

# Submerged Pagodas of Mahabalipuram – Study Based on Underwater Investigations

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## Abstract

Mahabalipuram, the famous centre of Pallava art and architecture is situated on the east coast of India. The local traditions and the foreign accounts are vividly referring the submergence of six temples out of seven pagodas where only one now has subsisted. Recent underwater archaeological explorations in the area have revealed many structural remains including fallen walls, scattered dressed stone blocks, a few steps leading to a platform and many other structural remains. The structures were badly damaged and scattered due to underwater strong currents and swells. Though thick biological growth cover the details, if any, on the stone blocks, based on the structural alignment and form, they are considered to be man made structures. The available data reveal presence of a large building complex, now submerged.

Based on the archaeological evidences around Mahabalipuram, the earliest possible date of these structures could be around 1500 years BP. The major cause of the submergence of these structures is severe coastal erosion.

## Introduction

Mahabalipuram is situated on the seashore about 55 km south of Chennai (Fig. 1) and is well known for its architectural marvels such as Shore Temple, Chariots Rathas carved out of single rock, Arjuna's Penance, bas relief and several cave temples built by the Pallava king Narasimha Varman during the 8<sup>th</sup> century AD and is recognised as a world heritage monuments by the UNESCO. It is also known by several other names such as Mamallapattana, Mamallapuram. Europeans referred this town as Mavalipuram, Mavalivaram, Mavellipore, Mauvellipooram and Mahabalipur. This 'the city of great wrestler' was controlled by Pallava kings from Kanchipuram, the capital of Pallava dynasty (Rabe, 2001) from the 3<sup>rd</sup> century to 9<sup>th</sup> century AD. Mahabalipuram literally means 'city of the Great Bali' in memory of tradition when Vamana (Vishnu's Dwarf incarnation), humbled the demon king Bali and caused his splendid beachfront palaces to collapse beneath the sea (Rabe, 2001).

Mahabalipuram, is said to have been a seaport right from the beginning of the Christian era. An 8<sup>th</sup> cen-

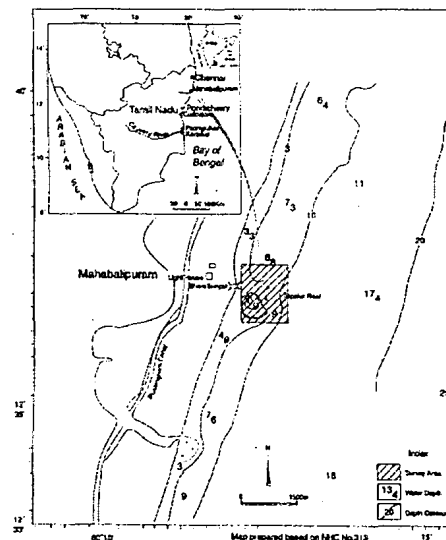


Figure 1. Location and survey area of Mahabalipuram.

ury Tamil text written by Tirumangai Alwar who described this place as Kadal Mallai (Ramaswami, 1989). A few Roman coins of Theodosius (4<sup>th</sup> century AD) suggest that Mahabalipuram had trade contact with the Roman world around the Christian era (Dayalan, 1992).

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The epigraphical sources also say that the Pallava kings had an active contact with Ceylon, China and the Southeast Asian countries. Pallava king Sihmavarman led two expeditions by embarking two ships from Mamallapuram. Pallava embassy and Vajradanthi, the famous Buddhist monk (who introduce Mahayana Buddhism to Sri Lanka) sailed to China from Mamallapuram port (Ramaswami, 1989). Archaeological excavations near Punjeri village, about 1.5 km west of Mahabalipuram revealed the remains of the early historic and medieval periods. The excavator has suggested that this place could have served as an ancient port (Dayalan, 1992).

