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Lineaments Study and Ground Water in Aizawl City, Mizoram

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Abstract: ***Lineaments are essentially features on the land surface that reflect the subsurface planar structures. In recent years, the construction of lineament maps has assumed considerable significance for ground water occurrences and it also helps in evaluating the geomorphological and tectonic evolution of continental areas. Lineaments maps may be constructed from satellite imageries, aerial photographs and topographic sheets. This paper investigates the salient characteristics of the lineaments and their relationship with the ground water.***

Keywords: Lineaments, Joints, Fractures

1. Introduction

The hydrogeology of the study area is much controlled by the lithology and secondary structures present in the rocks. The general lithology consists of alternations of siltstone, shale and sandstone, wherein the porosity of the rocks are very limited. This has significantly reduced the water yielding capacity of rocks. However, the presence of numerous sets of joints, fractures, bedding planes and faults act as good conductor for ground water. Thus, the availability and distribution of water sources in the study area is attributed to its peculiar geomorphological and geological set-up and to some extent to the climatic condition. The near surface weathered and jointed zones constitute the main water table aquifer. Due to low storage capacities of the aquifers and losses due to seepages through stream courses the study area faces drinking water shortage in spite of heavy rains. The discharge from spring *(tuikhur)* is highest during monsoon and gets reduced considerably during dry winter season. The water intake to the well is mainly from the weathered material from its vicinity.

2. Study Area

Aizawl, the capital of Mizoram state, is situated in on the hillcrests, steep slopes and small valleys. It is located on a north-south elongated ridge, which acts as the main hill from which many small ridges and valleys are extending towards the east and west directions. The topography is highly undulating and rugged. The altitude varies from 120 m to 1400 m above mean sea level. It falls between 23º 40’ N to 23º 50’ N latitudes and 92º 40’ E to 92º 49’ E longitudes (Fig. 1). It covers an area of about 128.98 sq km, and as per 2011 census, the population is 293,416 persons.

Lineaments Defined

The term lineament was introduced by Hobbs (1904) for generally rectilinear earth features like crests of ridges or boundaries of elevated areas, drainage lines, coast lines and boundary lines of different lithological units. He subsequently (1912) defined them as significant lines of landscape, which reveal the hidden architecture of the rock basement. In the years following Hobbs’s enunciation of the concept of lineament, slightly varying definitions of this term have been given by different persons including- Hills (1963), Billings (1972), Gay (1973), and Lattman (1985). Many of these definitions recognize that lineaments could be gently curved and that their development is influenced by regional structures. O’Leary *et al.* (1976) in their review of the term lineament defined it as a mappable, simple or composite linear feature of a surface whose parts are aligned in a rectilinear or slightly curvilinear relationship, and which differs distinctly from the patterns of adjacent features and presumably reflects a sub-surface phenomenon.

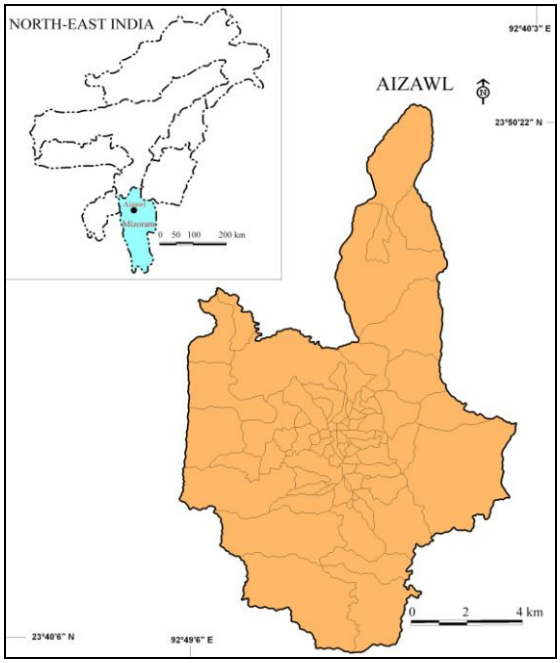

Figure 1: Study Area (Aizawl City)

Application in Ground Water Geology: As stated earlier lineaments are, in the majority cases, manifestations of zones of structural weakness. In these zones, the rock is generally fractured leading to an increase in the permeability which, in turns, allows free movement of ground water along the length of the lineament and into depth along the zone of structural weakness.

The dislocation and the deformation of strata gave rise to linear structural features in the study area. Totally 95 lineaments are identified and marked (Fig. 2). They are having varying dimensions, the smallest of them is 0.4 km

long, and some of them extend as much as 4 km. The total length of lineaments is about 108.62 km. Four different orientations of lineaments have been observed; one along NE-SW direction, the second NW-SE direction, the third N-S direction and the fourth along E-W direction. Majority of fractures are oriented in the NE-SW direction. The intersection of lineaments is more on the western part of the area. Based on the concentration and length of lineaments, the lineaments density map has been prepared (Fig. 3).

Therefore, in the areas of higher values of lineaments density there is a development of secondary porosities like joints and fractures (Fig 4 and Fig. 5). These are the main factors controlling the occurrence of natural water sources. Thus, a good numbers of spring (*tuikhur)* and hand pump have been noticed in and around the areas where the values of lineaments density is high. In brief, the lineaments density is high on the central and western part of the study area, whereas it is low on the southern part. Though, the lineaments density is high in the central part, due to expansion of residential area infiltration rates have been reduced considerably.

Therefore, the permeability of rocks possessing lineaments are expected to be significantly higher compared with the other rocks. At a number of places, hand pumps and spring (*tuikhur*) located at close proximity of lineaments have copious supply of water. Some os f such places observed during field investigations are found in *Ramhlun 'S', Ramthar, Electric Veng, Venghlui, College Veng, Mission Veng* localities, etc.

