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SIGNIFICANCE OF EOCENE RADIOLARIA FROM PORT BLAIR GROUP OF SOUTH ANDAMAN ISLAND, INDIA

HSIN YI LING[1] and M.S. SRINIVASAN[2]

1. DEPARTMENT OF GEOLOGY, NORTHERN ILLINOIS UNIVERSITY, DEKALB, ILLINOIS 60115, U.S.A.
2. DEPARTMENT OF GEOLOGY, BANARAS HINDU UNIVERSITY, VARANASI-221005, INDIA

ABSTRACT

A radiolarian assemblage successfully recovered from chert samples confirms the Middle Eocene age for the Port Blair Series of South Andaman Island in Bay of Bengal located in the northeastern Indian Ocean. The result demonstrates the effect of radiolarian biostratigraphy on the timing of tectonic processes, structural interpretation and the reconstruction of ophiolitic sequences of the region.

INTRODUCTION

South Andaman Island, the southernmost of the three Andaman Islands located in Bay of Bengal, India (fig. 1a), consists of two major rock types, Middle Eocene sedimentary Port Blair Group, and Late Cretaceous or Early Eocene ultramafic Saddle Hill Phase with small exposures of cherty Porlob Group (Jacob, 1854; Jafri, 1986) (fig. 1b). As early as 1950, Boileau indicated the presence of the radiolarian chert associated with ultramafic rocks. Using light photomicrographs, Jafri (1986) illustrated 18 species of hagiastrid radiolarians and suggested that the radiolarian chert enclosed within the Port Blair Group near Bambooflat (fig. 1c) was Early Cretaceous in age.

With the recent continuous refinements in Mesozoic and Cenozoic radiolarian biostratigraphy and the application of scanning electron photomicrography, the age of these chert samples from the island could be defined more closely to furnish the basis for future geological investigation and for better understanding of the tectonic history of the area.

MATERIALS AND METHODS

Three Rock fragments of pale greenish gray cherts were obtained from Jafri's collection from Corbyn's Cove, near the boundary of Port Blair Series and "Serpentinized igneous Rock (Saddle Hill phase) mapped by Tipper (1911) and Boileau (1950) (*fide* Jacob, 1954; Jafri, 1986) (see fig. 1b).

The samples were treated with dilute hydrofluoric acid, and rinsed several times with distilled water. The residues were sieved through a 63 µm mesh screen. Handpicked radiolarian specimens were classified under a transmitted light stereomicroscope. Selected specimens were mounted in canada balsam, and examined under a Zeiss Photomicroscope. In addition, several selected specimens were coated with gold-palladium and were observed and/or photographed using a JEOL JSM-35 CF Scanning Electron Microscope.

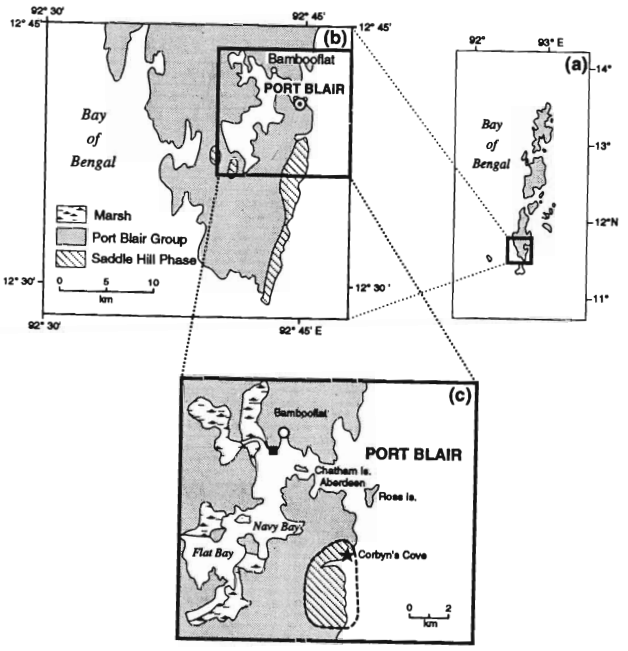

Fig. 1. (a) Index map of South Andaman Island, Bay of Bengal, India; (b) generalized geological map of a southern part of South Andaman Island (modified after Jacob, 1954); and (c) generalized geological map of Port Blair-Corbyn's Cove area (modified after Jacob, 1954; Jafri, 1986). Sample location for Middle Eocene fauna reported in this paper is marked with a solid star, and that of Cretaceous hagiasterids described by Jafri (1986) with a solid square.

All specimens examined during the present study are permanently deposited in the Micropaleon-

tology Collection, Department of Geology, Northern Illinois University.