Mahabalipuram was well known to earlier mariners as 'Seven Pagodas' since the 17<sup>th</sup> century AD. It is generally believed that out of 7 temples originally constructed, all but one have submerged in the sea over a period of time and what is now known as "Shore temple" is remaining. European travellers in the 18<sup>th</sup> and 19<sup>th</sup> century have recorded this folk tradition (Ramaswami, 1989). Carr (1869) refers to the account given by William Chambers (1869) after his second visit to Mahabalipuram in 1776 that "according to the natives of the place, the more aged people among them, remembered to have seen the tops of several pagodas far out in the sea, chinch being covered with copper, probably gilt, were particularly visible at sunrise as their shining surface used to reflect the sun's rays, but that now the effect was no longer produced, as the copper had since become incrustated with mould and Verde grease".

To confirm the traditions underwater investigations were carried out at Mahabalipuram. The survey comprised of the Geophysical methods and underwater visual inspection by diving.

### Geological Setting

The hinterland around Mahabalipuram is covered by charnockite and migmatite group of rocks. Discrete bodies of granites are seen in some parts of the area including the granitic promontories on the shore of Mahabalipuram. These outcrops may belong to the same age group of granitic activity that occurred in the central part of Tamil Nadu during Protorozoic

(Subramanyan and Selven, 2001). In the near shore zone off Mahabalipuram, the seabed is uneven with rocky outcrops of granitic boulders with occasional sand patches and it gradually slopes down towards east. There is a shoal called Tripalur reef, which is in the form of submerged rocks. A ridge is noticed south-eastern side of the temple in about 8 - 10 m water depth that extends from South and narrows towards North and is more than 2 km in length and 0.5 km in width. At some places the top of ridges gets exposed during the lowest tide and form a high-energy zone. Magnetic studies over the inner shelf of Mahabalipuram have delineated folded and faulted basement (Murthy et al., 1995). The inner shelf in this region is covered with sandy sediments (Selvaraj & Mohan, 2003). The continental shelf of Mahabalipuram has two fold morphological divisions separated by a terrace at about 120 m water depth (Mohapatra et al., 2002) The shelf off Mahabalipuram is about 40 km wide and the shelf break occurs around 135 m depth and covered by carbonate-dominated sediments in the outer shelf and sandy silt and silty clay in the other parts (Vaz, 1996).

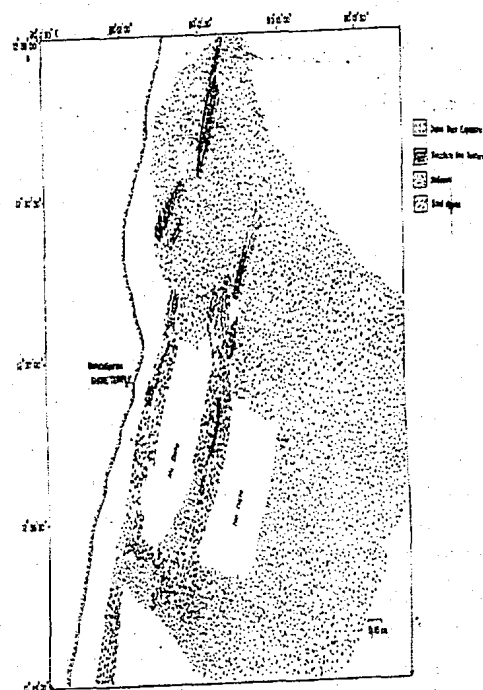


Figure 2. Map showing the results of Geophysical explorations.

**Methodology**

The offshore exploration involved both, geophysical and underwater visual survey. Initially the Geophysical survey comprising of echo sounder and side-scan sonar surveys carried out between 6 – 15 m water depths on the northeastern side of the Shore Temple. About 28 traverses of different lengths both parallel and normal to the coast was carried out followed by underwater visual inspection by diving and documentation.

**Results**

The seabed off Mahabalipuram in depth ranging from 6 - 15 m is highly undulating with variation in height from 1 to 6 m. Granitic rocks with patches of coarse-grained sand carpet the floor.

