

## Coralline Algae From The Ninniyur Formation (Thanetian) Of The Cauvery Basin, South India

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### Abstract

The Palaeocene sediment of the Tiruchirapalli area shows presence of some elements of geniculate and non-geniculate coralline Algae. Four coralline algal species are recorded from this Formation (Thanetian age). Two of the described species belong to *Sporolithon*. Of the remaining two, one is assigned to Coralline, while the other one is indeterminate, being referred to the subfamily Melobesioideae because of the absence of diagnostic features.

**Key words:** Coralline Algae, Palaeocene, Ninniyur Formation, Cauvery Basin.

### Introduction

The study area is a part of the Cauvery Basin which, forming in the southernmost portion of the Coromandel shelf regime of India (Fig. 1A). The Basin, located 160 to 460 km south of Chennai that covers an area of 25000 km<sup>2</sup> on land and about 35000 km<sup>2</sup> of the offshore shelf (Gulf of Mannar, Palk Strait and Coromandel Coast between India and Sri Lanka).

The present study from the study area is primarily aimed at enlarging the taxonomic database of the calcareous Algae and this should provide a result in a detailed account of their taxonomic composition. The present investigation on the fossil calcareous Algae of the Ninniyur formation in the Ariyalur-Pondicherry depression of the Cauvery Basin (Fig. 1B). It has revealed the presence of the earliest part of lower Tertiary sequence of rocks representing the Palaeocene epoch. Palaeocene epoch is a geologically significant time for calcareous Algae, as the latter not only recovered from a spell of their general decline in the terminal Cretaceous extinction

event but also flourished and achieved the levels of diversity prevalent prior to the extinction event, in spite of this well-documented observation (Barattolo 1991, 1998). Previous works on the calcareous Algae of the Ninniyur Formation include (Rao and Pia 1936; Rao and Gowda 1953, 1954; Chiplonkar 1944; Gowda 1953; Verma 1952, 1954; Pal 1972; Misra *et al.* 2000, 2001; Kishore 2001).

The Ninniyur Formation was assigned the Danian (early Palaeocene) age on the basis of *Hercoglossa danica* Schlotheim considered to be characteristic of the Danian stage (Blanford 1862, Rao 1956). Subsequent work revealed the presence of planktic foraminifera in the Ninniyur formation. Malarkodi and Nagaraj (1997, 1998). However, document on several species of benthic and planktic foraminifera from different litho-units of the Ninniyur Formation. The age-diagnostic taxa in their assemblage include *Morozovella praecursoria* (Morozova), *Acarinina spiralis* Bolli, *A. mckannai* (White) and the species of *Thalmanntia* which indicate that it ranges from early to late Palaeocene

(Danian to Thanetian) in age.

The most distinguishing feature of this formation the rich representation of the fossil Algae along with its lithology and fossils (Rao 1958). Three distinct units recognized in the Ninniyur formation are: Lower fossiliferous limestone (Adanakkurichi); Middle subcrystalline shelly limestone (Mattur, Ninniyur); and the Upper argillaceous gritty nodular limestone (Sendurai).

The following sections (upper and middle Unit only) have been explored for geological data and sample collection from the different litho-units of the Ninniyur formation (Fig. 1C).

#### **Mattur Section**

The section is near Mattur railway station that is situated about 4.5 km north of Periyakurichchi. It is exposed at periyakurichchi mines in the vicinity of Ninniyur village, which is nearly 4.5 southwest of Periyakurichchi. The sequence is about 10 m thick and comprises subcrystalline to crystalline shelly limestone. The general lithology shows compact hard limestone at the base and the marl beds above. The calcareous Algae are present in bands (PL. 1; Figs. 5-6).

#### **Ninniyur Section**

This section is about 3.8 km south-west of Periyakurichchi and shows outcrops of the middle unit which is similar to that observed in the Periyakurichchi section in general lithology and fossil contents. The exposures are seen in a few nala and well cuttings. In this section the cuddalore Sandstone overlies the Ninniyur Formation.

#### **Sendurai Section**

Sendurai is a railway station on the railway line between Chennai and Ariyalur district and lies at a distance of about 30 km E 27° N of

Ariyalur. It is about 2.4 km S10° W of Ninniyur and exposes the upper unit in a well cutting. The exposed surface was found to be only 6.0 to 8.0 m thick and the calcareous Algae usually occur as white, rounded to irregular patches. The floristic composition of these rocks appears to be rich.

All the thin sections and samples are preserved at the Algalology laboratory, Botany Department, University of Lucknow, Lucknow.

