

Trace Fossils and Microbial Mat- Induced Sedimentary Structures from the Girbhakar Sandstone of Marwar Supergroup, Bhopalgarh Area, Jodhpur, Rajasthan, India

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Abstract

Well-preserved trace fossils (*Thalassinoides isp.*, *Planolites isp.* and *Palaeophycus isp.*) and *Microbial mat-induced sedimentary structures* are reported from Girbhakar Sandstone of Marwar Supergroup, the upper sequence of Jodhpur Group. The trace fossils are preserved in fine grained sandstone and ferruginous sandstone, where as mat-induced sedimentary structures are, occur in patches on the top of fine grained sandstone bedding surface. The area under present investigation lies around Bhopalgarh, which is 70 km northeast of Jodhpur. All these ichnogenera shows marine and shallow marine to sub-tidal depositional environment. No age can be assigned on the basis of these trace fossils as they range from Cambrian to Recent but the presence of microbial mat-induced sedimentary structures are Ediacaran affinity and can be assigned Ediacaran age to Girbhakar Sandstone of Bhopalgarh area included in Girbhakar Sandstone Formation.

Keywords: Trace fossils; Microbial mat structures; Girbhakar sandstone; Marwar supergroup; Bhopalgarh; Jodhpur and Rajasthan.

Introduction and Geology of the Study Area

Marwar Supergroup is a Late Neoproterozoic to Early Cambrian lithostratigraphic unit occupies a large area in north western Rajasthan which was deposited in various shallow marine to non-marine environments [1]. It has been subdivided in three groups in stratigraphically ordered lower Jodhpur Group, middle Bilara Group and upper Nagaur Group, [2], where as Jodhpur and Nagaur Group's are argillo-arenaceous sequences and Bilara Group is basically a calcareous lithounit. The complete lithounit of Marwar Supergroup is 1000m thick that is unconformably overlies on Ca.779-681 Ma old Malani Igneous Suites [3,4] (Table 1). Biostratigraphy and palaeoecological conditions of Marwar Supergroup is still poorly known because body and trace fossils are very rare but recent studies shows that it yielded Microbial mat structures [5], Mega plant fossils, [6], Ediacaran medusoid associated with algal mats and trace fossils [7], *Thalassinoides* trace fossils Parihar [8], Trace fossils and microbial mat structures [8], five-armed body fossil [9]. The Early Cambrian trilobites trace fossils [10], provide more information about the stratigraphy of Marwar Supergroup. The lower sequence of Jodhpur Group named as Sonia Sandstone Formation are exposed in the quarries of Sursargar, Mandore, Kaliberi, Keru and Balesar areas whereas upper sequence of Jodhpur Group named as Girbhakar Sandstone Formation are exposed in Lohawat, Phalodi in northwest of Jodhpur and Mandalnath to Bhopalgarh areas in the northeast of Jodhpur (Figure 1). The area under present investigation lies around Bhopalgarh (N 26° 36'.063 : 073° 26'.413 E), which is 70 km northeast of Jodhpur and sandstones of the area represents the upper sequence of Jodhpur Group included in Girbhakar Sandstone Formation (Figure 2). The sandstone bodies of the area are divided into Eastern and Western Block. The sandstone with associated shale/ mudstone of both the blocks is divided into five coeval lithostratigraphic units. There is mainly very coarse grained to coarse grained pebbly sandstone and medium grained sandstone consisting of trough cross bedding, planar cross bedding in both eastern and western block. The lithologies of eastern block are fine grained sandstone, siltstone, shale, mudstone and chert, whereas fine grained sandstone, siltstone, shale and flute marks are characteristics of western block [11].

Palaeontology

Trace fossils and Microbial mat structures: Three trace fossil species and Microbial mat-induced sedimentary structures have been reported from ferruginous sandstone, fine and medium grained sandstone of western block of Girbhakar Sandstone at Sujannath temple hill section in the Bhopalgarh area (Plate 1A). They are identified as *Thalassinoides isp.* (*Both Thalassinoides suevicus isp.* and *Thalassinoides paradoxica isp.*), *Palaeophycus isp.* *Planolites isp.* and

