

Why were historical period ports of Goa located away from the coast? The decline of Gopakapatana

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Most of the ports of the historical period of the east and west coasts of India were located away from the seafront. But in later period, new ports were established mostly along the coastal regions. The reasons attributed to abandoning inland ports are: (a) bigger ships, which had to carry more cargo, (b) larger vessels could withstand the flow of current, (c) advancement in shipbuilding and navigation techniques, and (d) sediment deposition leading to navigational hazards. In the case of Goa, Chandrapura (Chandor) was the oldest inland port. During the later epoch, port activity shifted downstream to Gopakapatana, on the northern bank of the River Zuari. During the 15th century AD, Old Goa, on the bank of the Mandovi River, served as an important trade centre. Most modern port in Goa was built at Mormugao in 1885 in the Zuari estuary. This paper delineates the most likely cause for the decline of Gopakapatana, in particular, as a trade centre, from a geo-historical and oceanographic perspective. A detailed look into the evolution of the morphology of this river bank reveals rapid accretion that led to the formation of a shallow feature. A comparative study of maps of 1923, 1962-64, 2003 and modern images of 2010 confirm that the area is now occupied by a mud flat that extended by 68% during the last 40 years.

[Keywords: Ports, maritime trade, tide, mud flat, anchorage, technology, Goa]

Introduction

India is one of the oldest maritime nations of the world. Among historical harbours of India, the ports of Goa had played a significant role in the maritime trade. Archaeological and historical sources suggest that most of the ports and trade centres, both coastal and hinterland existed along the estuaries and tributaries of the rivers. The ports of Goa such as Chandor, Gopakapatana, and Old Goa were located on riverbanks and had trade contacts with the ports of India as well other parts of the world.

A question therefore arises as to why the ports were located away from the coast and how these declined. In order save the vessels from storms, their smaller size, easy handling of cargo and transportation goods to hinterland, ports were built away from the coastal region. It is evident from the studies¹ that mariners of India were aware of the tidal variations, tides, and currents along the coastline of India. Though ports were located in the hinterland, their shifting was noticed in the later period towards the coastal regions because traffic grew, and the size and carrying capacity of vessels increased. It has been observed that because of manmade and natural factors for instance weak economy and foreign attacks, ports

started declining after few centuries. Moreover, sedimentation and changes in the shorelines are some factors responsible for the decline ports of Goa. In this paper, the ancient port Gopakapatana, located on the present Siridao – Agassaim riverbank (Fig. 1) is taken as a case study. The possible reasons for abandoning this port are discussed from a geo-historical viewpoint.

Materials and Methods

Maritime history of Goa

Chandor had been the capital city, centre of trade and commerce as well as port town of Goa since the beginning of the early centuries of the Christian era to the medieval periods. Chandrapura, (Chandor) (Fig. 1) on the bank of Paroda or Kushavati River, a tidal tributary of the River Zuari, approximately 30 km from the sea, is said to be the oldest port of Goa. The author of the *Periplus of the Erythraean Sea* (*Periplus Maris Erythraei*) (1st century AD) has referred Goa as ‘Nelkinda’ by^{2,3}; ‘Nekanidon’ by Pliny (23-79 AD); and ‘Melinda’ by Ptolemy, the Geographer of 150 AD⁴. Arab mariners were known to Goa as ‘Kuwa’ or ‘Kuwe’⁵ and Al-Eidrissi, Al-Masudi, Rashid-ul-din and Ibn Batuta have referred to

‘Sindabur’ or ‘Sandabur’ and scholars believe that Chandor or Chandrapura of Goa could be Sindabur^{6,7}. The copper plate inscriptions of the Bhoja and Kadamba dynasties refer to Chandor. The inscription describes that the city comprised white plastered houses, alleys, horse stables, flower gardens, bazaars, parlours, quarters etc. The Kharepatana copper plates of the 11th century AD refers that ships docked at Chandrapura, similarly in the 1920 Stuarts Gomes suggested that Chandor must be ancient Chandrapura, which was a fortified town with mud fortification wall

and a moat running parallel to the fortification. The earliest reference to navigation in the river Paroda or Kushavati mentioned in the Panjim copper plates of Jayakeshi-I is datable to 1052 AD.