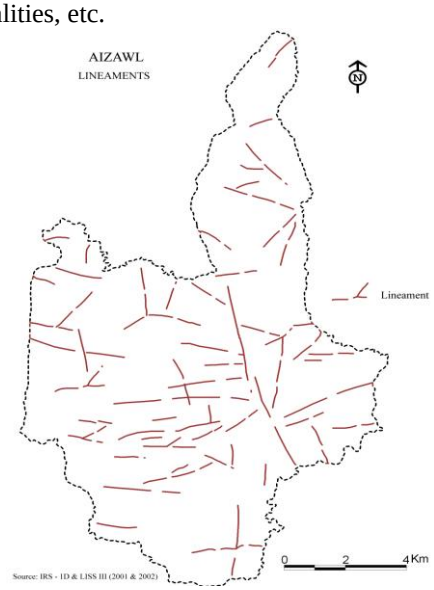

Figure 2: Lineaments in Aizawl

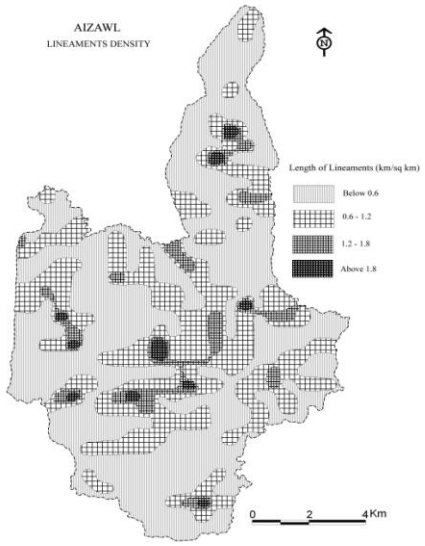

Figure 3: Lineaments Density in Aizawl

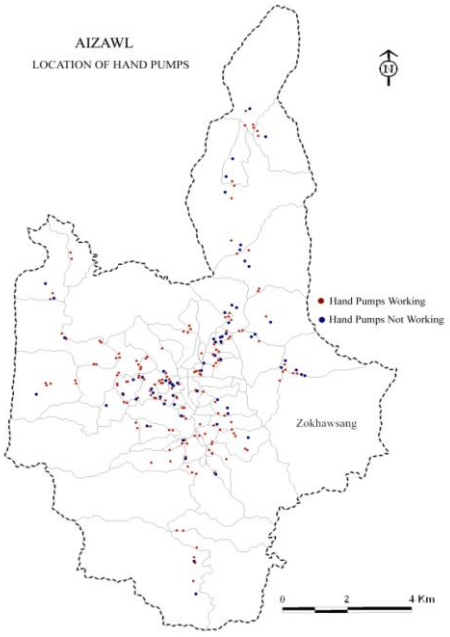

Figure 4: Location of Hand Pumps in Aizawl

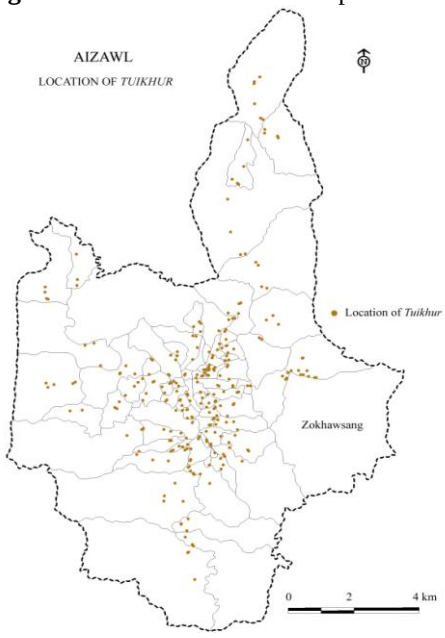

Figure 5: Location of Spring (*Tuikhur*) in Aizawl

he ground water in the study area occurs largely as disconnected local bodies in favorably perched aquifers under both confined and unconfined conditions and also in zones of jointing, fracturing and faulting. Relatively fault areas and gently sloping grounds characterized by deep weathering, such as hill tops, ridges, saddles, spurs and bulges of old landslide debris and fluvial fans form the recharge area, while steeper hill slopes, slope breaks and scarp of fans are observed to be the site of good discharge. The springs (*tuikhur*) and seepage issue out from all sides of the individual aquifers at different elevation. Springs (*tuikhur*) in the rocks of secondary porosity show great variability in yield even within short distances. A substantial number of springs (*tuikhur*) in the study area are formed in fractured and jointed hard sedimentary rocks. These springs (*tuikhur*) originate either along the hill slopes or along stream beds wherever the local water table is intersected by the fractures and joints or by the ground surface.

Following rains, water starts percolating down through the weathered material and saturate pore spaces in soils and rocks. The recharge of ground water tends to increase the amount of ground water storage and raises the pressure in primary and secondary pores. This results in increase in the discharge of water through spring *(tuikhur)* and thus its quick outflow. High rates of discharge lower the water table and its gradient and reduce pressure in pore spaces. This alteration of recharge and discharge is the cause of seasonal, local and short term fluctuations.

3. Conclusions

Lineaments are linear features on land surface that largely correspond to the straight segments of landforms and generally reflect subsurface planar structures. They can be easily mapped on satellite imageries, aerial photographs and topographic sheets and on analysis provide valuable information regarding earth features and earth processes. The study of lineaments should form an integral part of investigations in economic geology, ground water geology, structural geology and tectonics including seismology.

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