

Was the Large Rectangular Structure at Lothal (Harappan Settlement) a 'Dockyard' or an 'Irrigation Tank'?

NIGAM R

National Institute of Oceanography, Goa, India.

A large rectangular structure was revealed during the excavation at Lothal (located at the head of the Gulf of Cambay) while locating Harappan settlement within the present day borders of India. The purpose of this structure was variously interpreted by archaeologists as a "Dockyard" or an "Irrigation Tank". The study of the sediments contained in this structure revealed the presence of well preserved assemblage of marine organisms, e.g. *foraminifera*, and also abundant gypsum crystals. In view of the presence of these well known indicators of marginal marine environment, it is suggested that the rectangular structure was indeed a dockyard connected to the open marine environment with high tidal range. This connection was probably cut off due to shoaling of the Gulf of Cambay as a result of the Holocene sea level rise.

Foraminifera play significant role in geological, oceanographic and palaeoceanographic studies. Their distribution pattern provides a better understanding of sea level fluctuations, sub-marine topographic irregularities, migration of shorelines, shifting of substrate, water currents, sea-floor spreading and a host of other aspects. The objective of the present paper is to explain that foraminifera can be used to complement the information in the field of archaeology.

Lothal was discovered as a result of a systematic survey of Gujarat undertaken by S.R. Rao in the year 1954 as a part of the programme for locating Harappan settlements within the present day borders of India.

Lothal is located at the head of the Gulf of Cambay, a macrotidal bay. The Saragwala, the village which shelters Lothal (mound of dead), is included in Ahmedabad district being nearly 80 km due south of the city.

Three large structures like (i) Acropolis (ii) Wharf and (iii) Dock or Tank, encountered through excavation at Lothal have been discussed in detail by number of archaeologists (Rao, 1979 and 1985; Sankalia, 1974). Out of these, the Dock or Tank remains are the most important and disputed structure.

This structure is a trapezoidal or sub-rectangular basin on the eastern flank of the ancient city of Lothal. The basin measuring 214×36 m was excavated and closed by masonry wall of burnt bricks. The length of embankment is 212.4 m on the west, 209.3 m on the east 34.7 m of the south and 36.4 m on the north. The foundation is 1.78 m wide with two offsets on the exterior, but the width of the wall above the ground is reduced to 1.04 m.

To interpret the purpose of this structure, two different opinions have been advanced. The first school is known as 'Dockyard theory' (Rao, 1979 and 1985; Wheeler, 1973:viii). According to them, this rectangular structure was an inland dock, built away from the stream of the river and the sea to avoid frequent silting. Comparison of the dimensions of the docks at Bombay and Visakhapatnam with the one at Lothal by V. B. Lele has been cited by Rao to show that the Lothal dock was not small and its depth was sufficient for use by sail-using ship. The other school (Shah, 1960:310-20; Leshnik, 1968:911-22; Fairservis, 1971) is known as

'Tank theory' and they proposed that the basin was used as tank for storing drinking water, and probably for irrigation from which water was lifted up with the help of a *shaduf*.

Foraminifera are almost exclusive marine organism (Boltovskoy and Wright, 1976) having widespread geographic (horizontal) and bathymetric (vertical) distribution in the oceans including marginal marine bodies like estuaries, lagoons, bays etc. Their presence or absence could be a decisive factor in interpreting whether any ancient water body was filled with fresh or marine (including brackish) water. With this intention, author has undertaken a study of sediments deposited in this rectangular body.

Fig. 1 shows the location of the Lothal town and Plate 17 shows the rectangular structure under discussion. The site is now silt laden and part of it has been removed during excavation. When author visited this site on December 16, 1986, removal of silt to a depth of 4.5 m (from the present day surface) was going on. Four representative samples were collected from the lowest sediments.

