

Stone anchors from the Okhamandal Region, Gujarat Coast, India



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Introduction

The earliest archaeological evidence for maritime activity in India has come from the Indus Valley civilization (3000 BC) where people voyaged from the Gujarat coast (Western India) to Mesopotamian ports in the Persian Gulf and on the East African coast (Rao, 1987: 2). These maritime events are also recorded in Mesopotamian texts, where the word *Meluhha* has been identified with the Indus Valley civilization (Ratnagar, 1981). However, there is very little information on the nature of the navigation, boatbuilding and trade. Excavation at the well-known Harappan port town at Lothal has revealed a dockyard (Rao, 1979) and at Kuntasi a jetty (Dhavalikar *et al.*, 1996), in addition to a few stone anchors at both places. Such findings perhaps indicate the level of knowledge of maritime activity during the Harappan Period.

A significant amount of work on stone anchors has been carried out, in particular from the Mediterranean (Frost, 1963; Dimitrov, 1976; 1977; 1979; Nibbi, 1991; Shaw, 1995), the Black Sea coast (Kingsley & Raveh, 1994; Grossmann & Kingsley, 1996) and the African coast (Frost, 1979; Chittick, 1980; Nibbi, 1992; Galili *et al.*, 1994; Basch, 1994). Those anchors were dated from the mid-3rd millennium BC to the 15th century AD. Marine archaeological exploration on Indian coasts

especially at Dwarka, Somnath (Rao *et al.*, 1992), Sindhudurg (Sila & Gaur, 1997: 51), Vijaydurg (Sila *et al.*, 1998) and Mandapam (Rajmanickyam & Jayakumar, 1991) have brought to light a range of stone anchor types which have been dated.

This paper describes and discusses the stone anchors recovered during underwater exploration between 1986 and 1998 in Dwarka, Bet Dwarka, and Aramda.

Background history

Marine archaeological exploration has been carried out at several locations in the Okhamandal area, where anchors have been found (Fig. 1).

Dwarka

The site (22°14'N, 68°58'E) is located in Okhamandal Taluka in the Jamnagar District. Dwarka is one of the most important religious centres for Hindus and is considered one of the four *Dhamas* on the west coast extremity of India. The first systematic land excavation at Dwarka was conducted by Deccan College, Pune, in 1963 and dated the earliest occupation of Dwarka to the 1st–2nd century BC (Ansari & Mate, 1966: 13–17). Subsequently, a team from the Archaeological Survey of India demolished a modern building in 1979–80 in the forecourt of the Temple of Dwarkadhish which revealed the remains of a Vishnu temple of the 9th century AD.

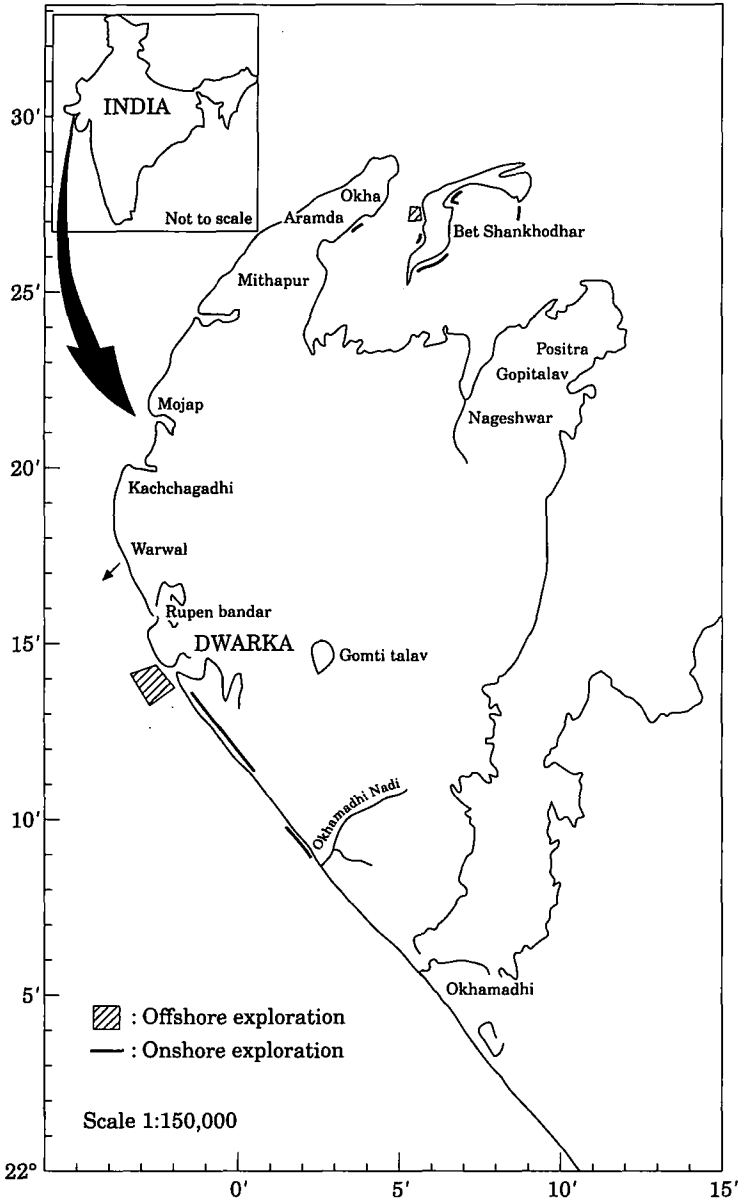


Figure 1. Map showing the location of onshore and offshore survey in the Okhamandal area. (Drawing: S. B. Chitari)

Further excavation revealed two more phases of the temple datable to the 1st century BC/AD (Rao, 1990: 63). Rao (IAR, 1979–80) has noted the presence of evidence for the destruction of a proto-historic settlement of the mid-2nd

millennium BC. Layers 10A and 11 in trench DWK 3 yielded Lustrous Red Ware of the 15th century BC.

Since 1983, the Marine Archaeology Centre of the National Institute of Oceanography, Goa, has been carrying out

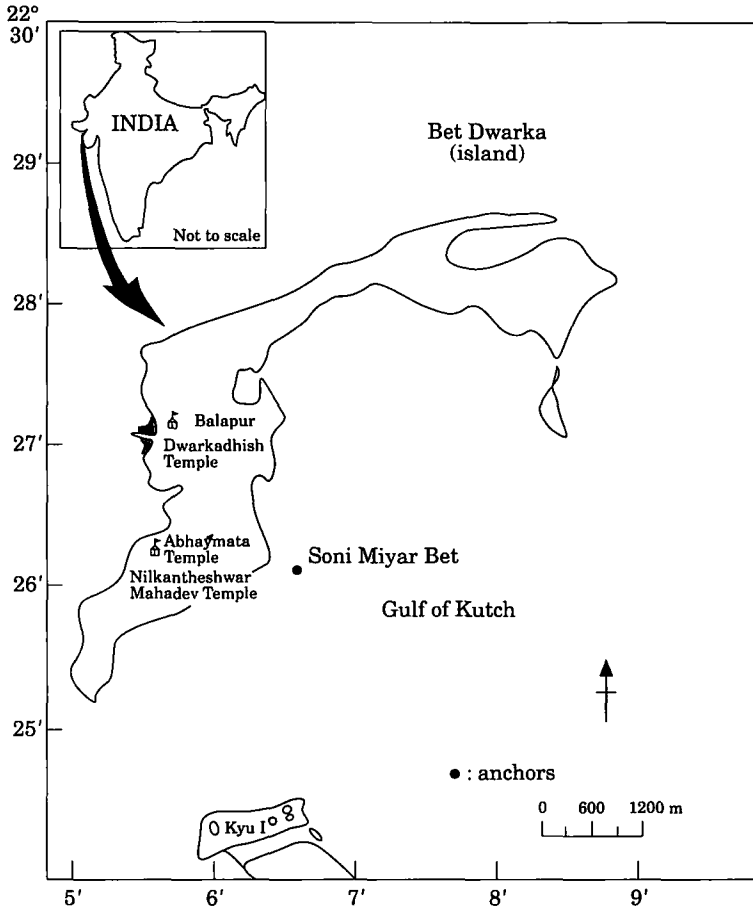


Figure 2. Map showing the survey area on Bet Dwarka Island. (Drawing: S. B. Chitari)

underwater exploration off Dwarka. A large number of structural remains have been recorded which include massive walls, bastions and stone pillars (Rao, 1987: 39; Rao *et al.*, 1994).

