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New Record of Ediacaran Biota from the Jodhpur Sandstone of Marwar Supergroup, western Rajasthan, India

Nuevo registro de la biota ediacárica en la Arenisca de Jodhpur (Supergrupo de Marwar), Rajasthan occidental, India

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ABSTRACT

In western Rajasthan, India, the Jodhpur Sandstone of the Marwar Supergroup has yielded a new Ediacaran fossil assemblage comprising macroscopic well-preserved specimens of *Aspidella*, *Hiemalora*, large Ediacaran discs, *Tirasiana disciformis, Medusinites asteroides, Anfesta*-like Ediacaran body fossils and microbial mat structures (*Arumberia banksi*, *Kinneyia* mat structures, wrinkle mat structures and other mat structures). The fossil record allows suggesting a broad correlation with the Fermuse Formation, Newfoundland, South Australia, White Sea of Russia and Norway, and regionally correlated with the Bhander Group of Vindhyan Supergroup and Krol Group of Lesser Himalaya

Keywords: Jodhpur Sandstone; Soft-bodied metazoans; Mat structures; Ediacaran.

RESUMEN

En el oeste de Rajasthan, India, la Arenisca de Jodhpur (Supergrupo de Marwar) ha librado un nuevo conjunto fósil ediacárico que comprende especímenes macroscópicos bien conservados de *Aspidella*, *Hiemalora*, grandes discos ediacáricos, *Tirasiana disciformis*, asteroides de *Medusinites*, fósiles de cuerpo blando ediacáricos similares a *Anfesta* y estructuras de tapices microbianas (*Arumberia banksi*, estructuras microbianas de tipo *Kinneyia*, estructuras microbianas arrugadas y otras estructuras microbianas). El registro fósil permite sugerir una amplia correlación con la Formación de Fermuse, Terranova, Australia meridional, el Mar Blanco de Rusia y Noruega, y la correlación regional con el Grupo de Bhander (Supergroup de Vindhyan) y el Grupo de Krol del Himalaya Interior.

Palabras clave: Arenisca de Jodhpur; Metazoos de cuerpo blando; Estructuras microbianas; Ediacárico.

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Introduction

The Marwar Supergroup (MSG), earlier known as Trans-Aravalli Vindhyans, occupies an area of about 51,000 km^2 in northwestern Rajasthan (Pareek, 1981). It consists of about 1000 m of undisturbed and unmetamorphosed sedimentary successions represented by sandstone, conglomerate, siltstone, dolostone, limestones and claystone indicative of various marine, shallow marine to sub-tidal and non-marine environments (Pareek, 1984; Pandey & Bahadur, 2009). The sediments of the Marwar Supergroup (MSG) uncomformably overlies the uneven and ragged basement of rocks of the Malani Igneous suite (Pareek, 1984), which have been dated at 771± 5 Ma by U-Pb methods (Gregory *et al*., 2009) and overlain by Permo-Carboniferous Bap Boulders beds (Pareek, 1984).

Results

The Marwar Supergroup is divided into three groups, in ascending order, the Jodhpu, Bilara and Nagaur groups. The Jodhpur and Nagaur groups are argillaceous-arenaceous while the Bilara Group is calcareous in nature. Evaporitic deposits are included in the Hanseran Group, which is found only in sub-surface (Kumar & Chandra, 2005). The Jodhpur Group has been further subdivided into the Pokaran Boulder bed, the Sonia Sandstone and theGirbhakar Sandstone. Both the Sonia Sandstone and the Girbhakar Sandstone were unified into the Jodhpur Sandstone by Chauhan *et al*. (2004). In the last few years, the Jodhpur Sandstone of the Marwar Supergroup is globally known for the best repositories of Ediacaran biota (Raghav *et al*., 2005; Sarkar *et al*., 2008; Kumar & Pandey, 2009; Parihar *et al*., 2012; Srivastava, 2012c). This study documents here the discovery of macroscopic well-preserved specimens of *Aspidella*, *Hiemalora*, large Ediacaran discs (diameter from 22 to 84 cm), *Tirasiana disciformis, Medusinites asteroides, Anfesta*-like Ediacaran body fossils and microbial mat structures (*Arumberia banksi*, *Kinneyia* mat structures, wrinkle mat structures and other mat structures) from the Jodhpur Sandstone of Marwar Supergroup in Sursagar and Bhopalgarh area, Jodhpur, western Rajasthan (Figs. 1–2). There, the *Tirasiana disciformis, Medusinites asteroides* and *Anfesta*-like Ediacaran body fossils are reported here for the first time. In Sursagar area, the Jodhpur Sandstone is known as Sonia Sandstone and the lithology is represented by about 16–18 m thick yellowish brown, purple and pinkish brown medium- to fine-grained sandstone, siltstone and brown shale and few conglomeratic beds having laminations, ripple-marks, cross-bedding, graded bedding and rain-prints sedimentary structures (Chauhan *et al*., 2001). In Bhopalgah area, the Jodhpur Sandstone is known as Girbhakar Sandstone and the lithology is represented by about 100 m thick sandstones, divided into eastern and western blocks, comprising sandstone, siltstone, claystone, and chert with ripple marks, flute casts, trough and planar cross beddings sedimentary structures (Ram & Chauhan, 2007).

