Introduction
CHAPTER - I

1. GEOLOGICAL SETTING OF ATTUR VALLEY:

1.1 INTRODUCTION:

An interesting geological setting at Attur Valley, Salem district, Tamil Nadu, with all complexities leads to an unique hydrogeological feature. The area under investigation (Fig.1) lies between the North latitudes of 11°30' and 11°41'33" and the East longitudes of 78°26'44" and 78°45'. This area is dissected mainly by deep seated faults running in the directions of NE-SW (Attur fault) and E-W trending Godumalai Shearzone. (Grady, 1971; Vemban et al, 1971; Srinivasan, 1974; Katz, 1978). The oldest rocks are represented by metasediments and Khondalites followed by charnockite, peninsular gneiss, pink granite, pegmatite and dolerite dykes.

The area under investigation is surrounded by Kalrayan and Chitteri group of hills in the North; Kolli-malai, Pachaimalai and Paithur hills in the South; Palani-apuri malai in the West. (Fig.2). Vasista river and Swetha nadhi flows from West to East in the area under investigation. The entire Attur valley is situated between two east-west trending fault zones. Srinivasan, (1974)recognises the northern fault zone as Vellar fault zone, and the southern fault zone as Swetha nadhi fault zone. Though two rivers are flowing in the study area the hydrological
FIG. 1

LOCATION MAP OF ATTUR VALLEY

SCALE

KMS: 0  20  40  60 KMS.

ANDHRA PRADESH

KARNATAKA

KERALA

STUDY AREA

1 Vaishista river
2 Swetha river
variations within the Attur Valley is highly significant and anomalous. Within a small span of few metres, one comes across highly productive wells and barren wells. To decipher the various parameters that are controlling this anomalous behaviour in Attur Valley, a detailed geological investigation including field mapping, aerial photograph- and remotely sensed photograph-interpretation, existing well investigations, have been undertaken to throw light on the hydrogeology of Attur Valley.

1.2 LOCATION:

Attur Valley is fed by Kollar river, Anaimaduvu river, Malliakarai river and Vasista river, which are subsidiary rivers to the main river Vellar. Swethanadhi, which is also a subsidiary to Vellar river flows in the south (Fig.1 and 2). The exact location of the area under investigation lies between the North latitudes of 11°30'0" and 11°41'33" and the East longitudes of 78°26'44" and 78°45'0" comprised with the toposheets number 584— and 5876 published by the survey of India, in the years 1932 and 1973. Attur township is 50 km. east of Salem, 120 km. north of Trichy and 280 km, south west of Madras. The study area is served well with a net work of state highways. The Salem—Virdhachalam meter-gauge railway line passes through Attur town.
1.3 GENERAL STATEMENT:

An United National Development Project undertaken along with the Government of Tamil Nadu during the year 1969, included aerial and field survey of the area under investigation. J.C. Grady, photogeologist of UNDP in the year 1971 published an article "On deep main faults in South India" and has shown the existence of several deep seated faults with the help of photogeology combined with the result of airborne geophysical survey and field work. Grady's 'F' fault (Fig.3) is in the direction of N 30° E and outcrops as a ridge 135 metre height and upto 1 1/2 mile wide at Chennimalai, Kannadianmalai, Pokkamalai (Plate I, Fig.1). This fault zone is designated as Attur fault zone. South east of Attur township the fault underlies a linear valley. He presumes the extension would pass through ultra-basic intrusions at Vaneripatti, through the Keeranur complex of metasomatised limestone and into the Kadavur ring complex, a layered intrusion containing anorthosite. On the north eastern side of Attur town this fault continues along the eastern side of Kalrayan hills, which is an uplifted fault block. He also opines that this fault zone is closely connected with the occurrence of the multi-mineral deposits of copper, lead and zinc at Mamandur, South Arcot District.

In addition to the above fault zone, Grady describes an east-west trending Godumalai shear zone of several kilometers
DEEP MAIN FAULTS IN TAMIL NADU

(After Grady, 1971)

Fig.

