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Permian Palaeo-Wildfire on Gondwana Land : Charcoal Remains from the Yellandu Coalfield, Godavari Graben, Telangana State, India

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Abstract Microscopic charcoal has been recovered from the sub-surface sediments of bore hole Q-563 of Yellandu coalfield area (Jawahar Khani-5 coal block), kothagudem sub-basin, (Barakar Formation), in the southenrmost part of the Godavari graben, India. These charcoal particles are widely accepted to be of palaeo-wildfire products and this study contributes to the Lower Permian wildfire data of Indian peninsular region. During this time, a global biotic crisis was taking place and changes in the palaeofloristic composition can be observed. The samples were processed by standard palynological method, using acids like HCL, HF and HNO_3, followed by alkali (KOH) treatment. In the present investigation, the microscopic charcoal particles are studied along with tracheidal elements and palynomorphs related to gymnosperms were recorded and these confirmed the occurrence of palaeo-wildfires in Yellandu coalfied. This contributes to the understanding of regional changes that took place during Permian period on Gondwana land. The presence of charcoal in Permian sediments associated with coal levels at different localities demonstrates that wildfires have been relatively common events in the peat-forming environments in which the coal formation took place in the Godavari graben.

Keywords Charcoal, Tracheids, Gymnosperms, Palaeoenvironment, Barakar.

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Introduction

In modern ecosystems, fire is a significant source of disturbance [1,2]. In addition, wild fires have occurred more or less regularly in different ecosystems since the appearance of the early embryophytic land plants [3] and it can be assumed that, during past periods of the Earth's history, these events would have played a important role in the evolution of different biomes [4—6]. Despite geochemical and petrological evidences (inertinites) are the most reliable method to reconstruct the occurrence of palaeo-wild fires in different palaeoenvironments. Direct evidence of Palaeozoic palaeo-wildfires has largely been studied in the Northern Hemisphere for the last two decades and macroscopic fossil charcoal remains are well described from Europe [7, 8] and North America [9] and used to support the pyrogenic origin of inertinite in coals [10, 11]. But in southern hemisphere, especially

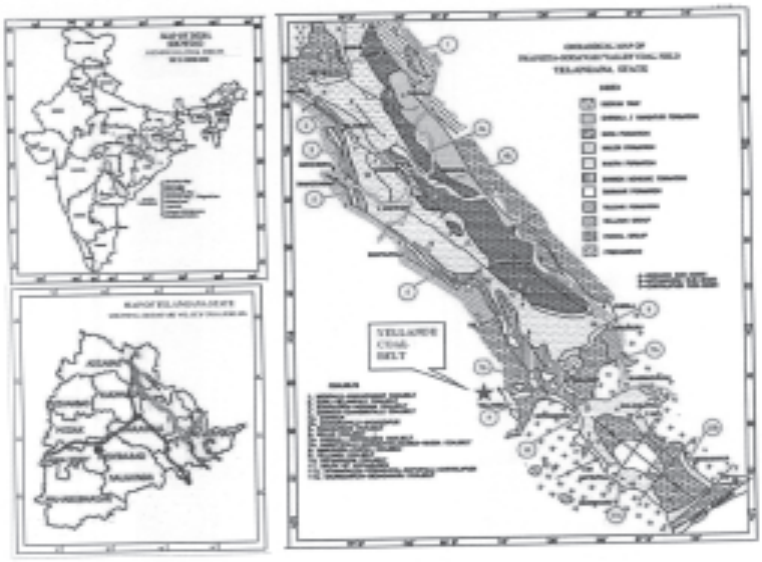

Fig. 1. Geological map of Pranhita-Godavari valley coalfields in which Yellandu coal belt area, Kothagudem sub-basin, Godavari graben, Telangana State (after SCCL, 2014).

in Indian subcontinent very less charcoal evidences are available [12, 13].

The present study is aimed at to provide information regarding the record of charcoal remains for the first time from sub-surface sediments of borehole Q-563 of Yellandu coalfield area (Jawahar Khani-5 coal block) of kothagudem sub-basin in Telangana State (Fig. 1) and is used to determine the depositional environment of the study area.

