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Exploration of the Portuguese Shipwreck in Goa Waters

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Abstract

The history of Portuguese shipwrecks began in Goa waters since the first quarter of the sixteenth century. The marine and other related documents state that between sixteenth and eighteenth centuries a number of ships has been wrecked off Goa, Cochin and Orissa during their journey from Portugal to India and back. The majority of them have occurred due to storms, hidden rocky reefs, woodborers, unskilled navigation, etc. The National Institute of Oceanography (NIO), Goa, has undertaken the exploration of the Portuguese shipwreck in Sunchi Reef off Goa, which led to the recovery of storage jars, barrel of handgun, Chinese ceramics, elephant tusks, hippopotamus teeth, guns, iron anchor, gun shot, bases of glass bottles, lead pipe and sheets, copper strap, stone and terracotta bricks and a number of dressed granite blocks. Among the shipwrecks explored in Indian waters the wreck at Sunchi Reef is the oldest and is an evidence of Indo-Portuguese trade and commerce of that time.

Keywords: Shipwreck, Archaeology, Sunchi Reef.

Shipwrecks are nothing but maritime casualties, considered to be important to maritime and underwater archaeologists who enhance their knowledge on maritime history, trade, and cultural contacts from the material remains of the shipwreck sites. Hence shipwrecks are also known as 'time capsules'. Of late, thousands of shipwrecks have been located both in sea and fresh water around the world. A shipwreck study reveals the history of shipwreck, interactions with people, construction pattern and other achievements made before the accident. After sinking, the cargo and the ship start deteriorating due to the presence of natural forces and marine organisms in the sea. However, it continues for certain duration and then diminishes slowly till it is disturbed by the re-

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searchers or treasure hunters. Further deterioration starts again. Countries bordering the seas and oceans have attempted to locate and excavate shipwreck remains with a view to reconstructing the maritime history and contact with other countries. Shipwrecks are the part and parcel of underwater cultural heritage of the country. India is not lagging behind in this field of research and has made considerable progress since the beginning of the Marine Archaeology Centre at the National Institute of Oceanography (NIO), Goa. Shipwrecks have been explored in Goa (Sila Tripathi *et al.*, 2003a; 2004), Lakshadweep (Sila Tripathi and Gudigar, 2001) and Tamil Nadu waters (Gaur *et al.*, 1997; Sila Tripathi *et al.*, 2003b) of India.

Portuguese Shipbuilding and Shipwrecks in Goa Waters

With the arrival of Portuguese a number of changes were noticed in the designing and building of ships on the west coast of India. Similarly, the Portuguese also borrowed some technology from the traditional shipbuilders of India. Before coming to India Portuguese used oak and pine for the construction of ships. Those ships were frequently affected by woodborers, crumbling due to weak timber. The maintenance cost of the ships was relatively high compared to their longevity. Nevertheless, the native sailors used teak, which was the best timber ever known for shipbuilding industry. Subsequently, Portuguese understood the superiority of teakwood for construction of ships and used teak extensively in the shipbuilding industry. For this purpose they established shipyard and dockyard in Goa and other parts of India for the construction of ships.

One of the desires of Afonso de Albuquerque who conquered Goa in 1510 was to capture the shipbuilding industry of Goa, which was the best during that period (Danvers, 1934). The shipbuilding centres of Portuguese India were located at Bassein (Maharashtra), Cochin (Kerala), Goa and Daman on the west coast of India. There were three dockyards in Goa between the city of Goa and the riverbank of the Mandovi. The ships that were built in Goa were *Nau Cinco Chagas*, *Galeão Bom Jesus*, *Madre de Deus*, and *Nau S. João Baptista*. Portuguese records related to shipping and navigation mention that between 1497-1612 a number of ships were wrecked off the Indian coast during their voyage between Portugal and Goa because of storms and lack of proper maintenance (Mathew, 1988). Exact location of the wrecks cannot be identified from these records. However, a majority of ships have wrecked in shallow waters mainly due to uneven topography, severe storms, hidden rocky reefs, and sandbars.

In 1648, twelve Portuguese ships, en route to Calcutta (Kolkata) from Goa sank near Aguada Bay owing to a severe storm. In 1651, five Portuguese

sailing ships namely *St. Helena*, *St. Joan*, *Evangelista*, *St. Francisco* and *St. Thomé* set sail from Portugal to Goa, but only two ships reached the coast of Goa and they were also wrecked in a storm on 10 March 1651. A Portuguese Pataxo *Santa Tereza de Jesus* was ready to sail to Bassein and Chaul in Maharashtra but wrecked in the sandbar off Goa on 18 May 1658. Some cargo was salvaged and the other remains were robbed. A small bag containing precious stones, royal money and other goods onboard the *Manoel Dias* went down in the sea. The records indicate that a number of ships have been wrecked in the sandbar of Aguada Bay.

