

A note on geophysical explorations for marine archaeology off Tamilnadu Coast, India

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Introduction

From the folklore in the area and along with the information and data available to archaeologists, it is widely believed that Kaveripattinam (Poompuhar) was a flourishing harbour at the beginning of the Christian era. Tranquebar, about 12 km to the south of it, was an active Dutch port in the 17th century and ships regularly plied from these ports to Java, Sumatra and China. Fishermen of the area occasionally complain of nets becoming entangled in some areas and frequently items of interest to archaeologists are found. Tranquebar Fort houses a museum of such objects, such as stone anchors and statues, including those collected from the seabed.

In September 1981, the National Institute of Oceanography in Goa had carried out geophysical surveys for marine archaeologists off Kaveripattinam–Tranquebar on Tamilnadu coast in association with the Tamilnadu Department of Archaeology (Fig. 1). The objectives of the survey were mainly to search for submerged remnants of erstwhile port structures and also for any shipwrecks. The surveys were planned in two stages. The preliminary surveys, the present one, with the help of geophysical equipment were to identify the presence of any structures and their locations for subsequent detailed study. The results of about 170 km of echo sounding and side-scan sonar surveys are discussed in this paper.

Previous work

The scope of marine archaeology is vast and encompasses many fields. Aspects such as changes of sea level, their effect on shore line, siltation etc. require some consideration and are described by Flemming *et al.* (1973) and Evans (1973). Muckleroy (1977) has made a detailed

study and classification of historic wreck sites and their environment. Dumas (1972) has discussed chances of wrecks in different conditions.

In the initial stages, the field of the marine archaeologists was limited to shallow waters (generally down to 8–10 m) where searches could be carried out with hand-held camera in continuation of the on-shore clues. This necessitated knowledge of the position of the structures and shipwrecks with some degree of certainty. The fact that during a dive a limited area only could be covered, made the search a time consuming proposition.

Since the development of marine geophysical equipment, primarily for exploring and developing offshore oil fields, marine archaeology has received tremendous impetus. The search can now be extended into deeper waters (even greater than 100 m) with the help of side-scan sonar and magnetometer where specific locations are not known. This equipment, along with the echo sounder, now form the basic equipments of reconnaissance for marine archaeological surveys. The successful use of such equipment in marine archaeology has been described by Théorêt (1980) and by Throckmorton and Edgerton (1973), Scoufopoulos and Mckernan (1975) and Watts *et al.* (1978); the spectacular discovery of the *Titanic* is a recent example (Ryan and Rabushka, 1986). Rabban (1980) and Bacon (1978) have taken a different approach and collected the data on ancient ports from literature and records.

Methods and equipment

Factors such as line spacing, total area to cover, range of sonar coverage etc. determine the quantum of work and the time required for the field

