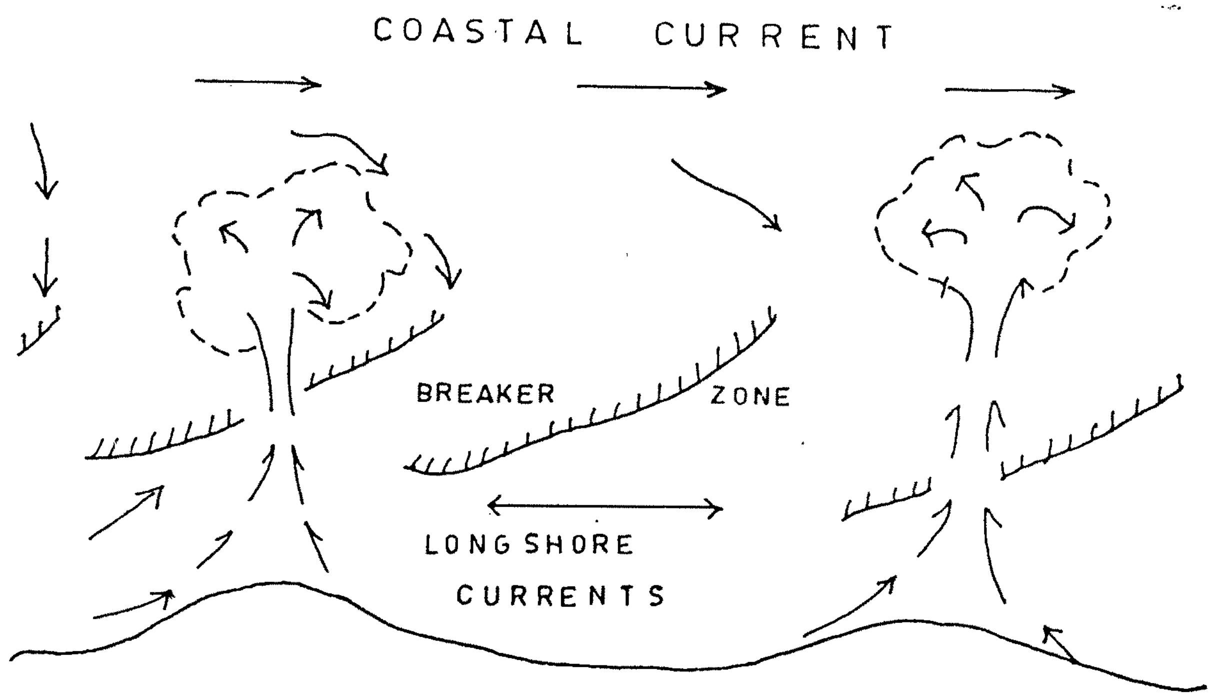


FIG. 2·2 RIP CURRENTS ALONG THE SHORE

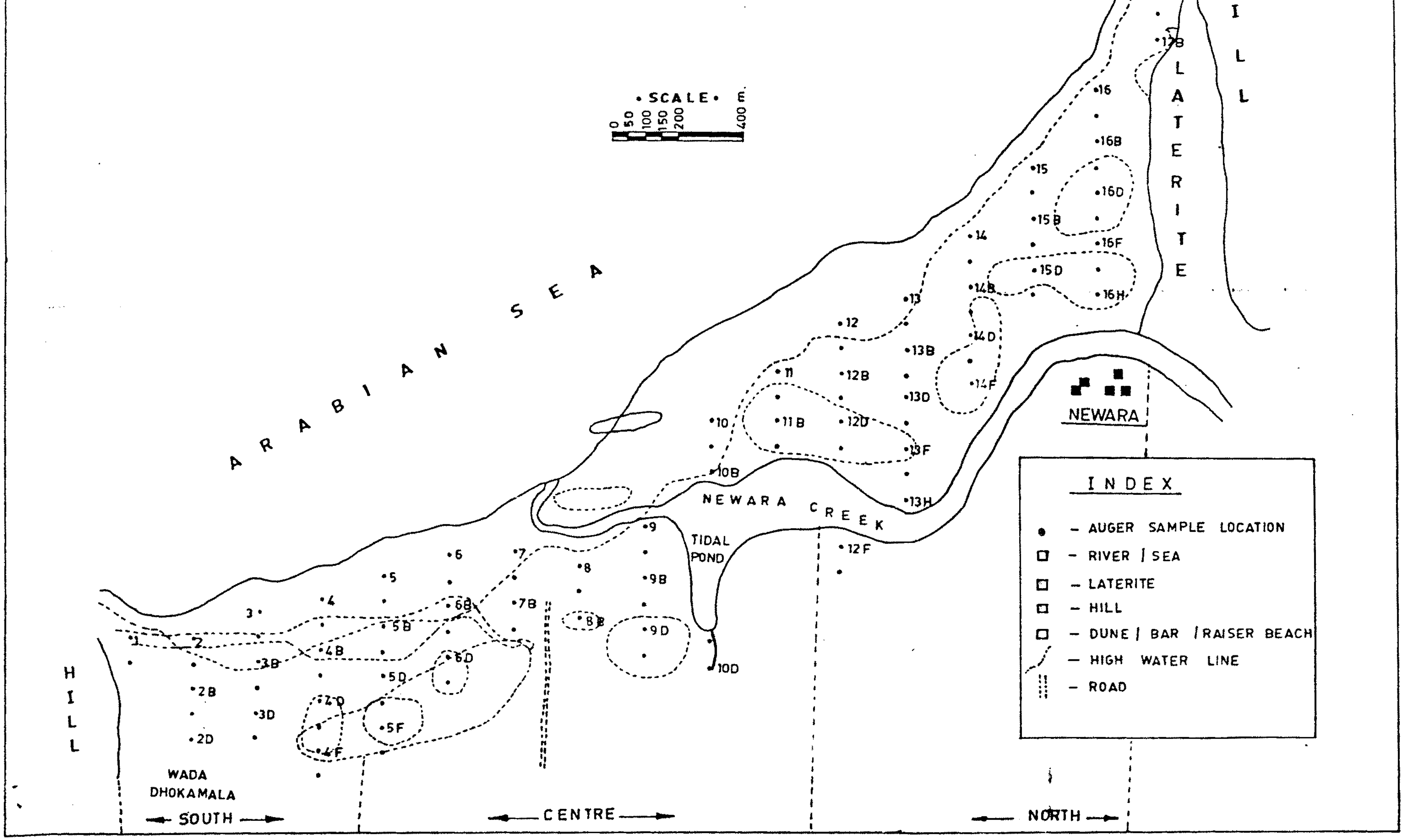
(After KOMAR 1976)

extends to 1 km. results in the formation of extensive mud flats along the banks. The eastern part of the Newara beach is represented by rugged topography containing numerous irregular hills and ridges which are separated by narrow valleys. These valleys have gentle slope seawards and are the sources for the seasonal and perenial streamlets which bring the material to the beach. The narrow low lying landscape between the shoreline towards west and the hilly rugged terrain towards east has a thick sandy soil used for cultivations.

The Quaternary sediments are predominantly found to occur as consolidated and unconsolidated sediments all along the tropical and subtropical coasts and represent Pleistocene age. The compact tertiary sediments developed on the beaches are referred as "raised beach sediments". In the vicinity of investigated area, towards north, these are rarely seen but are pronounced at the central part of the Malgund-Varvada beach. These are traced for about 80 meters in length. The presence of barchans and longitudinal dunes towards the northern part of the Newara beach is noteworthy. The dunes are covered by thin vegetation. They are characteristically absent in the southern part of the beach. The maximum height attained by a dune is about 3 meters. The slope of the beach is very gentle (3° to 5°), due to which swash and backwash have a role in contineous sediment sorting all along the beach (plate 2.1). This has resulted in the formation of alternate ripples of whitish light sand and dark coloured heavy sand(plate 2.2). It is noticed that the coastal tract under the present study is characterised by the presence of dunes, recent beaches followed by later deposition of sediments in high-tide zone, mid-tide zone and low-tide zone. The terminology used to describe the beach profile is shown in figure 2.3.

2.4 FIELD METHODS : Mapping was carried out in an area of 20 sq.km. in the vicinity of Newara, covering the beach placer deposits and part of its hinterland. During the course of fieldwork, lithological characters in the area were recorded and the contacts between the formations were located. Knowing the periodic, seasonal and rythmic variations of the above mentioned process variables, periodic sample selection to recognise their effectivity was felt necessary. With an aim to have better representation of quality and grade of heavy minerals, the grid type of sampling method was used and most of the selected traverses were planned perpendicular to the shoreline to acheive sampling across the productive zones. As the area is plenemensurate and no well defined strike and dip could be measured along the beach, the regular grid pattern of sampling was used (Fig 2.4). During the present investigation, the grid interval of 200 meters was chosen along the beach and that across the beach was 30 meters.

