

22. Underwater Archaeological Exploration of Dwarka and Somnath - Results of 1992 Survey and Problems to Attend

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Abstract

It has been well established by Marine Archaeological explorations since 1983 that a port city which existed near Dwarka now lies submerged under a water depth of 10m or so. The clues to the timing of the event come from many sources. The TL dating of pottery fixes the age at 3500 BP; the comparative study of the pottery, anchors, seal and inscriptions also corroborates the TL date. It is expected that further scientific and systematic marine archaeological investigations will resolve the problem of submergence. The exploration off Dwarka in 1992 had as its objective the delimiting of the area where structures of interest to archaeologists were found by diving archaeologists, to obtain the positions which can be easily repeated when necessary and to document the new finds with underwater drawing and photographs. For the purpose, during the first half of January, 1992, about 90 hrs of diving through 117 dives by archaeologists, photographers and professional divers were carried out. The deployment of underwater scooter (Aquazepp), besides usual diving gears i.e., SDDE and SCUBA, helped to optimize the search pattern. Nikonos V underwater camera was deployed for photography. The investigation was supported by optical position fixing system. An area of approximately 750 x 350 m was explored during the period. The important features noticed during the exploration were six Bastions and remains of walls measuring upto 3 m. in length and 1 m. in breadth at seven locations. Apart from these, the presence of eight stone anchors and an iron anchor have also been observed. A few truncated spheroid single holed stones and an anchor were found. Various multi-faceted challenging problems are thrown up by the findings of the explorations. The architecture and construction technology as well as the purpose of the buildings - jetty or defence are under study. Similarly, continuation of such systematic survey in the adjoining area, after compilation of the already available data, will no doubt be useful in determining the limits of the erstwhile port city.

INTRODUCTION

Marine Archaeology is a multidisciplinary science, however for exploration purpose the prime requirement is underwater search by divers. In India, Marine Archaeology Unit was established in 1981 and underwater investigations were initiated in 1983. Gradually archaeologists were trained in different methods of diving upto 1991. Nine successive expeditions at Dwarka have established that a flourishing port city existed at Dwarka in the past and a major part of it was submerged. As a part of continuing search in pursuit of demarcating the limits of the sunken port Dvaraka, one more expedition was planned in January, 1992. The main objectives of the underwater exploration were to demarcate the extension of the city, document the structures of Dvaraka and to carry out preliminary exploration in Somnath waters. A warehouse type of structure of 15th century BC and antiquities were found during the land excavations (Rao 1991) at

Prabhas, near Somnath a port believed to be contemporary of Dvaraka. The warehouse can be compared with the west Asian (Tepe Yahya) ware house, (Ghosh 1989). Therefore, underwater explorations were carried out in Somnath waters also with a view to find out structural remains if any lying on the sea bed. The present paper discusses the findings of the January, 1992 survey and makes the assessment of the progress done so far and the new problems which need attention.

LOCATION AND HISTORICITY OF DWARKA

Dwarka (20° 22' N and 69° 05' E) is located extreme north of the Saurashtra peninsula on the Arabian sea. It is believed that in ancient times it was a flourishing port, considered to be the gateway to the mainland. Various theories have been propounded about the location of Dvaraka of Mahabharata period by different scholars (Rao S.R. 1987;1988). The present site (fig.1) is the one selected

as original Dvaraka on various criteria. The land excavation nearby revealed in 1979 structural remains and pottery of 1500 B.C. at 30 to 40 feet depth (Rao 1979-80).

BRIEF REVIEW OF PREVIOUS WORK

The Marine Archaeological explorations in Dwarka and Bet Dwarka waters since 1983 have brought to light the remains of the submerged protohistoric city including bastions, walls, pillars, moonstones and portable antiquities such as a Late Indus type seal, inscribed jar with evolved Harappan script (Rao 1988). The protection walls with bastions might have served as a safeguard to the city. Anchorages can be inferred from the availability of large number of perforated triangular and prismatic stone anchors in Dwarka waters. The triangular anchors were used in Syria and Cyprus in the 15th and 14th century B. C. This date of the settlement of the protohistoric township is also corroborated by the late Harappan seal, inscription and pottery collected from the area (Rao 1987). The city was built by reclaiming land from the sea and boulder foundation was provided in lowlying areas. On these foundations fortification walls, pier and public buildings are found to have been built out of massive stone blocks (Rao 1990). Encouraged by the findings of underwater explorations side scan sonar and echosounding survey was initiated in 1989. The geophysical survey clearly located another submerged Gomati channel (Vora 1991).