Aspidella sp. (Billings, 1872) is a flat, circular to subcircular or oval shaped disc with very sharp inner circular body, and occurs on yellowish brown to pinkish brown medium- to fine-grained sandstone bedding surfaces, with positive relief in Sursagar area; it is considered as a buried holdfast of frond-like organisms (Fig. 1A-C) (Gehling *et al*., 2000). *Hiemalora* sp. (Fedonkin, 1980) is a circular to sub-circular, flat disc surrounded by numerous faint radiating arms resembling either tentacles or rootlets comparable to those of sea-anemones or jelly fishes (Fedonkin, 1980); it is recorded from the yellowish brown to pinkish brown medium- to fine-grained sandstone in the Sursagar area (Fig. 1D-E). *Tirasiana disciformis* (Palij, 1976) is circular or sub-circular to elongated or oval-shaped, having three concentric rings surrounding a prominent round central tubercle preserved in yellowish brown to pinkish brown medium- to fine-grained sandstone bedding surfaces with positive relief in Sursagar area; no radial structures or grooves are seen in our specimens; the diameters of the complete discs are 10 cm (Fig. 1F) to 15 cm (Fig. 1G) and their central tubercle is about 1.5 cm in diameter. *Medusinites asteroides* (Sprigg, 1949) is a circular to sub-circular, bipartite disc-shaped impression found in yellowish brown to pinkish brown medium- to fine-grained sandstone bedding surfaces in Susagar area; the outer raised disc is separated from the inner disc by a deep surrounding depression and inner disc relatively smaller; no radial structures or any ornament are