The echograms of the seabed at water depths between 3 and 20 m revealed that the topography is generally uneven and rough. A channel in the form of a symmetrical or asymmetrical cutting is the most prominent feature of the region (Vora *et al.*, 1991: 32–38).

Bet Dwarka

Bet Dwarka Island (22°22'12"N to 22°28'36"N and 69°05'03"E to 69°09'02"E)

is situated in the Gulf of Kutch about 5 km north of the mainland of Okhamandal and to the east of Okha port. Bet Dwarka is also known as Bet Shankhodhar. The island is about 13 km long with a narrow crooked strip of sand and rock. The eastern part of the island comprises sand-hills and bushes and is known as *Hanuman Point*. Its south-western half is rocky tableland and about 15–18 m (50–60 ft) high. The geological formation of Bet Dwarka is mostly Upper Miocene and Pliocene marls and arenaceous clays which are capped by a sandy limestone and a hard calcareous sandstone (Merh, 1995: 123).

Table 1. Details of triangular anchors from previous exploration off Dwarka

Anchor no.	Type of anchor	Raw material	Weight (kg)	Length (cm)	Width (cm)		Thickness (cm)	Diameter of top hole (cm)	Lower holes (cm)
					max.	min.			
1	Triangular	Calcareous	87	93	67	32	13	10	8 x 9 9 x 9
2	Triangular	Laterite	91	70	52	20	20	8	8 diameter
3	Triangular	Calcareous	78	76	53	35	13	9	8 x 8 9 x 8
4	Triangular	Calcareous	105	82	78	40	12	11	10 x 10 10 x 10 11 x 11 10 x 10
5	Triangular	Calcareous	82	71	63	40	18	10	
6	Triangular	Calcareous	18	59	34	27	5	7	
7	Triangular	Calcareous	15.5	47	34	23	6	5	5
8	Triangular	Calcareous	—	75	70	40	12	8	12 x 12 11 x 9
9	Triangular	Calcareous	—	112	54	20	10	8	9 x 9 9 x 9
10	Triangular	Calcareous	—	107	73	56	13	11	13 x 13 13 x 13
11	Triangular	Calcareous	45	73	50	23	13	12	9 x 9 9 x 9
12	Two-holed	Calcareous	—	71	58		15	11	9

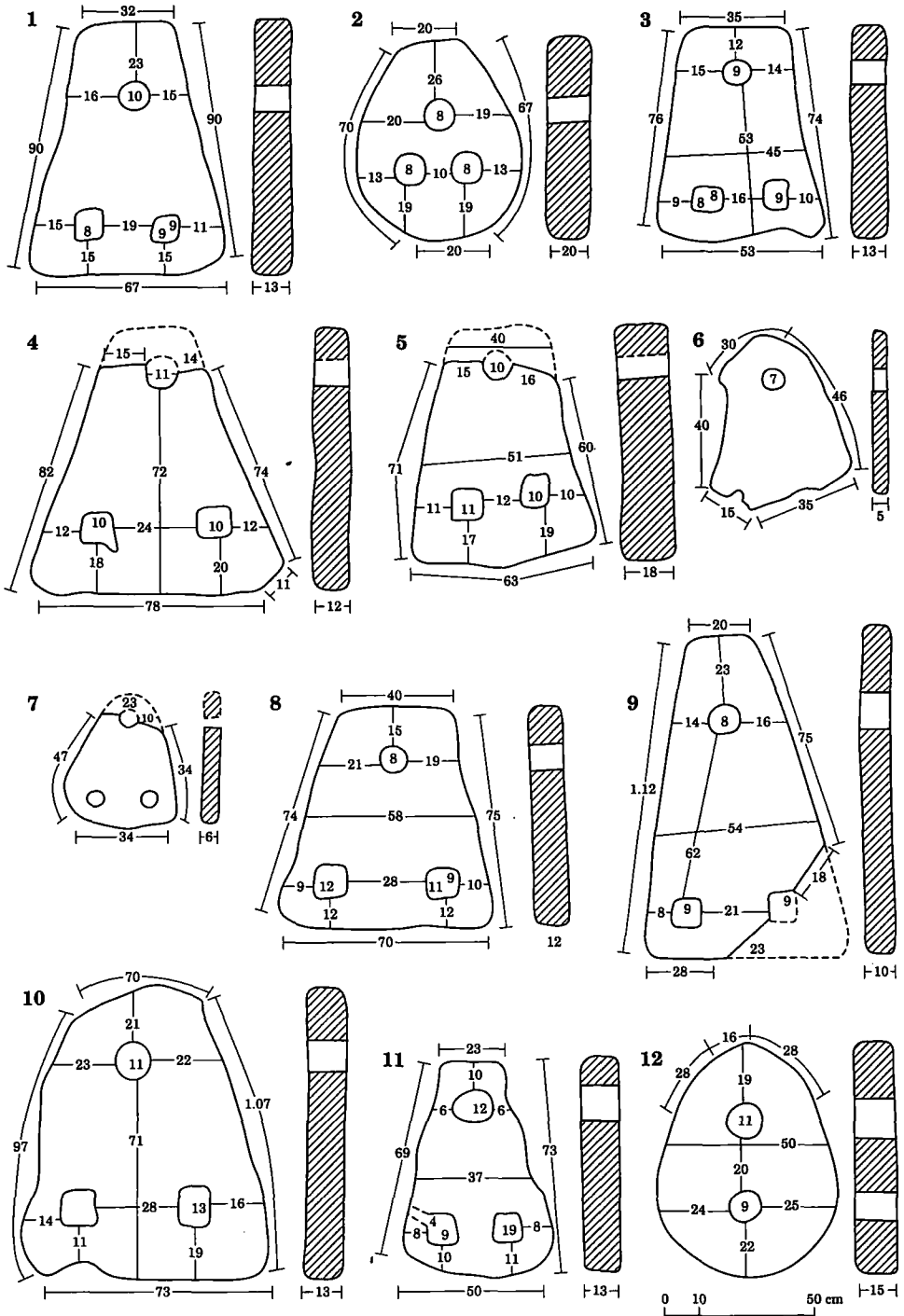


Figure 3. Triangular stone anchors from Dwarka waters. (Drawing: S. B. Chitari)



Figure 4. Primitive type of triangular laterite stone anchor no. 2 from Dwarka waters. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)

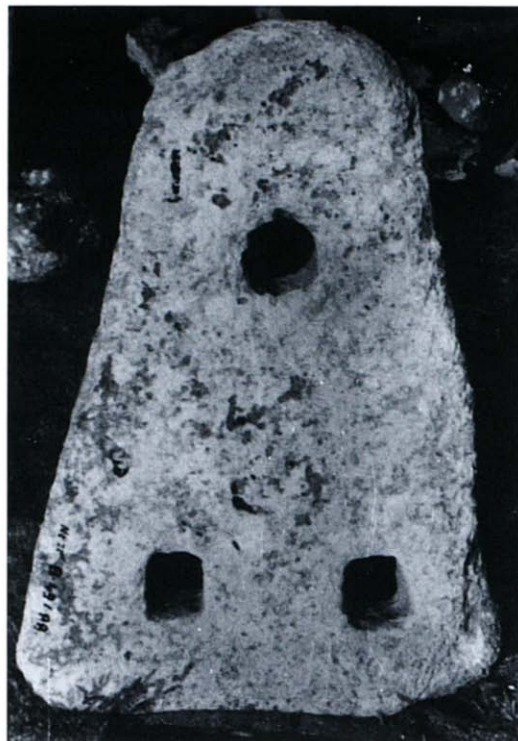


Figure 5. The most perfect triangular stone anchor (no. 1) from Dwarka waters. (Scale: scale 30 cm long) (Photo: S. N. Bandodker)

Earlier excavation near *Nilkantha Mahadev* behind *Dhingesvar Mahadev* identified an early historic settlement. Onshore exploration in 1979 (IAR, 1979–80: 29) has produced a number of potsherds belonging to the Protohistoric Period (2000 BC) from cliff sections near *Siddi Bawa Pir*, the south-eastern point of the island. Marine archaeological surveys have revealed a large quantity of pottery and other antiquities (Rao, 1990: 69) of the late Harappan Period (2000–1500 BC). No stone anchors were found previously.