METHODS

Diving is the main technique for underwater archaeological explorations. Basically two methods of diving were followed (i) SDDE (Surface Demand Diving Equipment) and (ii) SCUBA (Self Contained Underwater Breathing Apparatus). Maximum diving was carried out by SDDE. This system helps the diver to complete a long underwater schedule, particularly in shallow water. The SCUBA diving, however, is indispensable for marine archaeological search operations where much greater freedom of movement is desirable. This system helps in underwater drawing and photography.

SEARCH PATTERN

Circular Search Pattern : Two divers carry a rope about 50 m long. One diver sits by holding one end and the other diver takes another end and makes circular rounds with gradually increasing radius. This is generally carried out if the main boat is away from the working area and visibility is less. On the other hand, both the divers could swim keeping minimum distance between them with the help of the rope. The divers will come back to the starting point at last.

UNDERWATER SCOOTER

Underwater scooter, (Aquazapp) (Pl.I) which is a battery propelled, neutrally buoyant, cylindrical shaped was also used in Dwarka waters. This is an advanced tool for underwater archaeological explorations. A diver can ride on this and explore at desired depth without much efforts for maximum number of hours. This system helps in exploring a large area in a short time.

To know the topography of vast areas an echo sounder was used at Dwarka. This is helpful in identifying various geomorphological features such as ridges, scarps, channels etc.

DOCUMENTATION

For documenting the underwater objects two methods i.e., photography and drawing were used in Dwarka waters. Serially numbered buoys were dropped whenever any interesting object was encountered for which co-ordinates were obtained subsequently. The overgrown vegetation, (Pl.II) and sediment if any were removed by brushes and by other trenching tools.

Photography is a very effective means of documenting underwater objects. Underwater Nikonos V camera of 35 mm, with flashlight and 400 ASA negative films were used for photography. The quality of underwater photographs depends on the visibility. The visibility, in turn mainly depends on the light penetration which is good when sun rays are nearly perpendicular and turbidity of waters due to suspended sediments is nil, which depends on tide, current, wind speed, swells and such related matters. Photography was generally carried out only during noon time for best results, when visibility was good.

Another method deployed for recording the objects is underwater drawing. For this purpose, on a standard size drawing board a transparent polyester film of 75 micron is fixed with a graph sheet below it which serves as a scale. One or two divers take the dimensions of objects, for example, wall underwater, and draw the sketches of the objects.

UNDERWATER EXCAVATION

Underwater excavation is necessary to collect buried antiquities from the sea bed, if any, and to know the stratigraphy. It also helps to remove the overburden and spoils on the structures effectively. Airlift and water dredge are two major tools for this function (Nayak 1988). Powerful suction can be provided by using an airlift which consists of a 10 cm diameter pipe with a direct connection of air supply from a pressure compression through a 6" diameter pipe. A 12" long chamber is welded 9" above the

bottom of the main pipe. The main pipe has $\frac{1}{8}$ " diameter perforation within the chamber when air at about 90 CFM (Cubic feet per minute) or more is supplied through the chamber, the perforation causes split in air, forcing it to form air bubbles which moves within the main pipe upward. Also a low pressure is created at the seabed due to this and as outside pressure is more, sediments and particles are lifted up through the main pipe. This water and sediment mixture is collected on board the survey vessel and passed through a sieve to collect and scan antiquities while water is allowed to drain out to sea again.

RESULTS AND DISCUSSIONS

The exploration revealed structures such as bastions and walls as well as a few pillars and triangular and rectangular stone anchors. A ridge-like feature is observed at 8 to 9m water depth. Near the ridge area a semi-spherical single holed stone which might be the base for the flagpost is also noticed. Similar structures were noticed at buoy No. SS 12. Most of these underwater objects were documented either by photography or drawing. An area of 750 m x 250 m was surveyed off Samudranarayana Temple (SNT) the main concentration being 200 m off SNT.