Topography of Sunchi Reef

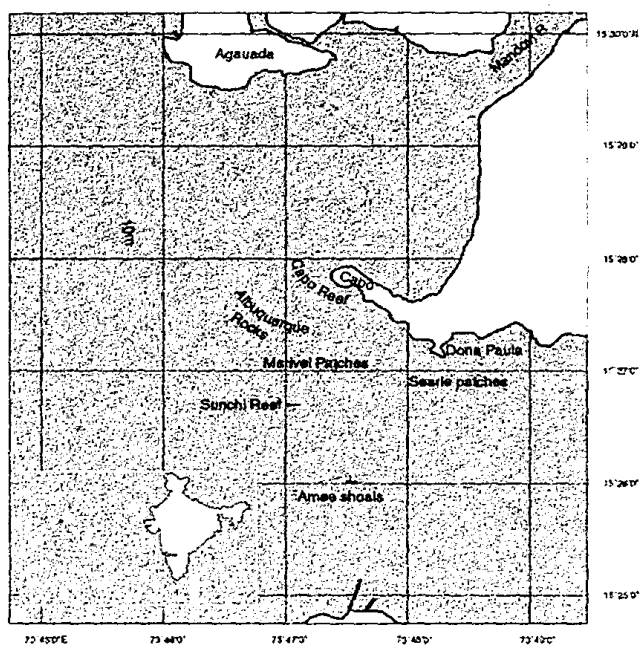


Fig. 1: Location of shipwreck on Sunchi Reef, off Goa

Sunchi Reef lies in between Marmagao harbour and promontories Cabo headland (Fig.1), which extends in north-south direction and separates Marmagao Bay from the Arabian Sea. The seafloor in the area is characterised by prominent submerged laterite bed with prominent flat surfaces with sandy patches. At places the height of the laterite shoal is more than 3 m. In Sunchi Reef region the ebb current is 3 knots and spring tide is 1.5 knots.

The river Zuari flows into the head of Marmagao Bay through a constricted passage and discharges huge quantity of sediment especially during the Southwest monsoon (rough weather), when the wave height reaches up to 2 to 3 m in this area. The comparison of the bathymetric charts of 1881 and 1976 show that Sunchi Reef and the adjoining area is not very conducive for sediment deposition. The sediments collected from the sand patches represent coarse grained shelly sand. Big boulders also occur in the area and their height is about 4m, some prominent erosional holes of various sizes are noticed in the area. Archaeological artefacts are found in the crevices of the laterite. Visibility of the working site depends upon the tide and state of the sea conditions.

Location of Wreck Site, Survey and Exploration

In the year 1988 the first preliminary exploration was initiated in Sunchi Reef and after relocating the wreck subsequent explorations were undertaken from 1997 onwards. This wreck is neither shown in the Hydrographic chart nor mentioned in the Portuguese records. The wreck remains are scattered over the reef in a large area where water depth ranges from 3 to 6 m according to tidal variations. During ebb tide, the speed of the current in the reef region is much stronger, and it hinders the exploration work and also visibility reduces. On account of this sometimes the duration of underwater exploration has to be curtailed. The wreck remains are overgrown with white and orange coloured gorgonians and green mussels and at places covered with fine layer of silt. The explorations were carried out mostly in Sunchi Reef of Goa waters between November to March due to the favourable sea conditions and underwater visibility. Diving, videography and other documentation were carried out by hiring either a fishing trawler or big canoe. Most of the diving was carried out by scuba for exploration and documentation and each dive lasted for more than one hour. Sometimes duration of diving was extended depending upon the requirement and weather conditions.

During visual survey, great attention was paid to the distribution of artefacts, ceramic shreds, granite blocks, and other cargo remains lying on the seabed. At places hand fanning was also carried out to expose the buried antiquities in the sediment. Positions of these artefacts are obtained through GPS and the smaller artefacts were recovered for study and analysis. More emphasis was given to visual survey because the wreck remains are scattered over the reef. The other features such as outcrop of rock, seabed topography of the region and movement of sediments and current direction in the reef region were noted in course of diving. After ascertaining the distribution of artefacts, documentation and recording were initiated.

Findings

The explorations in Sunchi Reef yielded iron guns, iron shot, barrel of handgun, iron anchor, elephant tusks, hippopotamus teeth, storage jar, Chinese ceramic, bases of glass bottles, metal hook, lead sheet, copper strap and dressed granite blocks. These artefacts were either buried or covered with a thin layer of silt. They were recovered after extensive and thorough search. The guns and iron anchor were lying on the laterite and prolific growth of marine organisms was noticed on them. The descriptions of the findings follow.

