



FIRST RECORD OF *PTILOPHYLLUM* FROM THE BAISAKHI FORMATION (JURASSIC), JAISALMER DISTRICT, RAJASTHAN, INDIA

SOHAN N. SALUNKHE and KANTIMATI G. KULKARNI*

BIODIVERSITY & PALAEOBIOLOGY GROUP, AGHARKAR RESEARCH INSTITUTE, G. G. AGARKAR ROAD, PUNE 411004, INDIA.

* Corresponding author e-mail: kgkulkarni@aripune.org

ABSTRACT

The present study reports the first record of *Ptilophyllum* from the marine Jurassic succession of the Marwar Region which is from Ludharwa Member (middle Kimmeridgian), Baisakhi Formation, Jaisalmer Basin, Rajasthan. However, it is slightly older than that known from Kachchh. The middle Member of the Jhuran Formation, which incorporates the beds yielding *Ptilophyllum* flora, is of Portlandian-Tithonian age, while the Ludharwa Member from which the present foliages are being reported is of middle Kimmeridgian age. The presence of terrestrial flora in the unequivocally marine strata is suggestive of the proximity of land during the deposition of both the Jhuran Formation and the Baisakhi Formation. However, their occurrence does not necessarily indicate identical environments of deposition for the rocks of the Jhuran and Baisakhi formations.

Key words: *Ptilophyllum*, middle Kimmeridgian, Baisakhi Formation, Rajasthan.

INTRODUCTION

In Indian Peninsula, the marine Jurassic rocks occur in Kachchh Region of Gujarat and Marwar Region of Rajasthan. In the Marwar Region, they rest upon the Lathi Formation, and in turn, are overlain by the Pariwar Sandstone (Das Gupta, 1975; Pareek, 1984) (Table 1). One of the formations of the marine Jurassic rock sequence of this region is the Baisakhi Formation, which was deposited during Oxfordian to Kimmeridgian. It has been classified by Pandey *et al.* (2012) into three members viz., Rupsi, Ludharwa and Lanala in ascending order, consecutively corresponding to the units A, B and C of informal classification proposed by Laul (1992). The Baisakhi Formation is broadly correlated to the lower part of the Jhuran Formation of the marine Jurassic sequence of the Kachchh Region.

OBSERVATIONS

Recent fieldwork has revealed presence of two fossil foliages in the Ludharwa Member (middle Kimmeridgian) of the Baisakhi Formation. One of the foliages was collected from an exposure 4 km south of Lanala (GPS coordinates N27° 03' 19": E70° 49' 32.9"); while the other from a ridge, about 3 km south-east of Kathori (GPS coordinates N27°06' 11": E70°53' 57") (Fig. 1; 2a, b). Preservation of these specimens is not very satisfactory. However, that they belong to the cycadeoid (Benettitales) genus *Ptilophyllum* could be ascertained as the pinnae are lanceolate in shape and of more or less elongate nature. Style of attachment and curvature of the bases of the pinnae are as per emended generic definition given by Watson and Sincock (1992).

Table 1. Correlation of the Jurassic strata in the Jaisalmer and Kachchh basins.

JAISALMER BASIN				KACHCHH BASIN				
Fm	Mb	Age			Age	Fm ^a	Fm ^b	
Bhadasar	Mokal	E. Cretaceous?			E. Cretaceous	Umia	Jhuran	
	Kolar Dungar	Tithonian	Late	Late	Tithonian			
			Middle	Middle				
			Early	Early				
Baisakhi	Lanala	Kimmeridgian	Late	Late	Kimmeridgian	Katrol	Jhuran	
	Ludharwa		Middle	Middle				
			Early	Early				
Rupsi		Late	Late					
Jaisalmer	Jajiya	Oxfordian	Middle	Middle	Oxfordian	X	Jumara	
			Early	Early				
	Kuldhar	Callovian	Late	Late	Callovian			Chari
			Middle	Middle				
			Early	Early				
	Bada Bag	Bathonian	Late	Late	Bathonian			Patc-ham
Middle			Middle					
Early			Early					
Joyan	Bajocian			Bajocian	Jhurio			
Lathi	Thaiat	Lower Jurassic-Bajocian				Jhurio		
	Odania							

Modified after Pandey *et al.* 2012

Modified after a:Fürsich *et al.* 2013; b:Biswas 1977

Fm- Formation and Mb- Member.