BAY OF BENGAL

SCALE

0 10 20 30 40 50 km

78° 00' 79° 00' 80° 00'

76° 00' 76° 30' 76° 00'

13° 00' 12° 00' 11° 00'

78° 00' 79° 00' 80° 00'

13° 00' 12° 00' 11° 00'

78° 00' 79° 00' 80° 00'

13° 00' 12° 00' 11° 00'

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78° 00' 79° 00' 80° 00'

13° 00' 12° 00' 11° 00'

78° 00' 79° 00' 80° 00'

13° 00' 12° 00' 11° 00'
This belt consists of mylonite and intersects the deep main N 45°E fault zone (‘C’ Fault — Refer Grady) West of Salem and ‘F’ fault of Grady near Attur Township. The Godumalai shear zone coincides with the Salem-Attur fault described by Vemban et al., (1971).

The Attur Valley is comprised of Archaean complex represented by metasediments, charnockite, peninsular gneiss, pink granite and dolerite dykes. The metasediments are represented by sillimanite gneiss and garnetiferous sillimanite gneiss. Charnockites forms the predominant rock type of this area. The acid variety, Enderbite, predominates over basic and ultrabasic varieties of charnockite. Sharp contacts between metasediments and acid charnockite have been observed at northern, western and southern portions of the study area. Ultrabasic and basic patches occur as lenses in the acid Variety.

Peninsular gneiss shows clearly visible foliation (Plate I, Fig.2) and a general trend in the NE-SW direction. However the trend changes to NW-SE direction south west of Keeripatti. At several places migmatitic varieties are observed along the contact of pelitic gneiss, charnockite with peninsular gneiss.

Pink granite occurring in the study area are mostly massive. They occur as bands and veins. Along the
margins, the massive granite show foliations. The veins are usually fine grained and show sharp contact with the country rock. The granite show concordant and discordant relationship with the country rock. In grain size they show variations from very fine grained to ultracorase varieties.

Dolerite dyke rocks varying in width from a few inches up to 25 metres intrude into the country rocks. The length of the dolerite dykes varies from 25 metres to 4 km. The trend mostly in NW-SE, NE-SW and E-W directions (Refer Fig.18).

Dolerite dykes of economic value are being worked at Manjani, Paithur, Malliakarai and Ethapur (Plate I, Fig.3). They are fine to medium grained varieties and fetch a price of 1200-1500 U.S. dollars per cubic metre.

1.4 PREVIOUS LITERATURE:

Previous work pertaining to this study area is rather thin. Most of the earlier works are concerned on the general geology of the tracks in and around Salem District.

In 1864 King and Brucefoot dealt on the geological structures of parts of the District Salem, Trichinopoly, Tanjore and South Arcot. In 1900 Holland described the
EXPLANATION OF PLATE I

Fig. 1. Looking through Northeast direction from Soolamalai, seen a mylonite ridge (Kolemalai) in the shear zone.

Fig. 2. Peninsular gneiss shows clearly visible foliation with minor folding and shearing at Kalloddachamalai, South of Attur Town.

Fig. 3. Dolerite dyke of economic value are being worked at Manjani.
geology of the neighbourhood of Salem. A particular mention has been made on the Attur Valley.

Geomorphic setting of the Attur Valley has been described in the field work of Pandurangi (1967, 1968); Ramadurai and Venkatesan (1971) in their established report.

Crady (1971) has published an account of the deep main faults in South India. Among these fault the Attur fault (17') and Codumalai Shear Zone (13') traverse the area under investigation. He regards the Attur fault as a 75° trending vertical fault which appears as a linear structure on air photos. It outcrops, as a ridge at Chennimalai (A 994'), Kannadichen Kallai (A 1006') and Budumalai (A 1034'). On the aeromagnetic maps, Crady has traced the continuation of this fault as shown in Fig. 3. He opines that this zone is connected with the occurrence of copper, lead and zinc mineralisation at Ramadurai.

Codumalai shear zone is several km. wide and is clearly shown on air photos. The shear zone consisting of mylonite intersects the Southeast trending fault zone. (Fig.3).

