



DISCOVERY OF THE OYSTER *HYOTISSA SEMIPLANA* (SOWERBY, 1813) FROM THE CAMPANIAN (LATE CRETACEOUS) OF SOUTH INDIA

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ABSTRACT

The oysters are the most dominant elements in terms of diversity and preservation in the Late Cretaceous (Campanian-Maastrichtian) bivalve benthic palaeocommunities of Ariyalur (south India). These oysters belong to the families Gryphaeidae, Exogyridae and Oystreidae. Here, the oyster genus *Hyotissa* and the species *Hyotissa semiplana* (Sowerby 1813) has been for the first time recorded from the Late Cretaceous (Campanian) of south India or even from the Indian subcontinent. The taxonomic status of the genus *Hyotissa* has been reviewed and *H. semiplana* has been systematically described with a brief autecological note.

Keywords: Oyster, *Hyotissa semiplana*, Campanian, Late Cretaceous, Ariyalur, south India

INTRODUCTION

Oysters of Ariyalur

The oyster bivalves in the Ariyalur area of south India are by far the most dominant elements amongst the Late Cretaceous molluscs. These occur both as articulated and disarticulated forms. The disarticulated shells are more common and sometimes the entire bed found packed with them. These oysters display a distinctive feature of adaptation for life on loose substrate. Most of them occupy calcareous substrates or even secondary hardgrounds constituting a favourable site, in which these oysters could sink their shells at a moderate depth thus evading ultimate burial (Abdel Aal and El-Hedeny, 1998). In some cases, these show no preference of orientation of shells, but at places large shells show convex upside orientation. The packing densities are moderate to poor, grain to clast supported and occur as loosely packed shell beds, may be reminiscent of closely adjacent pavements (Mishra and Jaitly, 2010). Besides, articulated shells are also common and occasionally they are also found in life positions representing relatively undisturbed relics of the former community. These point toward their allochthonous to para-allochthonous origin and their shell concentrations are compound creations of several events (Fürsich and Pandey, 1999). Jaitly and Mishra (2001) recorded the Campanian-Maastrichtian oysters of south India belonging to subfamilies Pycnodonteinae Stenzel 1959, Exogyrinae Vyalov 1936 (family Gryphaeidae Vyalov 1936), Ostreinae Rafinesque 1815 (family Ostreidae Rafinesque 1815) and Lophinae Vyalov 1936 (family Exogyridae Vyalov 1936). During the course of study, a few strongly plicate oyster specimens were found in the Campanian sediments of the Ariyalur area (Fig.1). These fit in the genus *Hyotissa*. Unlike the other oyster genera such as *Phygraea*, *Ceratostreon*, *Agerostrea*, etc, *Hyotissa* is quite uncommon in the Late Cretaceous and known by a single species *H. semiplana* (Sowerby 1813).

The marine Cretaceous sequence is supposed to have been formed with the induction of first marine transgression of southern sea during Albian-Cenomanian times and the deposition continued throughout the Cretaceous and Tertiary in a large Cauvery Basin. The youngest Late Cretaceous marine

sediments of the Cauvery Basin belong to the Ariyalur Group. The Ariyalur Group consists of four formations : Sillakkuddi Formation, Kallankurichchi Formation, Ottakkovil Formation and Kallamedu Formation in ascending order (Fig.2). All the hyotis oysters described here have been collected from the Sillakkuddi Formation. These oysters have been collected from the Bed No. 2 of ferruginous calcareous sandstone (Fig.3). The Geology, biostratigraphy and palaeoecology of the Late Cretaceous sediments of Ariyalur area have been discussed in much detail by Ayyasami, (2006) and Jaitly and Mishra (2001, 2007, 2009).

CLASSIFICATION

There have been frequent changes in the classification of oysters creating much confusion especially for the taxonomists working on individual group (family/subfamily/genus) of the order Ostreoida Férussac 1822. The classification of most of the oyster experts is based on the extant forms with more emphasis on soft parts. However, it has been revised by Stenzel (1971), who separated family Ostreidae and Gryphaeidae. Subfamily Pycnodonteinae Stenzel, 1959 has been included in Gryphaeidae having temporal distribution from Cretaceous to Recent and the two extinct subfamilies Ostreinae Rafinesque, 1815 and Lophinae Vyalov, 1936 in the family Ostreidae. The subfamily Pycnodonteinae includes oysters with the vesicular shell microstructure, strong radial folds on the shell surface, lath chomata and subcircular adductor scar close to postero-dorsal margin. Stenzel (1971) included his new genera *Hyotissa* and *Neopyconodonte* in this subfamily along with *Pycnodonte* and *Phygraea*. Although there have been modifications in Stenzen's nomenclature, but still widely followed by the most of the serious workers (e.g. Torigoe, 1981; Aqrabawi, 1993; Lam and Morton, 2004; etc.). Externally *Hyotissa* shows some semblance to *Nicaisolopha* Vyalov, 1936 and *Parahyotissa* Harry, 1985. But *Nicaisolopha* belongs to the family Ostreidae and genus *Parahyotissa* differs from *Hyotissa* by its small size and absence of lath-chomata.

