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Hydrogeological Studies At Jalakandapuram Sub – Basin Of Sarabanga Minor Basin, Salem District,Tamil Nadu.

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ABSTRACT :
The main objective of the present study is to investigate the hydrogeology of the Jalakandapuram sub – basin, groundwater potential and quality of groundwater for domestic, industrial and agricultural purposes. Jalakandapuram (Latitudes 11° 35'30''N to 11°46'25''N and Longitudes 77°48'30'' E to 78°2'E) Sub- basin is one among the four sub- basins of the Sarabanga minor basins which comes under the Cauvery basin. It has an areal extent of about 325 Sq.Kms. The study area has been studied with aerial Photographs (Block and white) prepared under UNDP Project (1971) and satellite Imageries (IRS IA – LISS II). The base map of the Jalakandapuram sub – basin has been prepared from the topo sheets (1: 50,000 scale) 58 E/14, 58 E/13, 58 I/2 Published by the Geological Survey of India in the year 1972. The location of the study area, its accessibility, Physiography, climate, rainfall and vegetation are presented. to classify the groundwater of Jalakandapuram sub-basin. This was done using the 25 water samples that were collected by the author and analysed in the Soil Testing Laboratory, Salem – 1. Plots of water samples in the hydrogeochemical classification diagrams (Piper's, Handa's and USSL) throw light on the quality of groundwater within the study area.

KEYWORDS: Hydrogeological Studies, Jalakandapuram Sub – Basin, Sarabanga Minor Basin, Salem District

I INTRODUCTION - JALAKANDAPURAM SUB- BASIN

1.1 Introduction

Salem District is known for its scarce water resources in view of low annual rainfall. Nowhere else in the world sub – surface groundwater exploitation has been attempted on such a massive a scale as in India, particularly Peninsular India, Comprising mostly of hard rock terrane. Limited and erratic variations in productivity of wells over relatively short distances are observed in this type of hard rock terranes. The main objective of the present study is to investigate the hydrogeology of the Jalakandapuram sub – basin, groundwater potential and quality of groundwater for domestic, industrial and agricultural purposes. They study is based on various techniques such as geophysical, geochemical, remote sensing and hydrological studies.

1.2 Location and Accessibility

1.2.1 Location

Jalakandapuram (Latitudes 11° 35'30''N to 11°46'25''N and Longitudes 77°48'30'' E to 78°2'E) Sub- basin is one among the four sub-basins of the Sarabanga minor basins which comes under the Cauvery basin. It has an areal extent of about 325 sq.Kms. The study area (Figure1.1) is surrounded by Mecheri sub – basin in the north Idappadi sub – basin in the south, Muthunaickanpatty sub – basin of Thirumanittar minor basin in the east and Mettur sub – basin of Cauvery minor basin in the west.The study area lies within Salem district between latitudes 11°35'30''N to 11°46'25''N and longitudes 77°48'30''E to 78°2'E and falls in the topographic sheets of Geological survey of India 58E/14, 58 I/2 and 58E/13. It includes parts of Nangavalli Union, Idappadi Union, Tharamangalam Union and Konganapuram Unions of Mettur Taluk.Sankari Taluk and Omalur Taluk. The Sarabanaga river originates in the Kadayampatti sub – basin and flows almost parallel to Northeast – Southwest direction.

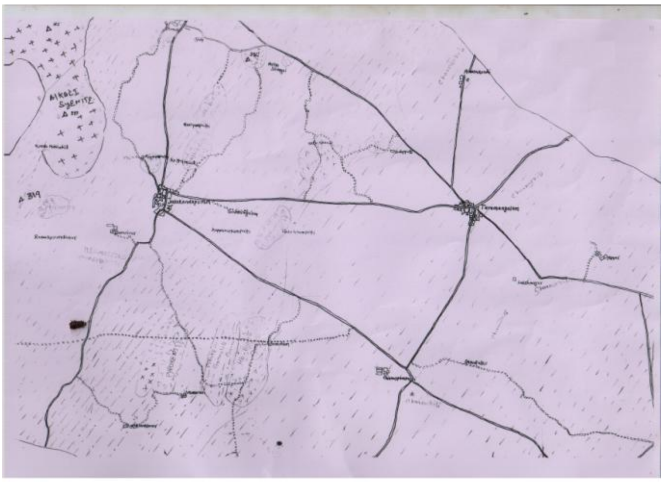

Figure 1.1 Location and accesibility

1.2.2 Accessibility

Jalakandapuram is a town panchayat in the Mettur taluk of Salem district and is well connected by state highways from salem.Tharamangalam.Mettur and Idappadi . The study is well connected by buses from salem – Jalakandapuram road via Tharamanglam on the east, Mettur – Jalakandapuram road via Nangavalli on the north and Sankari – Jalakandapuram road via Idappadi on the south. The villages in the Jalakandapuram sub – basin are also well connected by metalled roads unmetalled roads cart tracks and footpaths.