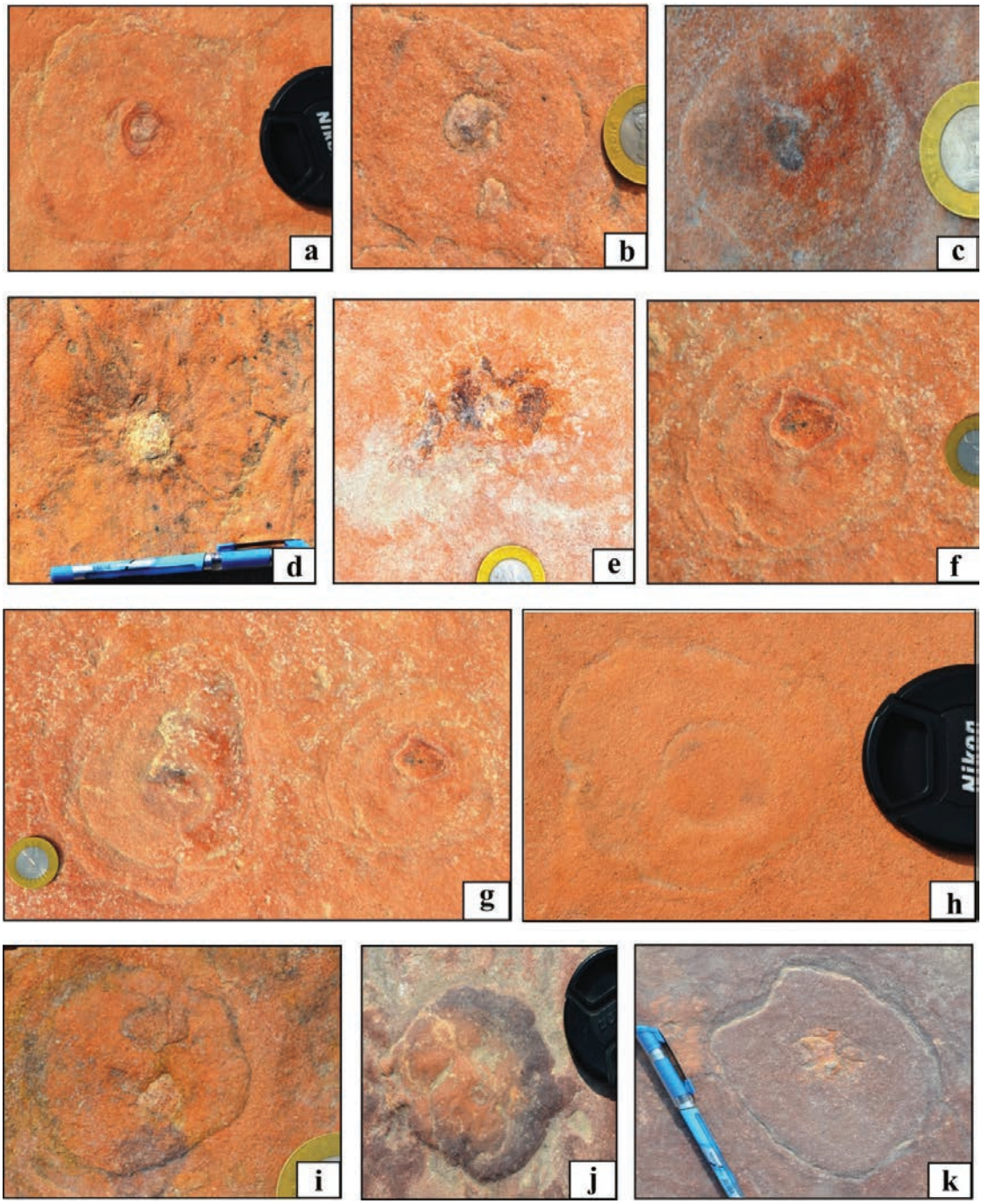

Figure 1.—A-C. Field photographs of *Aspidella* discs, preserved in yellowish brown to pinkish brown medium to fine grained sandstone in Sursagar area showing flat, circular to sub-circular or oval-shaped discoidal morphology with very sharp inner circular body. D-E. Field photographs of *Hiemalora* discs surrounded by numerous radiating lines/arms resembling either tentacles or rootlets founded in yellowish brown to pinkish brown medium to fine grained sandstone in Sursagar area, F-G. *Tirasiana disciformis* preserved in discoidal forms in yellowish brown to pinkish brown medium to fine grained sandstone bedding surfaces with positive relief in Susagar area. H. *Medusinites asteroides* occurred in yellowish brown to pinkish brown medium to fine grained sandstone in Sursagar area showing bipartite circular impression. I-K. *Anfesta* like triradial -shaped Ediacaran body fossils are preserved in yellowish brown and purple medium to fine grained sandstone bedding surfaces with positive relief in Sursagar area; scale bars: length of hammer = 30cm, pen = 14cm, coin diameter - 2.5 cm and camera cap diameter - 6.5cm.