The structure of the Attur Valley based on Photo-Anticiporation was attempted by Srinivasan (1971). The aerial photograph used for interpretation was on the scale
Figure 4: Azimuthal frequency diagrams for the areas north and south of Attur valley.

Figure 5: Azimuthal frequency diagrams for Attur valley.

(AFTER SRINIVASAN, 1974.)
1:36000 approximately. Using the azimuthal frequency diagrams (Fig. 4 and 5), he has recognised structural trends in three directions namely. 1 NW-SE, 2. NE-SW, and 3. E-W directions (Table 1).

**Table 1**

**Inferences from the Azimuthal Frequency Diagrams**

<table>
<thead>
<tr>
<th>Structural trends</th>
<th>Areas north and south of Attur Valley</th>
<th>Attur Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Faults and dykes</td>
<td>Frequency</td>
</tr>
<tr>
<td>NW-SE</td>
<td>Less</td>
<td>not present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
</tr>
<tr>
<td></td>
<td></td>
<td>not present</td>
</tr>
<tr>
<td>NE-SW</td>
<td>More</td>
<td>More</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less</td>
</tr>
<tr>
<td>E-W</td>
<td>Less (minor)</td>
<td>not present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(major)</td>
</tr>
</tbody>
</table>

(After V. Srinivasan, 1974.)

He concludes that the effects of the two major E-W trending faults of Vellar and Swetha Nadhi are (1) Northern and (2) Southern hill masses. The northern hills are represented by Shevaroy-Chitteri-Kalarayan and the southern hills are represented by Kollimalai-Pachamalai hills. They have suffered upward (thrust) movements in relation to Attur Valley and therefore structurally Attur Valley represents a graben and the relative throw is around 70 metres.)
LEGEND

GEOLOGICAL SYMBOLS

- Basic Dykes
- Mafic basic
- Metasediments
- Charnockite
- Gneissic Complex

- Geological Contact
- Fault
- Attitude with 45°-70°
- Strike: Fault
- Reverse Thrust Fault
- Attitude measured on ground
- Synclinal (normal)
- Overturned to north
- Anticlinal (nearly) normal
- Reverse Fault: High Angle Trench-Arrow
- Indicates Direction of Inclination (70°-75°)
- Of the Fault Plane (Uses, Driven)
- Section Line

(Figure 1) Photo-geotectonic map of Attur valley and the adjoining areas.

Figure 2 Geological cross section along A-B in fig.

(AFTER SRINIVASAN, 1974.)
He gives the following evidences to suggest the above thrust movements.

1. The E-W fault line scraps of the hill masses.

2. The altitude difference (700-1100 metres) between the hill masses and the Attur Valley.

3. The similar differences in the disposition of metasediments in the above two areas.

4. The preservation of metasediments in basin structures (example Kanjamalai, Palaniapuri basin etc.,) in Attur Valley, and

5. The minor structures of steps found on the fault planes.

He further states that 1. the concomitant N-S compression has partly modified the earlier NE-SW structural styles of Attur Valley into E-W ones and 2. the Attur Valley itself has suffered a minor eastward shift as exhibited by the off-setting of dykes and faults (Fig.6).

Srinivasan makes a brief mention on the geology of the Archaean complex present in the Attur Valley (Fig.7) and distinguishes charnockite and gneisses as the basement complex.

While discussing the granulite facies belt of South India, Katz, (1978) observes that the boundaries of
Figure  Tectonic analysis of Landsat-1 imagery of the Nilgiris (NI), Biligirirangan Hills (BG) and the Shevaroys (Sh) of Tamil Nadu. Dextral movement on the bounding lineaments, the Kabbani (Kb) and the Bhavani (Bh) has developed a regional northeasterly foliation (fine lines) and fracture patterns (dark lines) which can be fitted into approximately oriented strain ellipses. The Moyar (Mo) and the Attur Valley fault (AV) are considered as Riedel (R) shears developed from the Kabbani (Kb) – Bhavani (Bh) shear couple. (SG) Sankari granite. Scale 1 : 1,000,000.