The specimens are housed in the Invertebrate Palaeontology Laboratory, Center of Advanced Study, Department of Geology, Banaras Hindu University, Varanasi 221005, India.

SYSTEMATIC PALAEOONTOLOGY

Superfamily **Ostracea** Rafinesque, 1815

Family **Gryphaeidae** Vyalov, 1936

Subfamily **Pycnodonteinae** Stenzel, 1959

Genus **Hytissa** Stenzel, 1969

(Type species: *Mytilus hyotis* Linné 1758)

Hytissa semiplana (Sowerby, 1813)

(Fig.4, A-E)

Ostrea semiplana J.de C. Sowerby, 1825, pl.488, fig.3.

Ostrea sulcata Goldfuss, 1836, pl.12, fig.2a,b.

Ostrea semiplana (Sowerby) d'Orbigny, 1847, p.747, pl.488, fig.4-5.-Coquand, 1862, p.74, pl.28, figs.1-15.-Woods, 1913, p.379, pl.56, figs.17-19; pl.58, figs. 1-5; textfigs. 183-193.

Lophia semiplana (Sowerby) - Carter, 1968, p.482, pl.90, figs. 1-2.

Hytissa semiplana (Sowerby) - Pugaczewska, 1977, p.193, pl.14, figs.1-3.

Hytissa armata (Goldfuss) - Pugaczewska, 1977, p.193, pl.15, figs.1-7.

Hytissa semiplana (Sowerby) - Pugaczewska, 1977, p.194, pl.124, figs.4-5.-Dhondt, 1985, p. 17, fig. 4f.-Freneix and Viaud, 1986, p.35, pl. 3, figs. 1-4.-Aqrabawi, 1993, p.109, text-figs. 48, g-l.

Material: 7 disarticulated specimens (No. BHU010331-1, BHU010331-9, BHU010331-4, BHU010331-10, BHU010331-11, BHU010331-15) and few fragmentary specimens from the Campanian of Ariyalur, S. India.

Description: The Ariyalur specimens are of variable outlines (sub-orbicular to sub-ovate), moderate in size (for the genus), having well convex left valves. Umbones small and opisthogyrous. Ligamental area subtriangular with deep resilifer circumscribed by flat bourrelets. Hautmann (2004) named such ligaments alivincular-arcuate, archetypal of oysters and is probably an autapomorphy of oysters (Hautmann, 2006). Remnants of arborescent chomata visible in some of the specimens otherwise eroded.

Adductor scar of moderate to large in size, sub-circular and situated quite close to the posterior margin with variable positions (just above the shell mid-height to near the postero-dorsal margin) in the dorsal-half of the shell. Shell ornamented with strong plicate ribs, 7-9 in number, some of them dichotomous with commissural margin chevron appearance. The crests of the ribs are quite sharp but in two specimens (BHU010331-9, BHU010331-4) slightly blunt in nature and crossed by prominent non-addressed growth squamae. The interspaces in sharply crested ribs are narrower, while in blunt ribs wider.

Measurements:

Specimen No	Length	Height	Inflation
BHU010331-1	50.0 mm	59.0 mm	20.0 mm (left valve)
BHU010331-9	45.0 mm	67.0 mm	15.0 mm (right valve)
BHU010331-4	58.0 mm	73.0 mm	24.0 mm (left valve)

Remarks: The specimens from south India having orbicular, ovately elongated to subovate outlines and in most of the other characters are quite similar to the type species *H. hyotis*. However, the radial ribs in most of the Ariyalur specimens are sharply crested with wavy, saw-toothed margins, whereas in *H. hyotis* these are more or less rounded. It also differs from *hyotis* in outline and characters of ligmental area. Torigoe (1981,

