

Gymnospermous seeds from the Barakar Formation of Umrer Coalfield, Wardha Basin, Maharashtra

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ABSTRACT

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Platyspermic and radiospermic gymnospermous seeds are documented from the top seam of the Barakar Formation, Makardhokra Open Cast Project, Umrer Coalfield, Nagpur District, Wardha Basin, Maharashtra. A variety of seed types including *Cordaicarpus* sp., *Cordaicarpus zeilleri*, *Samaropsis feistmantelii*, *Samaropsis* sp., *Rotundocarpus ovatus* and a new species, viz. *Rotundocarpus mucronatus* are systematically described. The seeds are largely comparable with those described from the Karharbari Formation of Damodar Basin. Besides adding to the knowledge of the flora of the Wardha Basin, this communication provides information on the occurrence of these seeds for the first time from Makardhokra Open Cast Project, Umrer Coalfield.

Key-words—Gymnospermous seeds, Platyspermic, Radiospermic, Early Permian, Barakar Formation, Umrer Coalfield, Wardha Basin.

उमरेर कोयलाक्षेत्र, वर्धा द्रोणी, महाराष्ट्र के प्रारंभिक पर्मियन अनुक्रम से प्राप्त अनावृतबीजी बीज

रजनी तिवारी, नरेश सी. मेहरोत्रा, एस एस के पिल्लै, संदीप पंडिता एवं दीपा अग्निहोत्री

सारांश

बराकार शैलसमूह, मकरदोकरा विवृत खान परियोजना, उमरेर कोयलाक्षेत्र, जिला नागपुर, वर्धा द्रोणी, महाराष्ट्र की उच्च संस्तर से प्राप्त चिपिटबीजी एवं त्रिज्यबीजी अनावृतबीजी बीज प्रलेखित किए गए हैं। *कॉर्डैइकार्पस ज़ाइलराई*, *कॉर्डैकार्पस*जाति, *सेमेरोप्सिस फाइस्टमैटलाई*, *सम्रोप्सिस*जाति, *रोटंडोकार्पस ओवेटस* एवं एक नवीन जाति अर्थात् *रोटंडोकार्पस मुक्रोनेटस* सहित बीज टैक्सा के प्रकार क्रमबद्ध रूप से विश्लेषित किए गए हैं। ये बीज दामोदर द्रोणी में करहरबारी शैलसमूह के पहले वर्णित किए गए बीजों के सम तुल्य हैं। उमरेर कोयलाक्षेत्र के बराकार शैलसमूह में इनकीविद्यमानता करहरबारी शैलसमूह के पुष्पी तत्वों की निरंतरता स्थापित करती है। वर्धा द्रोणी में वनस्पति-जात की जानकारी शामिल करने के अलावा, यह स्प्रेषणमकरदोकरा विवृत खान परियोजना, उमरेर कोयलाक्षेत्र से पहली बार इन बीजों की प्राप्ति की जानकारी प्रदान करता है।

संकेत-शब्द—अनावृतबीजी बीज, चिपिटबीजी, त्रिज्यबीजी, प्रारंभिक पर्मियन, बराकार शैलसमूह, उमरेर कोयलाक्षेत्र, वर्धा द्रोणी।

Sementes Gymnospermicas da sequência eopermiana do Hulhífero Umrer, Bacia de Wardha, Maharashtra

RESUMO

Sementes radiospermicas e platyspermicas estão documentadas no topo da Formação Barakar, Makardhokra Open Cast Project, Hulhífero Umrer, Distrito de Nagpur, Bacia de Wardha, Maharashtra. Uma variedade de sementes incluindo

Cordaicarpus zeilleri, *Cordaicarpus* sp., *Samaropsis feistmantelii*, *Samaropsis* sp., *Rotundocarpus ovatus* e uma nova espécie, viz. *Rotundocarpus mucronatus* são sistematicamente analisadas. As sementes são comparáveis com aquelas descritas da Formação Karharbari da bacia Damodar. Sua presença na formação no hulhífero Umrer representa a continuidade de elementos florais da Formação Karharbari. Além de acrescentar conhecimento da flora da bacia de Wardha, esta comunicação fornece informações da ocorrência destas sementes pela primeira vez no projeto Makardhokra Open Cast, Hulhífero Umrer.

