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## **SEDIMENTARY STRUCTURES IN THE PART OF GWALIOR DISTRICT (MADHYA PRADESH)**

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### **ABSTRACT**

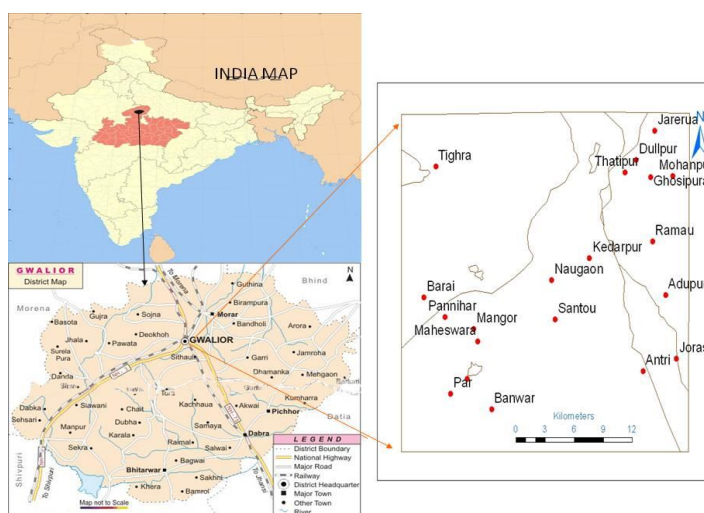
In the present paper, various types of tectonic and sedimentary structures are discussed such as joints, fractures, faults, unconformity, dyke, bedding plane, ripple marks, current bedding etc. Sedimentary rocks are the secondary rocks, in which the presence of different layers, beds or strata distinguishes them from the igneous ones in the study area. Sedimentary structures are important because they are the most valuable features for interpreting the depositional environment. Petrologically, the sandstone is white and pinkish coloured rock. In the study area primary and secondary structures are observed in Par, Morar and Kaimur formations.

**Key Words:** *Sedimentary Structures, Gwalior Group, Vindhyan Supergroup, Field Interpretation*

### **INTRODUCTION**

The present study covering an area of approximately 500 sq. km is located between longitude 78°0' to 78°15' E and latitudes 26°0' to 26°15' N (Fig.1). Hacket (1870) was the first to study the sedimentary rocks of southern part of Gwalior and gave the name of Gwalior series. Heron (1917) mentioned that the Gwalior series appears to be a platform analogous to geosynclinal sediments of Delhi system. Bajpai(1935) studied the traps which are exposed at Gwalior, Morar, Barai, Panihar, Chaura, and Mo in the Gwalior district. It occurs in the Morar formation as sills, dykes, and lava flows. The porphyritic quartz-dolerites, which show distinct ophitic structure are described generally as lava flows (Pascoe 1950; Wadia 1953; Krishnan 1968). Pateriya and Singh (1994) studied the geology of the part of Gwalior area. The lithological characteristics of different formations of the Gwalior area have been described by Singh and Singh (2011).

Sedimentary rocks are usually stratified due to variation in conditions of their deposition. As a result, they typically display a banded appearance on a photograph, although the width of bands depends on their altitude as well as thickness of individual strata (Duary, 1946).



**Figure 1: Location and Approach Map of Study Area**

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Geologically, the oldest rocks exposed in the study area are referred to as Bundelkhand Granite. It is intruded by quartz veins. The other formations deposited over the Bundelkhand massif along its northwestern margin are known as 'Gwalior Group'. It is overlain by Kaimur sandstones of upper Vindhyan Supergroup. Geologically, the study area is covered by the Archaean, Precambrian and Vindhyan Supergroup ( Fig 2). The Gwalior group of rocks divided into the older Par formation consisting of quartzites and sandstone while the younger Morar formation comprising chiefly ferruginous shales. The Par and Morar localities in this area are the Type areas of these Par and Morar formations separated each other by an unconformity.

