A GEOMORPHIC STUDY OF THE INCIDENCE OF MUD ALONG THE COASTAL STRETCH BETWEEN KELSHI AND ANJARLE, MAHARASHTRA

ABSTRACT

INDIA has an extensive coastline of about 7500 km and the physical regime of the Indian shoreline is characterized by various forms like headlands, promontories, rocky shores, sand spits, barrier beaches, open beaches, embayments, estuaries, inlets, bays, marshy lands and offshore islands.

Konkan extends from Damanganga River in the north to the Terekhol River in the south. The wide coastal belt is not uniform and varies between 40 and 50 km along the region.

All along the region the shoreline is broken by frequent headlands and promontories, which are the sites of steep sea cliffs, sandy pocket beaches, drowned river valleys, small tidal inlets and major river creeks. There is almost a regular sequence of headlands and tidal inlets. Narrow, flat and low shoreline terraces are covered with thin coastal alluviums which border the tidal inlets. These land facets have contributed immensely to distinctiveness of the Konkan coast.

Mud along Konkan

The occurrence of mud was not very common along the Konkan coast of Maharashtra until recently. Many beaches such as Navapur (19° 46'N), Revas (18°49'N), Revdanda (18°32'N), Shrivardhan (18°03'N), and Kelshi (17°56'N), have however started showing signs of mud deposition since last decade or so. It is
not easy to trace the source of this mud. Many sources such as river flow, dredging in the near shore areas, reclamation of bays and scouring of continental shelf are normally suggested. The very existence of mud on intertidal beaches and in tidal inlets suggests a local fluctuation of sea level, variation in climatic conditions and decrease in tidal component.

The mud on Konkan coast has started appearing in different coastal settings. Moreover the mud areas are not fixed and rigid. The mud appears to move on the beaches seasonally. At many places the mud is overlain by sand in fair weather and is scoured and resuspended in stormy monsoon seasons. It is found to have settled at different depths alternating with sand and shingles. The mud on beaches dries in post monsoon, desiccations cracks are developed. Mud chunks are produced and these mud chunks eventually are transformed into mud balls by rolling action. The armouring of mud balls by shells and shingles is however not very common and can be seen at a few places like Nagaon (18°31’), Revdanda (18°32’) and Kelshi (17°56’).

The climate of the area shows a regular variation on account of the alternating southwest and northeast monsoon. The weather on the coast is therefore more seasonal in nature. December to March is a relatively cool season with northeast winds. The weather is dry with little cloud cover. April and May are hot months. In this period the winds are light and variable with sea breezes on the coast. June to September is the season of southwest monsoon. Winds on the sea, in this period, are southwesterly and westerly. The winds on the coast, however, are mainly westerly. It is a season of general rains. October and November are marked by light winds. Occasional tropical cyclones may occur on the Arabian Sea in this period. The period from the end of southwest monsoon to its re commencement is usually identified as a fair weather season.

Variation in sea waves and tidal waves, their intensity and frequency, their approach, height and persistence, are the main factors that influence the processes along the Konkan coast. There is a remarkable north-south and seasonal variation in these attributes all along the coast. The variations are site specific within the major regions.
Sediments along most beaches are well sorted and major differences in the grain size reflect difference in the wave energy level. Swash aligned beaches on this coast are found along indented and irregular stretches. In some cases they are transformed to drift aligned beaches in monsoon. The ridge and the runnel and the rhythmic forms such as cusps, ripple marks, mega ripples, crescentic bars, berms and dunes are essential morphological features seen on konkan beaches. What is remarkable is the variation in size, shape and location of these features on Konkan beaches.

Coastal stretch between Kelshi and Anjarle

The study area is located between 17°57’ North and 17°50’ North Latitude and 73°3’ East and 73°6’ East Longitude. It forms the northern part of the Ratnagiri coast of Maharashtra, and is situated in Dapoli taluka. The total stretch is 12.5 km in length and is bound between, the Bharja River to the north, and the Jog River to the south.

The stretch of the coastline is characterised by four major beaches namely; Kelshi, Adhe, Padle, and Anjarle, from north to the south. The beach at Kelshi which also is the longest of the beaches under study lies between the Bharja River in the north and river line to the south. A headland which rises to a maximum height of 502 feet (167 m) separates the Kelshi beach from the line River. This extensive headland is fronted by rocky shore platform. In fact every headland in the study area has wide shore platform at its foot.

The stretch between the line River and the Jog river shows three beaches which are separated by smaller headlands. These headlands show marks of a higher sea level in the form of ancient cliffs facing the sea. All the beaches except the one at Padle are backed by casurina plantations.

The beach at Padle is peculiar as it is the only beach which is bound by headlands on its either sides. This is also the beach which has a fossil sedimentary feature locally known as ‘karel’ located about 100 m inland. It is a typical 1 km long pocket beach in the study area.
The climatic data available for Harnai weather sub-station which lies around 3 km south of Anjarle, shows that for the last decade and a half, the mean maximum temperature for any particular month has not been above \(33.9^\circ\)C while the mean minimum temperature for any particular month has never been below \(20^\circ\)C. The highest maximum temperature recorded for a day since 1990 is \(36.4^\circ\)C while the lowest minimum temperature recorded for a day has been \(15.8^\circ\)C. As the area receives rainfall from the South-West Monsoon winds, the months of mean maximum rainfall are July and August while the day of heaviest rainfall shuffles between the three months of June, July and August.