The structures like bastion, (PI 1) wall (PI II) and pillar are made out of dressed blocks of different rock types. The cementing material was not seen on the wall blocks generally. In the case of a few bastions 3 to 4 courses of blocks with binding material have been noticed where structures are intact. It appears that to protect the superstructure from erosion boulders were piled up to serve as foundation of the wall (PI III). The use of boulder is a very distinct feature noticed in the case of the structures exposed in previous years (Rao 1990). At a few places it is easy to determine the direction of the wall as the structure is standing but in other places it is quite difficult to identify as the wall blocks are scattered. The blocks of bastion and wall are buried in the sediment at some places.

Dredging by PWD is being done at regular intervals to keep open the Gomati channel. A few years ago dredging was carried out dispersing a huge quantity of sediment into the nearshore zone which has covered the structures exposed in the underwater excavations of 1986-90.

During the present investigation diving was initiated very close to an earlier known site and gradually the exploration was extended towards the deeper waters and adjoining area. Some structures found are in a disturbed condition making it difficult to determine their orientation.

A significant observation of this exploration is the evidence of L shaped edges of stones for proper grip and arresting wave action on bastions (PI I).

The presence of single holed stone artifacts in the water depth of 10 m off Dwarka (PI V) and also 7 m at Somnath is another find. Similar single holed spheroid stones found at San Diego off California coast are said to have been used as mortar. The use of these stones for pounding marine foods in ancient Dvaraka should be ruled out. The use of these objects can be inferred on the analogy of similar objects in Dhola Vira as parts of stone pillars.

PROBLEMS TO ATTEND

The underwater archaeological exploration and excavation have revealed the structural remains and artifacts of metal, terracotta, stone and conch besides accessories of boats in Dwarka and Bet Dwarka waters. Simultaneously a few objects have also been collected from the shore and nearshore region of these places in the course of previous explorations. The archaeological, engineering, geological and metallurgical aspects of these artifacts are yet to be fully studied.