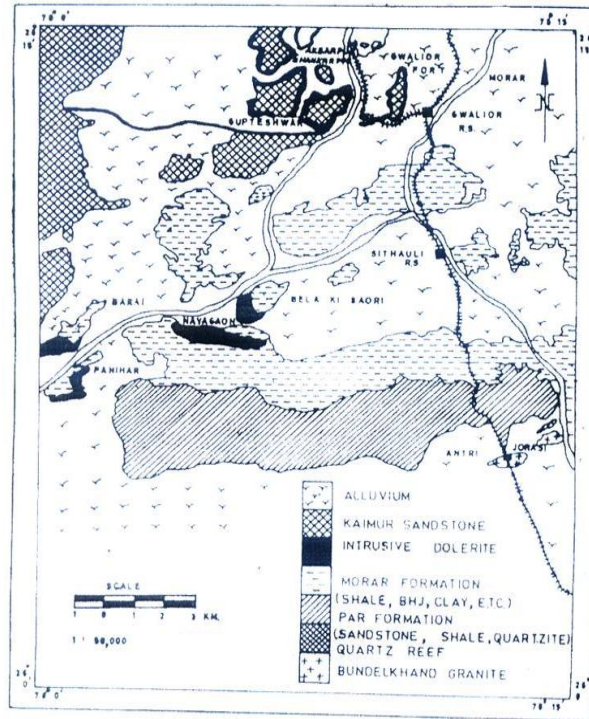


Figure 2: Geological Map of the Gwalior area (after Pateriya and Singh ,1994)

### MATERIALS AND METHODS

Field observations were carried out around Gwalior .Structural interpretations are based on the outcrop pattern and general orientation of the structural elements (both planar and linear structures) of sedimentary rocks. Sedimentary rocks are the secondary rocks, in which the presence of different layers, beds or strata distinguishes them from the igneous and metamorphic rocks. Depending on the mechanism of formation, the inorganic structures observed in the study area are as follows:

#### **Tectonic Structures:**

The process involving the breaking & bending of the earth's crust under interval of earth forces is known as tectonic movement (Mahapatra, 1990). Sedimentary beds are most suitable for preserving the records of crustal disturbances. As a direct result of diastrophism, the major group of structures produced in the sedimentary rocks were observed during field survey are:

#### **Minor Fault / Displacement:**

Faulting or displacement may result in the rupture of rock bodies into different parts or blocks and separation of these blocks relative to each other for distances varying from a few centimeters to many meters depending upon the nature of processes involved. The displacement of rocks is observed at Golpahadia hill near Gupteshwar temple (Fig. 3).

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**Figure 3: Minor displacement near Gupteshwar temple at Golpahadia on Tighra road side**

**Joints:** Joints are fractures along which no significant displacement has occurred. They are found in dolerites (Fig. 4) and sandstones (Fig. 5). Two or more joint sets intersecting each other produce a joint system. Joint systems are also observed.



**Figure 4: Joints exposed in dolerite near Kundawell, Nayagaon**



**Figure 5: Joints exposed in sandstone of Vindhyan Supergroup near Golpahadia**

**Unconformity:** An unconformity is a plane of discontinuity that separates two rocks, which differ notably in age. It is observed in the unconformable structure in which the older formation is made up eventually of plutonic rocks, while the younger formations are sedimentary rocks. The conglomeritic bed representing unconformity between Bundelkhand Granite and Par sandstone has been observed near Par village (Fig. 6). It consists of quartz and pebbles having 1.5 metre thickness. The structures formed



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through tectonic movement control the local pattern of drainage. The other unconformities were observed between Kaimur sandstone and Morar shale near Gupteshwar temple at Golpahadia (Fig. 7) and between Par sandstone and Morar shale near Jorasi village .



**Figure 6: Conglomeratic bed seen between Bundelkhand Granite and Par Sandstone near Par village**



**Figure 7: Conglomeratic bed between Vindhyan sandstone and Morar shale near Golpahadia**

### Primary Structures

Primary structures are those that are formed simultaneously during the formation of the rock. It is formed due to mechanical action of currents. These structures observed during field survey in the study area are:

**Bedding or stratification** : Sedimentary rocks occur in well defined layers or show the structure of stratification. In this rock, insoluble mechanically transported material is deposited in layers on the surface of accumulation, which is horizontal. Stratification is the result of variation in composition of different layers (Fig. 8 and Fig. 9).



**Figure 8: Banded hematite jasper seen in different layers at Railway cutting section near Harishankarpuram, Gwalior**

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**Figure 9: Stratification seen near Bela Ki Baori on AB road(NH3)**

**Ripplemarks:** Ripple marks are wave like undulatory structures found in sedimentary rocks. These ripple marks show current direction and environment of deposition. These are minute undulations formed due to current or wave action developed on arenaceous rocks. These are asymmetric in nature, having parallel, long, more or less equidistant ridges trending in straight lines at right angles to the direction of current. Here both the crest and trough are rounded and developed in the Par sandstone near Jorasi village (Fig. 10) and also near Gwalior Fort in Kaimur sandstone(Fig. 11).