It can be seen that June to October is a rainy period in the study area. January, February, March and July, August, September, are the months of slightly low maximum temperatures. Lowest temperatures are recorded in January only.

There has been a marked decrease in precipitation especially for the month of July. A slight rise in November maximum temperatures since 1990 can also be noticed.

The Konkan coast is not known to have the occurrence of mud, certainly not so when compared with the mud occurrence along the Eastern coast of India. The work incorporated in this thesis is an attempt to study the occurrences and evidences of mud along the stretch of the study area. The occurrence of mud along this coast is a recent phenomenon and indicates changing marine environment at a local level or even at a larger scale. The work is notably important because of the fact that mud whenever and wherever it occurs has always been reported to be near river mouths and deltas. In this case however it is found deposited on the Padle beach which is bound by headlands on either side with a small fluvial fresh water discharge from the nearby hills and that too during the monsoon season only. Initially believed to be an annual incidence, it was later observed and proved to be a seasonal one.

The varying mud occurrence, at varying times, its failure to occur in some recent years, its occurrence on a specific beach, are all too important
observations to go unnoticed. The quantity of the mud is not sizeble enough throughout the year to be noticed by a layman, but its incidence itself is of paramount geomorphic importance.

The total length of the shoreline stretch is about 12.5 km, which excludes the trips made into the creeks of Bharja, Iline and Jog upto their tidal limits. Including this the total coastal stretch measures 9.4 km in length.

The total coastal stretch of the study area was divided into three major parts for analysis and comparison. Each section consists of a creek and the adjoining beach. The three sectional areas thus identified were:

1. The Bharja river creek and the Kelshi beach.
2. The Iline river creek and the Adhe – Padle beaches.
3. The Anjarle beach and the Jog river creek.

The sediment samples collected from beaches were analysed to obtain sediment properties such as mean size and proportions of coarse, medium and fine sediment constituents in these samples. Central Tendencies like Mean, Mode and Median and parameters of the grain size distribution such as Skewness and Kurtosis were also obtained using software ‘Gradistat’.

The Naval Hydrographic charts of the creeks Kelshi, Utambar and Anjarle were procured from Harbour and port division office of Maharashtra Maritime Board at Khar, Mumbai. The hydrographic charts of the three creeks in the study area were digitized for DTM of the creeks.

Infrared spectroscopy of select samples from different season was carried out to identify the ratio of Clay mineral constituents and other characteristic indicators in the samples.

To evaluate the morphological properties several mud balls were studied. A one square meter grid was fixed at selected sites from the main mud patch to the channel. The total count of the number of mud balls in each of this grid was taken. Besides, the general shape of the mud ball was also noted. The nature of armouring, the material constituting the armouring was also noted. The possible change in the size and the shape of the mud chunks from the site of origin to the then present place was noted. A through geometric analysis of
representative mud balls/mud chunks in each of these grids was undertaken in which all the 3-dimensions were physically measured and were tabulated. The distances between each of these grids were measured and marked. The orientation of the long axis with reference to the beach, the tide, the wave approach and the fluvial channel was noted.

The occurrence of mud is being reported by local people in the area since 1992. The mud, however, is not reported everywhere and all places along the coast in the study area. The occurrence is sporadic and even inconspicuous at a few places.

The incidence of mud in the area was first observed and recorded by this researcher at Padle in October 1992. It was subsequently recorded in August 2004 and September 2006. Mud was invariably reported every monsoon by locals.

The incidence of mud reported by local people and observed by this researcher is considered for this thesis. However this thesis is mainly an account of mud incidence at Padle as it is a more conspicuous and consistent occurrence on this coast.

Most of the mud balls were found deposited near the southern end of the beach. Across the tidal channel there was hardly any trace of mud. All the mud deposits were on the channel beds or the channel banks.

Armouring of mud balls was not observed in October 1992. The beach was reported to be covered by 30 to 50cm thick sand cover in the post monsoon of 1992.

The occurrence of mud on the beaches in study area is a part of an ephemeral cycle. A distinct erosion, accretion cycle on the beaches supplemented with slight rise in sea level or scouring of shelf may be responsible for recent appearance of mud on the Konkan beaches.

The work has been presented in six chapters in addition to the introduction. Study area and method of research employed is discussed at length in chapter 1. Chapters 2, 3 and 4 discuss the respective beach stretches along with the adjoining creek. Chapter 5 discusses the incidence of mud in the
study area. Major observations and trends are listed and discussed in the last chapter.

This work is based on the observations, measurements and analysis of mud incidence in the study area from October 1990 to March 2009. The results and the conclusions are meaningful and suggest annual pattern in its occurrence. However, a more intensive study in future will be highly profitable and one can surely recognise the tendencies of mud deposition, scouring and mud ball formation on Konkan coast more precisely.