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Lower Vindhyan Rocks around Hirapur and its Relationship with the Basement Granites

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Abstract: ***The rocks of Semri Group are well developed in Son valley area with almost all of its succession preserved. These sediments are also substantially exposed in Bundelkhand area around Hirapur. They rest unconformably over Bundelkhand Granite with a profound non-conformity whereas their contact with the Bijawar Group is either a marked angular unconformity or disconformity. Both these unconformities can be mapped for several kilometers where the ferruginous clastic rocks of Bijawar Group mostly comes in contact with Semri Group. The sequence is well exposed along road and river cuts where the hillocks of Semri Group form a conspicuous hogback and cuesta topography. Lower Vindhyan succession starts from a horizon of rippled, thinly laminated, medium to fine grained glauconitic sandstones followed by a similar layer without glauconite. The sinuously crested asymmetric ripple marks and planner cross laminations show a NW directed palaeocurrent. Along Kalidhar River near Chouki village, these rocks grade in to thin layers of siltstones and glauconitic shales which often shows small scale ripple marks. The entire sandstone unit is locally known as Pandwafall Sandstone and is overlained by a rather thin unit of dolomitic limestone best exposed in nearby Tapariya village. The limestone surface shows less developed elephant skin weathering and is plane and thinly laminated. It rarely shows ripple marks and is locally termed as Ken Limestone. This carbonate unit is followed by a thin but prominent lenses of glauconitic shale which is highly weathered in appearance due to which it has poor exposure. It is mappable but limited in areal extent and is called as Olive Shale. The three distinct stratigraphic units described above form the entire Semri Group which is overlained by monomictic conglomerate of Kaimur Group.***

Keywords: Vindhyan**,** Semri Group, Bijawar Group, Bundelkhand Granite, Hirapur, Un-conformity

1. Introduction

The Lower Vindhyan sequence which unconformably overlies the Banded Gneissic Complex, or BGC is a distinctive feature of the westernmost portion of the Vindhyan basin in southeast Rajasthan as suggested by (Heron, 1953). Prakash and Dalela (1982) have documented that the Bundelkhand Granite/Mahakoshal phyllites are unconformably overlain by basal sandstone and the conglomerate of the Semri Group/Lower Vindhyans either mark a angular unconformity or nonconformity which is introduced in generalized stratigraphic succession Vindhyan Supergroup in Son valley. In Son valley, the Deoland quartzite of Semri Group which unconformably overlie the basement Bundelkhand granite. The Lower Vindhyan comprises breccia, pellet limestone, stromatolitic limestone, shale and glauconitic sandstone near Chitrakut area (Kumar A. et. al., 2001**).** The basement-cover succession of southeastern Rajasthan is summarized by Prasad (1984). The Semri Group of sediments unconformably overlie the Jhirgadandi Granite which overlie the Mahakoshal Group of rocks demarcated in generalized geological succession given by Mohan K. (2007, and references therein) . The time span (1.7 Ga) of the deposition of Lower Vindhyan (Semri Group) rocks is discussed by Mishra, (2011). In Son Valley area, the Lower Sasaram Sandstone of Kaimur Group conformably underlies the Rohtas Limestone of the Semri Group (Sen S., Mishra M., 2015). The stratigraphic succession of Mohar area comprises the Bundelkhand Granitoid Complex (BGC) overlain by basal unit of Semri Group which is not exposed and has a unconformably contact with the collapse breccia member (CBM) of Mohar formation (Gour V. P. et. al., 2016). The basement rock of the 1854±7 Ma Hindoli Group (Deb et al., 2002), the 2492±10 Ma Bundelkhand Granite (Mondal et al., 2002), or the terminal Archaean Berach Granite (~2.5 Ga) is unconformably overlain by the Semri sediments of Vindhyan Supergroup (Rathore S. S et. al.2022).

None of the aforementioned works describe the basement-cover relationship of the Vindhyan sequence exposed around Hirapur. The present work is therefore taken up with a view to document the unconformity bounded Vindhyan succession.

