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GEOLOGY AND ITS STRUCTUREAL CONTROLS OF GROUNDWATER OCCURRENCE IN PERIYAPATNA TALUK, MYSORE DISTRICT, KARNATAKA

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ABSTRACT

This study aims to evaluate geological and structural influences on groundwater of Periyapatna Taluk. Geology of this area is ranging from Precambrian age for the rocks of granite, gneisses, schist and quartzite rocks, to recent age overlain by thick layers of alluvial deposits. It is an essential resource in outcrop and structures of the area, because of local field conditions, such as rock type and complex structure. The rocks comprise the major hydrogeological units of the deep groundwater system in the study area. The tectonics was important in establishing the distribution of the rocks that control the present flow patterns of groundwater. The study area is affected by tectonic that caused faulting, folding, and fracturing. The main structures that are investigated include faults, fractures, folds etc. These structures greatly influence the groundwater occurrence and flow. Two types of folds (anticline and syncline) act as accumulation and drainage stream channels of groundwater flow and also act as aquifer in the study area. Structural geology observed in the study of fractures in drill holes, the subsurface structures about 150 m- 200 m depth at the boreholes are similar to surface structure, which have been helpful in assessing the surface structure.

KEYWORDS: *Out Crop, Tectonic, Fold, Groundwater, Aquifer, Drill holes.*

1. INTRODUCTION

Water is the important component of the development of any area. The human settlement depends on a large extent on the availability of water resources. In the recent years, the consumption of water is greatly increased due to the increase in human population in the study area. Groundwater is simply water that occurs in the ground; in the pore spaces between mineral grains or in weathering, cracks and fractures in the rock mass. It is usually formed by rain water or snow melt water that sweeps down through the soil into the underlying rocks. Crystalline bedrocks, In this paper we refer to igneous rocks as granite and metamorphic rocks, such as, gneisses, schist, and quartzite, where the inter-granular pore-spaces are negligible and where almost all groundwater flow takes place through weathering, cracks and fractures in the rocks. The formation of the study area was accompanied by tectonic movement as fractures, joints, faulting, folds, and veins. Generally, structures play different roles in ground water quantity and quality, and variations. Collection of this information gives a rather clear picture of the subsurface geology, leading to a better understanding of various water bearing formation and distributions. Structures as hydrodynamic contacts impact on the groundwater flow pattern of an aquifer, as well as, the major structural features impacting on groundwater are fractures and folds. Fractures are subdivided into joints, fissures and faults, which are formed by brittle fracturing of rocks.

2. LOCATION, ACCESSIBILITY OF THE STUDY AREA

The study area is bounded in the north by Hassan district, in the south by Hunsur taluk, in the east by K.R.Nagar taluk and in the west by Kodagu district. Periyapatna is located at 75^{0}24’00’’E -76^{0}30’00’’E Latitude and 11^{0}48’00’’N -12^{0}36’00’’N Longitude. with the geographical area extent of 815 km^2 covering 203 villages, (one town four Hoblies, 26 Gram panchayaths) comes under the Survey of India (SOI) toposheets nos. 57D/2, 57D/3, 57D/4, 48P/14, 48P/15, on a scale of 1:50,000. Periyapatna taluk is one of the 7 taluks of Mysuru district. The other taluks in the districts are H.D.Kote, Hunsur, K.R.Nagar, Mysuru, Nanjangud, and Periyapattana & T.Narasipura. Periyapattana is located at a distance of 185 Kms from Bangalore and 55 kms from the Mysuru district. It comes under the semi-arid region and good motorable road and is very well connected by Mysuru to Periyapatna and also main road of Madacare, Mangalore. A southern railway broad gauge line connects the headquarters passing through the eastern part of the study area. (Figure.1**).** The study area falls in southern dry –agro- climatic zone (VI). The main occupation of the people in the study area depends on agriculture and the Climate of the Periyapatna taluk is moist during the winter and rainy season. The mean maximum temperature is 34°C and the mean minimum temperature is 16°C. The average annual rainfall of as recorded at Periyapatna rain guage station has 854mm, later it has become erratic resulting in drought- prone conditions. The annual precipitation in the hydrogeological area varies from 700 mm to 810 mm. There are two rainy seasons; the long rains from March to June and a minor raining period in November and December.

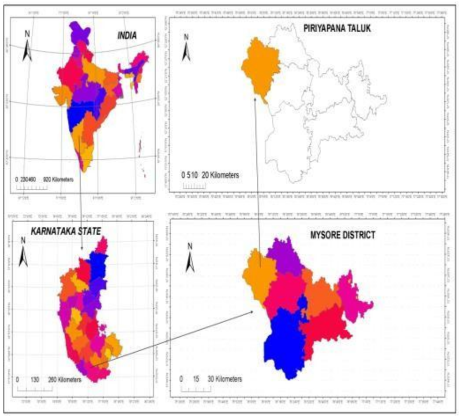

Figure 1: Location of the Study area.

3. AIMS AND OBJECTIVES

The main objectives of this study are

1. The identification, description and evaluation of structures.
2. The interpretation of structures and their impact on ground water flow.
3. The relationships between structures and groundwater.