An attempt for specific identification of these specimens revealed that the specimen obtained from near Kathori has acute, tapered apex (Fig. 3a); and is therefore closely comparable to

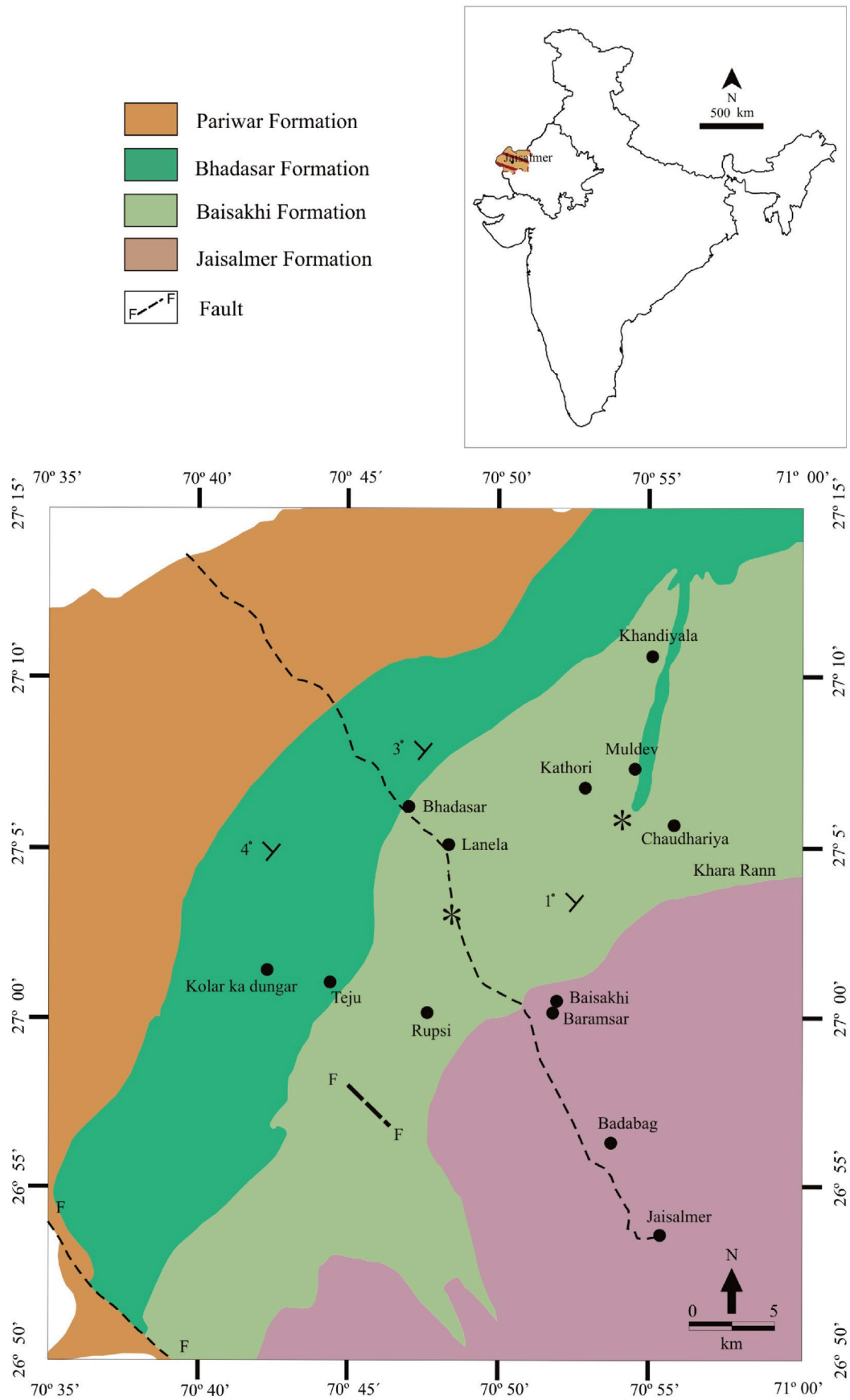


Fig. 1. Locality map. Fossil localities are shown by asterisk.

Table 2. Upper Gondwana flora from the Mesozoic rocks of Kachchh and Jaisalmer basins.