This work is carried out around Hirapur area of Sagar-Chhatarpur district, Madhya Pradesh through fieldwork and lithofacies identification in the research area. The Semri Group (Lower Vindhyan) of rocks are seen at road-cut site of Pathanwali-ki-ghati near Shahgarh where Olive shale unconformably overlies the basement Bundelkhand Granite with a profound non-conformity and along the Baxwaha road where the sandstone overlie the Karri ferruginous shale which marked a angular unconformity, Kalidhar River section near Chouki/Tapariya village comprises the various lithounit of Semri Group of rocks consists (Pandwafall sandstone, Glauconitic sandstone, Olive shale, Ken Limestone) which unconformably overlies the Bijawar Group near Hirapur.

General geological set up

Hirapur area of Sagar and Chhatarpur district, Madhya Pradesh covering the part of Survey of India toposheet no.54P/3. Hirapur town is situated around 80km NE of the Sagar city, connected with the Sagar-Chhatarpur state highway marked in the Fig.1. The Bundelkhand Craton is

one of the ancient Precambrian crust of Indian subcontinent with rocks dating back to the Archean Eon (around 2.5 to 3.3 billion years old). It is often referred to as the Bundelkhand Shield, which signifies its stability and resistance to tectonic activities over long geological periods. Shield areas are characterized by their old and stable geological features. The surface geology of Bundelkhand craton consists variety of rock type including granites, gneiss and metavolcanic. The overlaying Bijawar basin is geomorphologically distinguished by a variety of features, including low-lying zones, plains, and rolling terrains, after the basement morphology. In addition, the Vindhyan plateau is a flat area that rises over the Bundelkhand granite basement and Bijawar basins. The Vindhyan basin, that occupies 1, 04, 000 square kilometers and is located in the Central Indian states of Bihar, Uttar Pradesh, Madhya Pradesh, and Rajasthan, is an intracratonic sedimentary basin. The rocks of the Vindhyan Supergroup comprise an important phase in the Indian subcontinent's late Meso-Neoproterozoic geological evolution of Proterozoic Eon. The Vindhyan sediments span a vast geological time scale, ranging from the Precambrian to the Paleozoic eras. The Vindhyan plateau The geological sequence is well-exposed in road and river cuts. The Semri Group rocks are significant geological unit prominently exposed in the Son Valley area and the Bundelkhand region near Hirapur. These sediments rest unconformably over the Bijawar Group is characterized by marked angular unconformity or disconformity and over Bundelkhand Granite displaying a profound non-conformity with Olive shale. These unconformities extend over several kilometers, particularly where the ferruginous clastic rocks of the Bijawar Group interface with the Semri Group. This plateau is an extensive flat-topped region within the Bundelkhand Craton. It is known for its sedimentary rock formations, including sandstones, shales, and limestones.

Structural set-up

There are many sedimentary (primary) as well as deformational structures (secondary) present in Semri Group of rocks. They consists structures like planar bedding, thin lamination bedding, symmetrical and asymmetrical ripple marks, bifurcation and paleocurrent direction of ripple mark, unconformities (angular and non-conformable), folds, offsetting, faults.

Figure 1: Geographical location map of Hirapur

2. Methodology

The work is have been done around Hirapur town which is close to Mardewra village of Sagar-Chhatarpur district, Madhya Pradesh. It includes fieldwork, lithofacies identification and marking of unconformable contact related to basement rocks. The Semri Group of rocks are studied at Hirapur, beside the Baxwaha road, along the Kalidhar River in Chouki/Tapariya village and road-cut site of Pathanwali-ki-ghati near Shahgarh.