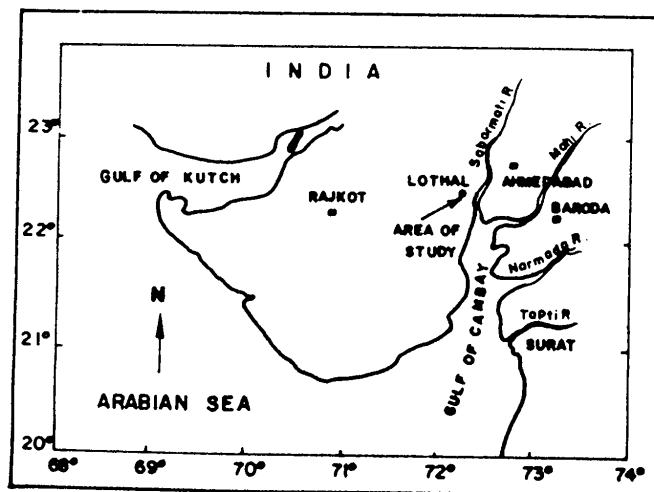


Fig. 1 Location map showing the area of study

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Samples were soaked in water for sometime and a few drops of H₂O₂ were added to it for dispersal. Then these samples were sieved over a mesh of 63 µm. Coarse material recovered was oven dried and analysed under stereoscopic microscope and all available tests of foraminifera were picked for the identification.

Study of sediment samples reveals a fairly well preserved assemblage of foraminifera. The assemblage includes the species belonging to *Asterorotalia*, *Bolivina*, *Egrella*, *Cibicides*, *Quinqueloculina*, *Globigerina*, *Lagena*, *Nonion*, *Nonionella*, *Spiroloculina*, *Uvigerina*, *Ammonia* and *Discorbis*. Specimens are well preserved and do not show any sign of wear and tear. Therefore, assemblage can be considered as *in situ*. Some specimens could not be identified and appear to be reworked. Sediment samples are also full of Gypsum crystals (Plate 18).

The occurrence of well preserved assemblage of foraminifera from the sediments inside the rectangular structure at Lothal itself indicates that it was a part of marine environment. The assemblage can be compared with the present day beach (Bhalla and Nigam, 1979:239-40), innershelf (Nigam, 1984:415-25; Nigam *et al.*, 1979:244-47; 1987:327-34) and marginal (Rao, 1974:36-50) marine environment of west coast of India. If total foraminiferal number (TFN) is considered, which is moderate at present site, it indicates marginal marine environment.

Majority of foraminiferal species in the study material are benthonic and typical to nearshore warm water environment. However, the occurrence of a few specimens of planktonic foraminifera is of considerable interest. Planktonic foraminifera thrive in open marine environment having at least moderate depth. Their rare presence on beaches (Bhalla and Nigam, 1980:147-48) has been attributed to high waves which transport these specimens along with other material (eg. reworked specimens) from the nearby offshore zone. Similarly, it may be concluded that presence of planktonic foraminifera in material from present study site indicates existence of high tidal range during Harappan times (2500-2000 BC). Even at present the tidal range in Gulf of Cambay is quite high (5-9 m). Details about possible high tides and their use in navigation by Harappans were discussed by Panikkar and Srinivasan (1971:36-50).

Among benthonic foraminiferal species, some species like *Ammonia parkinsoniana*, *Ammonia tepida*, *Lagena laevis* indicate a marginal marine (estuarine) type of environment. However, when total benthic fauna is compared with summary triangular plot (Murray, 1973) for environmental analysis, it indicates normal marine to hypersaline lagoonal conditions. Hypersaline conditions are also indicated by presence of large number of gypsum crystals which is known to occur in high evaporation

condition. In view of the foregoing it may be summarized that rectangular structure was a dockyard, connected through open marine environment with high tidal range. This connection was probably cut off due to shoaling of the Gulf of Cambay as a result of the Holocene sea level rise, which finally led to evaporation of marine water locked inside the rectangular body.

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