

Carbonaceous macrofossils and organic-walled microfossils from the Halkal Formation, Bhima Group, Karnataka with remarks on age

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Carbonaceous macrofossils, viz., *Chuarua*, *Tawuia*, *Sinosabellidites*, *Protoarenicola*, *Beltina*, the organic-walled microfossils belonging to *Leiosphaerids*, *Myxococcoides*, *Eomycetopsis* and vase-shaped forms are recorded from the Halkal Formation, Bhima Group, Karnataka. The overall assemblage supports an older age than the Vendian, i.e. 1000-850 Ma.

Key-words—Carbonaceous Macrofossils, *Chuarua-Tawuia*, Organic-walled microfossils, Halkal Formation, Bhima Group (India).

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सारांश

कर्नाटक में भीमा समूह के हलकल शैल-समूह से कार्बनमय सूक्ष्मजीवाश्म एवं कार्बनिक भित्तिदार सूक्ष्मजीवाश्म तथा इनकी आयु पर टिप्पणी

प्रभात कुमार माइती एवं रूपेन्द्र बाबू

कर्नाटक में भीमा समूह के हलकल शैल-समूह से कार्बनमय सूक्ष्मजीवाश्म — चुआरिया, तवुइया, साइनोसेबेलिडाइटिस, प्रोटोअरेनिकोला, बेल्टीना तथा कार्बनिक भित्तिदार सूक्ष्मजीवाश्म — लिओस्फेयरिडिस, मिक्सोकोकोयडिस, ईओमाइसिटॉप्सिस तथा मुग्दराकार प्ररूप अभिलिखित किये गये हैं। कुल मिलाकर यह समुच्चय वेन्डियन अर्थात् 1100-850 एम. ए. से अधिक आयु व्यक्त करती है।

INFERENCES on the age of rocks have been drawn in the past based on the biological remains preserved in them. However, accuracy of these dating depends much upon the proper identification of preserved fossils with a limited and restricted geological range. The Bhima Group of the Indian peninsular region has been dated in the past by several workers on the basis of biological remains, and different views have been put forth concerning its age. It has been dated to be equivalent to the youngest Lower Rohtas Formation, Vindhyan (Suresh & Sundara Raju, 1983), i.e. close to Meso-Proterozoic (1000 Ma). Contrary to this, Late Precambrian to Cambrian age has been assigned by several workers (Salujha *et al.*, 1970; Venkatachala *et al.*, 1973; Viswanathiah *et al.*, 1979; Das Sarma *et al.*,

1992). To examine these two distinct views and to ascertain a proper age of the beds, fresh collections were made from the Halkal Formation, Bhima Basin around Gulbarga District, Karnataka under the aegis of the research programme I.G.C.P. 303 Project—Precambrian- Cambrian Event Stratigraphy.

Lithostratigraphically, five formations have been identified in Bhima Group by Mishra *et al.* (1987). According to him the stratigraphic succession is as follows :

Group	Formations
BHIMA	Harwal Formation
	Katamdevarhalli Formation
	Halkal Shale Formation

Shahabad Formation
Rabanapalli Formation

The macrofossils and organic-walled microfossils are found in the fissile shales of the Halkal Formation (Text-figure 1). At Kolkur ($17^{\circ} 05'N$, $76^{\circ} 46'E$) the shales are grey, greyish-white, khaki and greenish-yellow with phosphatic bands. At Gangurti the argillaceous shales are grey and black in colour. The macrofossils are preserved along the bedding plane. Organic-walled microfossils are isolated by digestion of rock matrix in 40 per cent hydrofluoric acid.

All the specimens are deposited in the Repository of Birbal Sahni Institute of Palaeobotany, Lucknow.

SYSTEMATIC DESCRIPTION

Macrofossils

Chuarua Walcott 1899

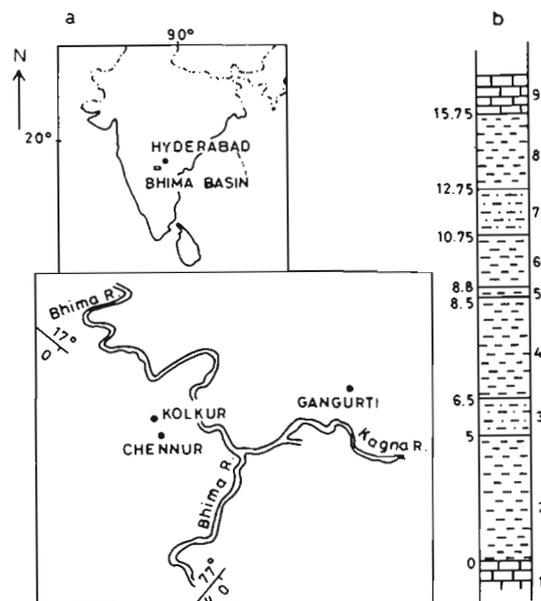
Type species—*Chuarua circularis* Walcott 1899

