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Ancient anchorage system in India with reference to Gujarat coast

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Abstract

The Indian coast, with a long history of maritime activities, has been dotted with several ancient ports. The evidence for this exists in port-related structures on the shore and in relics lying in the sea adjacent. Marine archaeological explorations have revealed the existence of jetties at Porbandar and Sultanpur and offshore anchoring points at Miyani, Visawada and Somnath, Kodinar and Ghogha on the Gujarat coast. The preferred anchoring points fall in a water depth of 5–7 m. This paper also discusses the effect of tide when using jetties and loading points along various parts of the west coast India.

1.0 Introduction

The Indian coast, with a long history of maritime activities, has been dotted with several ancient ports. The evidence for this exists in port-related structures on the shore and in relics lying in the sea adjacent. Marine archaeological explorations during the last two and half decades have revealed the existence of ancient jetties at Dwarka, Rupen Bandar, Porbandar and Sultanpur and offshore anchoring points at Bet Dwarka, Miyani, Visawada and Somnath, Kodinar and Ghogha on the Gujarat coast. The other important remains are comprised of stone anchors of various types such as composite, Indo-Arab and ring stone type. They are of various sizes weighing between 20 and >1000 kgs. The sizes indicate the uses of various sizes and types of boats visited this coast or were manufactured along this coast during the different phases of history.

Mesopotamian texts vividly described the existence of docks in the 3rd millennium BC. The king Sargon the Great was quoted to boast that boats of Dilmun, Magan, and Meluhha lay anchored at the docks of Agade, which was his capital (Kramer, 1964, 44-52). Excavations at Ur on the bank of Euphrates had revealed a massive brick structure, identified as a harbour (Woolley, 1974, 63), which is the oldest remnant of any port structure in the world. Similarly, archaeological studies of the oldest known civilization of the Indian subcontinent, namely the Indus Civilization, indicate that Lothal[Note 1] (Rao, 1979, 70), and Kuntasi (Dhavalikar et al., 1996, 76) might have served as tidal ports (situated on the river banks) on the Gujarat coast. Kautilya (Shamasastry, 1915, 168) in his *Arthasastra* has mentioned a Superintending of Shipping (*Navadhyaksha)* who was in charge of oceangoing ships and strictly enforced the rules framed for the management of ports. He was empowered to destroy pirates and punish

those who did not follow the rules. The owner of the ship had to pay taxes before leaving the port. The author of *Periplus of the Erythrean Sea* dating back to the 1st AD (Schoff, 1912, 38-47) has mentioned a chain of ports along the Indian coast. Several ancient texts, including Indian and foreign, have made ample references on the existence of harbors and ports along the Indian coast during the historical and the medieval periods. Several structures associated with ports and jetties have been discovered along the Mediterranean coast including at Carthage and Thapsus on the Tunisian coast (Muckelroy, 1977, 79-80), Caesarea on Israel coast (Raban, 1981, 287-308) etc.

Sanskrit term for the port is *Pattana* that has been used in various ancient texts. *Pattana* used to be two types namely *Samudrapattana* i.e. port on the coast of a sea and *Jalapattana* on the bank of a navigable river (Roy, 1994, 33-36). De Kerchove (1948, 598) in the dictionary of maritime archaeology described port as "a place for the loading and unloading of vessels recognized and supervised for maritime purposes by the public authorities". Further he adds on the differences between port and harbor "a port may possess a harbor but a harbor is not necessarily a port. Any natural creek or inlet on the seashore with adequate depth of water and sufficient shelter for ships fulfills the essential conditions of a harbor. To make it a port, in the accepted sense of the word there must be in addition accommodation and facilities for landing passengers and goods and some amount of overseas trade."

It is interesting to note the effect of prevailing tide in relation with jetties and anchoring points along various parts of the west coast India. The archaeological evidences indicate that two gulfs of Gujarat coast (Gulf Kachchh and Gulf of Khambhat) witnessed the hectic maritime activities in the past. Both gulfs have very high tidal range and the Gulf of Khambhat has the second highest tidal range in the world (11 m). Ancient texts such as *Vishnu Puran* and *Periplus of the Eruthreanean* Sea vividly describe the tidal range and its uses for the navigation purposes. The discovery of the large number of stone anchors in inter tidal zone along the gulf region support the above references.

The anchors are integral part of the navigation. Ships or boats must use an anchor where jetties are not there to keep her steady at one place, say at open sea where creek merges with sea at suitable water depth. Generally, the anchoring points have a rocky seabed as an anchor need to hold the boat firmly. The underwater investigations on the Saurashtra coast have clearly helped to mark several ancient anchoring points from where stone anchors were found, in water depth of 5 to 7 m. These observations correspond well with the depth of the traditional anchorage points all along the Indian coast. The underwater observation revealed that seabed topography between Bet Dwarka on the extreme west and Somnath on the east is almost less variants particularly at Dwarka, Miyani, Visawada, Porbandar, Tukda and Somnath. The seabed topography is comprised of the rocky formations with numerous channels filled with fine sand. The stone anchors were trapped in these channels and between the rocks, which were suitable for holding big boats like Arab *Dhows* and the Indian *Vahan.* The observation at Bet Dwarka and Porbandar revealed that boats of carrying more than 100 tons of cargo are anchored in a water depth of 4 to 5 m and some time they are resting on the sandy beaches during low tide. Exception at Somnath has been observed that most of the anchors are reported from 8 to 12 m water depth that

indicates the anchoring point at Somnath was in comparatively at deeper depth. This phenomenon could well be connected with low tidal height at Somnath, where boat needs to continuously float. However, the majority of these anchors belong to ring stone type.

The paper discusses the underwater explorations undertaken along the southern Saurashtra coast. The focus is on the remains of ports and anchorage points. The use of natural phenomena like tidal range has been discussed in detail.

2.0 Marine Archaeological Investigations along the Saurashtra coast

Except Okhamandal region the major marine archaeological explorations on the Saurashtra coast has been carried out in the first decade of 21st century. The important site include Miyani, Visawada, Kindar Kheda, Porbandar, Mithivirdi, Kodinar, and in the Gulf of Khambhat (Figure 1). A large number of stone anchors found from these sites (Table 1). The brief description of each site is given below.

2.1 Miyani

Miyani is situated about 40 km east of Dwarka. This is also famous for ancient temples dating back to the 10th century AD (Sampura, 1968, 87). On the coast of Miyani a temple dedicated to Goddess (locally known as Harshadmata) is situated on a high hill. A vast creek known as Meda creek runs a few miles in hinterland area, which has been used as a sheltered harbour for the country craft, particularly fishing vessel. The coastal area is consisted of plain sandy beaches except a high hill over which a temple of Goddess is situated.

Underwater explorations have been undertaken about 1 km offshore of Harshad Mata temple. The seabed comprises of sandy channels and rocky outcrops. There is not much vegetation growth noticed. Several places small gravels were also noticed. Sand is comprises of clayey element which makes visibility very poor. Twelve artifacts were discovered from here.

2.2 Visawada

The small town of Visawada lies about 40 km west of Porbandar and about 20 km east of Miyani. The Hindu pilgrimage center and a temple dedicated to the Lord Krishna, is situated in the middle of the town. A creek (known as Kindari Creek) runs to a long distance at least up to Kindar Kheda (a Harappan town) and perhaps Kindari name derived from this particular ancient town. The western side of the coast is represented by a high cliff while the eastern coast is consisted of sandy beach.

