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A STUDY ON ASSESSMENT OF GEOLOGY AND HYDROGEOLOGY CONDITIONS OF GROUND WATER IN VISAKHAPATNAM AREA- A CASE STUDY

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Abstract:-In this Study the regional geology as well as the detailed local geology are mentioned covering aspects like geological structure of the area and petrography. Details of ground water occurrence, ground water conditions in different aquifers, water table configuration and the water table fluctuation in the study area have been discussed under the geology, hydrogeology conditions of the study area.

Keywords:Geology, Hydrogeology, Khondalite, Charnockites, Aquifer, Soils, Lithology

INTRODUCTION

The study area geologically belongs to Precambrian age and characterized by occurrence of meta sediments and intrusive meta igneous bodies. The high hill ranges namely kailasa, Yarada and Duvvada surround the study area in three directions and other side the bay of bengal makes the boundary. In this way the region is endowed with different physiographic features and resulting in picturesque sequence. Apart from meta sediments the area is also marked by the occurrence of recent sediments such as red sediments with calcium carbonate calcretes, dune sands beach sands with economically important black sand concretions. All these rocks and sediments characteristically exhibit a variety of geomorphic features distributed from deepest hinterland to near coastal plains. Lithologically, these Khondalite and charnockite areas favoured groundwater conditions. In the charnockite areas, the wells having depth to water level from 7 mbgl (Meter below ground level). In the same way the depth to water level ranged from 4 mbgl to 15 mbgl in khondalite areas.

Petrography
Garnet-Sillimanite-Gneisses (Khondalite)

These are medium to coarse grained light dusty brown coloured with varying shades of brown to dark brown composed by quartz, perthite, garnet, plagioclase, biotite, sillimanite as essential minerals and apatites, zircon, graphite as accessories. Hard compact fine-grained (0.5mm) variants of the same rock are similar to the coarse grained varieties in composition but sillimanite, magnetite occupy the accessory mineral phase.

GEOLOGY OF AREA

Garnet sillimanite gneiss (Khondalite) hypersthene granite (Charnockites) garnetiferous granites (leptynites) Quartzite, pegmatites are the chief rock types occur as bedded and banded as well

as massive formations in the study area. About 90% of the areas are occupied by khondalite group of rocks covering hill ranges of northern part and hillocks in the central part. Garnet-biotite sillimanite gneiss as well as garnet sillimanite gneisses are present in the Yarada hill, hillocks of Waltair and at northern hill ranges to a minor extent.

Occurrences of white and gray coloured quartzite's with thickness of few centimeters to thousand meters are also common. Charnockites can be called as hypersthene bearing granite and mainly occur as two types. They are hypersthene bearing granite rocks and porphyritic ferro hypersthene granodiorites. In the study area, these rocks occur at Mudasarlova and pendurthi. They are blue, bluish black and greenish black in colour, hard and compact, medium to coarse grained with specific gravity varying from 2.7 to 3.3. Mineralogically they are composed of quartz, feldspar, hypersthene, biotite and granet. The accessory minerals include, apatite, monazite, zircon, and iron ores. Depending up on variation in felsic minerals the overall composition will vary from acidic to basic.

According to Rao and vijaya Kumar (1982) the Charnockites mostly confined to the axis of over turned folds exhibited by Khondalite hill ranges and occasionally shows a stock like intrusive relationship with garnet-biotite, granite(leptynites).Leptynites occur in association with khondalites and Charnockites having variable thickness of new meters to 1500 meters, which are mostly confined to Waltair area. The geology of the area is given in fig.2.1