Taxa	Jaisalmer Basin			Cretaceous		Kachchh Basin				
	Early	Middle	Late	Early	Late	Early	Middle	Late	Early	Late
<i>Equisetum rajmahalensis</i> Oldham and Morris				✓						✓
<i>Equisetum sehoraensis</i> Singh <i>et al.</i>				✓						
<i>Equisetum</i> sp.				✓						✓
<i>Maeattiopsis macrocapa</i> (O and M) Seward and Sahni										✓
<i>Maeattiopsis reversa</i> Sharma										✓
<i>Rienitsia</i> sp.										✓
<i>Cladophlebis daradensis</i> Bose and Banerji				✓						
<i>Cladophlebis denticulate</i> (Brong.) Fontaine				✓						✓
<i>Cladophlebis indica</i> (O and M) Sahni and Rao				✓						✓
<i>Cladophlebis kakadbhitisensis</i> Mehra and Verma				✓						
<i>Cladophlebis kathiawarensis</i> Roy				✓						
<i>Cladophlebis sahnii</i> Vishnu-Mittre										✓
<i>Cladophlebis srivastavae</i> Gupta										✓
<i>Cladophlebis</i> sp. A and B										
<i>Cladophlebis</i> sp.				✓						✓
<i>Cacumen</i> sp.										✓
<i>Osmundopsis</i> sp.										✓
<i>Phyllopteroides laevis</i> Cantrill and Webb										✓
<i>Todites denticulatus</i> (Brong.) Krasser										✓
<i>Todites indicus</i> (O and M) Bose and Sah										✓
<i>Gleichenia bosahii</i> (O and M) Pant and Srivastava										✓
<i>Gleichenia dhokutense</i> Sharma										✓
<i>Gleichenia gleichenoides</i> (O and M) Seward and Sahni										✓
<i>Gleichenia nordenskioldii</i> Heer				✓						
<i>Gleichenia rewahensis</i> (Feist.) Pant and Srivastava				✓						✓
<i>Gleichenia sonajoense</i> Bohra and Sharma										✓
<i>Gleichenia</i> sp. A				✓						✓
<i>Dictyophyllum indicum</i> Bose and Jana										✓
<i>Dictyophyllum</i> sp.										✓
<i>Hausmannia crenata</i> (Nath.) Moller				✓						
<i>Hausmannia dichotoma</i> Dunker										✓
<i>Hausmannia pachyderma</i> Sukh Dev										✓
<i>Hausmannia</i> sp.				✓						✓
<i>Matonidium indicum</i> Sahni										✓
<i>Matonidium</i> sp.										✓
<i>Pleopteris minutifolius</i> Banerji										✓
<i>Pleopteris</i> sp.				✓						✓
<i>Weichselia reticulata</i> (Stokes and Webb) Ward										✓
<i>Klulia rajmahalensis</i> Sharma				✓						
<i>Kulkia</i> sp.				✓						
<i>Mohriopsis</i> sp.				✓						
<i>Schizaeangium jurassica</i> Bohra and Sharma				✓						
<i>Marsilea</i> sp.										✓
<i>Haydenia thyrsopteroides</i> Seward				✓						
<i>Protocyathea cyatheoides</i> (Unger) Feistmantel				✓						
<i>Protocyathea cretacea</i> (Stenzel) Ogura				✓						
<i>Protocyathea rajmahalense</i> Jacob				✓						
<i>Protocyathea tokunagae</i> (Unger) Jacob				✓						
<i>Protocyathea trichinopoliensis</i> Feistmantel				✓						
<i>Coniopteris hymenophylloides</i> Seward				✓						✓
<i>Coniopteris minturensis</i> Brick										✓
<i>Coniopteris tatungensis</i> (Sze) Shuying				✓						
<i>Coniopteris</i> sp.				✓						
<i>Culcitites madagascariensis</i> Appert				✓						
<i>Dicksonia rajmahalensis</i> Sharma				✓						
<i>Dicksonia speciosa</i> Sharma				✓						
<i>Eboracia lobifolia</i> (Phill.) Thomas				✓						
<i>Onychiopsis psilotoides</i> (Stocks and Webb) Ward										✓
<i>Onychiopsis</i> sp.				✓						