Explorations have been undertaken off Kindari Creek about 500 m from coastline. Seabed topography is consisted of sandy channels and rocky outcrops. At several places small boulders and dense growth of vegetation was observed. Water depth varies between 8 to 5 m, however, archaeological findings were

concentrated between 5-6 m water depths. Total 14 stone anchors have been found and they represent by three varieties known as composite, Indo-Arabia and ring stone types.

2.3 Kindar Kheda

The village Kindar Kheda is situated about 20 km northwest of the present town of Porbandar and it is approachable by road from Porbandar. Archaeological site is under cultivation and located on the eastern side of village. On the site a Sun (*Surya*) temple dating back to the 9th century AD (Sampura, 1968, 91-92) of post *Maitraka* period is situated. A low lying area was observed on south of the site.

The coastal archaeological exploration around Porbandar has been rewarding by the findings at Kindar Kheda. The archaeological findings such as pottery and stone tools suggest that this is a protohistoric site (late Harappan) dating back to the 2nd millennium BC. The pottery types very compare well with those reported from other protohistoric sites at Bet Dwarka (Gaur and Sundaresh, 2003, 57-66) Nageswar (Hegde et al., 1990, 15-36), Porbandar (Gaur, et al., 2004, 103-107), and Rojadi (Possehl and Raval, 1989, 57-140). Discovery of a stone anchor (Figure 2) and other shell artifacts suggest the adoption of maritime practices as in the case of other Harappan sites along the Saurashtra coast. Study of an ancient map indicates that topography has changed significantly between Kindar Kheda and Porbandar and Kindari Creek. As per the study of ancient map Kindar Kheda was approachable by boat at least up to 1856 (Gaur and Sundaresh, 2005, 44-48). The study of sea level fluctuation suggests that during Harappan time sea level was higher than the present (Merh, 1992, 471). Archaeological, geographical and geological data suggest that Kindar Kheda might have been an active protohistoric and historical period port on the Saurashtra coast.

2.4 Somnath

The archaeological excavations on land at Prabhasa by the Baroda University and Deccan Collage Pune have yielded evidence of a township of 2000 BC. The temple of Somnath nearby is dedicated to Lord Siva and the linga is counted among the 12 *Jyotirlingas* of India mentioned in various Puranas.

The Prabhasa - Somnath coast forms a straight line revealing a vivid manifestation of marine aeolian and fluvial processes that have resulted in a number of important geomorphic land forms, as the near shore zone is characterized by the formation of recent alluvium deposits, sand bars, mud flats and mangroves swamps. The coastal zone is covered with beaches and littoral sand, oyster beds and sand dunes.

The explored area in Somnath water is located at a distance of 400 m south-west of the Somnath temple. The study area is comprised of rocky out crop and sandy patches. During the first season 6 objects, second season yielded 8 objects and present season 2001 yielded 21 ring stones. Somnath waters witnessed the occurrence of the largest number of ring stones. Out of 43 total discovered stone anchors, 80% belong to ring stone category. The water depth varies from 7 m to 15 m. The ring stone (Figure 3) noticed in less than 8m water depth and the growth of seaweeds also noticed, however ring stones of deeper depths have a layer of greyish marine growth.

2.5 Kodinar (Mul Dwarka)

A small coastal village known as Mul Dwarka near Kodinar in the district of Junagad is one of the claimant of the original Dwarka of Mahabharata. The proximity with Junagadh hills on the north and sea on the south the town has been associated with Dwarka (Sankalia, 1966, 7). An ancient temple is situated on a raised land close to the sea. The temple is in dilapidated condition and is not under worship. The shrine is dated to the post 10^{th} century AD (Sampura, 1968, 113). A circular structure of about 4 m in height constructed with similar type of dressed limestone blocks as of the temple in situated close to ancient temple. Locally this structure is called as *Diva Dandi* (lighthouse). If this structure has served as lighthouse (Figure 4) then this may be the oldest remains of lighthouse on the Saurashtra coast. Local fishermen informed that a few anchors similar to those of Indo-Arabia type were present but now they have either buried under new port or other private buildings, which cannot be noticed. An ancient well was noticed which is still used for drinking water source near the jetty.

The exploration in inter tidal zone yielded a composite stone anchor. The anchor gets exposed during low tide. It is made of sedimentary rock. The anchor has an upper circular hole and lower two holes are square. The upper portion is semicircular and edges are sharp. The thickness of anchor gradually increases from 12 cm at upper end to 20 cm at lower end. The anchor is similar to those reported from Dwarka (Gaur, et al., 2008, 23-57) and Bet Dwarka (Gaur et al., 2005, 113-129) and dated between the historical and the medieval periods.

The offshore exploration in Mul Dwarka region revealed uneven rocky and sandy patches as major observation of seabed topography. The exploration revealed a few stones possibly used as anchors for small boats but they are not similar to those anchor found from inter tidal zone of Mul Dwarka and other places on the Saurashtra coast. There is possibility that ancient anchoring point might have been vanished during the construction of new jetty.

Mul Dwarka, the third site, which has been considered as Dwarka of Mahabharata period has been surveyed extensively for any submerged archaeological remains. The remains of ancient port of Mul Dwarka have been destroyed due to the construction of cement jetty. However, discovery of a composite stone anchor and report on some grapnel type anchors from Mul Dwarka suggest that this was also an active port town during the historical and medieval periods. An ancient lighthouse may be dated to the 12^{th}-15^{th} century AD may be another indication of active maritime activities in this region. A tidal river, which has been blocked due to a sand bar (may be due to the construction of cement jetty) flows western side of Mul Dwarka village. Archaeological findings from Mul Dwarka suggest that this was a historical period settlement and was very active port during the medieval period.

The underwater investigations in and around Mul Dwarka (Kodinar) have been of significant in respect of understanding the archaeology of this region. Now the data of underwater explorations from all the three Dwarka on the Saurashtra coast are available and the most common aspects of them is the present

of similar type of stone anchors, therefore, the tradition of Dwarka at these places might have been existed at a same time (in the Early Medieval Period). Another common aspect of these sites is the presence of Harappan and late Harappan settlement within close proximity, for example, Nageshwar and Bet Dwarka near Okhamandal Dwarka, Kindar Kheda near Mul Dwarka (Visawada) and Kanjetar and Kaj near Mul Dwarka (Kodinar). All the three Dwarka have ancient temples dated to the 10^{th} -12^{th} century AD. Nonetheless, these sites were ancient busy ports and perhaps temples were served as coastal marker point for navigator and also they worship before embarking on the long voyage.

2.6 Mithi Virdi

The small village Mithi Virdi is situated about 30 km south east of Talaja, a *taluka*, headquarter. The village is lying on a raised plateau close to the seashore. A small seasonal river merges with the sea on the western side of the village. Archaeological site is located about a km west of the village in an agriculture field. The area is comprised of reddish soil with small quartz gravel signifying the flow of the river channel from this area.

Five stone anchors are lying in an agricultural land (ground nuts are the important crop of this field) about 1 km north of the seashore. Three anchors are lying together at a distance of 10 m and oriented in the east-west direction. One anchor is in a broken condition. The fourth anchor is laying partially buried north of the other three and oriented in the east west direction.

