

## Palaeo-coastline of Saurashtra, Gujarat: A study based on archaeological proxies

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Important archaeological sites of our investigation include Dwarka, Bet Dwarka, Kindar Kheda, Pindara, Somnath and sites in Gulf of Khambhat and evidences recorded from these sites include stone anchors, remains of jetties and other structures. While investigation on the coastal sites some habitation sites are in intertidal zone indicating the advancement of shoreline, examples include a few historical period sites in intertidal zone of Bet Dwarka island and a medieval period temple found in the sea at Pindara, whereas a few sites believe to be ancient ports are now situated far hinterland, thus suggesting the withdrawal of the sea in the recent past such as Kindar Kheda near Porbandar and Lothal in the Gulf of Khambhat. In the present paper we use archaeological evidences suggesting the change in shoreline pattern during the historical times.

**[Keywords:** Saurashtra coast, Stone anchors, Ports, Shoreline changes, Navigation]

### Introduction

Coastlines have been focal areas for the human settlement from the earliest times for varieties of reasons such as exploitation of marine resources and overseas maritime activities which substantially contributed to the growth of many civilizations across the globe. However, change in shoreline due to sea-level fluctuations, tectonic disturbances; erosion and sedimentation have directly affects human habitation of coastal area. Thus archaeological sites could be one of the most promising indicators of shorelines. For instance, the history of the Baltic Sea during the late Pleistocene and Holocene has been recorded through several prehistoric sites discovered from its bed<sup>1</sup>. Similarly, a few Mesolithic sites recorded from Sweden suggest a lower sea level during the early Holocene<sup>2</sup>. A large number of prehistoric and historical period sites discovered off the southern California coast indicate shoreline change over 2 to 6 km<sup>3</sup>. In India, particularly on the Tamil Nadu coast, several Palaeolithic sites are situated on the terraces at 73 m, 45 m, 30 m and 17 m above MSL formed by fluctuations of the sea-level<sup>4</sup>. Early Palaeolithic tools were found at 45 and 30 m while middle Palaeolithic tools were noticed on 17 m terrace. Several Mesolithic and Neolithic sites are located along the coastal belt of India and there are ample evidences of the exploitation of marine resources. Similarly, Gujarat on the west coast of India has several sites

which witnessed extensive maritime activity during the Harappan period<sup>5-7</sup>. Also, ancient Indian literature mentions the devastation of coastal towns by the sea. The *Mahabharata* (ancient Sanskrit Epic) mentions the submergence of the city of Dwarka on the west coast<sup>8</sup> and *Manimekhalai* (ancient Tamil text) mentions the submergence of Poompuhar<sup>9</sup> on the east coast of India. Marine archaeological investigations have brought to light the partially submerged historical period remains off Poompuhar<sup>10</sup> and the remains of an ancient harbour at Dwarka<sup>11</sup>. Mahabalipuram on the east coast is another site where several temple complexes are found under water<sup>12</sup>.

Ancient settlements also preserve each event, whether it be environmental, political, cultural diffusion, etc. that occurred in the course of time. These have been used by archaeologists and historians to rebuild the political and cultural history of the region. Though environmental history from archaeological sites has been a part of excavation reports, it has not received enough attention as full-fledged scientific data. However, archaeological sites are the *in situ* records of past events such as change in climate and shorelines in the respective regions. Besides archaeological sites, ancient maps and satellite imagery have been used extensively to understand the changes in past shorelines.