1.3 Physiography

The study area is characterized by almost an elevated topography with some undulations and hills. The general slope is towards the southwest direction. The maximum elevation of the study area is noticed in Vanavasimalai (Δ 839 m) (Plate I) and minimum elevation is noticed in the village. Karthikanakkanur (Δ 220 m) in plains. The study area is bordered in the northwest by the Vanavasi reserved forest comprising (Plate.II) Sita Malai (Δ 837m) and Kunda Malai (Δ613m) (Plate II) periyasoragai hill (Δ 493m) (Plate II) borders the study area in the north and Kanjamalai reserved forest (Δ 773m) borders the study area in the southeast.

1.3 Rainfall Data

The Tamil Nadu state is exposed to both southwest and North West monsoons. The westernghasts acts as a barrier to the rain clouds travelling from southwest to northeast direction. Southwest monsoons contribute precipitation of about one third of the annual rainfall. However the state depends mainly on the retreating northeast monsoon during the months of October, November and December. There are summer showers during the months of March, April and May. The annual rainfall in the study area is about 325mm. the precipitation during southwest monsoon ins 358 mm whereas during the northeast monsoon is 290mm.

1.4 Climate

Climate is an expression of the synthesis of day to changes of meteorological elements. Temperature and Precipitation forms the general backbone of the climate. The study area experiences dryclimate during February to July and sub – tropical climate during November to January. It experiences both southwest and northeast monsoons with summer in the months of March to May. Relative humidity is high from September to December. The temperature ranges from 25° C to little more than 40°C in the study area.

1.5 Vegetation

Both wet and dry crops are raised in the study area. Sugarcane, paddy and plantain are some of the wet crops and groundnut, cotton. Ragi and tapiaco are some of the drycrops raised in the study area. The major source for irrigation is from groundwater. The wet crops are raised during the monts of September,October, November and December. The drycrops are raised after the monsoon period. They are cholam, cotton, blackgram, greengram etc. The vegetation on the plains is comprised of perennial cactus shrubs that grows to a height of 7 feet. The important trees found in the study area are velvelam, Babool, Karungatan, Bamboo, Coconut and palm.

1.6 Methods of Study

1.6.1 Remote Sensing Techniques

The study area has been studied with aerial Photographs (Block and white) prepared under UNDP Project (1971) and satellite Imageries (IRS IA – LISS II). Different hydrogeomorphic features and linements have been demarcated in the study area. The linements may be pointing to the trace of faulting or fracturing of rock formations. Further, it is considered to have a significant control over the movement of groundwater. The lineaments are carefully marked and field work has been conducted to confirm the presence lineaments in the study area.

1.7 Field Geological Mapping

The base map of the Jalakandapuram sub – basin has been prepared from the toposheets (1: 50,000 scale) 58 E/14, 58 E/13, 58 I/2 Published by the Geological Survey of India in the year 1972. Systematic traverses were conducted to establish the lithological boundaries. Bearings were taken with the help of Brunton Compass in reference to prominent villages and other land marks located in the base map. Actual and inferred contacts represented in the geological map.

1.7.1 Hydrogeological Mapping

Groundwater moves and is stored in hard rock terrain in relatively open systems of fractures in unweathered rock and also in previous zones of the weathered rock layers. Relatively little recharge to groundwater in such fracture zones takes place by direct infiltration. The amount of water available to recharge groundwater in hard rock terrain of low relief depends on the annual total rainfall. The intensity and duration of individual rain storms evaporation, altitude and temperature. The average rainfall Jalakandapuram sub – basin is 290mm to 1150 mm. The present hydrogeological study is aimed at determining the water bearing and water yielding properties of hard rocks encountered and defining the regional groundwater flow system, delineating the discharge and recharge areas and to evaluate the hydraulic properties. Twenty five water samples have been collected by the author has been correlated to located suitable groundwater sources. The observations made by the author and earlier workers on the hydrogelogical conditions of Jalakandapuram sub – basin are discussed.

II GEOMORPHOLOGY

2.1 Introduction

Landform expressions observed on aerial photos and Satellite imageries give valuable informations regarding drainage and sub – surface geology of an area. The geomorphological map of Jalakandapuram sub – basin area was prepared using IRS-IA LISS II imagery on 1:50,000 scale. Aerial remote sensing techniques provide better and easier solution of groundwater problems. The different reflectance properties of the object on the ground provide different tonal expressions on imagery. This, together with other texture and the stage of geomorphic development of rock formations enable us to distinguish different lithological units from the imagery. The content of moisture in the soils also gives different great value in the reconnaissance and preliminary exploration. From the Satellite imageries, various geomorphic features were identified and periodic field check has been done to locate the geomorphic features in the study area. In Jalakandapuram sub-basin, a variety of geomorphic features like alluvial fans, pediments, shallow pediments, deep pediments, structural hills, residual hills and inselbergs were identified using satellite imageries.

2.2 Geographical Setting

The area under investigation is comprised of hillocks ranging from 300 mts. To 500 mts. In height. The important hillocks present in the study area are

i) Vanavasi Malai (Δ839 mts)
ii) Kunda Malai (Δ613 mts)
iii) Periyasoragai hill (Δ493 mts)
iv) Part of kanjamalai (Δ 773 mts).