Palavras-chave—Sementes gimnospérmicas, Platispérmica, Radiospérmica, Neopermiano, Formação Barakar, Hulhífero Umrer, Bacia de Wardha.

INTRODUCTION

Occurrence of seeds in different Gondwana sedimentary basins of India is rather sporadic and is mainly known from Damodar and South Rewa Gondwana basins with isolated records from Satpura Gondwana Basin (Maithy, 1965; Surange, 1974; Lakhanpal *et al.*, 1976; Srivastava & Chandra, 1982; Pant *et al.*, 1985; Maheshwari & Tewari, 1986; Chandra & Tewari, 1991). Earlier records of seeds from Wardha Basin include *Samaropsis milleri* from the Barakar Formation of Umrer Coalfield (Sundaram & Nandi, 1984) and *Samaropsis ganjrensis* from the Kamthi Formation of Semda area, Kamptee Coalfield (Tewari, 2007). The present work deals with systematic morphotaxonomical study of well preserved platyspermic and radiospermic seeds from the top seam of the Barakar Formation of Makardhokra Open Cast Project,

Umrer Coalfield. The seed taxa include *Cordaicarpus* sp., *Cordaicarpus zeilleri*, *Samaropsis feistmantelii*, *Samaropsis* sp., *Rotundocarpus ovatus* and a new species, viz. *Rotundocarpus mucronatus*. This is the first record of these seeds from the area and adds to the knowledgebase of megafloreal assemblage recorded earlier from the Barakar Formation of Umrer Coalfield, Wardha Basin by Sundaram and Nandi (1984) and Tewari *et al.* (in press). These records comprise the taxa *Schizoneura gondwanensis*, *Phyllothea indica*, *Gangamopteris cyclopteroides*, *G. clarkeana*, *Glossopteris arberi*, *G. browniana*, *G. communis*, *G. conspicua*, *G. damudica*, *G. indica*, *G. intermedia*, *G. longicaulis*, *G. searsolensis*, *G. spathulata*, *G. stenoneura*, *G. syaldiensis*, *G. tenuifolia*, *Glossopteris* sp., *Scutum* sp. cf. *S. leslii*, *Noeggerathiopsis hislopilii*, *Buriadia seawardii*, *Samaropsis milleri* and equisetalean axes.