History of maritime activities in Gujarat dates back to the 3rd millennium BC<sup>13</sup>. Evidence of the

exploitation of marine resources like shells, salt and fish has been recorded from many coastal sites. Bet Dwarka island, situated at the entrance of the Gulf of Kachchh, acted as a transit point for trade and commerce during the later phase of the Indus Civilization between Kachchh and Sind on one side and Saurashtra and mainland Gujarat on the other<sup>14</sup>. Archaeological explorations suggest that the availability of marine resources around this island attracted early settlers. Subsequently, the island became an international trade centre from the early historical period<sup>15</sup>. Onshore explorations of the island since 1983 have revealed the presence of a large number of habitational remains of the historical period in the present-day inter-tidal zone, it was reckoned that evidence of shoreline change and sea-level variation may be ascertained from here<sup>16</sup>. Therefore, to understand the stratigraphy of human habitation, as also the relationship between man and the sea, a few trenches were opened in the coastal area of the Bet Dwarka island for systematic archaeological excavation.

The present study is based on the data gathered in the course of archaeological investigations along the Saurashtra coast during the last one decade. The important sites include Bet Dwarka, Kindar Kheda, Pindara, sites near Kodinar and the Gulf of Cambay (Fig. 1).

### Materials and Methods

Archaeological sites were investigated through systematic explorations along the coast of Saurashtra

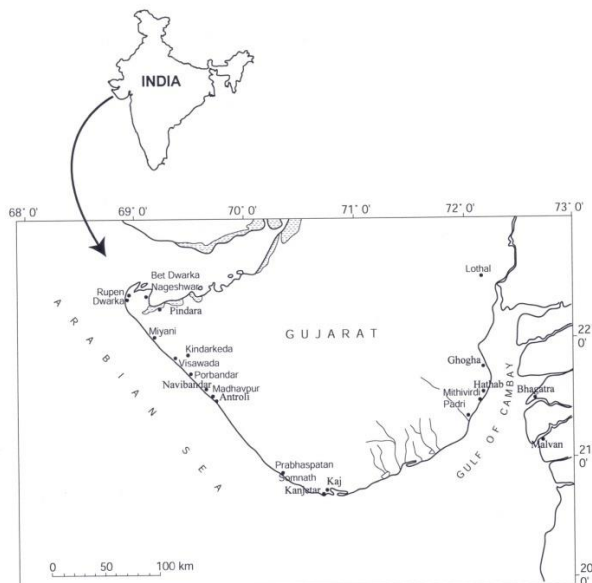


Fig. 1—Investigated archaeological sites along the Saurashtra coast

and a few sites such as Bet Dwarka, Kindar Kheda, and Bokhira were excavated to understand the cultural sequences and their role in maritime activities. Habitation deposit was correlated with the present high water line. Samples for radiocarbon were collected and they were analysed by the Birbal Sahnii Institute of Palaeobotany, Lucknow. Old maps and toposheets have been used to correlate present and past coastline which provide definite trend in a particular region.

### Results

The number archaeological sites have been investigated to record past human settlement along the Saurashtra coast. Archaeological findings of a few sites, which have been used to determine the past shorelines, are being described as follow:

#### *Pindara*

The ancient temple site of Pindara juxtaposes to the northern Saurashtra coast in the Gulf of Kachchh about 36 km west of Khambhalia and 24 from Kalyanpur. On the west of Pindara is a vast marshy land known as Okha Rann. Pindara way is a well-sheltered area free from open sea waves. It comprises of mud-flats up to a distance of 2 km from high waterline and a gentle slope with a minimum water depth of 1 to 2 m to a distance of 8 km, while the next 4 km has a water depth of more than 5 m. Average tidal range in the region is 1 to 4 m. geologically; the formation comprises the Deccan trap overlain by the Gaj Formation, which is further subdivided as Ranjitpur limestone. The unit is comprised of typical yellow to brown-coloured fossiliferous limestone that is extensively bored and contains recrystallized shells and fragments of coral. The lower age of this unit is lower Miocene<sup>17</sup>.