Several excavations have been conducted at Chandor and in the adjoining areas to identify and study habitational remains and maritime structures if any. The excavations⁸ at the temple site of Chandrapura brought to light the Satavahana bricks, pottery, copper coins, etc. datable to the 2nd century BC. The Archaeological Survey of India (ASI) excavated the site in 1974-75 which yielded bricks and pottery assigned to the 3rd-4th centuries AD. Subsequently, the ASI and the Society for South Asian Studies jointly carried out excavations in 1999-2002 at the temple site of Chandor in order to understand the habitation pattern during the ancient period⁹. In addition to other finds such as fortification wall built in different phases, bricks, pottery (early historical to medieval period), glass bangles, semiprecious stone ornaments, stone sculptures, gold rings, Portuguese coins and tiles, the significant find includes an embankment of 6 m long made of trap stones found 30 m away from the present river course. The frequent floods had destroyed the major area of Chandor and River Kushavati was silted up. The regular occurrence of floods probably necessitated constructing the embankment and the same was also used for loading and unloading of cargo (IAR, 2001-02) and (Shriguru Bagi, pers. comm.).

The Gopaka copper plate mentioned that King Viravarmadeva, elder brother of Jayakeshi-I (1052 AD) shifted the capital from Chandrapura to Gopakapatana on the bank of the river Zuari¹⁰ around 1049 AD probably due to silting of the river Kushavati. Further, it is mentioned that the Kadamba king Jayakeshi-I ruled Chandrapura until the middle of the 11th century subsequently shifted the capital to Gopakapatana⁶. Before the shifting of capital from Chandrapura to Gopakapatana, Gopakapatana was a port under the Shilahara dynasty (750-1010 AD) and the Kadambas developed Gopakapatana port and maintained trade contacts with the East African and West Asian countries¹¹. During the reign of Jayakeshi-I Gopakapatana was a flourishing port, commercial centre, and prominent emporium on the west coast of India. King Jayakeshi-I had trade contacts with Simhala (Sri Lanka), Kedah (Sumatra), Zangavar (Zanzibar), Callah (Kuwait), Pandu (Tanjore), Gauda (Bengal), Gurjara (Gujarat),