**Bathymetry**

The water depth in the study area, in general, varies from 2.1 to 14.2 m. The contour map has been prepared from the depth levels of 6 m to 14 m as the shallowest depths below 6 m were located at very few places and particularly in the region of Tripalur reef. As a whole the seabed is irregular between the water depths of 6 and 9 m where from the seabed appears to be smooth seawards. The northern part of the study region is relatively gentle when compared to the southern part particularly between the water depths of 6 and 9 m. The seabed is irregular and has sharp gradient off the shore temple region. From the physical observations and also from the sonographs, it is verified that the shallow region opposite to the shore temple is comprised of abundant rock exposures. These rocks are exposed during low tide. The bathymetry contour in Tripalur reef area indicates a NE – SW high on the seabed. The well-marked Tripalur reef occurs in this zone only. Stray relief features were noted in the northern part of the study area between the water depth of 7 and 8 m. Further, seaward the seabed gradient is smooth and gentle. The mosaic of the seabed images shows the distinct occurrence of rock outcrops mostly with in the water depths of 6 and 9 m. At some places these rocks are associated with some linear discontinuous structure like objects.

The southern part of the study area, particularly, within

the depth of 9 m shows rocky irregular seabed while the northern part is dominantly floored by sandy/clayey sediment with some stray occurrences of rock outcrops with in the linear discontinuous structure like objects. These linear structures appear both in the southern and northern part of the study area. The region beyond 9 m depth is entirely occupied by plain sediment.

The seabed image in the region around the fix No. 95, which appears at the northern most region of the study area, shows a group of small blocks arranged in a systematic pattern (Pl. 19). Some thin linear structures similar to the above structures appearing on the sonographs do not show any association of rock outcrops.

Several rectangular and square shaped structures have appeared on most of the sonographs, particularly in the northern part (For example fixes 111, 125 and 166) show groups and clusters of blocks in a systematic pattern, mostly discontinuous short linear structures parallel to each other (Fig. 2). Strong reflections of the images suggest that they are massive hard bodies that are well shaped. Some natural irregular rock outcrops are also associated with these linear structures. It appears from the study of the entire sonographs in the study area that some significant parallel discontinuous rocky structure like bodies exist on the seafloor at some places in addition to the dominance occurrence of rock outcrops.

**Underwater Diving**

The interesting findings were explored by diving based on the sonographs and found they were important from archaeological point of view from this area, which include structures, section of walls about >10 m in length. Among them a few structures in different locations were explored thoroughly and rest were spot diving for confirming the sonographs.

A huge structure was found about 700 m E of Shore Temple in 6 m water depth, which is comprised of several small structures. The upper portion of the structure is above sea surface during low tide and is visible from shore or from a boat. The structure covers an

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area of approximately 75 x 35 m (Fig. 3). The structure is broader on the northern side where a heap of stone blocks are also observed, while on the southern side scattered small stone structures of various sizes were observed. The Structure has several N – S oriented wall sections.

Dressed granite blocks were used for the construction of this structure. A wall, about 25 m in length and 65 cm in width with two to four courses is noticed. The dimensions of the blocks varies between 95 x 65 x 90 cm and 45 x 50 x 50 cm. Huge rectangular blocks measuring approximately 2 x 1 x 1.5 m were also noticed on the upper portion of the structure along with a few blocks having joinery projections. The structures are covered with marine growth, a few blocks were cleaned and chisel marks were observed.

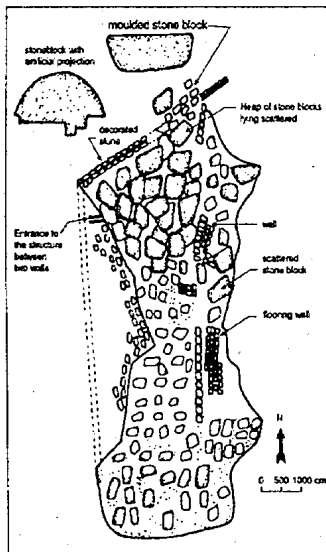


Figure 3. Plan of the underwater structure at site 1 off Mahabalipuram

Another wall, measuring about 5.40 m in length was seen on the northern side along with two parallel walls on southern side of the main structure with steps like structure leading from down to up. There was a small platform along with a wall towards northeastern side of the main structure. Further northern side remains of wall extended up to 15 m in length (Fig. 4).