A huge temple complex (10x10 m) is exposed during low tide in Pindara about 300 m from the high water line (Fig. 2). Presently, floor area made of dressed limestone blocks is well preserved, while the superstructure has been destroyed and the stone blocks have been washed or taken away. Dressed limestone blocks have been used for the construction of this temple. Temple is oriented in the E–W direction and the entrance appears to be on the eastern side. This temple was dedicated to Lord Shiva, as a yoni is present in the middle of the temple complex. Majority of the limestone blocks are measured 60x45x25 cm. The remaining part of the sanctum

(*Garbha Griha*) measures 4.75x4.5 m. The yoni measures 40x40 cm. Architectural feature of the submerged temple corresponds more or less with the existing temple on the shore of Pindara. Size of the submerged temple must have been as big as other surviving temples in the Pindara group of temples dating back to the 7<sup>th</sup> to 10<sup>th</sup> century AD<sup>18</sup>.

#### *Bet Dwarka*

The island of Bet Dwarka is situated in the Gulf of Kachchh about 5 km north of the mainland of Okhamandal and to the east of Okha port. Bet Dwarka (also known as Bet Shankhodhar) is famous for temples dedicated to Lord Krishna. The island is a narrow strip of sand and rocks about 13 km long. The eastern part of the island is known as Hanuman point, and comprises sand-hills and bushes. The southwest half of the island is rocky table with relief of +20 m. Recent geological studies have indicated faults and two prominent structures: the Padma teerth fault running WNW-ESE and the Sonimiyar fault running ENE-WSE, though the dates of the faults are not available at present. It is suggested that these faults caused wedging of the area between them, thus causing subsidence. Evidence of subsequent in-filling and episodes of uplifts during the recent past have been reported. Bet Dwarka island is located at a point from which boats and ships sailing from south enter the Gulf of Kachchh, approach the mainland sailing in a north westerly direction. The area is also referred to as the Gulf of Barake by foreign travellers.

Excavations at Bet Dwarka Island have yielded a rich antiquity concerning the exploitation of marine resources by ancient mankind<sup>19</sup>. The habitation was spread in a vast area (more than 2 km) along the southeastern coast and major parts of the ancient



Fig. 2—Remains of a medieval period temple exposed during low tide off Pindara

settlement have been destroyed by the sea, as a large number of ancient pottery can be collected from the inter-tidal zone of this area. The oldest habitation in three trenches, namely BDK-I, II and V is traced 1 m below the present high waterline, which is a clear indication of the lower sea level during these settlements. Similarly the site BDK-V near *Khuda Dost Dargah* is also flooded during the high tide (Fig. 3). The time bracket of both sites is between the 2<sup>nd</sup> century BC and the 4<sup>th</sup> century AD. During the early phase habitation extended towards the offshore and gradually extended landwards during the later stage. However, the remains of the later phase are also destroyed which suggest that up to 4<sup>th</sup> century AD the sea level was lower than the present.

#### *Kindar Kheda*

The village of Kindar Kheda is situated about 20 km northwest of Porbandar. The archaeological site is under cultivation, and is located on the eastern side of the village. A Sun temple dating back to the 9<sup>th</sup> century AD of the post-Maitraka period is situated here<sup>20</sup>. The southern part of the site is a low-lying area. Archaeological investigations have yielded a



Fig. 3—An Early historic site exposed during low tide in Bet Dwarka island



Fig. 4—Protohistoric Stone anchor from Kindar Kheda

stone anchor (Fig. 4) and evidence on shell-working which indicate the site's proximity to the sea in the past. A study of map dated to 1856 also suggests that Kindar Kheda was approachable through Porbandar and Visawada creek until 1856<sup>21</sup>. Therefore this evidence provides undisputed evidence on the change in coastal morphology.