The present exploration (1997–98) was mostly confined to the south-west coast near the present jetty at Bet Dwarka (Fig. 2).

Aramda

The village of Aramda is situated 7 km south of Okha port on a high tableland.

The village was an important centre of maritime activity during the medieval period. A Late Medieval fort is present in the middle of the village and a few hero stones bearing boat motifs are also present on the western side of the village. The earliest of these dates to AD 1800. The village also has a jetty which at present is extensively used for the repair of ships.

Methodology

Onshore exploration was carried out at Dwarka, Bet Dwarka and Aramda to locate important archaeological objects, such as anchors, cannons and jetties. The positions of finds were recorded by using GPS and sextant. A few objects thus located were retrieved and brought to the camp-site at Dwarka.

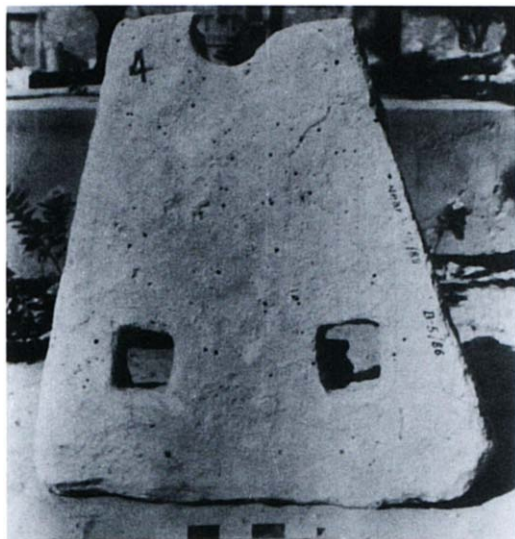


Figure 6. Broken triangular stone anchor no. 4 from Dwarka waters. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)

Based on the results of onshore survey, the diving operations were initiated from a convenient place, off Dwarka and Bet Dwarka. Diving operations were carried out at several places in shallow waters (1.5 m and 8 m) and also at eight locations in deeper waters (10 to 20 m) at Dwarka, while at Bet Dwarka the diving operation was concentrated near the present jetty. Each diving team covered an area of 50 m radius in a circular search pattern. A buoy was tied to each location wherever archaeological objects such as structures and anchors were noted. Underwater finds were documented by U/w TV camera, still camera and drawings. Weights of a few anchors were obtained by using standard weighing scales.

Description of anchors

A total of 32 anchors were noticed in Dwarka waters. Twenty-two anchors were retrieved between 1983 and 1994 and the remaining 10 anchors were found during the present (1997–98) survey. In Table 1 the descriptions of the 10 anchors of the

present survey (1997–98) have been described separately. Out of the remaining 22 anchors, 11 are triangular, 10 are grapnel and one is a two-holed anchor. The description of each anchor type is given below.

Triangular anchors

Triangular stone anchors of various sizes and forms were found off Dwarka (Fig. 3; Table 1). Anchor no. 2 (Fig. 4) is pear-shaped with three holes in the centre forming an equilateral triangle and may be described as primitive: all the holes are round; it has a rough surface and its edges are blunt. Rope marks round the upper hole were noted. Sea organisms are visible in places which are white in colour. It is only 20 cm thick but weighs 91 kg. The material of this anchor is laterite, which is not available locally.

Anchor no. 10 is one of the biggest triangular anchors, very irregular with an uneven thickness and rough surface. It has a circular hole at the top and two square holes below. The material seems to be beach rock which is locally available at Dwarka.

Of four well-preserved anchors with a fine finish, anchor no. 1 has a semi-round top (Fig. 5) and two other anchors, nos 3 and 8, have sharp edges. Perhaps they were not used extensively. They are made of locally available calcareous rock. The nearest source of this rock is at Dhangadra in the Okhamandal area. The anchors have a very smooth and even surface. Both nos 3 and 8 have a circular upper hole and two square holes below. The fourth anchor, no. 11, is smaller than the other three. The upper hole of this anchor has blunt edges and has lost its original shape, suggesting extensive use. It is made of locally available calcareous rock.

The upper portions of two other triangular anchors have broken. Anchor no. 4 has sharp edges and a very smooth surface (Fig. 6) while anchor 5 has blunt

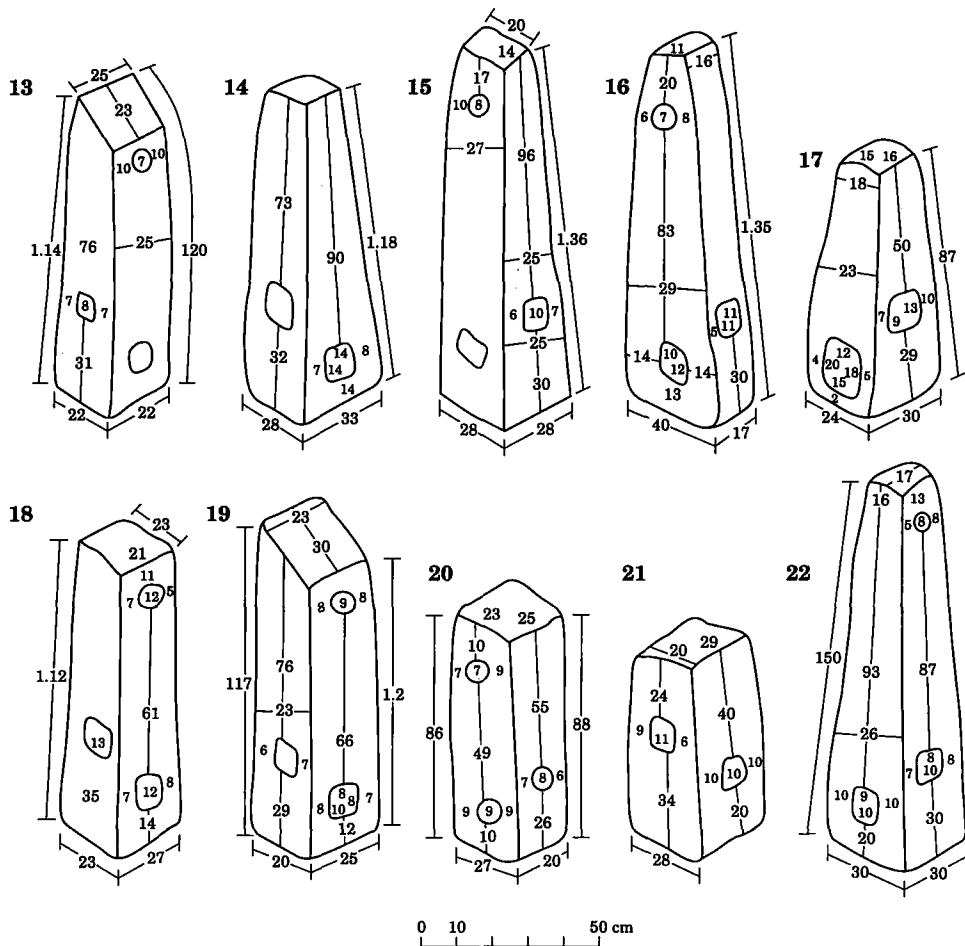


Figure 7. Grapnel stone anchors from Dwarka waters. (Drawing: S. B. Chitari)

edges and a rough surface suggesting extensive use. Both have two square holes at the bottom. They are made of locally available calcareous rock and weigh 105 and 83 kg, respectively. These anchors are at the Dwarka camp-site. Another triangular anchor, no. 9, is incomplete. It has the typical circular upper hole and two square holes below. The anchor has an even thickness, a smooth surface and is made of calcareous rock. The growth of vegetation was noticed.

There are two very small and broken triangular anchors, nos 6 and 7, presently at the Dwarka camp-site. No. 6 was broken at the bottom and the other, no. 7,

at the top. They have blunt edges, rough and uneven surfaces and are made of calcareous rock.