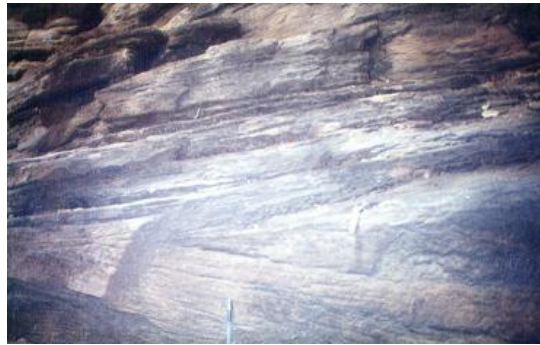
**Figure 10: Ripple marks seen in the Par sandstone near Jorasi village**



**Figure 11: Ripple marks in Kaimur sandstone at Gwalior fort**

**Current bedding:** It is found within sedimentary rocks, especially Kaimur sandstone (Fig. 12). It is formed due to change in the velocity and direction of flow of water.

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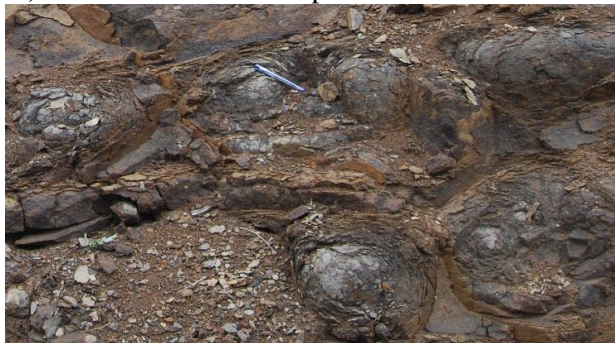
**Figure 12: Current bedding in Kaimur sandstone at Gwalior fort**

**Cross beddings:** Cross -stratification is characterized by bedding oriented at an angle to the bedding surfaces that mark top and bottom of the cross- stratified unit.(Davis,1984).It is common primary structural elements found within clastic sedimentary rocks, especially sandstone (Fig. 13).



**Figure 13: Cross bedding seen in the Kaimur sandstone near Gwalior fort**

**Spheroidal Weathering:** Differential weathering gives rise to the development of feature spheroidal boulders in dolerites (Fig. 14).It is formed due to the process of exfoliation.



**Figure 14: Spheroidal weathering seen in dolerite at Kunda well near Nayagaon**

**Local warping:** Minor anticlinal warping has developed in the shale of Morar formation (Fig. 15).



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**Figure 15: Minor anticlinal warping seen in Morar shale near Nayagaon (NH3) AB road**

**Table 1: Tectonic structures of the study area**

S.No.	Locations	Lithology	Formations	Tectonic Structures
1.	Golpahadia hill near Gupteshwar temple	Sandstone	Kaimur	Minor fault/Displacement
2.	Near Gupteshwar temple at Golpahadia	Sandstone and Shale	Kaimur and Morar	Unconformity
3.	Near Jorasi village	Sandstone and Shale	Par and Morar	Unconformity
4.	Par village	Bundelkhand Granite and Par Sandstone	Granite and Par	Unconformity
5.	Gwalior fort	Sandstone	Kaimur	Joint

**Table 2: Primary Structures of the study area**

S.No.	Locations	Lithology	Formations	Primary Structures
1.	Gwalior Fort,	Sandstone	Vindhyan	Ripplemarks, Cross bedding
2.	Par village	sandstone	Par	Cross bedding and Current bedding
3.	Bela Ki Baori, Panihar, Kunda well near Nayagaon	Dolerite	Intrusive	Spheroidal Weathering
4.	Railway cutting section	Shale	Morar	Banding and Quartz lenses
5.	Manderi Ki Mata Hill	Shale	Morar	Bedding or stratification

**RESULTS AND DISCUSSION**

Lithologically the three groups are exposed in the part of Gwalior area, which are Archean, Precambrian and Vindhyan Super group. Gwalior groups of rocks are belonging to Precambrian age. Sedimentary rocks are the secondary rocks, in which the presence of different layers, beds or strata have been distinguished in the study area. Sedimentary structures are easily identified in comparison to other structures. Structurally, various types of tectonic and primary structures are found in the sedimentary rocks occurring in the study area such as stratification, ripple marks, bedding plane, spheroidal weathering etc. These structures are well exposed in following locations (Table 1 and Table 2). The displacement of rocks is observed at Golpahadia hill near Gupteshwar temple. The conglomeritic bed represents the unconformity between various strata in the study area.

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