lopment. Pressure solution (solution transfer) is undoubtedly a dominant mechanism during the earlier stages of crenulation (up to stage 3 in Figure 4) and due to this phenomenon the rock attains its domainal fabric characterized by alternate Q and M domains. However, the presence of microstructures resembling S–C fabric and ECC which commonly occur in mylonites, within the cleavage zones (Figure 2) suggests that crenulation cleavages behave as microscale shear zones during the later stages of crenulation, because metamorphic differentiation has already occurred during earlier stages of the formation of crenulation cleavage. This is in accordance with the suggestion of Williams and Schoneveld[24] that the $S_2$ surface becomes the active surface of shear after all the mobile material has been removed from it.


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# Relict coral reef and evidence of Pre-Holocene sea level stand off Mahabalipuram, Bay of Bengal

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**A relict coral reef on the outer continental shelf off Mahabalipuram at –115 m depth yielded a radiocarbon ($^{14}C$) age of 14510 ± 190 yrs BP. A terrace at –130 m depth probably indicates the lowest sea level position during the late Pleistocene. It is inferred that the sea level rose at the rate of 5.71 m/kyr during the early stage of post-glacial transgression between 18,000 and 14,500 yrs BP.**

STUDIES document that global sea level has been rising with pauses since the late Pleistocene sea level minimum. Imprints of high and low sea level strands during the late Pleistocene have been well recorded along the west coast of India[1–4]. Although evidences are available about sea level high on the east coast of India[5–7], only fragmentary informations about low sea level are available[8–13]. In this paper, an evidence of Pre-Holocene low strandline from a relict coral reef on the outer continental shelf off Mahabalipuram in the east coast of India has been presented.

Echo sounding (3.5 kHz) data was collected along shore parallel and perpendicular transects on the continental shelf at 10 km interval during *R. V. Samudra Manthan* cruise No. 94. Sediment samples of the mid and outer continental shelf were collected using van Veen grab on 10 km grid. The sediment texture and type were classified. A coral chunk (25 × 20 cm) along with coral debris was collected at –115 m depth (12°33.523′N; 80°37.074′E) off Mahabalipuram (Figure 1). The mineralogy of the coral was determined by X-ray diffraction using $CuK_\alpha$ radiation. The coral was cleaned thoroughly and surface encrustations such as worm tubes and green lichens were removed prior to dating. Radiocarbon age ($^{14}C$) of the coral was determined by the Birbal Sahni Institute of Palaeobotany, Lucknow.

The continental shelf off Mahabalipuram is about 40 km wide and the shelf break occurs around – 135 m depth. Echo sounding profiles (3.5 kHz) reveal the presence of terrace at – 100, – 110 and – 130 m depths, probably related to low strandline positions. Dome-shaped reefal structures occur at about – 100 and – 115 depths in the outer shelf zone (Figure 2). These features extend parallel to the coast to a limited distance (Figure 1).

The shelf is covered by carbonate-dominated sediments and they are clayey sands with abundant skeletal fragments and ooids and occurs as shore parallel linear patches. Sandy silt and silty clay are also present.