FIG. 2·4 SAND SAMPLE COLLECTION AT NEWARA COAST, RATNAGIRI DIST., MAHARASHTRA



2.4a SAMPLE COLLECTION : To have a better representation of the material, the samples at the grid interval chosen were collected using auger. The depth chosen for the sample collection was either upto water table in the high-tide zone or to a depth of 2 feet away from the shore towards land. The collected samples were reduced to 2 kg. by coning and quartering. Rock samples for petrological studies were also collected from different regions adjcent to the Newara and adjoing beaches.

2.5 LABORATORY STUDIES : The procedures adopted for the sample preparation for laboratory investigations are elaborated here. The methods include determination of bulk densities, mechanical analysis of sediments by sieving, liquid separation of heavies, magnetic separation, preparation of grain mounts, preparation of polished mounts of heavy minerals and their study under polarised and reflection microscope.

2.5a Bulk Density : For bulk density measurements, the sand samples collected in the field were dried to avoid excess moisture. A representative fraction of the dried sample of raw sand was taken after coning and quartering. Then it was tightly packed in a hallow cylinder of known volume. It was weighed and the bulk density of the sample was calculated by dividing this weight by known volume of the cylinder. After determining the bulk densities of the 140 samples of the Newara beach (Table No 4.1) heavy mineral concentration map was prepared (Fig.4.1) and the relavent discussion on this aspect is dealt with in the chapter IV.

2.5b **Preparation of Samples** : The sand samples were thoroughly mixed and were reduced to 60 gms by coning and quartering. These were carefully washed so as to remove the organic materials and possible soluble salts. Decalcination of the samples were achieved by adding 10 percent HCl. This concentration of acid was chosen to avoid loss of the material. The secondary coatings were removed by treating the samples with 25 percent oxalic acid. The samples were rinsed using acetic acid. The samples after acid treatment were washed thoroughly with distilled water, dried and used for mechanical analysis.

2.5c **Mechanical Analysis by Sieving** : 40 gms each of processed samples were used for mechanical analysis by sieving with BSS sieves. During the grain-size analysis, each sample was sieved for constant time on ro-tap sieve shaker. After the required sieving, the material gathered on each sieve was separately weighed. Due precaution was taken while removing all the grains from each sieve. After weighing, the sieving loss, if any, was found and redistributed propoprtionally. The grain-size data is tabulated (Table No.4.2) and the results are discussed in the chapter IV.

2.5d **Liquid Separation** : To know the heavy mineral concentration in the samples and also their abundance in respective mesh size, heavy liquid separation method was used. During this work, each representative samples (20 gms) was taken in a separating funnel containing 100 c.c. of bromoform (sp.gr. 2.89). The constant time of 30 minutes for stirring and shaking was made for each samples. The settled heavies were then recovered into a filter funnel and later bromoform was recovered for reuse. Filter paper containing heavies of each samples were thoroughly washed with acetone. The heavy mineral samples were later subjected to the modal analysis and the magnetic separation.

2.5e Magnetic Separation : The heavy mineral samples were subjected to electromagnetic separation for the relative determination of magnetite and ilmenite. For this purpose, Frantz Isodynamic separator was used with a setting of the instrument at 1.5 amp. range current with a side slope of 20° and tilt of 3°, for the effective separation of ilmenite from magnetite.

2.5f Mineral Grain Mounting and Ore Microscopic Studies : For the quantitative and qualitative examination of various minerals in the representative samples, grain mounts were thus prepared, to carry out modal analysis of raw sand as well as heavy mineral fractions. The modal analysis of raw sand was carried out by counting 1000 grains, which was later converted to population percentage (Table No 4.5a to 4.5d) Similarly modal analysis of heavy mineral fraction was carried out by counting 500 grains. The data is tabulated (Table No 4.6a to 4.6d) and relavant discussion is dealt with in the chapter IV.

Polished sections of the heavy minerals from different regions of the Newara beach were prepared using various polishing materials such as Carborundum and Tinoxide. Thereafter, liquid alumina was also used to glaze the polished section for good reflection under the ore microscope.

Apart from preparing polished sections of heavy minerals, micro-sections of basalts and laterites were also prepared for the petrological studies. This was felt necessary to have an understanding of the provinance, from which the heavy minerals could have been derived.