



Reconstructing ancient vegetation, climate, depositional setting and ecology of the West Bokaro Coalfield, India: Insights from megaflorestics and palynofacies

Soumyashree Nanda^{a,b}, Shreerup Goswami^{c,*}, Neha Aggarwal^d, Debashish Das^c

^a Department of Earth Sciences, Sambalpur University, Jyoti Vihar, Burla 768019, India

^b Office of the Joint Director Geology, Zonal Survey, Sambalpur 768001, India

^c Department of Geology, Utkal University, Vani Vihar, Bhubaneswar 751004, India

^d Birbal Sahni Institute of Palaeosciences, Lucknow 226007, India

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ABSTRACT

This study investigates the ancient vegetation, climate, depositional setting, and ecology of the West Bokaro Coalfield, with a focus on megaflorestal and palynofacies analyses from the Parej East Open Cast Project (OCP). The floral assemblage includes 23 taxa, notably 17 species of *Glossopteris*, along with *Noeggerathiopsis hislopii* and Equisetales. This research records two new species of *Glossopteris* (i.e., *Glossopteris lanceolatus* and *Glossopteris subtilis*) and a new record of *Noeggerathiopsis hislopii* from this coalfield. The palynofacies study, indicates a low-energy, distal depositional environment with flooded palaeomires during the late Artinskian age. The palaeofloral assemblage represents a systematic morphological evolution in a comparatively cooler climate with enough rainfall, calm wind conditions and moderate intensity of light throughout the lower Barakar sedimentation in the Parej East area of West Bokaro Coalfield. The presence of Karharbari flora indicates the survival of older floral elements during the early Barakar sedimentation. The findings provide new insights into the palaeoenvironment of this important Gondwana basin, enriching our understanding of the interplay between climate, vegetation, and depositional processes during the Permian.

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1. Introduction

The Gondwana basins in peninsular India hold extensive deposits of Permian sediments, which are particularly notable for their rich assemblages of fossilized floral remains. Among these, the West Bokaro Coalfield stands out as a significant repository of Permian coal deposits, offering valuable insights into the geological and palaeobotanical history of Gondwana during the Permian period. This region encapsulates a wealth of information about past environments and ecosystems, serving as a key window into understanding the palaeoclimate, palaeovegetation, palaeoecology, and palaeodepositional settings that prevailed in this part of India during the Permian.

Previous research highlights the role of palynofacies in paleoenvironmental settings across different geological ages (Götz et al., 2003; Cazzulo et al., 2009; Hermann et al., 2012). Palynofacies

analysis has further emerged as a powerful tool in sequence stratigraphy, identifying proximal-distal trends, depositional processes, oxic-anoxic environments, and water depth variations (Zobaa et al., 2011; Mueller et al., 2014; Tyson and Follows, 2000; Aggarwal et al., 2019, 2024; Aggarwal, 2022). This approach is increasingly applied as an analytical proxy in paleoclimatic reconstructions, complementing geophysical and geochemical data (Mueller et al., 2014; Zhang et al., 2015; Aggarwal et al., 2024). Combining palynofloral records with palynofacies analysis has enhanced the precision of paleoclimate interpretations, integrating insights from paleophytogeography, paleoecology, and paleoclimatology (Modie, 2007; Césari and Colombi, 2016; Lindström et al., 2016; Aggarwal et al., 2019, 2024; Pradhan et al., 2024a). Additionally, palynofacies provides valuable data on organic matter provenance, sedimentary and paleobiological dynamics, and the potential for hydrocarbon generation (Aggarwal et al., 2024; Pradhan et al., 2024b).

The current study focuses on the megaflorestal and palynofacies assemblages recovered from the West Bokaro Coalfield, pro-

* Corresponding author.

E-mail address: goswamishreerup@utkaluniversity.ac.in (S. Goswami).