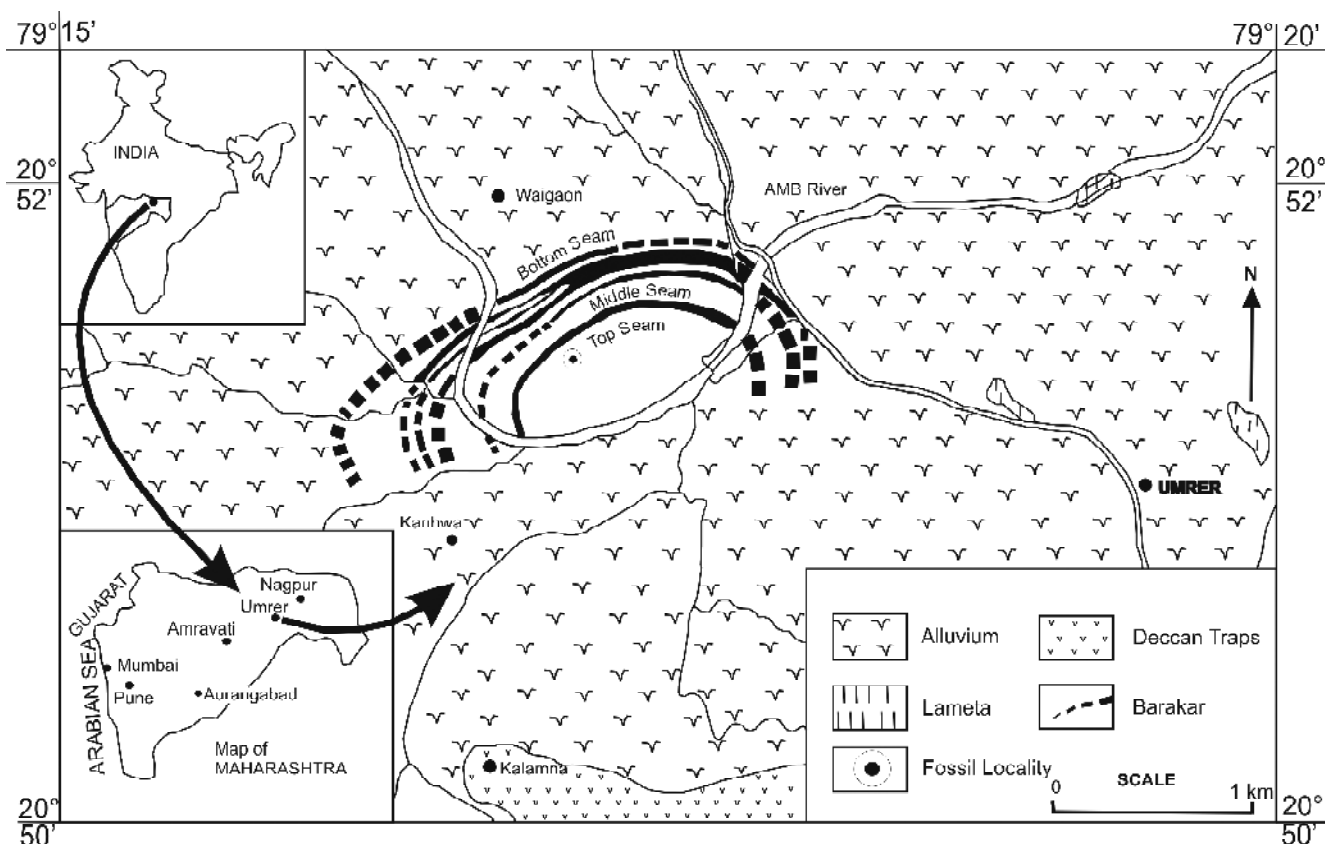


Fig. 1—Map of Umrer Coalfield showing fossil locality (modified after Raja Rao, 1982).

Age	Formation	Lithology
Recent	-----	Black soil migratory and derived
Cretaceous	Lameta	Limestones and sandstones
-----Unconformity-----		
Early – Triassic	Kamthi	Reddish- brown sandstones, yellowish and brown shales
-----Unconformity-----		
Early Permian	Barakar	Coarse-grained sandstones, Carbonaceous shales (spore/pollen rich) and coal seams
	Talchir	Greenish shales with occasional bands of sandstones
-----Unconformity-----		
Archaean	Metamorphics	Schists and phyllites

Fig. 2—Lithostratigraphic sequence of Umrer Coalfield (after Raja Rao, 1982).

GEOLOGY OF THE AREA

Umrer Coalfield lies on the west of Umrer Town, about 44 km south-west of Nagpur, Maharashtra in central India and is covered by thick black soil with sporadic occurrence of a few out crops of Lameta Formation (Fig. 1). The coalfield is situated in SSW-NNE belt along the river valleys of Godavari, Pranhita, Wardha and Kanhan. In the north the boundary is formed by the normal depositional contact of the Barakar with the underlying formations. The coalfield covers an area of about 5 km² lying between latitudes 20°50'45"N to 20°52'50"N and longitudes 79°16'00" E to 79°18'30"E. The Barakar Formation overlies the Talchir Formation with a gradational contact and is represented by shales, fine to coarse grained sandstones and carbonaceous shales. The total thickness of Barakar Formation is estimated to be about 200 m in the central part of the basin. Three distinctive units have been recognized within this Formation in Makardhokra Open Cast Project. The bottom, arenaceous / argillaceous unit is represented by fine to coarse grained greyish sandstones with interbands of grey and carbonaceous shales. This unit is devoid of any workable coal seam and attains a maximum thickness of 72 m. The middle unit of the Formation shows development of all the coal seams and is characterized by an alternation of shales, sandstones and coal seams. It is about 70 m in thickness including 30-40 m of coal. The top, arenaceous unit comprises mainly medium to coarse grained sandstones with one prominent band of carbonaceous grey shale. Lithostratigraphic sequence of Umrer Coalfield is given in Fig. 2 (after Raja Rao, 1982).

