

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

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(Received 16 September 2002; revised version accepted 24 September 2003)

ABSTRACT

Khowaja-Ateequzzaman & Garg R 2004. *Callaiosphaeridium scabratum* sp. nov. – A new dinoflagellate cyst species from the Early Turonian of the Cauvery Basin, India. Palaeobotanist 53(1-3) : 97-103.

A new dinoflagellate cyst species *Callaiosphaeridium scabratum*, is discovered from the Kulakkalnattam 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.

भारत में कावेरी द्रोणी के प्रारम्भिक तुरोनियन काल से प्राप्त एक नयी घूर्णीकशाभ पुटी
प्रजाति—कैलेयोस्फेरीडियम स्केब्रेटम नवप्रजाति

ख्वाजा-अतीकुज़्ज़ामा एवं राहुल गर्ग

सारांश

दक्षिणी भारत के कावेरी द्रोणी में अनावरित गरुडमंगलम शैलसमूह के कुलाककलनाट्टम बालुकाश्म सदस्य से एक नयी घूर्णीकशाभ पुटी प्रजाति कैलेयोस्फेरीडियम स्केब्रेटम प्राप्त की गई है। यह ध्यानाकर्षक प्रजाति अपने स्केब्रेट भित्ति और दूर खुलने वाले छोटे एवं चौड़े नलिकाकार पराप्रमेखला प्रक्रम के द्वारा पहचाने जाने वाली है तथा क्षेत्र में प्रारम्भिक तुरोनियन स्ट्रेटा-के सहसंबंधन में अत्याधिक सहायक होगी।

संकेत शब्द—घूर्णीकशाभ पुटी, प्रारम्भिक तुरोनियन, गरुडमंगलम शैलसमूह, कावेरी द्रोणी, भारत।

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 (1984 a, 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, Kallankurchchi 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 Kulakkalnattam 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