#### *Gulf of Khambhat*

The Gulf of Khambhat is a major part of the eastern Saurashtra coast and has preserved the remains of the oldest Civilization of the subcontinent. The famous Harappan port town at Lothal is situated at the head of the Gulf of Khambhat (Rao 1979). Other prominent Harappan sites include Padri<sup>22</sup> and Hanuman-no-Timbo<sup>23</sup> in the estuaries of the river Shetrunji at the entrance of the Gulf. Budhel, another small Harappan site is situated close to Bhavnagar on a seasonal river that merges with the Gulf in the eastern direction. The historical period remains have been discovered at Vallabhi on the western coast and Hathab on the southwest coast of the Gulf. This region of the Saurashtra coast has been vividly described in the *Periplus of the Erythrean Sea* dating back to the 1<sup>st</sup> century AD (Schoff 1912). Ancient Sanskrit text such as *Vishnu Purana* described the tidal range of 510 *angulas* (about 32 feet) and it is closely matching with the present day trends of the tide in the Gulf of Khambhat<sup>24</sup>.

Gulf of Khambhat is famous for high tidal range in India that is the 2<sup>nd</sup> highest in the world with 11 m rise (maximum) on full and new moon time. There is a reference in the *Vishnu Puran* about the rise of sea level during full moon time up to a height of 32 feet (510 *Angulas*). Perhaps this reference is well corresponds with present day conditions. The author of the *Periplus of the Erythrean Sea* also described the tidal range in the Gulf reason and difficulty in navigation. To navigate in the Gulf pilot services were provided by the contemporary establishments (Schoff 1912). The Location of the Harappan sites such as Lothal, Budhel, Padri and Hanuman-no-Timbo indicates that people of the oldest civilization of the subcontinent have used this natural phenomenon very effectively for the development of the civilization.

Vallabhi being an important educational center during the historical is situated on the tidal river connecting to the Gulf of Khambhat. Due to shoreline change<sup>25</sup> the tide is no more reaches to the town of

Vallabhi. The findings of two channel marker buoys of iron indicate that till the British period boats and ships use reach close to Vallabhi. Therefore the change of shoreline in this region is a recent phenomena.

#### *Little Rann of Kachchh*

Several Harappan sites have been reported along the Little Rann of Kachchh which suggests different environmental conditions prevailing during the late mid-Holocene. A preliminary investigation along the southern coast of the little Rann revealed two port sites namely Khod and Vavaniya. The brief description of these sites as follows:

#### *Vavaniya*

The coastal village of Vavaniya is situated about 30 km north east of Morvi (an important town in this area). It is also connected with railway, which runs up to Navlakhi Bundar. Juna Bundar of Vavaniya is further 5 km north of present village and presently it is approachable through salt pans run by private company. Presently no boats can reach up to this place. During the exploration in this area several construction were noticed with major one include a wall running more than 100 meters. The structures are made of stones and they have been collapsed (Fig. 5). At few places jetty also noticed. An ancient road connecting to the village Vavaniya and Bundar was also observed. The port was active until the emergence of Navlakhi Bundar in this area. There are some references in early writings of the British explorers<sup>26</sup> mentioning about this port and also suggesting that an ancient boat was excavated near Vavaniya dating back to the medieval period.

#### *Khod*



Fig. 5—Remains of a port at Vavaniya in the little Rann of Kachchh

Khod is situated about 60 km north east of Morbi town and 7 km east of Tikar village on the southern coast of the little Rann of Kachchh. According to the local tradition Khod was an important port during the medieval period. There is an archaeological site a km north of the present village. The pottery from the site suggest as a medieval period site. This place must have served as port when Rann was deep enough to navigate. Enquiry was made to identify correct place of port, local people knew about it but there is no structural remains above the surface. Another interesting aspect of Khod village is the presence of hundreds of hero stones. According to local people these were erected in memory of Hero who fought against enemies during the 17<sup>th</sup> -18<sup>th</sup> century AD.

### Discussion

Shifting shoreline due to one or other reason is not a new phenomena. A few Harappan sites have been discovered along the Makran coast which perhaps served as sea port during the 3<sup>rd</sup> millennium BC<sup>27</sup> and now these sites are located as far as 30 km inland. These evidences reveal that the coastline in this part of Pakistan had risen considerably during the past 4000 years. Similarly, several workers have demonstrated that the sea-level was higher than the present around 6000 years BP at the Saurashtra coast<sup>28</sup>.