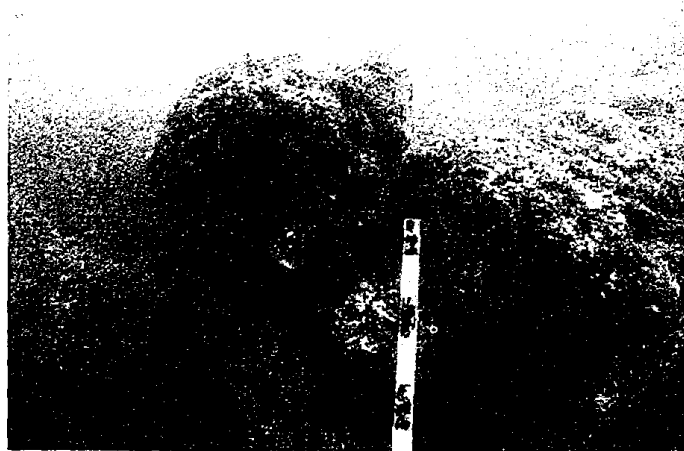
Anchor: The 'Admiralty Long Shanked' iron anchor belonging to the ship was observed on the northern side of the guns. This type of iron anchors were used

extensively by the Portuguese both in naval and merchant ships during the period from the sixteenth to eighteenth centuries. The finding of the anchor indicates that the ship cannot be of an Indian origin. Generally, ships carry a number of anchors. However, Sunchi Reef wreck has yielded only one anchor. It is not known whether the ship was carrying only one anchor or more.

The iron anchor is 3.10 m in length and the shank of the anchor is clearly visible whereas the arms are lying in between the boulders of laterite. The anchor does not have the wooden stock, which might have been decomposed. Similarly, the swivel ring, which was used for securing the cable, has been destroyed by corrosion. The length of one fluke is 1.10 m long and the length of other fluke cannot be measured as it is lying in the crevices of the laterite. Heavy barnacle and other marine growth are noticed on the anchor. Due to the marine growth it is not possible to know whether any lime coat had been applied on the anchor or not, however a similar size and type of anchor found in the Aguada Bay shows a coat of lime present, which was applied to prevent from corrosion. The size and shape of the anchor of Sunchi Reef resembles with those found in the Aguada Bay of Goa (Sila Tripathi, Gaur, and Sundaresh, 2003).

Armaments: There were a number of naval battles fought among the European powers in the Indian Ocean for supremacy. Due to the naval battles almost all European vessels used to have armaments such as guns onboard for self-defence. These armaments were used to get rid of pirates and resist the attack by the local rulers. Even cargo vessels were also carrying bare minimum armament.

During exploration four iron guns were noticed lying close to each other



(Fig. 2). The approximate length of each gun is 2 m. The nozzle of two guns is facing towards the seabed in slanting positions whereas the other two are lying parallel on the seabed. As they are lying over the reef, the exterior of the guns are heavily encrusted and overgrown with bar-

Fig. 2: Guns are lying over the laterite boulder, Sunchi Reef

nacles and mussels, hence monogram, symbols or identification marks are not visible on them. These guns have swivels on both sides, cascabel button at each end, without having any lifting dolphins or rings. It appears that the guns have two reinforcements and the chase. All guns are identical and belong to the seventeenth or eighteenth century. No further information is available to know if any guns were salvaged from the site. Further conclusions cannot be drawn on these guns unless they are lifted and treated to determine the alloy and to know the seal or marking of the manufacture and other details.

Similarly, a cast iron shot, which is slightly conical at the top, flat at the base and surface is uneven was retrieved from the western side of the gun. The diameter, specific gravity, and weight of the shot are 9.54 cm, 4.76 m/sec² and 1218 gm respectively. Stamps or other identification marks are not present on the shot. Due to flaky nature of the shot, water had seeped inside and this was subsequently removed by heating the shot in an oven. Due to dehydration some cracks have resulted over the surface of the shot while the interior portion of the shot is fully rusted and now crumbles easily.

Further explorations in the region revealed a brass barrel of a handgun (Fig. 3), which was trapped and half buried below the dressed granite blocks. Its length and weight is 56 cm and 2.200 kg respectively. The width of its mouth is 4 cm. The thickness of the tube is more at the back than in the front. It has a screw thread at the back for fixing the wooden part of the gun. The barrel has two notches. Out of these, the one on the front is intact while the other on the

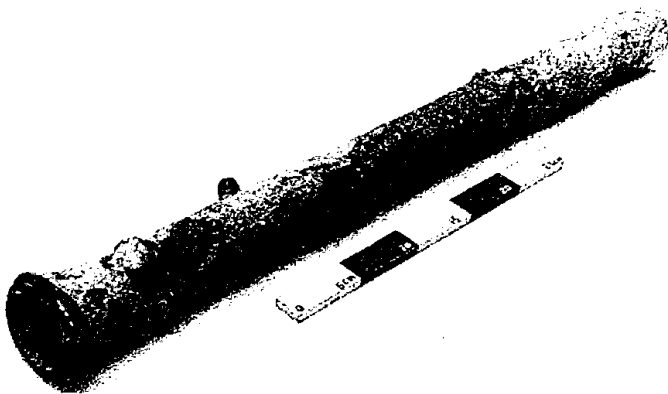


Fig. 3: Brass barrel of a handgun collected from shipwreck, Sunchi Reef

back is broken. These are meant for fixing screws to the wooden part provided below the handgun. The gun and other parts attached to the barrel are missing. No other remains of the gun were found in the nearby area.