On the western side of the main structure, remains of a wall were noticed on a raised platform. Some of the stone blocks of the western side were cleaned. One of

the blocks shows that it has the joinery projections for interconnecting the blocks (Pl. 20). The length of some of these six walls varies from 7 to 32.5 m. however; other walls are shorter in length. Large sized square and rectangular blocks are noticed middle of the structure, which had a height of 4 m above seabed. A floor measuring 2 x 2.5 m was also noticed towards the northwestern side of the structure. The entire structure has a thick marine growth of sponges, shells, barnacles and mussels.

Another site is located about 200 m towards the NNE of the former structure. At this site, two big reefs of nearly rectangular shape are visible during low tide where wave breaks on them. The water depth varies between 5 - 8 m. The site has remains of wall, dressed stone blocks and the natural boulders. Some of the stone blocks appear to have figurines carved on them, however identification was not possible due to thick marine growth. There was a wall of 2 m wide and 5 m in length running E – W direction and many fallen dressed stone blocks found scattered around it.

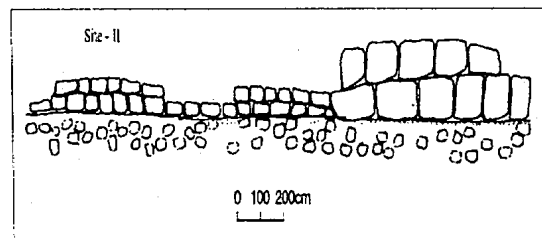


Figure 4. The section the fallen wall at site II off Mahabalipuram.

There is a rectangular stone blocks visible during low tide and the wave breaks on them. The extension of the structure is right from the seabed to the surface of the water. There are two similar stones noticed at one place within a distance of 50m. The other dressed stone blocks are scattered around it. Dressed stone blocks were also noticed on the eastern side of the structure. One of the most important finding of this location is a wall running more than 10 m with a width of 2.5 m.

One more structure having seven courses of small stone blocks of 1.5 m height and 2 m length with 65 cm width at 7 m water depth was noticed. It has an L shape, connecting wall having only one course of about

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5 m in length is noticed, part of which was buried in the sediment. Apart from this huge flat rocks were noticed but due to marine growth it was not possible to check them properly.

One more structure is noticed at about 100 m N of the previous structure, where the remains of wall were noticed (Pl. 21). The length of the wall is 50 m and the width is 0.60 m having three to four courses in N – S directions. About 10 cm thick marine growth of sponges and barnacles was noticed on them. Some natural boulders of large size were also noticed near this structure.

Another structure is noticed on the eastern side of the first location at a depth of 8 m. This is a huge natural rock, which is more than 100 m<sup>2</sup> with chisel marks and query marks. Stone blocks used for construction were probably extracted from here. Another wall of L shape having two courses was also observed. There were three more lines of dressed stone blocks noticed at this site running towards northern side of the rock.

Apart from the above structures there were many more found in the vicinity which includes different types of structures, fallen walls, dressed square and rectangular stone blocks, a square platform leading with steps and stone figurines etc.

### Discussions

The underwater inspections off Mahabalipuram clearly show the presence of wall sections, fallen and scattered long walls, structures at various locations, large number of dressed stone blocks of rectangular and square type of building materials at several places and perhaps a quarry. Many of them are man made in nature. Some times the extension of these structures can be noticed at least a few hundred metres parallel to the shore at various depths between 5 to 10 m. A few continuous remains of walls have been noticed at all the places. Structures running sometime more than 25 m in length, suggest that they are part of some building complex. At several places high platforms and steps leading to platforms are also noticed (Pl. 22). It is, however, difficult to determine the layout for all sites as the structures have been badly damaged and

are covered with a thick biological growth.