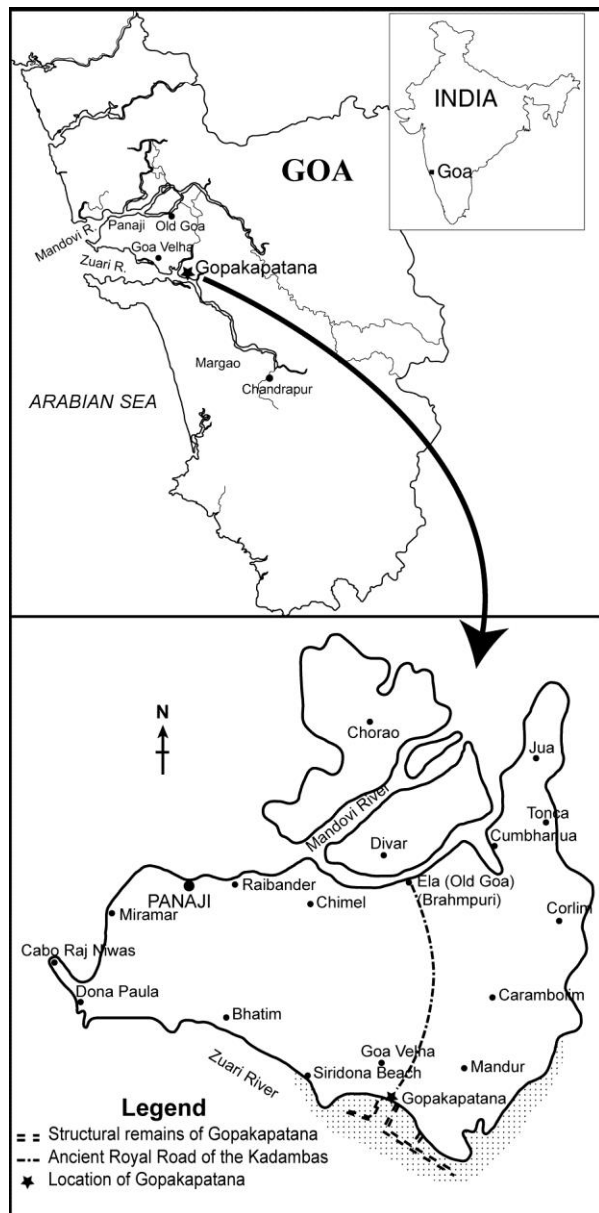


Fig. 1—Location of ancient ports within the rivers of Goa (top) The details of Gopakapatana and the adjoining river bank is shown below.

Srytam (Socotra) as well as ships of the Cholas and Pandyas were plying from Gopakapatana port to these places. Gopakapatana was connected with Ela (Old Goa) by the highway called as 'Vidhi' or 'Rajbidi'¹² and 'Rajvithi' or 'Rajpath'¹³ which still exists. The traders for carrying their cargo to Ela port used this road. Gopakapatana was the entry point for Arab traders to go to Bijapur and Vijayanagar kingdoms.

Fr. Cosme¹⁴ had carried out explorations around Gopakapatana and Pilar region to locate the remains of the port and antiquities if any. In the course of exploration amphorae, pottery, stoneware, and glasses have been collected. The removal of silt and debris from the tank of Pilar brought to light two Roman and Kadamba coins, Chinese ceramics, hero stones, and other artefacts. These Roman coins belong to King Constantine, the Great (309-337 AD)¹⁵. The finding of the St Thomas Cross with 'Pahlavi' language (7th century AD) used by the Persian traders during the Sassanid dynasty, shreds of Chinese ceramics, glazed pottery indicate that Gopakapatana was a maritime trade centre¹⁴.

During the Bahmanis rule, the capital of Goa was once again shifted from Gopakapatana from the banks of River Zuari to the banks of River Mandovi in Ela, (the present Old Goa) in 1472 AD. Yusuf Adil Shah of Bijapur conquered Goa in 1490 AD and Ela became the capital and served as an important port and trade centre of the Indian Ocean trade. During the Portuguese rule, Old Goa became the headquarters and a prosperous commercial city. Ships were sent from Old Goa to Diu, Bahrain, Basra, Muscat, and other places loaded with spices, lead, coconuts, ivory and drugs. *Rua direita* or *dos leiloes* was the chief trade centre of Old Goa¹⁶. Coffee, tea, Goan liquors, gunpowder, finished ivory artefacts, sandalwood, sugar, textiles, etc. were exported and slaves, tobacco, ivory, Chinese porcelains and gold were imported. Old Goa continues to be a minor port until today.

Results and Discussion

The archaeological and historical evidences suggest that Chandor, Gopakapatana, and Old Goa were ports of Goa and after decline of one port, another port came to existence. The inscriptional sources state that due to siltation or sedimentation, Chandor port deteriorated. Similarly, Gopakapatana port shifted to Old Goa, among other reasons it is presumed to be due to siltation, which could be a cause. Except inscriptional evidence, no other sources

shed light on the decline of Chandor and Gopakapatana.

In view of the above, sources such as old Survey of India (SoI) Toposheets and Naval Hydrographic Office (NHO) charts, have been taken into account (Fig. 2) to study the geomorphology of the area. A comparison of such maps, supplemented by coastal field observations and measurements, help to understand the changes in the topography and landforms of the region over the last few decades, by following the known to unknown methodology.

Presently, Gopakapatana is marked by a tidal flat that gets fully exposed during the lowest tide. This feature extends from the tip of Siridao in the west up to Agassaim further upstream. Visual megascopic observations indicate that the sediment is composed of sand near the bank where as silty clay dominates the strip seaward.