Chuarua circularis Walcott 1899

Pl. 1, figs 1, 10, 11

Description—Carbonaceous compressions (extremely fragile) and impressions of discs preserved on greenish-yellowish shale. Shape variable from circular to circular-oval; discs commonly flat with folds showing varying patterns, some of them showing distinct circular folds at margins. In some cases deep ruptures seen on margin. The size of discs grading from 2-10 mm (commonly 3 mm) in dimension. Surfaces of discs nearly smooth, however, in some cases small polygonal or globular areas perceptible.

Discussion—*Chuarua circularis* has been recorded earlier in India from the Suket Shale Formation, Lower Vindhyan, Ramapura, Madhya Pradesh



Text-figure 1 — a. Location map of the Bhima Basin and fossiliferous localities, b. Lithocolumn at Kolkur. 1. Shahabad Limestone, 2. Khaki and purple shale with *Chuarua* and *Sabellidites*, 3. Black phosphatic shale, 4. Variegated shale with *Sabellidites* and *Chuarua*, 5. Grey-black shale with abundant *Sabellidites*, 6. Khaki and purple shale with *Sabellidites* and *Chuarua*, 7. Black phosphatic shale, 8. Variegated shale with *Sabellidites* and *Chuarua*, and 9. Katamdevarhalli Limestone (after Das Sarma *et al.*, 1992).

(Maithy & Shukla, 1984) and from Rohtas Formation, Lower Vindhyan around Chopan (Maithy & Babu, 1988).

Tawuia Hofmann in Hofmann & Aitken 1979

Type species—*Tawuia dalaensis* Hofmann

Tawuia dalaensis Hofmann 1979

Pl. 1, figs 1, 3

Synonymy:

1992 *Sabellidites* Das Sarma *et al.*, p. 141, 142, figs 2a-c, 3a-h

PLATE 1

- | | | | |
|--------|---|-----------|--|
| 1. | Carbonised compressions of <i>Tawuia</i> and <i>Chuarua</i> , Specimen no. BSIP 37341, x 5. | 8,18. | Curved to twisted aseptate forms showing perforations due to postmortem alteration. Slide nos BSIP 11407 and 11409, x 500. |
| 2,4,6. | <i>Protoarenicola baiguashanensis</i> , Specimen nos BSIP 37342, 37344 and 37346, x 10. | 13,14. | Colonial sphaeroidal forms, cf. <i>Myxococcoides</i> , Slide nos BSIP 11409 and 11414, x 500. |
| 3. | <i>Tawuia dalaensis</i> , Specimen no. BSIP 37343, x 10. | 15. | Vase-shaped form, cf. Chitinozoa, Slide no. BSIP 11408, x 500. |
| 5,12. | <i>Beltina danai</i> , Specimen nos BSIP 37345, x 10 and 37351, x 4. | 16,17,21. | Solitary sphaeroidal form, cf. <i>Leiosphaeridia</i> , Slide nos. BSIP 11412, 11413 and 11410, x 500. |
| 7,9. | <i>Sinosabellidites huainanensis</i> , Specimen nos BSIP 37347 and 37348, x 10. | 19,20. | Tubular elongated filaments, cf. <i>Eomycetopsis</i> , Slide nos. BSIP 11410 and 11411, x 500. |
| 10,11. | <i>Chuarua circularis</i> , Specimen nos BSIP 37349 and 37350, x 10. | | |

