Structure
CHAPTER IV

STRUCTURAL FEATURES IN ATTUR VALLEY

4.1 INTRODUCTION:

The structure of the area under investigation is quite interesting with much folding, shearing, and faulting, normally anticipated in the Archaean terrain. The various structural elements delineated and interpreted throw light on the fact that the various lithological units have been involved in the sequence of a few intrusive and deformational episodes. Generally, the rocks present in the area under investigation are characterised by a foliated structure to which all joints and other structures are geometrically related. On the basis of structural data collected during the field survey, a geological map has been prepared and the important structural elements were plotted over the map (Fig. 16).

In addition to the field investigation, airphotos and landsat imagery pertaining to Attur Valley (available at the Remote sensing Laboratory, Institute for Water Studies, Taramani, Madras) were studied and the fold, fault, fracture and major lineaments were observed. A lineament map (Fig. 19) has been prepared and correlate with major streams and river channels.
4.2 FOLDS:

The variation in the general trend of the various rock types of the area under investigation prompted the author to make a detailed survey in the regions lying north, west and south of the study area.

In the western region of the area under investigation, between Palaniapuri and Malliakarai, a hill locally called Palaniapuri basin or Malliakarai malai, shows synform fold with a plunge, trending E-W (Fig. 18).

4.3 SHEAR ZONE AND FAULTS:

The area under investigation show two shear zones (Fig. 18) well marked by the existence of crushed and mylonatised rocks. (Plate IV, Fig. 3). One Zone trends in the NE-SW direction and the other zone trends in the E-W direction.

The NE-SW shear zone passes through Ramanujapuram, Kattukkottai, Chennimalai, Kannadianmalai near Valayamadevi, Neelamalai near Pungavadi (Plate I, Fig. 1), Pokkamalai near Kadambur (Fig. 18). All along the shear, the rocks have been mylonatised and crushed (Plate IV Fig. 3).

The shear zone connecting Pokkamalai in the south to the Kalrayan hill in the north, displays mylonite ridges trending NE-SW. But from Ramanujapuram (North of Kattukkottai)
to Kalrayan hill, though the trend continues to be the same, a slight displacement towards east in the alignment of the mylonite ridges is noticed, which perhaps indicates a susceptibility to a later deformational forces (Fig.18).

The E-W shear zone is located at Ethapur, Palandiyur Ramamoorthynagar and Manivilundan. The distribution of such mylonite patches perhaps indicates the extension of Godumalai shear zone (Grady, 1971). This extension was noticed to intersect the NE-SW shear zone at Ramanujapuram. The dislocation in NE-SW shear zone by another E-W trending shearzone indicate that the later one is younger in age. (Fig.18.).

Mylonites have been formed by extreme milling and pulverisation of rocks along the major fault zone (NE-SW fault and E-W fault) under strong direction pressure occuring in the area of investigation. The actual NE-SW fault zone is situated at NE and SE of Attur Town. The trend of the fault zone is in conformity with the trend of the zones of major shears, namely N 30°E. The NE-SW faults predominant and step faults (Srinivasan, 1971). These faults are followed by Kallar and Malliyakarai rivers.

The E-W fault zone is situated at North of Attur town along the foot hill of Kalrayan (Fig.18). This fault
zone is partly followed by the Vellar river, forms the northern boundary of Attur Valley (Srinivasan, 1974.).

Some minor shears noticed elsewhere in the area trending NE-SW, may be correlated to minor faults in the area distributed in an on echelon pattern, representing the tensional cracks developed (Plate V, Fig.1).

4.5 JOINTS:

The combination of fracture breaking up a given portion of the earth's crust is called the joint system of that area (Beloussov, 1962.). The distribution of the joints determines the surface shape of a rock outcrop. Joints in dolerites at Kiliakaranai, Paithur and Manjani (Plate I, Fig.8) and in granites at Kallodacharmalai, south of Attur are noticed.

Figure 2 in Plate VII, the photograph taken from the top of a well at Manjani depicts the crystalline nature of the rocks showing well developed horizontal joints. The copious supply of water at a depth of 60 feet might be due to horizontal joints.

4.6 STRUCTURAL ANALYSIS WITH THE RELATION BETWEEN FRACTURE PATTERN AND STREAM PATTERN IN ATTUR VALLEY:

Attur Valley is comprised of Archaean rocks, that belong to the class of impermeable, consolidated, but highly
EXPLANATION OF PLATE V.

Fig. 1. Peninsular gneiss at Paithur is broken into blocks by shear and tension.

Fig. 2. Photograph showing a displacement of blocks at Anaivari Water Falls, where the major fractures are observed.
Photograph showing the synform fold located in the north of Malliakarai. The other side of the hill locally called Palaniapuri malai. The foot hill areas are covered by valley filled sediments and Bajadas.

The photograph shows the joints in dolerite dyke at Paithur Village.

The photograph shows inclined joints in dolerite dyke at Malliakarai TAMIN quarry.
fractured rocks. In these rocks the water is transported through the joints and faults and therefore a detailed information of the fracture attitudes and their density in an unit area in Attur Valley is highly desirable for studying the ground water movement.

4.6.1 CLASSIFICATION OF FRACTURE:

Fractures in hard rock terrains in Attur Valley, based on the scale of development and genesis, can be classified into 2 orders.