The plan of the structure indicates that this construction could be of a big complex as the huge stone blocks and several fallen wall were noticed *in situ*. It appears that construction has been carried out on a raised platform with several walls and a floor made of granite blocks. An opening between two walls with steps has been noticed which probably may be entrance to the complex from the southern side. The natural rock boulders noticed on SW side are similar to those on land at Mahabalipuram on the hill in shape and size. Similarly, construction style observed in the structures underwater is identical to one observed on adjacent land. It was not possible, however, to verify the binding material of underwater structure due to huge marine growth and their damaged condition. There were many wall sections observed at different locations including the 'quarry area on a huge rock. The dressed stone blocks required for the construction were probably extracted from the quarry found near by. In fact, most of the religious / ceremonial constructions including the present shore temple, at Mahabalipuram, have been built with granite. The stone was extensively used for the construction of temples during Pallava regime.

### *Possible Date of the structures*

The presence of man-made structures of Mahabalipuram in 6 – 8 m water depth raises many interesting questions, such as when they were constructed and how and why they happened to be there. If we could have found some artefact or antiquity providing irrefutable clues, then answer would have been easy. Even some datable sample would have helped in solving this jigsaw puzzle. In the absence of datable evidences, the structures found underwater can be dated only based on the local traditions and available literature. The local tradition and the people of Mahabalipuram believe that five temples similar to the Shore Temple have been submerged in the sea.

### *On the basis of local traditions*

Ancient Tamil literature does not directly mention Mahabalipuram, but a poem, Perumpanarrupadai, (dedicated to Tondaiman Ilamtiraiyan, a king of Kanchipuram), describes a port called Nirppeyarvu,

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which could either be identified with Kanchipuram or Mamallapuram. The place has been dated to the end of 2<sup>nd</sup> century AD (Ramaswami, 1980). Similarly, early foreign travellers also do not mention this site, but the author of *Periplus of Erythrean Sea* (Schoff, 1974) has mentioned a port called as Sapatma, which could be identified with Sadras, situated about 20 km south of Mahabalipuram which was a small port during early centuries of Christian Era. Ramaswami (1980) mentions that Pallava king Mamalla who sets his workers working on the rock for the first time here in 7<sup>th</sup> Century AD, thereafter this place known as Mamallapuram. The name Mahabalipuram, therefore, is of a very late origin.

The local tradition does not mention how old the city is but associates it with the demon Mahabali, which led to imparting the name, Mahabalipuram to the site. As early Tamil literature do not mention the name Mahabalipuram, it is reasonable to infer that the tradition of submergence of these structures is not earlier than 1000 years are so. If the shore temple is the last surviving temple, which is about 1200 years old, then other temples submerged in the sea should be of the same age.

The archaeology of Mahabalipuram commences from the early centuries of the Christian era as a few Roman, Chinese coins were found (Ramaswami, 1980). Two Pallava coins bearing legends read as Srihari and Srinidhi have been reported in and around the Mahabalipuram (Dayalan, 1992). One of the inscriptions of Narasimha I mentions that he (Narasimha I) is the first person to introduce the construction of caves, temples in granite stones. The zenith of human habitation around Mahabalipuram was during Pallava dynasty, therefore, the dates of these temples may not be earlier than the 1500 years BP.

On the western side of Mahabalipuram about 1.5 km on the hill region known as Mallar region at Punjeri just on the western bank of the inlet water, Bunkingham canal, megalithic burials, cairn circles, jars with burials were observed. The earliest date of Megalithic culture of southern India is not earlier than 1500 years BC and continued till early centuries of Christian era. Dayalan (1992) noticed the Early Historic and medi-

eval period habitation from here. Probably Mallar area could be the ancient harbour on backwaters where it could be ideal place for safe landing. The boats may be entered either from Sadras where the opening channel between the river and the sea or the canal opening at 3 km south of Mahabalipuram.