4. GEOLOGICAL SETTING

The Periyapatna taluk, Mysuru District and covers geographical area of 815 sq.km and covered with 203 villages. Periyapatna taluk is located between 75^{0}24’00’’E -76^{0}30’00’’E Latitude and 11^{0}48’00’’N -12^{0}36’00’’N Longitude. Archaen and Proterozoic age group of rocks are well exposed, underlain by hard rock terrain consisting of peninsular gneisses, amphibolites, migmatites, ultramafics, hornblende-biotite gneiss, charnockites and intruded by dolerite dykes of proterozoic era. Migmatite, granodiorite, Tonalitic gneisses are wide spread and dolerite dykes is very less formation of the study area. Lithologically, 235.06 sq.km of area covered with southwestern part of the taluk by Charnockite and total geographical percentage of which 28.84., 5.32 sq.km is covered with NNW part by Amphibolite’s, area of percentage of 0.65. Major portion of area covered by migmatite, tonalite, migmatite gneiss of 572.42 sq.km and entire northeast and south east, central direction wide spread formation of 70.25%. Dolerite dyke area covered with few places is found to be below the central part of area and SSW and SSE (**Figure.2 and Table.1**). It is very less area of covered with compared to the total geographical extent. Weathering is commonly, more intense along geological structures such as faults and results in deep weathering soils. These zones where joints sets are present in the rock masses, these joints may results in the development of rock in the weathering profile. Basement rocks have shallow depth and human interference with nature has been increasing day by day. Moreover there is an unpredictable onset of monsoon and the search for subsurface water is the ultimate resort of private and government agencies. Quarrying of dykes is on very small scale, which has gone upto a depth of 20 to 25 meters. The frequently blasting of rocks in the surrounding area has a serious effect on the water table conditions, because new fracture will be developed in the basement rocks resulting in the depletion of the water table.

5 Geological formation of the study area

Stratigraphic position	*Rocks of the area* Younger intrusive	Dyke rock
Closepet granites	Coarse to medium pink and grey granite	
Charnockites	Mainly basic granulite	
Older Gneissic	Grey gneisses predominant complex	

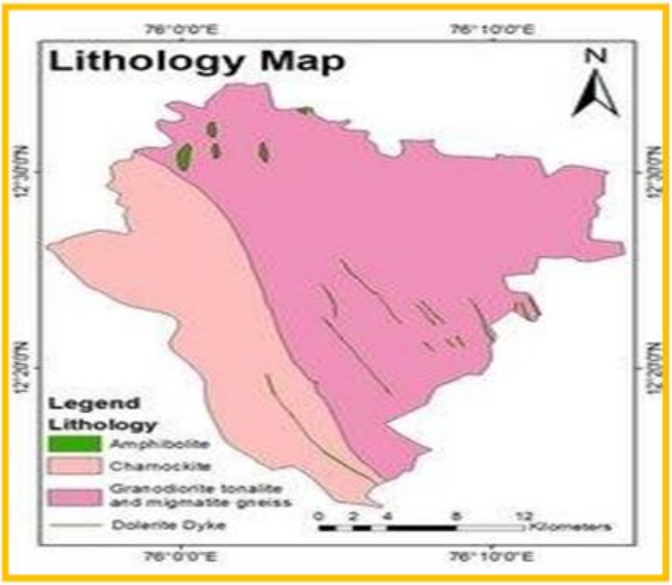

Figure 2: Lithology of the Study area.

Table 1: Statistics of different lithological units of Periyapatna taluk.

Lithology	Area (Sq. km.)	Percentage of the area
Amphibolite	5.32	0.65
Charnockite	235.06	28.84
Granodiorite tonalite and migmatite gneiss	572.42	70.25
Dolerite Dyke	2.20	0.26
Total	**815.00**	**100.00**

6. WEATHERING PROFILE OF THE STUDY AREA

The weathering stages typically manifested within a soil or rock profile from the ground surface to unweathered rocks are as follows.

1. **Residual Soil (Stage VI) -** The original structure of the material has been destroyed. The pedologic soil profile with characteristic horizons has been developed**. (Plate 5).**
2. **Completely weathered (Stage V)** - All rock material has been decomposed or disintegrated into soil. The original structure of the rock is still intact and visible. **(Plate. 2 & 5).**
3. **Highly Weathered (Stages IV)** - More than half of the rock material has decomposed or disintegrated into soil. Discolored rock is present as blocks or rounded core stones. **(Plate. 1).**
4. **Moderately weathered (Stage III)** - Less than half of the rock material has decomposed or disintegrated into soil. Fresh or discolored rock is present as blocks or rounded core stones that fit together. **(Plate. 1 & 2).**
5. **Slightly Weathered (Stage II) -** Discoloration on the rock surface indicates weathering especially along discontinuity surfaces. **(Plate.3).**
6. **Unweathered (Stage I) -** No visible sign of rock material weathering except perhaps slightly discoloration along discontinuity surfaces.

Plate 1: Field photographs showing Weathered stages (III to IV) near Hosahalli.

Plate 2: Field Photographs showing weathered rock formation (Stages III to V) near Naganahalli.

Plate 3: Field Photographs showing Weathered rock Stage (III and II) near Abbur.

Plate 4: Field Photographs showing Dolerite dyke with Weathered rock Stage (III and II) near Kugguhundi.

Plate 5: Field Photographs showing weathered rock Stage (V to VI Stages) near Abbur.

