

# Palynological evidence for the Permian-Triassic Boundary in Sohagpur Coalfield, India

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Palynological analysis of the Upper Pali sediments exposed along the Chundi River Section has been discussed. The palynotaxa recovered from the above sediments reveal the presence of non-striate disaccate pollen in dominance along with the striate disaccate pollen. Besides, the other significant taxa recorded in the assemblage are—*Goubinispora*, *Playfordiaspora*, *Densoisporites*, *Lundbladispora*, *Nidipollenites*, *Satsangisaccites*, *Brachysaccus*, *Foveosporites*, *Staurosaccites*, *Todisporites*, *Converrucoisporites* and *Kamthisaccites*. The overall palynoassemblages (I, II) decipher that the sediments of Chundi River Section have been deposited during Late Permian to Early-Middle Triassic period. Correlation of the palynofloral assemblages suggests that the sediments of the Chundi River Section lie between Nidpur bed and Tiki Formation of the South Rewa Basin.

**Key-words**—Palynology, Permian-Triassic Boundary, Sohagpur Coalfield, Gondwana, India.

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## सारांश

### सोहागपुर कोयला-क्षेत्र में परमियन-ट्रायैसिक सीमा के परागाणविक प्रमाण

राम अवतार

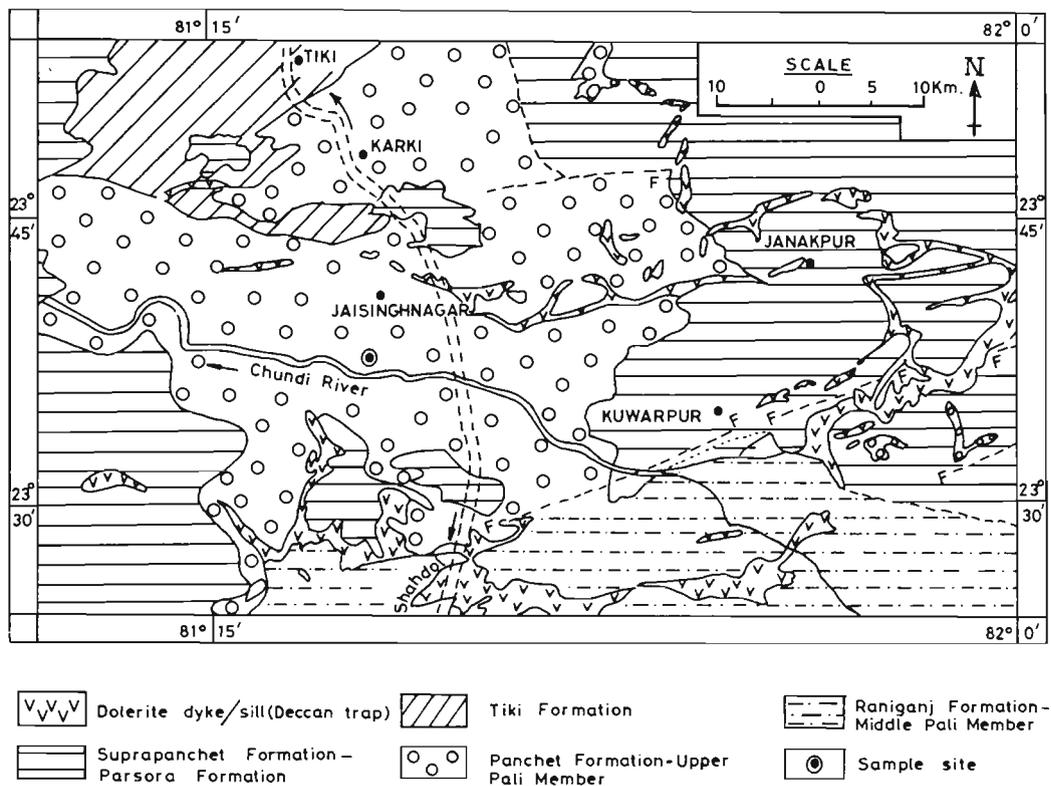
चंडी नदी खंड के संग-संग अनावरित उपरि पाली अवसादों के परागाणविक विश्लेषण से प्राप्त समुच्चय में अरेखीय द्विकोष्ठीय एवं रेखीय द्विकोष्ठीय परागकण उपलब्ध हुए हैं जिनमें अरेखीय द्विकोष्ठीयों की बाहुल्यता है। इसके अतिरिक्त गाउबिनिस्पोरा, प्लेफोर्डियास्पोरा, डेन्सोस्पोराइटिस, लुन्ब्लाडिस्पोरा, निदिपोलिनाइटिस, सत्संगीसेक्काइटिस, ब्रेकिसेक्कस, फोवियोस्पोराइटिस, स्टोरोसेक्काइटिस, टोडिस्पोराइटिस आदि विशिष्ट वर्गक भी समुच्चय में मिलते हैं। ऐसा प्रस्तावित किया गया है कि चंडी नदी खंड के अवसाद अनंतिम परमियन से प्रारम्भिक मध्य ट्रायैसिक कल्प में निक्षेपित हुए हैं तथा इनकी स्थिति दक्षिण रीवा द्रोणी के निदपुर संस्तर एवं टिकी शैल-समूह के मध्य है।