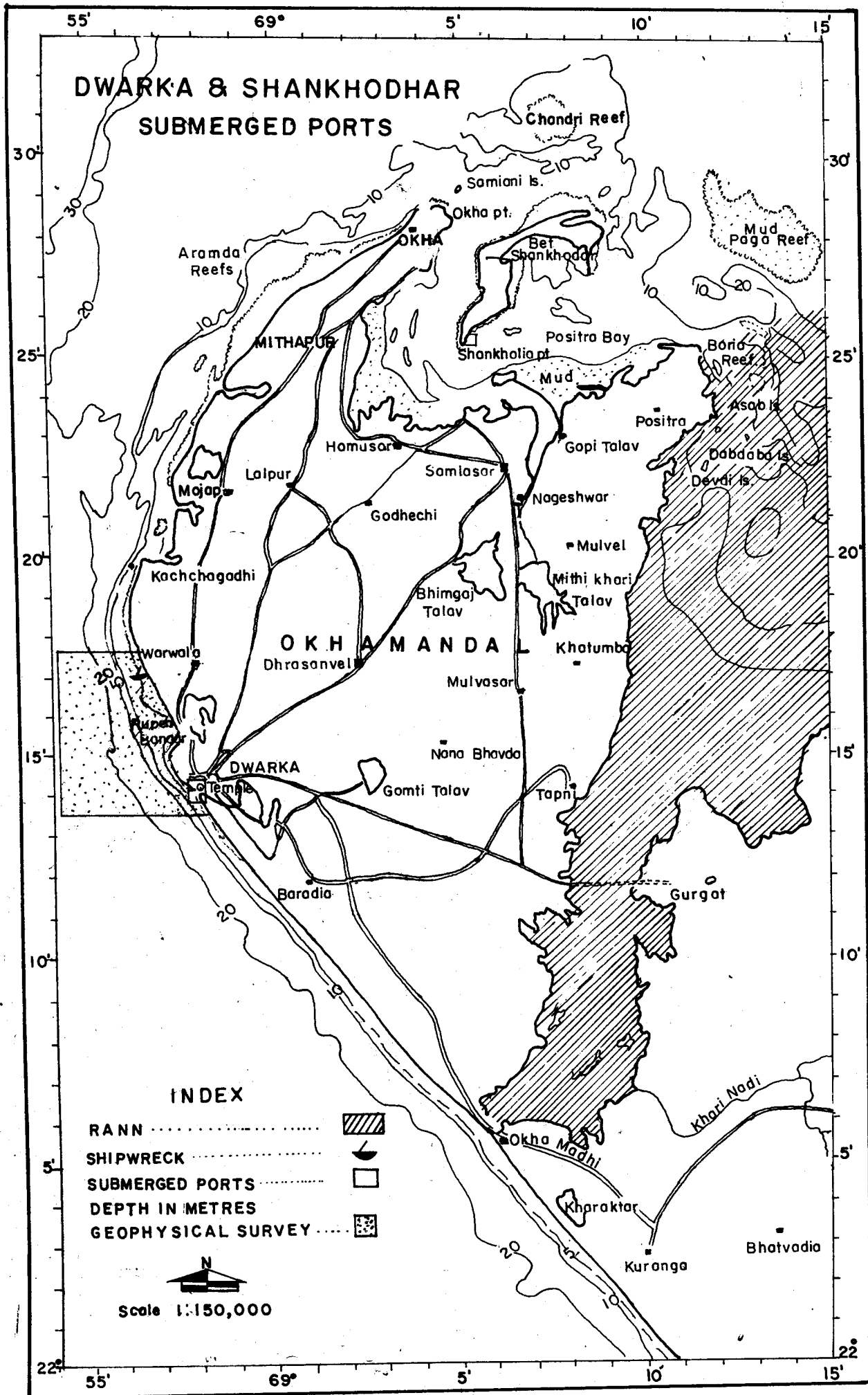
ARCHAEOLOGICAL

Artifacts found in the excavation and exploration help to determine the period and culture. The antiquities like seal, inscription, stone anchors of various types have been dated to 1500 B. C. The TL date of Period I of Dwarka and Bet Dwarka pottery is 3528 B. P. Certain prototypes of stone anchors are found this year. A majority of stone anchors is made out of sandstone and a few are of black stone (basalt). The raw material sandstone especially miliolite is available locally whereas basalt is not available in nearby areas. Petrological studies also can help to know the origin of these black stones. Further the study will throw light on long distance trade whether the black stone anchors came from neighbouring countries or through the traders of other countries who used to call at Dwarka port. The stone anchors of Cyprus and Syria resemble Dwarka anchors. The stone sculptures, terracotta beads, Bronze, copper and iron objects are being studied.

ENGINEERING AND ARCHITECTURAL

Since 1983 a number of bastions, pillars, flagposts and stone anchors of various types have been found in Dwarka water.

During 1992 exploration circular bastions were noticed in zone No. 1. Dressed blocks were used for construction and slits were provided in them for dowels. A strong mortar was used as a binding material. Whether iron or wooden dowels were used in the construction is not known, but iron technology was known to the inhabitants of Dwarka by 1500 BC. The composition of the mortar used in the construction of bastions and walls is being studied. It is necessary to know its composition. Whether any



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- RANN [Hatched Box]
- SHIPWRECK [Circle with Cross]
- SUBMERGED PORTS [Square]
- DEPTH IN METRES [Number]
- GEOPHYSICAL SURVEY [Stippled Box]