7. Field investigations

Peninsular gneiss are the consisting of between essentially grey to pink granitic gneisses and the strike of lineation in gneisses. Peninsular gneisses exposes direction of which is NW-SE with a dip towards NE, and schistose occur as an enclave within this formation. These rocks strike N10^{0}E-S10^{0}W to N30^{0}E - S30^{0}W with varying eastern dips about 60^0 to 80^0**. (Plate. 6 and 7)**. Hornblende gneiss is amphibolites group of rocks. It is mainly composed of amphibole and plagioclase feldspars with little or no quartz. The physical properties of hornblende gneiss are dark grey to green in colour, heavy and weakly foliated of schistose (Flaky) structure. Amphibolite schist rocks are well exposed in the areas of sulekote, kambipura, honnapura, ambalgere. The mineral composition of amphibolite isomorphism mixture of four molecules such as calcium, iron, magnesium and silicate. Charnockite is the blue quartz-hypersthene bearing granular suite of rocks. It is also known as Pyroxene granulite. Charnockite type of rock formations are well exposed near Muttur colony, Dodda hosur, Navalur and Beguru. Migmatites, granodiorite tonolites are well exposed and found in near Vaddarahalli hosahalli, Sal koppalu, Bylakuppe, Kodihalli and periyapatna all most all entire part of the study area. **(Plate. 6, 7, and 8)**.

Plate 6: Field Photographs showing Granitic Gneiss of fracture near Kurgalu.

Plate 7: Field Photographs Showing Granitic gneiss Pegmatite Vein near Joganahalli.

Plate 8: Field Photographs Showing Granitic gneiss Pegmatite near Basavanahalli.

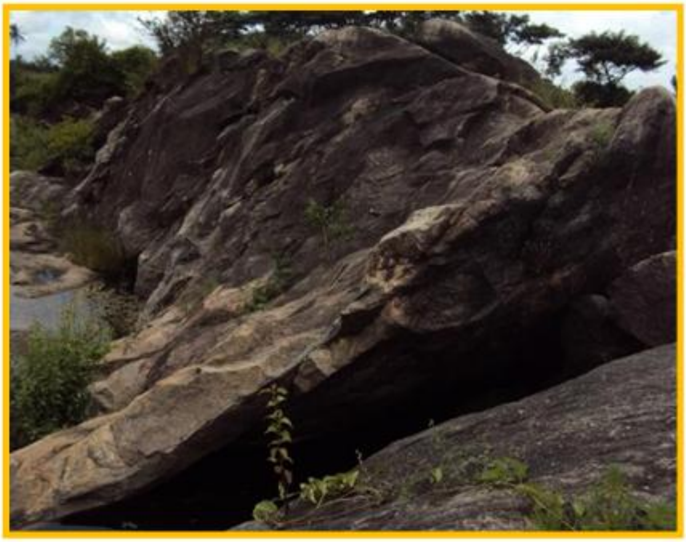

Plate 9: Field Photographs Showing Dolerite dykes near Kamalapur.

Plate 10: Field Photographs showing Quartzite near Bhavanahalli.

Plate 11: Field Photographs Showing Dolerite dykes near the Basalapur.

Plate 12: Field Photographs Showing Charnockites near the D.G Koppalu.

8. GEOLOGICAL STRUCTURES

Groundwater is simply water that occurs in the ground; in the pore spaces between mineral grains or in weathering, cracks and fractures in the rock mass. It is usually formed by rain water or snow melt water that seeps down through the soil and into the underlying rocks. Crystalline bed rocks in this area I have ground truth check to igneous rocks as granite and metamorphic rocks, such as gneisses, schist, and quartzite, where the inter granular pore spaces are negligible and where almost all groundwater flow takes place through weathering, cracks and fractures in the rocks. The formation of the study area was accompanied by tectonic movement as fractures, joints, faulting, folds, and veins. Generally, structures playing different roles in groundwater quantity and quality variations include the following are groundwater reservoirs occurring in igneous, sedimentary, and metamorphic rocks; voids between minerals and grains; and joints, fractures, and faults. In the study area, it is found occurring of metamorphic rocks. The distribution and composition of rocks affect the availability and chemical constituents of groundwater. In general, a geological study should include a lithological phase, covering mineral composition, grain size, sorting and packing; a stratigraphic phase describing the age, unconformities, and geometrical relationships between different lithologies; and a study of structural features. Collection of this information gives, rather clear picture of the subsurface geology, leading to a better understanding of various water bearing formation and distributions. Structures as hydrodynamic contacts impact on the groundwater, flow pattern of an aquifer. The major structural features that are impacting on the groundwater are fractures and folds. Fractures are subdivided into joints, fissures and faults, which are formed by brittle fracturing of rocks. Folds are produced by ductile deformation, and the extent of this deformation reflects on the magnitude of the fractures formed. **(Plate. 6 and 13).** Fractures are not homogeneously distributed in the rock mass, because the permeability of the fracture system is very sensitive to the fracture aperture and degree of fracture connectivity, it is very difficult to predict the yield of a well or borehole in crystalline bedrocks (David and Nick, 2002). During the field visit geological field type outcrops are verified and descriptions of lithological units and their assessment of joints, fractures, folds done and observed different types of large faults. These structures are of great influence on groundwater flow patterns in the aquifer of the study area. A better understanding of structures, and how they affect the flow of groundwater at all levels of the aquifer, is achieved. The identification, description and evaluation of structures, the interpretation of structures and their impact on groundwater flow and the relationships between structures and groundwater. The outcome is achieved for a better understanding of the complexities of the geology and the effects and impacts; it has on hydrogeological conditions, by integrating all the data available into useful concepts of groundwater occurrence and flow in the study area.