DURING the last four decades extensive palynological investigations have been carried out on Gondwana sediments in South Rewa Basin. However, meagre palynological work has been done on the Sohagpur Coalfield (Ram-Awatar, 1993, 1996b). The present paper deals with palynology across the Permian-Triassic boundary in the Chundi River Section, 4.5 km south of Jaisinghnagar, Madhya Pradesh. The boundary has been delineated in the lower part of the Upper Pali Member.

The geological succession of the post-Barakar sequence in the western part of the Sohagpur Coalfield is given below (Tarafdar *et al.*, 1993).

AGE		FORMATION/MEMBER
Eocene to Cretaceous		Deccan Trap
Lower-Middle Jurassic		Parsora Formation ..... hiatus.....
Rhaetic-Carnic		Tiki Formation
Middle-Lower Triassic	P	Upper Member
Upper Permian	A	Middle Member
Middle Permian	L	Lower Member
Lower Permian	I	Barakar

The Upper Member of Pali Formation shows a conformable relationship with the Middle Pali Member in Chundi River Section. It comprises coarse to medium-grained sandstone, yellow colour



Map 1—Generalised geological map of part of South Rewa Basin showing the location of Chundi River Section (after Kundu *et al.*, 1993).

sandstones, olive green micaceous sandstone, gritty sandstone, grey to greyish white siltstone, carbonaceous shale and red-green mottled clays.

### MATERIAL

Fifteen outcrop samples have been collected from the Chundi River Section (Map 1). Of them, nine samples were found to be productive. Details of the samples are given below.

Sample No.	Lithology	Thickness in m	Reference
* CRS-1A	Micaceous sandstone	0.25-1	Top
* CRS-1	Fine grained sandstone (grey colour)	0.75-1	
* CRS-2	Micaceous sandstone	1-2	
* CRS-3	Fine-grained sandstone	1-2	
* CRS-4	Fine-grained sandstone	1-2	
* CRS-5	Fine-grained sandstone	1-2	
* CRS-6	Fine-grained sandstone	0.70-1	
* CRS-7	Carbonaceous shale	0.75-1	
* CRS-8	Carbonaceous shale	0.50-1	
CRS-9	Claystone (yellow colour)	0.25-50	
CRS-10	Claystone (red colour)	0.20-50	
CRS-11	Claystone (yellow colour)	0.30-50	
CRS-12	Carbonaceous shale	0.50-1	
CRS-13	Claystone (grey colour)	0.40-1	
CRS-14	Micaceous siltstone	0.50-1	Bottom

\*Productive samples

### PALYNOLOGICAL ASSEMBLAGES, DATING AND CORRELATION

The recovery of the palynofossils was poor in most of the samples except for sample nos. CRS-1A, 1, 3. Based on the taxonomic composition and quantitative estimation two palynoassemblages have been identified (Text-figure 1).

*Assemblage I*—In this assemblage (Sample nos. CRS 4, 5, 6, 7, 8), *Horriditritetes*, *Densipollenites*, *Striatopodocarpites*, *Fauntpollenites*, *Alisporites* and *Satsangtsaccites* each represents 2-5 per cent. The other taxa encountered less than one per cent are *Brevitritetes*, *Microfoveolatispora*, *Playfordiaspora*, *Ibisporites*, *Scheuringipollenites*, *Vertictpollenites*, *Cuneatisporites*, *Krempipollenites* (= *Klaustipollenites*), *Falcisporites*, *Nidipollenites*, *Arcuatipollenites* (= *Lunatisporites*) and *Striatites*. The stratigraphically significant palynotaxa in Assemblage - I are *Striatopodocarpites venustus*, *Fauntpollenites gopadenis*, *Crescentipollenites fuscus* and *Densipollenites invisus* associated with the rare occurrence of *Playfordiaspora cancellosa*, *Alisporites tenuicarpus*, *Satsangtsaccites* sp. and *Goubintispora morondavenis*. This assemblage compares with the