Taxa	Jaisalmer Basin					Kachchh Basin				
	Jurassic			Cretaceous		Jurassic			Cretaceous	
	Early	Middle	Late	Early	Late	Early	Middle	Late	Early	Late
<i>Tinpaharia sinuosa</i> Jacob				✓						
<i>Actinopteris peitata</i> Schenk									✓	
<i>Actinopteris</i> sp.									✓	
<i>Acrostichopteris</i> sp.									✓	
<i>Adiantopteris</i> sp.									✓	
<i>Murlipaharopteris indica</i> Banerji				✓						
<i>Asplenites</i> sp.				✓						
<i>Dennstaedia rajmahalensis</i> Sharma				✓						
<i>Dryopteris cladophleboides</i> Sharma				✓						
<i>Dryopteris indicus</i> Sharma				✓						
<i>Rhizopteris chukschu</i> Ganju				✓						
<i>Rhizopteris rajmahalense</i> Gupta				✓						
<i>Rhizopteris sahnii</i> Gupta				✓					✓	
<i>Rhizopteris</i> sp.									✓	
<i>Sphenopteris arguta</i> Lindley and Hutton				✓					✓	
<i>Sphenopteris bindrabunensis</i> Feistmantel				✓						
<i>Sphenopteris elaminata</i> Sharma				✓						
<i>Sphenopteris hislopii</i> Feistmantel				✓						
<i>Sphenopteris imbricata</i> Sharma				✓						
<i>Sphenopteris khairbaniensis</i> Ganju				✓						
<i>Sphenopteris membranosa</i> Feistmantel				✓						
<i>Sphenopteris metzgerioides</i> Harris				✓					✓	
<i>Sphenopteris naukhoffiana</i> (Heer) Halle				✓						
<i>Sphenopteris otagoensis</i> Arber				✓						
<i>Sphenopteris patagonica</i> Halle				✓						
<i>Sphenopteris rajmahalensis</i> Sahni and Rao				✓						
<i>Sphenopteris sakrighaliensis</i> Sah				✓						
<i>Sphenopteris tiruchirapalliense</i> Sukh Dev and Rajanikanth				✓						
<i>Sphenopteris</i> sp.				✓					✓	
<i>Sagenopteris</i> sp. cf. <i>colpodes</i> Harris									✓	
<i>Pachypteris indica</i> (O and M.) Bose and Roy				✓					✓	
<i>Pachypteris specifica</i> (Feist.) Bose and Banerji									✓	
<i>Pachypteris</i> cf. <i>elegans</i> Archangelsky									✓	
<i>Pachypteris</i> sp.									✓	
<i>Thinnfeldia amarjolensis</i> Sharma <i>et al.</i>				✓						
<i>Thinnfeldia indica</i> Feistmantel				✓						
<i>Thinnfeldia khatangiensis</i> Sen Gupta				✓						
<i>Thinnfeldia nirmali</i> Roy				✓						
<i>Thinnfeldia vemavaramensis</i> n.sp.				✓						
<i>Thinnfeldia</i> cf. <i>lancifolia</i> (Morr.) Walkom				✓						
<i>Trambaua apiculata</i> Bose and Banerji									✓	
<i>Nipaniophyllum raoi</i> Sahni				✓						
<i>Taeniopteris crassinervis</i> (Feist.) Walkom				✓						
<i>Taeniopteris kutchensis</i> Bose and Banerji									✓	
<i>Taeniopteris oldhamii</i> Bose and Banerji				✓						
<i>Taeniopteris sarbadhikarii</i> Sen Gupta				✓						
<i>Taeniopteris spatulata</i> McClelland				✓					✓	
<i>Taeniopteris vittatum</i> Brong.									✓	
<i>Taeniopteris</i> sp.				✓					✓	
<i>Ctenis rajmahalensis</i> Banerji				✓						
<i>Ctenozamites kachchhensis</i> Bose and Banerji									✓	
<i>Cycadites rajmahalensis</i> (Oldh.) Bose and Banerji				✓						
<i>Cycadospadix</i> sp.									✓	
<i>Macrozamiphyllum mucilagica</i> Sharma <i>et al.</i>				✓						
<i>Pseudoctenis fragalis</i> Bose and Banerji									✓	
<i>Anomozamites amarjolense</i> (Sharma <i>et al.</i>) Bose and Banerji				✓						
<i>Anomozamites crenata</i> (McClelland) Bose and Banerji				✓						
<i>Anomozamites fissus</i> (Feist.) Bose and Banerji				✓						
<i>Anomozamites</i> sp.				✓						
<i>Dictyozamites falcatus</i> (Morr.) Medli. and Blan. Bose and Bano				✓						
<i>Dictyozamites hallei</i> (Sahni and Rao) Bose and Bano				✓						
<i>Dictyozamites indicus</i> (Feist.) Bose and Bano				✓						