In addition to the above hillocks the study area is comprised of a number of small rocky knobs, knolls and boulders marked as outcrops.The Jalakandapuram sub-basin terrain can be classified physiographically into two regions. They are (i) western uplands and (ii) eastern undulating plains. Roughly the longitude 77°55'N separates the eastern division from the western division

2.2.1 Western Division

Western division is comprised of uplands of Vanavasi reserved forest with highest peak measuring (Δ685 mts).The ridges mostly trend in the direction of N-S to NW-SE. This upland division is comprised of ridges characterised by several peaks. The most important among them are Δ613, Δ551, and Δ313.This division is mostly comprised of alkali syenites and its variants. The slopes of the hilly region are thickly vegetated and numerous streams are found to originate. They are filled by fan shaped alluvial fans and Bajadas

2.2.2. Eastern Division

The eastern division of the Jalakandapuram Sub – basin is comprised of more or less plain region. There are number of small lakes and points distributed in the study area.These lakes and ponds form a major source for irrigation of the surrounding areas. The important tanks are Velllapuram tank, Vembaneri , Kottapalayam tank, Katinayakkanpatti tank (Plate III), Jalakandapuram tank (Plate III) and chikkampatti tank. The rock types occurring in the division mostly trend in the direction of NNE – SSW.

2.3 Geomorphological Divisions

2.3.1 Deep Pediments

Deep Pediments exhibit darker signature in the black and white Satellite pictures and reddish colour in false colour composite suggesting that the colluvial materials hold more water and hence support more vegetation. (Reger.Fig – 6) It is a recharge zone and groundwater is found under water table conditions. The thickness of deposited material varies from place to place. It may be emphasized that the deep pediments are best suited nfor groundwater storage. The buried pediments occupy shallow depressed low relief areas connected with good drainage network of streams and tanks and consist of highly weathered and joined zones. These are developed over a considerable part of the study area.

2.3.2 Shallow Pediments

Shallow pediments is seen immediately around the erosional hills and is marked by a thin soil cover made up of weathered materials. Sporadic is seen in shallow pediments. The shallow pediments are also identified throughout the study area with their medium grey tone, medium texture and they cover intermediate zone between pediments and deep pediments

2.3.3 Pediments

The pediments cover vast areas in Jalakandapuram sub – basin. These are recognized in the Satellite imageries by their light tone, fine texture. The pediments represents the recession of mountain from weathering and stream erosion and have thin covering of alluvium. These are gently sloping away from the hill. Development of drainage is feeble, vegetation cover is very spares

2.3.4 Alluvial Fans

The alluvial fans are somewhat analogous to deltas and are the deposits on land Where a heavily loaded stream emerges from hills or mountains onto a lowland. Where there is a marked change in gradient with resulting deposition of alluvium, apexing at the point of emergence and spreading out in fan like form to the low land, These are identified in the Satellite imageries by their reddish colour having thick vegetation. Many alluvial fans were identified at the foot hills of Kundamalai, Vanavasimalai and kanjamalai

2.3.5 Bajadas

Bajadas represent geologic conditions that are excellent flock obtaining groundwater in large quantities. Bajadas are continuous sheets of alluvium,miles in length at the border zones between the basin floor and surrounding high lands. They connect alluvial fans and the products of stream floods and mudflows. The bajada zones are identified in the foot hills of Kundamalai.

2.3.6 Structural Hills

Structural hills are minor ridge landforms found as small and detached hills in the plains. It is characterised by its linear alignment parallel to the strike of the terrain. Kundamalai (Δ 613 mts) Vanavasi Malai (Δ 685 mts). Periyasoragai hill (Δ 493 mts) and Kanjamalai (Δ 607 mts) are some of the structural hills in the study area.

2.3.7 Residual Hills

Residual hills, are those hills which are not aligned to the regional strike of the area. Such type of hill is noticed near Nachampatti (Δ 293 mts)

2.3.8 Catchment Ageas

In the western portion of the study area, Kundamalai, Vanavasi reserved forest serve as recharge areas whereas in the northern portion, Periyasoragai hills in the eastern portion Kanjamalai serve as an important recharge areas for Jalakandapuram sub – basin.

2.4 Rainwater Infiltration

Rainwater is initially absorbed by the soil but if the rain is either intensive or persistant, the rate of infiltration will be too slow and surface run _ off results. Some rainwater will evaporate from the surface of the vegetation or from the ground. To begin with, the water that infiltrated is observed as soil moisture. As infiltration continues, more free water gravitates down through soil. If there has been no rain for a long time, a great deal of water will be observed by the sub-soil resulting into meager flow of groundwater

2.5 Drainage Pattern

Drainage patterns refers to the particular plan or design which the individual stream course collectively forms. The drainage patterns of the study area generally reflects the influence of such factors as initial slopes, inequalities in hardness of rocks, structural controls, recent diastropism and the recent geologic and geomorphic history of the drainage basin. The most commonly encountered drainage patterns are the dentritic, trellis, barbed, rectangular, complex and deranged plate III. The drainage patterns in the study area shows both radial and dentritic patterns. Topographical high areas are drained by stream which radiate outward from the central part and flow down on the flanks of the billocks in all directions Major line of drainage appear to align themselves either along the directions of major lineament or parallel to them.