All the anchors are similar to each other in shape and sizes. The anchors have rectangular cross-sections and trapezoidal longitudinal sections (Figure 5). These have sharp edges and chisel marks on them are clearly noticed. They have been cut from conglomeratic sedimentary grit rock, which is dark brown in colour and small gravel can be noticed. The anchors have only lower two rectangular holes and upper circular hole is absent in all the anchors. Brief description of each anchor is given below.

2.7 Gogha

The town of Gogha is located on the mid western coast of the Gulf of Khambhat in Bhavnagar district of Gujarat. A famous Gujarati proverb "*Lankani lari ane Ghoghono var*" (Bride of Lanka and groom of Ghogha) indicates direct overseas relation between Gogha and Sri Lanka in the past (Chaukasi, 1989, 634). The presence of ancient Jaina temples at Gogha dating back to the 10^{th} –11^{th} centuries suggest that this was a religious center also. The earliest Arabic inscription from Gogha dates to 1170 AD (Oza, 1885, 2). During the British period ships up to 1500 tons were laden here (Habib, 1982, 23).

The exploration at Gogha was undertaken during low tide and findings were recorded with still photography and drawing. A large number of stone anchors were recorded between 100 and 200 m distance from the high water line. The majority of the anchors belong to the Indo-Arab type and nearly about 40% anchors are fragmented. Interestingly, the fresh surface of broken part suggests that fragmentation of the anchors took place during the manufacturing stage and not during the anchoring

processes. A composite anchor made of lime stone is another noteworthy finds from the site. A few anchors unfinished were also found from Gogha and Hathab. However, these anchors submerge in 5 to 7 m water depth during high tide. Thus, it indicates that big boats were anchoring at this point during high tide. The author of the *Periplus of the Erythrenean* also refers that during low tide boats rest on the seabed.

The exploration in inter tidal zone has also yielded several sherds of the glazed ware (Figure 6 & 7) in the vicinity of stone anchors. These include a jar (Figure 8) with internally and upper half externally glazed and rests of the sherds are glazed only internally. There are three main type of glazed ware i.e. green, blue and brown. These are very similar to the Islamic glazed ware found from various parts of the country (Mohammad, 1985, 105). The medieval period glazed ware at Hastinapur (Lal, 1954-55, 5-151) was found in association with coins of Balban (1206-87 AD). The sherds recovered from the inter-tidal zone of Ghogha are very similar to those reported from another medieval period site at Lashkarshah in Khambhat which have been dated to 14-16th century (Bhan, 2006, 90-95). Thus the glazed sherds Ghogha may also be dated to the late medieval period.

2.8 Hathab

Hathab an early historical site finds mention as *Astacampra* in the Periplus of Erythrenean Sea (Schoff, 1912, 40). On shore excavation yielded rich antiquities of the historical period and maritime contact with the west. It is located about a km in hinterland. The exploration in inter tidal zone of Hathab yielded 2 anchors similar to those of Indo-Arab type and one anchor with a wide groove surrounding in middle of the anchor (Figure 9). This is very similar to those reported from Japan and Chinese waters.

2.9 Harappan sites at Budhel and Sultanpur

Budhel a late Harappan site is situated about 20 km southwest of Bhavnagar. The site is extended in a large area that is partially covered with Mohammedan graveyard and remaining part is under cultivation. A small seasonal stream is flowing close to the mound and merges in the Gulf of Khambhat near Gogha. Another Harappan site known as *Hanuman-no-Timbo* is situated in the estuary of the river Shetrunji near Sultanpur in Talaja taluka. A modern road divides the site into two. On the western side the mound is very high while as on the eastern side the mound is low which is just banking the river Shetrunji. The site is extended approximately over a km in length and half a km in width. The entire site is surrounded with a low lying area, which may be the remains of a tidal channel inundated during the spring tide in the 3rd millennium BC. A large number of pottery including perforated jar painted pottery were noticed from site during the exploration. It was interesting to note that the fishing boats are reaching very close the site during the high tide. Thus the site has potential to be an ancient port town of Harappan period (Gaur and Bhatt, 2008, 99-104).

The remains of a jetty were notice at the mouth of the river Shetrunji near the village Sultanpur. This was primarily a wooden jetty now abandoned due to emergence of other ports in the vicinity. As per

information received during the discussion with local resident the jetty was built about 100 years before and it was abandoned in the early seventies.

2.10 Gopnath

Gopnath serves as the entry point to the Gulf of Khambhat. The coast is marked with high cliffs, rocky and sandy beaches. Being close to the Gulf the tidal range is very high and a large area gets exposed during low tide. A large number of broken sculptures can be noticed in inter tidal zone area. An Indo-Arab type of stone anchor has been reported at the lowest water line and gets exposed during the low tide of new moon day. It is complete in shape and made of hard basaltic rock (Figure 10). It has two lower square holes and upper hole is circular in shape. The length of this anchor is 2.2 m. It is lying about 2 km offshore from high waterline.

2.11 Vallabhipur

Vallabhi has been described as one of most famous Universities of ancient India, is situated on a seasonal stream merging on the western bank of the Gulf of Khambhat. Topographical location suggests that the river must have been a tidal creek in the past. Ancient site is just located on the bank of Vallabhi river. According to the tradition boats used to come up to the site from sea about few decades earlier, but now it has been completely silted up.

While an onshore exploration around Vallabhi it was informed that two anchors were lying near present bus stand and those were recently shifted to the Taluka Office. Then Taluka Office of Vallabhipur was visited and those two artifacts are lying open. These are channel marker buoys and made of iron. No information is available in the Taluka office about their uses and period. However, with observation and comparative studies suggest that these artifacts are the British period buoys for channel indicators. Discovery at Vallabhipur indicates that during the British period ships/boats used to come up to the Vallabhipur and later on river has been silted up and presently shoreline is about 4 km away from Vallabhipur. With this reference it may be argued that rapid shoreline change must have affected the function of the historical and medieval period ports around the Gulf of Khambhat.

3.0 Discussion

Coastal and underwater archaeological explorations along the Indian coast, during last two decades have yielded a large amount of data on the existence of ancient ports, jetties and anchoring points. In the last case we refer to places where vessels are known to have moored i.e. to sit at anchor offshore. An important artifact for identification of a port and anchoring point is the anchor itself, and usually these are lost having parted from the parent boat through a break in the cable or other accident such as being abandoned due to the sudden onset of storms or being caught on the seabed. These lost anchors are amply found all along the Indian coast.

The present paper then deals with some elements of the underwater archeology of ports, jetty and anchoring points along the Indian coast with special mention of the Gujarat coast as an example of the nature of this resource. The important antiquities mentioned include underwater and onshore timber and stone structures and stone anchors recovered during the marine archaeological explorations. A comparative study has also been made with modern traditional jetties found all along the Indian coast.