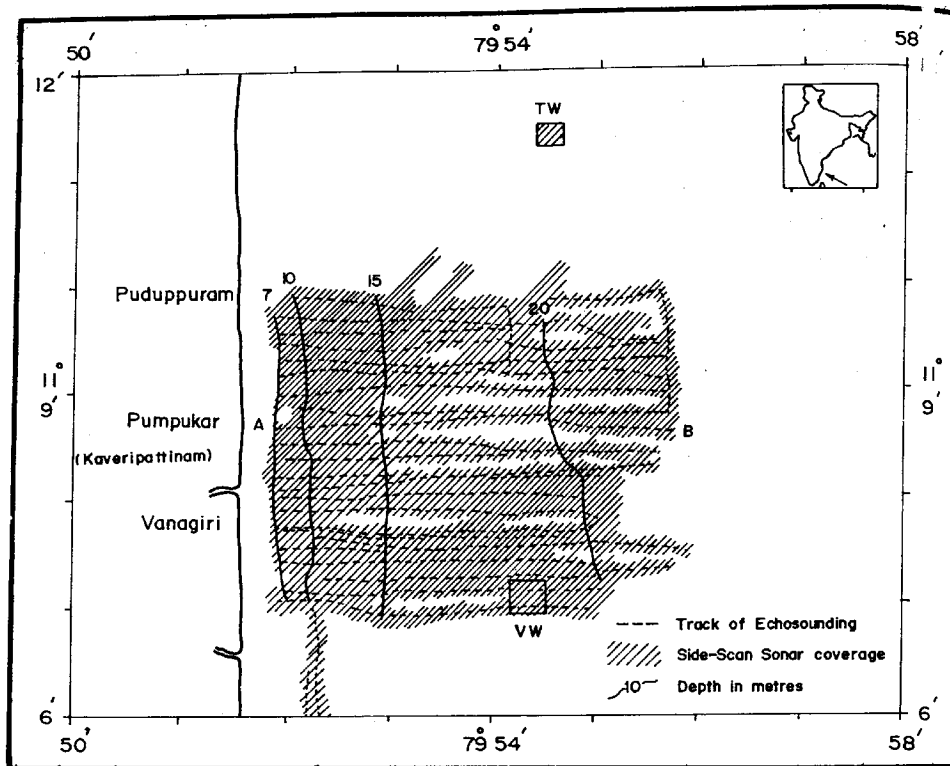


Figure 1. Location map with survey tracks.

work. When the primary objective is a search rather than a survey, the approximate size of the objects expected helps in determining the resolution required on sonograph, which in turn decides the range to be operated for side-scan sonar as also the spacing of tracks. Obviously for smaller objects line spacing would be closer and therefore there would be more work. Similarly, when the positions are not known accurately the requirement will be to cover as much area as possible. A compromise therefore is inevitable for completing the surveys within given time schedule and budget.

Position fixing plays a vital role in such surveys, where not only accuracy, but also the repeatability of the system is important to enable further detailed investigations and excavation.

During the surveys, a Motorola Miniranger system was deployed to provide the positions. The advantage of using a radio electronic position fixing system is that it has an accuracy to within 3 m and good repeatability, the sextants were also used in part of the area.

An Atlas Deso-10 echo sounder with dual operational frequencies (30 and 210 KHz) was used for the bathymetry. The echogram revealed the nature of the sea bed and provided the height of the objects. The lower frequency also provided some sub-bottom penetration in soft sediments.

Side-scan sonar provided plan view of the sea floor and recorded the topographical and lithological variations on either side of the track up to 125 m in the form of tonal variations. The

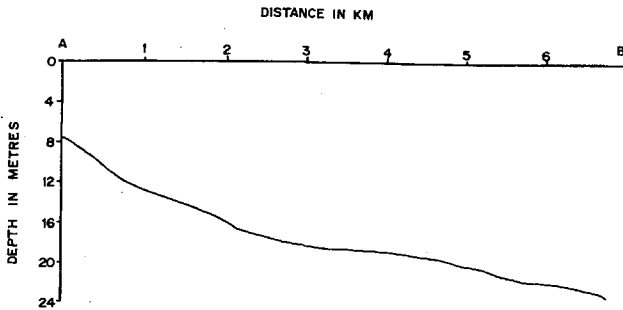


Figure 2. Typical bathymetric profile off Kaveripattinam—locations in Fig. 1.

shape, size and orientation of features are also provided by the sonographs which may help in identification.

The surveys extending from Kaveripattinam to Vanagiri were carried out on the scale of 1:25,000. The survey tracks were planned at 250 m spacing, perpendicular to the coast and were limited to about 22 m depth. Wherever some interesting features were recorded, a detailed search was carried out for similar features in the vicinity. Figure 1 shows locations of such surveys marked as TW and VW.

Local geology

Wadia (1975) described the geology of the adjacent coast where sedimentary rocks of the upper Cretaceous age, relicts of the great marine transgression, are exposed. The lithology mainly consists of limestone, silts, clays and gritty sandstones. The thickness of the beds varies from 300 to 1000 m. The hydrographic charts of the survey area indicate the presence of sand to about 10 m water depth, the seabed in the area deeper than 10 m is covered with mud and occasionally with sand and mud.

Results and discussion

The surveys extended from 7 m to about 22 m of the water depth. the typical bathymetric profile (Fig. 2) clearly indicates that the gradient is steeper near the shore but after an abrupt change at about 17 m it is gentler. The dual frequency echogram also reveal the 2–4 m thick acoustically transparent clay in the area. However, the area near the shore to water depth of 7–8 m

shows no penetration due to exposure of sand on the bed which is also confirmed by sonographs.