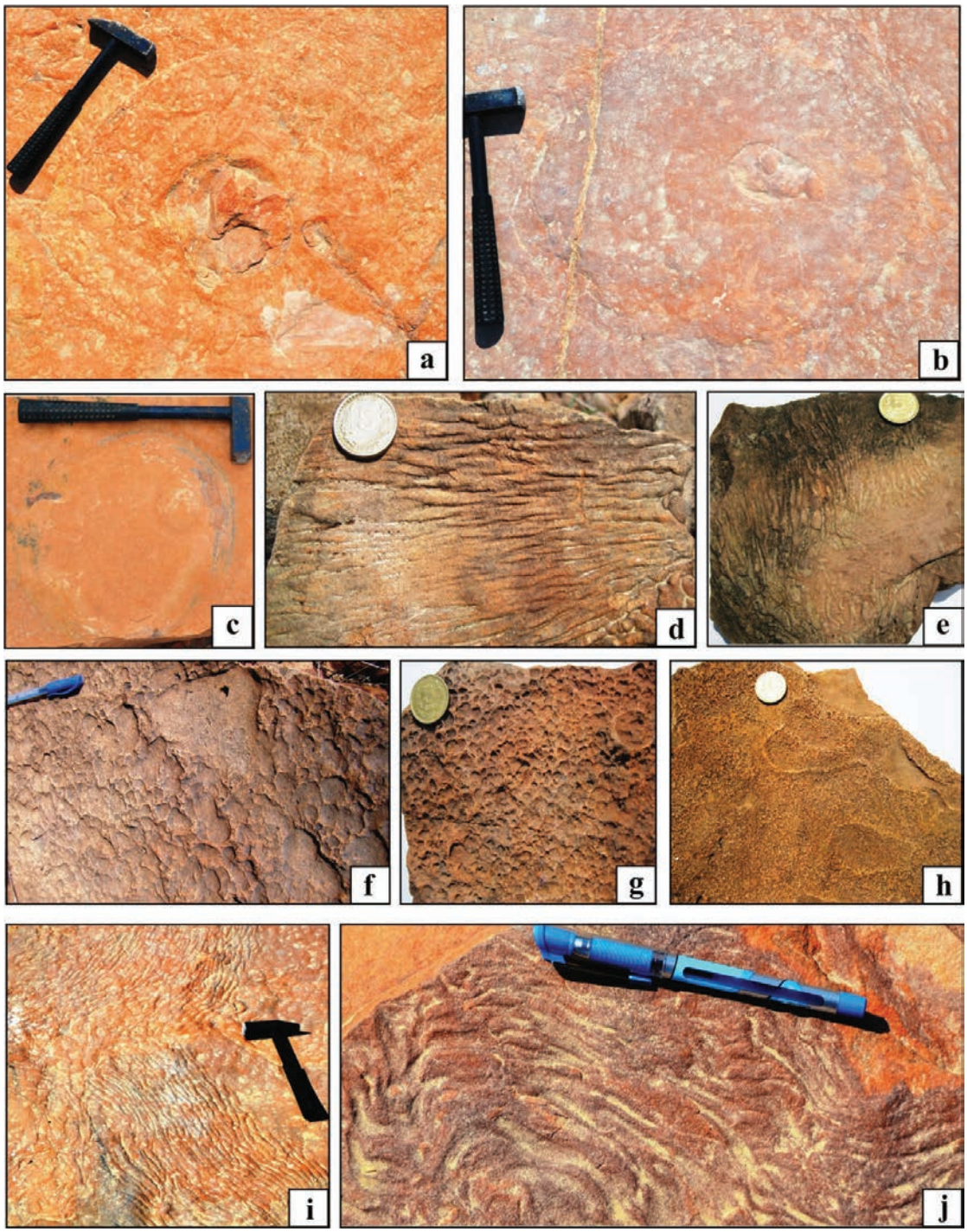

Figure 2.—A-C. Field photograph of circular to sub-circular or sheath like large Ediacaran discs (diameter-62cm; 84cm & 30cm) preserved in yellowish brown to pinkish brown medium to fine grained sandstone bedding surfaces of Jodhpur Sandstone in Sursagar area. D-E. *Arumberia banksi* mat structures occurs in top and sole of light brown to pinkish brown medium to fine grained sandstone bedding surfaces of Jodhpur Sandstone in Bhopalgarh area. F-G. *Kinneyia mat structures* showing honeycomb structures morphology, occurred in patches on the top and sole of brownish medium to fine grained sandstone bedding surfaces of Jodhpur Sandstone at Bhopalgarh area. H. Photograph showing Algal mat-structures, preserved as negative relief scour mark on mat laminated sandstone bedding surfaces of Jodhpur Sandstone in Bhopalgarh area. I-J. Field photographs of sinuous, curved to meandering and straight wrinkle mat structures occurred in yellowish to pinkish brown medium to fine grained sandstone bedding surface in Sursagar area, Jodhpur; scale: length of hammer = 30cm, pen =14 cm and coin diameter = 2.3 cm.