3.1 The role of tidal range in construction of jetty

The study of the existing traditional jetties along the west coast of India suggests that Gujarat coast does not have jetties built of wood while going down to Maharashtra and Karnataka coast, wooden jetties are found, many still operational, particularly in backwater areas where they are by local fishing trawlers and canoes. Indeed, the presence and absence of a jetty at a recognized port could well be connected with tidal variations as Gujarat coast by and large experiences a higher tidal range and the gulf areas further more. The tidal curves of Okha and Porbandar, for example, suggest a comparatively higher tidal range of 0 to 4 m and 0 to 3 m respectively whereas the southwestern coast of India has lower tidal range of 0 to 2 m at Karwar and 0 to 1 m at Cochin (Indian Tide Table, 2010). Where the higher tidal range results the exposure of a larger beach area, it is apparent that jetties are not necessary. After anchoring offshore to await the incoming tide, fishermen take their boat as far inshore as possible right up to the high water line during the high tide. During low tide, as the water recedes their boats rest on the sandy beaches and they carry out loading and unloading and also small repairing of boats, if necessary, without needing any kind of structure. This appears to be a very old tradition in Gujarat, as a large number of stone anchors from inshore as well as inter tidal zones of Dwarka, and Bet Dwarka, and one each at Armada, Tukda, and Gopnath have been recorded. However, moving down the coast the tidal variations reduces significantly and falls in the range of 1 to 2 m. This does not allow the large exposure of land low water. Where there is minimal tidal range, the boats need to be continuously afloat, necessitating a landing as well as loading and unloading points. In these cases timber jetties provide as affordable solution. Tidal currents need also be considered in these circumstances, for it weak the can often not be strong enough for the boat to propel back to the sea, especially if it lies on the shore and the breezes are contrary.

3.2 Structure of wooden jetty

A jetty is fashioned by employing a trestle arrangement similar to that of a light- weight bridge on a small river by using the strong forest wood. Normally piles are sunk vertically into the seabed or into a rock support. The selection of wood log is depended on its straightness. The distance between pair is normally 0.5 m, which allows at least two planks of 0.25 m width rest between pairs. The distance between two rows varies from 0.75 m to 1.5 m. On the two rows, wooden planks would be resting that is used for loading unloading of the vessels. This type of jetties has been noticed right from Ratnagiri in the north to Kerala in the south.

3.3 Anchoring Points along the Saurashtra coast

To approach a port in the creek, often ships or boats use to anchor at open sea where creek merges with sea as well as at suitable water depth. Generally, the anchoring points have a rocky seabed as an anchor need to hold the boat firmly. The underwater investigations on the Saurashtra coast have clearly demonstrated that ancient anchoring points were in water depth of 5 to 7 m. These observations well correspond with the depth of the traditional anchorage points all along the Indian coast. The underwater observation revealed that seabed topography between Bet Dwarka on the extreme west and Somnath on the east, is almost less variant particularly at Dwarka, Miyani, Visawada, Porbandar, Tukda and Somnath. The seabed topography is comprised of the rocky formations with numerous channels filled with fine sand. The stone anchors were trapped in these channels and between the rocks, which were suitable for holding big boats like Arab *Dhows* and Indian *Vahan.* The observation at Bet Dwarka and Porbandar revealed that boats of carrying more than 100 tons of cargo are anchored in a water depth of 4 to 5 m and some time they are resting on the sandy beaches during low tide. Exception at Somnath has been observed that most of the anchors are reported from 8 to 12 m water depth that indicates the anchoring point at Somnath was in comparatively at deeper depth. This phenomenon could well be connected with low tidal variations at Somnath, where boat needs to continuously float. However, the majority of these anchors belong to ring stone type.

The port plays a dominant role in facilitating the sea trade and there were several ports all along the India coast since antiquity. The prerequisite of the selection of any port site include a sheltered place particularly protection from high wind and rough seas, sufficient water depth for sailing the vessel and a suitable anchoring point. Besides structural part of the port, it is also important to keep in mind that the enough products from the hinterland reach to the port and from the port to hinterland. The majority of the ancient ports were situated on the river banks and the back waters. A few Harappan sites including Kuntasi (Dhavalikar et al., 1996, 5), Amra, Lakhawavel and Vasai (Rao, 1991, 152) on the northern Saurashtra coast are located on the banks of tidal rivers where tidal variation is as high as 5 m that helped mariners to reach up to the site during high tide.

The archaeological findings have indicated that the existence of several ports, jetties and anchoring points along the west coast of India from the protohistoric period (Ray, 2003, 2). The discovery of a large number of stone structures and anchors at Dwarka suggests that it was a busy port during the historical and the medieval times (Gaur, et al., 2008, 61). They have profusely used large limestone blocks for its construction. Whereas, addition to stone block wooden logs were used for a later period jetty at Rupen *Bandar*. Though there is no remains of an ancient jetty at Bet Dwarka the presence of the stone anchors in inter tidal zone indicate that the high tide was effectively used for beaching the boats. Conversely, the northwest coast of India has jetties in creeks, which are made of limestone blocks while southern side traditional wooden jetties continued to be in use.

The tidal variation and seabed topography played a significant role in construction of jetties. As stated earlier, that the higher tidal variation in Gujarat has been used by the navigators to anchor the boats in

inter tidal zone and loading unloading of boat become easier. It has also been confirmed with the discovery of stone anchors from inter tidal zone areas of Dwarka, Bet Dwarka and Armada. The stone anchors are the indicator of the ancient anchoring points and underwater findings have indicated that the preferred anchoring points on the Saurashtra coast falls between 5 and 7 m water depth.

4.0 Conclusions

The findings from coastal and underwater investigations on the Saurashtra coast have indicated that the mouth of the various creeks has vast potential for underwater archaeology. The tidal variation and seabed topography played a significant role in construction of jetties. The higher tidal variation in Gujarat was used very effectively by the navigators to anchor the boats in inter tidal zone and loading unloading of boat become easier.

The coastal archaeological explorations along the western coast of the Gulf of Khambhat yielded the remains beginning from the Harappan times to the modern time. Tidal range has been the major attraction for the continuous settlement, which facilitates movement of boats without much energy in a given particular time. Budhel and Hanuman-no-Timbo are important Harappan sites situated along the Gulf and Vallabhi and Hathab are noteworthy sites of the historical period. Gogha was the most important port during the medieval as a large number of stone anchors have been recorded from inter tidal zone. The majority of the anchors fall in the group of Indo-Arab type and they have been dated between the 10^{th} and the 14^{th} century AD on the basis of finding of the Islamic glazed ware along with the anchors. Similarly, anchors have been reported from Hathab and Gopnath. The most interesting anchor includes a Chinese type datable to the 12^{th}-14^{th} century.

The Kodinar region is rich in archaeological remains as two Harappan period sites are located at Kanjetar and Kaj respectively. Similarly, historical period remains have been traced at Kaj and Mul Dwarka. The discovery of amphorae sherds from Kaj indicate that another settlement with Roman trade was situated between Bet Dwarka and Hathab as these two sites have been mentioned in the Periplus of the Erythrenean Sea. Perhaps this lost the importance as a port during the medieval period when Veraval, Mul Dwarka and Div emerged as leading trade centers. Another site of late historical and early medieval period at Chhara has interesting location and part of it submerges during the highest high tide. The evidence suggest that coast has gone under change during early medieval period may be due to sea level changes. Marine archaeological investigations in and around of Mul Dwarka region has yielded the remains stone anchors at Chhara, Kanjetar and Mul Dwarka, which indicate that during the historical and the medieval period these were active maritime trade centers. It will worth to mention the discovery of a medieval period lighthouse on the shore of Mul Dwarka.