2.6 Soil Types

The soils of salem district are classified into five types. They are, 1) Red soil 2) Black soil,3)Brown soil,4) Alluvial soil and 5) Mixed soil. The soil of the study area were developed from weathering of rock types like syenites, migmatites etc.the soil types encountered in the study area are, 1) Red insitu calcareous 2) Non – calcareous, 3) Brown calcareous, 4) Red colluvial non – calcareous 5) Black soils and 6) Mixed soils.

III GEOLOGY OF JALAKANDAPURAM SUB – BASIN

3.1 Introduction

Jalakandapuram sub _ basin area exposes a highly dissected Precambrian shield terrain comprising rocks of diverse origin. The western and northern parts of the study area are made up of high hill ranges namely Kundamalai, Vanavaimalai, and Periyasoragai hill mostly comprised of alkali syenites. Major part of the plains are occupied by charnockite gneiss. The study area has undergone polymetamorphism multistructural events. Metamorphism and their impress are well marked throughout the study area.

3.2 Mobile Belt

The South Indian granulite terrain was considered till recently as a single black forming part of the charnockitic region (Fermor, 1936). Later it was considered as a mobile belt around South Indian craton of granite greenstone ensemble. However, recent synthesis of all available field and laboratory data pertaining to Tamil Nadu has brought to light that this granulite _ gneiss terrain is made up of at least four distinct petro – tectonic blocks characterised by distinct litho – assemblages, marked igneous intrusives and by different structural and deformational styles. These blocks are welded together by narrow linear straight belts bounded by major linements. Evidences are available in certain sectors to indicate that these distinct petrotectonic blocks are probably separate individual (micro continental plates) while the straight belts form the corresponding ancient suture zones, along which they collided and are now welded. Supportive evidences for the suture zones are in the form of occurrence of remnants of oceanic crust with tectonic slices of probable ophiolite sequences, thrust slices and incorporation of marginal sequence of micro- continent, shear zones with mylonitisation, compressive mechanism manifested by high temperature, high pressure assemblages etc. These sutures were avenues for later rifting with emplacement of alkaline and alkali carbonatite complexes (Gopalakrishnan et al,1990). This recognition is supported by the facts Moyar – Bhavani linement hosts the Sittampundi layered anorthosite complex (3000 Ma – Show and Basu, 1986), Bhavani layered gabbro anorthosite complex and forms the zone of younger igneous activity.

3.3 Betrology and Mineralogy of the rocks of the Study Area

The following rock types have been encountered in the study area. The important petrological and mineralogical characteristics in the following are,

1) Migmatised charnockite
2) Pyroxenite (1)
3) Pyroxene granulite ± Garnet
4) Amphibolite
5) Hornblende biotite gneiss
6) Younger ultramafics
7) Dunite
8) Pyroxenite
9) Younger intrusive and fenitization
10) Alkali syenite
11) Carbonatite
12) Pegmatite and quartz veins.

3.3.1 Migmatised Charnockite

Charnickite forms the most predominant litho – type in the study area (Plate IV, Fig – 1) occupying the major part of the plains. In the eastern part of the study area,charnockite generally contains older supracrustal enclaves. The intimate association of charnocklite with the other litho- units has often led many workers to mistake it to be host rock older than all others. However, detailed work from different parts of South India has established beyond doubt their relative younger stratigraphic position and the sparse geo – charonlogical data on charnocklite of South India have all indicated an age between 2.5 – 2.6 Ga Crawford, (1969), Spooner et al (1970), Venku (1975), Buhi (1987) Vidal et al (1988), Narayan et al (1988), Griffiths et al (1987) etc. Charnocklite is a medium to coarse grined rock showing apparently poor foliated nature, but on weathering the rock shows well banded mafic and nature, but on weathering the rock shows well banded mafic and felsic layers (Plate IV, Fig – 2)

The present rock (Palaeosome) of the Jalakandapuram sub – basin is charnocklite and gneiss. The younger intrusions in this sub – basin areas are alkali syenites, Dunite, pegmatite and quartz veins. These younger intrusions are responsible for migmatization. According to Mehnert (1986) A migmatite is a megascopically composite rock consisting two or more petrographically different parts, one of which is the country rock which is generally in a more or less metamorphic stage. The other is of pegmatitic aplitic granitic or granitic or generally plutonic appearance.

3.3.2 Pyroxenite (1)

Pyroxentie occur as thick elongated body covering the entire hillock (Δ 293) in Nachampatti trending NNE – SSE . Pyroxenites of this area are medium grained granulated and foliated, weathered surfaces show thin limonitic coating. The pyroxenites also occurs in Pachchanur.Selavadai (Δ 305) and Sedappatti. This pyroxenite body is intruded by a number of quartz veins. A few pyroxenites of Nachampatti have got altered to workable deposits of talc – steatite. The steatite deposits occur at Nachampatti and Nariyampatti. The pyroxenites show a uniform mineralogy, represented by orthopyroxene, hornblende, Plagioclase and accessory quartz. Orthopyroxene is often a highly pleochroic hypersthene and hornblende is bright green.Rarely some clinopyroxene and secondary brown biotite co – exist with the above assemblages.