Palynotaxa	Sample Nos.									
	CRS.8	7	6	5	4	3	2	1	1A	
HORRIDITRILETES	+		+	+	+					
BREVITRILETES	+		+					+		
MICROFOVEOLATISPORA	+	+	+	+				+		
IBISPORITES	+	+								
STRIATOPODOCARPITES	+	+	+	+			+	+	+	
FAUNIPOLLENITES	+	+	+	+			+	+	+	
CRESCENTIPOLLENITES		+		+			+			
VERTICIPOLLENITES		+								
DENSIPOLLENITES			+	+					+	
SCHEURINGIPOLLENITES			+							
STRIATITES			+	+			+		+	
CUNEATISPORITES					+					
ALISPORITES					+	+	+	+	+	+
FALCISPORITES					+			+	+	+
KREMPIPOLLENITES					+		+		+	+
NIDIPOLLENITES					+	+	+		+	+
SATASANGISACCITES					+				+	+
PLAYFORDIASPORA					+				+	
GOUBINISPORA					+		+	+	+	+
ARCUATIPOLLENITES						+	+	+	+	
CONVERRUCOSISPORITES										+
CHORDASPORITES							+		+	+
LUNDBLADISPORA							+		+	+
DENSOISPORITES							+		+	+
BRACHYSACCUS										+
KAMTHISACCITES										+
FOVEOSPORITES										+
STAUROSACCITES										+
TODISPORITES										+
Age	Late Permian					Early-Middle Triassic				

Text-figure 1—Distribution of qualitatively significant palynotaxa recorded from Chundi River Section.

youngest palynozone of the Raniganj Formation (*Denstpollentites magnicarpus* Zone, Tiwari & Tripathi, 1992).

The other known palynoassemblages equivalent to Palynoassemblage-I have recently been recorded from Umaria Coalfield (Ram-Awatar, 1996a); Satpura Basin (Kumar, 1996) and Bazargaon, Kamptee Coalfield (Srivastava & Bhattacharyya, 1996). Tiwari and Vijaya (1994) have opined that occurrence of high percentage of striate-disaccates with rare occurrence of *Playfordiaspora*, *Goubintispora* and *Lundbladispora* (FAD-U) at the top of the last coal seam in the Damodar Basin marks a major floral change. Similar sequence has also been observed in the Chundi River Section; though percentage of the striated-disaccates pollen is relatively poor.

*Assemblage II*—The dominant palynotaxa in the assemblage (Sample nos. CRS - 3, 2, 1 & 1A) are *Falcisporites* (25%), *Alisporites* (28%) and *Krempipollenites* (10%). Other important palynotaxa in the assemblage are *Denstpollentites* (2%),

*Striatopodocarpites* (5%), *Fauntpollenites* (2%), *Striatites* (5%), *Crescentipollenites* (3%), *Arcuatipollenites* (5%), *Nidipollenites* (2%), *Satsangisaccites* (3%), *Goubintispora* (5%), *Densoisporites* (2%), *Chordasporites* (3%), *Lundbladispora* (2%) and *Brachysaccus* (1%). Certain taxa such as *Todisporites*, *Playfordiaspora*, *Kamthisaccites* and *Converrucosisporites* though rare (1%) in occurrence, yet suggest a Panchet (= Early Triassic) equivalent affinity of Assemblage-II. The presence of *Brachysaccus ovalis*, *Foveosporites triassicus* and *Staurosaccites marginalis* indicates their early appearance in the Chundi River sediments.