**Division Rhodophyta** Wittstein, 1901

**Class Rhodophyceae** Rabenhorst, 1863

**Order Corallinales** Silva and Johansen, 1986

**Family Sporolithaceae** Verheij, 1993

**Genus *Sporolithon*** Heydrich, 1987

*Sporolithon* sp. 1

#### **PL. 1, fig. 1**

Growth form encrusting, thickness of encrusting thalli up to 1.5 mm. Thallus organization monomerous. Core filaments non-coaxial, core portion 135µm thick. Cells 20-28 µm in length and 15-18µm in width. The peripheral region on encrusting portion is restricted to the dorsal part of the thallus that is usually 1.3-mm. Cell lengths 15-20 µm and 10-14 µm in width. Cell fusions present. Sporangial compartments arranged in sori. Individual sporangial compartments rectangular with rounded to elliptical or ovoid corners in longitudinal section and circular in transverse section. They are 70-90 µm in length and 35-45 µm in width. Cells underlying the sporangial compartments longer than other peripheral cells. Sori usually arise from a layer of elongated cells. 1-3 filaments (paraphyses) are interspersed between the sporangial compartments. Up to 25 sporangial compartment can be counted in a single sours. Old sori buried in the thallus. *Sample* No.: B/Mt/A20. *Slide* No.: M/CB-34.

*Locality:* Mattur.

*Horizon:* Middle Unit (Subcrystalline shelly Limestone).

*Remarks*

This species can be compared with *Sporolithon oulianovi* Pfender in general thallus morphology and arrangement of sori. However, the dimensions of tetra/bisporangial compartment are slightly different from those of Johnson's species. Johnson (1964) reported *Sporolithon oulianovi* Pfender from the Palaeocene beds of Northern Iraq.

*Sporolithon* sp. 2

**Pl.1, fig. 2**

Growth form encrusting thickness of encrusting thalli up to 1.2-mm. thallus organizations monomerous. Core filaments non-coaxial, core portion 180 µm thick. Cells 15-25µm in length and 15-16 µm in width. The peripheral region on encrusting portion restricted to the dorsal part of the thallus, which is usually 930 µm. Cell length 16-20 µm and cell width 8-12 µm, cell fusion indistinct. Sporangial compartments arranged in sori. Individual sporangial compartments with elliptical or ovoid corners in longitudinal section. They are 70-80 µm long and 40-45 µm wide. Cells underlying the sporangial compartments longer than other peripheral cells. Sori usually arise from a layer of elongated cells. 1-4 filaments (Paraphyses) are interspersed between the sporangial compartments. Up to 30 sporangial compartments can be counted in a single sorus. Old sori buried in the thallus.

*Sample No.:* B/Mt/A22.

*Slide No.:* M/CB-82.

*Locality:* Mattur.

*Horizon:* middle Unit (Subcrystalline shelly Limestone).

*Remarks*

This species differs from *Sporolithon* sp.

1 in the of cell size of core and peripheral filaments. The present specimen can also be differentiating on the basis of its arrangement of sori in the thallus.

*Melobesioideae* gen. et spec, indet.

**Pl. 1, fig. 3**

Growth forms encrusting. Thallus organization monomerous. Core filaments coaxial, cells 16-20 µm in length and 10-12 µm in width. The peripheral tissues, whose cells are arranged in layers parallel to the surface and are 10-15 µm in length and 8-10 µm in width, surround it. Cell fusions present. Tetra/bisporangial conceptacles not preserved

*Sample No.:* B/Nin/A8.

*Slide No.:* N/CB-102.

*Locality:* Ninniyur.

*Horizon:* middle Unit (Subcrystalline shelly Limestone).

*Remarks*

The present specimen appears to compare with *Mesophyllum* cf. *pfenderae* in the light of growth form and predominantly coaxial morphology of core filaments. Beckmann (1982) reported this species from the Paleocene of Monte Giglio, Italy. The present specimen, however, lacks conceptacles, while Beckmann's specimen showing conceptacles. Hence, described as unnamed species of family Melobesioideae.

Sub-family Corallinoideae

Genus *Corallina* Linnaeus, 1758

*Corallina* sp.

**Pl.1, fig. 4.**

Plant geniculate, fragments of thalli about 700 µm in length and 320-350 µm in diameter. Genicula indistinct. Core cells of intergenicula 16-26 µm in length and 10-12 µm in diameter composed of a single tier of elongated cells. Conceptacles not preserved.

*Sample No.:* B/sen/C8.

*Slide No.:* S/CB-176.

*Locality:* Sendurai.

*Horizon:* Upper Unit (Argillaceous gritty nodular Limestone).

*Remarks*

The present specimen lack of genicula and conceptacles. As the conceptacles occur externally in the genicula of thallus, they are usually lost during preservation. Thallus organization of the present specimen suggests its similarity with *Corallina*; however, its specific identification is not possible due to absence of conceptacles.

**Discussion**

As previously noted, the coralline red Algae are abundantly represented in the Ninniyur Formation as fragments, crusts and rhodoliths along with other fossil groups. Based on the systematics of the present-day representatives, the present investigation led to the identification of four taxa, belonging to the geniculate and nongeniculate corallines (Corallinoideae, melobesioideae, and Sporolithaceae).

