Mini Review

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Composite lithology of Kolhan Basin: tectonic implications

Abstract

The pear-shaped epi-continental Kolhan basin lies unconformable over the Singhbhum granite in the east and has a faulted contact with the Iron Ore Group in the west. Structurally it represents a dome and basin. The basin has four lithostratigraphic units - Kolhan conglomerate, Kolhan sandstone, Kolhan limestone and Kolhan shale. The sandstones are composed of sub-arkose to quartz arenite. The Singhbhum craton in eastern India is mainly composed of Archean granitoids forming the nucleus rimmed by a Proterozoic mobile belt to the north and east. Towards the western part of the Singhbhum granite the Kolhan Group of sediments are preserved as a linear belt covering an area of 800sq.km. The Kolhan Group of rocks represents one of the least studied basins in the Singhbhum-Orissa–Iron Ore craton. The Kolhan Group is preserved as linear belt extending for 80-100 km with an average width of 10-12 km revealing deposition of Kolhan sediments in narrow and elongated troughs formed in an initial basinal rifting stage. The Kolhan Group is similar in many respects with Manganese-bearing WylliesPoort Formation of 1.8-1.96Ga of Soutpansberg Group, Northeast Kaapvaal Craton, South Africa suggesting a possible Indo-African connection during the Neo-Archean age.1 The Kolhan Group lying unconformably above the Singhbhum granite is bounded by the Jagannathpur lavas on the southeast and south and the Iron Ore Group on the west. The western contact of the basin is faulted against the Iron Ore Group. There has been division the Kolhan Group of sediments into four detached sub-basins-Chaibasa-Noamundi basin, Chamakpur-Keonjhargarh basin, Mankarchua basin and Sarapalli-Kamakhyanagar basin.

Keywords: kolhan, cratonic, petrography, litholog technique

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Introduction

The Indian Shield is believed to have been stabilized to its present-day configuration by 2.1 to 1.8 Ga through the amalgamation of several Archaean continental nuclei that comprise granite-greenstone terrain with elements as old as 3.4 Ga. Five major Archaean cratonic nuclei, namely the Aravalli-Bundelkhand, East and West Dharwars, the Singhbhum, and the Bastar constitute the Precambrian continental crust of India. The Aravalli and the Bundelkhand blocks constitute the northern Indian shield, and the Dharwars, Bastar and the Singhbhum blocks joined together along rift valley define the southern Indian shield. The northern and southern Indian shields are sutured along the Satpura Mobile Belt, which is redefined as the Central Indian Tectonic Zone (CITZ). During the Meso- and Neoproterozoic, a number of nearly unmetamorphosed sedimentary succession record the development of several major cratonic basins, which are collectively referred to as Purana basins. These Purana basins are important for understanding the origin and evolution of the continental crust, its composition, earth's surface processes, sediment provenance, paleoclimate and weathering condition. The origin and evolution of many such basins and basin-fill successions are poorly understood, not because the records of the thick Proterozoic supracrustal successions are not widespread in the geological history, but because of the absence of the present day analogs. The unmetamorphosed sedimentary sequences within the Proterozoic basins of India occur in multiple unconformity-bounded sequences, and are characterized by a high degree of commonality with respect to the lithological and lithofacies associations and depositional environments. The sequences are dominated by fluviatile clastics and carbonates, occurring as facies sheets that extend over thousands of square kilometers and are arranged in an aggradational facies architectural order. These are commonly described as layer-cake stratifications. It is believed that the ancient basins were formed within the cratonic rifts that developed along the crustal weak zones and later rapidly evolved into small and large basins. Interpreting the depositional environment of the Proterozoic Kolhan sequence was difficult because of:

a. The absence of body fossils which could provide telltale evidence of the depositional environment and

b. The absence of land vegetation, which has a profound influence on the precipitation, run-off, and sediment yield

c. Scarcity of exposures. The lines of evidence adopted to determine the environment of deposition for the Kolhans were grain size, petrography, lithofacies analysis, type, scale, abundance and the directional attributes of sedimentary structures and fining upward cycle. Bhattacharyya et al.[2] and Bhattacharyya et al.[3] updates the reader's about the current inventions in petrology and geochemistry of Kolhan group of rocks and assigns it the best possible age.

