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Palaeoenvironmental Dynamics during Early Permian from Damodar Basin, India: A Reconstruction Based on Glossopteris flora and Geochemical parameters

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The present study deals with the Early Permian floral diversity, palaeoenvironment, palaeoclimate, and depositional setting using a multiproxy approach that includes morphotaxonomy, palynology, and organic geochemistry of Karo OCM (Open Cast Mine), East Bokaro Coalfield, Damodar Gondwana Basin, India. The Permian sediments of peninsular India are widely regarded as fluvial, along with some marine incursions. The macroplant fossil assemblage exhibits the presence of Glossopteridales, comprising *Glossopteris*, *Gangamopteris*, and *Vertebraria*, as well as Coniferales, which includes *Noeggerathiopsis*. The palynological assemblage encompasses the dominance of the striate bisaccate pollen *Faunipollenites* sp. and the sub-dominance of the non-striate bisaccate pollen *Scheuringipollenites* sp. with Glossopterid affinities. The megafloral and palynofloral assemblage confirms the biostratigraphical age to be Upper Barakar palynoflora of Kungurian affinity. The studied morphological characteristics, including small to large *Glossopteris* leaves exhibiting a lanceolate shape, acute apices, and acute cuneate or tapering bases, as well as entire margins with narrower lamina and narrow meshes, suggest the existence of a dense forest with the prevalence of a warm and humid climate during their deposition. The organic geochemical characterization based on functional group and biomarker analyses reveals the diagenetic effects on organic matter. Aliphatic symmetric (~2865–2855 cm^{-1}) and asymmetric stretching (~ 2930–2910 cm^{-1}) peaks are identifiable in coal samples, whereas they are absent in carbonaceous shale. The A-factor vs. C-factor plot suggests that the kerogen type is Type III, which can generate mainly gaseous kerogen. The vitrinite reflectance studies (Rr av. 1.1%) show increased maturity of the samples, which is supported by the *n*-alkane distribution pattern and the absence of hopane terpenoids. The Indian floral assemblages in contemporary southern Gondwana continents reveal a stronger inclination/affinity with the flora of Africa than that of South America, thereby supporting the age to be of Artinskian-Kungurian.

Keywords: Glossopteris, Palynomorph, FTIR, GCMS, Gondwana, Permian, Palaeoclimate