

Letter Section

SUBMERGED TERRACES IN THE LACCADIVE ISLANDS, INDIA

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(Submitted October 10, 1974; revised and accepted March 3, 1975)

ABSTRACT

Siddiquie, H.N., 1975. Submerged terraces in the Laccadive Islands, India. *Mar. Geol.*, 18: M95—M101.

The Laccadive atolls have recently been surveyed in detail (1:5,000 and 1:10,000). These surveys indicated the occurrence of a number of terraces on the seaward reefs of these islands at 7—12, 15, 21—36 (prominent) and 43—47 m depths. The first break in the profile of the seaward reefs occurs at depths of 3—5 m and on the windward side this extends down to about 12 m, the break at this shallow depth represents a wave-cut platform. The deeper terraces (>12 m) appear to have been formed during periods of lowered sea level. The most prominent terrace at 21—36 m is correlable with similar terraces recorded on other atolls. The terraces at Bangaram Island are covered by sediment while those at Kadmat do not have any sediment. In some of the atolls, surfaces at depths comparable to the seaward terraces are found in the lagoons also indicating extensive effects of lowered sea levels.

INTRODUCTION

The Laccadive Islands situated at the northern extreme of the aseismic Laccadive Chagos Ridge, consist of a number of atolls, drowned atolls, submerged reefs and coral banks (Fig. 1). The topography of the area and those of the reefs, atolls and coral banks including the atolls described here is shown in the Indian Naval Hydrographic Office Chart 22 and British Admiralty Chart 827.

A detailed survey of the different atolls, reefs and banks of the Laccadive Islands has been carried out recently. The island, the lagoon and the seaward reef, were surveyed by conventional methods. The shore markers were fixed by traverses on the coastline with a theodolite and later these were used for further surveys with a sextant. In all, eleven atolls have so far been surveyed on a scale of 1:5,000 and 1:10,000, by traverses of the shores of the islands, bottom sampling and echo-sounding in the lagoon and over the reef. More than 1800 bottom samples from the lagoon and 600 from the reefs were collected and about 1200 km of echo-sounding was carried out in the lagoons

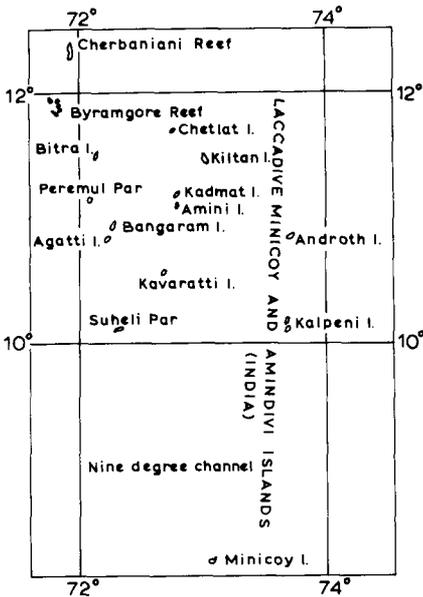


Fig.1. Map showing the location of Laccadive Islands.

and over the reefs. A portable Furuno Pilotograph Echosounder with a scale of 0–18, 18–36 and 36–54 m was used in these surveys. The surveys were carried out to estimate the reserves and chemical quality of calcareous sediments in these lagoon for mining by dredging and subsequent utilisation in industries. The preliminary results of these surveys have been reported earlier (Siddiquie, 1973).

The lagoons vary in size considerably, the smallest covers an area of about 1 km², while the largest has an area of about 150 km². The bottom topography and geomorphology of the lagoons also vary considerably. Some of the smaller lagoons (Chetlat, Kiltan, Amini and Kadmat) are virtually filled with sediments while the larger ones (Bitra, Bangaram, Suheli and Minicoy) have remained relatively deep (about 10–16 m). The deeper lagoons are characterised by a complex topography consisting of shallow sand banks bordering the reef with a deeper region in the centre of the lagoon.

SUBMERGED TERRACES

While carrying out the echo-soundings on the seaward reefs of these atolls, a number of well-defined submerged terraces were observed. These terraces are well-developed on the seaward reefs of Kadmat and Bangaram Islands. On the seaward reef of Bangaram Island, a well-defined terrace occurs between 21 to 36 m (usually between 22–32 m). A terrace within this depth range is found all around the atoll. Terraces are also observed at 7–12 m and at 15 m depth at various locations along the seaward reef (Figs. 2 and 3) but the