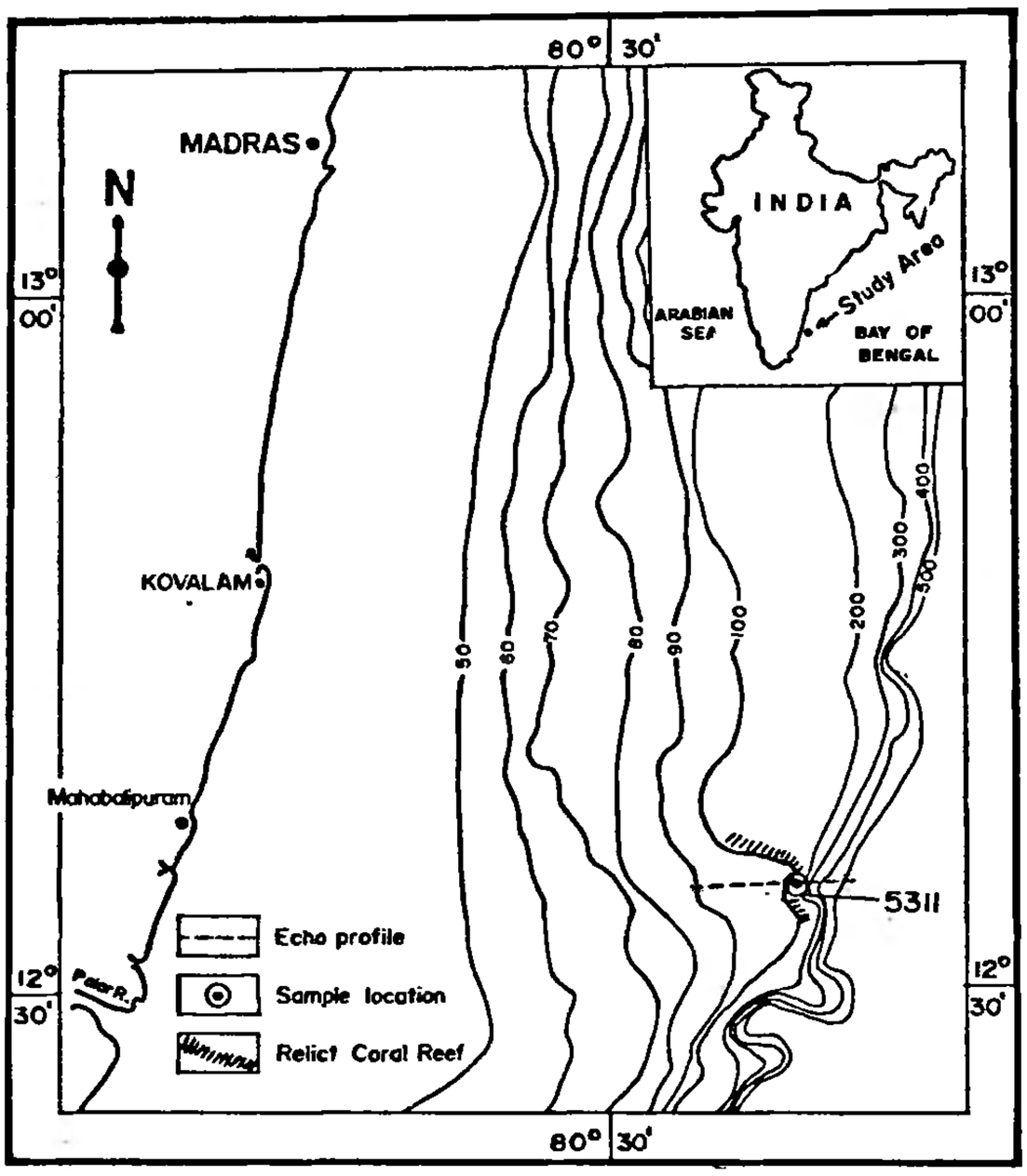


**Figure 1.** Map showing bathymetry and sample location in the study area.

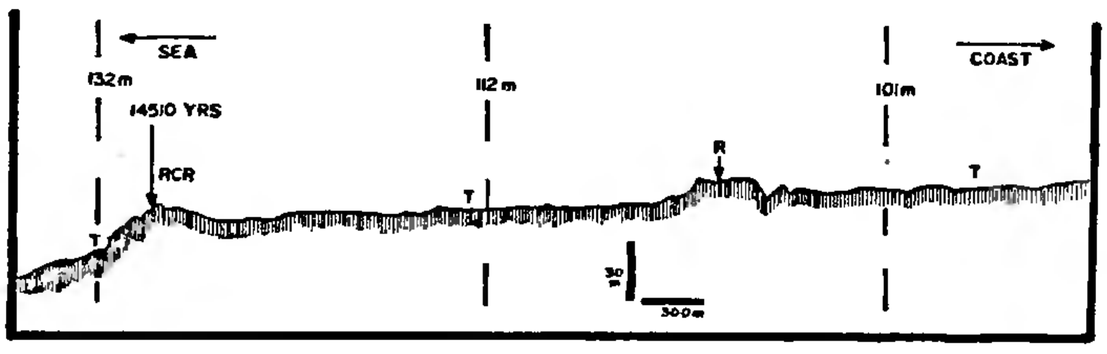


**Figure 2.** Echo profile (3.5 kHz) off Mahabalipuram showing relict coral reef (RCR), algal reef (R) and terrace (T).

Calcareous concretions are more common in the outer continental shelf sediments.