1. First Order - Fractures related to fault zones
2. Second Order - Fractures related to the cooling history, diagenesis and metamorphism.

First order fractures are developed on macro-scale, while the second order ones on micro-scale. Macro- and micro fractures influence ground water development on different scales. The relevant aspects on fracture for groundwater development are summarised in Table 6.
### Classification of Fractures in Attur Valley.

<table>
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<th>Order and Class of Fracture</th>
<th>History of Development</th>
<th>Geologic/Geomorphic Features</th>
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<td>I: Macro-features</td>
<td>Related to early and late Archaean fold and fault tectonics.</td>
<td>Water divide, Fault Zones.</td>
<td>Water divide between tributaries along Palaniapuri fold axis, Paithur and Kalrayan hills, N30°E Attur fault zone, E-W Attur Valley fault zone, NNE-SSW Paithur fault, N-S Malliakarai fault in Palaniapuri basin, ENE-SSW Malliakarai river fault, etc.,</td>
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4.6.1. (a) FIRST ORDER FRACTURE:

The first order fracture in the hard rock terrain of Attur Valley are related mainly to Archaean tectonics. The axial-zones of folds that have also served as sites of emplacement of granitoids serve as divides between the tributary streams of Attur Valley. The fold tectonics at Palaniyapuri basin (Fig.18) is followed in most instances by faulting, which are parallel, across and at an angle to the fold axis.

4.6.1. (b) SECOND ORDER FRACTURE:

The second order fractures are by far most ubiquitous and important from the point of view of groundwater development. In the Archaean granitoids they are represented by joints due to consolidation shrinkage. In Archean rocks by fracture cleavages, tensile, shear and relief joints developed during folding. (Plate V. Fig.1).

The macro fractures could be speedily and effectively studied by the satellite and aerial photographs, with groundcheck at selected points. Photographs with infrared imagery have been particularly found to be useful in groundwater exploration. The use of satellite photograph for groundwater exploration has been initiated in...
Tamil Nadu by Ozoray in 1973. Morphotectonic analysis, bringing out tectonic lineaments and their cross points are very helpful for groundwater exploitation, since such cross points are characterised by extreme yield conditions.

4.6.2 Inferences from the study of LANDSAT Imagery:

MSS band 7 has been selected for the present study. It is observed that MSS band 7 gives more information on structural elements.

The observations and inferences from the MSS band 7 are:

1. The drainage lineaments, especially light tone features, are much more distinct and clear.

2. Grady's (1971) Attur fault (N 30°E fault zone) and Katz's (1976) Attur Valley fault (E-W fault zone) can be clearly marked.

3. Abrupt change in the direction of tributaries has been observed towards the northern part of the imagery. (Refer Plate II, Fig.1). A similar trend can also be observed at Anaivari Water Falls (Plate V, Fig.2) north of Attur town. They are marked as first set of lineaments of NW-SE to NNW-SSE trend in Figure.19.
4. The second set of lineament show NNE-SSW trend constituting parallel to the Grady's 'F' fault. This is suggested from the trend of Kallar river in the north and Malliakarai river in the South of the area under investigation.

Principal output from the examination of these imageries is the recognition of several prominent structurally controlled lineaments. Besides several linear features in the form of straight and/or curved lines of uncertain origin, some of which are definitely structurally controlled were also picked up. Considering the spatial relationships, frequency magnitude and continuity, these lineaments have been classified into three categories:

1. Fracture lineament—linear outline, lesser magnitude, greater density of aerial distribution and arrangement in several orientations;

2. Probable fault lineament—zones of block displacement, large magnitude and abrupt change in orientation of linear features. (Plate V, Fig.2).

3. Major Fault zone lineament, 1) N 30°E and 2) E-W zones of lineaments represent the Attur fault of Grady and Attur Valley fault of Katz respectively. (Fig.19.).
LINEAMENT MAP OF ATTUR VALLEY DEMONSTRATING TECTONIC CONTROL OF DRAINAGE SYSTEM

(Based on Photo- and Landsat Imagery - Interpretation.)
(After Srinivasan, 1974; Subramanian et al, 1979; Modified by the author.)

LEGEND

--- Fracture lineament.
--- Probable fault lineament.
--- Major fault zone.
--- Hill boundary.
Spot height.

Locality.
Drainage.
Lake / Tank.
Anaivari Waterfall.
Spring.

SCALE

miles. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 miles
Three structural trends are very clear (Refer Fig.1 in Plate II and Fig.19) in the area under investigation. The northern region of Kalrayan hill is characterised by prominent NNE-SSW and E-W trending fault lineaments, a few NW-SE trending linear features. In the southern and western region of the study area, fault lineaments consisting of ENE-WSW and E-W trending sets of lineaments are prominent.

Study of the implications of the lineaments on the geological set up of the area shows that some of the lineaments represent NE-SW and E-W shear zones. The major drainage direction in the study area coincides with the major lineaments (Fig.19).

There are about 20 small irrigation lakes and tanks, 5 springs, and a water-fall (Plate V, Fig.2) which are located on lineaments (Fig.19).

Example: 1. Malliakarai river along NE-SW lineament; 2. Paithur river along N 30°E - S 30°W lineament; 3. Anaivari water fall at the triple junction of NE-SW, N 30°E and NW-SE lineaments. Therefore the tectonic control of the drainage system and the ground water movement are controlled by the lineaments of the study area.