



CONTROVERSY CONCERNING 'CAMBRIAN' FOSSILS FROM THE VINDHYAN SEDIMENTS: A RE-ASSESSMENT

S. KUMAR

CENTRE OF ADVANCED STUDY IN GEOLOGY,
UNIVERSITY OF LUCKNOW, LUCKNOW, UTTAR PRADESH
Email: surendra100@hotmail.com

ABSTRACT

In 1998, Azmi created a controversy by announcing the discovery of small shelly fossils and brachiopods of the Cambrian age from the Rohtasgarh Limestone (Rohtas Formation) of the Semri Group (Lower Vindhyan). This discovery did not find much favour with most of the workers. In the mean time, Azmi and his group continued to support the Cambrian age for the Rohtas Formation by extending their work in other areas within the Vindhyan Basin (the Chitrakut area) as well as outside the Vindhyan Basin (the Gangolihat Dolomite) (Azmi *et al.*, 2007). Recently, his discovery became alive again with the publication of a paper by Bengtson *et al.* (2009), who studied the phosphatic stromatolites of the Tirohan Limestone (= the Rohtas Formation) of the Chitrakut area. Bengtson *et al.* (2009) discussed the identification of small shelly fossils reported by Azmi *et al.* (2007) from the Tirohan Limestone and rejected their claim of the Cambrian element in the microfossil assemblage. They also dated the phosphatic stromatolites of the Tirohan Limestone as Palaeoproterozoic. Though Bengtson and his group did not work on any material from the Rohtasgarh Limestone (Rohtas Formation) from where Azmi has originally described brachiopod and small shelly fossils, still Bengtson *et al.*'s (2009) work helped in resolving the age controversy created by Azmi's (1998) work. The Bengtson *et al.* (2009) support the traditional age given to the Vindhyan Supergroup. The Semri Group can be bracketed between Palaeoproterozoic and Mesoproterozoic and the Upper Vindhyan can be given the age between Mesoproterozoic and Ediacaran as there is no evidence of any Cambrian fossil within the Vindhyan Basin.

Keywords: Vindhyan Supergroup, Small Shelly Fossils, Semri Group, Tirohan Limestone, Rohtas Formation, Brachiopod

INTRODUCTION

Traditionally, the Vindhyan Supergroup has been considered Mesoproterozoic to Neoproterozoic on the basis of stromatolites, carbonaceous megafossils, microfossils and available radiometric dates. However, two announcements made by Seilacher *et al.* (1998) and Azmi (1998) challenged this well entrenched age connotation. Seilacher *et al.* (1998) discovered trace fossils purported to have been produced by triploblastic animals in the Chorhat Sandstone (= the Glauconitic Sandstone) of the Semri Group (Lower Vindhyan), and Azmi (1998) described small shelly fossils (SSFs) and small inarticulate brachiopods of Lower Cambrian age from the Rohtasgarh Limestone (Rohtas Formation) of the Lower Vindhyan (Semri Group) from two localities namely Maihar (M.P.) and Rohtasgarh (Bihar) (Fig. 1). Both the discoveries attracted global attention and debated extensively for their implication for the early evolution of life and for the age of the Vindhyan sediments. In the light of this, the Palaeontological Society of India, in collaboration with the Geological Survey of India and the Department of Geology, University of Lucknow, organized a seminar and a field workshop in 1999 to the Maihar area from where Azmi had collected his samples which have yielded SSFs. Azmi participated in the field workshop and identified the locality from where he had collected the SSF-yielding rock samples. Many participating members collected the so called fossil yielding samples under his supervision and reported their findings to Dr. O. N. Bhargava which were later published in the Journal of the Geological Society of India (see Notes – Vindhyan Fossil Controversy, Journal of the Geological Society of India, vol. 55: 675 – 680). The Editor, JGSI closed the discussion with the remark that the identification of fossils by R. J. Azmi is far from convincing. The lithology of the fossil yielding sample was a silicified