MATERIAL AND METHODS

Seeds have been recovered from the samples collected from the carbonaceous grey shales of top seam (Barakar

Formation), Makardhokra Open Cast Project, Umrer Coalfield near the village Waigaon (Figs 1, 3). The seeds are well preserved in form of the impressions and compressions on shales and show morphological details. An attempt was made to recover the cuticles from seed compressions to study the anatomical details but the cuticles disintegrated as soon as the cellulose acetate cuticular peels were treated with concentrate nitric acid. The morphotaxonomy of the seeds was studied with the help of hand lens and low power binocular microscope. The identification of seeds is based on their external morphological features like shape, nature of sarcotesta, sclerotesta, apex and base. Nomenclature of external morphological features follows that of Maithy (1965). All the type and figured specimens are deposited in the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow, India.

SYSTEMATICS

Seeds

Genus—*CORDAICARPUS* Geinitz, 1862

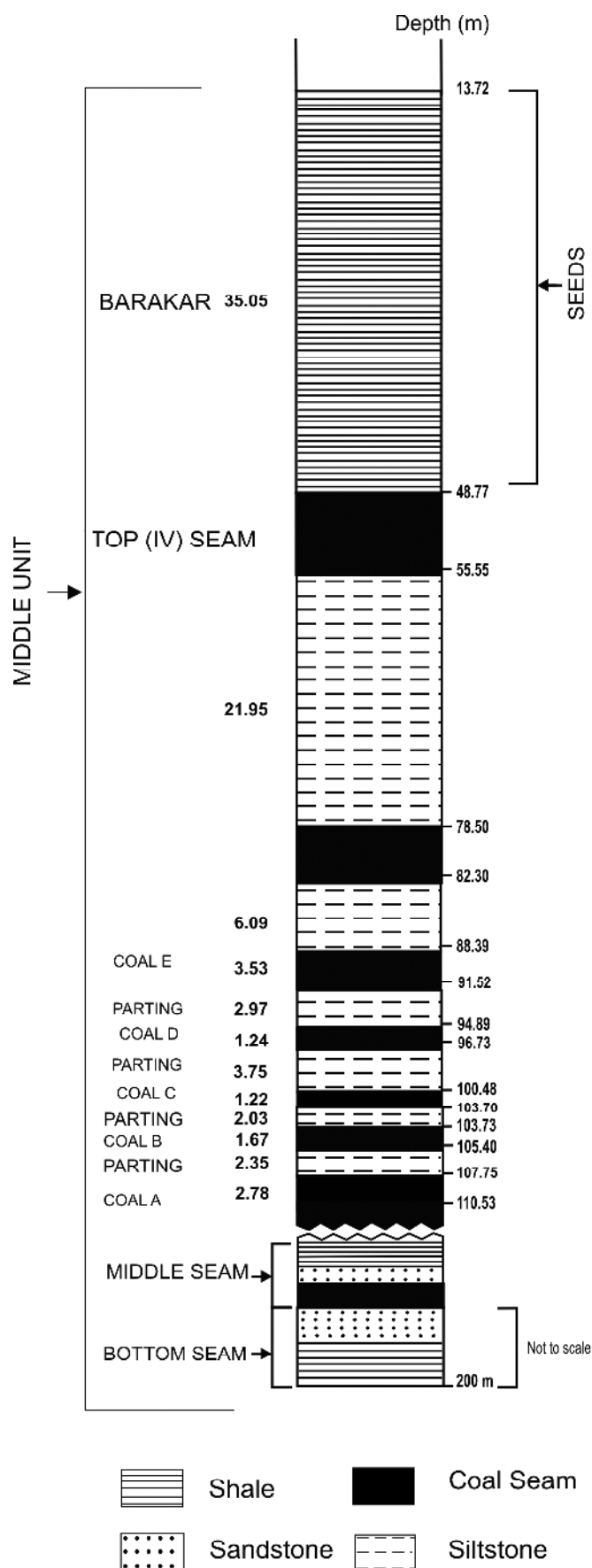
Type Species—*Cordaicarpus cordai* Geinitz, 1862