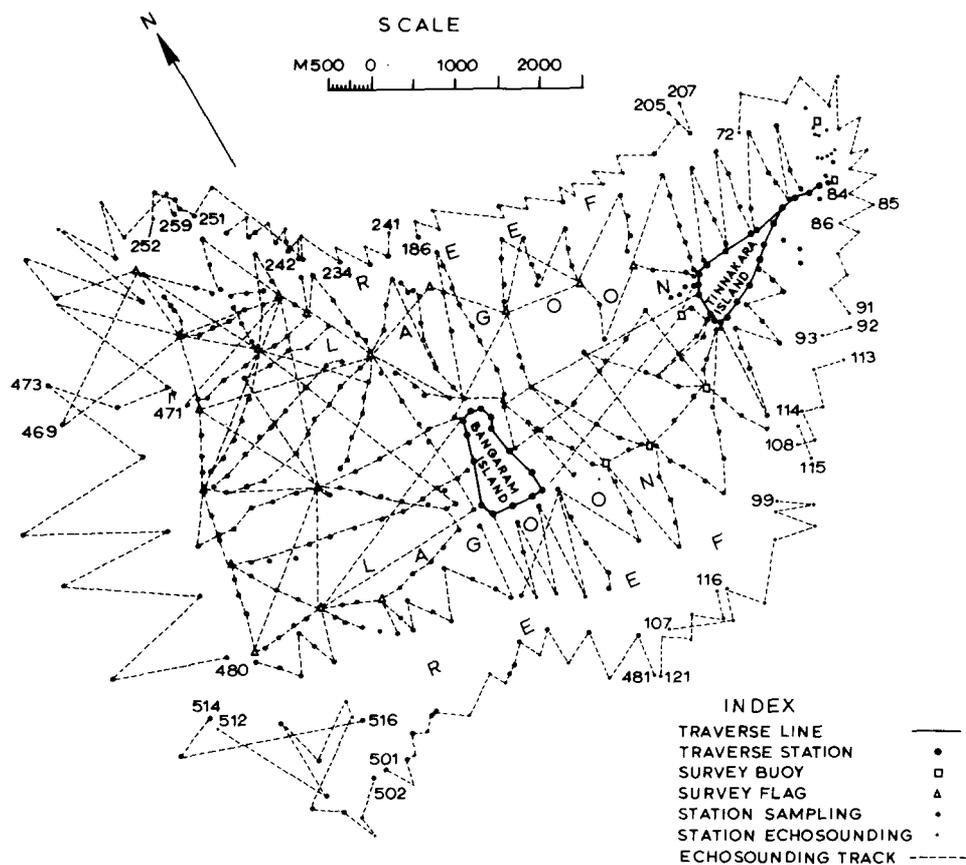


Fig. 2. Base map of exploration in the lagoon and offshore areas of Bangaram Island, Laccadive Islands showing the surveys carried out. Tracks 72–115, 99–107, 186–207, 234–259 and 259–514 are on the seaward reef, the other tracks are within the lagoon. The area separating the two sets of tracks is the reef.

depth of these shallow terraces varies and these do not appear to be continuous along the seaward reef. Samples of dead corals with very little sand were recovered from the terraces at 21–36 m depth indicating that the terrace region is thinly covered by sediments. The other terrace at a shallow depth range of 7–12 m, on the northern (leeward) side is covered by sand and this sand differs from the sands of recent origin, being slightly darker in colour. At some of these depths, terraces may not occur along the entire seaward reef, but a distinct change in slope in the echogram profiles can be distinguished (Fig. 3). Similar terraces can also be identified from the echograms of Kadmat Island. The most prominent terrace on the seaward reef is at a depth range of 25–36 m although ill-defined terraces can be observed at depths of 7–11, and 43–47 m (Figs. 3 and 4). Visual observations and samplings indicate that little or no sediment occurs on these terraces. The terrace occurring at a depth of 21–36 m at Bangaram and 25–36 m at Kadmat may be of the same age.