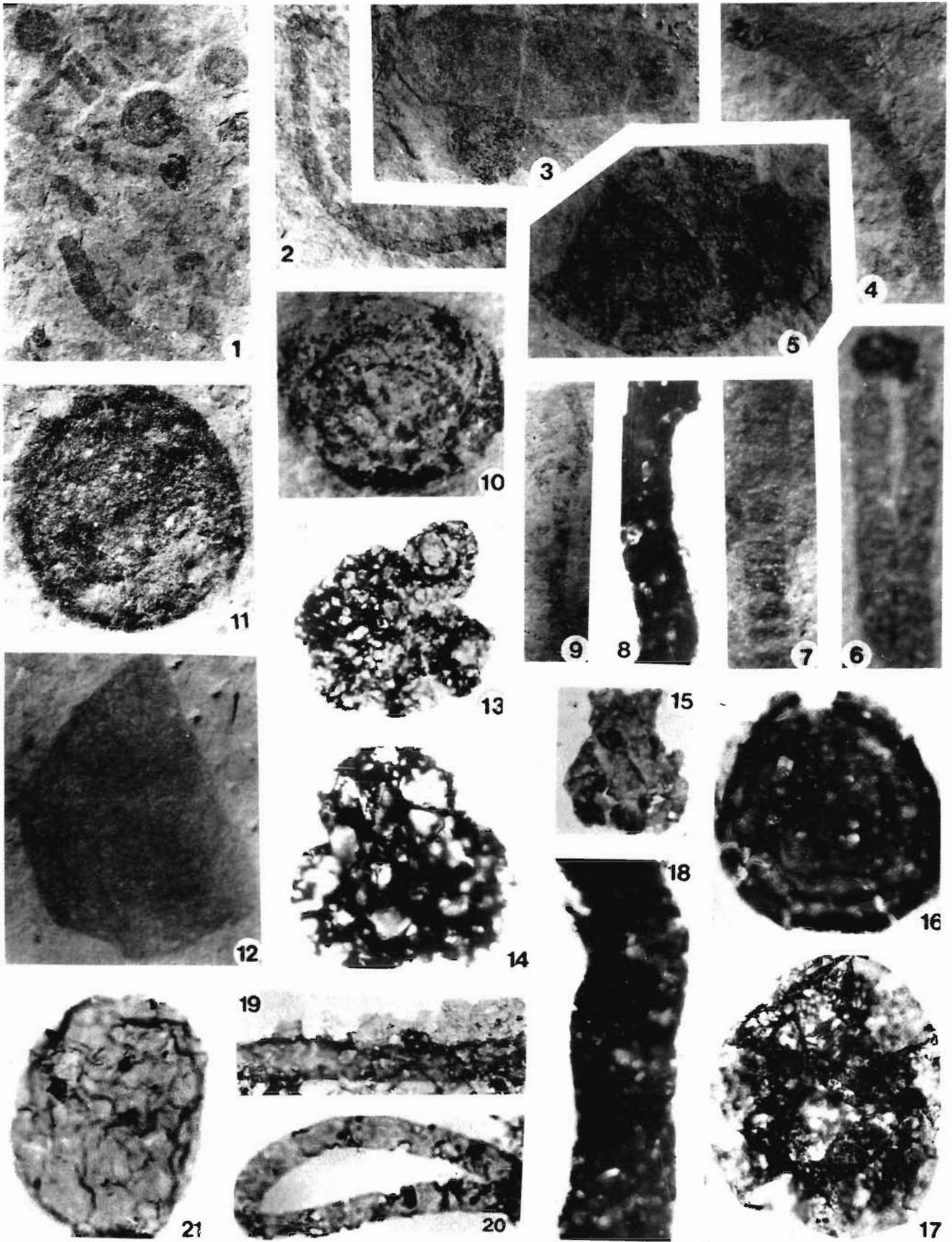


PLATE 1

Description—Rod or ribbon-like films, short or slender, straight or mostly reflexed, parallel-sided, ends rounded or blunt, margins very smooth and distinct, surface smooth; size 15-30 mm in length and 2-3 mm in width.

Discussion—*Tawuia dalaensis* has been previously reported by Maithy and Shukla (1984) from the Suket Shale Formation, Semri Group, Ramapura and Maithy and Babu (1988) from the Rohtas Formation, Semri Group, Chopan dated to be 1000 Ma. Das Sarma *et al.* (1992) reported *Sinosabellidites* from the Halkal Formation, Bhima Group. The specimens are lacking in chitinous matter. Therefore, morphologically it is alike *Tawuia*.

Sinosabellidites Zheng 1980

Type species—*Sinosabellidites huainanensis* Zheng

Sinosabellidites huainanensis Zheng 1980

Pl. 1, figs 7, 9

Description—Flattened ribbon-like compressions or impressions, straight or curved, but not twisted, both ends rounded, margin entire, surface with fine, closely spaced transverse thickenings; specimens measuring 25-30 mm in length and about 1-3 mm in width

Discussion—*Sinosabellidites* has not been reported so far from India. It is known from the Late Precambrian of North China Platform, dated to be 800-850 Ma.

Protoarenicola Wang 1982

Type species—*Protoarenicola baiguashanensis* Wang

Protoarenicola baiguashanensis Wang 1982

Pl. 1, figs 2, 4, 6

Description—Body very narrow and slender, occasionally curved consisting of numerous, fine, straight annulations with uniform diameter throughout the length; sides distinct and smooth; anterior end conical with a small, distinct, ovate bulb in front, measuring up to 25 mm long and ± 2 mm broad.

Discussion—The Halkal specimens compare in organisation to the figured specimens described by Sun *et al.* (1986, figs 4, 7) from the Jiuliqao Formation, Feishui Group, dated to be about 740 Ma.