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Table 1: Stone anchors from various sites along the Gujarat coast

Site	***Composite anchors***	***Indo-Arabia type anchors***	***Ring stone anchors***	***Total***
Dwarka	35	63	25	123
Bet Dwarka	25	17	--	42
Miyani	2	6	4	12
Visawada	10	2	2	14
Kindar Kheda	1	--	--	1
Srinagar	1	--	--	1
Ghumli	--	--	1	1
Somnath	6	2	35	43
Mithi Virdi	--	4	--	4
Gopnath	--	1	--	1
Hathab	--	4	--	4
Ghogha	1	18	--	19
Mul Dwarka	3	1	-	4
Total	**84**	**118**	**67**	**269**

Note (1): A few scholars (Shah, 1960:310-20; Leshnik, 1968:911-22; Pandya, 1977:99-103) have contested the identification of dockyard as not being a real dockyard but drinking water pond or irrigational tank.

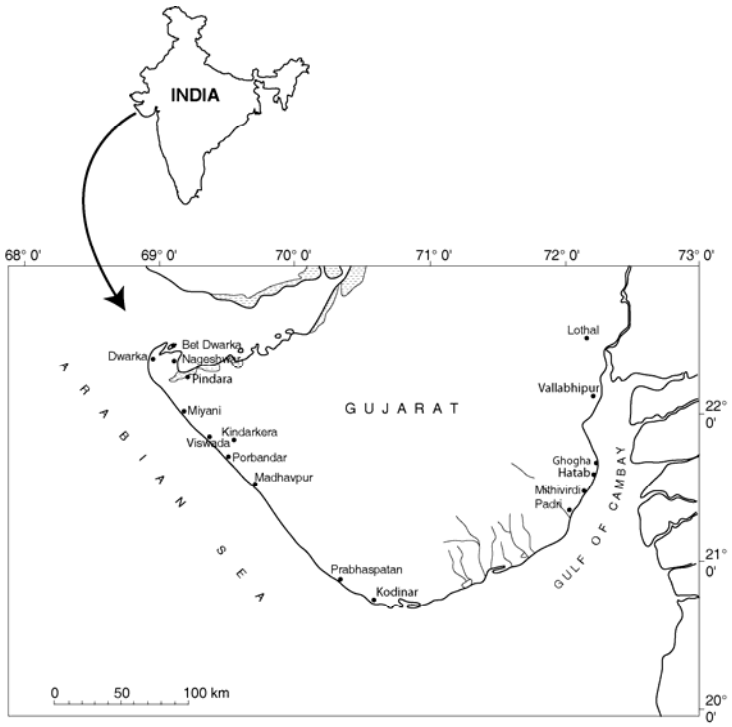

Figure 1. Archaeological sites along the Saurashtra coast

Figure 2. Stone anchor found at Kindar Kheda

Figure 3. Ring stone anchor found in Somnath waters

Figure 4. Medieval period light house at Kodinar

Figure 5. Biggest stone anchors noticed at Mithivirdi, Gujarat.

Figure 6. Medieval period Blue glazed pottery from Ghogha

Figure 7. Medieval period brown glazed pottery from Ghogha

Figure 8. Large glazed vessel found in Ghogha area

Figure 9. Chinese type stone anchor from Hatab

Figure 10. An Indo-Arab type anchor exposes during the lowest low tide off Gopnath

Maritime Archaeology of Gujarat: Northwest coast of India

A.S. Gaur and Sundaresh

Abstract

The evidence of maritime activity in India may be traced back to the Bronze Age (early 3rd millennium BC to mid- 2nd millennium BC). The excavation of several Harappan sites including Lothal, Kuntasi, Padri, Nageshwar, Bagasra and many others have conclusively demonstrated an advance maritime culture during the third millennium Before Christ (BC). During the historical period several coastal towns had international trade and commerce including Bet Dwarka, Somnath, Hathab, Vallabhi, and Bharuch. Maritime activity reached it's zenith in Gujarat during the Medieval period (8th to 14th century AD) when Arab traders dominated the Indian Ocean for over a millennia. Underwater investigations have been carried out at various places along the Saurashtra coast and a large number of stone anchors were found.

This paper also discusses the effect of tide when using jetties and anchoring points along various parts of the west coast India. The archaeological evidence indicates that two gulfs along the Gujarat coast (Gulf Kachchh and Gulf of Khambhat) witnessed the hectic maritime activities in the past. Both gulfs have very high tidal ranges. The Gulf of Khambhat has the highest tidal range in India (11 meters). Ancient texts such as *Vishnu Puran* and *Periplus of the Eruthreanean Sea* vividly describe the tidal range and its uses in navigation. The discovery of the large number of stone anchors in the inter tidal zone along the gulf region support the above references.

Introduction

Maritime activities along the Gujarat coast dates back to the Harappan period and extensive excavations at Lothal (Rao 1974:70), Kuntasi (Dhavalikar, *et al.* 1996:76), Nageshwar (Hegde, *et al.* 1990:152), Bagasra (Sonawane, *et al.* 2003:41) and Nagwada (Bhan and Gowda 2003:51-80) have yielded conclusive evidence on maritime practices during the 3rd millennium BC. During the historical period (3rd century BC to 4th century AD) a series of ports existed all along the Gujarat coast and important among them were Nani Rayan (Irani and Dandekar 2003:91-97) Bet Dwarka (Gaur and Sundaresh 2003:57-66), Dwarka (Ansari and Mate 1966), Vallabhi, and Hathab (Pramanik 2004:133-140). Whereas by the Medieval period (8th to 14th century AD) the entire Gujarat coast had series of ports.

Gujarat coast is punctuated with several creeks and seasonal rivers that facilitated safe harbours all along the coast. The waters around the Gujarat coast are also rich in marine resources, such as shells which were used as food as well as export products. Conch shell have been a major economy source for many fishermen in Gujarat (Pota and Patel 1991:445-450).

The important sites of the maritime archaeological investigations along the Gujarat coast include Dwarka, Bet Dwarka, Miyani, Visawada, Somnath, Kodinar and Ghogha (Figure 1). The brief descriptions of the findings from these sites are provided in the following paragraphs.