Plate 13: Field Photographs Showing fractures in Dolerite dykes near Kamalapur.

9. GEOLOGICAL SETTING

The crystalline basement is exposed extensively in north eastern and south western part of the study area. There are outcrops/exposes of rocks belonging to the crystalline basement complex, which are composed of granitic gneisses, schist, charnockites and quartzites **(Plate 9).** The area is belongs to Proterozoic period in some places intrusive rocks are observed. The crystalline basement complex are gradually overlain by a series of mostly unfossiliferous formations, composed of unconsolidated material of sands, and clays, sediments which are commonly termed as the Superficial deposits or alluvial form in recent age. Detailed geological studies for rock samples and their field relationships, laboratory, representing these complexes were carried out and compared and correlated with those complexes surrounding the study area. The Basement complex in the study area is affected by tectonic activities, which resulted into widely distributed joints, faults, foliation and folds, which includes igneous– metamorphic rocks. The granitic gneisses have a general foliation trend towards north to south direction with a dip angle varying towards the north eastern direction. The granitic gneisses are highly weathered, compact, fine to coarse grained, greyish brown to deep in colour. The mineral composition of granitic gneiss is consisting of biotite, plagioclase and quartz. (**Plate. 9).** The granitic gneisses rocks in the northen eastern and southern eastern part of the study area. Strongly in some places and symmetrical alternate (chevron) folds anticline in some places, which are representing elastic deformation as well as brittle deformation, and also deduced from in hand specimens the essential minerals hornblend biotite and quartz. This quartzite composed essentially of quartz mineral in fine to medium grained in texture. No primary structures-porosity of geological contact between hydraulically different lithologies. The secondary structures developed from the tectonic events. These include porosity of lithological boundaries, faults or lineaments, fracturing or opening and weathering, which permits the flow and storage of groundwater. In the particular study area mainly groundwater aquifers namely; Quaternary and fractured basement. It is recharged directly from the rainfall and indirectly from the basement rocks through fracture systems. Quaternary aquifer is hand pump, dug wells, open well etc maintained and recorded by the Mines and Geology Department, Mysuru, Mysuru District. The suitability of the formations in the hydrogeological / investigated area, which are basically igneous rock and metamorphic in origin, as aquifers depends on the development of primary structures. The investigated area is located in a hydrogeological zone, which is characterized by medium to high groundwater potential. The aquifers in the area occur in the fluvial deposits, weathered and fractured metamorphic rocks overlying the basement system rocks at much greater depths. A significant groundwater discharge occurs in the faulted, fractured and weathered zones.

10. STRUCTURES EVIDENCE

The structure is plays a role in flow control and basic geological features of an area. The stratigraphic and composition of lithological units, of these both acts as structural controls for flow. A structure is a strong influence on the topography and on the surface drainage patterns **(Fig.3)**. The morphology of structural or residual hills are controlled by large-scale rock structures and lithology. Since the rocks in this unit are hard and compact, they act as run-off zones; limited infiltration can take place along the weak planes like joints faults, fractures, folds, dykes and veins **(Fig.4)**. The residual hills are divided into upper and lower parts as inselberg pediment, buried pediment, valley fill, and pediment inselberg complex respectively. Discontinuity is a collective term used to include joints, fractures, folds, veins, mineral cleavage, foliation, shear zones, faults and other contacts etc. However, structurally the area displays shears, joints, faults and lineaments which appear to be moderate in the intensity of development. They are small to moderate in extent with variable dipping. They too have played some roles in groundwater percolation. As joints, fractures, and shears are smaller and localized, they could not be quantified through remote sensing data. (**Plate. 1 to 11).** Most of the drainage network in the study area is controlled by these lineaments. Joints occur as well-defined sets along the bedding planes at right angles to the bedding (longitudinal), cross-joints are formed normal to these, and oblique-joints cut at acute angles to the cross joints (**Plate. 12).** The longitudinal and cross-joints are formed by extension of fractures, but near fold hinges longitudinal joints form conjugate shear fractures (Roberts, 1982). High intensities of joints lead to increased permeability and the field evidence it appears that the bedding joints are the most dominant master joints in the fold. **(Plate 3.10, 11, 12).** The different structures influenced, and controlled the flow, by acting as low permeability zones (barriers) or high permeability zones (conduits).

Plate 13: Field Photographs Showing Joints, Pink Granitic gneiss Bettadapur.

11. FAULTS/LINEAMENT ANALYSIS

Faults/lineaments act as conduits and very good aquifers other hand faults act as drains, lowering the water table and thus affecting the distribution of groundwater. The central part as well as southern part of the study area has lowest water table where as northern part of the study area has high level water table because the border of the study area Cauvery River is flowing. Besides faults act as barriers to the flow of groundwater if filled with impermeable material such as silts and clays. These factors have a strong influence on the good aquifer and these results which yields through the boreholes, static water levels, water flow, and hence distribution of groundwater. Therefore the amount of water available in a faulted region would be highly influenced **(Figure. 3 and 4**).

