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Palynostratigraphy and palynofacies of the early Eocene Gurha lignite mine, Rajasthan, India

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ABSTRACT

A 105 m early Eocene section exposed in the Gurha mine in the Nagaur-Ganganagar Basin, Rajasthan, India, archiving remains of equatorial vegetation at a time of extreme global warmth and close to the onset of the India-Eurasia collision, is investigated using palynostratigraphic and palynofacies analyses. Four palynozones e.g., *Palmidites plicatus* Singh, *Botryococcus braunii* Kützing, *Triangulorites bellus* Kar and *Ovoidites ligneolus* are identified stratigraphically on the basis of abundance of these pollen taxa over others. The occurrence of taxonomically highly diverse angiosperm pollen in all the four palynozones attests to an extremely rich near-coastal tropical flora subject to frequent wildfires under a strongly seasonal precipitation regime. Palynotaxa characteristic of these palynozones are widely distributed in other early Paleogene sediments of India. Sedimentary organic matter (structured terrestrial, biodegraded, amorphous, grey amorphous, resins, charcoal/black-brown debris and algal remains) recovered from mire and lacustrine sediments are of terrestrial origin, recording fluctuations in burial anoxia and salinity. Episodes of elevated salinity are due either to seepage of marine waters and/or a periodic excess of evaporation over precipitation at times when the depositional system was closed.

1. Introduction

The early Eocene is a critical time for the evolution of the Indian flora. Palaeogeographically what is today northern peninsula India was equatorial (≤10°N), with the now subducted greater India extending towards Eurasia to the north (Molnar and Stock, 2009). Most authors consider that the Indian and Eurasian plates made contact at 55 ± 10 Ma (for a recent review of the evidence see Wang et al., 2014) and although biotic exchange between India and Eurasia undoubtedly preceded ocean closure, the establishment of a land connection enhanced that exchange.

The early Eocene was a time of marked global warmth (e.g. Eberle and Greenwood, 2012; Zachos et al., 2001, 2003) and immediately post-dates the short-lived thermal spike known as the Paleocene-Eocene Thermal Maximum (Zachos et al., 2001), but despite its equatorial palaeoposition a recent physiognomic study of leaves preserved in the Gurha mine, Rajasthan, showed that northwestern India experienced a climate characterised by strongly seasonal rainfall, implying a significant disruption to the 'ever wet' precipitation regime that normally exists at equatorial latitudes today. Moreover the overall temperature regime, while being megathermal, was cooler than perhaps one might have expected for an equatorial position under global 'hothouse' conditions (Shukla et al., 2014).

Given these exceptional circumstances it is important to understand better the composition of early Eocene equatorial vegetation on the Indian plate. The Gurha lignite mine, near Bikaner, in the Nagaur-Ganganagar Basin, Rajasthan (27.87398° N, 72.86709° E) provides access to a rich megaflora of early Eocene age. While the fauna has yet to be explored, insect fossils are common (Shukla et al., 2014). Here we investigate the microflora and palynofacies of the Gurha mine.

Palynostratigraphic and palynofacies analyses of the Gurha lignite mine (Fig. 1) were carried out with the aim i) to establish spore-pollen zonations in the early Eocene strata of the area, ii) to define stratigraphic ranges of significant palynotaxa, iii) to correlate the recorded palynoflora with regional and other basinal stratigraphic successions, and iv) to reconstruct palaeoenvironmental conditions prevailing during the deposition of the sediments. The study provides fundamental information on the diversity of palynofossils and their possible modern relatives in the various habitats represented in the stratigraphic succession.

Previous palynological work in the region has been limited by lack of suitable sections. Rao and Misra (1949) reported *Botryococcus braunii*

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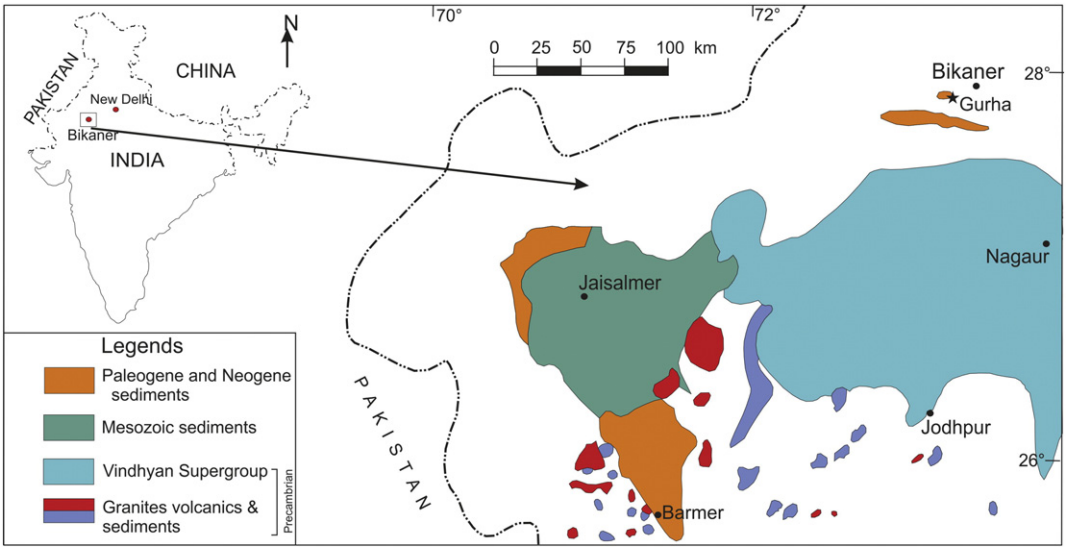

