2.1 INTRODUCTION

The occurrence, origin, distribution and movement of ground water is controlled mainly by the lithology and structure of the water bearing formations. Aquifer parameters like porosity and permeability will help in storing and transmitting water. The crystalline rocks, which are also known as "Hardrocks" (Radhakrishna, 1971, 1992) are impermeable whereas sedimentary rocks are porous and permeable. The porosity and permeability of the hard rocks may be attributable to process of rock fracturing and weathering, controlled by topography, lithology, structure and climate. Whereas mineralogy and chemistry of aquifer influences the chemical quality of groundwater. Therefore, knowledge of geological set up of the basin is very essential in hydrogeological and geo-environmental studies. Hence, in this chapter, the geology of Varada River basin is discussed.

2.2 GEOLOGY OF KARNATAKA

Karnataka craton of southern India is one of the oldest Archaean terrains of the world and exposes large section of continental crust. It is mainly comprised of low k-tonalitic to trondhjemitic gneisses (Peninsular gneiss) with in folded supracrustal (Sargur group) and capped by younger series of volcano sedimentary sequences (Dharwar super group). Calc-alkaline granites (Closepet granite) form the latest Archaean magmatic event in the craton. The pronounced N-S elongation of regional grain in the craton is one of the most important and conspicuous feature. The strong N-S trending fabric of the Dharwar craton is partly due to late Archaean transcurrent shearing episode (Drury and Holt, 1980, Chadwick et al., 1989) and is contemporaneous with the emplacement of Closepet granite (Jayananda et al., 1993), which forms the boundary between the Western block and Eastern block. The western block is characterised by large (Dharwar type) Schist belts, showing evidences of having accumulated in distinct sedimentary basins and the Eastern block is characterized by voluminous juvenile granites and remobilized gneiss with remnants and slivers of schist belt (Kolar type).
Proterozoics belongings to the Kaladgi, Bhima and Badami group are well exposed in the north part of the state. Basalts of the olistolith composition belonging to the Deccan trap are also exposed in the northern part of the state. The laterite cappings are found along the Coastal plains and also as discontinuous sheets on the Plateau (Fig. 2.1.).

2.3 GEOLOGY OF THE VARADA RIVER BASIN

Geologically Varada river basin forms the part of western Dharwar craton and principally comprised of gneisses, manganiferous phyllite, BIF, quartz-chlorite schist, greywacke and basic intrusives. These lithounits are covered by the indurated horizons of ferruginous duricrust i.e. laterite (Fig. 2.2). The spatial distribution of the lithounits are given in Table 2.1

2.3.1 Gneisses

Poly phase migmatitic granodiorite to tonalitic gneisses of Archaean age are widespread in the Dharwar craton. The controversies regarding the basement cover relationship and relative age of schists and the gneisses have existed since long. However, the gneissic complex is divided into two viz., the Older Gneisses Complex (OGC) and Younger Gneissic Complex (YGC) (Radhakrishna and Vidyarnadhan, 1994; Ramakrishnan, 1994). The younger group of gneissic rocks are mostly of granodioritic and granitic in composition generally found in the eastern parts of the state, representing remobilised parts of an older crust with abundant additions of newer granitic material. Where as the older gneisses are tonalitic-trondhjemite-granodioritic in composition and act as basement for the wide spread schist belts. Recent studies have shown that Western block has both OGC and YGC (Ramakrishnan, 1994).
Fig. 2.1 Geological map of Karnataka
Fig. 2.2 Geological map of Varada river basin
In the study area, the older gneisses are confined to southern part of the basin. These are grey in colour, highly jointed and weathered. Trend of the gneissic foliation varies from NNW-SSE to NW-SE direction and the dip also varies from $30^\circ$ to almost vertical ($80^\circ$). The component of younger gneissic complex is exposed near Chandragutti in the west central part of the basin. These occur as bouldary out crops (Fig. 2.3) and are less weathered and jointed.

![Fig.2.3. Out crops of younger gneiss exposed at Chandragutti](image)

2.3.2 Manganiferous Phyllite

Bands of manganiferous chert, quartzite and phyllite occur as marker horizons (Radhakrishna and Vaidhyanadhan, 1997) in almost all the schist belts of the Dharwar craton. Quite often beds of pure manganese oxides alternate with bands of chert are not uncommon. In the study area Manganiferous phyllite bands occurs as minor component and confined to south and southeastern parts. The general
strike of these bands is NW-SE and dipping westerly with varying angles. Highly weathered phyllite is exposed near Averguppa in Siddapura taluk.

2.3.3 Banded Iron Formation

Banded iron formation is the characteristic and distinct formation of all the younger schist belts (Radhakrishna and Vaidhyanadhan, 1997). In the study area it is an insignificant lithounit and exposed in north-eastern corner and southern part of the basin as minor bands. At places it grades into ferruginous quartzite.

2.3.4 Greywacke

Greywacke is one of the important lithounit in the study area and its occurrence is confined to eastern and southern margin of the basin. This rock is weathered, fractured and jointed. Weathering is generally seen to the extent of 50-60 feet on an average. Joints are spaced at 2-3 feet intervals and are open in the upper level and get closed at depth. The fresh surface of the rock is light green in colour and is devoid of joints. The strike direction of this rock varies from NNW-SSE to NW-SE with steep dip towards east. The exposures of greywacke are found near Jambani and Kanur in Sagar and Siddapur taluks respectively.

2.3.5 Laterite

The term laterite was coined by Buchanan (1807) and is applied to a peculiar hardened earthy material, diffused in immense masses without any stratification. Laterites are the products of intense sub aerial weathering of rocks (Schellmann, 1981) and are considered to be formed during Tertiary period (Viswanathaiah et al., 1974). Laterite is broadly defined as a product of intense rock weathering, generally reddish in colour and consists mainly of kaolinite, goethite, hematite, gibbsite and quartz. It is vesicular and vermicular in appearance, soft when it is fresh but hardened on exposure.
Generally, two types of laterites are distinguished as *detrital* or *coastal laterite* and *in-situ laterite*. The coastal laterite is generally detrital in nature, sandy and contains well rounded pebbles of the size and shape of the bird’s egg. The in-situ laterite is more homogenous less sandy and formed due to alteration of the underlying rocks in place. This laterite does not contain pebbles in them and is confined to ghats at elevation of 600 m and above.

Laterite is the most important lithounit in study area and covers about 70% of Varada river basin. The laterite found in the study area is in-situ laterite, it is reddish in colour, pervious, soft when it is fresh and hardened on exposure. Because of this reason it is cut into bricks for building stones (Fig. 2.4). It is also a good aquifer (Fig. 2.5) because of its pervious nature which helps to hold and transmit good amount of water.

**Table 2.1 Spatial distribution of lithological units in Varada river basin**

<table>
<thead>
<tr>
<th>Lithounits</th>
<th>Area (sq km)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gneisses</td>
<td>77.14</td>
<td>5.26</td>
</tr>
<tr>
<td>Manganiferous Phyllite</td>
<td>7.28</td>
<td>0.49</td>
</tr>
<tr>
<td>Quartz chlorite schist (Banded Iron Formation)</td>
<td>58.81</td>
<td>4.01</td>
</tr>
<tr>
<td>Greywacke &amp; Argillites</td>
<td>287.80</td>
<td>19.64</td>
</tr>
<tr>
<td>Laterite</td>
<td>1033.82</td>
<td>70.57</td>
</tr>
</tbody>
</table>
Fig. 2.4 An view of laterite quarry near Talaguppa, being cut into bricks for building stones.

Fig. 2.5 An open well in laterite near Talaguppa having a good yield.