Generally, tidal flats are located in estuaries and low energy marine environments and at these places, fine-grain sediments accumulate. Three categories of tidal mud flats are noticed such as: the supra tidal zone above high water, the intertidal zone between high and low water, and the sub tidal zone which is rarely exposed to the atmosphere. The Gopakapatana mud flat could be termed as intertidal as a maximum of 1.3 km is exposed during low tides (Fig. 2C, NHO chart, 2003). Tidal flats often form the buffer zone between deeper reaches of the sea thereby protecting intertidal habitats by dissipating wave energy, and hence reduce erosion. Such features show a tendency to accrete spatially and temporally¹⁷. However, such marine features can also be detrimental to shipping and navigation owing to the shallow nature of such habitats.

In order to understand the spatial evolution of the Siridao - Agassaim mud flat over time, it would be worthwhile to compare the available maps (Fig. 2). The US Army toposheet ND 43-2, Series U502 of 1923 (compiled in 1954; scale 1:250,000) only depicts an indented riverbank; no marine features are seen in the near shore area (Fig. 2A). The Survey of India (SoI) toposheets 1962-64 (scale 1:50,000) shows a well developed mud flat, irregular in shape, with two lensoid features, with an intervening narrow opening of the river. The maximum length is 3 km, and the maximum width is 560 m. The total area occupied by the mud flat equals 1.32 square km (Fig. 2B). The Naval Hydrographic (NHO) chart of 2003 (scale 1:60,000) also shows a well-developed