p. 300) mentioned in the diagnosis of the species that crests of the ribs are mostly sharp which is well evidenced in his specimens (Pl.10, fig.5). It has been emphasized by most of the workers (e.g. Woods, 1913; Stenzel, 1971; Torigoe, 1981; Lam and Morton, 2004, etc) that the shape and the surface features in oysters are highly variable and directly related to the nature of the substrate and size of the attachment area. In general morphological characters, these specimens are quite close to *H. semiplana*, the oldest taxon (Turonian-Maastrichtian) of the genus *Hytissa*. Some of the present specimens from Ariyalur are a bit different from *semiplana* having sharply crested radials and the size and position of adductor scar. In our specimens, although the adductor scars are present close to posterior margin in the dorsal half of the shell yet not so close to the dorsal margin as seen in most of the figures of *semiplana* of earlier workers. Schneider (2006), while discussing the bioimmuration of sponge, published three figures (1-3) of *H. semiplana*, displaying the similar positions of adductor scars as in Indian specimens. Also, in some of the present specimens the crests of the ribs are not so sharp. Therefore, these characters can be taken as ecophenotypic variations and attributed to the xenomorphic behaviour as a consequence of the nature of the substrate. Hence, the present specimens of Campanian of Ariyalur are identified with *Hytissa semiplana*. In Late Cretaceous, *H. semiplana* is the only known species recorded from Turonian-Maastrichtian of the different parts of Europe (Woods, 1913; Dhondt, 1985, 1999; Dhondt and Jagt, 1987; Aqrabawi, 1993; Malchus *et al.*, 1994, 1996; Dhondt *et al.*, 1999).

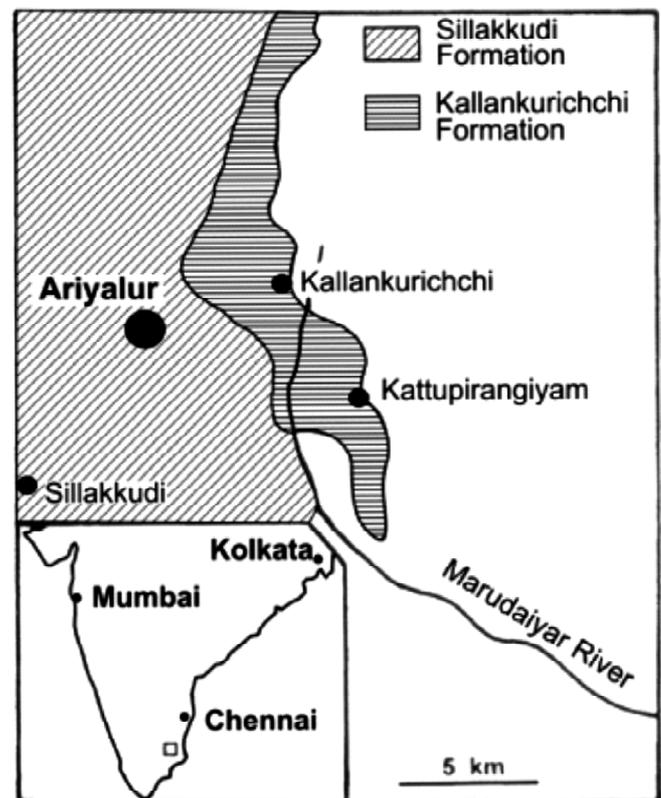


Fig. 1. Location map with outcrops of the Late Cretaceous (Campanian - Maastrichtian) sediments.

Group	Formation	Age
Ariyalur	Kallamedu	Maastrichtian
	Ottakkovil	
	Kallankurichchi	
	Sillakkudi	Campanian

Fig. 2. General stratigraphy of the Ariyalur Group (after Madhavaraju and Ramasamy, 1999).

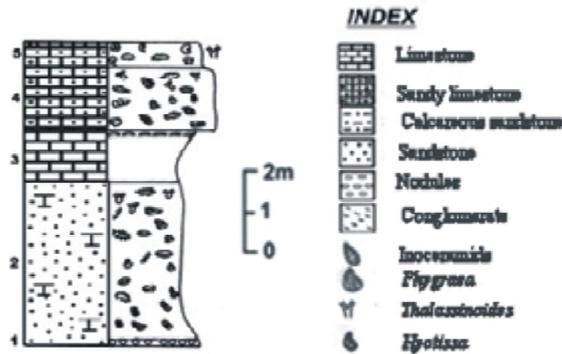


Fig. 3. Litholog of the Campanian sediments at Sillakkudi

AUTECOLOGICAL REMARKS

This thick-shelled *Hyotissa* with strongly plicate ornament can be attributed to tropical, high-energy environments (Morrison and Brand, 1986) and high salinity (El-Hedeny, 2005). However, oyster’s growth is rapid in the fluctuating salinity conditions in comparison to the stable conditions (Pierce and Conover, 1954). The elongate shells may be due to either mud sticking-habit or due to competition of space in the closely crammed animals (Seilacher, 1984). All the *Hyotissa*

shells are disarticulated and this high frequency of disarticulation may be due to delicate dysodont hinge or due to predation of adductor muscles and ligaments during life time in turn annihilating the tools of opening and closing of the valves, resulting in rapid gapping and disarticulation after the death of animals (El-Hedeny, 2005). Also, similar to other post metamorphic oyster, it lacked a byssus and foot (Stenzel, 1971)

