Callaiosphaeridium scabratum sp. nov. — A new dinoflagellate cyst species from Early Turonian of the Cauvery Basin, India

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ABSTRACT


A new dinoflagellate cyst species Callaiosphaeridium scabratum, is discovered from the Kulakkalnallam Sandstone Member of the Garudamangalam Formation exposed in the Cauvery Basin, southern India. This striking new species, characterised by a scabrate wall and distally open short and broad tubular paracingular processes, will add greatly to the ability to correlate Lower Turonian strata in the region.

Key-words—Dinoflagellate cyst, Early Turonian, Garudamangalam Formation, Cauvery Basin, India.

INTRODUCTION

The marine Cretaceous (Barremian to Maastrichtian) sediments in the Cauvery Basin along the east coast of India occur in three important areas, Ariyalur, Vriddhachalam and Pondicherry, extending from south to north (Blanford, 1865; Ramanathan, 1968). The marine Cretaceous rocks of the Cauvery Basin have long been investigated for their rich microfossil content, mainly foraminifers. Dinoflagellate cysts were first reported from the Cauvery Basin by Jain & Subbaraman (1969) from the Ariyalur area. Subsequently, morphology, taxonomy and biostratigraphic significance of dinoflagellate cysts from the basin have been discussed by several workers: Jain & Taugourdeau-Lantz (1973), Jain (1977), Venkatachala & Kumar (1980), Khowaja-Ateequzzaman & Jain (1990), Khowaja-Ateequzzaman et al. (1991), Khowaja-Ateequzzaman (1993), Khowaja-Ateequzzaman & Garg (1995),...
Khowaja-Ateequzzaman & Garg (2002) and Khowaja-Ateequzzaman & Garg (in press) have reported dinocysts from the Ariyalur area; and Jain (1978) and Mehrotra & Sarjeant (1984a, b, c; 1986) have described forms from the Vriddhachalam area.

The stratigraphic succession in the Ariyalur area (Figs 1, 2) has been divided in ascending order, into the Dalmiapuram, Karai, Garudamangalam, Sillakudi, Kallankuruchchi and Kalamedu formations (Sundaram & Rao 1986; Tewari et al., 1996). The Garudamangalam Formation, consisting of a coarse sandy to shaly succession interbedded with highly fossiliferous gritty to conglomeratic calcareous sandstones and shelly calcareous sandstones, is subdivided into a lower Kallakknattam Sandstone Member and an upper Anaipadi Member (Sundaram & Rao, 1979; Tewari et al., 1996). The contact between the Garudamangalam and Karai formations is marked by a fossiliferous pebbly calcareous sandstone at the base of the former, occurring as medium to large concretions. This concretionary sandstone is characterised by the occurrence of pebbles and cobbles of quartz and Archaean rocks, and lenses/nodules of the underlying Karai Formation. This concretionary sandstone, generally considered to indicate

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Fig. 1—Geological map of the Ariyalur area (adapted after Blanford, 1864; Sundaram & Rao, 1986).
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Ariyalur Group | Ariyalur Group | Ariyalur Formation
Silakudi Formation | Silakudi Formation | Break in sedimentation not recognised
Garudamangalam Formation | Anaipadi Formation | Garudamangalam Formation
Trichinopoly Group | Kulakkalnattam Sandstone Formation | Kulattur Member
Kulakkalnattam Sandstone Member | Ultraipadi Member | Anaiipadi Member
Karai Formation | Kottarai Member | Kottarai Member

Fig. 2—Lithostratigraphic classification of the Cauvery Basin (after Tewari et al., 1996).

an unconformable relationship between the two formations, has been interpreted to result from a transgressive event, indicative of a sequence boundary caused by forced regression at the top of the underlying deeper water Karai Shale (Hart et al., 1996).

In the present study, a new dinoflagellate cyst species, Callaiosphaeridium scabratum is described from a clay nodule (reworked from the underlying Karai Shale) in the basal concretionary shelly calcareous sandstone of the Kulakkalnattam Sandstone Member of the Garudamangalam Formation (Fig. 3). However, several samples obtained from the upper part of the Karai Shale proved unproductive of dinoflagellate cysts, possibly due to preservational factors. The age of the productive sample is Early Turonian based on the occurrence of Cribroperidinium edwardsii, Florentinia cooksoniae and Litosphaeridium siphoniphorum (Khowaja-Ateequzzaman & Garg, 2002). Kale and Phansalkar (1992) have assigned the nannofossil assemblage from the uppermost part of the Karai Shale to the lower part of the Quadrum gartneri Zone (CC 11) of Early Middle Turonian age. It is presumed that the new dinoflagellate cyst species will greatly help to date and correlate Lower Turonian strata in the region.

The type is housed in the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow. The specimen locations refer to the England Finder position on the slide.