Scale 1:150,000

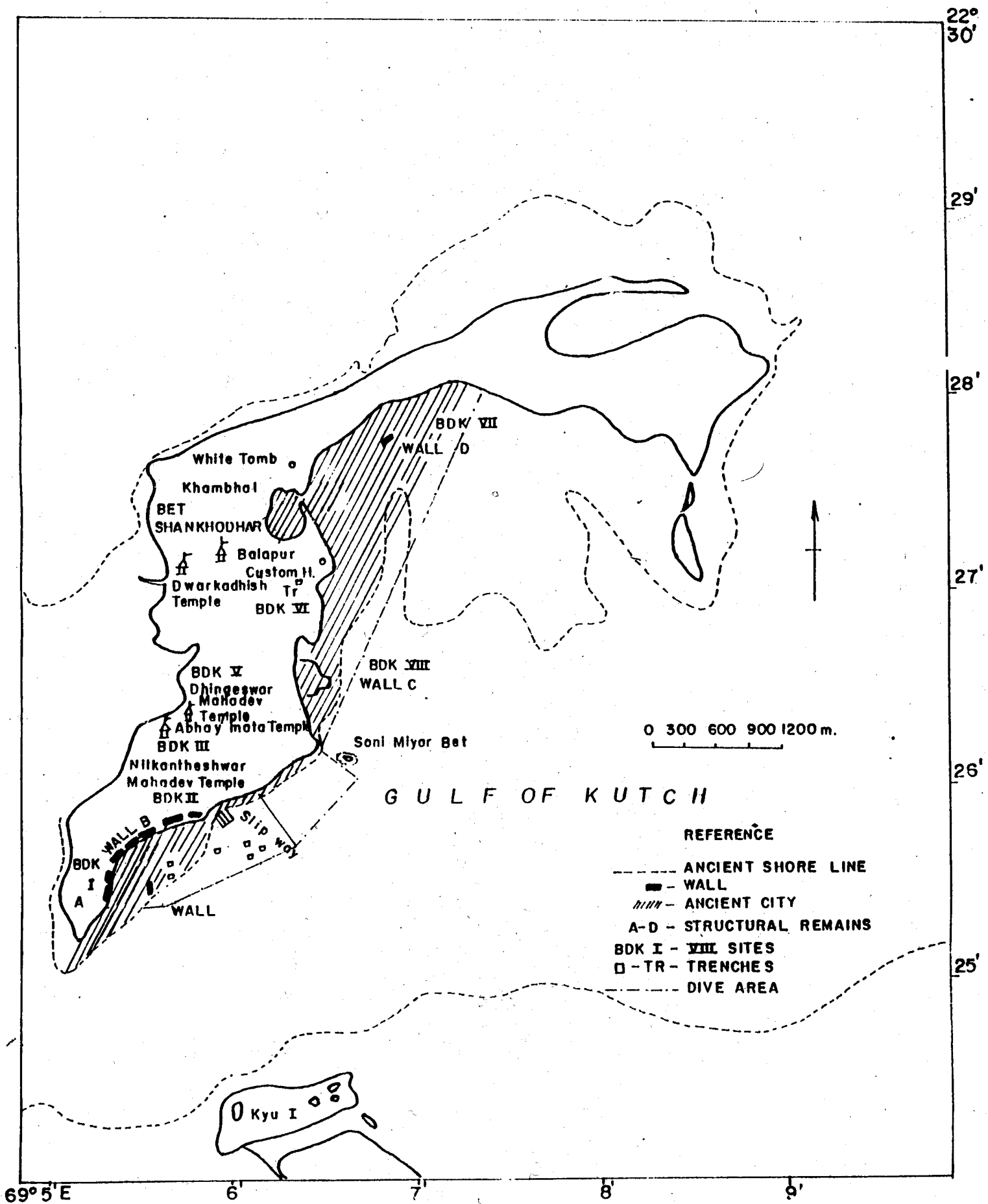


Fig.2 Excavation Trenches in Bet Dwarka.

waterproofing material had been used while constructing in the sea or in waterlogged area is yet to be assessed. Though Dwarka falls in a high energy zone the structures are not much affected by waves and currents except for the few upper courses of bastions. This has to be studied taking into account, wave action, position or orientation of the structures, currents, movement of the sediment and other factors.

The plan of the city of Dvaraka has been ascertained within the limited area of 1x0.5 km explored so far. Four main fortified sectors, two on the right bank and two on the left bank of submerged channel of Gomati and some more structures are noticed on the second channel recently discovered in geophysical survey. An evolution in the plan of bastions from the Harappan to Epic Period is noted at Dvaraka.

The city in Bet Dvaraka extending over 4 km in length was submerged simultaneously with Dvaraka on mainland (Fig 2).

GEOLOGICAL

Further attempt will be made to study the various geological aspects of the submergence of structures at Dwarka. The simplified history of sealevel fluctuations on western Indian shelf reveals that sealevel which was below 110m or so from present level started rising about 10,000 yr. B. P. and reached above 3 to 5m present level about 4000 yr. B P. and since then it is oscillating within 2 to 6m.