The occurrence of shells of *Hyotissa*, as attached to each other mostly with left valves to form a cluster or bunches, is enigmatic. It can happen only when the cemented animal somehow detach itself from the substrate and attached with each other. Todd (1993) termed this habit of oysters as “lifts off” from its substrate. A variety of such identifiable cementing strategies are developed and most characteristic being “pie dish” morphology (Cooper, 1992) where a left valve lifts-off near perpendicularly from substrate. However, it has not been confirmed whether this lifts-off is a response to crowding in these typically gregarious taxon. There may be oyster spat settling on the earlier formed larva followed by spat settling on the subsequently formed juveniles. This is followed by the growth of individual juveniles ultimately forming clusters or bunches. Another plausible explanation may be that such a crowded attachment took place after death with the mechanical detachment shells from the substrate and subsequently re-cemented during diagenesis. However, presently it is difficult to explain exactly the mechanism of such clustering/crowding/bunching, in which practically individual shells attach each other by almost three-fourth height of their outer shell surface.

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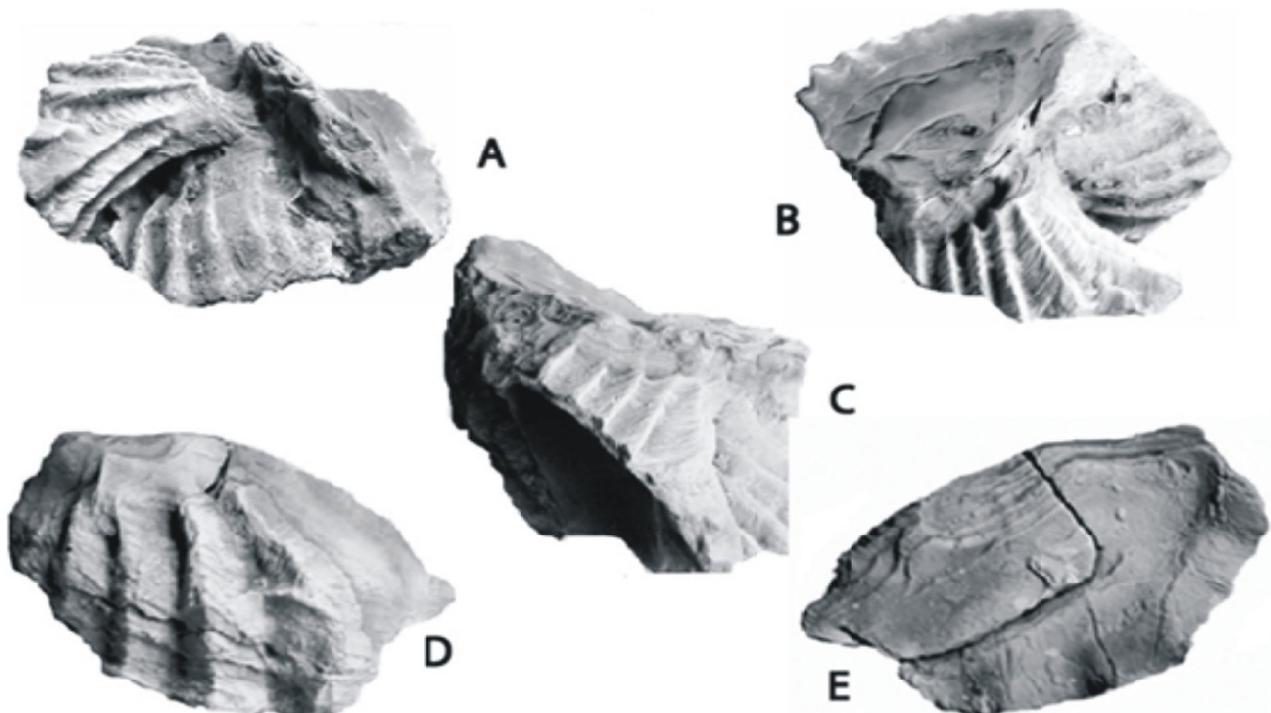


Fig. 4. *Hyotissa semiplana* (Sowerby1813), A-C: Different views of the clusters of H.semiplana (x 1), D. Left valve (Specimen no.BHU010331-1); external view (x 1); E. Internal view of the same specimen (x 1).

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