Figure  Structural elements in the Attur Valley fault zone. (Fig. 8) ENE en echelon fold axes, NNW dolerite dikes, NNE sinistral faults and resultant strain ellipse (inset) after Srinivasan (1974).

(AFTER KATZ, 1978.)
these belt are often in an en echelon pattern. He considered that Attur Valley fault located in the area under investigation as Riedel (R shears) developed from the Kabbani (Kb) - Bhavani (Bh) Shear couple (Fig. 8). This Attur Valley fault zone separates the Shevaroys from the Kollimalai - Pachamalai hills to the south (Srinivasan, 1974.). Structural elements in the Attur Valley fault zone ENE trending en echelon fold axis, NNW dolerite dyke, NNE sinistral fault and the resultant strain ellipse are shown in Fig. 9.

Structural elements within this zone are compatible with overall dextral simple shear. Similar observations were made by Moralev et al, (1971) from the Krishnagiri area.

Subramaniam and Mani (1979) dealing on the geomorphic significance of lateritic bauxite in the Shevaroys and Kollimalai hills observed that though at first sight the altitudinal difference of 2050 metres between the plateau landforms on the Kollimalai and Shevaroys suggest the prevalence of two independent surfaces, but on closer examination, they are only erosional remnants of a single surface with a southerly gentle slope of 0°15′.

Figure 10 based on landsat imagery interpretation by Subramaniam and Mani (1979), shows the lineaments in and
around Attur Valley. According to them the dominant
lineament direction North of Attur Valley are in the
directions of 1. NW-SE, 2. NNE-SSW, 3. NE-SW, 4. ENE-
WSW and 5. E-W. To the south of the Attur Valley NE-
SW and NNE-SSW lineaments are present. The Attur Valley
itself is bounded by E-W trending lineaments.

The major drainage direction in Shevaroys and
Kollimalai hills coincide with the lineaments (Subra-
manian and Mani, 1979.).

Dealing on the ground water potential of the
Salem District, various ground water organisations of
State Government and Central Government, (Tamil Nadu
Public Works Department Ground Water Division, Tamil
Nadu Water Supplies and Drainage Board, Tube Well Cor-
poration, Central Ground Water Board etc.,) have reported
on,

1. Runoff zone at Kairayan and Kollihills.
2. Infiltration zone at Mangalapuram.
3. Highly weathered and fracture zone in Salem,
   Rasipuram and Attur Taluk.
4. Moderately weathered and fracture zone in
   poorly recharged areas around Rasipuram.
5. Alluvial zone along the Attur Valley.
LINEAMENTS ACROSS SHEVAROY-CHITTERI-KALRAYAN-KOLLI-AND PACHAIMALAI HILLS.

LEGEND

- Mega Lineament.
- Minor Lineament.
- Intermediate Lineament.
- Outline of Hills.

(After Subramanian, Mani, 1979)
6. The depth to water table in all the taluks of Salem District.

7. Aquifer characteristics of Salem District.

However the data are given in unpublished reports. (Refer Groundwater News July 1984 Page 17-25).

1.5 METHODS OF STUDY:

1.5.1 FIELD GEOLOGICAL MAPPING:

The author completed a detailed field investigation during the periods May and December 1985 and April-June 1986 and a detailed geological map of the area under investigation was prepared. As a base map, toposheet Numbers 56 6 and 58 7 of the Survey of India published in the year 1932 and 1973 were used. The base map was enlarged two times using a pantograph, and field observations were recorded.

As no detailed geological map is available in the previous literature, every care has been taken to project the field observation faithfully in the geological map. Bearings were taken with the help of Brunton compass in reference to prominent villages and other landmarks located in the base map. Systematic traverses were conducted to establish the lithological boundaries. Actual and inferred contacts of the lithological units are represented in the geological map using the green-ink mapping
technique. Lineaments, faults, fracture zones, shear zones, were carefully checked in the field.