Marine Archaeological investigations have proved that walls and bastions of large dimensions are lying in sites submerged in 3 to 12m depth of Dwarka and Bet Dwaraka. Harappan type of seal, inscription and typical pottery enable the archaeologists to date the site close to 3500 B. P. The stone anchors found from Dwarka are considered to be similar to those of Cyprus and Syria where they are believed to be of the same age.

The main geological problems to attend are 1) to confirm as to what happened exactly, whether the sunken part of city was actually constructed on land and was submerged subsequently or the sunken part was originally so constructed as to serve as jetty, breakwater or such other purpose. 2) the cause of submergence was either eustatic rise in sealevel, or tectonic displacement 3) gradual erosion of seabed, effectively allowing shoreline to migrate landward.

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TABLE I : STRUCTURES AND FEATURES OF ARCHAEOLOGICAL IMPORTANCE OBSERVED UNDERWATER OFF DWARKA DURING JANUARY 1992 EXPEDITION

Bastion

S. No.	Buoy No.	Description
1.	SS 5	Bastion with <i>in situ</i> fallen wall
2.	SS 7	Bastion measuring 1.55 m x 0.5 m x 0.45 m
3.	SS 8	L shaped semi-circular stone block of a bastion half buried under sediment. 1.98 m x .50 m
4.	SS 9	Bastion
5.	SS 14	Three semicircular blocks of a fallen bastion
6.	SS 16	Big semi-circular blocks of bastion
7.	SS 21	Four semi-circular stone blocks of bastion 1.25 m x .35 m upto .75 m x .50 m and .3m thick
8.	SS 22	Bastion <i>in situ</i> .90 m x .50 m x .34 m
9.	SS 23	2 bastions <i>in situ</i>
10.	SS 26	Fallen bastions. One has L shaped joints in masonry

Wall

1.	SS 1	Rubble wall <i>in situ</i>
2.	SS 2	Fallen wall
3.	SS 3	Wall 3 m x 1 m x 2 courses, A block measures 1.25 m x .60 m x .15 m
4.	SS 4	Scattered blocks of a wall. One block measures 1 m x .50 m
5.	SS 5	Fallen wall
6.	SS 6	Fallen wall. One block of this wall measures 1.08 m x 1 m
7.	SS 7	Scattered stone blocks (1) 1.25 m x .50 m x .40 m (2) 1.20m x .50 m x .45 m and (3) .85m x .55 m x .30 m
8.	SS 8	Fallen wall. The block measures 1 m x 1.5 m
9.	SS 9	This wall <i>in situ</i> is continuation of structure at buoy 8
10.	SS 10	Big stone blocks of a wall

11.	SS 11	Stone blocks of a wall
12.	SS 15	Big stone blocks height about 1 1/2 m and 2-3 holes also noticed
13.	SS 17	Big stone blocks of a wall
14.	SS 18	Big stone block with a square hole
15.	SS 23	Stone block of a wall
16.	SS 24	A rectangular block of a wall with a length .92 m and width .31 m
17.	SS 25	A wall <i>in situ</i> upto a height of this about 1 m and one rectangular block of this wall measures 1.67 m x .36m x .21 m
18.	SS 26	A portion of wall <i>in situ</i> visible which measures 1.9 m x three courses
19.	SS 27	Extension of the scattered blocks at buoys 25-26 wall.
20.	SS 28	Big stone block with four holes of a wall

Pillar

1. SS 24 - A broken pillar with octagonal section

Single Holed Stone Artifact

1. SS 12 - Part of a pillar with diameter about .50 m and height about .40 m

Anchors

1.	SS 4	A triangular stone anchor
2.	SS 8	A rectangular prismatic anchor 1.67 m x .48 m
3.	SS 9	A three-holed triangular anchor
4.	SS 11	A prismatic three-holed stone anchor
5.	SS 19	Rectangular stone anchor
6.	SS 20	Rectangular stone anchor
7.	SS 22	A prismatic stone anchor
8.	SS 23	Triangular stone anchor
9.	SS 25	A prismatic stone anchor length - 1.75 m.
10.	SS 29	Three-holed prismatic stone anchor
11.	A 1	Triangular stone anchor, measurement 1.23 m x .62 m - .30 m x .15 m.
12.	A 4	Triangular stone anchor