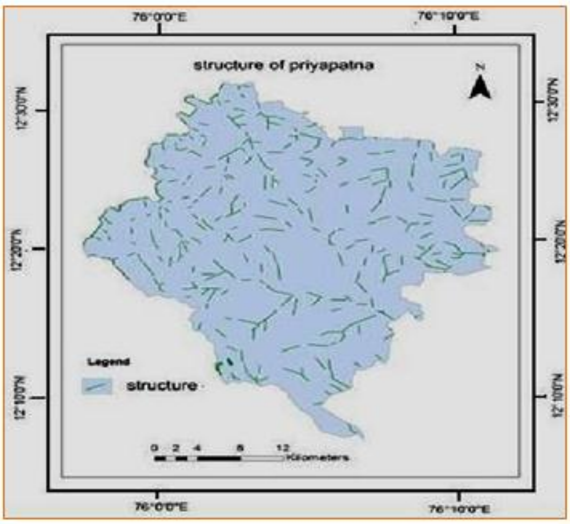

Figure 3: Structures /lineaments of the Periyaptna Taluk.

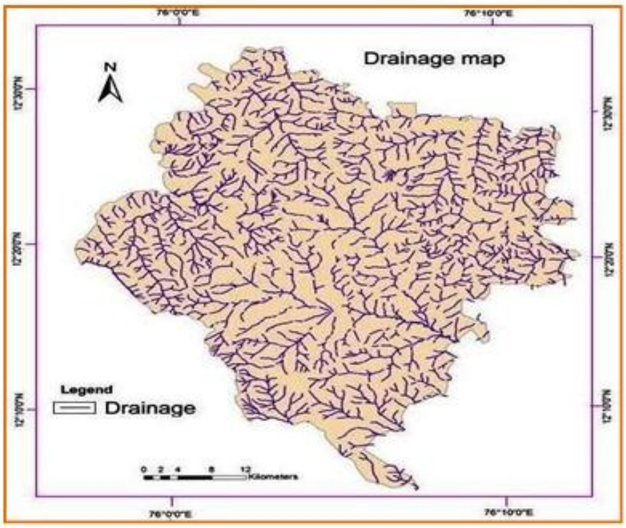

Figure 4: Lineaments/ faults of the Periyaptna taluk.

In the particular study area of major faults showing exposed surface at north eastern portion of length and width of a fault is ten to eight hundred meters respectively. This has high permeability in the shear zone. There would be both vertical and horizontal components of flow in this shear zone, and there are indications of possible conduit flow in this site or area. The border of the present area is very good aquifer. The entire area is s dendritic drainage pattern. **(Fig.4).**

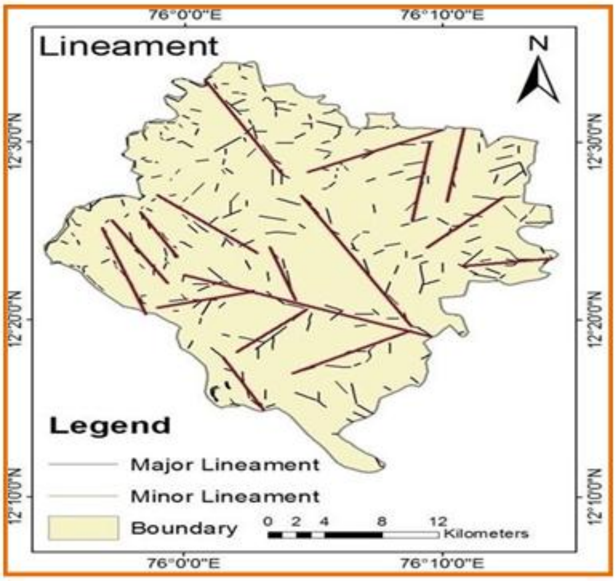

Figure 5: Drainage map of the Periyaptna taluk.

12. FRACTURES AND JOINTS ANALYSIS

The major and minor lineaments underlain by potential zones of localized weathering which increased permeability and porosity results from good conditions of groundwater and exposes of rock which joints and fractures. The porosity and permeability which is the morphology of fracture plane.

This morphology of fracture plane is consists of three basic types as follows:-

1- Open fractures.
2- Mineral-filling fractures.
3- Deformed fractures (Slickenside fractures).

The structures within the study area are having the extensively developed joint systems. These have been recognized for their importance in groundwater flow. These have been found to be distributed throughout the study area, and their cumulative effect on flow is considerable. Fractures (open or cracks) in rocks may affect groundwater recharge which results shows the importance as barriers (low permeability) or conduits (high permeability) for flow of groundwater. In this connection, both surface and subsurface fractures at the location can be characterized in two classes- They are, open and closed. Open fractures can be permeable zones, some of which contain open cavities. Closed fractures can consist of simple fractures with hairline or wider apertures sealed by secondary mineralization. In the particular study area the core and log analysis of the dug well has been conducted successfully to delineate fracture occurrence and distribution in the bore well.

13. FOLDS ANALYSIS

Fold become an impermeable boundary on all sides of the asymmetrical area anticline expect weathered fold where fold structures are flow control on a large scale i.e. means restricting flow. The strike of the folds is very important.