Taxa	Jaisalmer Basin					Kachchh Basin				
	Jurassic			Cretaceous		Jurassic			Cretaceous	
	Early	Middle	Late	Early	Late	Early	Middle	Late	Early	Late
<i>Araucarites cutchensis</i> Feistmantel				√						√
<i>Araucarites janaianus</i> Bose and Banerji										√
<i>Araucarites minutus</i> Bose and Maheshwari				√						√
<i>Araucarites mittrii</i> Bohra and Sharma				√						
<i>Araucarites nipaniensis</i> Singh				√						
<i>Araucarites</i> cf. <i>nipaniensis</i> Singh										√
<i>Araucarites</i> sp.				√						
<i>Elatocladus chawadensis</i> Bose and Banerji										√
<i>Elatocladus conferta</i> (O and M) Halle				√						√
<i>Elatocladus jabalpurensis</i> (Feist.) Sahni				√						√
<i>Elatocladus plana</i> (Feist.) Seward				√						√
<i>Elatocladus sahnii</i> Vishnu-Mittre				√						
<i>Elatocladus tenerrimus</i> (Feist.) Sahni				√						√
<i>Elatocladus</i> sp.				√						√
<i>Nipanioruha curvifolia</i> Vishnu-Mittre				√						
<i>Nipanioruha lanceolata</i> Vishnu-Mittre				√						
<i>Stachyotaxus</i> sp.										√
<i>Indophyllum nipanica</i> Vishnu-Mittre				√						
<i>Indophyllum raoi</i> Vishnu-Mittre				√						
<i>Indophyllum sahnii</i> Vishnu-Mittre				√						
<i>Sitholeya rajmahalensis</i> Vishnu-Mittre										√
<i>Taxites lanceolata</i> Ganju				√						
<i>Torreyites sitholeyi</i> Ganju				√						
<i>Harrisiohyllum</i> (<i>Desmiohyllum</i>) sp.				√						
<i>Conites sessilis</i> Sahni				√						
<i>Conites</i> sp.										√
<i>Lorumformophyllum dentatum</i> Bose and Banerji										√
<i>Muralipaharopteris indica</i> Banerji						√				
<i>Carpolithes</i> sp.						√				
<i>Pterophyllum</i> sp.		√								
<i>Equisetites</i> sp.		√								
<i>Sagenopteris</i> sp.			√							

* Reported here for the first time by authors; √ Flora compiled from Bose and Kasat, 1972; Bose *et al.*, 1990; Rajanikanth and Chinnappa, 2016.

Ptilophyllum acutifolium Morris (in Bose and Kasat, 1972) (Fig. 3b) occurring in Kachchh. The frond fragment is 1.38 cm wide, while pinnae are 0.8 cm long and 0.24 cm wide. These dimensions are well within the range of dimensions of *P. acutifolium*. Similarly, the specimen obtained from near Lanala (Fig. 3c) is comparable with *Ptilophyllum cutchense* Morris (in Bose and Kasat, 1972) (Fig. 3d), also from Kachchh, by having closely comparable dimensions and arrangement of pinnae. This frond fragment is 1.44 cm wide, while its pinnae are 0.68 to 0.90 cm long and 0.29 to 0.36 cm wide. Incidentally, both the species from Kachchh, with which Baisakhi specimens are compared, were procured from an unknown locality little south of the Charwar Range of Kachchh and were originally described by Morris (Bose and Kasat, 1972). However, the Baisakhi specimens are not complete and their venation is not seen. Hence their formal specific determination is deferred till better specimens are procured.

Plant fossils, which occur in marine Jurassic sequence in Peninsular India that can be unequivocally assigned to *Ptilophyllum* flora, were hitherto known only from certain layers of the Jhuran Formation, Kachchh. The layers which yielded that flora were termed Narha Plant Beds in earlier days (Fox, 1931; Pascoe, 1959). These layers are now included in the shales of the middle member of the Jhuran Formation (Biswas, 1977).

DISCUSSION

Although *Ptilophyllum* flora is well documented from the Kachchh as well as Jaisalmer basins (Table 2), the present find documents the first record of *Ptilophyllum* from the marine Jurassic succession of the Marwar Region. However, the Baisakhi *Ptilophyllum* is slightly older than that known from Kachchh. The middle member of the Jhuran Formation, which incorporates the beds yielding *Ptilophyllum* flora, is of Portlandian-Tithonian age, while the Ludharwa Member from which the present foliage specimens are being reported is middle Kimmeridgian in age.

Presence of marine ammonoids and gastropods occurring in the layers, not far from the spots where these foliage specimens were found, evince that the horizons which contain *Ptilophyllum* are a part of the strictly marine succession. Near Lanala such layers consist of reddish brown coloured, oolitic ironstone shales (Fig. 2a); while those near Kathori are buff to reddish brown coloured siltstone (Fig. 2b). The ammonoid genus *Torquatisphinctes* found to occur in these layers (Fig. 2) confirms the middle Kimmeridgian age, which is in total agreement with the age assigned to the Ludharwa Member by Prasad (2006) on the basis of ammonoid assemblage.