Palynoassemblage-II is closely comparable with Nidpur palynoassemblage (Tiwari & Ram-Awatar, 1990) in view of the presence of non-striate disaccates pollen, i.e., *Falcisporites*, *Alisporites* and *Krempipollenites*, in association with cavate and cingulate spores. The occurrence of *Brachysaccus*, *Staurosaccites*, *Densoisporites*, *Kamthisaccites* and *Foveosporites* makes this assemblage younger to the Nidpur palynoflora. The Nonia Nala palynoassemblage from the Raniganj Coalfield described by Banerji and Maheshwari (1974), fairly resembles the Chundi River palynoassemblage in having non-striate disaccates in dominance but the latter *Playfordiaspora* is recorded in low percentage and *Decisporites* is completely absent. It is also somewhat comparable with the Denwa palynoassemblage (Nandi, 1996) from Satpura Basin. However, in the present assemblage *Samaropollenites*, *Camerosporites*, *Tethyspora*, *Dictyophyllidites*, *Polycingulatisporites*, *Ringosporites* and *Guttatisporites* are absent, hence it seems to be older than the Denwa assemblage. The stratigraphically significant taxa of the Tiki Formation, i.e., *Aulisporites*, *Convolutispora*, *Decisporites*, *Ritmaesporites* and *Samaropollenites* (Kumaran & Maheshwari, 1980) also do not encounter in the Chundi River Section. However, presence of *Staurosaccites*, *Brachysaccus*, *Todisporites*, *Converrucosisporites*, *Foveosporites* and *Kamthisaccites* suggests that the Assemblage-II lies somewhere between the Nidpur bed and Tiki Formation.

**DISCUSSION AND CONCLUSION**

The Permian/Triassic boundary in the Indian Gondwana has been drawn mainly on the basis of

palaeobotanical/palynological and lithological characteristics. Ghosh *et al.* (1996) have drawn the Permian/Triassic boundary on the basis of estheriids, small vertebrates and burrows in the Raniganj Coalfield which corroborate with lithofacies. In South Rewa Basin, there is no homogeneity regarding the lithological characteristics as compared to Damodar Basin due to the paucity of khaki-green shales in the Upper Pali sediments.

The Palynoassemblage-I of Chundi River Section (Upper Pali Member) contains high percentage of striate-disaccates *Fauntpollenites* and *Striatopodocarpites*, in association with *Crescentipollenites*, *Densipollenites*, *Vertictpollenites* and *Cuneatisporites*. Similar palynological assemblages have been identified in Johilla, Korar, Singrauli and Umaria coalfields (Tiwari & Ram-Awatar, 1987a, 1987b, 1990; Ram-Awatar, 1996a). This assemblage suggests the presence of Late Permian (Middle Pali) palynoflora in the Chundi River Section. The Assemblage-II, comprises high percentage of non-striate disaccates, i.e., *Altsporites*, *Falcisporites* and *Krempipollenites* associated with *Densoisporites*, *Goubinispora*, *Arcuatipollenites*, *Kamthisaccites*, *Playfordiaspora*, *Lundbladisporea* and *Satsangisaccites*. This composition suggests an Early Triassic age of the sediments. *Brachysaccus*, *Foveosporites*, *Staurosaccites* and *Todisporites* are some of the stratigraphically significant taxa which

show the presence of Middle Triassic sediments in the Chundi River Section.

The present finding is significant because for the first time P/T boundary has been demarcated on the basis of spores and pollen in the lower part of the Upper Member of Pali Formation. Chakraborti (1982) has also expressed similar view on the basis of lithological characteristics in the north-western part of Sohagpur Coalfield.

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## PLATE 1

(All photomicrographs are enlarged, ca x 600 ; coordinates on Leitz Laboulux D, Microscope no. 512794/066300).

1. *Staurosaccites marginalis*, Slide. no. BSIP 11715; coordinates 40 x 95.
2. *Kamthisaccites* sp., Slide no. BSIP 11721; coordinates 15 x 101.
3. *Playfordiaspora cancellosa*, Slide no. BSIP 11720; coordinates 18 x 120.
4. *Arcuatipollenites noviaulensis*, Slide no. BSIP 11715; coordinates 18 x 97.
5. *Chordasporites* sp., Slide no. BSIP 11713; coordinates 25 x 101.
6. *Lundbladisporea brevicula*, Slide no. BSIP 11711; coordinates 34 x 108.
7. *Brachysaccus ovalis*, Slide no. BSIP 11711; coordinates 35 x 107.
8. *Nidipollenites monoletus*, Slide no. BSIP 11714; coordinates 12 x 95.
9. *Densoisporites complicatus*, Slide no. BSIP 11713; coordinates 41 x 105.
10. cf. *Todisporites* sp., Slide no. BSIP 11715; coordinates 40 x 105.
11. *Foveosporites* sp., Slide no. BSIP 11712; coordinates 17 x 105.
12. *Cuneatisporites* sp., Slide no. BSIP 11720; coordinates 15 x 107.
13. *Goubinispora morondavensis*, Slide no. BSIP 11724; coordinates 16 x 110.
14. *Satsangisaccites* sp., Slide no. BSIP 11724; coordinates 28 x 98.
15. *Osmundacidites senectus*, Slide no. BSIP 11718; coordinates 44 x 99.
16. *Densipollenites indicus* sp., Slide no. BSIP 11711; coordinates 46 x 102.
17. *Falcisporites nidpurensis*, Slide no. BSIP 11711; coordinates 45 x 102.
18. *Convruccosisporites* sp., Slide no. BSIP 11716; coordinates 20 x 109.
19. *Krempipollenites indicus*, Slide no. BSIP 11711; 48 x 104.