Considering these evidences, it may be concluded that Mahabalipuram was a port before Pallavas. It became the principal port during Pallava rule and they had voyages to Sri Lanka and South East Asian Countries. The port was continued till early British period where a mention of British ship anchored at Mahabalipuram (Ramaswami, 1980). With these it may be mentioned that Mahabalipuram was an active port since last 2000 years BP.

Ramaswami (1980) refers to the several accounts of Europeans about the submergence of the city and the tradition that 'a large city and 5 magnificent pagodas have been swallowed up at this place by the sea'. Robe (2001), Chambers (1869), Graham Hancock (2002), Mohan and Rajamanickam (2002) believe that out of seven temples carved out of granite during 8<sup>th</sup> century AD only one has survived and the rest have submerged. However, based on the facts that the rock art sculpture was encouraged by the Pallavas at this place and most of them were made during that period, these structures may be dated as 1500 -1200 years BP.

The history of stone structures in Tamil Nadu, it is only during Pallava regime when stone was extensively used for the construction of temples and residential houses were of bricks and wood. Whereas the earliest stone constructions in India have been reported during Harappan period (Joshi & Bisht, 1994) especially in Gujarat and other coastal areas. The stone blocks are not very regular and mud mortar was used for the construction. However, stone pillars, statues are made on finely dressed stones. While in the case of Mahabalipuram the stones are nicely dressed and chiselled properly. So far archaeology of Tamil Nadu does not refer to stone masonry older than the 4<sup>th</sup> - 5<sup>th</sup> century AD. Therefore, the dates of submerged structures may be dated to later than early centuries of Christian era.

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Changes in shorelines in the past have been recorded in various parts of the world. These comprise of both, due to submergence and emergence of coast. The shoreline changes are generally due to, amongst other reasons, either sea level changes and / or change in sedimentary regime. Either eustatic sea level rise or local tectonic event generally induces Sea level changes. These changes cause shoreline to advance or retreat. Similarly, sedimentation pattern - depending on local hydrographic characteristics it could be depository or erosional - in turn, will effect the shoreline. Very detailed and comprehensive study is required to determine local shoreline changes. However, it is possible that sedimentary pattern may vary along the coast depending on nature of coastline, presence of river mouth, change of climatic zone along the coast etc.

On the basis of sea level history it is inferred that about 10,000 years BP, shoreline was lower by more than 100 m then at present and present sea level was arrived at about 6,000 yr. BP and that global sea level fluctuation has been between 2 - 4 m in last 6000 years (Fairbridge, 1960). Several recent papers have mentioned a few 'little ice ages' in historical period and medieval period when sea level went down by about 2 - 3 m. A brief review of available published literature is given below for South India in general and Tamil Nadu in particular.

Recent studies have indicated that during mid-late Holocene period 2-3 times sea level fluctuated between 2 to 6 m along the both coasts of India (Merh, 1987). Banerjee (2000) has documented sea level fluctuation on the East Coast during last 5000 years. The east coast of India is marked by raised beaches along Orissa, Nellore, Madras and Tinnevely coasts, indicating sea level higher than present in the past. Banerjee (1973) has studied foraminiferal bio-stratigraphy of Thanjavur sub-section of Cauvery delta and traced the evidences of sea level changes.

Geological studies carried out in the water depths between 20 and 30 m in the central eastern continental shelf of India have indicated the evidences of submerged beaches and beach ridges formed during lower sea level times (Mohan Rao et al., 2001 & 1989; Mohan Rao and Rao, 1994). Srinivasa Rao et al. (1990) ob-

tained a radiocarbon date of 8200 yrs for the carbonate sample recovered at 17 m water depth in the Nizamapatnam bay in the east coast of India. Banerjee and Sengupta (1992) have broadly identified two low stands, one at around 30 m and other at around 100 m depth based on anomalous sediment, geomorphic, Palaeontological and geological criteria. However, the shelf of Tamil Nadu coast is believed to have undergone severe tectonic activity and because of which the sea level history varies from place to place.