Fig. 1. Geological map showing the fossil locality (after Roy and Jakhar, 2002).

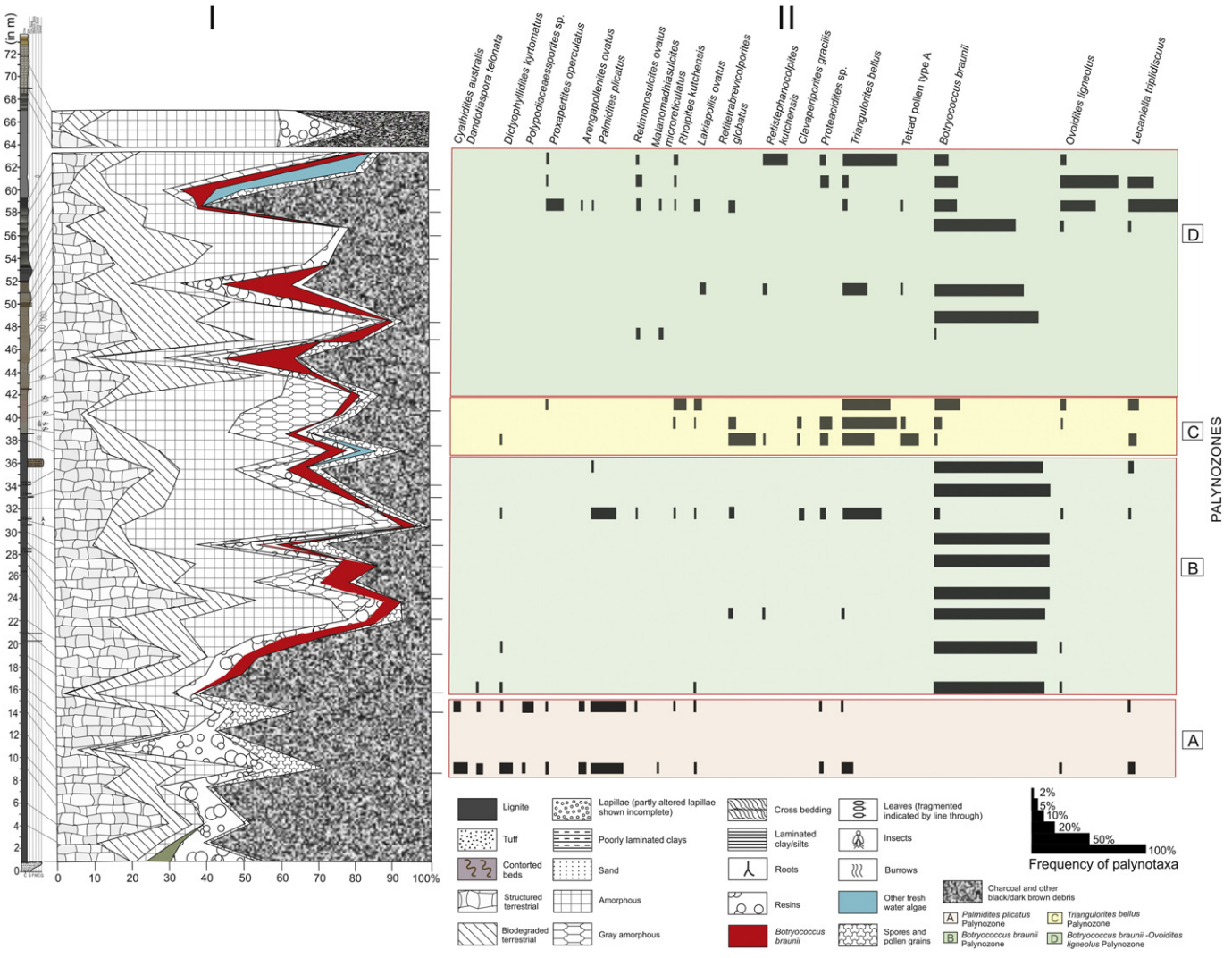

Fig. 2. Showing abundance of (I) various types of sedimentary organic matter and (II) spores, pollen grains and algal remains in the Gurha lignite mine section.