**SYSTEMATICS**

**Division**—DINOFLAGELLATA (Bütschli 1885) Fensome et al. 1993

**Subdivision**—DINOKARYOTA Fensome et al. 1993

**Class**—DINOPHYCEAE Pascher 1914

**Subclass**—PERIDINIPHYCIDA Fensome et al. 1993

**Order**—GONYAULACEAE Lindemann 1928

**Subfamily**—Uncertain


1966 Callaisosphaeridium Davey & Williams, p. 103
1967 Hexaplaera Clarke & Verdier, p. 42
1980 Callaisosphaeridium Davey & Williams emend. Duxbury, p. 113

**REMARKS**

Davey and Williams (1966, pp. 103-104) proposed the genus Callaisosphaeridium with Hystrichosphaeridium asymmetricum Deflandre & Courteville (1939, pp. 6-7, pl. 4, figs 1-2) as the type. They inferred the paratabulation from the arrangement of processes as 1‘ (2‘), 6‘, 5‘, 1p, 0“ and 0-1s. Stover and Evitt (1978, p. 202) modified this and described it as gonyaulacean, 1-2‘, 5-6‘, 6c, 5“”, 1“” and 1-3s. They indicated that number of precingular processes varies from 5 to 6, that there is one antapical process and they increased the number of sulcal processes from 0-1s to 1-3s.

Duxbury (1980, p. 113) emended the generic diagnosis of Callaisosphaeridium accepting that the number of epi- and hypocystal processes and/or crests can vary, and maintaining the presence of six tubular paracingular processes as the distinctive feature. In other respects, Duxbury compared Callaisosphaeridium with Avellodinium Duxbury 1977 and Heslertonia Sarjeant 1966 emend. Duxbury 1980. He stated that in the epi- and hypocystal areas, Callaisosphaeridium might combine the gonal process type of Avellodinium with the high parasutural crests typical of Heslertonia. Below (1981, pp. 27-28) further emended the genus Callaisosphaeridium and considered Avellodinium Duxbury...
(1977) its junior synonym. Lentin and Williams (1981, p. 23) however, retained *Avellodinium* Duxbury (1977), rejecting the synonymy between the two genera because of the distinctive nature of the processes in each.

**CALLAIOSPHAERIDIUM SCABRATUM** sp. nov.  
(Pl. 1.1-9)

_Holotype_—Figs 1-3, BSIP Museum Statement No. 1065, Slide No. 11504, coordinates 10.2 x 152.5.

_Type Locality_—Tappy, Trichinopoly, Cauvery Basin, Tamil Nadu, India.

_Derivation of name_—Named after the ornamentation on the endophagm.

**DIAGNOSIS**

Skolochorate cyst with six, _tubular_, distally open, short and broad paracingular processes; endophragm scabrate; parasutural crests between gonial processes attaining height equal to that of processes; paratabulation gonyaulacacean, 1", 6", 5", 1p, 1", 1-2s. Archaeopyle epicystal.

**DESCRIPTION**

_Shape_—Central body subspherical to ovoidal.

_Wall Relationship_—Cyst wall two layered, endophagm and periphagm appressed between processes. Periphagm alone forms processes and crests.

_Wall Features_—Periphagm thin, endophagm thicker than periphagm, scabrate. Sparsely placed grana occasionally occur especially along the paracingular region, at the surface area under the proximal ends of paracingular processes. Paracingular processes six, tubular, short (less than half the diameter of the cyst) and broad (length and width almost equal), distally open, flared with irregular margins, occasionally with few spines present on distal terminations. Epicyst and hypocyst areas bear parasutural ridges, extending between gonial processes, forming a hexagon and a pentagon respectively. Gonial processes solid, distally forked, connected by parasutural crests. Parasutural crest thin, attaining height

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**PLATE 1**

1-3. *Callaiosphaeridiium scabratum* sp. nov. (holotype), Slide No. 11504; E.F. no. R53/3. (1) specimen in dorsal view showing parasutural ridges extending between distally forked, solid, gonial processes forming a hexagon. (2) specimen in optical view showing short and broad paracingular processes. (3) specimen in ventral view showing parasutural ridges extending between distally forked, solid, gonial processes forming a pentagon, parasutural crest and scabrate surface ornamentation.

4-8. Other specimens of *Callaiosphaeridiium scabratum* sp. nov.  
4-5. Slide No. 11504; E.F. no. L63/3. (4) specimen in optical view showing short and broad paracingular processes. (5) specimen showing distally forked gonial processes with crest on the epicyst.  
6. Slide No. 11504; E.F. no. J57. specimen showing short and broad paracingular processes and parasutural ridges on the hypocyst.  
7. Slide No. 11504. E.F. no. P38; specimen showing, epicyst archaeopyle with attached operculum, parasutural ridges on the epicyst forming a hexagon, distally forked solid gonial processes, parasutural crest and scabrate ornamentation on the endophagm.  
8. Slide No. 11504. E.F. no. D40/4; specimen in optical view showing short and broad paracingular processes.
equal to that of gonal processes, the maximum being at the
distal extremities of the gonal processes following the forked
extremities in the form of long aculei that are sometimes curved.
Crest bearing a thickened row running along its distal margin.

Paratabulation — 1', 6°, 6c, 5°, 1p, 1''', 1-2s.

Archaeopyle — Epicystal

Dimensions: Body size — length 35-45 μm
width 28-32 μm.

Paracingular processes — length 12-16 μm
width 13-16 μm.

COMPARISON

Callaiosphaeridium scabratum sp. nov. differs from
Callaiosphaeridium asymmetricum (Deflandre & Courteville
1939) Davey & Williams 1966 and C. trcherum Duxbury 1980
in wall ornamentation, shape and size of its paracingular
processes and parasutural crest. The paracingular processes in
Callaiosphaeridium scabratum are short and broad with
irregular or entire distal margins whereas in
Callaiosphaeridium asymmetricum and C. trcherum these
are long, and distally flared with long spines at their distal
margins.

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