Marwar Supergroup (Late Neoproterozoic to Early Cambrian)	Nagaur Group (75-500m)	Tunklian Sandstone Nagaur Sandstone		
	Hanseran Group (upto 60m)	Clay stone, silt stone, dolostone, anhydrite, halite		
	Bilara Group (100-300m)	Pondlo dolomite Gotan limestone Dhanapa dolomite		
	Jodhpur Group (125-340m)	Girbhakar Sandstone / Formation	Buff, brownish, purplish to reddish white, spotted, gritty, pebbly, massive to thickly bedded sandstone and siltstone sequence.	
		Sonia Sandstone/ Formation Pokran Boulder Bed		
	-----Unconformity-----			
Basement	Malani Rhyolites and Granites			

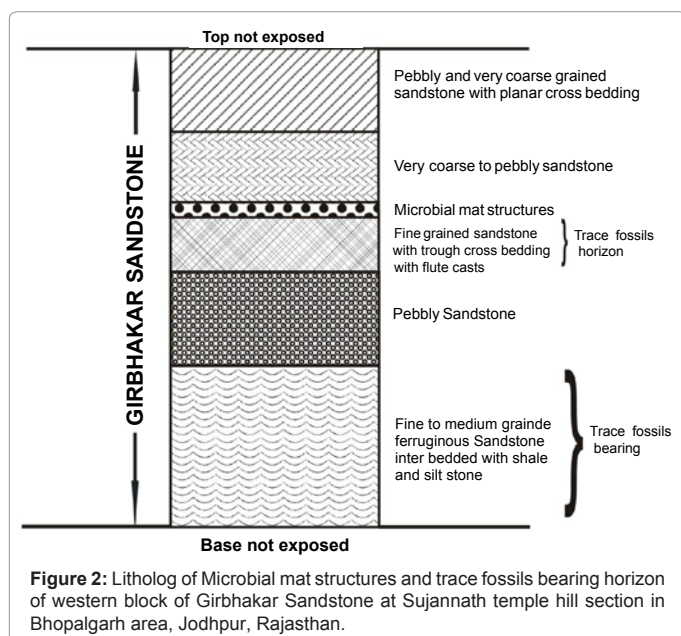
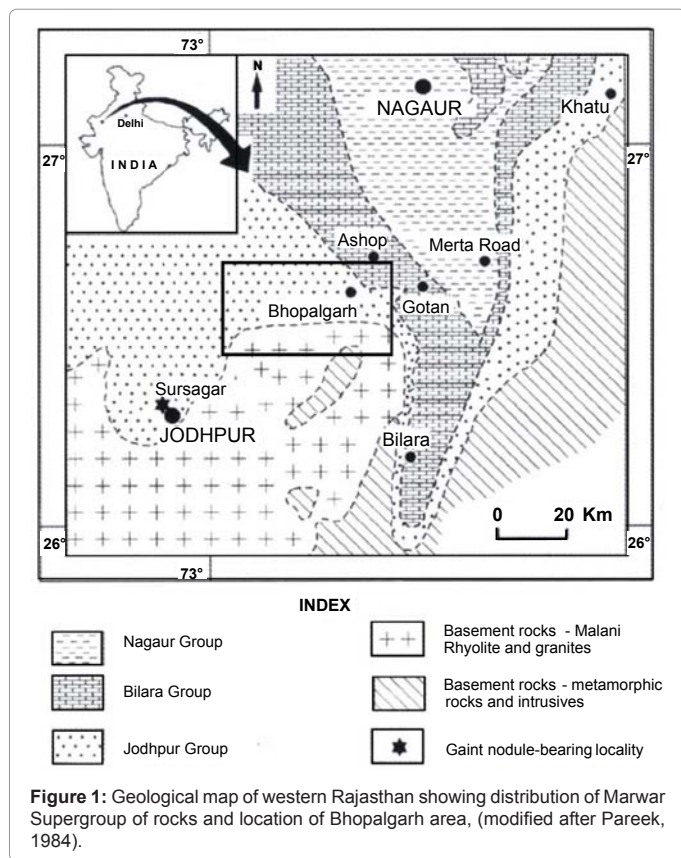
Table 1: Stratigraphic succession of the Marwar Supergroup, Rajasthan (modified after Pareek, 1984).

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Microbial mat -induced surface ridge (*misr* - a type of microbial mat induced sedimentary structure).