RESULTS OF ANALYSIS AND DISCUSSION

Although radiolarian specimens recovered from the Port Blair Group appear well-preserved, some are apparently very fragile possibly due either to the tectonic process or to change in silica composition with time. The assemblage consists of: *Actinommids* spp., *Lithochytris verspertilio* Ehrenberg, *Spongodiscus* spp., *Theocotylissa ficus* (Ehrenberg) and *Thyrsocyrtis* sp. aff. *T. triacantha* (Ehrenberg) (Plate I), suggesting a Middle Eocene age.

Our results agree with previous age assignments for the Port Blair Group proposed by Oldham (1885), Jacob (1954), and Srinivasan, (1979), although the basis for their age consideration was not clear.

A noteworthy comment is that the location of our examined sample nearly coincides with locality 10 from the recent investigation by Roy *et al.* (1988; also see for the historical review of microfossil investigations) (fig. 2) which is described as "Olistolith of cherty limestone in the Lipa Formation along the road from Corbyn's Cove to south of Port Blair airport...is rich in planktic foraminifera and some Radiolaria" and assigned a Paleocene age based on planktic foraminifera. Radiolarians are described as: ". . .mostly represented by: *Cenodiscus* sp. with a few *Brachiospyris* sp., *Gorgospyris* sp., and *Porodiscus* sp." All their radiolarians were identified under a transmitted light microscope.

Jafri's (1986) hagiastrid-bearing Cretaceous radiolarian chert was "an inlier of 20 m by 15 m outcrop within the sedimentary sequence of greywacke and sandstone of Port Blair Group (Andaman Flysch) outcropped at sea shore, about 1 km SW of Bambooflat" (fig. 1b). One of Roy *et al.*'s (1986) samples, locality 5 (Shore Point) (fig. 2), seems to come from the same location as described by Jafri. (1988), Roy *et al.* (1986) described the lithology of the area as "the bedded reddish brown ribbon chert, marl, radiolarian earth and variegated agrillites occurring directly below the gritty sandstone of the Namunagarh Formation or with a sliver of deformed shales of the Lipa Formation ... rich in radiolarians and foraminifera..." They considered their sample to be of Paleocene age based on planktic foraminifera, and also listed 30 Tertiary radiolarians, and "Hagiastrids *indet.*" Judging from their faunal list, radiolarians appear to be Paleogene in age, although further examination of the specimens is necessary before a precise age determination can be made. Identification of "Hagiastrids *indet.*" in the samples requires confirmation, because the occurrence of hagiastrid radiolarians is stratigraphically limited to the Mesozoic. Radiolarian analysis from this part of the island is currently underway, and may yield additional results with regard to the faunal composition that will strengthen the evidence for the age determinations.

Confirmation of the presence of Middle Eocene sediments from the island is significant because a

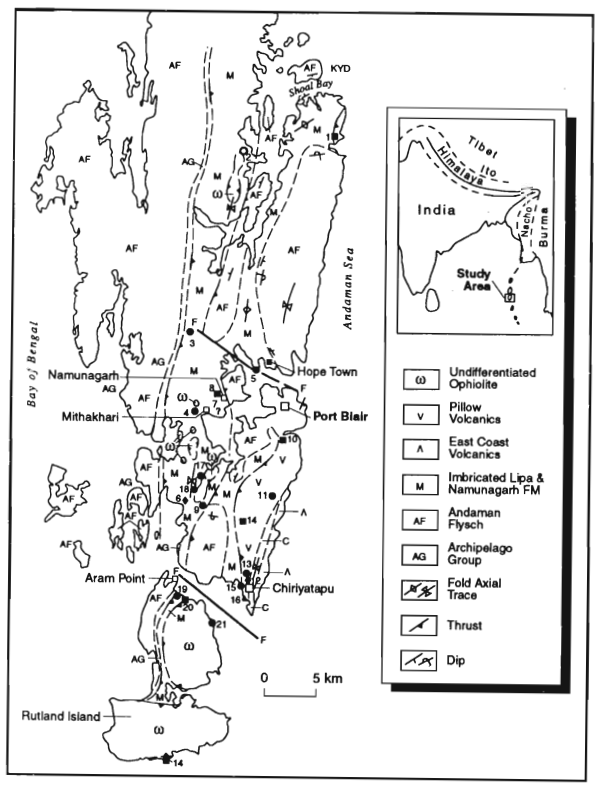

Fig. 2. Generalized geological map of South Andaman Island and locations of samples (after Roy *et al.*,1988).

similar lithological sequence has been reported from the adjacent north, Middle Andaman Island (Gee, 1927), where the occurrence of Early Eocene *Assilina* (larger foraminifera) above the basement "Serpentine Series" has been reported. Further north, similar foraminiferal-bearing pelagic sediments are observed in Naga Hills Ophiolites (Acharyya *et al.*, 1989) of eastern India-Burma region. Future investigation of these sediments might give an indication of the presence of Middle Eocene radiolarians. In the southeast and east, the senior author has already observed similar Middle Eocene radiolarian faunas from Nias Island of western Indonesia, and Waigeo (Ling *et al.* 1991b) and Halmahera Island (Ling *et al.*, 1991a) of eastern In-

donesia. Taken together, the tectonic accretion of Indo-Austral plate to Asian Plate for this area occurred during the post-Eocene times along Tethys megasuture line.