A complete two-holed stone anchor, no. 12, which is pear-shaped was found in Dwarka waters. It has even thickness and is made of calcareous rock. Growth of vegetation was noticed.

Grapnel anchors

A total of 10 grapnel stone anchors of different sizes and weights have been found (Fig. 7; Table 2).

Two grapnel anchors, nos 14 (Fig. 8) and 17, have a round upper portion and lack an upper hole. Both anchors have two

Table 2. Details of grapnel stone anchors from previous exploration off Dwarka

Anchor no.	Type of anchor	Raw material	Weight (kg)	Length (cm)	Width (cm)		Thickness (cm)	Diameter of top hole (cm)	Lower holes (cm)
					max.	min.			
13	Grapnel	Yellow sandstone	125	114	26	22	25	7	8 × 11 8 × 8
14	Grapnel	Calcareous	97	118	33	18	28	—	13 × 16 14 × 14
15	Grapnel	Yellow sandstone	150	136	28	14	28	8	10 × 11 10 × 11
16	Grapnel	Calcareous	—	135	40	11	17	7	12 × 10 11 × 11
17	Grapnel	Calcareous	—	87	24	18	30	—	20 × 15 9 × 13
18	Grapnel	Calcareous	103	112	27	21	23	12	11 × 12 9 × 13
19	Grapnel	Calcareous	—	117	23	30	30	9	8 × 8 8 × 8
20	Grapnel	Calcareous	96	88	27	23	25	7	9
21	Grapnel	Calcareous	75	70	28	20	29	—	11 × 11 10 × 10
22	Grapnel	Basalt	175	150	30	16	30	8	9 × 10 9 × 10



Figure 8. Grapnel stone anchor no. 14 from Dwarka waters. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)

square holes below. The lowest hole has lost its original shape due to extensive use. The anchors are made of reddish yellow calcareous rock. It is possible that these anchors were used as bollards.

Another stone anchor, no. 21, has two square holes which indicate that it is a broken grapnel. It is made of calcareous rock. It has an uneven surface but sharp edges.

Anchor no. 22 is the most important grapnel anchor found in Dwarka waters. It was made out of basalt rock, and weighs an estimated 175 kg. As basalt is not available locally, its origin should be sought either in the lower Saurashtra region or from the Gujarat coast. It has the usual single circular hole at the top and two



Figure 9. Grapnel stone anchor no. 15 from Dwarka waters. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)

square holes below. It tapers towards the top, has a smooth surface and blunt edges. Anchor no. 16 is made of very fragile calcareous rock. The lower two holes have lost their original shape but can be seen to be rectangular. Its upper portion has become smooth and round.

Two grapnel anchors, nos 13 and 15 (Fig. 9), are of locally available yellowish conglomerate rock with a very rough surface and blunted edges. Both have the usual circular hole at the top and two square holes on either side of the lower portion. Chisel marks surviving round the upper hole indicate less use of this anchor. In anchor no. 13 the surviving square hole is very much eroded because it was exposed above the seabed.

Two other grapnels, nos 19 and 20, are in good condition with a fine finish and are made of calcareous rock. They have very sharp edges. Both of them have a circular

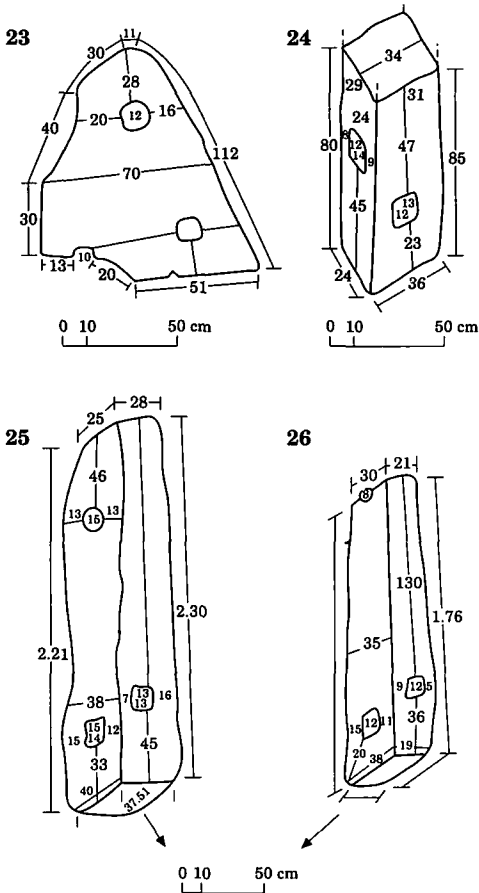


Figure 10. Anchors from the intertidal zone off Dwarka. (Drawing: S. B. Chitari)

hole at the top, but no. 20 has, unusually, two circular holes below.

Stone anchors recorded during the 1997–98 season

Dwarka

During current offshore archaeological exploration at Dwarka several stone anchors were discovered in the intertidal zone as well as others offshore.

Anchors from the intertidal zone (Fig. 10; Table 3). Four stone anchors were found at low tide. Among them were two grapnel anchors submerged 0.5 m at low tide.

1. Broken triangular anchor no. 23 (Fig. 11) is made of calcareous rock and lay on a rocky beach. It has two square holes in the bottom, a smooth surface, texture and even thickness.
2. Broken grapnel no. 24 was found further south of the triangular anchor on a rocky beach. It is made of calcareous rock, has a very smooth surface texture and two square holes in the lower part.
3. Grapnel no. 25 (Fig. 12) has an uneven lower part. It has the usual circular hole at the top and two square holes below. This is the largest and may be one of the heaviest anchors found in Dwarka. It has a rough surface and is made out of yellow sandstone.
4. Grapnel no. 26 is incomplete but is the same weighting and type as no. 25. It has a smooth surface and appears to be of calcareous rock. The growth of vegetation was also noticed.

Anchors from offshore. During the offshore exploration six stone anchors were discovered (Fig. 13; Table 3). These anchors were mostly trapped between rocks. They lay in a rough alignment between approximately 400 and 800 m from the present shoreline (Fig. 14).

1. Grapnel anchor no. 29 was found in 8 m of water at buoy no. 12. It has a circular upper hole and two square holes below. It is of calcareous rock and has a very rough and uneven surface.
2. Grapnel anchor no. 31 was found in a channel near buoy no. 20 (Fig. 15) at a depth of about 6 m. It also has a circular upper hole and two square holes below. It is of yellow sandstone and the lower holes have eroded significantly, suggesting prolonged use.
3. Grapnel anchor no. 30 was recorded at a depth of 7 m at buoy no. 26 (Fig. 16). The anchor is trapped between rocks. This anchor seems to be one of the heaviest (based on the size) recorded underwater. It is of locally available

Table 3. Details of stone anchors off Dwarka found during the 1997-98 season

Anchor no.	Type of anchor	Raw material	Length (cm)	Width (cm)		Thickness (cm)	Diameter of top hole (cm)	Lower holes (cm)	Location
				max.	min.				
23	Triangular	Calcareous	112	70	—	—	12	10	IZ
24	Grapnel	Calcareous	85	36	31	24	—	12 × 14	IZ
25	Grapnel	Calcareous	230	40	25	28	15	13 × 13 15 × 14	IZ
26	Grapnel	Sandstone	176	38	30	21	8	12 × 12	IZ
27	Triangular	Calcareous	80	55	28	10	—	12 × 12 10 × 10	IZ
28	Triangular	Calcareous	65	75	—	—	—	15 12	UW
29	Grapnel	Calcareous	110	30	26	30	10	15 × 11 15 × 10	UW
30	Grapnel	Calcareous	116	27	20	18	11	15 × 15	UW
31	Grapnel	Calcareous	103	25	21	20	14	14 × 14 14 × 14	UW
32	Two-holed anchor	Calcareous	50	75	65	10	—	10 10	UW

IZ, intertidal zone; UW, underwater.



Figure 11. Broken triangular stone anchor no. 23 from the intertidal zone off Dwarka. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)



Figure 12. Grapnel stone anchor no. 26 from the intertidal zone off Dwarka (Photo: S. N. Bandodker)

calcareous rock. The upper hole is circular but the lower hole is eroded.