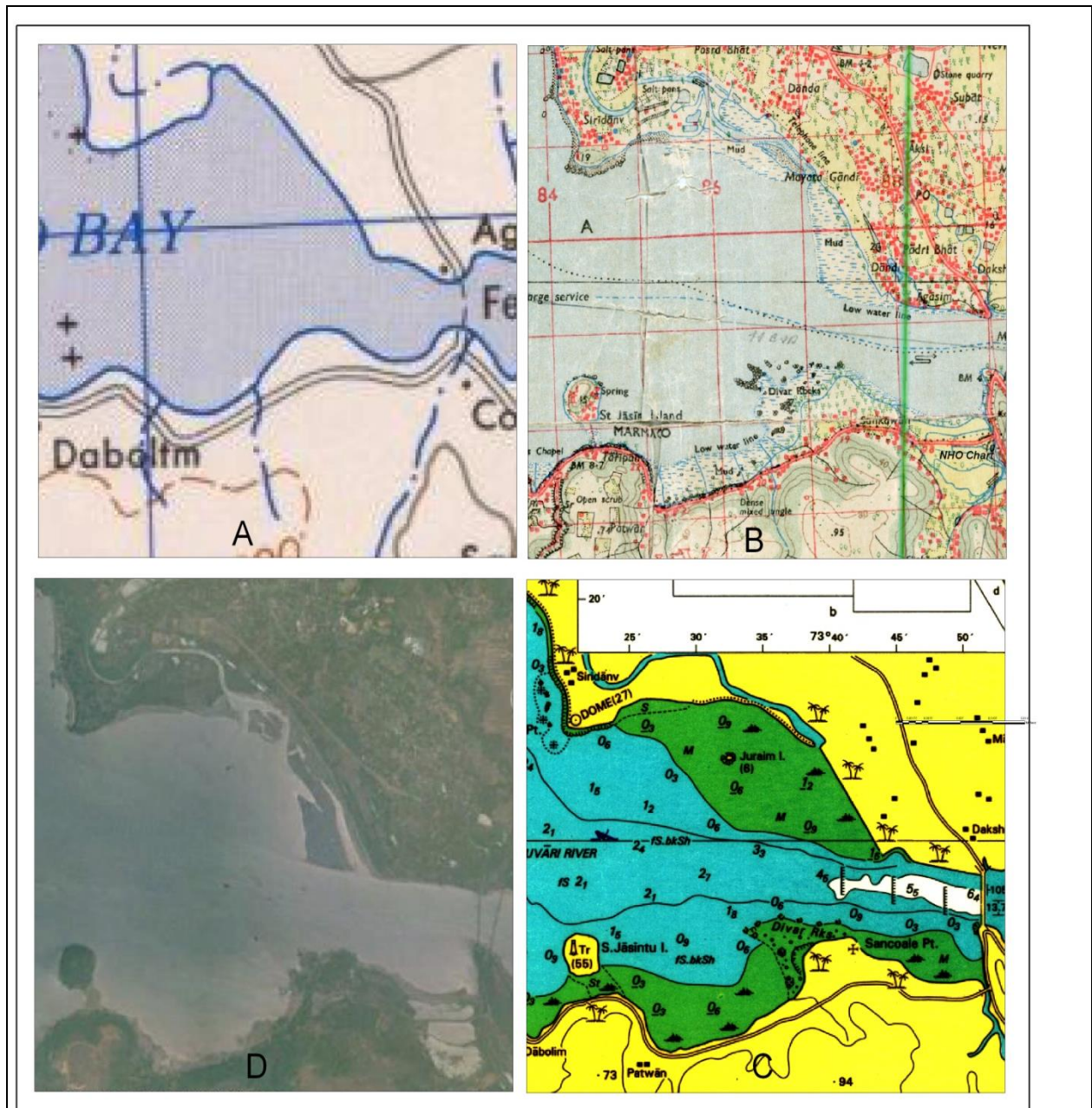


Fig. 2—Multidated maps showing the evolution of the Siridao – Agassaim flat over time: (A). The US Army toposheet ND 43-2, Series U502 of 1923 does not show any geological formations within the Zuari estuary; (B). The toposheet of 1962 shows sedimentation of mud at this site; (C). The NHO chart of 2003 shows a large mud flat that, when exposed, extends 1.2 km into the river; (D). Google Earth image of 22 April 2010 reveals a well developed mud flat fully exposed, at high tide, on the eastern side.

mud flat that is entirely exposed at low tides. The feature is diamond shaped, trending NW-SE with a maximum length of 3.4 km and a maximum width of 1.3 km. The total area of the flat equals about 2.21 square km (Fig. 2C). Google Earth image of 22 April 2010 reveals an exposed surface 1.5 km in length and about 0.4 km in width (Fig. 2D). Similarly, the Google Earth image of 01 May 2013 shows a smaller

exposed eastern patch 0.7 km in length and 0.15 km in width. The comparison made above clearly indicates that the mud flat has accreted considerably over time. If the SOI toposheets of 1962-64 and the NHO chart of 2003 are compared, the mud flat has accreted by about 68% in around 40 years.

The bathymetric profile (W-E) (Fig. 3) along the present day navigation channel in the Zuari river,

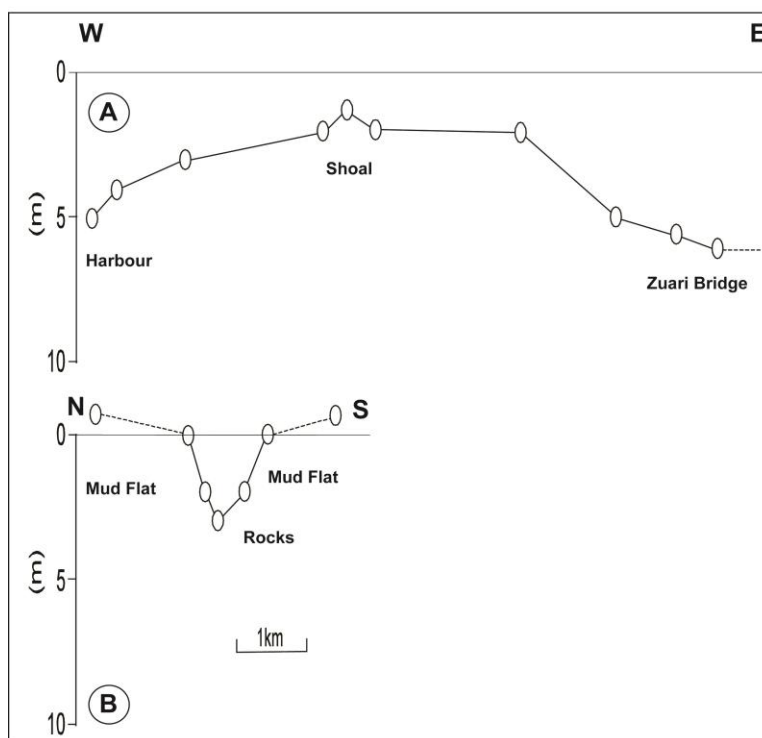


Fig. 3—(A) Depth profile along the shipping channel of Zuari river from the bridge towards the harbour; (B) A similar N-S profile across the tidal flats of both banks. Note the narrow channel at this point (downstream of bridge), the abrupt shoaling where the river gets wider, and rock outcrops on southern bank.

