Littoral Currents in Relation to the Mud Bank Formations Along the Coast of Kerala

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The mud bank formations in the inshore waters of the Kerala coast influence the shoreline changes along this coast considerably. Studies have shown that converging littoral currents play an important role in the formation of the mud bank south of Alleppey. More laboratory studies and field observations are necessary to arrive at a final explanation to the complex phenomena of mud bank formation.

Introduction

The mud banks of the Kerala coast are well known but poorly understood. These regions of highly turbid water with heavy load of suspended mud in the inshore waters of the Kerala coast are of special interest to the coastal oceanographer because they act as natural barriers and protect the beach from wave action; and to the marine biologist as they are very good fishing grounds.

The mechanism of formation, maintenance, movement and dissipation of the mud bank is not clearly known. Various theories have been put forward to explain their formation. Rhode's hypothesis (Reported by Bristow, 1938) is the earliest in which the formation of mud bank is attributed to a subterranean channel flow of mud from the backwaters to the sea, this flow being maintained by the hydrostatic pressure-head developed in the backwaters due to their higher water level during monsoon. Ramasastry and Mylne (1959) sought an explanation for mud bank formation in the phenomena of upwelling in the coastal waters of Kerala. Du Cane et al. (1938) were the first to point out the role of waves in churning up the bottom mud and bringing it into suspension. Kurup (1969) critically reviewed the existing knowledge on the physical aspects of mud banks and showed how meagre was our knowledge of the dynamics of the mud banks. Kurup observed that Du Cane's suggestion that the premonsoon swells churn up and bring into suspension the fine mud of the bottom at shallower depths was sufficient to explain a phase of the problem and that the
lowering of salinity of the inshore waters during monsoon and the associated deflocculation of suspended silt could explain another phase of the problem viz. the continued existence of the mud banks throughout the monsoon season. But the fine bottom mud and pre-monsoon swells exist all along this coastline and the lowering of salinity during monsoon due to fresh water influx is also a general feature of the inshore waters at this coast. The fact that mud banks occur only at definite localities could not be explained by means of these theories.

**Littoral Currents and Rip Flows**

More recent studies reported by Varma and Kurup (1969) explained the localized formation of the calm zones. They found from wave refraction studies and field observations that Niricunnam where a mud bank was reported to appear during the past few years, formed a zone of converging littoral currents for higher period waves. Hence for these waves, one can expect formation of rip flows at Niricunnam. These rip flows carry finer sediments offshore and prevent onshore transport of sediments by waves (Fig. 1). Thus localization of suspended sediments takes place at the rip head. The

[Diagrams and maps are shown, illustrating the transport of mud in suspension by rip flow and wave action.]

![Diagram 1: Transport of mud in suspension by rip flow and wave action.](image)

![Diagram 2: Bathymetry of mud bank regions.](image)
High concentration of mud in suspension leads to viscous damping of waves which accounts for the calmness of the mud bank regions.

The low salinity waters from near the shore when carried offshore by the rip flows dilute the offshore waters and the deflocculation of sediments delays their settlement. The increase in salinity during the postmonsoon seasons leads to flocculation and settlement of mud and the disappearance of the calm zones. The mud when settled shoals the bottom—the bottom contours in the mud bank regions broaden out towards offshore (Fig. 2).

All mud banks do not appear simultaneously. Some are of premonsoon origin, some appear during active monsoon. The life span of the mud banks also varies. Some of them last for two to three months whereas others disappear after two or three weeks.

**Movement of Mud Banks**

The mud banks exhibit some movements alongshore, the year to year shift being more conspicuous than the movement within the year. Fig. 3 shows the location of the Narakkal mud bank during different years between 1871 and 1970. (Years during which reliable reports regarding the position of the mud bank are not available have been left out. The lines represent the alongshore stretch and location of the calm zone; the offshore distances of these lines from the coast do not represent anything.) According to the available records, the Narakkal mud bank has moved southward at an average rate of 7 miles in 100 years with a partial return to the north in between. The average rate of movement of the Purakkad mud bank is about 15 miles in 100 years. The movement of the Purakkad mud bank is restricted to a range of 15 miles of coastline from about two miles north of Alleppey to Purakkad.
Coastal currents are considered to be responsible for the southward drift of the mud banks. Along the southwest coast of India, the coastal currents are directed southward from March through October and are northerly during the remaining period. Coastal currents acting over long periods can provide the necessary force to move the mud banks to the south. But this suggestion gives no explanation for the partial northward return of the mud banks.

According to the theory put forward by Varma and Kurup, the formation of the mud bank is the result of the interaction between the onshore and offshore transports of sediments in suspension, the former by waves and the latter by rip flows. This would mean that the location of a mud bank is decided by the location of converging littoral currents strong enough to cause an offshore sediment transport. Thus the shift in location of the mud bank can be considered to be caused by a shift in the location of the zone of convergence of littoral currents. The latter being determined by the wave refraction pattern, it can be deduced that the shifts of the mud bank, both year to year and within the year, are the results of the changes in the bottom topography of the mud bank regions (caused by the deposition of mud on the dissipation of the mud bank) and of the changes in the composition of the wave spectrum.

The validity of this suggestion can be tested only if we have accurate bathymetry of the mud bank regions through years. Precise depth sounding in the mud bank regions is difficult as the lead line sinks to more than 3 feet in the soft bottom mud. Acoustic soundings may be helpful if the actual velocities of the sound pulses in liquid mud of different concentrations could be determined correctly and if the bottom is defined in terms of the concentration of mud in the mud-water mixture as the boundary of the mud surface is not clearly demarked in these regions. This would require knowledge of the physical properties of mud suspension in water. An attempt to study the frictional resistance on a model boat under different concentrations of mud suspensions in water was made by Srivastava and Kurup (1971) and it was found that the static friction exerted by the suspension showed a marked increase at about 16% concentration v/v. This or similar other properties of the mud suspensions may be made use of to define the bottom in regions like the mud banks where the sediments are highly agitated so that the bottom is not clearly demarked.

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