3.3.3 Pyroxene Granulite ± Garnet

Pyroxene granulite occurs as linear band west of Samudram. The pyroxene granulite with garnet exposed in a nalla, south of chitrapalayam. These are greenish black to brown in colour, coarse to very coarse grained rocks composed of garnet, pyroxenes, feldspar and amphibole. These are well foliated rocks with trends varying from N50°E with steep dips. In the field these pyroxene granulite bodies exhibit a dark coloured feebly ribbed weathered surfaces.In the study area most of the pyroxene granulite is garnetiferous.Migmatites in this region is also show profusion of garnet thus indicating that the garnet formation is related to injection of magmatic activity. Pyroxene granulite bear a sharp contact which other litho – units. However, locally migmatization of pyroxene granulite has diffused its contact with the adjacent rock.

3.3.4 Amphibolite

Amphibolites are foliated metamorphic rocks composed essentially of hornblende and plagioclase. Hornblende and plagioclase are equally abundant. Garnet and micas are also present in minor quanitiy. A linear band of amphibolite body is seen in Nariyampatti and Kottamedu near Jalakandapuram. The entire amphibolite band is subjected to alteration.

3.3.5 Hornblende Biotite Gneiss

Horblende biotite gneiss is characterised by typical gneissic banding with varying trends from N20° E to N55° E with steep dips along the contacts with the garnetiferous pyroxene granulite (Plate V – Fig - !) number of quarries and outcrops around Chittrapalayam, Tirmalur exhibits development of hornblende biotite gnelss from migmatised charnockite. The development of hornblende biotite gneiss has progressed the both along and across the foliation trends. Foliation commonly follows NNE – SSW set of fractures. Horblende biotite gneiss from the retrogressed zones is relatively fresh and less altered when compared to the Larger lenticular bodies. It is often exposed in cultivated plains and well cuttings. The hornblends biotite gnesis very obten shows zoning structure.

3.3.6 Younger Ultramafics

A discreate body of dunite / peridotite is located in the south western side of Kundamalai. It occurs as underformed ultramatic complex in the study area. It is comparable the ultramafic complex occurring at Chalk hills.

3.3.6.1 Dunites

The dunite is olive green in colour, fine to medium grained equigranular monomineralic phaneric rock.It is composed of olive green coloured olivine with sacchoroidal texture. Accessory minerals are magnetite and augite. The magnestic body occurs along the linements. They may be considered as younger intrusives .Magnesite bearing ultramafic bodies are associated with supracrustal rocks, as found in Sargur and Sathyamangalam terrains. Fresh dunite varieties are found at the southwest foot hills of Kundamalai (Δ613). Plate V is completely made up of weathered dunite. The degree of serpentinization varies from place to place compared to the northern portion from the tapering portion.

3.3.6.2 Pyroxenite

Pyroxenite of second generation occur as detached lenticular bodies, varying in length from 10 to 250 mts and 2 to 50 mts in width are observed. They have intruded into the syenites along the subsidiary N30°E fault plane. The pyroxenite body is observed near Tirumalur (Plate V). Pyroxenites are mainly composed of diopside with lesser amounts of aegirine.

3.3.7 Younger Intrusives and Fenitisation

The younger intrusives in the Jalakandapuram sub – basin areas are alkali syenites, carbonatites and pegmatite in great abundance.the hilly terrain of the sub – basin is coverd by younger intrusives of alkali syenite. The fenitisation effect is prominent along linement zones.Fenites are formed by insitu metosomatism of the country rocks around carbonatites. The outer boundery of the fenitised aureoles is gradational and often difficult to determine. In view of the fact that 90% of all known carbonatites have been emplaced in an environment of granite and gneisses, most description of the fenitisation of basic igneous rock is essentially the same process characterised by enrichment in alkalies.

3.3.7.1 Alkali Syenite

Suryanarayana Rao et al (1978) give a vivid report on the occurrence of syenite. They report the low hills to the west of Pakkanadu and Mulakkadu which excend from Kundakal in the Southeast to Mulakkadu and beyond in the northeast composed of alkali – syenite emplaced along the faulte zone. About 2 km north of Pakkanadu they take an arcuate bend and end up in the Kundamalai hills 3 km NE of pakkanadu. The strike varies from N30°E to N60°E with easterly dips from 45° to 60°. They are pale pink in colour, medium grained in texture and carry several lenses of feldspathic breccia. Because of their high resistance,the alkali syeites are used for building stones and road metals. Such syenites are being quarried in the eastern part of Kundamalai (Δ613), Seetamalai (Δ557) and Periyasoragai area (Plate VI) As syenites are in immediate contact with migmatite it shows inclusions of migmatite components. The alkali syenites found in association with crystals of pyrite and chalcopyrite.