Caulking: The caulking is one of the most important techniques

that are performed for the vessels with utmost care particularly for those which were meant for overseas maritime trade and naval activities. The

traditional shipwrights of India were caulking the vessels with oakum between planks. However, Ludovico Varthema (AD 1470-1510) who visited India during this period mentions that the shipbuilders of Kerala, west coast of India did not use oakum between the planks; instead the planks were joined so skilfully that water did not pass through (Mookerji, 1912). From the above description it appears that lead sheets were not used by the native shipwrights for caulking the vessels. Caulking by lead sheet was probably introduced by the Portuguese in India.



Fig. 4: Lead pipe, sheets and copper strap collected from the wreck site.

The exploration has brought to light a copper strap, three lead sheets, and a pipe (length and diameter 37.5 and 36 cm respectively) from the wreck site (Fig. 4). Out of these sheets, two are 'L' shaped and the other one is plain. Even, these sheets do not have any holes meant for nailing. However, they have

teeth like projections only at one side, which probably served as groove for better gripping and fixing. Lead sheets are nailed on the keel and copper straps were placed at the joints during construction of ships. Marine growth was present on all of them. These are in very much fragile condition and worn out. Only one copper strap has so far been found, which has a cut and is twisted. Probably a nail or a bolt was fixed on it. The surface of the strap is uneven and thickness is not uniform all thorough. The lead sheets and copper straps were used to protect the vessel from the attack of woodborers, leakages and prevent from damage after hitting to the rocks and coral reefs. The lead pipe has got some square holes, which are twisted and worn out. Probably lead pipes were used as an outer cover to protect hosepipe or tube. Lead sheets and straps have been recovered from the *Nossa Senhora dos Martires* 1606 off Lisbon (Castro, 2001).

Cargo of the Wrecked Vessel

Elephant Tusks and Hippopotamus Teeth: Elephant tusks of different sizes ranging from 58 to 36 cm in length have been recovered from the site. These

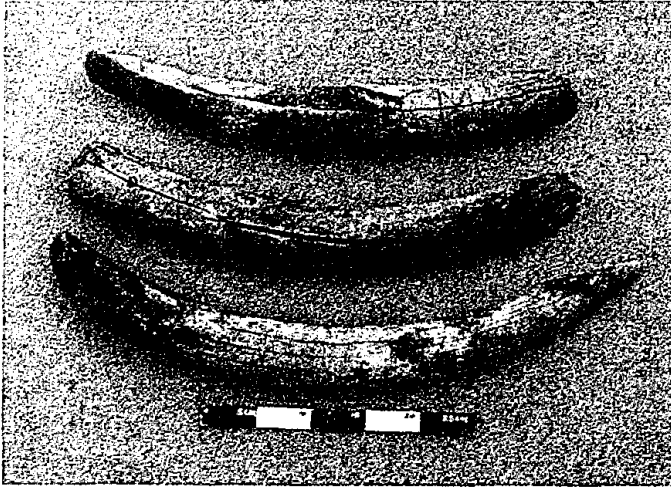


Fig. 5: Elephant tusk recovered from shipwreck, Sunchi Reef

tusks were buried in the coarse sand and covered with dead shells and only small portions were visible in the seabed. Out of the seven tusks two are inscribed, one has three English letters "ICM", out of which "CM" is visible clearly, and the first letter "I" is worn out (Fig. 5). The second tusk has some geometrical designs. These tusks being under-

water for long duration have become soft, brittle, flaky, and degraded.

Five different sizes of (53.5, 38.5, 20.5, 16 and 12.5 cm in length) hippo-

potamus teeth (Fig. 6) partly buried in the seabed were recovered near the guns. All the hippopotamus teeth are canines as they are curved. No incisor teeth, which are straight, were found in the exploration. The glaze coat, which is present on the outer surface, is the enamel and the hard substance (ivory) in the inner side is the dentine. Originally the teeth were white but due to long duration in underwater have turned brownish. Marine growth is also present on these teeth.