14. FRACTURED BASEMENT AQUIFER

Fractured basement rocks belonging to Precambrian time are outcropped in many sites of the study area, and composed of igneous and metamorphic rocks that are mentioned before. It's characterized by high density of fractures beside the permeability of aquifer is of secondary type that is formed due to the effect of regional and local structural events. Rainfall is the main source of aquifer recharge and other fracture systems, where the quantities of rainfall affect the rate of recharge of groundwater. In the study area many number of wells are dry due to the lack of recharge (precipitation) and the presence of structures that act as barrier preventing the groundwater movement. In the hard rock areas, weathered and fractured zones form aquifers. Even in a small area, the nature and extent of weathering vary a lot and depend mostly on the presence of fractures at depth and favourable morphological features at the surface. In fresh rocks, joints and fissures tend to close at a depth of about 70 meters and there will be practically no circulation of groundwater and below this level. Pockets of weathered and fractured rocks may form isolated groundwater reservoirs. Fracturing and folding results in a high degree of in- homogeneity in the hydrogeological characteristics of different aquifers. This inhomogeneous character causes aquifers yields and groundwater flow direction to vary over a whole area (Mulwa et al., 2005). The secondary weathered and fractures aquifer extends across the whole study area. It has variable thicknesses ranging from 25m to 40m. The lithological units compose the aquifers and aquitards. The basement aquitard is the clay formation and forms the aquitard between the lower aquifer (weathering and fractures) and upper aquifer (quaternary). The results show that high yielding wells and to large lineament and corresponding structural features. Fractures in hydraulic connection with hard rock aquifers, and weathered bedrock constitute best aquifers and the relation between tectonic settings of the area with groundwater potentiality. To understand the geological and structural influence on groundwater due to combination of lithology, and tectonics is under-scored by the difficulties in interpreting its dynamics. A good understanding of its various components and their interrelationships were achieved by the integration of the studies such as geology, structure, topography, and hydrogeology. The study identified the different types of structures, namely geological contacts, fold systems, faults and joints. It is provided detailed descriptions of these features from field investigation, and further to evaluate the effects and controls they have on groundwater flow in the study area.

15. LINEAMENTS

An examination of lineament map of Periyapatna taluk shows the presence of large/major number and small/minor number of lineaments. A number of these, cut across each other while some are observed running parallel to each other. Generally, the length of the lineaments in the particular area or any area is variable. Lineaments of less than 10 km are predominant. In the particular study area, (According to kowalik & Gold,) minor or less than 10km of length of lineaments are 12 numbers and intermediate lineaments 10 to 100km of length of lineaments are 31 numbers and also major or long lineament 100 to 500km of length of lineaments are 35 numbers. The lineaments of the study is covered by 78 based on the length and direction. Here the major lineament of maximum length is 345km and minor lineaments of maximum length is 95km. This longest lineament passes through Peninsular gneiss, Dharwar schists and Kaldagi sediments. The shortest lineament is mainly in the Deccan Trap region.

16. ROSE DIAGRAM

In earth science or Geology or Earth resources management, Rose diagrams are used for orientation distribution of lineaments). Lineaments are commonly analyzed by using frequency or length against Azimuth histogram. (Rose diagram of the study area was created in Rockworks 14 software. **(Fig. 6)**.

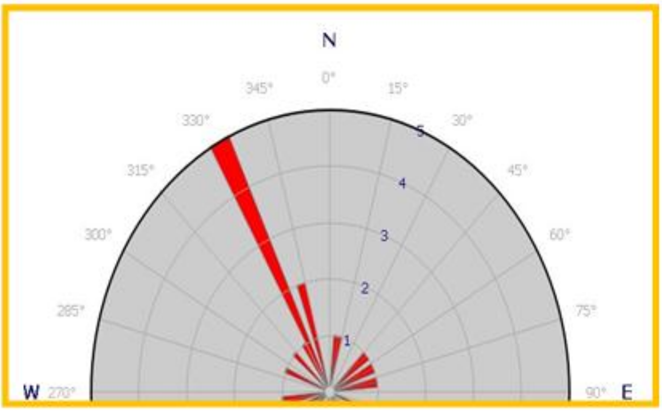

Fig. 6: Major rose Diagram of Periyaptna taluk.

Table 3: Minor Azimuth and direction of the study area.

Sl. No	Direction	Azimuth	Sl. No	Direction	Azimuth
1	N65^{0} E	65	31	N80W	280
2	N70^{0} W	290	32	N70W	290
3	N80^{0} W	280	33	N15W	345
4	N80^{0} E	80	34	N20W	340
5	N75^{0} W	285	35	E90W	0
6	N75^{0} E	75	36	E90W	0
7	N70^{0} E	70	37	N10E	10
8	N60^{0} E	60	38	N85E	85
9	N5^{0} E	5	39	N20E	20
10	N70^{0} E	70	40	N27E	27
11	N65^{0} E	65	41	N10W	350
12	N40^{0} E	40	42	N25W	335
13	S85^{0} E	95	43	N88W	272
14	N30W	330	44	N40W	320
15	N68E	68	45	N35W	325
16	N40E	40	46	N40W	320
17	N5E	5	47	N85W	275
18	N7E	7	48	N70W	290
19	N70E	70	49	N68W	292

20	N5E	5	50	E90W	0
21	N12E	12	51	N60E	60
22	E90W	0	52	N30E	30
23	N10E	10	53	N32E	32
24	S65E	115	54	N70E	70
25	E90W	0	55	N30E	30
26	N40W	320	56	N80E	80
27	N50W	310	57	N60E	60
28	N45W	315	58	N60W	300
29	E90W	0	59	N55W	305
30	N30W	330	60	N50W	310

The total lineaments of the study are about **78** including major and minor. The rose (Azimuth –frequency) diagram of the lineaments delineated on the imagery shows the following trends N-S, NE-SW, NNE-SSW, NNW-SSE and E-W directions (**Table 2 and 3)**

Table 2: Major Azimuth and direction of study area.