3.3.7.2 Carbonatite

The epidote amphibolite facies group of rocks occur mostly in the Sarabanga minor basin and the fenitised zones shows intrusive syenites and carbonatites. The carbonatites of pakkanadu and Mullakadu have been dated an age of 750 m.y. The carbonatite body was also encountered near Periyasoragai. Some of these bodies show a crude foliation and most of them are discordant. Carbonatites occur invariably within carbonated gneiss.

3.3.7.3 Pegmatite and Quartz Veins

Instrusions of zoned pegmatite occur southwest of Ramakavaudanur. They intrude into the migmatites rich in amphibolite palesome. They are rich in microline feldspar and are extensively mined for quartz and potach feldspar (Plate VI). They also carry semi – precious stones. Quartz veins are noticed in pegmatites at Vangliyur, Nachampatti, Ramakavundanur, Selavadai (Plate VII) etc.Villages.Almost all the quartz veins are pure milky white and massivs with iron coatings on paring surface, the thickness of quartz veins from 2 to 10 mts.d

IV STRUCTURAL AND TECTONICS OF THE STUDY AREA

4.1 Early Literature on Structures

Structural patterns in high grade terrain is normally anticipated with much contortion. Folding and shearing. Generally the rocks are characterised by a foliated structures, An attempt is made her to give a detailed account on the various thoughts generated by various author. Such a study will be useful in understanding the groundwater movement in hard rock terrain. To a large extent, our present knowledge on petrology. Tectonic setting and distribution of these rocks of Peninsuler India is due to the work of the early pioneers. Among them may be mentioned, Bruce Foot, king, Middlemiss, Walker, Vredenbery , Holland and others of Geological Survey of India and Smith, Sampath Iyengar and Jayaram of Mysore Geological Department, Fermor,Krishnan,RamaRao,Narayanaswami and Pichamuthu are the other geologists who have presented interpretation on the complex geological problems of this region.

4.2 Present work by the Author

Having reviewed the above observations, the author has carefully prepared a lineament map of the study area (Fig – 22). Correlates with the observations made by others. Lineaments can be traced more easily when the contrast of the images is sharp.the imagery used by the author in this synoptic interpretation is on 1: 10,00,000 scale. The linear features were checked by regular field visits during the periods Octoer – November and December 1994 and January 1995. The field visits were highly useful in identifying the tonal difference and rock types occurring in the study area.

V HYDROGEOLOGY AND GEOPHYSICAL INVESTIGATION OF JALAKANDAPURAM SUB / BASIN

5.1 Introduction

Geophysical techniques, especially electrical resistivity method give indirect indications of groundwater so that underground hydrologic data can be inferred from surface data. Electrical resistivity methods are widely used for both regional and detailed survey because of their greatest resolving power, wide range of field applicability and comparatively low cost. Electrical resistivity using wenner and schlumberger configuration techniques have been used in the present study by the author.

5.2 Hydrogeology

The salem district lies in the interior of Tamil Nadu State and lies between the Eastern and Western Ghats and has a total geo-graphic area of 8650 sq.kms. It has a density of population of more than thousand per sq.km. People in rural areas cultivate coconut, sugarcane, groundnut tapious, cotton etc. There are large number of bore wells and dug wells in Salem district and the number of wells in a square mile is almost 100.Salem district is almost wholly consisting of hard rock terrain with semi – arid climatic condition.The main source of groundwater is the rainfall that occurs over the land area.The disposal of rainwater is the rainfall that occurs over the land area. The disposal of rainwater after it falls on the land involves the process of surface run – off, infiltration and soil moisture recharge. evaporation and evapotranspiraion from the surface water. The rainfall data related to the study area were collected from the office of Tamil Nadu Water and Drainage Board (TWAD). The nearest rain gauge stations to the Jalakandapuram sub-basin are Omalur, Mettur, and Sankari.

5.3 Geophysical Investigation Techniques adopted

The electrical methods of geophysical exploration include a variety of techniques employing both natural and artificial sources of which the artificial source group, in which electrical currents are created in the earth, a distinction may be made between inductive and conductive methods. The former involve the use of frequencies upto a few thousand cycles per second and the measurement of the electromagnetic field set up by the induced earth currents. The latter involve the use of direct current or alternative current with frequencies upto a few tens of cycles per second and the study of the electic field.

Most geologists use the electrical resistivity methods in the exploration of groundwater potentials.Because of the dry conditions of geological formations, they have a higher resistivity than the wet geological formations, as moisture is determined by applying an electric current (I) to outer electrodes driven into the ground and measuring the apparent potential differences (V) between the inner electrodes driver into the ground.Changing the spacing of electrodes also changes the depth of Penetration of the current and apparent electrical resistivity Pa.When Pa is obtained for different depths by measuring the resistance R which is equal to V/I, it can be plotted against the depth, Table II shows the resistivity of rocks and minerals compiled on the lines adopted by Edge and Laby (1931) and other recent authors.The prospecting techniques are mostly electrical profiling. dipole electrical sounding, induced Polarization, spontaneous polarization, radial electrical sounding, radio interference sounding, radiowave profiling and vertical electrical sounding methods.There are mainly two common systems of arrangement namely Wenner method and Schlumberger method.