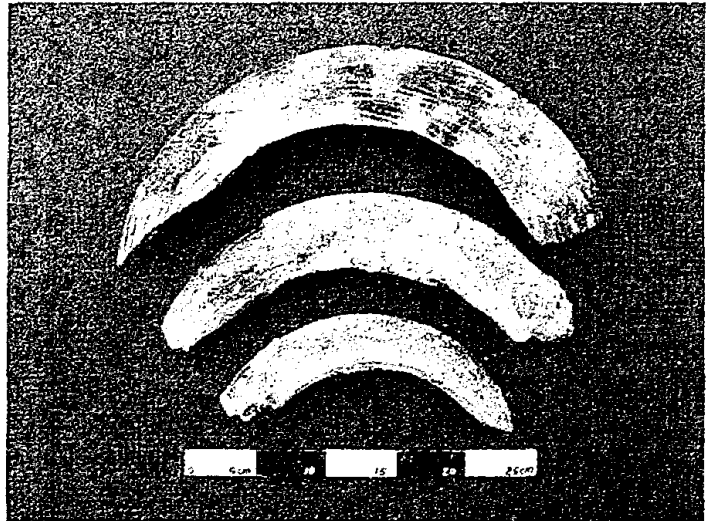


Fig. 6: Hippopotamus teeth retrieved from shipwreck, Sunchi Reef.

Chinese Ceramic: The exploration yielded broken Chinese ceramic shreds consisting of bases, rims and a lid, which are of medium in fabric. Blue on white

paintings are present both on inner and outer side of these shreds, whereas, a base and a shred have green paintings on white on the inner side. A number of bases have been collected. Among them a few are plain and rest have blue on white paintings. Chinese characters are present on two base shreds, on one shred the character reads as 'lucky jade' but age is not specific, whereas on the other Chinese characters are present (Fig. 7a, b), but the character is illegible. The other shreds have paintings both on inner and outer side. Base shreds belong to jars, plates and bowls. Some bases of jars have raised ring and others are normal. Besides, a little broken lid was recovered which has blue on white

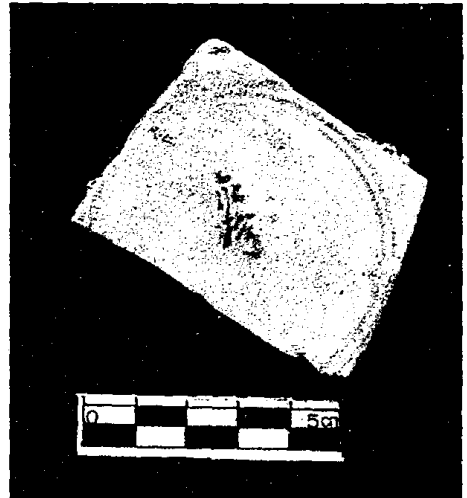


Fig. 7a, b: Stamped Chinese jar bases collected from shipwreck, Sunchi Reef

paintings on the outer side and the inner side is plain. The knob of the lid has floral designs (Fig. 8). Marine growth is present on all shreds. Majority of Chinese ceramic, which have been collected are broken and not a single intact jar, bowl, or a plate has been found during exploration. The paintings on these shreds include lotus flowers, pomegranate, pine trees, hills, and mountains. The symbols painted on the ceramic generally belong to the Chinese traditions and mythology, whereas most of the decorative elements on Chinese ceramic belong to Chinese folklore and history. There are rarely some patterns which are used purely for decoration. Each design and painting on

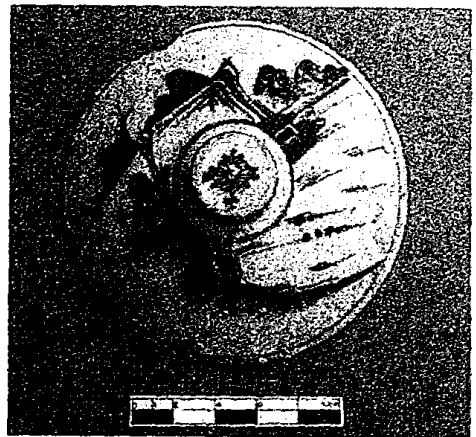


Fig. 8: Chinese ceramic lid found in shipwreck, Sunchi Reef

Chinese shreds carries some theme or background message.

Storage Jars:The survey brought to light a number of storage jar shreds, which were lying in the crevices of laterite. The shapes include rims, bases, lids and body parts and they belong to different shapes and sizes. These shreds are well fired and are comprise medium to thick fabric. Due to long exposure to seawater, paint and glaze have been washed out on some shreds while other shreds still have the dark brown glaze coat. Further, they do not show any spalling, cracking, or other defects despite a long burial time in the marine environment.

Recent exploration yielded a shoulder fragment of a brown glazed storage jar stamped with Chinese character (Fig. 9) but it is illegible. Maximum bases of storage jars have pontil mark hence a ring shaped little projection is distinct on them (Fig. 10).