4. Two-holed anchor no. 32 was found lying in a sandy channel at a depth of 7 m at buoy no. 25 (Fig. 17). It is triangular with circular holes and made of locally available calcareous rock.
5. Broken triangular anchor no. 28 was found at a depth of 5 m at buoy no. 19 (Fig. 18). The upper portion is broken but two square holes at the base are intact. It is trapped between rocks and is made of locally available beach rock.
6. Broken triangular anchor no. 27 is lying in a sandy channel at a depth of 7 m at buoy no. 27. Only the lower holes are preserved and both unusually are circular. It has a very smooth and even surface and is made of sandstone.

Bet Dwarka

Extensive work had previously been carried out on Bet Dwarka Island, particularly on the south-east coast where a protohistoric settlement was recorded. Off-shore survey never revealed stone anchors. During the current offshore survey an extensive examination of jetty areas has been undertaken. Several stone anchors have been noted in the intertidal zone as well as offshore. The three stone anchors from the intertidal zone are as follows.

Anchors from the intertidal zone (Fig. 19; Table 4).

1. Broken grapnel no. 33 (Fig. 20) was found lying north of the present Bet Dwarka jetty. The lower two holes are preserved. It has a very rough surface and is made of locally available conglomerate. The anchor was in use as a mooring stone on the shore before it was removed to the camp-site at Dwarka.
2. Grapnel anchor no. 34, the heaviest of the three, was found in mud on the southern side of the jetty. It has a circular upper hole and two square holes below with rope marks round the upper hole (Fig. 21). Before it was recovered boats used to tie up to it. It

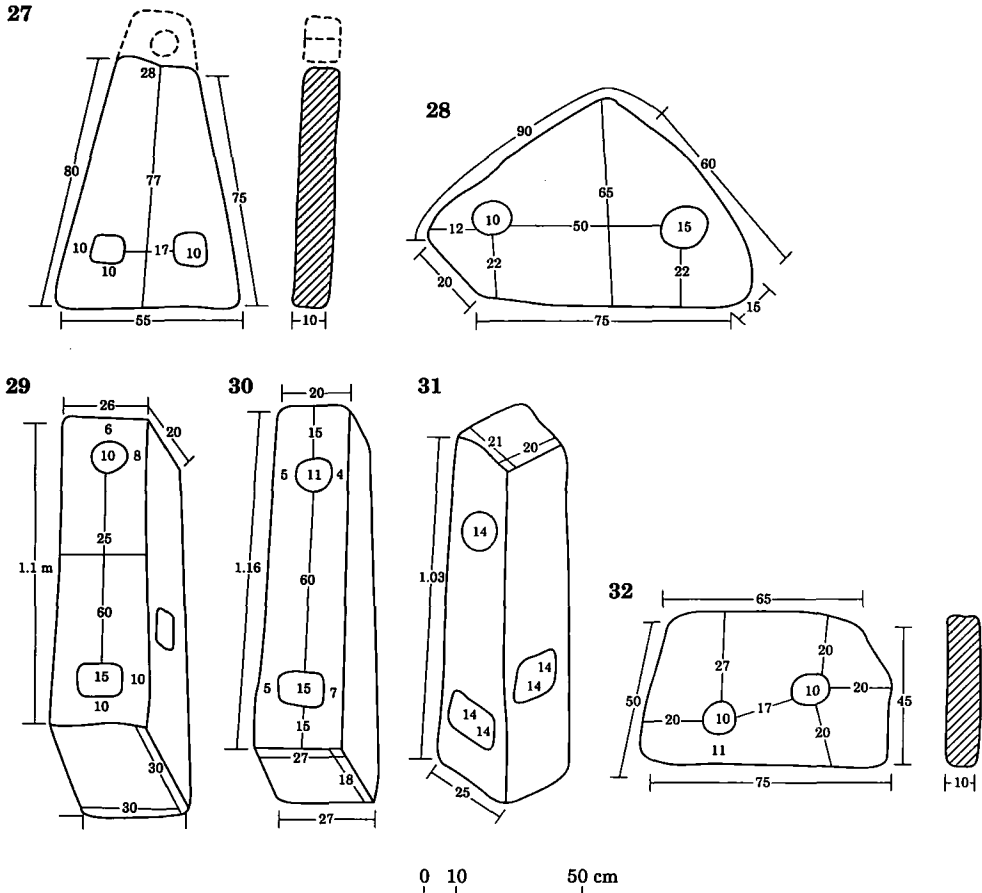


Figure 13. Anchors from Dwarka waters found during the current survey. (Drawing: S. B. Chitari)

is made of locally available yellow sandstone and has a smooth surface.

3. Worn-out triangular anchor no. 35 is lying south of the present jetty (Fig. 22). The form is perfectly equilateral but has a very rough surface due to its porous material. The upper hole is broken and the lower two holes are square. It is made of locally available calcareous rock grey in colour.

Anchors from offshore (Fig. 19; Table 4).

1. Triangular anchor no. 36 has a very rough surface (Fig. 23). It was lying north of the present jetty in a 7 m water depth and about 150 m offshore. As

usual the upper hole is circular with two square holes below. It is made of very porous rock. The edges are blunted and it may have been used extensively.

2. Two-holed anchor no. 39 lay at a depth of 7 m near anchor no. 38 (Fig. 24). Both holes are circular. Although it is also made of beach rock, it is better preserved and the rock is not porous. The anchor is proportionately thick.
3. Triangular anchor no. 38 has three holes and an irregular shape (Fig. 25). It has a very rough surface and is made of porous beach rock. The anchor is in very fragile condition with blunt edges. It was discovered at a depth of 6 m.

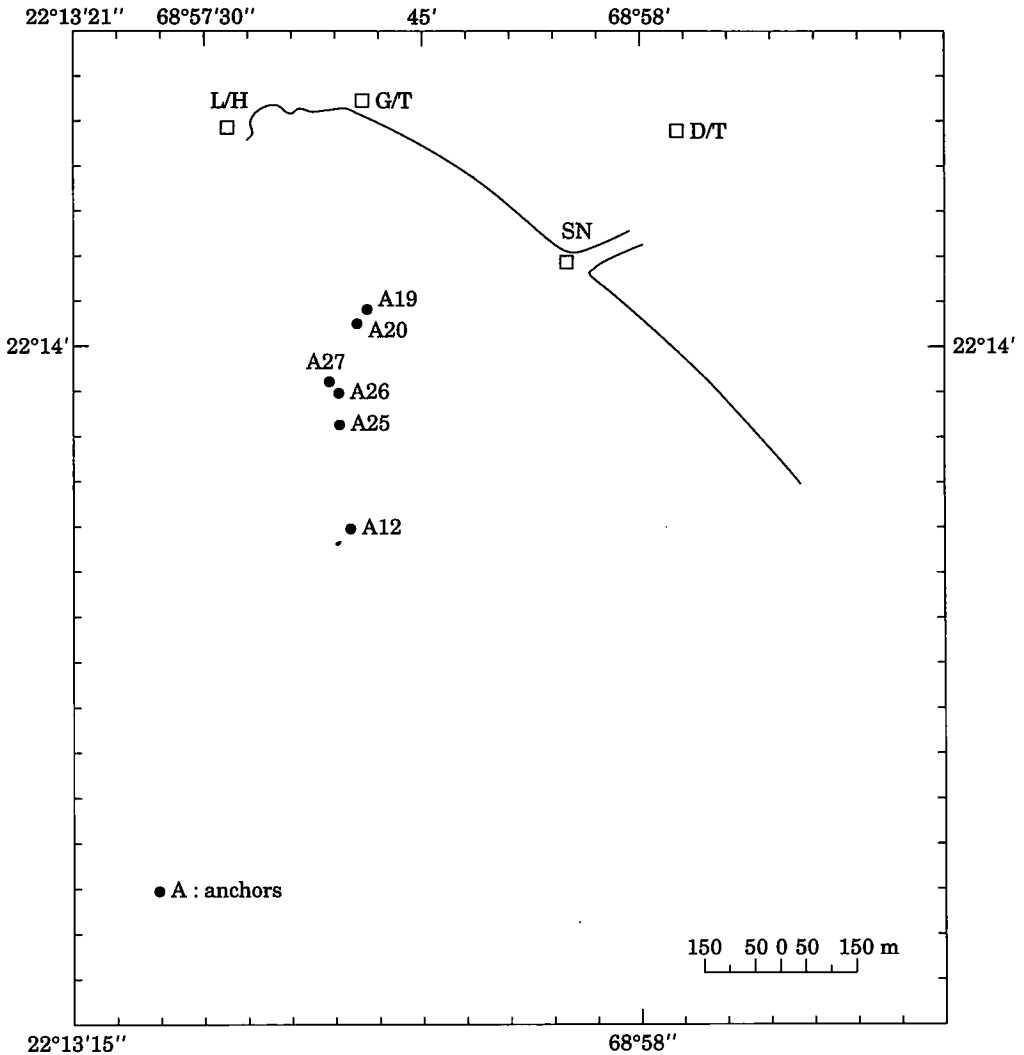


Figure 14. Map showing the location of stone anchors in Dwarka waters. (Drawing: S. B. Chitari)

4. Broken triangular anchor no. 37 was also found at a depth of 6 m and is of the same material as no. 3. The lower holes are preserved but it is very fragile. A growth of barnacles was noted. The anchor lies south of nos 2 and 3 but north of the present jetty.
5. Single-holed anchor no. 40 was found near the jetty. It is made of local beach rock. It has a very irregular shape with a round hole.