Beltina Walcott 1899

Type species—*Beltina danai* Walcott 1899

Beltina danai Walcott 1899

Pl. 1, figs 5, 12

Description—Carbonaceous films, fragmented, dark, irregular, unornamented and smooth, occasionally triangular in outline, ends angulate; size variable even up to 3 cm.

Discussion—Morphologically the specimens compare to *Beltina danai* reported by Hofmann (1985a, pl. 3, fig. 8) from the Middle Proterozoic of Little Dal, Mackenzie Mountains, Northwest Canada. The presence of large-sized *Beltina* demonstrates the presence of macroscopic forms in Proterozoic seas. However, it is difficult to say whether they are the fragments of large thallii or compressions of procaryotic or eucaryotic mats.

Organic-walled microfossils

Studies of the organic-walled microfossils from the Proterozoic succession show that they can be best classified into following four major groups:

- Solitary sphaeroidal forms
- Colonial sphaeroidal forms
- Tubular forms
- Unusual forms

It is interesting to note that the studied material from the Halkal Formation, Bhima Group contains all the four forms.

Solitary sphaeroidal forms

Pl. 1, figs 16, 17, 21

Circular, measuring 60-180 μm , deformed in outline by irregular foldings, surface texture smooth which gets variously ornamented due to diagenesis.

Similar-looking forms have been earlier reported under the acritarch form *Kildinella suketensis* by Maithy and Shukla (1977, pl. 3, fig. 21) from Suket Shale Formation, Semri Group, Vindhyan exposed near Ramapura.

Colonial sphaeroidal forms

Pl. 1, figs 13, 14

Small globular cells, measuring 10-20 μm , clumped together to form a flat colony, individual cells non-ensheathed, surface smooth to granulate, margin thickened.

The comparable forms have previously been figured as *Myxococcoides* by Maithy and Shukla (1977, pl. 3, figs 1-4) from the Suket Shales, Vindhyan exposed around Ramapura.

Tubular forms

Pl. 1, figs 8, 18, 19, 20

Blackish-brown, simple, tubular aseptate tubes, twisted, fragments up to 300 μm long and 3-9 μm wide or more, commonly solitary and occasionally in clusters. The degradational forms include several types or forms modified by crystallization. These forms were previously assigned to *Eomycetopsis* Schopf (Maithy & Shukla, 1977) and considered to be the sheaths of cyanobacterial microbes.

Unusual forms

Pl. 1, fig. 15

Brownish, vase-shaped vesicle, measuring 60 μm long and 50 μm in width, margin entire, surface distorted due to diagenesis. The present form is morphologically comparable to chitinozoa described by Bloeser *et al.* (1977) from the Chuar Group (1000 Ma), Grand Canyon, Arizona and Maithy and Babu (1988) from the Semri Group, exposed around Chopan, Mirzapur District.

AGE OF THE BHIMA GROUP

Suresh and Sundara-Raju (1983) equated Bhima Group with the younger beds of Semri Group, Vindhyan (i.e., ± 900 Ma). This inference was drawn on the basis of finding of *Chuaria circularis* from Gangurti Shale, Halkal Formation. Contrary to this, on the basis of microfossils—acritarchs, Precambrian to Cambrian age was assigned to the Bhima by Saluja *et al.* (1970), Venkatachala and Rawat (1973) and Viswanathiah *et al.* (1976, 1979).

In recent years, new informations are available on the Vendian and Early Cambrian acritarchs and other

biological entities (Jankauskas, 1989, 1990). The Vendian acritarch assemblage is characterised by *Cymatiosphaeroides* and other small ornamented forms in association with large-sized *Leiosphaeridia*. The assemblage of organic-walled microfossils so far known from Halkal Formation including the present record is devoid of above mentioned Vendian forms. The assemblage comprises mainly Leiosphaerids and compares with the assemblage of Suket Shale Formation, Vindhyan exposed around Ramapura (Maithy & Shukla, 1977) considered to be ± 1000 Ma in age. Therefore, on the basis of organic-walled microfossils the Halkal bed is older than Vendian.

Chuaria, *Tawuia* and *Beltina* macrofossils are commonly known from the global beds of 1000-900 Ma (Maithy & Babu, 1988; Hofmann, 1985b). *Sinosabellidites* and *Protoarenicola* are known only from about 850 Ma sequence in China (Hofmann, 1992). The comparable macrofossils assemblage in India is known from the Suket Shale Formation, Lower Vindhyan exposed around Ramapura (Maithy & Shukla, 1977, 1984a) and Rohtas Formation, Vindhyan exposed at Chopan (Maithy & Babu, 1988). Therefore, on the basis of the present data it can be safely concluded that the Bhima Group is older than the Prevaranger glaciation, i.e. 750 Ma.

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