Though the overall lithostratigraphy and fossil biota of the marine Jurassic sequences of Kachchh and Marwar

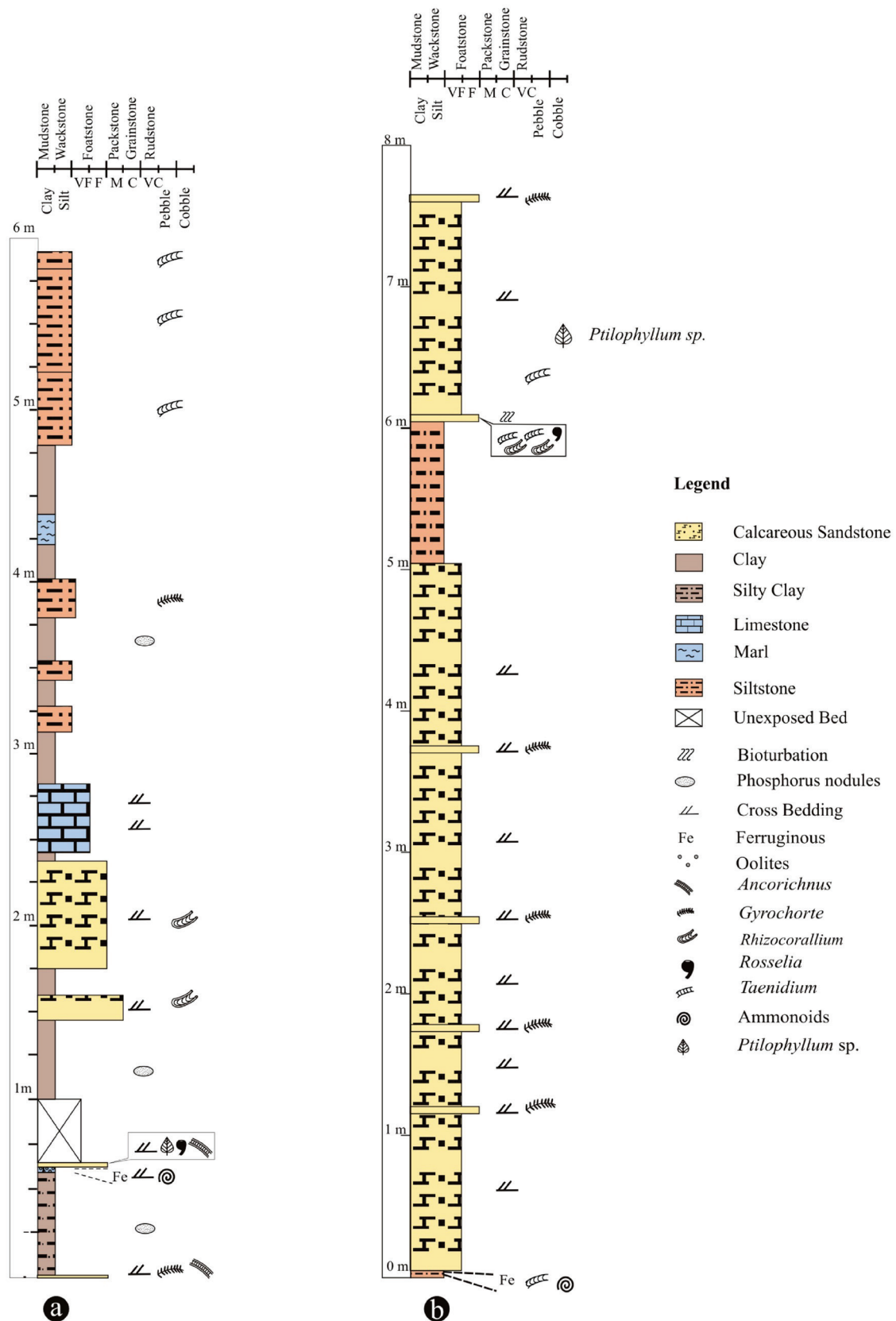


Fig. 2. Lithosections at the localities from where the fossil foliages were collected.
 a. Section exposed 4 km south of village Lanela.
 b. Section exposed 3 km southeast of Kathori.

