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***Obruchevella* AND OTHER TERMINAL PROTEROZOIC (VENDIAN) ORGANIC-WALLED MICROFOSSILS FROM THE BHANDER GROUP (VINDHYAN SUPERGROUP), MADHYA PRADESH** by Bijai Prasad, *Jour. Geol. Soc. India*, v.69, pp.295-310.

P.K.Maithy, formerly Birbal Sahani Institute of Paleobotany, Lucknow and **Gopendra Kumar**, formerly Geological Survey of India, Lucknow comments:

The author has postulated following age to the Bhander Group, Vindhyan Supergroup on the basis of cyanobacteria genus *Obruchevella* and other organic-walled microfossils – Acritarch. (i) Ganugarh Shale- Late Cryogenian-Early Vendian (ca 650 – 590 Ma); (ii) Nagod Limestone – Early Vendian or Late Vendian (ca 570 – 560 Ma); (iii) Sirbu Shale – Late Vendian to Early Cambrian.

1. The author has considered cyanobacteria genus *Obruchevella* as an “Index Fossil” for Vendian though its presence is well known from Late Precambrian to Devonian (Mankiewiz, 1992). Moreover, recently this genus has been reported by Rai and Singh (2004) from Late Paleoproterozoic sequence of Semri Group of the Vindhyan. It may not be out of point to mention that *Obruchevella* compares exactly with modern helical Cyanobacteria *Spirulina* and *Arthospira*. Thus, this form exists in fossil form in Precambrian and extends up to the present time. As such it has no biostratigraphic significance. This fact has been pointed out by Riding (1991; p.326). Therefore, the age conclusion drawn by the author on the basis of long ranging genus *Obruchevella* is incorrect.

2. The Neoproterozoic biostratigraphy is best based in the presence of Acritarch and organic-walled microfossils produced by phytoplanktonic protists (Timofeev, 1973). Both spheromorphic and acanthomorphic forms have played useful role in correlating the rocks of Neoproterozoic-Cambrian succession. Results of studies have demonstrated that the size of spheromorphs increases towards the close of Proterozoic whereas the acanthomorphic forms are larger in Neoproterozoic and show gradual reduction towards Precambrian/Cambrian onwards (Maithy and Babu, 1997).

The biostratigraphy is based on the overall composition of assemblages, in particular Acritarch. According to Bijai Prasad (2007) the Ganugarh Shale is dominated by filamentous cyanobacteria along with spheromorphs *Symplastosphaeridium*, *Kildinosphaera*, *Trachysphaeridium* and *Stictosphaeridium*. The overlying Nagod Limestone also shows dominance of filamentous cyanobacteria along with spheromorphs *Trachysphaeridium*, *Favosphaeridium*, *Letosphaeridia*, *Kildinosphaera*, *stictosphaeridium* and *Vandalosphaeridium*. The Sirbu Shale shows dominance of the spheromorph *Letosphaeridia* associated with tubular filamentous cyanobacteria viz *Siphonophycus* and *Oscillatorioopsis*. The acritarch details given by the author does not support the conclusion drawn.

Biostratigraphic conclusions can not be drawn solely on the basis of organic-walled microfossils when other evidences are also present, viz macrofossils evidence, stromatolitic, radiometric dates and global events as given below

- 1 Presence of *Chauria-Tawula* assemblage is known from entire Bhandar sequence (Srivastava, 2002, Kumar, 2001) Up till now this assemblage is known below Sturtian glaciation (Cryogenian),
- 2 Stromatolitic evidence of the Bhandar Group (Kumar and Srivastava, 2003) has previously supported older than Terminal Proterozoic
- 3 Recent C, O, Sr and Pb isotope systematics of carbonates sequence of the Vindhyan Supergroup also do not support Ediacaran (Vendian) – Cambrian age for the Bhandar Group Admittedly, the Pb-Pb isochron age (ca 650 Ma) for the Bhandar Limestone is not reliable due to small spread in $^{206}\text{Pb}/^{207}\text{Pb}$, yet other tools such as $^{87}\text{Sr}/^{86}\text{Sr}$ ratios suggest an early Mid-Neoproterozoic and Late-Neoproterozoic age for the Bhandar Limestone and Lakheri Limestone, respectively (Ray et al 2003)
- 4 Absence of well established record of global events such as Cryogenian Sturtian and Marinoan (Vendian) glaciations, and development of phosphorite at Precambrian-Cambrian boundary from the Vindhyan Supergroup, also do not support latest Cryogenian-Ediacaran (late Vendian) age (ca 650 – 544 Ma) as suggested by the author These global events are well known from other parts on Indian subcontinent and are globally correlatable (Knoll et al 2006)