Ancient settlements are the storehouse of information of past events such as climate and coastal morphological changes. Gujarat coast has been the focal point of human activities since the earliest time and has provided ample opportunities to understand natural phenomena that occurred in the past. Pindara is an important archaeological site to understand the coastal behaviour of the southern coast of the Gulf of Kachchh in the recent past. The coastline has advanced landward at least by 300 m during the last 1000 years or so. The exact reason for submergence of the temple is not known. Being in the seismic zone, tectonic disturbances and sea-level rise could have played a vital role in the destruction of the temple complex.

Archaeological remains from Bet Dwarka indicate that the Early Historical period settlement took place on the island when sea level might have been lowered by 2-3 m compared to the present. If the sea level is lower by 2-3 m during early centuries of the Christian era then a few places in Bet Dwarka island would have been connected to mainland during low tide. A

local belief in this area that in the past people could reach the island by walking and bullock carts might reflect a past reality. Radiocarbon date of the lowest level of BDK-II is 2040-1860 years BP. Excavation of the present Dwarka suggests that around the Christian era the sea level was lower than the present<sup>29</sup> in Okhamandal area. In general, the sea level during the Christian era was lower than the present by 2-3 m. Another important point may be mentioned here is that until the medieval period the anchoring point for boats would have been near present Bet Dwarka jetty. A large number of amphorae, lead anchors and a lead ingot possibly from a shipwreck were noticed besides a large number of stone anchors datable between the Historical and Medieval periods.

The data from Gujarat coast suggest that the behaviour of shoreline was different at different places. Lothal is located about 26 km from the present shoreline and about 12 m above the MSL. The gulf is narrow and a few major rivers debouch here such as Narmada, Tapi, and Mahi. Offshore currents are also responsible for depositing the sand in the Gulf. Earlier studies also mentioned that the Gulf of Khambhat and Gulf of Kachchh were connected during the early mid-Holocene period<sup>30</sup>. Bruckner<sup>31</sup> had suggested that the river-generated sediments may have played a vital role in the seaward movement of the shoreline.

Explorations on the coast of the Little Rann of Kachchh yielded interesting evidence on the retreatment of sea during the recent times. The most glaring example is the abandonment of the Vavaniya Bundar east of Navalakhi port, which was functional until early decades of the 20<sup>th</sup> century<sup>26</sup>. There is very strong tradition of the existence of a port at Khod about 120 km east of Navlakhi. Though there is no evidence of the port remain but a medieval period site was noticed on the southern bank of the Rann of Kachchh near Khod which indicate that the existence of this site may be due to its involvement in maritime activities. Thus it makes a very interesting scenario for the role of Rann of Kachchh as a navigational pool of water in the past.

### Conclusion

Archaeological investigations along the Saurashtra coast which include Saurashtra-Kathiyawad coast, Gulf of Khambhat, Gulf of Kachchh and little Rann of Kachchh yielded ample evidence indicating shoreline has changed at several places. Based on above discussion following conclusion can be drawn: i)

During Harappan time shoreline was landward in the Gulf of Khambhat and perhaps Rann of Kachchh was navigable, however there was not much change in coastal configuration from Gopnath to Dwarka during the last 4000 years or so. ii) During the early historic period (the 4<sup>th</sup> BCE to the 4<sup>th</sup> CE) sea level was lower around 2 meters around Bet Dwarka island and northern coast of Saurashtra. iii) Shoreline again advanced during the medieval period when temple at Pindara was engulfed. iv) Tectonic disturbances played an important role in displacement of past shoreline coupled with river siltation in the Gulf of Khambhat and little Rann of Kachchh. Thus the archaeological proxies have provided high resolution data on the shoreline changes since the late mid-Holocene along the Saurashtra coast.

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