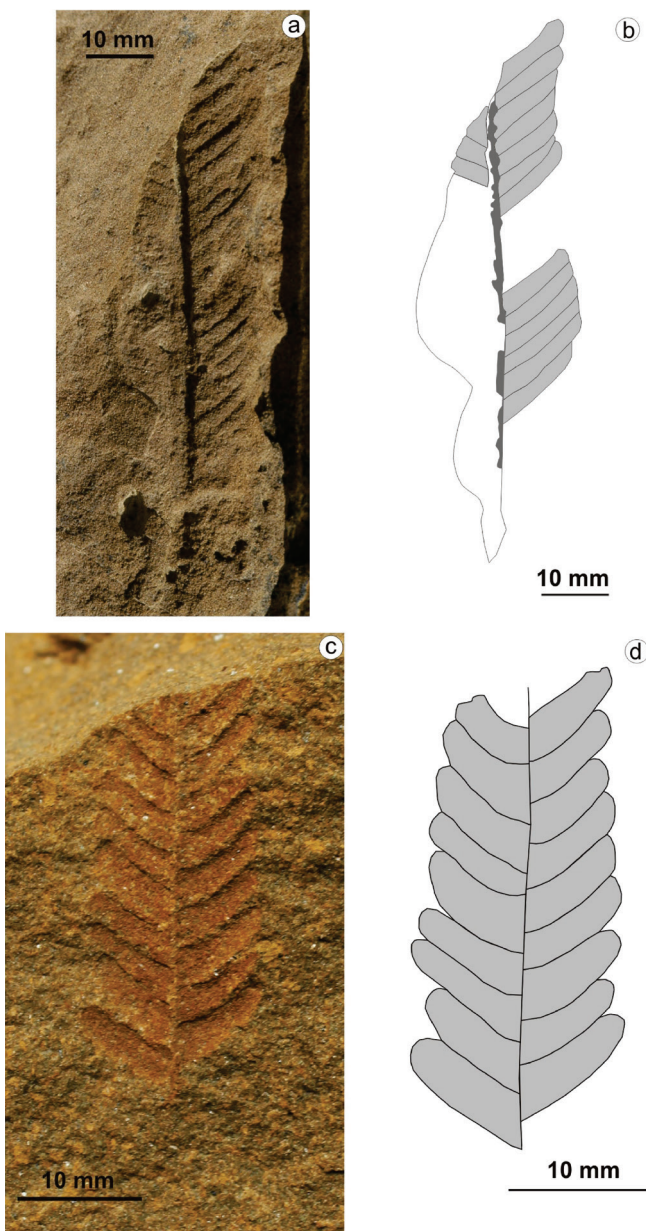


Fig. 3. *Ptilophyllum* sp. from the Baisakhi Formation Rajasthan.

a. *Ptilophyllum* sp. cf. *P. acutifolium* Morris, from near Kathori. ARI Repository Registration No. MACS G 5472. Bar scale is 10 mm.

b. Line drawing of MACS G 5472 (comparable to Plate 1, figs. 1-6, Bose and Kasat, 1972).

c. *Ptilophyllum* sp. cf. *P. cutchense* Morris, from near Lanela. ARI Repository Registration No. MACS G 5473. Bar scale is 10 mm.

d. Line drawing of MACS G 5473 (comparable to Plate 1, figs. 7-10, Bose and Kasat, 1972).

regions are believed to be extremely similar, there are certain nuances between the two. Those relevant to the present research communication are enunciated here vis-à-vis this discovery of *Ptilophyllum*.

1. The Jhuran Formation is 792 m thick (Biswas, 1977), and was deposited during Upper Oxfordian to Tithonian. This time span is represented in the Marwar Region by the Baisakhi and Bhadasar formations together. The Baisakhi Formation is 150 to 165 m thick (Narayanan *et al.*, 1961;

Pareek, 1980; Pandey and Dave, 1998); while the Bhadasar Formation is 79 (Laul, 1992) - 85 m thick (Pareek, 1984). Thickness of these two formations together is to the tune of just 229 to 250 m.

2. The Jhuran Formation consists predominantly of a thick sequence of alternating beds of sandstone and shale (Biswas, 1977). But in the Marwar Region the Bhadasar Formation comprises only sandstones. Moreover, there are sizeable siltstone and fine-grained sandstone units along with shales in the Baisakhi Formation (Das Gupta, 1975; Pareek, 1984).
3. Presence of terrestrial flora in the unequivocally marine strata is suggestive of proximity of land during the deposition of both, the Jhuran Formation and the Baisakhi Formation. However, their occurrence does not necessarily indicate identical environments of deposition. That the *Ptilophyllum* bearing strata associated with the Baisakhi Formation is somewhat older than that associated with the Jhuran Formation is already alluded to (*vide supra*). But variety and frequency of the plant foliages in the Baisakhi sediments is extremely low in comparison to those in the Jhuran sediments. Also the rocks yielding *Ptilophyllum* flora of the Jhuran Formation are dark grey to black, laminated gypseous shales containing coaly streaks and stringers. The site receiving *Ptilophyllum* bearing sediments was closer to land in the Kachchh Region than that in Marwar. It is, therefore, inferred that the *Ptilophyllum* bearing rocks within the Ludharwa Member were deposited in a marginal marine to partly terrestrial or fluvial conditions as interpreted by Alberti *et al.*, (2017) on the basis of sedimentary attributes and associated trace fossils; while the *Ptilophyllum* bearing rocks in Kachchh were deposited in a prodelta set up (Biswas, 1981).