Despite the general smooth topography of the area, echograms show some conspicuous features recorded such as peaks or pinnacles, in depths of about 18–19 m. These features at times, have a broad base (about 80–90 m wide) and height of about 4–6 m (Fig. 3). It is seen that while some of the features have broad base (A,B,C), others are slender (E). Some of the features (A and C) have twin peaks. The peak itself may be sharp (E) or blunt (B). In some cases (B) one side of the peak may be sloping and the other straight. A small mound is seen on an otherwise even sea floor (F).

There are 16 features which are considered to be significant and more than 16 others, which are not conspicuous, but are as important from the same area.

Sonographs from the very shallow area to water depth of 7 m were not studied for wrecks or structures for two reasons. First, being in the shallow zone any object if present, should be visible at low tide. Secondly, the seabed to 10 m water depth is covered by unconsolidated and mobile sand, which is seen in the sonographs with various features such as furrows etc., making it difficult to identify other features.

In general, sonographs from the area, are monotonous and featureless as the seabed is covered by clay. However, there are some interesting features revealed by the sonographs which require detailed observations. These features are linear, rectangular, circular, oval and irregular (Fig. 4). The perfect and near perfect geometrical

shapes recorded on sonographs (H, J and K) underline the peculiarities attached to these features as they have diameter of 20 m or more. While I is just linear, it has considerable length; G and L have somewhat irregular shapes, but they have some symmetry. Some of these features are associated with shadow zones, indicating that the objects have considerable height and are therefore three dimensional (H, J, K and L). While examining the sonographs, care was taken

of the distortion caused by the speed of the survey vessel, about 3-4 knots, due to which a sphere may be recorded as oblong and a square as a rectangle. The features lie in water depth range of about 17-18 m. Though the echo sounder and side-scan sonar were operated simultaneously, the features were not recorded at the same time. Hence it is difficult to correlate them for comparison.

As there are no rocks exposed on the nearby

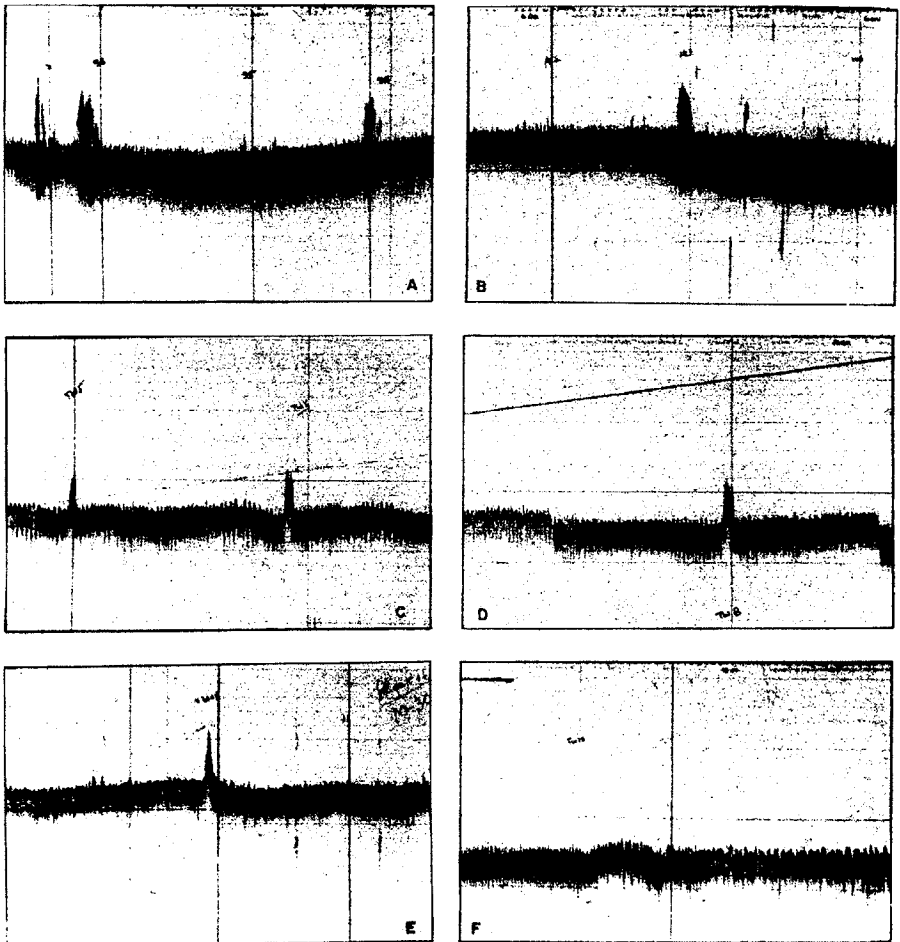


Figure 3. Typical features recorded on echograms.