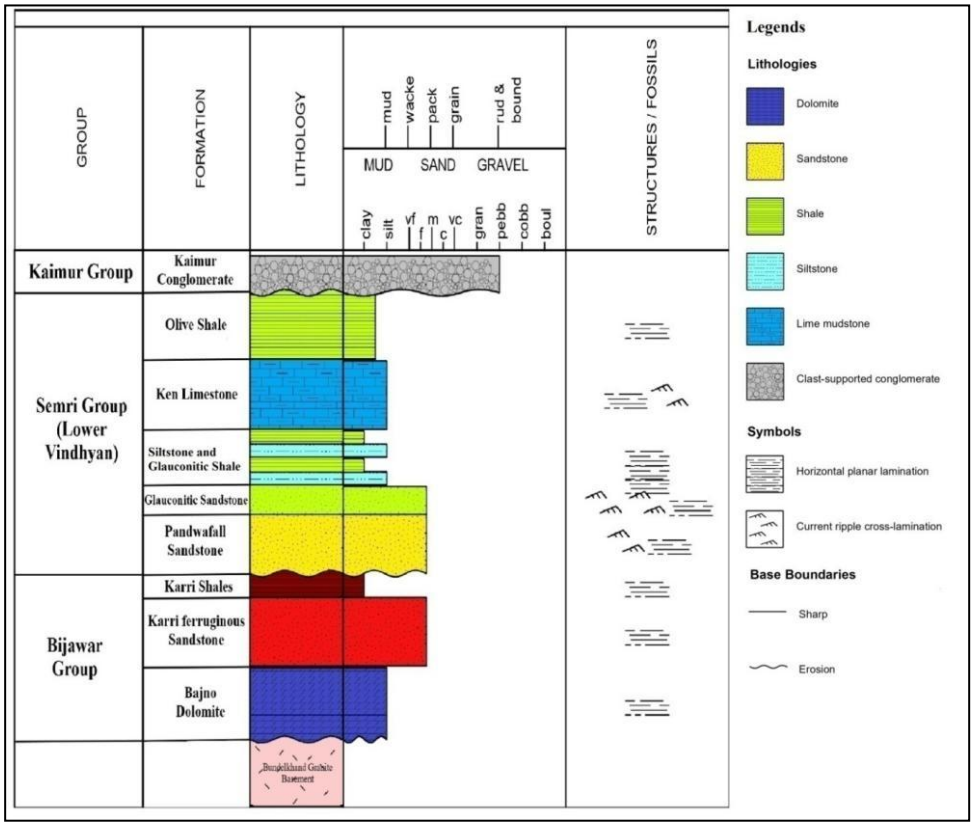

Figure 2: General litholog of the area

Facies interpretation

The Lower Vindhyan succession within the Semri Group commences with rippled, thinly laminated, medium to fine-grained glauconitic sandstones, Pandwafall Sandstone and Olive Shale, overlies the sandstone unit and is succeeded by a relatively thin layer of impure Ken Limestone, these three distinct stratigraphic units together comprise the Semri Group, which is overlain by the monomictic conglomerate of the Kaimur Group. Paleoproterozoic intra-cratonic Bijawar Group consist upper Kari ferruginous sandstone and shale in contact with Semri group of rocks around study area.

Gap in research/work

The Lower Vindhyan succession within the Semri Group commences with rippled, thinly laminated, medium to fine-grained glauconitic sandstones, followed by a similar layer lacking glauconite. Near Chouki village along the Kalidhar River, these rock units transition into thin layers of siltstones and glauconitic shales, often displaying small-scale ripple marks. A distinct stratigraphic unit, locally referred to as Pandwafall sandstone unit is overlays and succeeded by a relatively thin layer of impure Ken dolomitic limestone exhibit elephant skin weathering, best exemplified in Tapariya village near Hirapur. Ripple marks are infrequently observed in Ken Limestone. Immediately following the carbonate unit is a thin but conspicuous lens of glauconitic shale, which, due to extensive weathering, exhibits limited exposure. Although it is mappable, its areal extent is restricted, and it is referred to as Olive Shale

Figure 3: Glauconitic Olive Shales of Semri Group having non-conformable contact with basement granite exposed at Shahgarh.

Figure 4: Contact between Bijawar fine grained ferr-uginous shale and Semri sandstone represent a mark disconformity at Chouki village near Hirapur

Figure 5: A small scale listric offset observed in Pandwafall Sandstone near Kalidhar river. The layers have been slightly buckeled across the fault.

Figure 6: Slumping seen in sandstone and shale of Lower Vindhyan exposed near Pathanwali-ki-Ghati, Shahgarh.