Lithology and lithounit characteristics

The lithofacies analysis based on the field descriptions, petrographic investigation, and their vertical packaging has been done for assessing the sediment depositional framework and the environment of deposition. The detailed examination of outcrop patterns along with the variations in the sedimentary structures appears to be the most effective means for analyzing and interpreting the stratal geometries and the depositional history. The architectural elements used in the present study are the field stratal characteristics, primary sedimentary structures, textures, fabrics of the lithofacies and their geometrical relationships.[4]

The major lithounits have been described below.

i. Kolhan shale

ii. Kolhan sandstone

iii. Kolhan conglomerate (Figure 1)

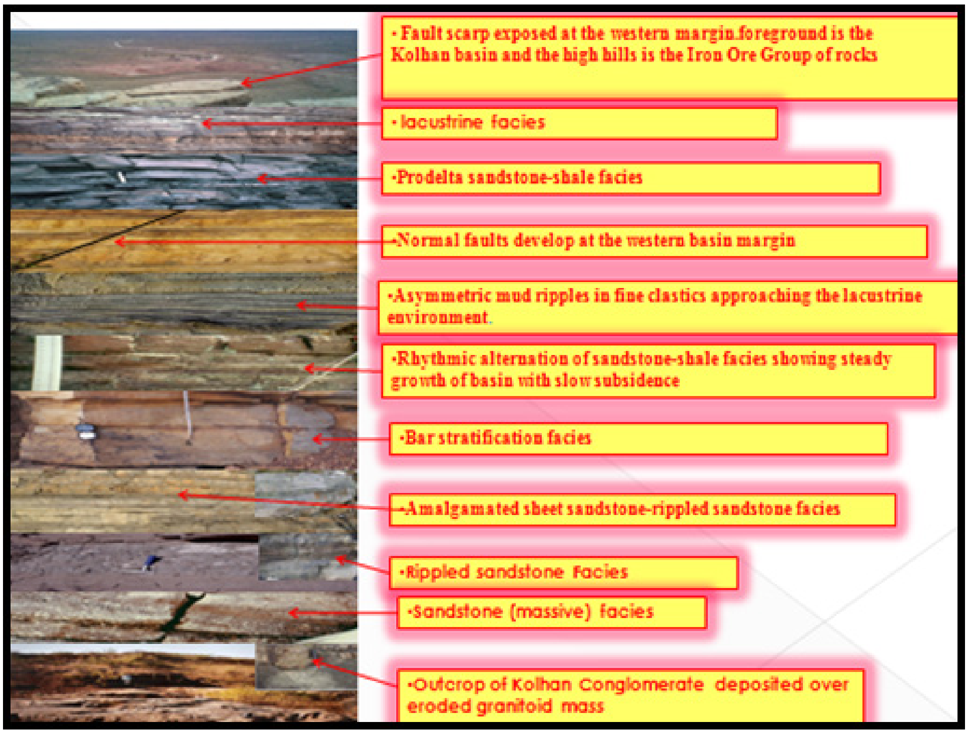

Figure 1 Composite Lithology.

Weathering intensity as indication of paleoclimate

The abundance of shale itself poses another problem as because it is commonly assumed that the mud formation is very limited under conditions that favour arenites-arkoses. Apart from the fact that the Chemical Index Alteration (CIA) (CIA=Al_2O_3/ Al_2O_3+CaO+Na_2O+K_2O)x100 as used to determine the weathering intensity in the source areas of shales is in need of reassessment and refinement, the conflict climate signals between sandstones and shales of the Kolhans may also be inherent in the way sandstones and shales are produced. For example, sediment transport can, via hydraulic sorting, lead to compositional fractionation of sediment-size fractions. The unaltered feldspars and well rounded quartz and feldspar grains in conjunction with low latitude suggest that the Kolhans were deposited in an arid to semi-arid climate. In such a climatic setting, unaltered feldspars would become concentrated in sandy deposits of braided streams and may also undergo inland reworking, whereas fine detritus and clay (from feldspar weathering) would be carried to the basin as suspended load, thus leading to a separation between intensely (clay fraction) and incompletely weathered (sand fraction) material. Therefore intensities of chemical weathering indicated by shales will tend to be higher than those indicated by sandstones.