Cordaicarpus sp.

(Pl. 1.1)

Description—Seed compressed, platyspermic, pear-shaped, measures 5 mm in length and 4 mm in width, apex notched, base rounded, sarcotesta 0.4 mm wide, surrounds sclerotesta, at apex forms a 'v' shaped sinus.

Remarks—Seed resembles *Cordaicarpus zeilleri* (Maithy, 1965, Pl. 1, figs 1, 2) in overall shape and nature of



base. However, apex is rounded in *Cordaicarpus zeilleri* whereas, it is slightly notched in the present specimen. Hence, the seed is not given a specific status here.

***Cordaicarpus zeilleri* Maithy, 1965**

(Pl. 1.3, 7B, 8, 12)

Description—Seeds platyspermic, oval to cordate, measure 5-6 mm in length and 3-5.2 mm in width, apex pointed, base rounded, sarcotesta 0.4-1 mm wide, surrounds cordate sclerotesta.

Remarks—Seeds resemble *Cordaicarpus zeilleri* Maithy (1965, Pl. 1, figs 1, 2, Text-figs 1, 2) in external morphological details like shape, nature of apex and base. On the basis of cuticular studies, Pant *et al.* (1985) instituted the genus *Palaeocarpus birsinghpurensis* for morphologically similar seeds from the Karharbari Formation of Giridih Coalfield. They merged *Cordaicarpus zeilleri* described by Maithy (1965) with *Palaeocarpus birsinghpurensis*. It is proposed here to retain the name *Cordaicarpus zeilleri*, since essentially the seeds described as *Palaeocarpus birsinghpurensis* have similar external morphology. The comparison of structural features of the present seeds is not possible since they are mostly preserved as impressions. Though, a thin cuticle was present in some of the specimens, it disintegrated as soon as it was treated with conc. nitric acid.

No. of specimens—Ten.

Genus—ROTUNDOCARPUS Maithy, 1965

Type species—*Rotundocarpus striatus* Maithy, 1965

***Rotundocarpus ovatus* Maithy, 1965**

(Pl. 1.4-6, 7A, 9, 11, 13)

Description—Seeds radiospermic, oval, convex, wingless, measure 5-5.5 mm in length and 3-4 mm in width, apex and base rounded.

Remarks—Seeds resemble *Rotundocarpus ovatus* (Maithy, 1965, Pl. 2, fig. 15) in shape, nature of apex and base. The genus *Rotundocarpus* is known by two more species, viz. *Rotundocarpus striatus* (Maithy, 1965, Pl. 2, fig. 14, Text-fig. 9) and *R. mucronatus*, which is a new species and is described below. *R. striatus* is spindle-shaped, has acute base and apex and shows presence of striations.

No. of specimens—Ten.

Fig. 3—Litholog of Makardhokra Open Cast Project, Umrer Coalfield showing details of top seam of Barakar Formation (after WCL).