Wenner Method

In wenner mehod (Refer Fig.23), the electrodes are spaced at equal distance 'a' and the apparent resistivity 'Pa' for a measured resistance R (=V/I) is given by Pa = 2π a.R and the field curve is plotted on a log – log paper, Pa vs a/Pa, Pa is in ohm metre an d 'a' in metres.

Schlumberger Method

In Schlumberger method (Refer Fig.23) the distance between the two inner electrodes is kept constant for some distance and the distance between current electrodes is varying .the apparent resistivity Pa for a measured resistance R = V/I is given by

$$Ps = \frac{\pi\,(a/2)^2 - (b/2)^2}{b}$$

Where V = Voltmeter readings I = Ammeter readings.

5.4 Interpretation of V.E.S data of Jalakandapuram Sub – basin

Vertical Electrical Sounding data were obtained during the field work in the study area using wenner and Schlumberger methods. Part of the data were collected by the author and other data from Tamil Nadu Water Board and Drainage Board (TWAD) of Salem.11 Locations in the study area were detected and surveyed by Schlumberger method.The Geophysical data of the selected stations are presented in the Table III to XV. A simple method suggested by Shankarnarayan and Ramanujachari called as the inverse slope method is very successful in hard rock terrain . 'a/Pa' is plotted against 'a' and they are joined by straight lines. The depth to different layers and their resistivities are obtained from the respectively.and inverse slopes of the different straight line respectively.

From the curve, to find out the actual resistivity upto a depth OM, the following equation is used.

$$\text{Resistivity} = \frac{a}{a/Pa} \times \frac{\text{Horizontal division}}{\text{Vertical division}}$$

But normally vertical division by horizontal division is the slope of a particular straight line (OA). This implies that the resistivity of the strata upto a depth of OM is equal to the inverse of the slope OA.

Inference from the Inverse Slope Method

The depth of various layers have been inferred from the depth sounding data and inverse slope methods.(Table XVI). The depth sounding place, the depth from the ground level, the resistivity of different lithologies.

5.5 Discussion

The study area bring out the variation in thickness of top soil, weathered zone,fractured/jointed zones bed rock. The top soil ranges in thickness from metre to metre, the minimum value is at Jalakandapuram, Irupali and hilly slopes of the study area and the maximum value is at Avadathur, Chetimonkurichi, areas situated along the deep pediments. The weathered zone is more prominent at Tharamangalam and Surapalli recording a maximum value of 10 metres.

The fractured/joined zone at Savuriyur is 65 metres against an average value of 25 metres.

Surapalli

In Surapalli the soil cover is only upto 10 metres.From 30 to 80 metres, the resistivity decreases there by indicating a lateral inhomogeneity with very low groundwater potential. From 80 to 90 metres the resistivity is that of massive charnockite, plate IX, Fig.1 shows a well section with low groundwater potential. The well section shows highly weathered migmatite with quartz veins.

Jalakandapuram

In Jalakandapuram the resistivity is very high from 0.5 mts to 15 mts. ie . 300 ohm metres indicating a massive charnockite. The resistivity at 15-25 mts. thereby indicating a fracture zone. From 25 mts. to 60 mts. the resistivity is about 700 ohm metres. The inferred lithology is massive charnockite or gneiss.

Indira Nagar

The hydrological conditions at Indira Nagar is more favourable for groundwater when compared to othe stations in the study areas. This area is situated along the fracture zones and lineaments. The recorded resistivity below 130 mts is very high indicating massive charnockite orgneiss.

Chinna Soragai

In the Chinna Soragai area, a number of fractured zones, favourable for groundwater is inferred upto a depth of 30 mts. From 90 to 160 metres., the resistivity is very high indicating massive syenites. The top soil thickness is 3.5 mts only.

Tharamanagalm.

Tharamangalam is located in the charnockite – gneiss terrain. The resistivity increases from 0 -30 mts indicating weathered and fractured gneiss. From 30-50 mts, resistivity decreases there by indicating a fracture zone. Below 50 mts, the resistivity abruptly raises indicating a massive rock type, probably charnockite. A well section in Tirumalur near Tharamangalam shows weathered gneiss(Plates IX)

Dhoramangalam

In this station, top soil is deciphered to a depth of 7 mts. A lateral inhomogenity is recorded at a depth ranging from 20-40 mts indicating a fracture zone. The resistivity gradually raises to 1000 from 40-60 mts indicating charnockitic gnesiss. Another fracture zone is inferred at a depth of 60 – 70 mts as the resistivity decreases from 1000 – 667 completely massive charnockite gneiss is inferred below 70 mts.

Desavilaku

This area is more favourable for groundwater because three fracture zones at depths of 5 -40 mts, 40 – 100 mts and 100 -110 mts are inferred. Further, the resistivity stands at 203 ohm m even at a depth of 1000 mts. the inferred lithotype of this location is charnockite – gneiss. A well section with high groundwater potential

Avadathur

The resistivity data upto a depth of 40 mts is very low i.e 23 ohm m there by indicating a highly weathered and fractured zone which more suitable for groundwater recharge. A sudden increase in resistivity is noted from 40 -55 mts (500 ohm m) which indicates the presence of massive rock.Further two lateral inhomogeneties. At depth of 55- 60 mts and 100 -100 mts are recorded. The bed rock in this area is inferred at a depth below 110 mts.