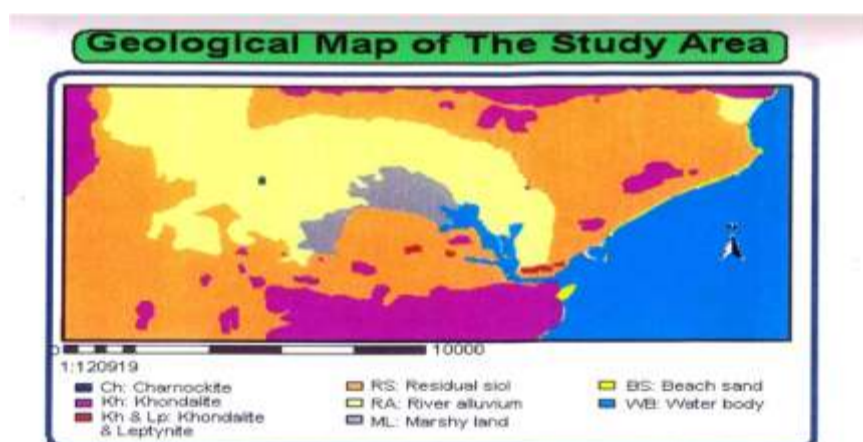


Fig. 2.1

Structure of the area

Khondalite series of rocks marked with bedding foliation boundaries, lineation and joints. Garnet-Sillimanite gneiss at yarada Konda exhibits a general strike of NE-SW having 500 to 800 SW dip. The strikes are variable from N 750 E (Eastern) through E-W (central) to N750 W (Southern) and showing southerly dip of 600-800. In the Waltair area Charnockite bands occur with E-W strike and 600 0 900 step angled southerly dips characterized by felsic mineral bands with four sets of joints and ENE-WSW lineaments.

Natarajan and Nanda (1981) studied the structure of this area in detail. According to them this area can be classified into a large-scale basin coupled with a domal structure near Madhuravada. This area can be termed as Archeans high-grade metamorphic migmatite complex of the eastern ghat mobile belt. Two major phases of deformation were identified one of which shows regional continuity and developed non-plunging tight and isoclinal folds. The axial trends of these folds vary from NE-SW to ENE-WSW.

HYDROGEOLOGY OF THE AREA

The ground water occurrence is dependent on a variety of factors such as lithology,

geomorphology, rainfall, drainage etc. As already mentioned, the area of investigation can be broadly divided into charnockite and khondalite areas. The khondalite area is further distinguished into fractured khondalite, weathered khondalite and khondalite areas. The aquifer conditions of these areas covered in the present study have been discussed here.

GROUND WATER CONDITIONS IN DIFFERENT AQUIFERS

Aquifer: Aquifers are the permeable formations having structures which permit appreciable quantity of water to move through them under ordinary field conditions. Thus, these are the geologic formations in which ground water occurs.

The ground water conditions of the aquifers localized in plains as well as charnockite and khondalite areas have been studied considering the depth of water table and ground water fluctuation.

Charnockite Areas

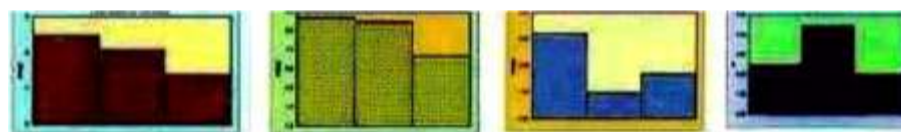


Fig. 2.2 A: GROUND WATER CONDITION IN DIFFERENT AQUIFERS CHARNOCKITE AREA

These wells are mainly circular in shape and are generally constructed with connecting rings. The diameter of these wells vary from 2.42 to 6.15m. Water from these wells is mostly used for domestic purposes.

Depth of the dug wells in this category vary from 7.40 to 8.45 mbgl and histogram of this parameter is shown in fig.2.2. A at a mode of 7.3 to 8.5. During pre-monsoon period the depth of the water table ranges from 3.70 to 5.70 mbgl and histogram at a mode of 3.8 to 5.8 while it ranges from 1.00 to 3.20 mbgl during post-monsoon period with histogram at a mode of 1.0 to 3.2. Water levels in the dug wells of this category are reported to fluctuate annually with a range of 2.00 to 4.45 mbgl with histogram at a mode of 2.4 to 4.5.