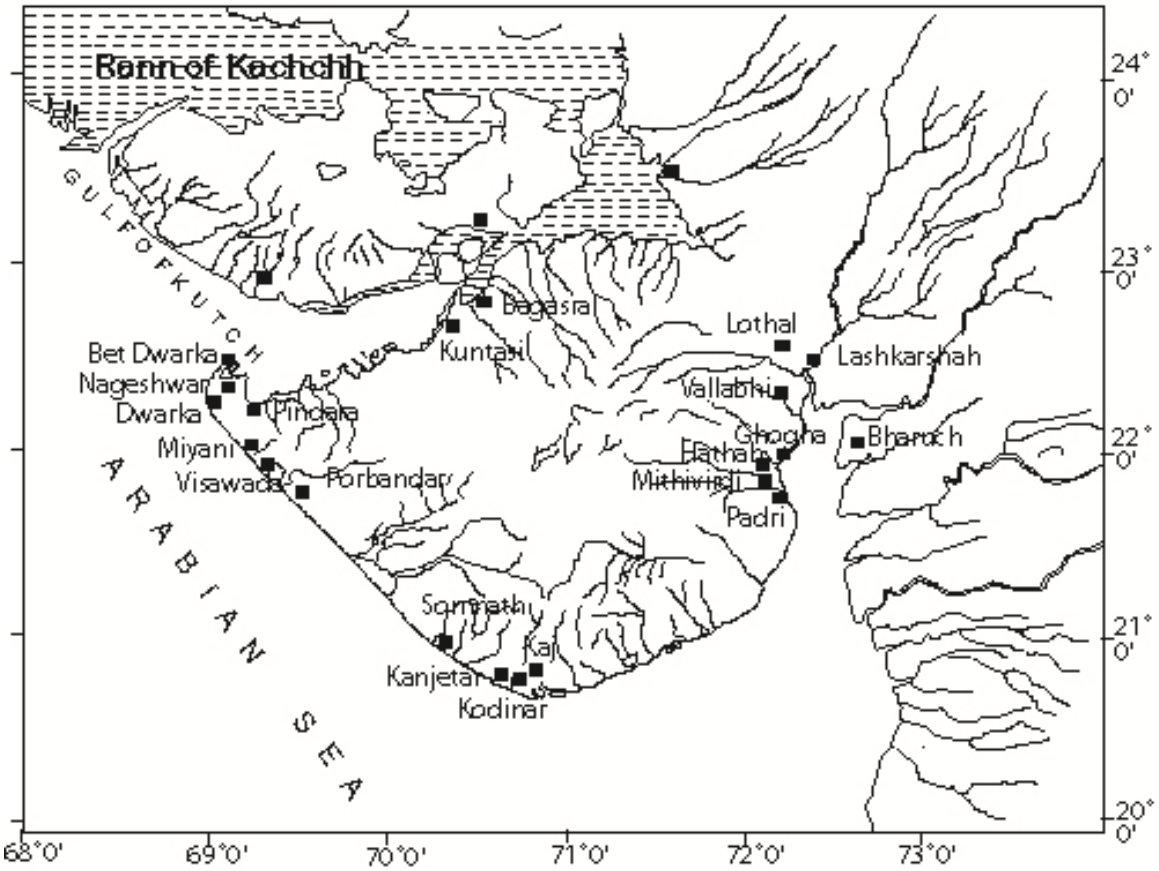

Figure 1. Map showing archaeological sites mentioned in the manuscript along Gujarat coast (Prepared by. S.B. Chitari)

Dwarka

Dwarka was the first site in India where marine archaeological exploration commenced and investigations continued for almost two decades (Rao 1988:47-53; Gaur, *et al.* 2004:1256-60). A number of artifacts were discovered during offshore explorations between 3 and 16 m water depths. Several stone structures were noticed off Dwarka and they are of various shapes and sizes. A few semicircular structures are partially intact and have jointed with hard binding material. The semicircular structures were constructed by using L-shaped blocks with provision for dowels (Gaur, *et al.* 2008:16). Besides semicircular blocks, a large number of rectangular blocks have been noticed in this area. They are scattered over a vast area and do not follow any regular plan. These blocks are found close to the semicircular structures, which indicate that these might have been parts of a larger structure. The circular and semicircular structures are presumably the bases of pillars and rectangular and square dressed blocks are of a main jetty structure that ran from shore into the water and continued until 300 m offshore. Hasmukh Sankalia (1966:10) has mentioned that “Sayajirao Gaekwad of Baroda had built a dock along the Gomati creek and a landing place on the opposite side, with huge stone pillars to facilitate tying the ship”. It is quite

likely that the remains lying on the shore and offshore regions are remains of the same dock. The presence of stone anchors that are lying along these structures also supports this hypothesis.

Along with stone structures a large number of stone anchors of different shape and sizes were noticed between the inter-tidal zone and 16 m water depth, the concentration of them being in 6 to 8 m water depth (Sundaresh, *et al.* 1999:229-252). Broadly these anchors have been divided into three groups,

a) **Composite anchors:** majority of the anchors have been chiseled out of a thin limestone block triangular in shape but often the narrower portion has a half circle with a circular hole known as rope hole and two rectangular or square holes on the wider side called fluke hole. The biggest anchor of this variety has a length of 1.8 meter and maximum width 86 centimeters (cm) and the estimated weight is 496 kilograms (kg) (Figure 2). The smallest anchor weighs 16 kg.

b) **Indo-Arabia type** of anchors were cut from a hard and long stone block with a tapering on one side and a circular hole and the other side with two rectangular or square holes on either face of the block (Gaur, *et al*. 2004a:134-51). The biggest anchor has a length of 2.37 m, a width of 40 cm and an estimated weight of 668 kg while the smallest anchor with its shape fully preserved has an estimated weight of 82 kg.

c) **Ring stone anchors**: twenty-four ring stone anchors have been found from Dwarka water and they are of various sizes (Gaur, *et al*. 2002: 390-404). The biggest has a height of 50 cm and diameter 52 cm and an estimated weight of 245 kg whereas the smallest ring stone weighs 20 kg. Similar types of ring stones have been reported from Oman waters (Vosmer 1999: 301).

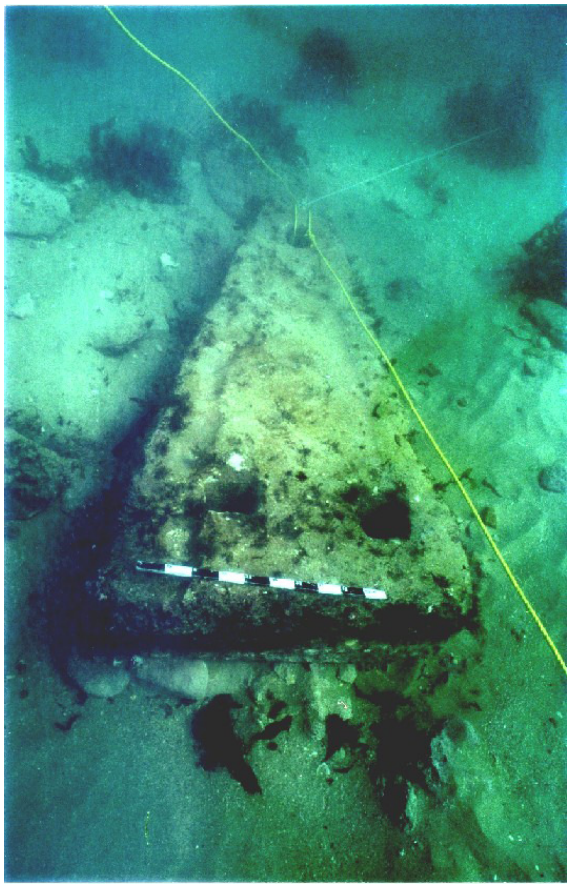

Figure 2. Dwarka: Composite type stone anchor
(Photo by S.N. Bandodkar in 2001)

Bet Dwarka

Bet Dwarka is an island situated in Okhamnadal and at the entrance of the Gulf of Kachchh. The area is also referred to as the Gulf of Barake in the Greek sea guide, the *Periplus Maris Erythraei* (Schoff 1912:38). However, Ptolemy mentioned Barake as an Island in the Gulf of *Kanthi*, which has been identified as the Gulf of Kachchh (McCrindle 1885:36).

