

Dynamic Tidal Barrier of Gulf of Kutch and its Relevance to the Submergence of the Ancient Dwarka

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Dwarka is well known for its temples. Since 2nd century BC five temples were built upto the 15th century AD. Except the last two temples the others came under the catastrophic attacks of the sea. The usual phenomena like the sealevel fluctuation, coastal erosion and tectonic activity could be the factors responsible for the submergence of Dwarka and Beyt Dwarka. Regardless of these reasons the dynamic tidal barrier of Gulf of Kutch is one of the main factors to aggravate the other processes by filtering off the sediments transported towards the Saurashtra coast.

INTRODUCTION

The onshore excavations in the forecourt of the temple of Dwarkadhish at Dwarka during 1979-80 have provided the evidences of second millenium BC settlements to the archaeologists (Rao, 1983 a:25; 1987:22) on one hand and on the other raised question for the oceanographers to find out the causes for the submergence. The possible answer to this phenomena could be found generally in the changes due to sealevel fluctuation, coastal erosion and the changes due to the tectonic movements. Here an attempt has been made to view this problem in the light of the dynamic tidal barrier hypothesis of the Gulf of Kutch (Nair et al., 1982:77)

Dwarka, the city of temples and port on the north western coast of the Gujarat State was main gateway of India more than 2000 years, (Rao, 1983 b:51). Since then there is a war between man and nature for this part of land. Every time man constructs the temple, the sea destroys it. In this process upto 15th century AD five temples were built at different times right from the 2nd century BC (Rao, 1983 b:51). Now the question arises as to why so much persistence from man about the place of the temple. Partly the answer to this question may be attached to the sentiments of the people. Being the gateway of India in the past several voyages must have started from this place and before the start of the voyage everyone wishes to propitiate the gods. The temple of Samudranarayana could be the proof for the same.

To understand the relevance of the dynamic tidal barrier of Gulf of Kutch to the submergence of the ancient Dwarka, some general information about the Gulf of Kutch and the adjoining continental shelf is dealt in the following paragraphs.

THE GULF OF KUTCH

The Gulf of Kutch is an east-west oriented indentation north of the Saurashtra peninsula, having an area of about 7300 square km. Depth ranges from a maximum of about 60 m at the mouth to less than 20 m at the head of the Gulf. The climate is semi-arid and the maximum rainfall is of the order of 500 mm/year. It has therefore little run-off from the land and no major river flows into it.

The gulf has an average tidal range of 4 m. It varies from 3.06 m at Okha near the mouth to 5.89 m at the head, and has a spring tide range of 6.2 m at its head.

TOPOGRAPHY AND SEDIMENTS

The topography is very irregular at the mouth and the central part of the gulf and consists of pinnacles and scarps ranging in height from 6 to 32 m. Towards the head the relief is subdued due to the covering by fine grained sediments. A large area of the floor of the mouth of the gulf, at depths greater than 20 m, is covered with algal limestones, aragonite cemented sandstones and dead corals having the radio-carbon dates in the range of 4290-13460 BP.

Silt size materials are found at the mouth, fine silt and medium silt occur at the southern side of the gulf at its head (Hashimi et al. 1977:9; 1981:1). Sediment sources are likely to be due to wave erosion of the rocks bordering the shores of the gulf and those derived from the Indus river.

CONTINENTAL SHELF AREA

Located about 100 km northwest of the gulf is the mouth of the river Indus, one of the major rivers of the world. The Indus is an ancient river, some 35 million years old, and has its source in the high ranges of the Himalayas. It is 3200 km in length, discharges over 200 cubic km of water with 450 million tonnes of suspended load annually prior to the construction of dams and barrages on the Indus River System. This enormous sediment load makes the river Indus the third largest of its kind in the world. It has created the Indus cone, a 2500 m thick pile of unconsolidated sediment on the floor of the Arabian sea 1500 to 2000 km away from the mouth of the river. The discharge of sediment and the water is greatest during the southwest monsoon season which lasts from June to September.