The coral chunk recovered from the reef at – 115 m water depth is sub-massive, hemispherical and corallites are polygonal to circular (Figure 3). The coral belongs to the genus *Goniastrea* sp. Majority of the coral debris are of branching type belonging to the genus *Acropora* sp. The radiocarbon ($^{14}C$) dating of the coral (*Goniastrea* sp.) yielded an age of 14,510 ± 190 yrs (calibrated) BP.

The X-ray diffraction studies on the coral indicate that it contains only aragonite (100%), thus confirming no recrystallization of aragonite.

Reef-building colonial corals thrive in calm shallow waters[14] with temperature of about 22°C. The presence of patchy coral reef at – 115 m depth in the study area

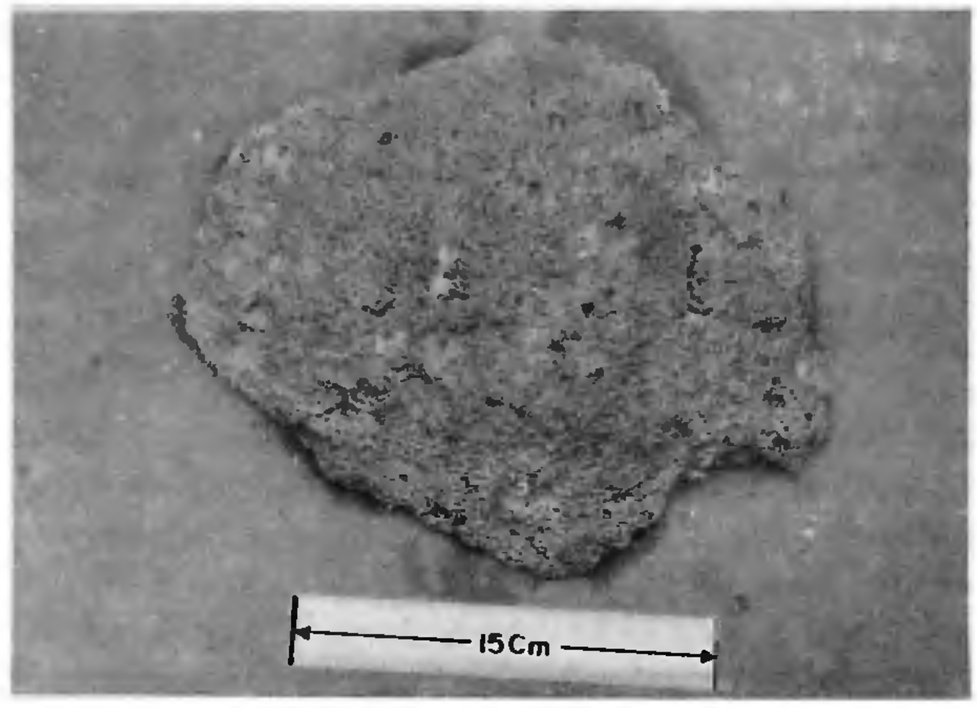


**Figure 3.** Coral *Goniastrea* sp.

indicates a sea level stand probably at about – 110 m depth which facilitated the growth of patchy coral reef at – 115 m depth. Further, a lowest terrace feature with ooid concentration was recorded around – 130 m depth. This suggests that the lowest sea level during the Last Glacial Maximum (LGM) might have been closer to – 130 m in this region. This observation corroborates well with the glacio-eustatic sea level low recorded elsewhere[15–17] at depths between – 115 and – 130 m.

On the eastern continental shelf of India, terraces at – 55, – 60, – 70, – 85 and – 100 m depths, probably formed during the Late Pleistocene–Holocene transgression, have been recorded[9,10–13,18]. Algal barriers at – 85 m and – 100 m depths off Visakhapatnam have been dated 10,790 ± 170 yrs BP and 12,530 ± 170 yrs BP respectively[13]. Similarly, the molluscan shells collected from an offshore bar at – 17 m depth in Nizampatnam Bay have given an age of 8200 ± 120 yrs BP[10].

It is surmised that the lowest sea level during the LGM was at about – 130 m depth in the study area. The coral reef at – 115 depth yielded an age of 14,510 ± 190 yrs BP. Presuming that the lowest terrace at about – 130 m level formed at 18,000 yrs BP, and there were no pauses in sea level between 18,000 and 14,500 yrs BP, it is inferred that the sea level in the study area rose at the rate of 5.71 m/kyr until 14,500 yrs BP.

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