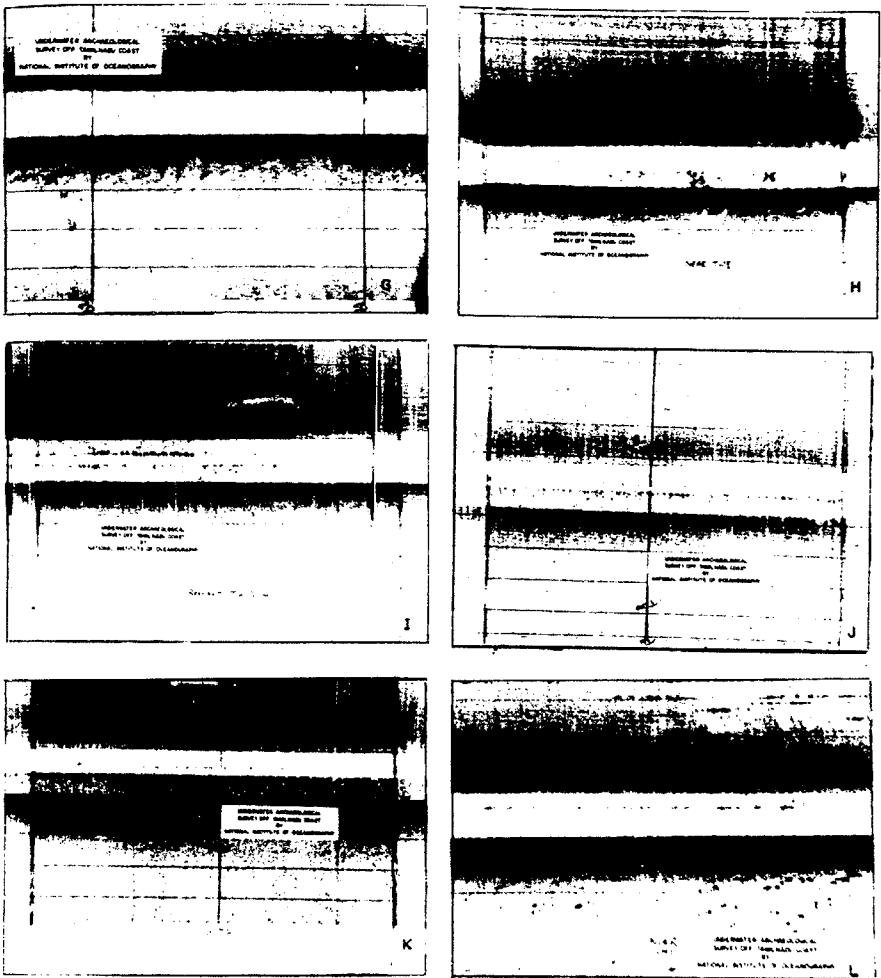


Figure 4. Typical features recorded on sonographs.

coast and the local geology indicates only sedimentary formations, it is difficult to interpret these features as natural geological ones. Similarly the presence of about 2-3 m thick clay on either side of the peak on the echogram and the nearly perfect geometrical shape recorded on sonograms also leads to the conclusion that these may represent wrecks or submerged structures which remain to be investigated in detail.

Conclusion

The survey carried out off the Tamilnadu coast in the vicinity of the ancient ports of Kaveripattinam and Tranquebar shows anomalous features on the sea floor. A number of conspicuous peaks of 2-5 m height on echograms and associated features on sonographs with geometric shapes (linear, circular and rectangular) were recorded in the water depth of

18–19 m. It is difficult to attribute these features to geological origin. They may represent submerged structures and wrecks and need to be checked by divers.

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