In the 17th century BC the late Harappan people had established their settlement on the northwest part of the Island (Gaur and Sundaresh 2003:57-66). They used rich marine resources available around the Island such as the variety of fishes and shells (Gaur, *et al.* 2005:941-46). A large fishhook (Gaur and Sundaresh 2004:512-14) and shell artifacts are the testimony of the above statement. The scanty habitation deposit suggests that the site was abandoned after a couple of centuries (Gaur and Sundaresh 2003:57-66). The Island was again inhabited during the 8th century BC on the southeastern coast of the Island. Maritime activities reached it's zenith during the historical and the medieval periods. The Island continued to be an important center of maritime activity until the emergence of the Okha port in the Okhamandal area.

The underwater explorations were carried out near the present Bet Dwarka passenger jetty in two seasons (2001 and 2002). A large number of artifacts including sherds of amphorae, lead anchors, lead ingot, a hand-mill of

stone, besides 45 stone anchors, were noticed from this area between water depth of 5 and 8 m.

There are 42 stone anchors lying in Bet Dwarka waters close to the present Bet Dwarka jetty, in 6-8 m water depth. They are of two types: A) composite type: majority of them were cut from locally available limestone blocks. The circular hole (rope hole) is often found broken whereas two square/ rectangular holes on other side are preserved. The anchors are very similar to those reported from Dwarka and other places in Saurashtra. B) Indo-Arab type anchor are made of hard rock such as basalt and sometimes sandstone. The stone anchors have been dated between the historical and medieval periods.

Pindara

The ancient temple site of Pindara is situated close to the Northern Saurashtra coast in the Gulf of Kachchh about 36 km west of Khambhalia and 24 km from Kalyanpur. On the west of Pindara is a vast marshy land known as Okha Rann. Pindara is a well sheltered area, free from open sea waves. It is comprised of mud flats up to a distance of 2 km from the high waterline with a gentle slope. The average tidal range in the region is 1 to 4 m.

A huge temple complex (10 X 10 m) is exposed during low tide in Pindara at about 300 m from high water line (Gaur, *et al.* 2007:733-35). Presently, the floor area is made of dressed lime stone blocks (Figure 3), it is well preserved, while the superstructure has been destroyed and the stone blocks have been washed/ taken away. This temple was dedicated to the Lord *Shiva*, as a *yoni*[1] is present in the middle of the temple complex. The majority of the stone blocks measure 60 X 45 X 25 cms. The remaining part of the sanctum (*Garbha griha)* measures 4.75 X 4.5 m. The *yoni* measures 40 X 40 cms. The architectural feature of the submerged temple corresponds more or less with existing temple on the shore of Pindara. The size of the submerged temple must have been as big as other surviving temples in Pindara's group of temples dating back to the 7th to 10th century AD. The evidence indicates that the Saurashtra coast shoreline has changed significantly during the last 1000 years.

[1] Yoni is symbol of creation and worshipped across the Indian subcontinent since the antiquity.

Figure 3. Pindara: An ancient temple complex exposes during low tide (Photo by A.S. Gaur, 2006)

Miyani

Miyani is situated about 40 km east of Dwarka. This area is famous for ancient temples dating back to the 10th century AD (Sampura 1968: 87). On the coast of Miyani a temple is dedicated to a Goddess (locally known as Harshadmata). It is situated on a high hill. A vast creek known as Meda Creek runs a few miles into the hinterland, which has been used as a shelter in the harbour for local small craft, particularly fishing vessels.

Underwater explorations were undertaken about 1 km offshore of Harshad Mata temple. Archaeological findings comprised of twelve stone anchors of various types.

Visawada

The small town of Visawada lies about 40 km west of Porbandar and about 20 km east of Miyani. The Hindu pilgrimage center and a temple dedicated to the Lord Krishna, is situated in the middle of the town. Kindari Creek runs a long distance up to Kindar Kheda (a Harappan town) and perhaps the creek's name is derived from this particular ancient town. The western side of the coast is represented by a high cliff while the eastern coast consists of sandy beaches.

Explorations were undertaken off the Kindari Creek as a baseline, it is located about 500 m from the coastline. Features and artefacts were concentrated between 5-6 m water depths. A total of 14 stone anchors were

found and represent three varieties: composite, Indo-Arabia and ring stone types.

Somnath

The archaeological excavations on land at Prabhasa by the Baroda University and Deccan Collage Pune have yielded evidence of a township dated to 2000 BC (Rao, *et al.* 1992:13-16). The temple of Somnath nearby is dedicated to Lord Siva and the linga[2] is counted among the 12 *Jyotirlingas* of India mentioned in various Puranas.

The explored area in Somnath water is located at a distance of 400 m south-west of the Somnath temple. Somnath waters contained the largest occurrence of ring stones anchors (Figure 4). Out of the 43 total anchors discovered, 80% are ring stone. The water depth varies from 7 m to 15 m. The ring stones observed shallower than 8m water depth had seaweed growth, however ring stones of deeper depths have a layer of greyish marine growth.

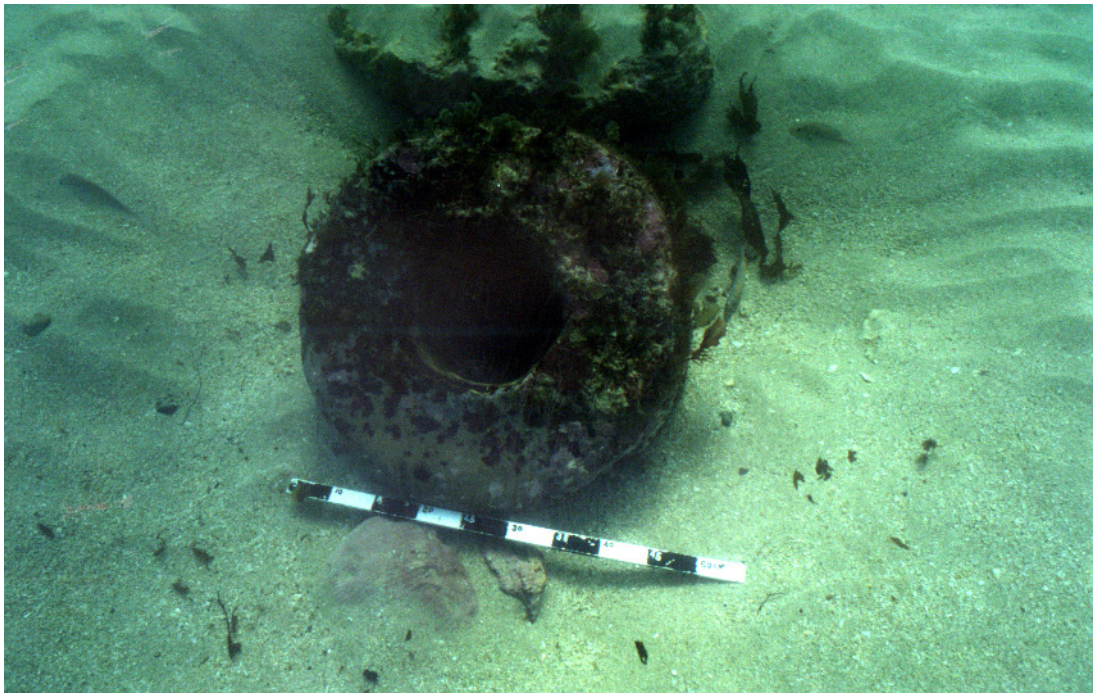

Figure 4. Somnath: Ring-stone anchor (S.N. Bandodkar in 2001)