Khondalite Areas

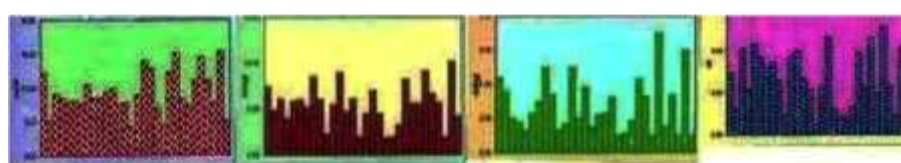


Fig. 2.2 B: GROUND WATER CONDITION IN DIFFERENT AQUIFERS KHONDALITE AREA

In this category also, the dug wells are predominantly circular in shape and the diameter of these wells range from 0.84 to 10.45m. Generally, these wells are constructed with the help of connecting rings and the ground water is exploited in this zone mainly by the dug wells. It is used for domestic purposes.

Fractured Khondalite Areas

Two of the sampled wells come under this category and the diameter of these wells is 1.0 m and 4.85 m. These are circular in shape and are constructed with connecting bricks. The water from these wells is mainly used for domestic purposes.

TABLE-2.1: GROUND WATER CONDITIONS IN VARIOUS AQUIFERS						
Location	Total Depth (mbgl)	Diameter (m)	Depth to Water level (Pre-monsoon)	Depth to Water level (Post-monsoon)	Annual Fluctuation (m)	Lithology
HYDROGEOLOGICAL PARAMETERS IN CHARNOCKITE AREAS(Dug wells)						
Pendurthi	8.45	3.15	5.70	3.20	2.50	Black soil,darkbrown soil
Juttada	8.10	6.15	5.45	1.00	4.45	Kankar,gravel brown soil
Thathichetlapalem	7.40	2.42	3.70	1.70	2.00	Black soil, dark coloured soil
HYDROGEOLOGICAL PARAMETERS IN KHONDALITE AREAS(Dug wells)						
Pedagadi	12.30	1.31	7.40	4.40	3.00	Stone in deep
Jerriputhulapalem	5.30	1.20	4.85	3.60	1.25	Red soil, Yellow white soil
Karakavanipalem	9.10	0.95	6.10	2.00	4.10	Black soil, brown soil
Chintala Agraharam	8.50	1.00	3.99	1.80	2.19	Kankar, white soil
Padmanabhapuram	7.95	1.30	5.85	1.30	4.35	Brown soil, white soil
Narava	8.10	0.95	6.00	2.30	3.70	Brown soil, white soil
Jaggayypalem	7.70	1.20	6.20	3.00	3.20	Kankar, Brown soil
Natayypalem	10.60	3.10	8.50	5.00	3.50	Black soil, brown soil, kankar
China Gantyada	8.50	3.50	6.00	3.40	2.60	Kankar, Brown soil
China Mushidiwada	8.50	1.75	2.30	1.35	0.95	Kankar, Brown soil
Rajyapeta	9.50	1.27	5.45	1.70	3.75	Brown soil, white chalk
Purushothamapuram	10.00	3.65	9.00	5.00	4.00	Red soil, white chalk
Vijunagiripalem	7.60	0.95	4.70	2.00	2.70	Black soil, brown soil, kankar
Adivivaram	7.90	3.60	6.10	3.85	2.15	Black soil,dark brown soil
Bcuhirajupalem	4.30	0.84	2.00	1.50	0.50	Red soil,kankar,white chalk
Sriharipuram	9.00	3.59	4.50	2.20	2.30	Brown soil, sandy material,clay
Pineapplegarden colony	14.00	3.55	7.00	2.35	4.65	Kankar, red soil,brown soil
Marripalem	12.90	1.00	4.50	3.25	1.25	Red soil,kankar,brown soil
Kancharapalem	7.00	2.85	1.85	1.00	0.85	Kankar, brown soil
Gnanapuram	4.30	10.45	1.96	1.15	0.81	Red soil,dark coloured clay
Mudasarlova cheruvu	12.30	1.00	3.25	1.90	1.35	Black clay, brown soil
Suryabagh	15.20	1.10	8.25	4.30	3.95	Black soil,dark brown soil
Soldier peta	8.25	1.50	5.60	3.30	2.30	Black soil, marine clay
Chemudupalem	7.50	5.40	5.60	1.00	4.60	Red soil,brown soil,kankar

