Topography and surface sediment distribution around Amee shoal Mormugao

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The general topography and sediment distribution in the Amee shoal has been studied where the ship wreck was recently discovered in the water of 3 m. The area consists of rocky shoals and reef extending in a north-south direction across the entrance of the bay, separates the bay from the Arabian Sea. The rocks are exposed in the bay all along the northern side except near the Dona-Paula point. There is a patch of coarse sediment extending from the north-western end of the bay in a NW-SE direction into the bay which indicates the incoming and outgoing of currents and prevent finer sediments from accumulating and sitting up in the bay. The coarser material mainly consists of sand which is moderately sorted and is confined to the bay margin of high energy area. The fine sediment poorly sorted and consisting predominately of silts and clays is present in the central bay of low energy area. The bathymetric contours indicate that the area has a gradual slope towards the west. The area to the northern and eastern sides of Amee shoal consist of shelly-sand and rock outcrops. The lowlying rocky sub-bottom appears to be the main cause for the ship-wrecks. However, due to absence of fine sediments such as silt and clay in the area, the ship is expected to suffer least from corrosion and biofouling.

INTRODUCTION

It is well known that ancient civilizations had their origin mainly around the river banks, channels and other places of water resources. The mode of international trade was mainly through the sea. Majority of the shipwrecks occur in shallow waters. The marine records show that more than 75% of the shipwrecks were in shallow waters. One of the main reasons for the shipwreck in the shallow water was inadequate knowledge about sea bottom topography.

Marine archaeological objects are at times preserved naturally when they remain submerged in the sea. The pre-

Fig. 1 Sample location and topographic contours of the Mormugao Bay (after Rao & Rao, 1974).
The preservation of archaeological objects depends upon the type of sediments (Rao, 1987). The geomorphic features that favour a high degree of preservation include the sites covered by the sediments in low energy environment. Water depth, waves, currents, tides, sea bottom topography, sediment suspension and movements and sediment texture are important factors at the site location (Nayak, 1987). In the present case, the geology around the Ameec Shoal - Shipwreck, Mormugao has been studied to understand the extent and potential of the shipwreck.

GENERAL GEOLOGY

The Ameec shoal is located between Mormugao and Cabo (Fig. 1) headlands. It is bordered by Sunche reef in the north and Mormugao bay in the east. The river Zuari has its opening to the sea near the Ameec shoal in the west. The geology around Ameec shoal has been described by Rao and Rao (1974), Wagle and Rajamanickam (1980), Veerayya et al. (1981), Kidwai et al. (1981). The area consists mainly of Precambrian ferruginous quartzites covered by laterites of variable thickness.

The Zuari river mouth is about 5.5 km wide and narrows down upstream to less than 0.5 km. The water flow is regulated by tides of semi-diurnal type. The river drains mostly the metamorphic terrain of quartzites, phyllites, banded hematite quartzite, gneisses and granite gneisses. This river is the main supplier of sediments to beaches and to nearshore and offshore areas. The Mormugao bay (14 km length and 5.5 km width) extends in east-west direction. The rocky shoal and reef extending north-south separates the bay from the Arabian Sea. The area, sample locations and topographic contours are shown in Fig. 1.

RESULTS

Details about sampling and sediment texture are discussed by Rao and Rao (1974). Sand predominates in the inshore region (Fig. 2a). Along the northern and southern sides, the sand abundances are 60-90% and 70-90% respectively. It decreases towards east and west direction. The sand gradually decreases from the inshore region to the central bay. Sand and gravel contours show that in the eastern part of the Ameec Shoal the sediment is coarser.

Silt percentage contours (Fig. 2b) represent a pattern similar to those of sand and gravel. The silt content is around 10% in the north-western portion of the Mormugao bay and increases up to 40% towards the harbour area. The silt content increases from the inshore region into the central bay away from the Ameec Shoal area.

Clay (Fig. 2c) is almost negligible along the northern margin of the Mormugao bay except for a isolated patches. Clay predominates in the harbour area and along the axis of river Zuari. In the central part clay and silt abundance is about 45%.

DISCUSSION

From the textural characteristics (Rao and Rao, 1974) the bay sediments have been divided into four sedimentary environments: (i) marginal high energy area of bay with sands, (ii) bay mouth with coarse sands, (iii) eastern bay with silt and clay and (iv) central bay with fine silt and clay. The Ameec Shoal area which is close to the bay mouth consists of coarse sand environment.
The sediments along the northern and southern margin of the bay are predominantly sands which are well to moderately sorted. A patch of coarse material extends into the bay from its mouth in a NW-SE direction. The Ameo Shoal area is therefore of high energy zone suggesting predominance of sand deposition. Sandy patch indicates strong current in NW-SE direction, winnows the fine sediments such as silt and clay and carries it away from the Ameo Shoal leaving the coarse sediments. The transport and mixing of the sediments is brought about by wave action. Fine sediments accumulate in the central bay due to littoral currents from northern and southern sides and maximum wave heights near Dona Paula and Cabo Raj region (Reddy, 1970). These currents might have been weakened by the shoal and reef present at bay mouth.

In the eastern bay sediments are mainly clay associated with fine silt and are poorly sorted. This is affected by the sediment brought by river Zuari that enters into the eastern bay through a narrow constricted at Agacium and Cortalim. The deposition of fine sediment gradually decreases towards the central bay as the river Zuari meets the salt water of higher salinity, which flocculate the silt and clay.

The Ameo Shoal area thus shows predominance of coarse sand. Comparatively, the porosity of sand is more than silt and clay. Therefore any archaeological objects (such as ship, etc.) buried in the sand will have more exposure to the sea water thereby increasing the chances of corrosion and heavy encrustation.

CONCLUSIONS

1. The sediment around the Ameo Shoal-shipwreck area consists mainly of coarse sands.

2. The preservation potential of any archaeological objects in coarse sand is poor as compared to silt and clay.

3. The chances of heavy encrustations, corrosion and contamination with chlorides are more in the Ameo Shoal area.

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