Figure 7: Lower Sandstone overlain by Glauconitic Shale and these Shale underlying below impure Ken Limestone lithounits belongs to lower Semri Group

Figure 8: Slickenside in Pandwafall Sandstone, near kalidhar river, Tapariya village

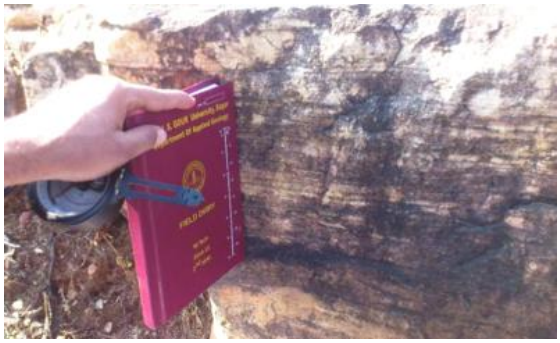

Figure 9: Planar laminations within sandstone of Semri Group near Baxwaha road, Hirapur

Figure 10: Asymmetrical ripple mark in impure Ken limestone of lower Semri Group of rocks

Figure 11: Symmetrical ripple marks in Pandwafall sandstone of lower Vindhyan Supergroup of rocks

Figure 12: Stylolites in Ken limestone near Kalidhar river, Tapariya village.

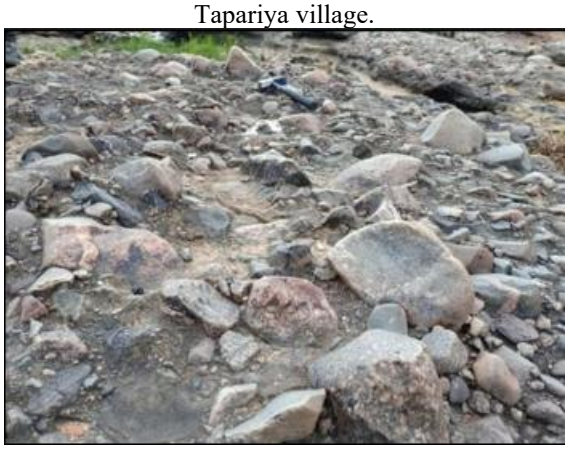

Figure 13: Kaimur conglomerate of upper Vindhyan Supergroup of rocks.

Figure 14: Cross lamination in Kaimur sandstone, near Hirapur.

3. Results and Discussion

The Lower Vindhyan succession within the Semri Group commences with rippled, thinly laminated, medium to fine-grained glauconitic sandstones, followed by a similar layer lacking glauconite. The presence of sinuously crested asymmetric ripple marks and planar cross-laminations indicates a paleocurrent flowing in a northwest direction. Near Chouki village along the Kalidhar River, these rock units show transition into thin layers of siltstones and glauconitic shales, often displaying small-scale ripple marks. A distinct stratigraphic unit, locally referred to as Pandwafall Sandstone, overlies the sandstone unit and is succeeded by a relatively thin layer of dolomitic limestone, best exemplified in Tapariya village. The limestone's surface is even and lightly laminated, displaying more primitive elephant skin weathering. Commonly recognized as Ken Limestone, ripple marks are rarely seen locally. The carbonate layer is succeeded subsequently by a thin but noticeable glauconitic shale lens that shows restricted exposure as a result of intense degradation. Although it is mappable, its areal extent is restricted, and it is referred to as Olive Shale.

The basement is unconformably overlain by olive shale. Bundelkhand Granite with significant nonconformity and the sandstones of Semri Group lies on top of the Karri ferruginous shale, resulting in an angular unconformity.

4. Conclusion

The study of the Semri Group in the Son Valley area and Bundelkhand region has revealed a complex geological history marked by unconformities and a diverse range of sedimentary rock types. This research enhances our understanding of the geological evolution of the region and provides valuable information for future geological studies and stratigraphic correlations. The distinct lithological units within the Semri Group, as described in this work, contribute to our broader understanding of the Lower Vindhyan succession and its paleoenvironmental significance.

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