Name of Taxa / Horizon	Damodar					Satpura				Wardha/ Godavari			South Rewa Gondwana Basin				
	EP			MP	LP	EP		MP	LP	EP	MP	LP/ET	EP				
	Talchir	Karharbari	Barakar	Ironstone	Raniganj	Panchet	Talchir	Barakar	Motur	Bijori	Talchir	Barakar	Barren Measures	Kamthi	Talchir	Karharbari	Barakar
<i>Samaropsis feistmantelii</i> Maithy 1965	*										*						
<i>Cordaicarpus zeilleri</i> Maithy 1965	*						*				*						
<i>Cordaicarpus</i> sp.											*						
• <i>Samaropsis milleri</i> (Feistmantel) Seward & Sahni 1920	*										*					*	
<i>Samaropsis</i> sp.											*						
<i>Rotundocarpus ovatus</i> Maithy 1965	*										*						
<i>Rotundocarpus mucronatus</i> sp. nov.											*						

(EP = Early Permian, MP= Middle Permian, LP = Late Permian, ET = Early Triassic)

Note: • Not recorded in present study

Fig. 4—Distribution of gymnospermous seeds of Umrer Coalfield in Indian Gondwana horizons.

***Rotundocarpus mucronatus* sp. nov.**

(Pl. 1.10)

Holotype—Specimen No. 39702B.

Horizon and age—Barakar Formation, Early Permian.

Locality—Makardhokra Open Cast Project, Umrer Coalfield, Nagpur District, Wardha Basin, Maharashtra .

Diagnosis—Seed small, radiospermic, wingless, spindle-shaped, apex mucronate, base pointed, elongated.

Description—There is only one specimen in the collection but it is distinct enough for assignment to a new species. Seed is radiospermic, spindle-shaped, wingless, measures 6 mm in length and 4 mm in width, apex is mucronate, 1.8 mm long, basal part of apex is 1.7 mm wide, base of seed is pointed, elongated, apparently a ridge is present in basal 1/3 portion.

Comparison—Seed differs from *Rotundocarpus ovatus*

and *Rotundocarpus striatus* in shape, nature of apex and base. Accordingly, *R. ovatus* is ovate in shape with rounded apex and base (Maithy, 1965, Pl. 2, fig. 15) while *R. striatus*, though spindle-shaped, shows presence of striations and has acute base and apex (Maithy, 1965, Pl. 2, fig. 14, Text-fig. 9).

Genus—SAMAROPSIS Göppert, 1864

Type species—*Samaropsis ulmiformis* Göppert, 1864

***Samaropsis feistmantelii* Maithy, 1965**

(Pl. 1.14)

Description—Seeds platyspermic, almost circular in shape, measure 3-4 x 3-5 mm in size, sarcotesta 0.3 mm wide, surrounds circular sclerotesta.

Remarks—Seeds resemble *Samaropsis feistmantelii* Maithy (1965, Pl. 1, fig. 11) in shape. However, sclerotesta is oval in Maithy's specimen.

No. of specimens—Three.

Samaropsis sp.

(Pl. 1.2)

Description—Seed compressed, platyspermic, oval, measures 5 mm in length and 4 mm in width, apex and base notched, pointed, sarcotesta narrow, 0.4 mm wide, surrounds sclerotesta.

Remarks—Seed is platyspermic and resembles *Samaropsis milleri* described by Maithy (1965, Pl. 1, fig. 6) from the Karharbari Formation of Giridih Coalfield in overall shape, and in presence of apical and basal sinuses. However, the base of sclerotesta in *Samaropsis milleri* is broadly rounded. Hence, the seed is being described here as a species of the genus *Samaropsis*. On the basis of cuticular studies, Pant *et al.* (1985), instituted a new genus *Otofeistia* for morphologically similar seeds and merged all the specimens of *Samaropsis milleri* described by different workers (Seward & Sahni, 1920; Walkom, 1935; Hoeg & Bose, 1960; Maithy, 1965). It is proposed here to retain the name *Samaropsis milleri*, since essentially the seeds described as *Otofeistia milleri* have similar external morphology.