Fig. 9: Chinese character stamped on the storage jar shoulder shred, Sunchi Reef

Some of the rims have horizontal and vertical loop handles. The recent exploration has brought to light a high neck jar with vertical loop handles and linear designs around the neck. This type of rim is found for the first time from the Sunchi Reef (Fig. 11). Vertical loop handles are bigger, and more prominent than the horizontal loop handles. Some of horizontal loop handles are smaller and prominent whereas others are thicker and less prominent. Besides rims and bases, a body shred was recovered that shows dark brown glaze coat liner design. From the shape and size of the rims it appears that these jars were made for different purposes or manufactured by different makers. On the basis of

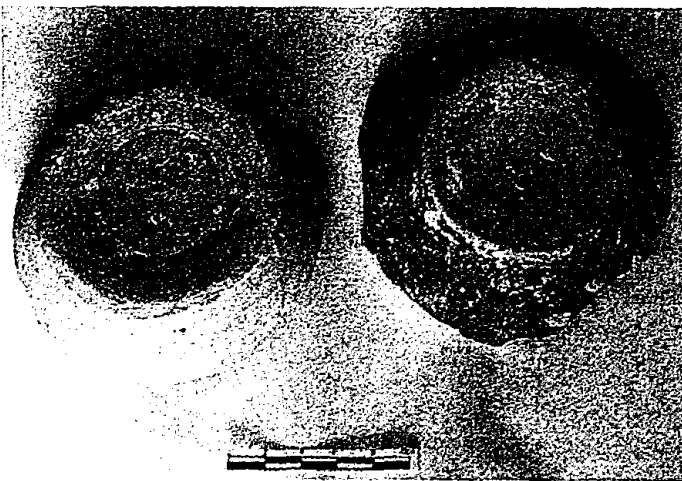


Fig. 10: Storage jar bases with pontil mark retrieved from shipwreck, Sunchi Reef

the findings of the bases, rims and body shreds of pottery can be classified into

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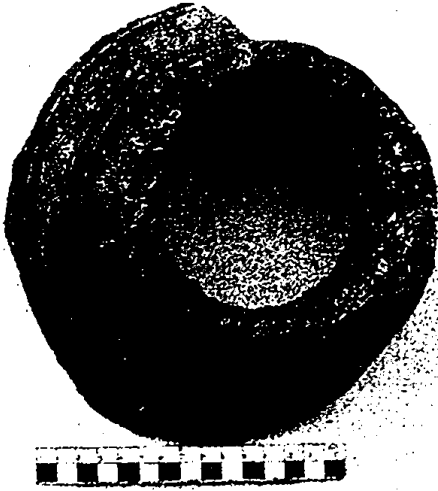


Fig. 11: Storage jar rim recovered from shipwreck, Sunchi Reef

two groups such as (i) stoneware (ii) clay ware. The exploration has so far yielded three types of rims namely (1) clay ware with dark brown glaze horizontal prominent loop handles, without raised dots, without neck, medium mouth and big size jars, (2) raised dots small horizontal loop handles with small mouth, high neck, medium size jars, (3) raised dots prominent vertical loop handles with dark brown glaze big size mouth, high neck, and medium size jars. Among the collected shreds, large portion belongs to stoneware having raised dots around

the neck and body. Ropes are tied with the loop handles during transportation, which provides greater balance and stops breakages of the jars.

Copper Vessel: The exploration brought to light a very much fragile copper vessel (Fig. 12), which was trapped in the laterite. The vessel has been twisted and some portion is missing. It is made out of thin sheet of copper without using any rabbets. It does not have designs and marks on its surface. The distinctive carination is present below the neck. It has a wide opening mouth with insignificant height. Its particular use onboard is yet to be ascertained but it could be used for various purposes.

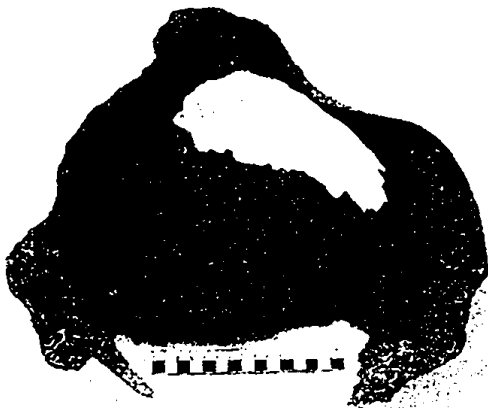


Fig. 12: Copper vessel recovered from Sunchi Reef

Bases of Glass Bottles: A number of broken glass bottle bases (Fig. 13 a-b) were recovered which are scattered over the wreck site. Out of these bases, sixteen have a conical depression at the base, round in shape and their diameter is 28 cm, whereas twenty square shaped bases are recovered, which measure 8.5 x 8.5 cm. The recent exploration has yielded an inner-side