Aramda

During low tide three stone anchors were found north of the jetty (Fig. 26, Table 5). One was triangular, one a grapnel and one an irregular shape with a single hole.

1. Triangular anchor no. 41 with three holes was exposed at low water (Fig. 27). This is one of the most perfect anchors found in the entire Okhamandal area. It has very sharp edges and the usual circular upper

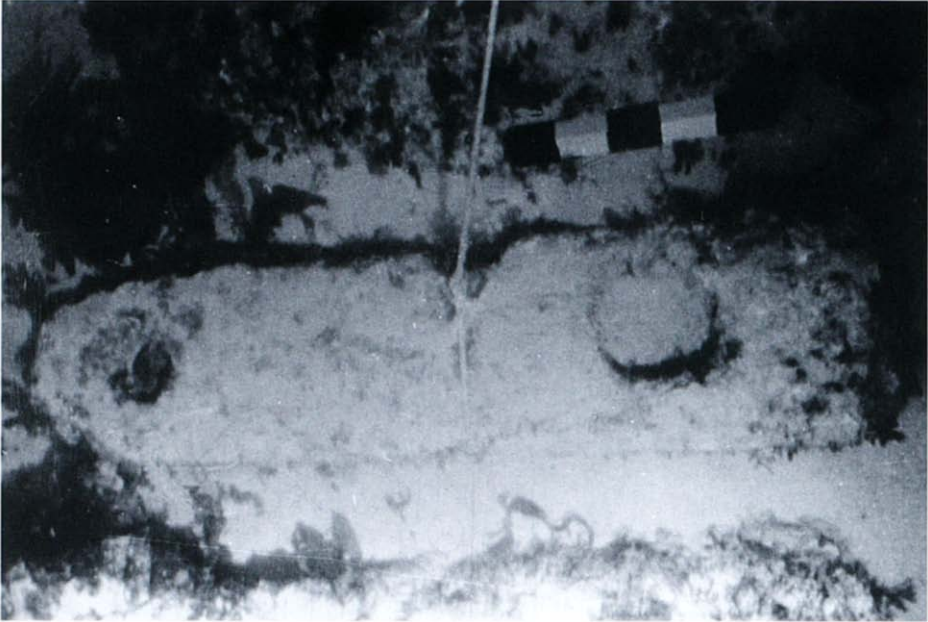


Figure 15. Grapnel stone anchor no. 31 from Dwarka waters. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)

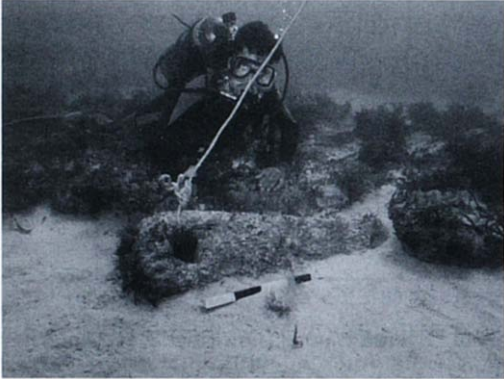


Figure 16. Grapnel stone anchor no. 30 from Dwarka waters. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)



Figure 17. Two-holed stone anchor no. 32 from Dwarka waters. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)

hole and two square holes below. Made of sandstone, it has a uniform thickness and perhaps was not used extensively.

2. Broken grapnel no. 42 was found near the Aramda jetty. Only one lower rectangular hole was preserved. It is made of sandstone.

3. Single-holed stone anchor no. 43 has a very rough and irregular surface and was found north of the present jetty.

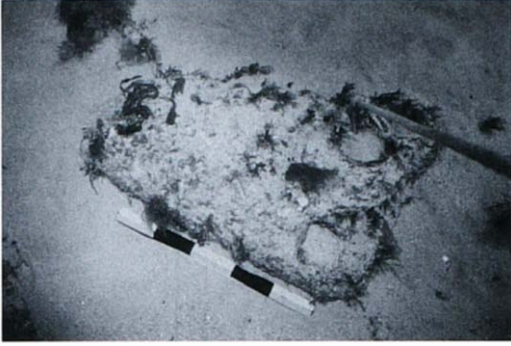


Figure 18. Broken triangular stone anchor no. 28 from Dwarka waters. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)

Probable date

The dating of stone anchors is very complex in the absence of any archaeological association and markings. A few anchors with markings have been reported from the Mediterranean (Gianfrotta, 1977: 92). In the absence of direct evidence the stone anchors have to be dated by comparing them with anchors of similar shape and size from elsewhere as was done previously by Honor Frost (1973). Such dated anchors fall within a large range of archaeological time, between 2500 BC and AD 1400 in the Mediterranean.

In India the earliest anchors have been reported from Lothal and Kuntasi and were dated to the Harappan Phase (Rao, 1979; 1991; Dhavalikar *et al.*, 1996). The present anchors are entirely different in shape and size compared with those from Lothal and Kuntasi. Therefore, the anchors of Dwarka, Bet Dwarka and Aramda are not to be associated with the Harappan or the Late Harappan Phase.

Recent marine archaeological exploration at Malwan (Sila & Gaur, 1997) and Vijaydurg in the Sindhudurg district of Maharashtra yielded a number of stone anchors. In Vijaydurg eight grapnel-type anchors used as lintels in the parapet wall of the fort wall during the Maratha Period have been identified (Sila *et al.*, 1998). This proves that these anchors were in use prior

to the Maratha Period. Further, mooring stones have been identified on the unused dockyard located on the Vaghotan river-bank. Archaeologically these ports are not dated earlier than the beginning of the Christian Era.

The excavation of the 12th–14th century AD port at Periyapattinam in the Ramanathpuram district of Tamil Nadu yielded an identical grapnel three-holed mooring stone which was installed on the bank of the River Kappalaru. Further, oral tradition in the village clearly stated that the stone was used for tying up boats (Rajan, pers. comm.). Identical stone anchors were also noted at Vijaydurg and Dwarka. Another two grapnels from south of Tamil Nadu have been reported which are similar to those of the Dwarka rectangular anchors. Rajamanickam (1992) unsuccessfully tried to date them to 1000 BC.

Honor Frost (1985; 362) terms grapnel anchors as 'Arabic' and 'Proto Grapnel'. Raban (1990: 303) believes that if these anchors were fundamentally made for safer anchorage in a coral bottom, typical of the Indian Ocean, then they were not necessarily confined to Arab boats or modelled by Arab influence. Parallels to this type of anchor have been found in the Red Sea on the Lone Mushroom wreck (Raban, 1990).

A similar type of grapnel anchor is reported from Kilwa Kisiwani and Mogadishu on the East African coast (Chittick, 1980: 73–75). David Whitehouse's excavations at Siraf on the Persian Gulf have yielded two fragmentary stone shanks (anchors) of a similar nature which he compares with a complete specimen found by the villagers at the same place (Whitehouse, 1970: 141). According to his dating these stratified fragments are not later than the 8th century.