Conclusion

The Kolhan Group represents the youngest Precambrian stratigraphic unit in Singhbhum geology.[5,6] The unmetamorphosed, low westerly dipping sedimentary piles lie unconformable over the Singhbhum granite to the east and show a faulted contact with the Iron Ore Group of rocks to the west. The Kolhan basin represents an intracratonic basin within the Singhbhum–Orissa Iron Ore craton. Depending upon the source area and other environmental conditions, the lithology of the basin varies. Petrography and geochemistry of Kolhan sediments by Bandopadhyay & Sengupta[1] suggest passive margin tectonic setting, an intensely weathered low-relief provannce dominantly composed of granitiod rocks and semi-arid to arid palaeoclimate. The basin represents an event of major transgression and relative sea level rise. Petrofacies analysis[7] is suggestive of sediments in the Chaibasa and Noamundi basin was derived from various acid plutonic rocks and the Iron Ore Group. These sandstones are quite mature and fall in the cratonic interior zone. The main basin has undergone a phase of extension. During this phase, the eastern side of the Iron Ore synclinorium was faulted giving rise to a half graben structure, which leads to the sedimentation.[8] Sediment logical studies by Chatterjee and Bhattacharya, 1969 the basin to be an embayment from geosynclines. The Kolhan succession represents a syn-rift to post-rift succession. Terminal Mesoproterozoic-Neoproterozoic deposits preserved as widely separated outcrop belts on the Dharwar-Bastar cratons and in the PG-Valley comprise a transgressive sequence of lime-mudstone-shale succession of below wavebase depositional settings beyond the reach of coarser siliciclastic detritus. Based on the lithostratigraphic correlation it is plausible that the southern Indian shield witnessed major subsidence and sea level rise during the Meso Neoproterozoic transition. Such cratonwide submergence is likely

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to be triggered by major global plate divergence events, such as the breakup of a supercontinent.

Lithofacies study has been done following standard litholog technique.[4] Seven different vertical sections have been prepared from different locations viz. Matgamburu, Gangabasa, Rajanka, Arjunbasa, Bistampur, Rajanbasa and Gumua-Gara river section in and around Chaibasa-Noamundi basin. All the logs show the fining upward sequence from conglomerate, sandstone, limestone and shale resting unconformably on the Singhbhum Granite. There are five diagnostic characters of sedimentary facies namely, geometry, lithology (grain size), sedimentary structures, paleocurrent patterns and fossils. Based on these parameters, six different lithofacies have been established for the sandstone of Kolhan Group.[9,10]

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Conflict of interest

Author declares that there is no conflict of interest.

References

1. Bandopadhyay PC, Sengupta S. Paleoproterozoic supracrustalKolhan Group in Singhbhum craton, India and the Indo-African Supercontinent. *Gondwana Research.* 2004;7(4):1228−1235.
2. Bhattacharyya K, Subhasish Das. Evolutionary History Of The Proterozoic Kolhan Basın: A Review. *Int. J. Of Geology & Earth Sci.* 2015;1(2):50−54.
3. Bhattacharyya K. Clues For Age Of Kolhan Basin: Tectonic İmplications. *Global J Technol Optim.* 2017;8:1.
4. Miall AD. *The Geology of Fluvial Deposits: Sedimentary Facies, Basin Analysis, and Petroleum Geology.* Springer-Verlag: Berlin; 1996. 582 p.
5. Mukhopaddhyay J, Ghosh G, Nandi AK, et al. Depositional setting of the Kolhan Group: its implications for the development of a Meso to Neoproterozoic deep-water basin on the South Indian Craton. *South African Journal of Geology.* 2006;183−192.
6. Bose MK. Precambrian mafic magmatism in the Singhbhum craton, Eastern India. *Jour Geol Soc Ind*. 2009;73(1):13−35.
7. Dalabehera L, Das S. (2007) Petrofacies analysis of the sedimentary rocks of Kolhan Basin- a case study from Chaibasa-Noamundi, West Singhbhum, Jharkhand-Vistas in Geological Research. *UU Spl Publ in Geology.* 6:1−13.
8. Panda M, Das S. The Kolhan Basin-A Riview. *Vistas in Geological Research UU Spl Publ in Geology.* 2007;6:50−57.
9. Bhattacharya AK, Chatterjee BK. Petrology of Precambrian Kolhan formation of Jhinkpani, Singhbhum district. *Bihar-Geologische Rundschau.* 1964;53:758−779.
10. Folk RL. *Petrology of Sedimentary Rock.* Hemphill Publ. Co: Texas; 1980. 184 p.