ACKNOWLEDGEMENTS

We thank the Director, Agharkar Research Institute for providing all necessary facilities. We are grateful to Dr. Pawan Govil, BSIP for making available the reference of Watson and Sincock, 1992. Detailed discussions and critical comments by Dr. V. D. Borkar, PG Dept (Geology), Fergusson College, Pune, are gratefully acknowledged.

REFERENCES

- Alberti, M., Pandey, D. K., Sharma, J. K., Swami, N. K. and Uchman, A. 2017. Slumping in the Upper Jurassic Baisakhi Formation of the Jaisalmer Basin, western India: Sign of synsedimentary tectonics? *Journal of Palaeogeography*, (in Press).
- Biswas, S. K. 1977. Mesozoic Stratigraphy of Kutch, Gujarat. *The Quarterly Journal of the Geological, Mining and Metallurgical Society of India*, 49 (3, 4): 1-52.
- Biswas, S. K. 1981. Basin framework, palaeo-environment and depositional history of the Mesozoic sediments of Kutch basin, western India. *The Quarterly Journal of the Geological, Mining and Metallurgical Society of India*, 53 (1, 2): 56-85.
- Bose, M. N. and Kasat, M. L. 1972. The genus *Ptilophyllum* in India. *Palaeobotanist*, 19: 115-145.
- Bose, M. N., Taylor, E. L. and Taylor, T. N. 1990. Gondwana floras of India and Antarctica survey and reappraisal, p. 118-148. In: *Antarctic Palaeobiology: Its role in the Reconstruction of Gondwana* (Eds. Taylor, E. L. and Taylor T. N.), Springer-Verlag, New York.
- Das Gupta, S. K. 1975. A revision of the Mesozoic- Tertiary stratigraphy of the Jaisalmer Basin, Rajasthan. *Indian Journal of Earth Sciences*, 2 (1): 77-94.

- Fox, C. S.** 1931. The Gondwana System and Related Formations, *Memoirs of the Geological Survey of India*, **58**: 1-241.
- Fürsich, F. T., Alberti, M. and Pandey, D. K.** 2013. Stratigraphy and palaeoenvironments of the Jurassic rocks of Kachchh – Field Guide. *Beringeria*, Special Issue 7: 1-174.
- Laul, V. P.** 1992. A note on the lithostratigraphic classification of Bedesar Formation (Jurassic-Tithonian) in Chhatrel-Salkha area, Jaisalmer District, Rajasthan. *Records of the Geological Survey of India*, **115** (7, 8): 59-62.
- Laul, V. P. and Kumar, V.** 1994. A note on the Kaladungar phosphorite occurrence, Jaisalmer district, Rajasthan, *Current Science*, **66** (3): 224-225.
- Narayanan, K., Subrahmanyam, M. and Srinivasan, S.** 1961. Geology of Jaisalmer. *Unpublished report O.N.G.C. Dehradun, India*.
- Pandey, D. K., Choudhary, S., Bahadur, T., Swami, N. Poonia, D. and Sha, J.** 2012. A review of the Lower- lowermost Upper Jurassic lithostratigraphy of the Jaisalmer Basin, western Rajasthan, India. An implication on biostratigraphy. *Volumina Jurassica*, **10**: 61-82.
- Pandey, J. and Dave, A.** 1998. Stratigraphy of Indian Petroliferous basins. Presidential address XVI Indian Colloquium on Micropalaeontology and Stratigraphy, 1-248.
- Pareek, H. S.** 1980. Geology of northwestern Rajasthan, Geology through pictures. *Indian Mines*, **33**: 60-63.
- Pareek, H. S.** 1984. Pre-Quaternary Geology and Mineral Resources of northwestern Rajasthan. *Memoirs of the Geological Survey of India*, **115**: 1-99.
- Pascoe, E. H.** 1959. *A Manual of the Geology of India and Burma*, **2** (3rd edn.), 485-1343.
- Prasad, S.** 2006. Ammonite biostratigraphy of Middle to Late Jurassic rocks of Jaisalmer Basin, Rajasthan, India. *Palaeontologica Indica*, **52**: 1-146.
- Rajanikanth, A. and Chinnappa, Ch.** 2016. Early Cretaceous flora of India- A Review. *The Palaeobotanist*, **65**: 209-245.
- Watson, J. and Sincock, C. A.** 1992. Bennettiales of the English Wealden. Monograph of the Palaeontographical Society, London (publication 588, part of vol. 145 for 1991) pp. 1-228.

Manuscript received : November 2017

Manuscript accepted: July 2018