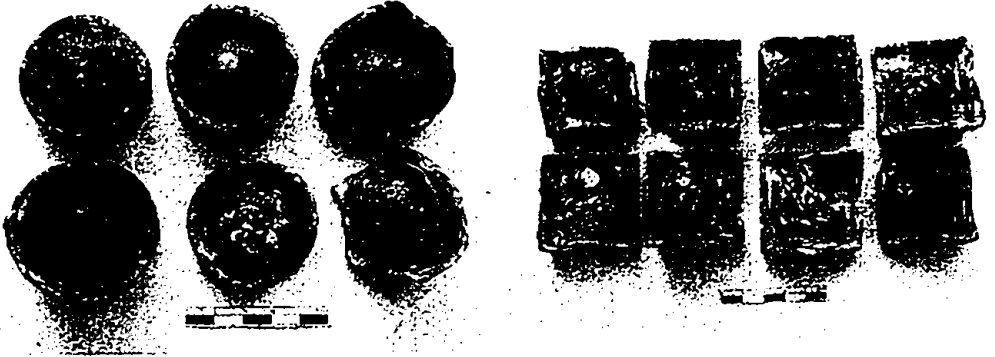


Fig. 13a, b: Broken glass bottles bases (round & square) found in shipwreck, Sunchi Reef

stamped square base. All the bases and pieces of glass bottle belong to extremely dark green in colour. All the square bases have pontil marks. Marine growth is present on the pieces. The square bases are thinner in section. Similarly, previous exploration had yielded a full bottle with broken rim having round base stamped with "A 0751" inside the depression, this could be either the makers' mark or the serial number of the concerned firm. Unbroken square base glass bottle has not been recovered so far from the site. It appears that

olive oil and wine were being imported in these glass bottles. However, maximum quantity of wine was imported in wooden casks.

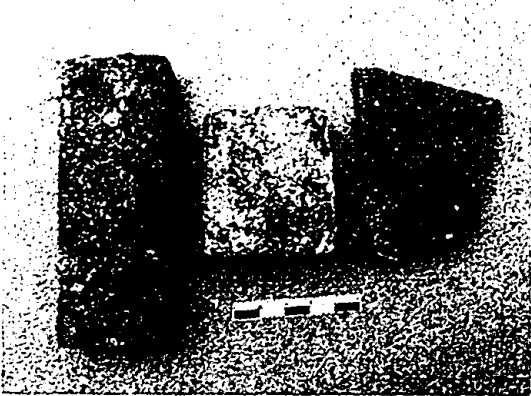


Fig. 14 Stone and clay bricks recovered from shipwreck, Sunchi Reef

Bricks: The underwater exploration yielded three well fired clay and four stone bricks which are square and rectangular in shapes (Fig. 14). These are nicely trimmed from all four corners. All are intact but profuse numbers of holes are present on clay bricks. Clay bricks measure 15x10x3, 11x11x4, and 10x10x3 cm respectively. Out of four stone bricks two are intact and other two are broken. Out of the two intact one is square and other is rectangular which measures 10x9.5x6 and 22x8.5x5 cm respectively. The raw material is schist. The two broken bricks are flat, thin, and different in sizes and

material is schist. The two broken bricks are flat, thin, and different in sizes and

raw material appears like slate. All these bricks belong to metamorphic group of rock. The uses of stone and clay bricks onboard are yet to be ascertained. One of the possibilities of use could be for furnaces, for cooking etc.

Granite Stone Blocks: A large number of rectangular and square dressed granite blocks of different sizes were found lying at random on the seafloor (Fig. 15). It appears that there could have been about 250 granite blocks, which were probably served both as cargo and ballast. Some blocks are more than 2



Fig. 15: Well-dressed granite blocks lying randomly on Sunchi Reef

x 0.40 x 0.10 m in size. Maximum blocks have fallen in the crevices of the laterite boulder and concentrated in and around the guns. These blocks can be categorised under 4 groups based on their sizes such as (200 x 40 x 10 cm (232 kg), 190 x 35 x 15 cm (289 kg), 125 x 35 x 15 cm (190 kg), 75 x 35 x 12 cm (91 kg). The estimated

weight of the above granite blocks have been calculated on the value of 1 cubic metre of granite is 2900 kg. The X-ray diffractometry (XRD) (Philips PW 1840) analysis of the rock sample shows the presence of quartz and feldspar as dominant minerals and corresponds to granite.

Discussion

No documentary evidence has so far been found on Sunchi Reef wreck which could have provided some more information on the ship. The information and location of this wreck was given by the local divers and fishermen. During Portuguese regime Old Goa was the capital, port and main trade centre of Goa. Ships coming to Old Goa would have to cross the River Mandovi to reach Old Goa. The sand bar at the confluence of the River Mandovi near Aguada Bay has caused grounding of a number of ships. Sunchi Reef is not far away from the sand bar of Aguada Bay. Though the causes of the wreck still remains mysterious, the possible reasons for the shipwreck of Sunchi Reef could be due to one of the following factors:

- (i) Inadequate knowledge about the sea bottom topography of the region
- (ii) The non-availability of navigational charts of the region showing the submerged rocks, shoals and reefs
- (iii) Grounding of the vessel on the shallow submerged rocks because of human error in navigation.

The height of laterite cliff near the gun is 3 to 4 m and the current action during low tide in the region is very strong. Except for a thin layer of silt and sand not much deposit of sediment was noticed on the guns, granite blocks, and iron anchor. However, growth of green mussels was noticed on them during recent exploration. The potshreds, glass bases and other remains are preserved as these were lying either below the laterite boulders or within the crevices and sometimes buried in the silt and sand.