However, the environmental characteristics shown by coralline in general are not characteristic of most subgroups. the two family-subfamily groupings display distinct depth-temperature distributions in the present-day marine environments. Sporolithaceans, though restricted to low-latitude areas, occur in deep-water and cryptic reef habitats. Although broadly distributed, Melobesoids occupy deep-water habitats in low latitudes. In the studies section, Sporolithaceans and melobesoids groups suggest deposition in reefal environment below 20m. Geniculate coralline Algae, also associated with reef-complexes, are varied in their adaptability and hence are widely distributed in different parts of the complex. *Corallina* is some important geniculate coralline genera that generally live in the water less than 30 m. deep and are

common at depth between 200 and 25m. (Johnson 1957).

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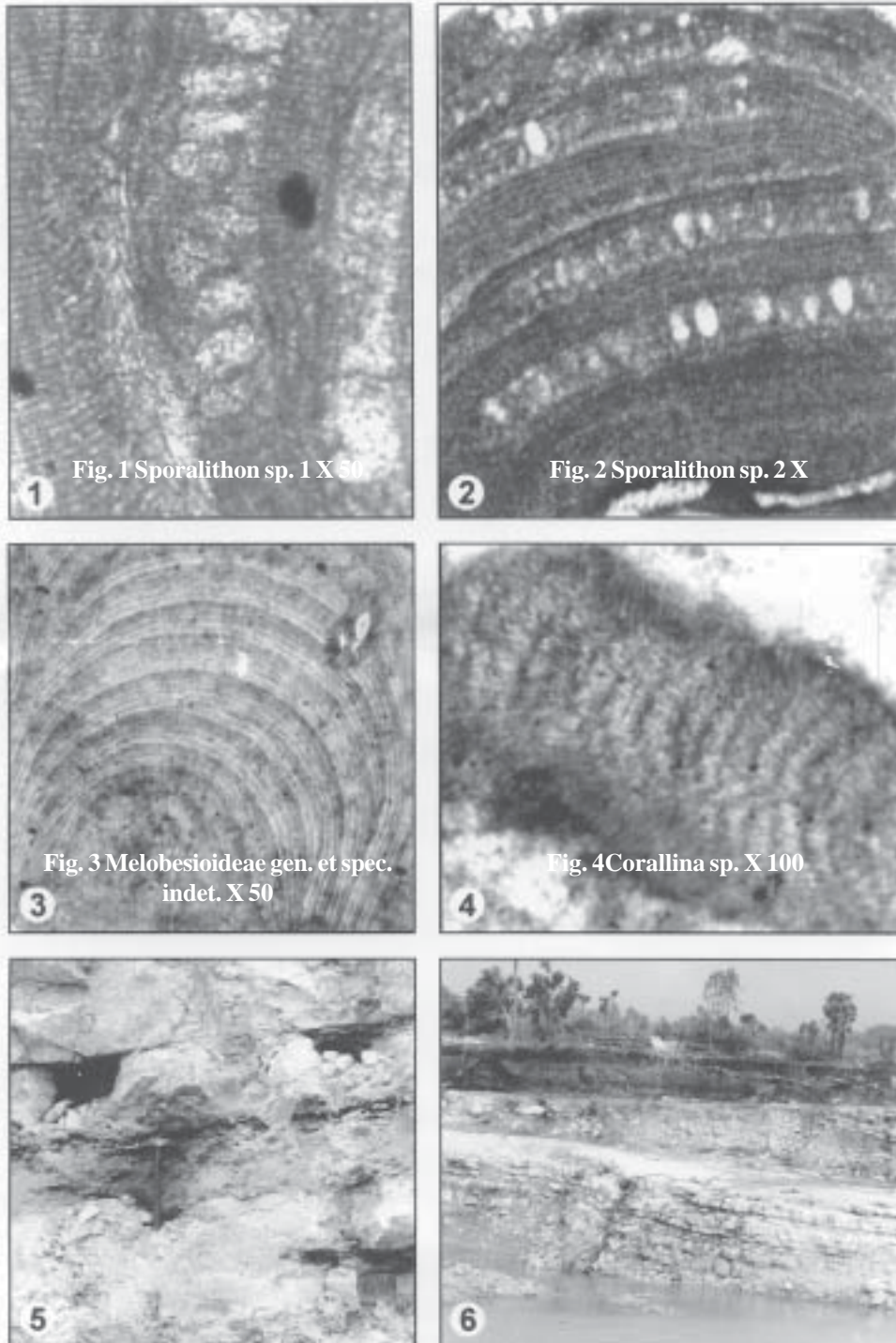
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**Fig. 5,6 Section exposed at Periyakurichchi mines showing outcrop area.**