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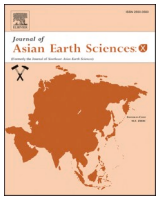

Assessment of the source rock potential in the Sirka and Giddi collieries of South Karanapura coalfield, Jharkhand, India: Insights from megaflora, palynology, and geochemistry

Sanghamitra Pradhan [a,1], Divya Mishra [b,1], Neha Aggarwal [b,*,1], Shreerup Goswami [c,1]

[a] Department of Earth Sciences, Sambalpur University, Jyoti Vihar, Burla 768019, India
[b] Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow 226007, UP, India
[c] Department of Geology, Utkal University, Vani Vihar, Bhubaneswar 751004, Odisha, India

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ABSTRACT

Permian deposits in the Indian Peninsula have long been a significant source of coal and have great potential for hydrocarbon exploration. Here we present results of megafloral, palynological, and geochemical analysis of the Late Artinskian-Kungurian sediments in the South Karanpura coalfield to assess hydrocarbon generation potential, kerogen types, depositional settings, and thermal maturation. The results suggest anoxic to oxic depositional environments with fluctuating water levels, influenced by terrestrial inputs. The Sirka colliery is considered to be most favorable for hydrocarbon generation due to the palaeodepositional setting dominated by flooded palaeomires. The dominance of degraded organic matter and the rarity of opaque phytoclasts suggest type II/III to type III kerogen material in the palaeomire of the Srika succession, characterized by low-energy dysoxic to anoxic conditions. The thermal maturation values (Tmax 429℃) and the production index (0.01–0.02) indicate that the Sirka area has immature kerogen, but the Giddi colliery has a relatively higher Tmax (average 435℃) placing the studied sample within the mature zone. However, due to deposition in the oxidized swamp, Giddi C has poor potential for hydrocarbon generation, showing that type III/IV material has charcoal input into the sediments. Our findings contribute to global knowledge of coal formations' oil and gas storage capacity, which has implications for energy resource assessment and exploration strategies.

1. Introduction

The increasing demand for hydrocarbon fossil fuels and the expansion of the petroleum industry, driven by their substantial resource potentials, have led researchers to focus on unconventional petroleum sources, such as shale gas, as well as deep petroleum systems (Bai et al., 2017; Zheng et al., 2019; Wang et al., 2014; Xiang et al., 2013). The Permian sediments represent one of the most important targets for petroleum sources worldwide (Montgomery et al., 2005; Jarvie et al., 2015; Loucks and Ruppel, 2007; Rowe et al., 2008; Ruppel and Loucks, 2008; Loucks et al., 2009; Varma et al., 2015; Bakshi et al., 2018; Misra et al., 2018, 2020). The South Karanpura coalfield is a substantial province in terms of hydrocarbon potential which was observed by Kumar et al., 2018. They investigated the central part of this coalfield to explore coal bed methane (CBM) through gas content and organic petrographic studies and found that the area is promising for CBM. Following their study, the eastern part of the coalfield has been explored to study the palaeodepositional settings and the hydrocarbon generation potential of the basin. Palaeoenvironmental factors directly influence the deposition of distinct organic matter (OM) forms in sediments. These conditions directly affect the hydrocarbon generation of the source rocks. A source rock is sediment rich in organic matter capable of generating or expelling hydrocarbons (Jarvie et al., 2015). This feature establishes a material foundation and stands out as a crucial factor in petroleum accumulation, particularly in the context of unconventional petroleum resources. Hydrocarbon generation and expulsion are vital properties of source rocks. A comprehensive understanding of these characteristics considerably improves the accuracy of resource evaluation and the ability to predict favorable exploration zones. This knowledge plays a crucial role in advancing petroleum exploration and

* Corresponding author.
E-mail address: neha_264840@yahoo.co.in (N. Aggarwal).
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