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ORIGINAL ARTICLE

Palynological dating and incidence of the fossil *Botryococcus* in variable pH from the Mesozoic sediments of the Godavari Valley Coalfield, South India: insights in palaeoecology and palaeoenvironment

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Abstract
The influence of marine components in the study area is attributed to seafloor spreading and opening in the Indian Ocean during the Aptian, coupled with eustatic sea-level rise throughout the Aptian–Albian period. The present investigation delineates a marine incursion in the Chintalapudi sub-basin of the Godavari Valley Coalfield based on the occurrence of dinocysts, acritarchs and prasinophytes. Noteworthy stratigraphic marker taxa are recognized as key components in the age assignment of the sedimentary rocks. Sum total of four zones have been recognised in the studied part of the sequence. The oldest zone in the deepest set of sedimentation is identified as *Cicatricosisporites australiensis* Zone. This zone is assigned based on the first occurrence (FO) of *Cicatricosisporites australiensis* and *Biretisporites eneabbaensis*. The next zone, further above in the sequence is *Foraminisporis wonthaggiensis* Zone. The FO of *Foraminisporis wonthaggiensis* attested to the initiation of this zone. The third zone is *Cyclosporites hughesii* Zone recognised by the FO of *Foraminisporis asymmetricus*. The accessory palynotaxa comprised of *Retimonocolpites* sp.*, Tricolpites confessus, Tricolpites* sp., *Tricolporites* sp. and *Triporites* sp. in the recognition of this zone. The youngest zone of this sequence is recognised at the top of the sequence named *Crybelosporites striatus* zone based on the FO of *Crybelosporites striatus*. Palynological analysis places the studied part of succession between the Berriasian to early Albian. The primary objective of this investigation is to explicate the characteristics of sedimentation and paleoenvironmental contexts, with a specific emphasis on utilizing palynofacies and *Botryococcus* morphotypes as distinct benchmarks. Based on the palynofacies investigation three different depositional regimes have been assigned, which are distinguished as follows: (a) continental (384.30–203.75 m) dysoxic–anoxic basin; (b) shallowest nearshore–inner shelf, marginal marine/brackish water settings; and (c) heterolithic proximal shelf deposition with significant sea transgression (94.50–36.50 m). Unpredictable morphotaxonomical responses across diverse habitats with varying pH levels are projected to enhance comprehension of the palaeoecological and palaeoenvironmental significance of fossil *Botryococcus* colonies. The uppermost marine part of the sequence denotes the least abundance, reduced size, and ill-defined amorphous forms of fossil *Botryococcus* colonies. The continental part displays the less abundant but well-defined and fully grown sporadic distribution of fossil *Botryococcus* colonies; the middle part records its presence with a well-diversified, sturdy structural framework and cellular cup-like structures. The investigation of the Cretaceous strata reveals a dynamic geological history influenced by tectonic activities, including plate drifting and rifting. Present investigation enhances our comprehension of palynostratigraphy, and paleoenvironmental history and facilitates the formulation of models elucidating environmental processes during the Early Cretaceous. In addition, the lipid-rich composition of *Botryococcus* renders it promising for biofuel production, attracting attention in biotechnology and renewable energy research endeavors.

Keywords Upper Gondwana · Early Cretaceous · *Botryococcus* · Marine transgression · Marginal marine to proximal shelf · Godavari Valley Coalfield

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