A STUDY ON ASSESSMENT OF GEOLOGY AND HYDROGEOLOGY CONDITIONS OF GROUND WATER IN

Thotagaruvu	11.10	1.20	9.10	7.00	2.40	Clay,kankar,red soil
Bokkannapalem	14.50	0.99	6.70	1.55	5.15	Black soil,kankar,white chalk
Gollavaripalem	11.10	1.20	5.70	3.35	2.35	Brown soil, white chalk
Lawsonbay colony	7.60	1.50	1.95	1.00	0.95	Clay, black clay
Yendada	15.30	0.98	10.18	6.00	4.18	Red soil,kankar,brown soil
Rushikonda	5.10	7.85	4.20	1.00	3.20	Sand soil, kankar,red soil
FRACTURED KHONDALITE AREA						
Vepagunta	9.00	1.00	5.30	1.00	4.30	Red soil,kankar
Yarada Konda	22.10	4.85	17.10	12.00	5.10	Kankar
WEATHERED KHONDALITE AREA						
Gorapalli	10.50	1.65	5.90	2.30	3.60	Kankar,gravel, black stone
Satlavanipalem	12.30	0.85	7.50	3.00	4.50	Stcy soil
Golla Jogarajupeta	10.30	3.00	7.30	4.10	3.20	Kankar, sticky soil
Porlupalem	9.20	1.00	8.70	5.95	2.75	Brown soil, Chalk
Kothpalem	6.50	1.00	4.30	2.30	2.00	Kankar, brown soil
Akkireddipalem	7.20	2.30	5.60	3.20	2.40	Black soil, brown soil, gavel
Krishnapuram	12.65	2.20	6.70	2.70	4.00	Brown soil, white chalk
Peda Waltair	10.46	3.60	4.95	1.00	3.95	Caly,Kankar
Kommadi	7.50	1.00	5.70	1.75	3.95	Brown soil,kanakr
M.V.P.Colony	9.70	0.88	7.30	2.00	5.30	Soil, Clay
PM palem	6.25		3.80	1.00	2.80	Red soil, kankar
Gudilovapalem	11.60		8.30	2.80	5.50	Brown soil, Kankar
Chandrapalem	9.34	1.00	9.15	7.15	2.00	Kankar,red soil, brown soil

Weathered Khondalite Areas

Most of the dug wells in this category are also circular in shape and are constructed with connecting rings or bricks. Diameter of these wells ranges from 0.85 to 3.60 m. Ground water in this area is exploited mainly through wells and mostly used for domestic purposes.

LITHOLOGY

Lithologically, these khondalite and charnockite areas favoured groundwater conditions. In the charnockite areas, the wells are having depth to water level from 7 mbgl to 9mbgl (category-II). In the same way the depth to water level ranged from 4 mbgl to 15 mbgl in khondalite areas.

CONCLUSIONS

Hydrogeologically, Majority of the wells sampled confine to the plain areas of the study area. Wells in these plain areas are predominantly showing very shallow to moderate depth of water table, while the wells confined to hilly terrains are more of moderately deep to deeper water table levels. The ground water fluctuations have shown an increase with increase in the depth of the wells. Lineaments are found to have an impact on the ground water occurrence and ground water table configuration and fluctuations. The influence of high density lineament is prominent on the wells in the plain areas. The low density lineaments are associated with moderately deep and deep wells with poor ground water occurrence. The observations on lineament show a good relationship between ground water occurrence and lineament pattern and this aspect can better utilized in ground water exploration in the study area. The lithology has also played a major role in the ground water conditions and also the quality. Wells in the khondalite areas are characterized by relatively more deeper water tables than those in the charnockite areas. The distribution of pH with reference to lithology suggest that the wells in the chrnockite areas have strikingly low pH values (<8) and those in the khondalite areas have moderate to high pH values.

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