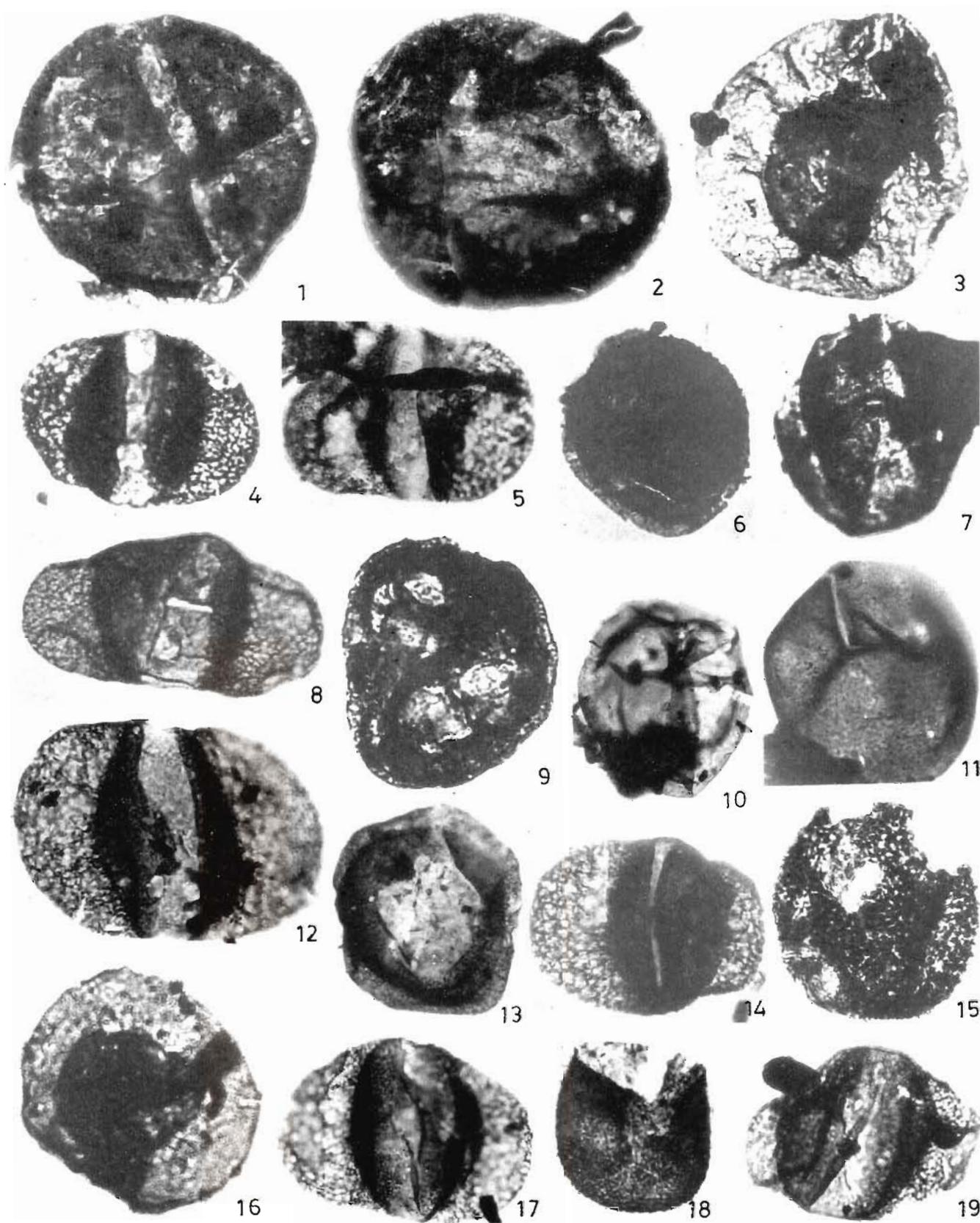


PLATE 1

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