Geology of study area

Indian Gondwana basins occur in the form of linear belt along the present day river systems viz. Damodar, Wardha-Godavari and Son-Mahanadi. The Godavari Basin is further divided into four sub-basins, viz., from NW-SE Godavari sub-basin, Kothagudem sub-basin, Chintalapudi sub-basin and Krishna-Godavari coastal tract (Fig. 1). The Singareni coal fields of Godavari valley are one of the largest coal deposits of India, in which the Yellandu area is one of the coal belts of Kothagudem sub-basin under Pranahita-Godavari basin. Yellandu coal field (Jawahar Khani-5 coal block) is an elongate, NNW-SSE trending, 20 km long and 6 km wide, situated about 40 km west of Kotha gubem, outside the eastern margin of Pranahita-Godavari basin. The Yellandu coal belt is graben bounded by normal faults along the eastern-western margins with the northern latitudes of $17^{0}29'55''$ to $17^{0}33'\ 59''$ and eastern longitudes of $80^{o}19'04''$ to $80^{o}32'45''$ and falls in Survey of India toposheet no 65C/6/SW. The pioneering geological work has been done by King [14—18].

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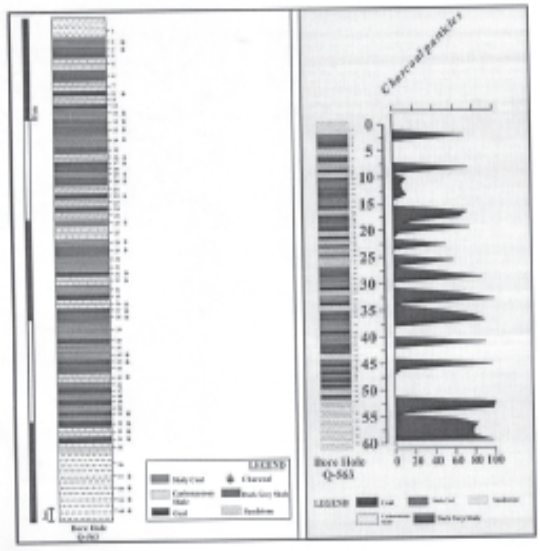

Fig. 2. Diagram showing the Lithology of borehole Q-563 samples and frequency (%) of Charcoal particles from the Yellandu coal field (Jawahar Khani-5 coal block), Kothagudem sub-basin, Godavari graben, Telangana State.

Fig. 3. Photographic plate showing the Charcoal particles (i) along with trachied elements (ii) and palynoflora (iii) from Yellandu coal field (Jawahar Khani-5 coal block), Kothagudem sub-basin, Godavari graben, Telangana State.

Materials and Methods

The coal samples for the present study have been collected from Borehole No. Q-563, Jawahar Khani-5 coal block near Yellandu village (Fig. 1). A total of 60 bore core samples were collected for palynological investigation (Fig. 2). The lithology of samples viz. coal, shaly coal, carbonaceous shale and dark grey shales and sand stones. The total depth of the borehole was 441m and samples were collected from the Index seam and A/Queen seam from the depths of 289 m to 314 m for qualitative and quantitative analysis of palynomorphs. The samples were processed by standard palynological method [19], using acids like hydrochloric acid (HCL) for 1-2 days, hydrofluoric acid (HF) for 3—4 days, followed by concentrated nitric acid (HNO_3) for 2—5 days, followed by 10% alkali (KOH) treatment. The materials were sieved through 150 and 400 meshes and palynological slides were prepared using DPX as mounting medium for the recovery of palynomorphs from the coal samples and 5 slides were prepared for each sample. Microscopic study has been done under the Olympus microscope. The prepared slides were housed in the Palaeobotany and Palynology Research Laboratory, Department of Botany, University College of Science, Saifabad, Hyderabad.

Results and Discussion

Microscopic fossil charcoal has been discovered in the Yellandu Coalfield, Barakar Formation, in the southernmost portion of the Godavari graben, Telangana State. In the present study high amount of charcoal particles were recorded along with trachidal elements and palynoflora from top to bottom of the borehole (Q-563) samples (Fig. 3). A decrease of the charcoal concentration from the base to the top of borehole samples indicates probably due to the less consumption of vegetation by the forest fire (Fig. 2) . During this time, a global biotic crisis was taking place and changes in the palaeofloristic composition can be observed. The Petrological study of Yellandu coal also suggests rich of inertinite macerals are due to oxidized environment of depo-

sition [20]. Therefore the presence of charcoal in Permian sediments associated with coal levels at different localities demonstrates that wildfires have been relatively common events in the peat-forming environments in which the coal formation took place in the Godavari graben.

Conclusion

In Yellandu coalfield (Jawahar Khani-5 coal block) the microscopic charcoal particles were detected along with gymnospermous tracheid elements besides palynoflora confirmed the occurrence of palaeo-wildfires in Yellandu coalfield. And the rich of inertinite macerals suggests that Yellandu coals were deposited in oxidizing environment. This contributes to the understanding of regional changes that took place during Permian period on Gondwana land. The presence of charcoal in Permian sediments associated with coal levels at different localities demonstrates that wildfires have been relatively common events in the peat-forming environments in which the coal formation took place in the Godavari graben.

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