As the ship wrecked in rocky and shallow waters, the perishable material may have been decomposed and subsequently disintegrated, the light material such as glass bottles, tusks, ceramic etc, was scattered over the region. Some of them have been retrieved for study and analysis, whereas heavy material namely the guns, granite blocks and iron anchor are lying *in situ* in their original location.

The storage jar shreds, meant to carry both solid and liquid items, have been collected from Sunchi Reef. All the rims of the jars have loop handles to tie a rope and the base has a pontil ring, which gives greater balance during transportation. Oils, water, food grains, and other perishable material were transported in these jars. Similar kind of shreds and jars have been reported from *Nossa Senhora dos Martires* 1606 off Lisbon (Francisco *et al.*, 1998), *Santo Antonio de Tanna* 1697 off Mombasa (Piercy, 1981, Sassoon, 1981 and Willoughby, 1991,) and the VOC *Risdam* wreck off Malaysia (Green, 1986). For better preservation of eatables, sometimes wooden or clay lids were provided to close the mouth of the jars (Desroches, 1998).

Comparatively the finding of storage jar shreds are more in number than the Chinese ceramics, which appear to be used daily onboard. This is because if the Chinese ceramics had been part of cargo then a large quantity of shreds could have been found in the course of exploration. The bases of glass bottle indicate that both olive oil and wine were imported from Portugal to Goa. The hippopotamus teeth and ivory were either imported from Mozambique or some other countries of Africa to Goa and from Goa those were sent to Gujarat for carving sculptures and making handles, chess pieces, dices, etc, finally the fin-

ished artefacts were sold in Portuguese colonies. The marks on the ivory could be the dealer's mark. These were the items of trade hence these could be the small part of the cargo of the ill-fated ship. The size and shape of the iron anchor resembles the anchors, kept in the Archaeological Museum at Old Goa and the one found in Aguada Bay. Generally these iron anchors used to have the wooden stocks. However, the stock of the anchors of Sunchi Reef and Old Goa is missing. The iron anchor, which was retrieved from Aguada Bay, has the wooden stock. The anatomical analysis of wood indicates that it belongs to the *Tectona grandis* species for which the trade name is teak (Sila Tripathi *et al.*, 2005). These anchors are datable to the sixteenth-eighteenth century AD and belong to the 'Admiralty Long Shanked' type of anchor (Sila Tripathi, Gaur, and Sundaresh, 2003). Granite blocks are lying randomly on the seabed. It appears that these dressed granite blocks initially fell on the rock, in course of time slipped down, and fell into the crevices of laterite. These blocks could be the main cargo of the ship and may have also served as ballast.

The exploration has yielded a limited quantity of glass bottles, elephant tusks and hippopotamus teeth, pottery, Chinese ceramics etc; hence the mystery remains what could be the main cargo of the ship? It appears that the granite blocks could be the main cargo and the other findings are the part of secondary cargo. On the basis of the weight of the granite blocks the carrying capacity of the ship could be around 1000 tons. Probably, further research on this wreck would be able to give some more information on the issues which are unknown now. However, on the basis of the radiocarbon date of ivory, thermo-luminescence date of storage jar is 360 ± 40 years old and date of the iron anchor indicates that the wreck could be dated to the early seventeenth century AD and belongs to the Portuguese period. Furthermore the shipwreck findings are the evidence of maritime trade between India and Portugal.

Conclusion

Due to non-availability of archival information, it is not possible to state whether the ship was built in India or not, as also its name, name of the captain, whether all the crew onboard died or survived. Similarly, no timber remains of the wrecked ship have so far been noticed, hence its construction pattern and other details remain obscure. The exact causes of the loss of the ship remain unidentified but the results of the survey leave a number of possibilities open, which can be taken into consideration.

Sunchi Reef wreck is the oldest wreck in Indian waters and the first Portuguese wreck to be explored and detailed. The wrecked ship of Sunchi Reef could be a wooden-hulled ship, because sixteenth and seventeenth century

Portuguese ships were wooden hulled cargo sailing ships. As the ship was wrecked in the rocky area, survival of perishable and light material is ruled out. The waves and currents might have also washed out the timber, other part of the ship and some antiquities. Except for the granite blocks, hippopotamus teeth and tusks, no other cargo has so far been found.

The Sunchi Reef shipwreck findings are indicative of the trade and commerce between Goa and other Portuguese colonies as mentioned in the literature. Shipwrecks prior to the Portuguese period has not been located in Goa waters, hence the present findings are breaking new ground in field of nautical archaeology of India in general and of Goa in particular. Further, the Sunchi Reef explorations have opened a wide scope to undertake explorations of unknown wrecks because Goa has a rich potential for shipwreck archaeology of India.

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