TAXONOMIC LIST

Eocene radiolarians recovered during the present study have been reported from the low latitude regions of both land outcrops and submarine sequences in the drilled sites of the Deep Sea Drilling Project and Ocean Drilling Program. Consequently, radio-larian taxa are listed in alphabetical order for genera and species within the genus of the current taxonomy and the original epithet, and remarks are made only where appropriate.

Actinommids sp.

Remarks : All specimens with the spherical cortical shell and radial spines are grouped and no further differentiation was attempted.

Lithochytris vespertilio Ehrenberg, 1873, p. 239; 1875, pl. 4, fig. 10 - Riedel and Sanfilippo, 1970, p. 528, pl. 9, figs. 8, 9.

Remarks : Within the species, there are apparently two forms which are characterized by the distance between the latticed, robust, conical feet, reflecting the overall appearance (compare figs 4 and 5 Plate I). This is noted by Riedel and Sanfilippo (1970). They interpreted that" ....early specimens are invariably longer than they are wide... and the later specimens closely approach the proportions of a regular tetrahedron."

It should be added here that a definitely longer form with shorter distance between feet superficially resembles those illustrated by Ehrenberg (1847, Fig. 6; 1954, pl. 36, fig. 6) as *Lychnocanium lucerna* from Barbados (not *Lithochytris lucerna* Haeckel, 1987, p. 1364, pl. 67, fig. 14, which was identified from Challenger Station 297 from South Pacific), although Ehrenberg's illustration definitely shows two segments instead of three.

Spongodiscus sp.

Remarks : All discoidal spumellarians with spongy cortical shells are grouped, and no attempt was made to indentify the specimens down to specific level.

Theocotylissa ficus : (Ehrenberg) Sanfilippo and Riedel, 1982, p. 180, pl. 2, figs. 19, 20, = *Eucyrtidium ficus* Ehrenberg, 1873, p. 228; 1875, pl. 11. *Thyrsocsrtis* sp. aff. *T. triacantha* (Ehrenberg).

Remarks : A few specimens recovered during the present study possess an inflated, broadly conical abdominal segment with fewer, but larger, pores, and the three feet, although thin, are slightly curved convexly outward, suggesting that the specimens are best considered as having affinity with *T. triacantha*. Unfortunately, all the specimens are very fragile as evidenced in the illustration (Pl. l, Fig. 6), which was selected from among the most complete forms, but was damaged during the mounting into microslide.

Neither a long cephalic horn or distinct rim at the distal end of the thoracic segment, nor strongly curved feet that are generally observed in *T. triacantha* (Riedel and Sanfilippo, 1970, p. 526, pl. 8, figs. 2,3 = *Podocyrtis triacantha* Ehrenberg, 1873, p. 254; 1975, pl. 13, fig. 4) are present. Radioalarians similar to the present Andaman forms with an inflated abdomen, less distinct lumbar structure, without apparent peristome, and probably with straight feet are referred to as *T. tensa* by Sanfilippo and Riedel (1982, pl. 1, figs. 6-7; pl. 3, fig. 2), and Sanfilippo *et al.* (1985 pp. 689-690, fig. 26.6b). However, while she holds a broad species concept in mind, Foreman (1973, p.442, pl. 3, figs 13-16; pl. 12, fig. 8) clearly referred her *T. hirsuta tensa* (= *T. (Pentalacorys) tensa* Foreman, Sanfilippo and Riedel, 1982, p. 176, pl. 1 figs. 6-7; pl. 3, figs. 1-2) to those with an inflated abdomen *(but not laterally,* italics by present authors') which narrows at the distal end into a smooth rim (=peristome), and three strong feet that are straight or generally curved convexly inward. This concept has been followed by most of the later workers (for the complete list, refer to Sanfilippo and Riedel, 1982).

Foreman (1973, l. 3, figs. 18-19; pl. 12, figs. 7, 12) observed forms similar to the Andaman specimens under consideration, and identified them as *Thyrsocyrtis* (?) sp., which are later included in *T. tensa* by Sanfilippo and Riedel (1982).

