SEDIMENTARY STRUCTURES IN THE PART OF GWALIOR DISTRICT
(MADHYA PRADESH)
Vineesha Singh and U.C. Singh
School of Studies in Earth Science, Jiwaji University, Gwalior
*Author for Correspondence

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
Research Article

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 ferrigenous 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)](image)

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).
**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.

**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
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.

**Research Article**

**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 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

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

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.
Research Article

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).
Table 1: Tectonic structures of the study area

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

Table 2: Primary Structures of the study area

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

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.
REFERENCES


