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

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ABSTRACT


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 Cordaiacarpus sp., Cordaiacarpus zeilleri, Samaropsis feistmantelli, 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.

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

RESUMO

Sementes radiospermicas e platispermicas 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
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; Lakhnopal 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 megaforal 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, Phyllotheca 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 hislopii, Buriadia sewardii, Samaropsis milleri and equisetalean axes.

Palavras-chave—Sementes gimnospermas, Platispermas, Radiospermas, Neopermiho, Formação Barakar, Hulhífero Umrer, Bacia de Wardha.
GEOLGY 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 outcrops 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 Barakars with the underlying formations. The coalfield covers an area of about 5 km² lying between latitudes 20º50'45"N to 20º52'50"N and longitudes 79º16'00"E to 79º18'30"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.

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

<table>
<thead>
<tr>
<th>Name of Taxa / Horizon</th>
<th>Damodar</th>
<th>Satpura</th>
<th>Wardha/Goavari</th>
<th>South Rewa Gondwana Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Takhar</td>
<td>Karharbari</td>
<td>Barakar</td>
<td>Ironstone</td>
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<td></td>
<td>Talchir</td>
<td>Raniganj</td>
<td>Barakar</td>
<td>Raniganj</td>
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<td></td>
<td>Panchet</td>
<td>Barakar</td>
<td>Motur</td>
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<tr>
<td></td>
<td>Bijjir</td>
<td>Takhar</td>
<td>Barakar</td>
<td>Motur</td>
</tr>
<tr>
<td></td>
<td>Barren Measures</td>
<td>Kambhi</td>
<td>Talchir</td>
<td>Karharbari</td>
</tr>
<tr>
<td></td>
<td>Barakar</td>
<td></td>
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</tr>
</tbody>
</table>

**Samaropsis feistmantelii** Maithy 1965

- Holotype—Specimen No. 39702B.
- Horizon and age—Barakar Formation, Early Permian.
- Locality—Makardhokra Open Cast Project, Umpper 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** Göeppert, 1864
- Type species—**Samaropsis ulmiformis** Göeppert, 1864

**Rotundocarpus mucronatus** sp. nov.

(Pl. 1.10)

- Holotype—Specimen No. 39702B.
- Horizon and age—Barakar Formation, Early Permian.
- Locality—Makardhokra Open Cast Project, Umpper 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** Göeppert, 1864
- Type species—**Samaropsis ulmiformis** Göeppert, 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 floras 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 Kanthi Formation, Wardha Basin (Tewari, 2007) and Bijori Formation, Satpura Gondwana Basin (Srivastava & Agnihotri, 2010). Fig. 4 shows distribution of gymnospermous seeds of Unmer 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 Ummer 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 Ummer Open Cast Project, respectively, of Ummer 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 Ummer area.

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PLATE 1
REFERENCES