1.5.2 AIRPHOTOS AND LANDSAT IMAGERY INTERPRETATION:

In addition to the field investigation, air photos (Run No.14, Photo Nos. 43 to 52 and Run No. 16, Photo Nos. 35 to 43 with a scale of 1:63000) and Landsat Imagery pertaining to Attur Valley available at the Remote Sensing Laboratory, Institute for water studies, Taramani, Madras, were studied during the month of September 1985. Carlzeiss mirror stereoscope and pocket stereoscope were used for observing the landforms, rock types, fold, fault, fracture, and their special relations with one another, using the seven basic characteristics, shape, size, pattern, shadow, tone, texture and site. Lithological boundaries as observed in the air photos were checked during the field investigation.

Landsat Imagery (Plate II, Fig.1) has been studied in detail by the author to locate the major lineaments, stream pattern and fault zones (Fig.19). Band 5 and 7 of the MSS gave more information on the geological features and water bodies.

1.5.3 HYDROLOGICAL MAPPING:

The work includes inventory of the existing wells in the area, collection of water-level data, collection and
analysis of samples to determine quality of water, and in a few cases estimating the physical properties of the water-bearing strata as related to storage and movement of ground water.

These studies aim at a quantitative assessment of the groundwater resources of the region so as to prepare a scientifically sound plan for its exploitation. The systematic water surveys include:

(i) Geological mapping and determination of principal aquifers of the area.

(ii) Preparation of a series of water table maps (Fig. 34) to show the source, movement and discharge of groundwater and seasonal changes in these features.

(iii) Detailed inventory of existing wells and springs to determine the extent of present utilisation of Ground Water for irrigation, industrial and public water supply.

(iv) Observations of significant water table fluctuations.

(v) Preparation of maps showing quality of water to indicate the aerial distribution of Salinity and other changes in the quality of Ground Water.

Since the ground water unlike other mineral deposits is replenishable, it is essential to carry out such studies
to quantitative estimate the amount of annual recharge of particular water bearing formation. These studies include precipitation characteristic of the area, nature of soil, slope and vegetation cover controlling the run-off, water losses through evaporation and transpiration, influence of surface water bodies etc., Systematic groundwater surveys principally relate to the occurrence, storage and movement of groundwater within a water-bearing formation. These studies include determination of physical properties of the water-bearing formations, determining field co-efficients of permeability and storage, collecting water-level data from observation wells located at suitable places in the area and determining the fluctuations over a continuous period of many years.

Quality of water studies include, collection of water samples from individual water-bearing horizons from as many representative localities as possible within the area of study and carrying out partial and complete chemical analysis of the same with a view to determining the suitability of water for domestic, irrigation and industrial uses.

1.5.4 COMPILATION OF HYDROLOGICAL DATA:

An important problem in hydrology is to interpret a past record of hydrologic events in terms of future probabilities of occurrence. In groundwater hydrology, this problem arises in the estimates of rainfalls, droughts,
aquifer storages, low streamflows and water qualities.

The successful prospecting of groundwater depends on the geological features of the sub-surface. Hence, an intensive knowledge and study of the geology of the area and the preparation of sub-surface geological map should be the foundation of groundwater study. Readily available hydrogeological data as revealed by the existing dug wells, dug-cum-bored wells, tube wells and based on the surveys conducted by the State or Central Agencies such as Central Ground Water Board, Exploratory Tube Well organisation of the Ministry of Food and Agriculture, the Tamil Nadu Water Supply and Drainage Board and Public Works Department Ground Water Division.

The Tamil Nadu Government sanctioned a scheme of comprehensive survey and investigation of groundwater potential and a programme has been drawn up in the Public Works Department Ground Water Division, took up investigations throughout the State in a phased manner.

The Public Works Department (Groundwater) undertook the ground water investigation of Attur Taluk, Salem District between the years 1980 and 1983. As a result of detailed investigations carried out by this Department, a large volume of hydrogeologic data have been collected.
The author has analysed and interpreted the data relating to Attur Valley. The relevant data are given in the table. [In Appendix]