A 10th-century story relating to stone anchors was mentioned by Hourani (1975: 115) with reference to the *Kitab Ajaib*

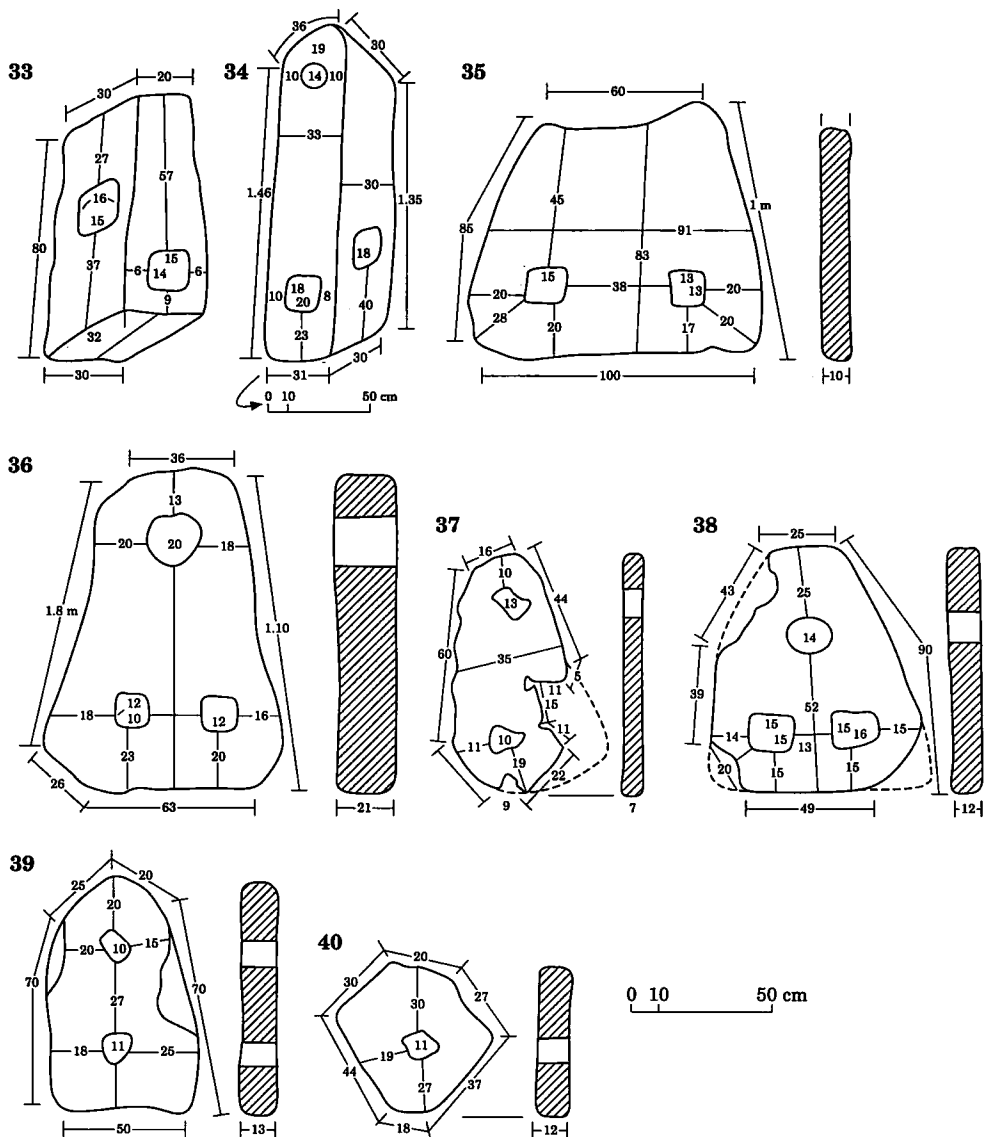


Figure 19. Anchors from Bet Dwarka Island. (Drawing: S. B. Chitari)

al-Hind (The Book of Wonders) written in the middle of the 10th century AD by Buzurg ibn-Shahriyar of Ramhurmuz who was one of the greatest Arabic writers. He was an Iranian and collected many of his stories from captains at the Iranian port of Siraf. A story is told by Shahriyari, one of the captains on the China route:

Our ship was overloaded with heavy cargo from Siraf. When we reached the entrance of the

China Sea, we saw Abharah, a man well versed in the China Sea. After paying a huge price to Abharah, he came on our boat and ordered us to cut the larger mast, take up the anchors, and then to cut the cable of the larger anchor which we did. Then he ordered us to cut the cable of the other anchors and continued until we had thrown six anchors into the sea. We arrived in China and stayed there until we had sold and bought, repaired our ship, finally left for Siraf. While passing the same place where Abharah had boarded our ship he ordered us to drop

Table 4. Details of stone anchors from Bet Dwarka waters

Anchor no.	Type of anchor	Raw material	Length (cm)	Width (cm)		Thickness (cm)	Diameter of top hole (cm)	Lower holes (cm)	Location
				max.	min.				
33	Grapnel	Conglomerate	80	32	30	20	—	15 × 16 14 × 16	IZ
34	Grapnel	Sandstone	146	36	31	30	14	18 × 18 18 × 20	IZ
35	Triangular	Beach rock	100	100	60	10	—	13 × 13 13 × 13	IZ
36	Triangular	Beach rock	116	76	36	21	20	10 × 12 12 × 12	UW
37	Triangular	Beach rock	80	35	—	7	13	10	UW
38	Triangular	Beach rock	90	73	25	12	14	15 × 15 15 × 16	UW
39	Two-holed	Beach rock	70	54	45	13	10	11	UW
40	Single-holed	Beach rock	68	50	18	12	11	—	UW

IZ, intertidal zone; UW, underwater.

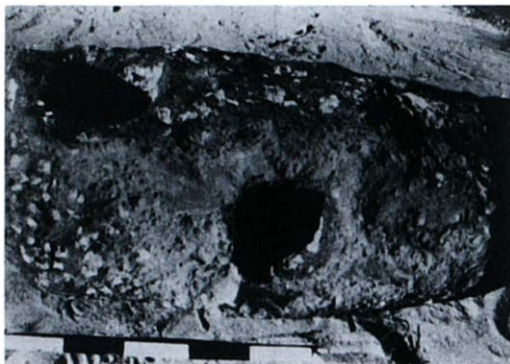


Figure 20. Grapnel stone anchor no. 33 from the intertidal zone off Bet Dwarka Island. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)



Figure 22. Triangular stone anchor no. 35 from the intertidal zone off Bet Dwarka Island. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)



Figure 21. Rope marks on grapnel stone anchor no. 34 from the intertidal zone off Bet Dwarka Island. (Photo: S. N. Bandodker)

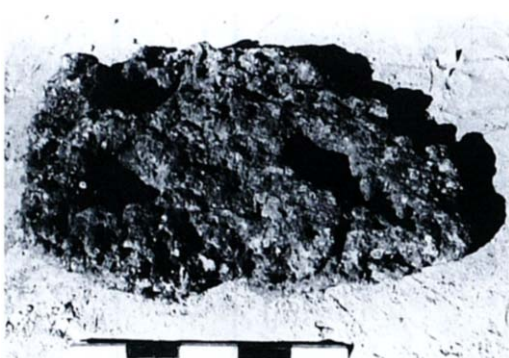


Figure 23. Triangular stone anchor no. 38 from Bet Dwarka waters. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)



Figure 24. Two-holed stone anchor no. 39 from Bet Dwarka waters. (Scale: 50 cm with five divisions) (Photo: S. N. Bandodker)



Figure 25. Triangular stone anchor no. 38 from Bet Dwarka waters. (Scale: 25 cm with five divisions) (Photo: S. N. Bandodker)

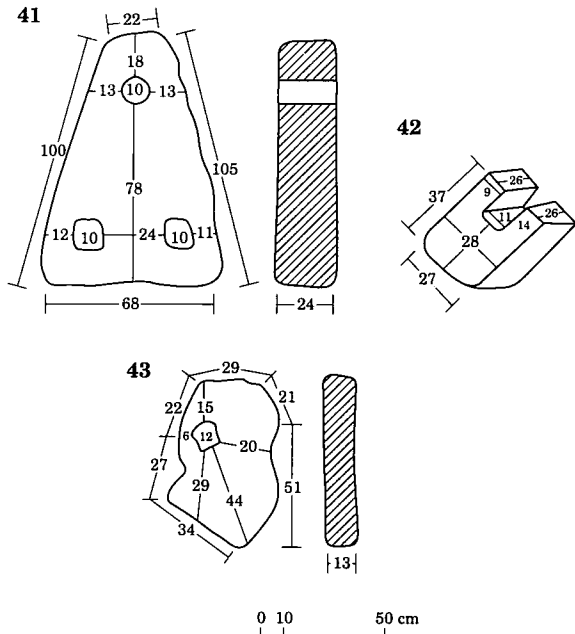


Figure 26. Stone anchors from Aramda. (Drawing: S. B. Chitari)

anchor and send 15 men in the life-boat and bring our anchors from the reef. They brought a total number of three anchors.