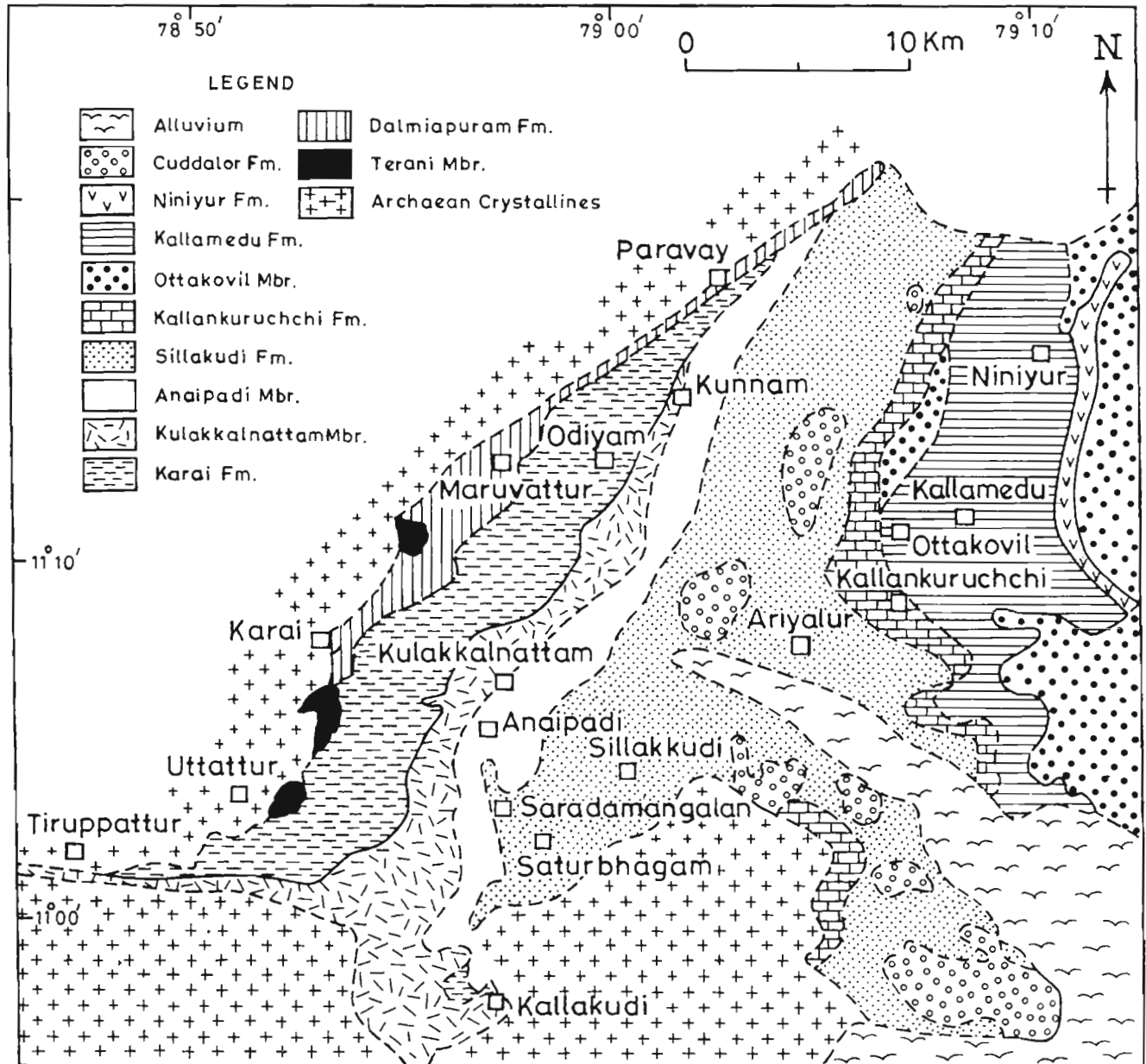


Fig. 1—Geological map of the Ariyalur area (adapted after Blanford, 1864; Sundaram & Rao, 1986).

Tewari <i>et al.</i> (1996)		Sundaram & Rao (1986)		Banerji (1982); Ramasamy & Banerji (1991)	
Ariyalur Group	Silakudi Formation	Ariyalur Group	Silakudi Formation	Ariyalur Formation	.
Uttatur Group	Garudamangalam Formation		Anaipadi Formation	Garudamangalam Formation	Break in sedimentation not recognised
	Anaipadi Sandstone Member	Trichinopoly Group	Kulakkalnattam Formation		Kulattur Member
	Kulakkalnattam Sandstone Member				Anaipadi Member
	Karai Formation	Uttatur Group	Karai Formation	Uttatur Formation	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 (CC11) 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—GONYAULACALEST Taylor 1980

Suborder—GONYAULACINEAE (Autonym)

Family—Gonyaulacaceae Lindemann 1928

Subfamily—Uncertain

Genus—CALLAIOSPHAERIDIUM Davey & Williams 1966 emend. Duxbury 1980 emend. Below 1981

1966 *Callaiosphaeridium* Davey & Williams, p. 103

1967 *Hexasphaera* Clarke & Verdier, p. 42

1980 *Callaiosphaeridium* Davey & Williams emend. Duxbury, p. 113

1981 *Callaiosphaeridium* Davey & Williams emend. Duxbury emend. Below, pp. 27-28.

REMARKS

Davey and Williams (1966, pp. 103-104) proposed the genus *Callaiosphaeridium* 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", 6C, 5"', 1p, 0''' and 0-1s. Stover and Evitt (1978, p. 202) modified this and described it as gonyaulacacean, 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 *Callaiosphaeridium* 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 *Callaiosphaeridium* with *Avellodinium* Duxbury 1977 and *Heslertonia* Sarjeant 1966 emend. Duxbury 1980. He stated that in the epi- and hypocystal areas, *Callaiosphaeridium* 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 *Callaiosphaeridium* and considered *Avellodinium* Duxbury

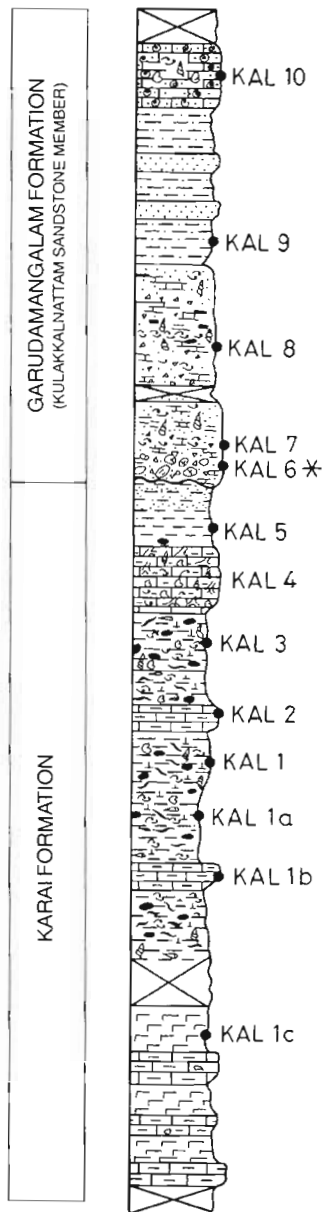


Fig. 3—Lithologic column of Kallakudi-Tappy area showing sample positions.