Kattinaikanpatti

In this Kattinaickanpatti area the soil is only upto 7mts.From 10 to 100 mts, the lower value of resistivity indicating a weathered fractured/jointed zone and its favourable for groundwater soureces.From 100 to 120 mts the resistivity is 155 indicating massive charnockite. The Kattinaikanpatti area is situated very nearer to the water tank and deep pediments.

Karikapatti

Karikapatti shows a highly weathered and fractured zone upto a depth of 50 mts. At 70 to 80 mts the resistivity is 412 ohm its indicating massive rock. From 80 to 120 metres, the resistivity slowly decreases indicating a fracture zone.

Savuriyur

In this station upto 1.5 mts top soil is inferred. From 5 -60 ,mts a constant raise in resistivity is noted indicating a fractured formation. 60 -100 mts is marked with high resistivity, thereby indicating massive rock typem, ie. Charnockite. At a depth of 100 -115 mts a fracture zone is inferred with lowering in resistivity. Below 115 metres the resistivity suddenly increases indicating the presence of bed rock.

VI SUMMARY AND CONCLUSION

The study area namely Jalakandapuram sub – basin is one of the 4 sub – basins of Sarabanga minor basin. The author has taken the hydrogeological studies of Jalakandapuram sub-basin to throw light on the recharge an dplanned utilization of groundwater.The rock types and the structural patterns have been studied in detail by the author.Geological map and structural map have been prepared after 3 months of careful field work. The author has collected geophysical data from Tamil Nadu Water Supply and Drainage Board, Salem Office. Futher the author has collected 25 water samples from the study area and analysed them. The location of the study area, its accessibility, Physiography, climate,rainfall and vegetation are presented. The author discusses about the methods of study adopted by him.

The geomorphological characteristics of Jalakandapuram sub – basin is presented. The study area is surrounded by hillrocks ranging in heights from 300 to 500 mts and includes four reserved forest areas in the western portion.The area has been subjected to prolonged sub-aerial weathering and denudation.Jalakandapuram sub-basin is classified physiographically into two divisions, namely the western uplands and eastern undulating plains. Drainage patterns in the study area show both radial and dentritic patterns indicating an high slope and undulating terrain. The geomorphological deivisions, deep pediments, shallow pediments, pediments, alluvial fans, bajadas, structural hills, residual hills, catchment areas, rainwater infiltration and soil types are also discussed by the author. The study area hs undergone ploymetamorphism, multistructural events. Metamorphism and their impress are well marked throughout the study area. The geological map of the study area show different rock types such as migmatised charnockites, pyroxenite (1) pyroxene granulite ± garnet, amphibolite, hornblende biotite gneiss, younger ultramafics, such as dunite and pyroxenite and younger intrusives which include alkali syenites, carbonatites and pegmatite with quartz veins. The movement of groundwater in a highly metamorphosed terrain is discussed under the heading " Structure and Tectonics" of the study area. Groundwater in such a terrain can move only along structural discontinuities and therefore the study of the structure of hard rock terrain of Jalakandapuram sub-basin has been studied in detail. The Satellite imageries are most useful to map alignments of geological significance and such features appears as lineament. The author presents the lineaments map of the study area. He has noticed four lineament directions namely, i) NNE – SSE , ii) N –S iii) E – W and iv) WNW – ESE. The structural hills has a definite lineament direction.When the north – south lineament cuts across east – west of WNE – ESE lineament , a good groundwater potential is noticed eg- Nachampatti Irupalli and Savuripalayam. The hydrogeological features of Jalakandapuram sub-basin are presented. The study area is recharged mostly by rainwater and the groundwater level increases immediately after the rainy seasons namely pre-monsoon, post-monsoon and summer showers. The electrical resistivity data collected from Tamil Nadu Water Supply and Drainage Board (TWAD) and processed the data. Eleven graphs for Vertical Electrical soundings (VES) using Inverse slope method were drawn from the depth sounding data and inverse slope method, the depth of various rock layers have been inferred. It has been noticed that deep pediment regions are normally good locations for groundwater sources An attempt is made to classify the groundwater of Jalakandapuram sub-basin. This was done using the 25 water samples that were collected by the author and analysed in the Soil Testing Laboratory, Salem – 1. Plots of water samples in the hydrogeochemical classification diagrams (Piper's, Handa's and USSL) throw light on the quality of groundwater within the study area. According to USSL classification, 40% of water samples fall in moderate to bad water classes. The remaining 60% of the water samples are classified as good for irrigation purpose.

Based of Handa's classification, 4 localities (Chinnappampatti) Jalakandapuram, Chettimonkurichi and Taramangalam) which fall under the C_5 S_3 class of water do not satisfy the quality requirements for irrigational use in the study area. ALL the other 21 locations, falls within C_3S_1, C_3 S_2 and C_4 S_2 Classes and can be used for irrigational purpose. The author has noticed several dyeing factories which are operated in the above localities leading to contamination of groundwater source.

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