SL.No	**Azimuth**	**Direction**	**SL.No**	**Azimuth**	**Direction**
1	60	N60^0 E	10	325	N35^0 W
2	290	N70^0 W	11	340	N20^0 W
3	330	N30^0 W	12	330	N30^0 W
4	50	N50^0 E	13	65	N65^0 E
5	340	N20^0 W	14	10	N10^0 E
6	75	N75^0 E	15	9	N9^0 E
7	330	N30^0 W	16	45	N45^0 E
8	310	N50^0 W	17	80	N80^0 E
9	330	N30^0 W	18	330	N30^0 W

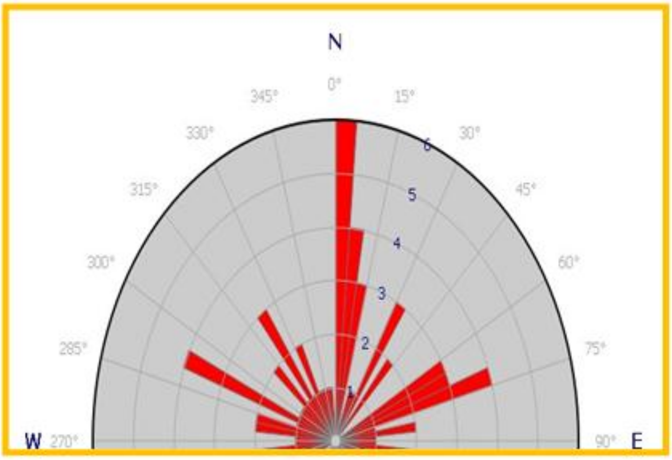

Fig. 7: Minor rose diagram of Periyaptna taluk.

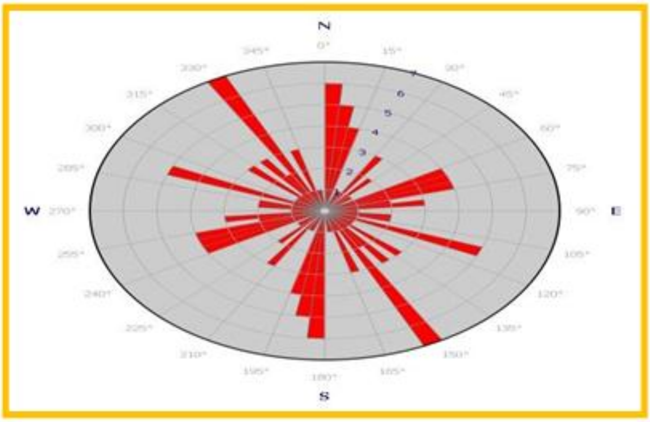

Fig. 8: Major and Minor rose diagram of Periyaptna taluk.

17. NATURE OF THE SOIL

The visual observation and simple field index tests to identify the characteristics of the soil constituents. Soil classification is based on the distribution and behavior of the fine- grained and coarse-grained soil constituents. The soil of the entire Periyapatna taluk is derived from Granitic gneissis and charnockite rocks. Red soil is present in upland areas and also found at the contacts of granites and schist. This soil is admixture of sand and silt. Black soil is clay type and dark black in colour. Mixed types of soil also found in localized manner at some places along the contact of schist and other intrusions (**Fig.9**).

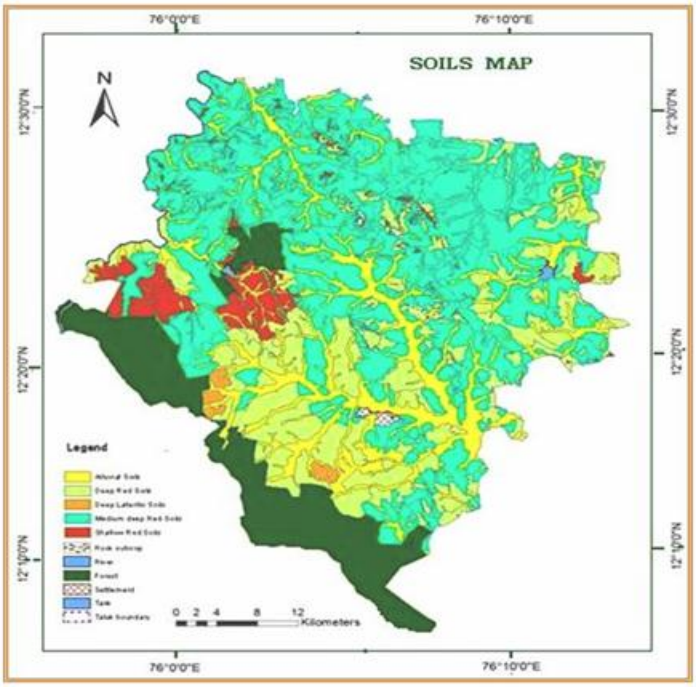

Fig. 8: Soil map of the Study area.