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The author appreciates the interest shown by PK Maithy and Gopendra Kumar on the above paper The author has already given ample justification on various points in the paper which have been raised by them However, explanations to their observations are given below

- 1 Commentators' observation on *Obruchevella*, discussed by the author in the paper, appears to be the misinterpretation of author's statement The author has stated "Vendian marker species" of *Obruchevella*, and not referred to the *Obruchevella* genus as a whole an index fossil The author is well-aware that the occurrence of *Obruchevella* is known from Lower Mesoproterozoic (ca 1550Ma) to Cambrian-Ordovician, with one exceptional doubtful record from

the Devonian (Chuvashov, 1985) But majority of the *Obruchevella* species show their appearance and disappearance at various stages during Upper Neoproterozoic to Terminal Proterozoic-Cambrian times, and these events have very important biostratigraphic significance Similarly, the species of *Obruchevella*, such as *O parva*, *O delicata* and *O parvissima*, which are recorded from the Bhandar sediments by the author (BP), globally appear during Lower Vendian (now Ediacaran, ca 630 Ma) and disappear close to the Pre-Cambrian-Cambrian boundary or in Lower Cambrian (for details, Mankiewicz, 1992, Song, 1984) Moreover, Knoll (1996) stated that the abundance (acme) of *Obruchevella* during Vendian-Lower Cambrian is the real phenomenon without adequate paleobiological explanation It may be the commentator's perception if they are not treating the above mentioned species of *Obruchevella*, recorded from the Bhandar Group, as stratigraphic potential (age-marker) species of *Obruchevella*

- 2 The author has also documented the associated acritarchs from the Bhandar Group with illustrations Amongst these, *Vandalosphaeridium reticulatum* (Pl 1, figs 11-13) are abundantly recorded from the Upper Visingsko Beds (Sweden) and homotaxial sediments from the Norwegian Platform (Vidal, 1981) with oldest records from the Upper Cryogenian (ca 700Ma) sediments (Knoll, 2000) In addition, the author has also recorded two species of *Germinosphaera*, viz *G unispinosa* and *G bispinosa* (Pl 1, figs 1,2,9,10), considered to be large acanthomorphs Nevertheless, the author has discussed in detail in the paper on various motives of the Ediacaran age for the recovered acritarch assemblages from the Bhandar Group In addition, upper parts of the Nagod Limestone and Sirbu Shale recorded *Lophosphaeridium truncatum* (Pl 2, fig 11), *Dictyotidium* spp (Pl 2, figs 3-6) and *Cristallinium* spp (Pl 2, figs 7, 8, 18) These forms appear close to Precambrian-Cambrian boundary and become abundant in Lower and Middle Cambrian It appears that the commentators have not taken the note of the above acritarch records which include the above stratigraphic potential forms, and they (PKM and GK) have drawn the superfluous conclusions that the Bhandar acritarch assemblage recorded by the author is devoid of acritarchs of Ediacaran times The author would like to add that one of the present commentators (PK Maithy) has already assigned Vendian (Lower Ediacaran in new classification

scheme) age for the Bhandar Group on the basis of records of acritarchs of similar age (Maithy and Babu, 1997)

Recently De (2006) recorded rich assemblages of soft-bodied metazoans (Ediacaran megafossils) from the same section of Bhandar Group (Satna-Maihar area) from where the present author recorded the Vendian species of *Obruchevella* and associated acritarchs. This latest finding of soft-bodied Ediacaran megafossils strongly corroborates with the age inferences drawn by the author.

The author is not competent to comment on the

Chuarina-Tawuia assemblage and stromatolitic evidences on the age of Bhandar Group

- The author agrees that there are no well established field evidences of Sturtian (ca 700Ma) or Varangerian (ca 630 Ma) glaciation in the Vindhyan Basin. But, the conglomeratic beds recognized at the base of Rewa Group in western parts of Vindhyan Basin appear to be related to Sturtian glaciation. However, its lateral prevalence is yet to be established. Extensive field observations are required for the search of evidences related to Varanger and associated glaciations in the Vindhyan Basin.

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