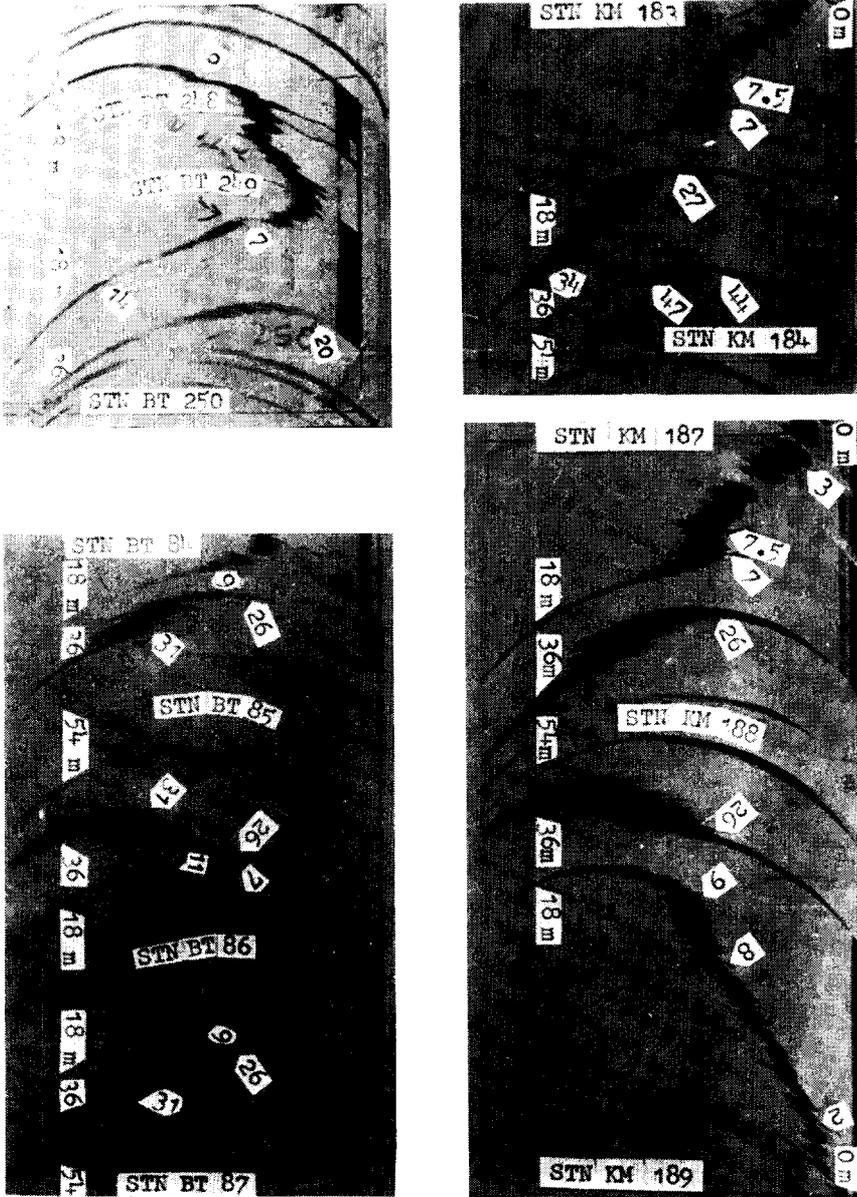


Fig. 3. The upper part shows the echograms on the seaward reef of the Kadmat Island (for location of tracks see Fig. 2). The lower half shows the echograms on the seaward reef of the Bangaram Island (for location of tracks see Fig. 4).