The sediment supply coming through the Indus river will be having fine and coarse sediments. The fine material such as clay minerals travel in suspension whereas the coarse material such as quartz grains, mica flakes etc. travel as bed-load close to or on the seabed by sliding, rolling and siltation processes. The discharge from the river, which will be at its peak during the monsoon, will be relatively fresh and less saline than the sea water. Hence, this river water will be less dense and floats on top of the sea water. This sediment laden plume moves away from the river mouth, and the heaviest particles settle first close to it. The flow

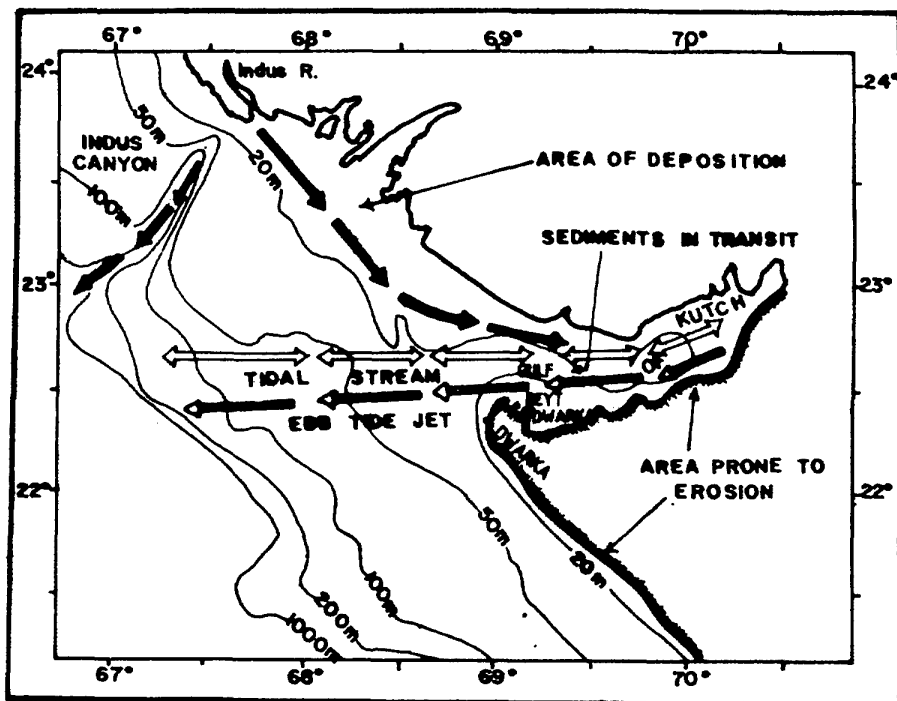


Fig. 1 The dynamic tidal barrier due to which the southern part of Gulf of Kutch including Dwarka and Beyt Dwarka are more prone to erosion.

carries the suspended particles further and further away, until the plume reaches the region of the Gulf of Kutch. As the gulf is surrounded by semi-arid lands, there is no significant flow of fresh water into the gulf, so its water has a normal salinity and density for the sea water.

EFFECTS OF THE TIDAL BARRIER

The tidal currents carry these waters in and out of the gulf, and on the continental shelf the fresh water plume flows over the tide stream, carrying with it the suspended load across the mouth of the Gulf.

Any coarse material that reaches the region off the gulf will encounter the fast tidal currents. The ebb tide is generally but not always stronger and the sediment will be deflected offshore to rest on the continental slope. The upshot of all these processes is that the continental shelf south of the mouth of the gulf is starved of sediment, more so for sand-sized material than the finer material.

Under this condition the sediments supplied by Indus will not reach south of the gulf and leave that place deprived of the bulk of the sediment, as is shown by echogram records (Nair et al. 1982:77).

This starvation of the sediments make the coast line more prone to the erosion (Fig. 1) as the protective fringe of sand in the form of beaches that absorbs the impacts of the waves is either totally absent or too narrow. In the absence of this shock absorbers, the full force of the wave on the coastal material resulting in their erosion and the consequent retreat of the coast line. This phenomena of severe erosion was also detected by

Pathak et al. (in this volume) and they have calculated the rate to be as much as 4 m per year in this area.

Regardless of the extent of sea-level fluctuation which is considered to have been of the order of 3 m over the past 5000 years, the lack of sediment supply remains a constant factor and the structures become a victim of erosion.

With this it can be summarised that the erosion must have been one of the most important reasons of the destruction of the settlements of Dwarka and Beyt Dwarka which must have been aggravated by the presence of dynamic tidal barrier. On a larger scale it can further be concluded that the area south of gulf i.e. the northern and western coastal parts of Saurashtra peninsula (Fig. 1) are more prone to erosion and that any structure built there will always be threatened by the sea.

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