Later Abharah explains that 'the total weight of the anchors on the boat was half that of the entire cargo on board.

Table 5. Details of stone anchors from *Aramda*

Anchor no.	Type of anchor	Raw material	Length (cm)	Width (cm)		Thickness (cm)	Diameter of top hole (cm)	Lower holes (cm)	Location
				max.	min.				
41	Triangular	Sandstone	105	68	22	24	10	10 × 10 10 × 10	IZ
42	Grapple	Sandstone	37	27	—	26	—	11 × 14	IZ
43	Single-holed	Beach rock	72	38	29	13	12	—	IZ

IZ, intertidal zone.



Figure 27. Triangular stone anchor no. 41 from Aramda. (Photo: S. N. Bandodker)

Therefore to reduce the weight I had jettisoned the anchors. At that time it was high tide and now it was low tide so the anchors can be seen from the surface’.

They were carrying a number of anchors at the same time because they were aware that anchors are often lost in the sea. However they were so heavy that Abharah ordered some to be thrown out. Therefore, it seems an obvious assumption that they were stone anchors and also very heavy ones. They might have been grapnel-type anchors. When a ship was overloaded, anchors were dropped at a known place and on the return voyage they were picked up again. In the process they were losing anchors and these are often found underwater today.

From the above-mentioned examples the dates of the stone anchors from the Okhamandal area may not be earlier than the historical period but not later than the 14th century AD. To achieve a firm dating an-

chors will need to be found associated with other archaeological material; for instance, shipwrecks or a dated context on land.

Conclusion

Recent marine archaeological surveys in Indian coastal waters suggest the presence of a large number of stone anchors all along the coast. Several stone anchors in the Okhamandal area confirm the greater importance of this area for past maritime activity. For the first time stone anchors have been discovered at Bet Dwarka and Aramda in the Okhamandal area showing the importance of these places for trade and commerce along with Dwarka. The anchors of various sizes indicate that ships of different size and origin visited the region in the past. At present the data indicate possible dates for these anchors of between the 2nd century BC and 10th century AD. It is possible that the iron anchor was introduced when European traders arrived in Indian waters, while prior to that stone anchors were extensively used.

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References

- Ansari, Z. D. & Mate, M. S., 1966, *Excavations at Dwarka (1963)*. Pune.
- Basch, L., 1994, Some remarks on the use of stone anchors and pierced stone in Egypt. *IJNA*, **23**: 219–227.
- Chittick, N., 1980, Stone anchor shanks in the Western Indian Ocean. *IJNA*, **9**: 73–76.
- Dhavalikar, M. K., Raval, M. R. & Chitalwala, Y. M., 1996, *Kuntasi-A Harappan Emporium on the West Coast*. Pune.
- Dimitrov, B., 1976, Stone anchors from Sozopol Bay. *IJNA*, **5**: 81–83.
- Dimitrov, B., 1977, Anchors from the ancient ports of Sozopol. *IJNA*, **6**: 156–163.
- Dimitrov, B., 1979, Underwater research along the south Bulgarian Black Sea Coast in 1976 and 1977. *IJNA*, **8**: 70–79.
- Frost, H., 1963, *Under the Mediterranean*. London.

- Frost, H., 1973, Ancore, the potsherds of marine archaeology: on the recording of pierced stones from the Mediterranean. In: Blackman, D. G. (Ed.), London. *Marine Archaeology*. 397–410.
- Frost, H., 1979, Egypt and stone anchors: some recent discoveries. *Mariner's Mirror*, 65: 137–61.
- Frost, H., 1985, Stone anchor: criteria for a corpus. *Thracia Pontica III*. 352–369. Sozopol.
- Galili, E., Sharvit, J. & Artzy, M., 1994, Reconsidering Byblian and Egyptian stone anchors using numerical methods: new finds from the Israeli Coast. *IJNA* 23: 93–107.
- Gianfrotta, P. A., 1977, First elements for the dating of stone anchor stocks. *IJNA*, 6: 285–292.
- Grossmann, E. & Kingsley, S. A., 1996, A three-hole stone anchor with wood remain from Crusader Arsuf (Apollonia) Israel. *IJNA*, 25: 49–54.
- Hourani, G. F., 1975, *Arab Seafaring in the Indian Ocean and Early Medieval Times*. New York.
- IAR (Indian Archaeology—A Review), 1979–80, Archaeological Survey of India, New Delhi.
- Kingsley, S. A. & Ravch, K., 1994, Stone anchors from a Byzantine context in Dor Harbour Israel. *IJNA*, 23: 1–12.
- Merh, S. S., 1995, *Geology of Gujarat*, Geological Survey of India, Bangalore.
- Nibbi, A., 1991, Five stone anchors from Alexandria. *IJNA*, 30: 185–194.
- Nibbi, A., 1992, A group of stone anchors from Mirgissa on the Upper Nile. *IJNA*, 21: 259–267.
- Raban, A., 1990, Medieval anchors from the Red Sea. *IJNA*, 19: 299–306.
- Rajamanickyam, G. V., 1992, Marine archaeological exploration activities from the Centre of Tamil University, Tamilnadu. In: Kasinathan, N. (Ed.), Seminar on Marine Archaeology, 34–44. Madras.
- Rajamanickyam, G. V. & Jayakumar, P., 1991, *Maritime History of South India, Phase-I*. A Technical Report submitted to CSIR, Thanjavur.
- Rao, S. R., 1979, *Lothal-A Harappan Port Town*. Memoir of Archaeological Survey of India, New Delhi.
- Rao, S. R., 1987, *Progress and Prospects of Marine Archaeology in India*. National Institute of Oceanography, Goa.
- Rao, S. R., 1990, Excavation of the legendary city of Dwarka in the Arabian Sea. *Journal of Marine Archaeology*, 1: 59–98.
- Rao, S. R., 1991, *Dawn and Devolution of the Indus Civilization*. New Delhi.
- Rao, S. R., Sila, T., Gaur, A. S., Gudigar, P., Sundaresh & Vora, K. H., 1994, Underwater archaeological exploration of Dwarka and Somnath—Results of 1992 survey and problem to attend. In Rao, S. R. (Ed.), *The Role of Universities and Research Institutes in Marine Archaeology*, 113–119. Goa.
- Rao, S. R., Tripathi, S. & Gaur, A. S., 1992, Marine archaeological exploration off Somnath. *Journal of Marine Archaeology*, 3: 13–16.
- Ratnagar, S., 1981, *Encounters: the Westerly Trade of the Harappan Civilization*. Delhi.
- Shaw, J. W., 1995, Two three-holed stone anchors from Kommos Crete: their context type and origin. *IJNA*, 24: 279–291.
- Sila, T. & Gaur, A. S., 1997, Stone anchors from Sindhudurg, west coast of India. *IJNA*, 26: 51–57.
- Sila, T., Saxena, M. K., Sundaresh, Gudigar, P. & Bhandodker, S. N., 1998, Marine archaeological exploration of Vijaydurg—a naval base of the Maratha Period, Maharashtra, on the west coast of India. *IJNA*, 27: 51–57.
- Vora, K. H., Naik, D. K., Ganesan, P. & Moraes, C. N., 1991, Offshore extension of Gomati River, Dwarka. *Journal of Marine Archaeology*, 2: 32–38.
- Whitehouse, D., 1970, Excavations at Siraf. Third interim report. *Iran VIII*: 1–17.