shale-though originally he described it as silicified limestone, and doubts were raised even in the field during the field workshop how fossils could be recovered from the silicified shales by maceration using 10% acetic acid. Concerning the discovery of brachiopod, the author had the chance to see the original samples in the Wadia Institute of Himalayan Geology, Dehradun in 1998. The morphologies which were referred to as brachiopods, were simply nonbiogenic features seen on the upper surface of a secondary fibrous calcite vein. I conveyed my opinion to Azmi about the abiotic nature of the so called brachiopods and the secondary nature of the calcite vein. In subsequent publication, Azmi (1999) withdrew the discovery of brachiopod. Bhatt *et al.* (1999) have also examined the fossils reported by Azmi (1998). They also collected the samples from the same sections as described by Azmi (1998), i.e. the Maihar (M.P.) and Rohtasgarh (Bihar) areas, and concluded that the field observations of Azmi are incorrect. They could not recover the fossils by maceration with normal conventional method. They also rejected the identification of brachiopod. Realising the global importance of Azmi's findings, the PSI organized another field workshop in December 2002 with international participation in which besides R.J. Azmi and other Indian scientists, H.J. Hofmann, B. Runneger, Linda Sohl, S.M. Porter and J. R. Lyons also participated. During the workshop Azmi showed his material on SSFs to the participating members. No body was impressed by his material. With new radiometric age data generated by a number of workers (Kumar *et al.*, 2001; Rassmussen *et al.*, 2002; Ray *et al.*, 2002; Sarangi *et al.*, 2004), it was thought that the controversy created by Azmi concerning the Cambrian age of the Rohtas Formation is more or less settled and his inferences about the Cambrian age of the Rohtas Formation can be discarded. However, Azmi with his group continued to pursue the same line of thinking (Azmi and Paul, 2004; Azmi *et al.*,

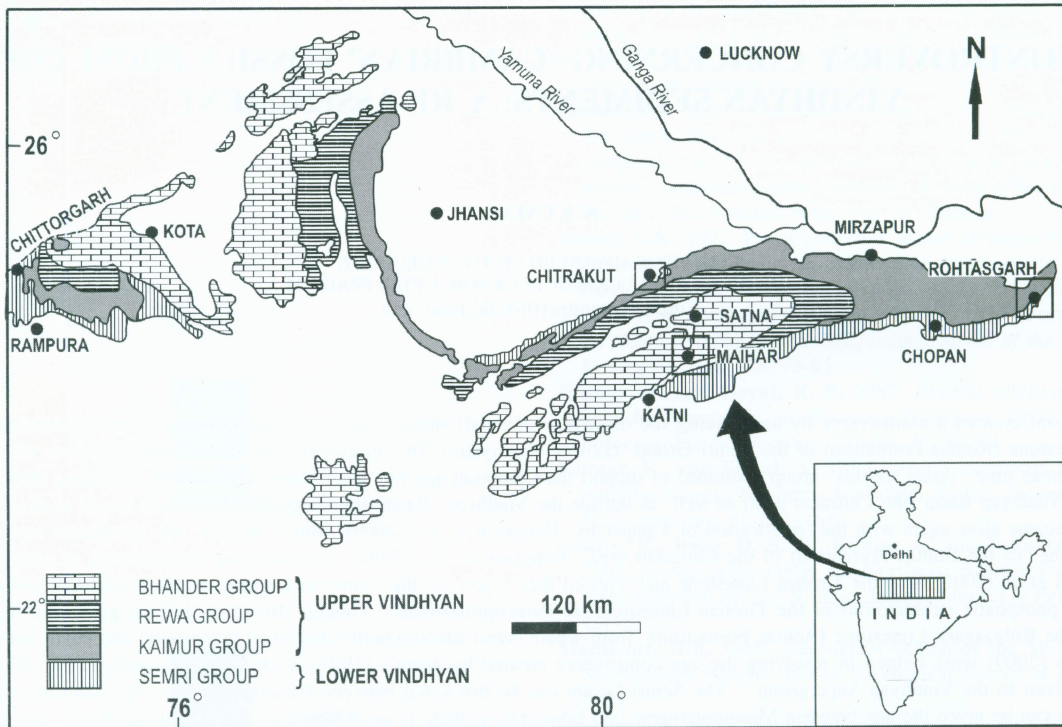


Fig. 1. Geological map of the Vindhyan Basin (After Krishnan and Swaminath, 1959). The boxes show the Maihar, Rohtasgarh and Chitrakut areas from where the material for the recovery of small shelly fossils was collected.

2007; Azmi *et al.*, 2008; Joshi *et al.*, 2006) and extended the area of investigation to other regions and stratigraphic horizons. One area was in the Lesser Himalaya (the Gangolihat Dolomite) (Azmi and Paul, 2004) and the other was Chitrakut area within the Vindhyan Basin (Azmi *et al.*, 2007). In the Chitrakut area, the Tirohan Limestone is exposed, which has been correlated with the Rohtas Formation. From the new localities, SSFs were also recovered and both the Gangolihat Dolomite and the Tirohan Limestone were assigned the Cambrian age.