founded in our specimen; the total diameter of the *Medusinites* disc is 9–10 cm (Fig. 1H) and is considered to be a medusoid cnidarian (McCall, 2006). *Anfesta* like (Fedonkin, 1987) body fossils are triradial-shaped discs belonging to the Class Trilobozoa (trilobal medusa), and are preserved in yellowish brown and purple medium- to fine-grained sandstone of the Jodhpur Sandstone in Sursagar area; no radial structures or grooves are noted (Fig. 1I-K); the diameter of theses triradial-shaped discs ranges from 8 to 12 cm, and the remains considered as radial cnidarians (Fedonkin, 1987, 1992). The Ediacaran discs (Fig. 2a-c) are large (diameters range from 22 to 84 cm), circular to sub-circular or sheath-like structures preserved as discoidal forms on the top of yellowish brown to pinkish brown medium- to fine-grained sandstone bedding surfaces in Sursagar area, as three dimensional body fossils with morphological comparable to largest Vendian medusoid sedentary forms (Wade, 1972; Fedonkin, 1987; Hagadorn *et al*., 2000; McCall, 2006). *Arumberia banksi* (Glaessner & Walter, 1975) (Fig. 2D-E), *Kinneyia* mat structures (Walcott, 1916) (Fig. 2F-G) and algal mat structures (Fig. 2H) occur on top and sole of light brown to pinkish brown, brownish medium- to fine-grained sandstone bedding surfaces of the Jodhpur Sandstone in the Bhopalgarh area, whereas the various types of well-preserved sinuous, curved to meandering and straight marks known as "wrinkle mat structures" (Fig. 2I-J) are preserved on yellowish brown to pinkish brown medium- to fine-grained sandstone bedding surface of the Jodhpur Sandstone in Sursagar area. These mat structures were created through the interplay of Cyanobacteria or other microbial mat-forming groups of bacteria and physical sedimentary processes (Gehling, 1999; Noffke *et al*., 2001; Noffke, 2010).

Conclusions

This study suggests that the aforementioned Ediacaran fossil assemblages consist mainly of benthic organisms and indicated shallow-marine environments under moderate energy conditions for the Jodhpur Sandstone of the Marwar Supergroup. Based on the above mentioned Ediacaran fossil assemblages, the Jodhpur Sandstone of the Marwar Supergroup is broadly correlated with the Fermuse Formation, Newfoundland, South Australia, White Sea of Russia and Norway, and regionally correlated with the Bhander Group of Vindhyan Supergroup and Krol Group of Lesser Himalaya.

References

Billings, E. (1872). On some fossils from the Primordial rocks of Newfoundland. Canadian Naturalist, 6: 465–479. https://doi.org/10.5962/bhl.title.38279

Chauhan, D.S.; Mathur, K.M. & Narayan Ram (2001). Geological nature of the Pokaran boulder Bed: Palaeoenvironment, Palaoclimatic and Stratigraphic Implication. Journal of the Geological Society of India, 58: 425–433.

Chauhan, D.S.; Bhanwara Ram & Narayan Ram (2004). Jodhpur Sandstone: A gift of Ancient Beaches of Western Rajasthan. Geological Society of India, 64: 265–276.

Fedonkin, M.A. (1980). New Precambrian Coelenterata in the north of the Russian platform. Paleontological Journal, 14: 1–10.

Fedonkin, M.A. (1987). The non-skeletal fauna of the Vendian and its place in the evolution of the Metazoa. Trudy Paleontologiceskogo Instituta Akademia Nauk SSSR, 226: 1–174.

Fedonkin, M.A. (1992). Vendian faunas and the early evolution of the Metazoa. In: Origin and Early Evolution of the Metazoa (Lipps, J.H. & Signor, P.W., Eds.). Plenum, New York, 87–129. https://doi.org/10.1007/978-1-4899-2427-8_4

Gehling, J.G. (1999). Microbial mats in Terminal Proterozoic siliciclastic Ediacaran death masks. Palaios, 14: 40–57. https://doi.org/10.2307/3515360

Gehling, J.G.; Narbonne, G.M. & Anderson, M.M. (2000). The first named Ediacaran body fossil, Aspidella terranovica. Palaeontology, 43: 427–456. https://doi.org/10.1111/j.0031-0239.2000.00134.x

Glaessner & Walter, M.R. (1975). New Precambrian fossils from the Arumbera Sandstone, Northern Territory, Australia. Alcheringa, 1: 56–69. https://doi.org/10.1080/03115517508619480

Gregory, L.C.; Meert, J.G.; Bingen, B.H. Pandit, M.K. & Torsvik, T.H. (2009). Paleomagnetic and geochronologic study of Malani Igneous suite, NW India: implications for the configuration of Rodinia and the assembly of Gondwana. Precambrian Research, 170: 13–26. https://doi.org/10.1016/j.precamres.2008.11.004

Hagadorn, J.W.; Fedo, C.M. & Waggoner, B.M. (2000). Early Cambrian Ediacaran-type fossils from California. Journal of Paleontology, 74: 731–740. https://doi.org/10.1666/0022-3360(2000)074<0731:ECETFF>2.0.CO;2

Kumar, V. & Chandra, R. (2005). Geology and evolution of Nagaur - Ganganagar Basin with special reference

to salt and potash mineralization. Geological Survey of India Special Publication, 62: 1–151.