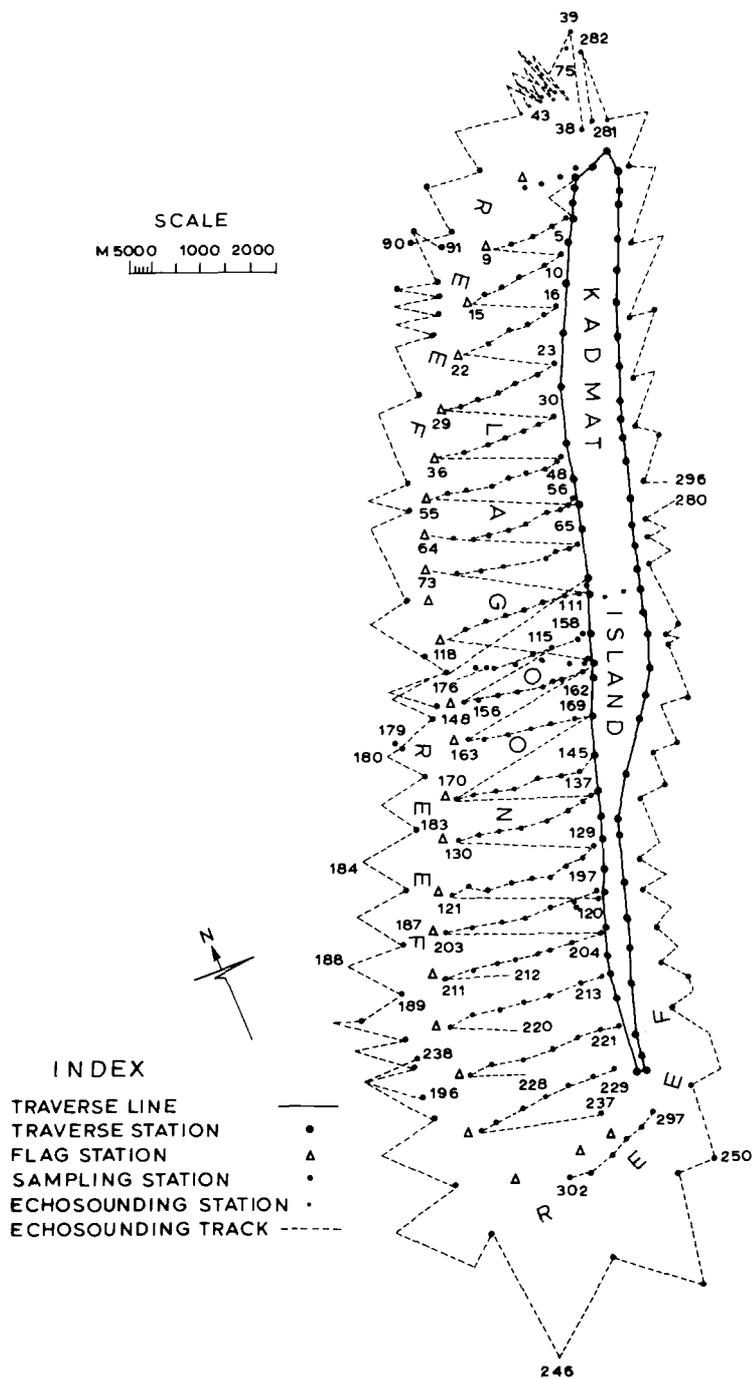


Fig.4. Base map of exploration in the lagoon and offshore area of Kadmat Island, Laccadive Islands showing the surveys carried out. Tracks 38–90, 91–118, 176–196, 238–280, 296–281 etc. are on the seaward reef, the other tracks are in the lagoon. The area separating the two sets of tracks is the reef.

DISCUSSION

The depths to which rocks can be abraded by waves has generally been accepted as approximately 10 m (Bradley 1958, quoted in King, 1972). The first break in the profiles of all the seaward reefs of these islands occurs at a depth of about 3–5 m which extends to a depth of 12 m on the windward and particularly the southwestern side, this represents a recent wave-cut platform (see echograms in Fig.3). It seems likely that the surf base extends to a depth of about 12 m particularly on the windward southwestern side. The terraces in the Laccadive Islands at shallow depths (3–5 m all around the atolls and about 12 m on the windward side) could have been cut by waves in recent times. It is however, unlikely that the terrace at similar depths (i.e. 10–12 m) on the leeward side could be caused by waves. For instance, some of the terraces occurring at depths of about 10–15 m are on the northern, leeward, reef of Bangaram Island and could not be called a wave-cut platform as the most forceful waves in this area are from the southwest direction. This terrace (10–15 m on the leeward side) and the deeper terraces (21–36 m and 43–47 m) seem to have been formed during periods of lowered sea levels. The flat step-like surface on the otherwise steep slope seems to have been formed due to its exposure to the fury of waves at a period when the sea level was low. The occurrence of sediment on these terraces, on the leeward side in Bangaram at depths of about 15 m and 30 m on the windward side indicates that there is little movement of sediment at present, because forceful wave action could have easily removed all the sediments from this side. In some of the deeper lagoons planed surfaces comparable to the seaward terraces are found to continue in the lagoons also, this may indicate the effect of lowered sea levels. The terraces at depths of 18 m (10 fm) and 23–35 m have been reported from a number of seaward reefs in the Pacific and Indian Oceans. Terraces at 18 m (10 fm) and 54 m (30 fm) have been reported from the outer reef of many atolls in the Pacific (Emery et al., 1954; Tracey Jr. et al., 1961 and Emery, 1962). In the Indian Ocean, Stoddard (1971) mentions marked bevellings at depths of 8–20 and 33–90 m in the Mascarenas Plateau and Chagos Archipelago while Lewis (1963) has reported minor bevels at depths of 8–15 and 18–22 m in Seychellas. Similarly, Spencer Davies et al. (1971) have reported terraces at depths of 25 and 45 m at Addu Atoll and Scheer (1971) refers to a terrace at a depth of 10 m from the Red Sea. Most of these terraces have been directly related to Quaternary glacio-eustatic and climatic oscillations. Recently doubts have been cast on the glacio-eustatic interpretation of these terraces (Shepard, 1973). The regularity of the distribution of the terraces on the two atolls in the Laccadive, particularly the deeper ones all around the atolls and the shallow one on the leeward sides indicates that this is not a local phenomenon, but seems to be related to the world-wide lowering of the sea level in the Quaternary. At places, where no terraces are present at the corresponding terrace depths, a distinct change in slope in the profile can be identified. This indicates a significant change in the growth rate of

the reef which is probably related to climatic changes and in turn related to changes in the sea levels. Further work on the distribution of these terraces and their correlation is in progress.

ACKNOWLEDGEMENTS

The field work was carried out while the author was in the Geological Survey of India and the author is grateful to Shri C. Karunakaran, Director-General of the Survey for his interest and permission to publish this paper. The note was written at the National Institute of Oceanography and the author is grateful to Dr. S.Z. Qasim, Director for critically going through the manuscript. The author also thanks Mr. R.R. Nair for going through the manuscript and for discussions.

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