If Azmi's age assignment is accepted, the following points need to be addressed:

1. If the Rohtas Formation is Cambrian, why the Cambrian trace fossils, body megafossils, archaeocyathids and other carbonate buildups are not present in it?. All the Cambrian sequences in India such as the Tal Formation, the Nagaur Sandstone, the Lolab Formation, the Kunzum-La Formation and the Garbyang Formation (Kumar and Pandey, 2009) show preservation of trace fossils. Why are they not present in the Rohtas Formation?
2. The rocks of the overlying Kaimur, Rewa and Bhandar Groups which attain a thickness of more than 3000 m do not show evidence of the presence of any Phanerozoic fossils including the trace fossils. These sediments are unmetamorphosed and more or less undeformed. The rocks show excellent preservation of sedimentary structures and there is every possibility that with many Upper Vindhyan successions representing tidal flat deposits (Singh, 1973, 1976) there is every possibility that biogenic sedimentary structures, if present, should have been preserved. Their absence simply suggests a Precambrian age to the Upper Vindhyan.
3. Why, in the Rewa and Bhandar Groups, the carbanaceous megafossil assemblage dominated by *Chuarina* and *Tawuia*, a characteristic of the Precambrian is present?
4. Abundance of columnar stromatolite *Baicalia* in the Bhandar Group favours a Neoproterozoic age to the Bhandar Group.
5. The microbial mat *Arumberia banksi* and body fossil *Beltanelliformis minuta* are present in the upper most part of the Bhandar Group (Kumar and Pandey, 2008) suggesting uppermost Neoproterozoic age. Barring Azmi's claim, no Cambrian fossil has so far been reported from the Vindhyan Supergroup.
6. The carbon isotope data also favours Neoproterozoic age to the Bhandar Group (see Kumar *et al.*, 2005).
7. On what basis can the radiometric age data from the Semri Group which favours the Palaeoproterozoic to Mesoproterozoic age, be rejected.

The above facts do not support Azmi and his associate's claim of Cambrian age for the Rohtas Formation. However, a recent publication by Bengtson *et al.* (2009) with a title "The controversial 'Cambrian' fossils of the Vindhyan are real but more than a billion years old" has once again brought Azmi's claim for discussion. Bengtson *et al.*'s (2009) paper has a confusing title which does not objectively evaluate Azmi's work but gives space for misinterpretation. It negates the earlier effort by a number of individual workers and agencies to find out the truth behind Azmi's claim. Bengtson *et al.*'s (2009) paper failed to address the main issue of the discovery of SSFs from the Rohtas Formation by Azmi (1998) for which the material was collected from the Maihar and Rohtasgarh areas. Bengtson *et al.*'s (2009) paper deals with the new material from a new locality (Chitrakut area) (see fig. 1), however, the title of the paper is misleading as it conveys the feeling that it is addressing the controversy created by Azmi's (1998) paper. Actually, the paper deals with the fossils recovered from the phosphatic stromatolites of the Tirohan Limestone. It is surprising that Bengtson did not collect the material of the

Rohtas Formation from the Maihar and Rohtasgarh areas to check the validity of Azmi's claim. Instead, he has chosen a new locality (Chitrakut area) and a new horizon (Tirohan Limestone). No body has cross checked Azmi's work on the Tirohan Limestone as it could not attract much attention. The main and original issue was the recovery of fossils from the samples belonging to the Rohtas Formation (Rohtasgarh Formation) and his interpretation of its age.

Bengtson *et al.*'s (2009) work has brought out two points about Azmi's work:

1. that his identification of fossils was wrong as no Cambrian element could be identified in the Tirohan Limestone which is considered homotaxial with the Rohtas Formation.
2. that Bengtson *et al.* (2009) have rejected Azmi's identification even at generic level and have also rejected his conclusion about the age of the Rohtas Formation. They also rejected Azmi and his coworkers claim of the discovery of metazoan embryo.
3. that the age of the Semri Group is Palaeoproterozoic to Mesoproterozoic on the basis of Pb-Pb radiometric dates of the phosphatic stromatolites and not Cambrian as claimed by Azmi and his group.

CONCLUSIONS

The age controversy created by Azmi (1998, 1999), Azmi *et al.* (2007, 2008) and his associates (Joshi *et al.*, 2006) should be taken as settled in favour of traditional age unless he and his associates publish unequivocal evidence for the age of the Rohtas Formation and explain meaningfully the absence of typical Phanerozoic fossils from the Upper Vindhyan. They must also give reasons why radiometric age data of the Rohtas Formation as well as that of the Tirohan Limestone should be rejected. As of now, the age of the Semri Group is accepted as Palaeoproterozoic to Mesoproterozoic and the upper age of the Vindhyan is Mesoproterozoic to Ediacaran as no Cambrian fossil has so far been reported from the Vindhyan sediments.

ACKNOWLEDGEMENTS

The author is thankful to Dr. M. P. Singh and Dr. Mukund Sharma for reviewing the manuscript.