Many places, which were along the shore some centuries ago, are now a few miles inland. Coringa, near mouth of Godavari, and Korkai on the coast of Tinnevely, were all flourishing seaports about 1000 - 2000 years ago but are now defunct due to siltation or erosion. Their present position some distance inland may be attributed to the gradual growth of deltas of the rivers at whose mouths they lie. Similarly on the Tinnevely coast, in the Valinokkam bay, a submerged forest has been noticed, with numerous tree trunks of about 0.6 m diameter at the base, getting exposed at low tide over a bed of black clay containing oyster and other marine shells, a clear indication of earlier prevalence of marine environment (Krishnan, 1968).

The above references clearly indicate that the violent fluctuations in the sea levels / shoreline in last few thousand years and clear trend of changing shoreline at places in Tamil Nadu.

Sea level / shoreline changes and Tectonic history of the region: This aspect is very critical in determining the dates of the structures. The sea level has fluctuated between 2 - 6 m about 2 - 3 times during mid-Holocene period on both the coasts of India (Merh, 1987). The sea level fluctuation has documented on the East Coast of India for the last 5000 years (Banerjee, 2000). In continuation of general background on history of sea level changes Krishnan (1968), Mohapatra and Prasad (1999) point out that the major and important factor affecting Mahabalipuram coast is erosion. Severe erosion at Kalpakkam, south of Mahabalipuram due to long shore sediment drift has also been reported (Mohapatra and Prasad (1999). A recent study suggests the rate of coastal erosion in and around Mahabalipuram is 55 cm/yr (Ramiyan et al.,

1997). If the same rate has prevailed since last 1500 years, then shoreline at that time might have been around 800 m eastward and all the structures noticed underwater would have been on the land. If the rate of coastal erosion derived for Poompuhar, located 125 km to south, are applied for Mahabalipuram, then the structures in -5 to -8 m must be on the land 1500 yr. BP (Sundaresh et al., 1997).

Interestingly, due to construction of semi-circular breakwater recently, the shoreline over a stretch of 3 km towards north of Shore Temple experiences accelerated erosion (Subramanyam & Selvam 2001). There is an evidence of the tectonic activity around Mahabalipuram during early Quaternary period (Murthy et al. 1995) However, there is no evidence of tectonic activity on the coast during last 1200 years BP as shore temple has not been affected (Mohapatra and Prasad 1999)

It is interesting to note here that a 12<sup>th</sup> century AD city known as Dunwich in Baltic Sea, Europe, is lying between 5 -16 m water depth as a result of coastal erosion (Bacon 1978)

From above discussions, it may be attributed that coastal erosion followed by invasion of sea has played a major role in submergence of these structures and sea level changes might have played a contributory role. However, further data on this aspect need to be collected and analysed to confirm this.

### Conclusions

The underwater structures, especially the long walls having 2 to 3 courses, scattered dressed stone blocks of various sizes, stones having projections considered to be man-made in nature. The structures found at different locations appear to be similar, but have different dimensions as they were probably constructed for different purposes. Some of these structures are observed on raised platforms of existing natural rocks. The structures were noticed mainly in the area close to reef and are thickly covered with marine growth. These structures may be the remains of huge complexes or the temples of seven pagodas. As Pallavas encouraged the temple architecture at Mahabalipuram during 8th Century AD, these structures may be assigned

to the same period. Mahabalipuram has served as port during Pallava period. Part of earlier Mahabalipuram town may have been submerged in the sea. The possible causes for submergence of these structures may be due to shoreline changes by erosion. Further investigations are required to understand the nature of submerged structures and their dates.

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