CONCLUSIONS

The detached seeds of *Glossopteris* flora are mainly known from the Early Permian sediments of India, viz. Talchir, Karharbari and Barakar (Lakhanpal *et al.*, 1976; Srivastava & Chandra, 1982; Pant *et al.*, 1985; Maheshwari & Tewari, 1986; Chandra & Tewari, 1991). Besides, there are sporadic records of seeds from the Kamthi Formation, Wardha Basin (Tewari, 2007) and Bijori Formation, Satpura Gondwana Basin (Srivastava & Agnihotri, 2010). Fig. 4 shows distribution of gymnospermous seeds of Umrer Coalfield in Lower Gondwana horizons of different basins of India. An analysis of Fig. 4 reveals that, except for the new species *Rotundocarpus mucronatus*, *Cordaicarpus* sp. and *Samaropsis* sp., all the

other taxa recorded in the present study have earlier been described from the Karharbari Formation. *Samaropsis milleri* (Feistmantel) Seward and Sahni (1920) recorded by Sundaram and Nandi (1984) from the Barakar Formation of Umrer Coalfield is also known from the Karharbari Formation of South Rewa Gondwana Basin (Seward & Sahni, 1920) and Giridih Coalfield (Maithy, 1965). Apart from the Wardha Basin, the gymnospermous seeds are largely known from the Damodar Basin. Sporadic occurrences are recorded from Satpura and South Rewa Gondwana basins. The presence of similar seeds in the Karharbari and the Barakar formations suggests that they appeared in the Karharbari Formation and continued in the Barakar Formation. This derives support from the studies carried out by different workers (Bajpai, 1990; Srivastava, 1992; Singh *et al.*, 2005, 2006) in different Indian Lower Gondwana basins who believe that the flora of Basal Barakar Formation represents the continuation of plant fossil assemblages of Karharbari Formation. The dominance of the genus *Glossopteris* along with a few *Gangamopteris* species, abundant *Noeggerathiopsis* leaves (Tewari *et al.*, in press) recorded from the top and middle seams of Barakar Formation of Makardhokra Open Cast Project and Umrer Open Cast Project, respectively, of Umrer Coalfield and a variety of seeds recorded from the top seam of the Barakar Formation of Makardhokra Open Cast Project (present study), suggest local and lateral variation of *Glossopteris* flora in the area. The variety of seeds points towards the diversity of gymnosperms in the Umrer area.