(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 endophragm.

DIAGNOSIS

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

DESCRIPTION

Shape—Central body subspherical to ovoidal.

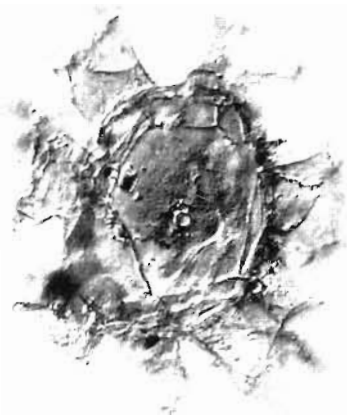
Wall Relationship—Cyst wall two layered, endophragm and periphragm appressed between processes. Periphragm alone forms processes and crests.

Wall Features—Periphragm thin, endophragm thicker than periphragm, 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 gonal processes, forming a hexagon and a pentagon respectively. Gonal processes solid, distally forked, connected by parasutural crests. Parasutural crest thin, attaining height

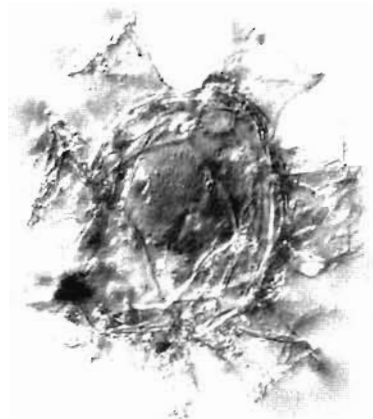
PLATE 1

- 1-3. *Callaiosphaeridium 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, gonal 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, gonal processes forming a pentagon, parasutural crest and scabrate surface ornamentation.
- 4-8. Other specimens of *Callaiosphaeridium 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 gonal 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, epicystal archaeopyle with attached operculum, parasutural ridges on the epicyst forming a hexagon, distally forked solid gonal processes, parasutural crest and scabrate ornamentation on the endophragm. 8. Slide No. 11504, E.F. no. D40/4. specimen in optical view showing short and broad paracingular processes.



1



2



3



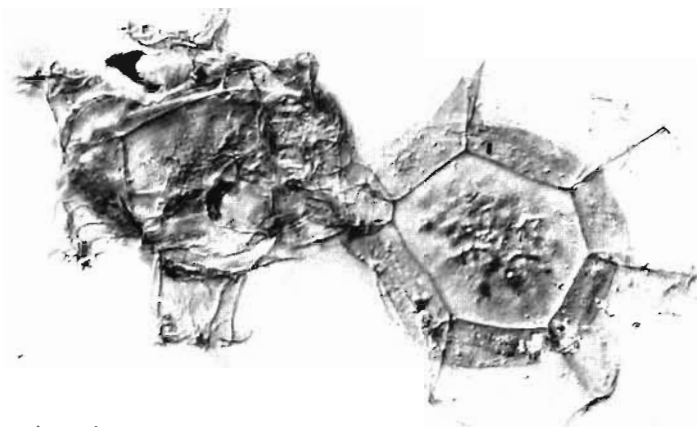
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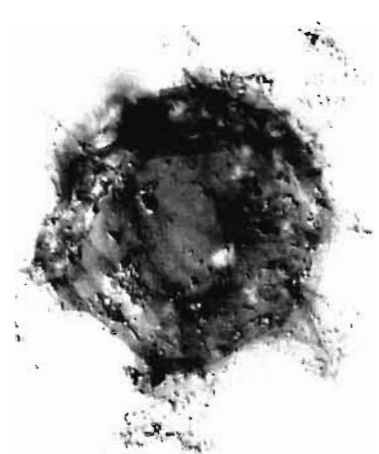
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6



7



8

10 μ m

PLATE 1

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. trycherum* 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. trycherum* these are long, and distally flared with long spines at their distal margins.

Acknowledgements—The authors are grateful to Professor Anshu K. Sinha, Director, BSIP, Lucknow for providing facilities and constant encouragement. The authors are indebted to Dr KP Jain for discussion and suggestions. Sincere thanks are due to Dr Robert A Fensome for critical review of the manuscript and constructive suggestions.

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