With these considerations, the present Andaman specimens are best considered as *T.* sp. aff. *T. triacantha*, but probably an early evolutionarily transitional form of *T. triacantha* from ancestral *T. tensa*. The datum of this evolutional transition has been regarded as an event that defines the boundary between the *Dictyoprora mongolfieri* zone below and the *Thyrsocyrtis triacantha* zone above within the Middle Eocene (Sanfilippo *et. al.*, 1985).

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EXPLANATION OF PLATE

Plate I

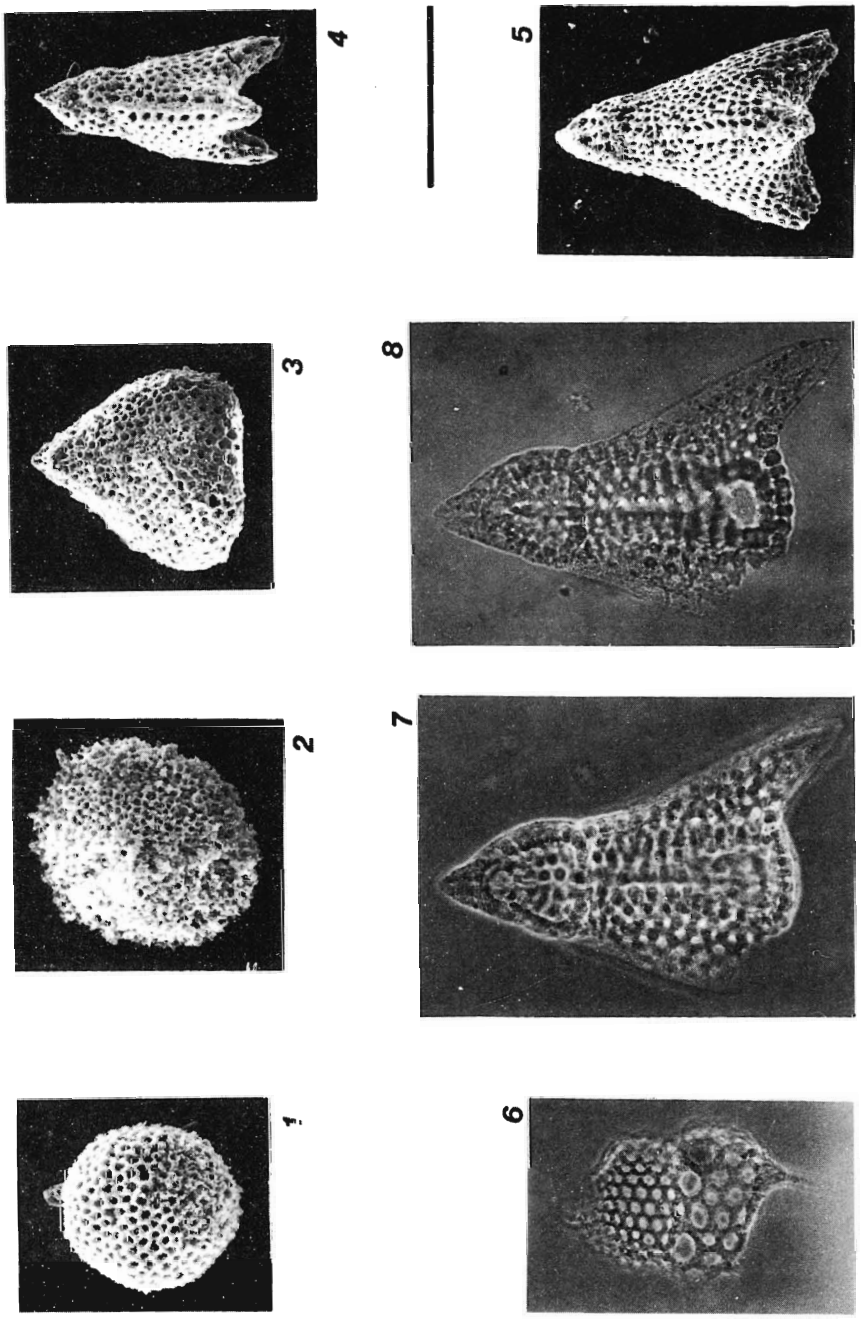
Scale bar = 100 mμ for figs. 1-5.

1. *Actinommid* sp.
2. *Spongodiscus* sp.
3. *Theocotylissa ficus* (Ehrenberg).

4, 5. *Lithochytris vespertilio* Ehrenberg.

6. *Thyrsocyrtis* sp. aff. *T. triacantha* (Ehrenberg), x200.

7, 8. *Lithochytris vespertilio* Ehrenberg. Different focus levels under transmitted light microscopy with phase contrast, x 300.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