REFERENCES

- Azmi, R.J. 1998. Discovery of Lower Cambrian small shelly fossils and brachiopods from the Lower Vindhyan of Son Valley, Central India. *Journal Geological Society of India*. **52**: 381 – 389.
- Azmi, R.J. 1999. Discussion. *Journal Geological Society of India*. **53**: 120 – 130.
- Azmi, R. J. and Paul, S. K. 2004. Discovery of Precambrian-Cambrian boundary protoconodonts from the Gangolihat Dolomite of Inner Kumaun Lesser Himalaya: Implication on age and correlation. *Current Science*. **86**(12): 1653 – 1660.
- Azmi, R. J., Joshi, D., Tiwari, B.N., Joshi, M.N., Mohan, K. and Srivastava, S.S. 2007. Age of the Vindhyan Supergroup of Central India: An exposition of biochronology vs radiochronology, p. 29-62. In: *Micropalaeontology: Application in Stratigraphy and Palaeoceanography* (Ed D.K. Sinha), Narosa Publishing House, New Delhi, India.
- Azmi, R. J., Joshi, D., Tiwari, B.N., Joshi, M.N. and Srivastava, S.S. 2008. A synoptic view on the current discordant geo- and biochronological ages of the Vindhyan Supergroup. *Himalayan Geology*. **29**(2): 177 – 191.
- Bengtson, S., Belivanova, V., Rasmussen, B. and Whitehouse, M. 2009. The controversial "Cambrian" fossils of the Vindhyan are real but more than a billion years old. *PNAS*. **106**: 7729-7734.
- Bhatt, D. K., Singh, G., Gupta, S., Soni, H. K., Moitra, A. K., Das,

- D. P. and De, D. 1999. Fossil report from Semri Group, Lower Vindhyan. *Journal Geological Society of India*, **53**(6): 717 – 723.
- Bhargava, O.N. and Srikantia, S. V. 2000. Vindhyan Fossil Controversy. *Journal Geological Society of India*, **55**: 675 – 680.
- Joshi, D., Azmi, R. J. and Srivastava, S.S. 2006. Earliest Cambrian Calcareous Skeletal Algae from Tirohan Dolomite, Chitrakoot, Central India: A new Age Constraint for the Lower Vindhyan. *Gondwana Geological Magazine*. **21**(2): 73 – 82.
- Krishnan, M. S. and Swaminath, J. 1959. The great Vindhyan Basin of northern India. *Journal Geological Society of India*, **1** : 10 -30.
- Kumar, A., Gopalan. K. and Rajagopalan, G. 2001. Age of the Lower Vindhyan sediments, Central India. *Current Science*, **81**(7): 806 – 807.
- Kumar, S. and Pandey, S.K. 2007. *Arumberia* and associated fossils from the Neoproterozoic Maihar Sandstone, Vindhyan Supergroup, Central India. *Journal of the Palaeontological Society of India*, **53**(1): 83 – 97.
- Kumar, S. and Pandey, S.K. 2009. Trace fossils from the Nagaur Sandstone, Marwar Supergroup, Dulmera area, Bikaner District, Rajasthan, India. *Journal of Asian Earth Sciences* (Under review).
- Kumar, S., Schidlowski, M. and Joachimski, M.M. 2005. Carbon isotope stratigraphy of the Palaeo-Neoproterozoic Vindhyan Supergroup, Central India: Implications for Basin evolution and intrabasinal correlation. *Journal of the Palaeontological Society of India*, **50**(1): 65 - 81.
- Rasmussen, B., Bose, P. K., Sarkar, S., Banerjee, S., Fletcher, I. R. and McNaughton, N. J. 2002. 1.6 Ga U-Pb zircon age for the Chorhat Sandstone, lower Vindhyan, India: Possible implications for early evolution of animals. *Geology*, **30**: 103 – 106.
- Ray, J. S., Martin, M. W., Veizer, J. and Bowring, S. A. 2002. U-Pb zircon dating and Sr isotope systematics of the Vindhyan Supergroup, India. *Geology*, **30**: 131 – 134.
- Sarang, S., Gopalan, K. and Kumar, S. 2004. Pb-Pb age of earliest megascopic, eukaryotic alga bearing Rohtas Formation, Vindhyan Supergroup, India: implications for Precambrian atmospheric oxygen evolution. *Precambrian Research*, **132**: 107 – 121.
- Seilacher, A., Bose, P. K. and Pfluger, F. 1998. Triploblastic animals more than 1 billion years ago: trace fossil evidence from India. *Science*, **282**: 80 – 83.
- Singh, I.B. 1973. Depositional environment of the Vindhyan sediments in Son Valley area, p. 146-152. In "Recent Researches in Geology" (A collection of papers in honour of the Sixty fifth birthday of Prof. A. G. Jhingran). Hindustan Publishing Corporation, Delhi.
- Singh, I.B. 1976. Depositional environment of the upper Vindhyan sediments in Son Valley in the Satna-Maihar area, Madhya Pradesh, and its bearing on the evolution of Vindhyan sedimentation basin. *Journal of the Palaeontological Society of India* **19**: 48 – 70.

Manuscript Accepted May 2009