Systematic palaeontology

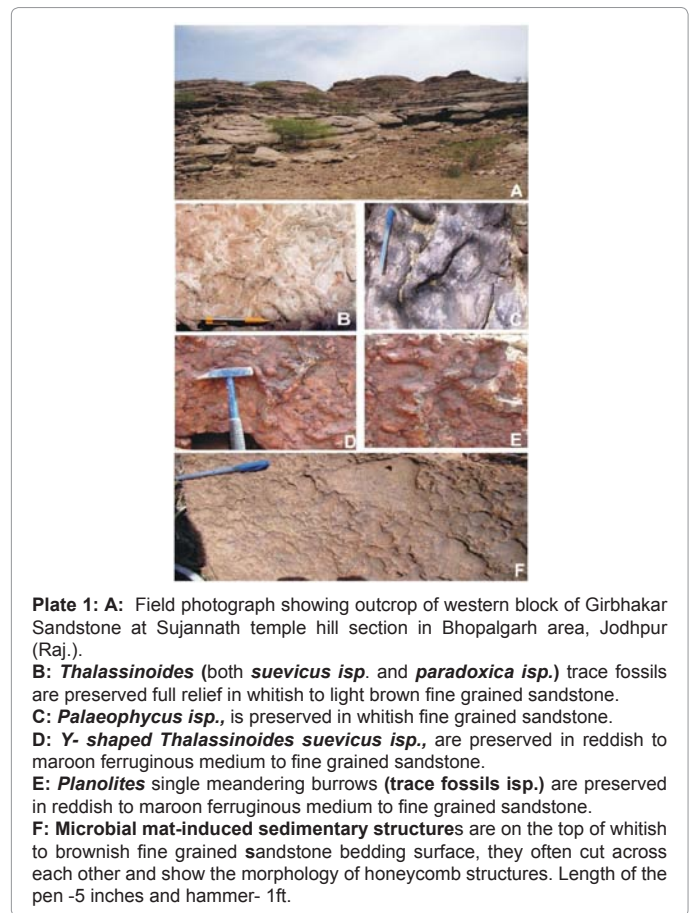
Thalassinoides *isp.* (Ehrenberg, 1944): In this area both species Y-shaped (*Thalassinoides suevicus* *isp.*) and T-shaped (*Thalassinoides paradoxica* *isp.*) are found in whitish to brownish fine grained sandstone

and reddish brown to maroon medium to fine grained ferruginous sandstone (Plate 1B and 1D). It is feeding or dwelling process, smooth wall tubes and displaying a network of triple junction. These tubes were filled with siliciclastic sediments. These species are known to be produced by decapods crustaceans and it shows shallow marine depositional environment.

Palaeophycus *isp.*, (Hall, 1847): *Palaeophycus* *isp.* is a single burrow that can show branching, is oriented horizontal or oblique to bedding, and has a distinctive burrow lining. It is found in whitish to light brown fine grained sandstone (Plate 1C). The burrow tubes were filled with siliciclastic matrix. It has length about 6-7 inches (Plate 1C). *Palaeophycus* is considered as a combined and dwelling burrow formed by worm like animals.

Planolites *isp.* (Nicholson, 1873): It is single meandering burrows oriented horizontal or oblique to bedding, straight to gently curve are found in reddish brown to maroon medium to fine grained sandstone. The burrows were filled with sandy and silty matrix (Plate 1E). *Planolites* is interpreted as a feeding burrows made by worm like animals.

Microbial-mat structures: Here we report well-reserved linear, polygonal and spindle-shaped microbial mat-induced sedimentary structures from the whitish to brownish fine grained sandstone bedding surface in the Girbhakar sandstone at Sujannath temple hill section in Bhopalgarh area included in western block of Girbhakar Sandstone Formation. It is known as microbial mat -induced surface ridges (*misr* (a type of microbial mat induced sedimentary structure), except for the parallel ones, they often cut across each other and show the morphology of honeycomb structures (Plate 1F). These microbial



mats -induced surface ridges (misr) are occur in patches on the top of brownish fine graind sandstone bedding surface. It is suggested that the mat- induced sedimentary structures were formed when the sand devoid of mud content was made cohesive by the presence of microbial mats. Detailed work is in progress.

Conclusion

- (i). All these ichnogenera are well-preserved and shows marine and shallow marine to sub-tidal depositional environment [12,13].
- (ii). No age can be assigned on the basis of these trace fossils as they range from Cambrian to Recent [14,15], but the presence of Microbial mat -induced sedimentary structures (Ediacaran affinity) and stratigraphic status (it's overlies on Ediacaran Sonia Sandstone of Jodhpur Group) can be assigned Ediacaran age to Girbhakar Sandstone of the Bhopalgarh area.

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