from the bridge towards the mouth of the estuary, shows that the channel is deeper (around 5-6 m) adjacent to the bridge, but shallows abruptly further downstream; depths as low as 1.5 m are observed in this stretch (Fig. 3A). The waterway gets deeper (> 5 m) further west, towards the harbour. Here, extensive mud flats occur along either bank. Similarly, a N-S section across the navigation channel off Siridao reveals an extremely narrow canal, about 1 km wide, and with a maximum depth of 3 m (Fig. 3B). It is this stretch, downstream of the bridge that vessels need to exercise caution: a restricted channel and shallow depth.

Along the Zuari River, higher values of silt are noted in the lower half of the estuary, particularly around the Zuari Bridge, in all the three seasons.

Similarly, clay content shows maximum values of 57%, 63%, and 68% during monsoon, post monsoon, and pre-monsoon in the same stretch. In general, sand is dominating in the upper estuarine region whereas higher values of silt and clay are observed in the lower half of the estuary¹⁸. The main source of sediment in the Zuari estuary is attributed to mining and its associated activities such as transportation of

ore to the platforms, ore loading, and barge building. Other anthropogenic activities such as sewage outfall, agricultural practices, coastal construction, and indiscriminate waste dumping can also be attributed as sources of sediment. Concentration of metals in the lower estuarine region indicates presence of favourable condition as far as the presence of higher quantities of finer sediments in this sector¹⁹.

Recent published work indicates an increase of finer sediments from 1980 until the present and that finer sediment (mud) was deposited during the higher rate of sedimentation²⁰. With growing human activities like increase in iron ore mining²¹, agriculture, and constructions in the catchment area in recent years, there has been alteration of land use patterns. This must have enhanced sediment yields of rivers resulting in the observed higher rate of sedimentation in the estuarine and creek regions²⁰.

Based on the comparison of multidated maps (Fig. 2A-2D) and the underwater relief described above (Fig. 3A-3B), it is clear that: (a) although the mud flat is mapped in 1962-64 showing an area of 1.32 square km, it must have started forming much earlier, (b) considering an accretion rate of 68% in 40 years

(1962-64 to 2003), the formation of this feature probably started in beginning of 1900's, or even earlier, (c) the constricted nature of the river channel adjacent to the bridge followed by the sudden widening of the estuary would then slacken the ebb flow and tend to deposit the suspended sediment here²²; this process explains the shallow part of the estuary and also the expanding mud flats along either river banks, (d) the opinion of historians that the ancient port of Gopakapatana was abandoned due to siltation therefore is proved by the occurrence of the large mud flat that has evolved over time and is emerging sea ward even at present.

Conclusions

In the maritime history of India, ports of Goa have played a significant role because of navigable rivers, well located anchoring, and landing facilities, which served mariners for better oceanic trade since the early historical period. Based on the location of Chandor port, it is evident that ancient ports of India were located away from coastline. Over a period of time, demand of goods increased, technology developed, the size of vessels became bigger, and new ports were established at new strategic locations, mostly along the coast.

Concurrently, hinterland ports started declining because of frequent wars among the neighbouring kingdoms for supremacy, poor economy, trade monopoly, draught, famine, and the natural hazards such as cyclones and storms. Sedimentation, formation of sand bars and spits seem to have been also responsible for their decline. In case of ports of Goa, Chandor declined because of sedimentation, evident from inscriptional sources. In the case of Gopakapatana in particular, it is evident that sedimentation and recurrent wars caused the decline of the port. It is concluded from geological data that Gopakapatana was abandoned due to shallowing because of rapid sedimentation with the consequent formation of a mud flat that is actively growing at present.

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