Kumar, S. & Pandey, S.K. (2009). Note on the occurrence of Arumberia and associated fossils from the Jodhpur Sandstone, Marwar Supergroup, Western Rajasthan. Journal Palaeontological Society of India, 54: 171–178.

McCall, G.J.H. (2006). The Vendian (Ediacaran) in the geological record: Enigmas in geology's prelude to the Cambrian explosion. Earth-Science Reviews, 77: 1–229. https://doi.org/10.1016/j.earscirev.2005.08.004

Narayan Ram & Chauhan, D.S. (2007). The Jodhpur sandstone of Bhopalgarh area: Its geological nature and environment of deposition. Emerging trends of research in Geology, NW India (Avadich, P.C. & Bhu, H., Eds.). MLSU, Udaipur (Rajastan), 89–103.

Noffke, N. (2010). Geobiology: Microbial Mats in Sandy Deposit from the Archean Era to Today. Springer Heidelberg.

Noffke, N.; Gerdes, G.; Klenke T. & Krumbein, W.E. (2001). Microbially induced sedimentary structures - a new category within the classification of primary sedimentary structures. Journal of Sedimentary Research, 71: 649–656. https://doi.org/10.1306/2DC4095D-0E47-11D7-8643000102C1865D

Palij, V.M. (1976). Palaeontologiya i Stratigrafiya Verkhnego Kembriya i Nizhnego Paleozoya Yugo-Zapada Vostochno-Evröpeiskoi Platformy. Kiev, Naukova dumka, 63–77.

Pandey, D.K. & Bahadur, T. (2009). A Review of the Stratigraphy of Marwar Supergroup of west- central Rajasthan. Journal Geological Society of India, 73: 747–758. https://doi.org/10.1007/s12594-009-0060-6

Pareek, H.S. (1981). Configuration and sedimentary stratigraphy of western Rajasthan. Journal of the Geological Society of India, 22: 517–523.

Pareek, H.S. (1984). Pre-Quarternary geology and mineral resources of north- western Rajasthan. Memoirs of the Geological Survey of India, 115: 1–99.

Parihar, V.S.; Gaur, V. & Nama, S.L. (2012). Trace fossils and microbial-mat Induced sedimentary structures from the Girbhaker sandstone of Marwar Supergroup, Bhopalgarh, Jodhpur, Rajasthan, India. Journal of Earth Science and Climate Change, S12: 002. https://doi.org/10.4172/2157-7617.S12-002.

Raghav, K.S.; De, C. & Jain, R.L. (2005). The first record of Vendian medusoids and trace fossil bearing algal mat ground from the basal part of the Marwar Supergroup of Rajasthan, India. Indian Minerals, 59: 23–30.

Sarkar, S.; Bose, P.K.; Samantha, P.; Sengupta, P. & Eriksson, P. (2008). Microbial mat mediated structures in the Ediacaran Sonia Sandstone, Rajasthan, India and their implications for Proterozoic sedimentation. Precambrian Research, 162: 248–263. https://doi.org/10.1016/j.precamres.2007.07.019

Sprigg, R.C. (1949). Early Cambrian "jellyfishes" at Ediacara, South Australia and Mount John, Kimberley District, Western Australia. Transactions of the Royal Society of South Australia, 73: 72–99.

Srivastava, P. (2012). Ediacaran discs from the Jodhpur Sandstone, Marwar Supergroup, India: a biological diversification or taphonomic interplay? International Journal of Geosciences, 3: 1120–1126. https://doi.org/10.4236/ijg.2012.35113

Wade, M. (1972). Hydrozoa and Scyphozoa and other medusoides from the Precambrian, Ediacara Fauna, South Australia. Palaeontology, 15: 197–225.

Walcott, C.D. (1916). Cambrian geology and paleontology III, No. 2 - Precambrian Algonkian algal flora. Smithsonian Miscellaneous Collections, 64: 77–156.