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PLATE 1



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| <ol style="list-style-type: none"> 1. <i>Cordaicarpus</i> sp. Specimen No. BSIP 39704B x 5, scale 4 mm. 2. <i>Samaropsis</i> sp. Specimen No. BSIP 39735 x 5, scale 5 mm. 3, 7B, 8, 12. <i>Cordaicarpus zeilleri</i> Maithy 1965. 3. Specimen No. BSIP 39704A x 4, scale 4 mm. 7B. Specimen No. BSIP 39705 x 4, scale 3.5 mm. 8. Specimen No. BSIP 39706 x 4, scale 3.5 mm. 12. Specimen No. BSIP 39681, scale 3.4 mm. 4-6, 7A, 9, 11, 13. <i>Rotundocarpus ovatus</i> Maithy 1965. 4. Specimen No. BSIP 39733 x 4, scale 5 mm. 5. Specimen No. BSIP 39734A x 5, scale 5 mm. | <ol style="list-style-type: none"> 6. Specimen No. BSIP 39702A x 5, scale 5 mm. 7A. Specimen No. 39705 x 4, scale 3.5 mm. 9. Specimen No. BSIP 39732 x 5.5, scale 5 mm. 11. Specimen No. BSIP 39734B x 3, scale 5 mm. 13. Specimen No. BSIP 39734C x 7.6, scale 5 mm. 10. <i>Rotundocarpus mucronatus</i> sp. nov. Specimen No. BSIP 39702B x 5, scale 4.7 mm. 14. <i>Samaropsis feistmantelii</i> Maithy 1965. Specimen No. 39734D x 7.6, scale 5.5 mm. |
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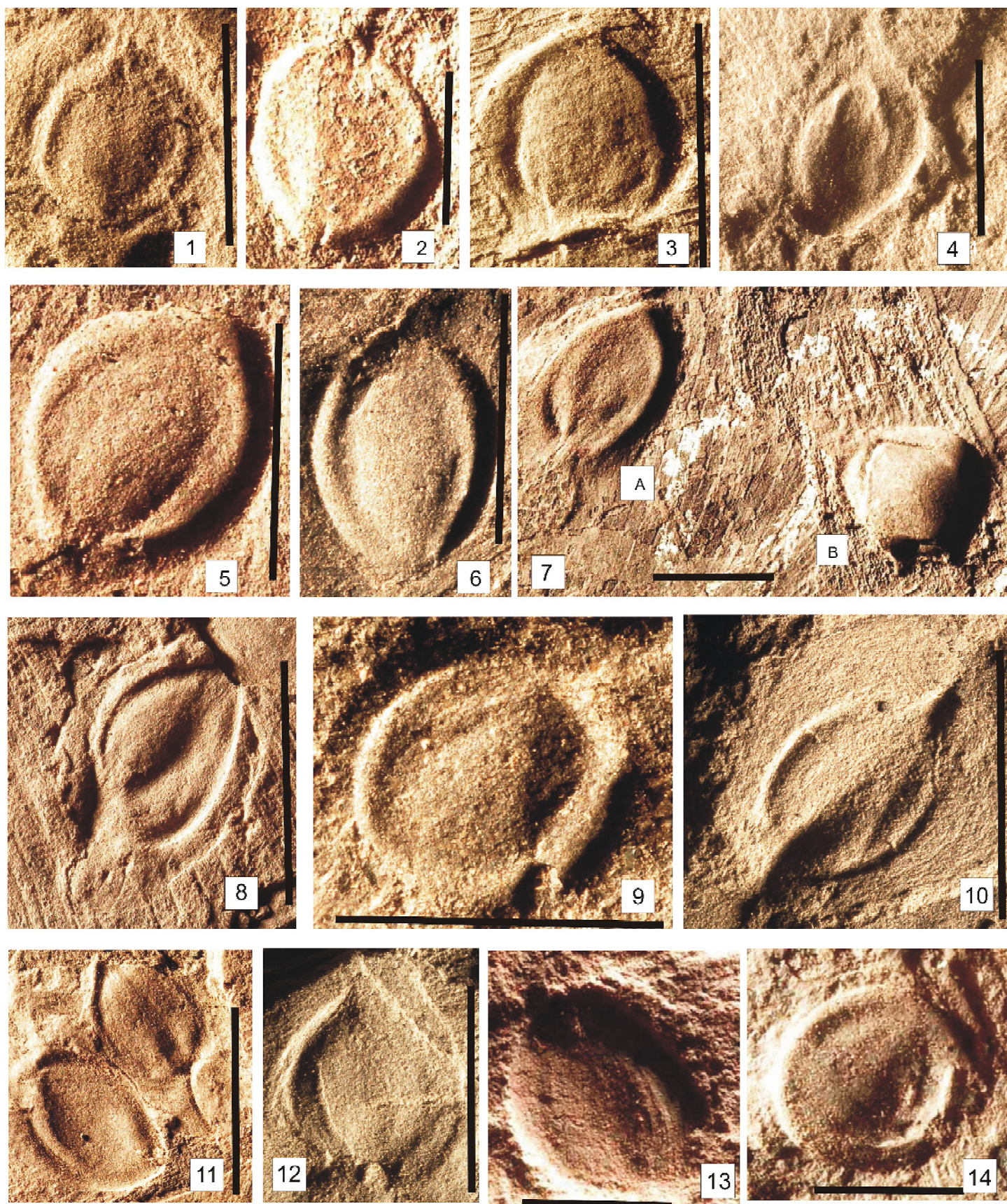


PLATE 1

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