Table 4: Statistics of Soil of Periyaptna Taluk.		
Soils	**Area sq.km**	**Percent**
Alluvial soils	51.90	15.01
Deep Red soils	143.60	18.02
Medium deep Red soils	438.47	47.20
Shallow Red soils	38.27	3.95
Deep Lateritic soils	11.92	0.62
Rock outcrop	3.60	0.46
Forest	120.31	14.76
River	2.07	0.26
Tank	1.2	0.15
Settlement	1.66	0.21
Total	815.00	100.00
Source: KSRSAC, Bangalore		

18. FIELD INVESTIGATION

In the study area, a very good exposure of granitic gneisses, quartzite and amphibolites have been identified. There is a thick soil profile which measures 12 meters from the bed rock, variation of colour in the field. The weathered zone extends up to 1.5 meter from the bed rock and above the weathered zone; a thick soil cover is recorded of about 5ft. The soil classification, categorization, and discussion are done as follows. Clay minerals are hydrous silicates that contain metal cations. They are variously known as **layer silicates**, **phyllosilicates**, and **sheet silicates**. Their basic building blocks are sheets of silica (Si) **tetrahedral** and oxygen (O) and hydroxyl (OH) **octahedra**. A silica tetrahedron consists of four oxygen atoms surrounding a silicon atom. Aluminum frequently, and iron less frequently, substitutes for the silicon. The most common minerals found in clay deposits, such as quartz and carbonate, are also present in clay soils. Sandy clay loam (SCL) is a soil texture of gritty. A soil texture is a specific mixture of sand, Silt and clay particles. SCL can have 74 to 80% of sand and 20 to 35% of clay. Sandy soil has biggest size of particles which does the determination of the degree of erosion and allow the drainage. The sandy soil texture is gritty and granular and it consists of rock and mineral particles that are very small in size. Sandy soil is derived from weathered granitic gneiss and constitute majority of quartz grains with moderate to good permeability. These soils are evaluated on higher topographic condition, mainly in rolling plains and pediments.

Gravel soil has better drainage capacity than clay soil and holds more water than sandy soil. The soil thickness of 100 Cms and the infiltration rate is 1.0 to 1.2 cm/hrs and these also could be classified in a similar manner as these of red loam and on size and texture.

19. HYDROGEOLOGY

Groundwater is the main source of water supplies in the study area. The occurrences, distributions, and quality of groundwater aquifers controlling by different factors such as structures, geomorphology, climate changes, type of rocks and minerals. Groundwater occurs under semi-confined to confined conditions in fractured crystalline gneisses and charnockites in the study area. The aquifer recharged directly from rainfall and through structures systems. Most wells in quaternary aquifer presence in the study area are shallow wells with limited production reaching below 165 g/h. The thickness of weathered zone generally from to 5.00 m to 35.0m.groundwater occurs under phreatic (unconfined / water table) condition in weathered zone and alluvium. The depth to water levels ranges from 0.38 mbgl to 17.21 mbgl during pre-monsoon period (May- 2017) and from 0.20 mbgl to 17.30m bgl during the post-monsoon period(November 2017). But, generally the depth to water level ranges between 2 m bgl and 10.0m bgl and shallow water levels of less than 2m bgl are observed in canal irrigation area of neighbouring taluk (Yalandur and Kollegal taluks.) of the study area, totally dependent on this source and the proximity of the aquifers means continued exploitation as demand increases.

20. GROUNDWATER OCCURRENCE AND FLOW

Hydrogeology of igneous and metamorphic rocks has become very important because hard rock terrain covers good part of southeastern and southwestern. With the growing demand of water, groundwater exploitation in this terrain has become inevitable. More boreholes over these rocks being vats (dry) in semi arid areas, their importance has become significant for development. Structures in the study area show strong influence on the topography and on surface drainage patterns. There is an established north and south trend to these features as there are for the faults. There is evidence that the same applies to groundwater flow at the local level and is probably also the case for deep flow.

21. RESULTS AND DISCUSSION

Results show that high yielding wells and to major lineament and corresponding structural features. Fractures in hydraulic connection with hard rock aquifers, weathered bedrock constitute best aquifers and the relation between tectonic settings of the area with groundwater potentiality. To understand the geological and structural influence on groundwater due to combination of lithology, and tectonics is under-scored by the dynamics. A good understanding of its various components and their interrelationships were achieved by the integration in this study of geology, structure, topography, and hydrology, geology. The study identified the different types of structures, namely geological contacts, fold systems, faults and joints. It provided detailed descriptions of these features from field investigation, and went further to evaluate the effects and controls they have on groundwater flow in the study area.

22. CONCLUSION

Remote sensing and GIS proved to be efficient tool in drainage basin analysis. In this study, the integrated method adopted by using topographic and drainage details, lithologic units, hydrogeomorphic units and other parameters was focused to identify the groundwater potential zones. The landforms like plateaus, residual hills, pediments, pediplain, piedmont zones, valleys and other landscape features are suitable for the occurrence of the water resources of any basin or region. The geomorphic unit wise ground water prospect zones, their subsurface phenomenon, their identification and distribution were done based on the analysis of directly observable terrain features like geological structures, geomorphic features and their hydrological significances.

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