Kodinar (Mul Dwarka)

A small coastal village known as Mul Dwarka near Kodinar in the district of Junagad is one of the claimants of the original Dwarka of Mahabharata. The proximity with Junagadh hills on the north and the sea on the south situate the town as being associated with Dwarka (Sankalia 1966:7). An ancient temple is situated on raised land close to the sea. The temple is dilapidated and not under worship. The shrine is dated to the post 10th century AD (Sampura 1968:113). A circular structure situated close to the ancient temple is about 4 m in height and

[2] Linga is a phallus symbol worshipped across the Indian subcontinent since the antiquity.

constructed with a similar type of dressed limestone blocks as that of the temple. Locally this structure is called as *Diva Dandi* which means a lighthouse (Gaur, *et al.* 2010:418-422). If this structure served as a lighthouse then this may be the oldest lighthouse remains on the Saurashtra coast. An ancient well was noticed near the jetty which is still used as a drinking water source.

The exploration in the inter tidal zone yielded a composite stone anchor. The anchor is exposed during low tide. It is made of sedimentary rock. The anchor is similar to those reported from Dwarka (Gaur, *et al.* 2008:23-57) and Bet Dwarka (Gaur, *et al.* 2005:113-129) and dated between the historical and the medieval periods.

The underwater investigations in and around Mul Dwarka (Kodinar) have been of significance in respect to understanding the archaeology of this region. Now the data of underwater explorations from all the three Dwarka on the Saurashtra coast are available and the most common aspects of them is the presence of similar types of stone anchors, therefore, the tradition of Dwarka at these places might have been existed contemporaneously (around 7^{th} - 8^{th} century AD). Another common aspect of these sites is the presence of Harappan (mid 3^{rd} millennium BC) and late Harappan (early 2^{nd} millennium BC) settlement within close proximity to each other. For example, Nageshwar and Bet Dwarka near Okhamandal Dwarka, Kindar Kheda near Mul Dwarka (Visawada) and Kanjetar and Kaj near Mul Dwarka (Kodinar). All the three Dwarka have ancient temples dated to the 10^{th} -12^{th} century AD. Nonetheless, these sites were busy ancient ports and perhaps temples were served as coastal marker points for navigators, as well as for worship before embarking on long voyages.

Mithi Virdi

The small village Mithi Virdi is situated about 30 km south east of Talaja, a *taluka* headquarter. The village is lying on a raised plateau close to the seashore. A small seasonal river merges with the sea on the western side of the village. The archaeological site is located about one km west of the village in an agriculture field.

Five stone anchors are lying on agricultural land (ground nuts are the important crop of this field) about 1 km north of the seashore. Three anchors are lying together at a distance of 10 m and oriented in the east-west direction (Gaur, *et al.* 2005:110-14) The fourth anchor is laying partially buried north of the other three and oriented in the east west direction.

All the anchors are similar to each other in shape and size. The anchors have rectangular cross-sections and trapezoidal longitudinal sections. These have sharp edges and chisel marks on them are clearly noticed. They have been cut from conglomeratic sedimentary grit rock, which is dark brown in colour and small gravel can be noticed. The anchors have two lower rectangular holes and an upper circular hole is absent in all the anchors.

Ghogha

The town of Gogha is located on the mid western coast of the Gulf of Khambhat in Bhavnagar district of Gujarat. A famous Gujarati proverb, "*Lankani lari ane*

Ghoghono var" (Bride of Lanka and groom of Ghogha) indicates direct overseas relation between Gogha and Sri Lanka in the past (Chaukasi 1989: 634). The presence of ancient Jaina temples at Gogha dating back to the 10^{th} – 11^{th} centuries suggest that this was a religious center also. The earliest Arabic inscription from Gogha dates to 1170 AD (Oza 1885: 2). During the British period ships up to 1500 tons were laden here (Habib 1982: 23).

The exploration at Gogha was undertaken during low tide and findings were recorded with still photography and drawing. A large number of stone anchors were recorded between 100 and 200 m distance from the high water line (Gaur 2010:146-155). The majority of the anchors belong to the Indo-Arab type and nearly about 40% anchors are fragmented. Interestingly, the fresh surface of broken parts suggests that fragmentation of the anchors took place during the manufacturing stage and not during the anchoring processes. A composite anchor made of lime stone was found at the site. A few unfinished anchors were found from Gogha and Hathab. However, these anchors were submerged in 5 to 7 m water depth during high tide. Thus, it indicates that big boats were anchoring at this point during high tide. The author of the *Periplus of the Erythrenean* also refers to such activities detailing that during low tide boats rest on the seabed.

The exploration in the inter tidal zone has also yielded several sherds of the glazed ware in the vicinity of stone anchors. These include a jar with internally and upper half externally glazed; and the rest of the sherds are glazed internally only. There are three main types of glazed ware (i.e. green, blue and brown). These are very similar to the Islamic glazed ware found from various parts of the country (Mohammad 1985:105). The medieval period glazed ware at Hastinapur (Lal 1954-55:5-151) was found in association with coins of Balban (1206-87 AD). The sherds recovered from the inter-tidal zone of Ghogha are very similar to those reported from another medieval period site at Lashkarshah in Khambhat which have been dated to 14^{th}-16^{th} century (Bhan 2006: 90-95). Thus the glazed sherds Ghogha may also be dated to the late medieval period.

Hathab

Hathab an early historical site is referred to as *Astacampra* in the *Periplus of Erythrenean Sea* (Schoff 1912: 40). On shore excavation yielded rich antiquities of the historical period and maritime contact with the west. It is located about one km into the hinterland. The exploration in the inter tidal zone of Hathab yielded two anchors similar to those of the Indo-Arab type and one anchor with a wide groove wrapped around the middle of the anchor. This is very similar to those reported from Japan and Chinese waters (Yang 1990:113-121).

The remains of a jetty were noticed at the mouth of the river Shetrunji near the village Sultanpur. This was primarily a wooden jetty now abandoned due to emergence of other ports in the vicinity.

Conclusions

Coastal and maritime archaeological investigations along the Gujarat coast have conclusively proven that it holds the earliest evidence of the maritime activity in

the Indian subcontinent. Archaeological set up of the Kachchh region provide enough indication that the Rann of Kachchh was a navigable body during the third millennium BC. During the historical period Gujarat witnessed hectic maritime activities and boats from various regions including the Mediterranean Sea. The maritime activity reached its zenith during the Indo-Arabia trading network of the medieval period and a large number of evidence indicates that Gujarat played an important role in the Indian Ocean trade system during this period. Marine archaeological investigations during the last two and half decades have brought out a number of potential sites along the Indian coast which include ancient ports, jetties, and shipwrecks. The extensive explorations of the Saurashtra coast revealed several ancient ports and jetties. Interestingly, archaeological discoveries suggest that natural phenomena like tidal variations have been very effectively used in the Gulf of Kachchh and the Gulf of Khambhat in the past.

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