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GEOMORPHIC ANALYSIS OF MAWSMAI CAVE, MEGHALAYA, INDIA

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ABSTRACT

Caving is an art which can be best experienced in the mystic Mawsmai Cave of Meghalaya. This Cave is fast becoming a hot tourist's destination offering great adventurous opportunity to the tourists. The cave is located in the East Khasi Hill region near Cherrapunjee and is made of limestone. The emotion of thrill heightens after entering the cave. The entrance has a narrow vertical opening and is well lit. Due to its location in the world's largest rainfall region, dripping of water from the cave roofs occurs almost throughout the year. The formation of stalactites and stalagmites create wonderful phenomena specially found in this caves. The conspicuous pillars formed due to the joining of the roof and the floors are an awe-inspiring creativity of the creator of this world.

Keywords: Cave, Limestone, Stalactite, Stalagmite, Pillar, Solution.

INTRODUCTION

Caves have always hunted the imagination of mankind already from the start of human history; these natural formations provided shelter to early man and were sought after earnestly, to provide a 'safe home'. Caves are natural habitats for a wide spectrum of fascinating life forms. Caves offer natural, experimental study system of the subsurface for fundamental geomorphologic studies (Baskar, 2008). The civilized people like to visit the caves for its scenic beauties.

Meghalaya, which means the 'abode of clouds', is one of the most picturesque states in India. Notwithstanding the fact, that state capital Shillong, is often referred to as the 'Scotland of the East,' and Mawsynram receives the highest rainfall in the world, coupled with the fact that the two-tier living 'Root Bridge' at Tyrna village and lush greenery of the Khasi, Garo and Jaintia hills lures the visitor to the natural beauty of the hills, Mawsmai caves, a few miles further away from Cherrapunjee or Shora (In Khasi language, 'Soh' means fruit and 'rah' means carry. Since the fruits of Sohra are carried from the villages around, it is alluded that 'Sohra' got its name from 'Soh' and 'rah'. We cannot vouch for the correctness of this assumption. Cherrapunjee's original name is 'Sohrapoonjee'. 'Poonjee' refers to the head village where the seat of power of the Chieftain is. The English who ruled over this place from 1830-1947 could not pronounce 'Sohrapoonjee' correctly and as was typical of them named it 'Cherrapunjee') is fast emerging as a new tourist destination(Sanyal,2005).

The Mawsmai cave, made of limestone, spellbind the visitor the moment who enters the cavern. Locals tell that cave was discovered by their hunters who hunted down animals living in this cave. Maw Smai in Khasi language means - "Oath stone". Most likely this name comes from one of local megalythic monuments - Khasi land is very rich with them.Often in Internet there is said that the second name of this cave is Krem(Cave) Phyllut. This is wrong - Krem Phyllut is another, much longer cave nearby(Lal,2010).

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Location:

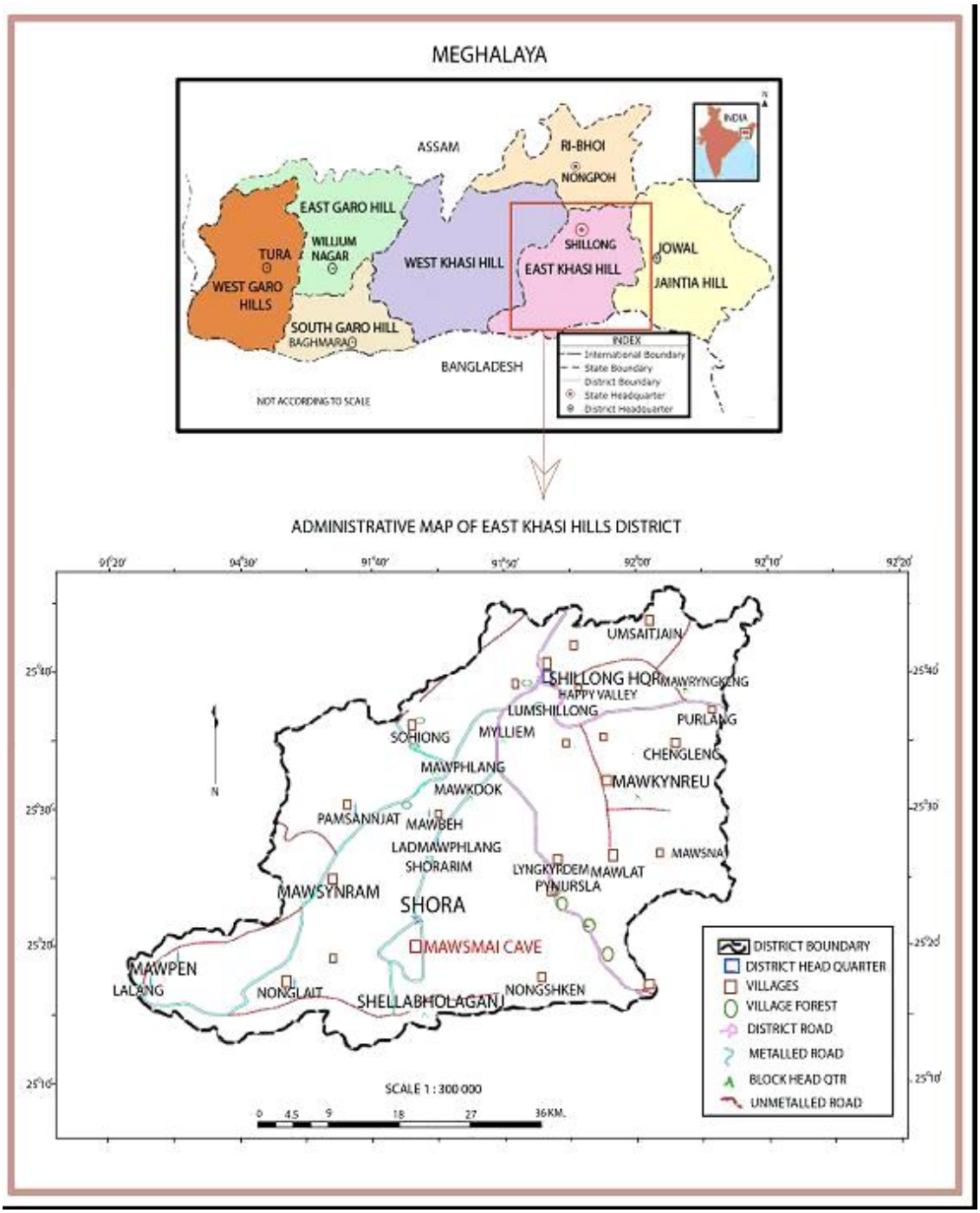

Figure: 1.1 Location of the Study Area

In the state Meghalaya, the Khasi Hills District was divided into two districts, viz. the East Khasi Hills District and the West Khasi Hills District on 28th October 1976. On June 4th, 1992, East Khasi Hills District was further divided into two administrative districts of East Khasi Hills District and Ri-Bhoi District.The Mawsmai village is situated in the East Khasi Hills District within 6kms distance from Cherrapunjee(Shora) .The Cherrapunjee is at a distance of only 58 kms from Shillong. Shillong is the capital city of the state of Meghalaya. A motorable road links the two places of Cherrapunjee and Shillong. One can avail buses and taxis to reach Cherrapunjee from Shillong by road. The entire journey takes around two hours.
The Mawsmai cave is in the southern foothill region of Mawsmai ridge belongs to the Mawsmai village. The latitude of the cave is**:** 25°18′00″N and the longitude is 91°42′00″E.

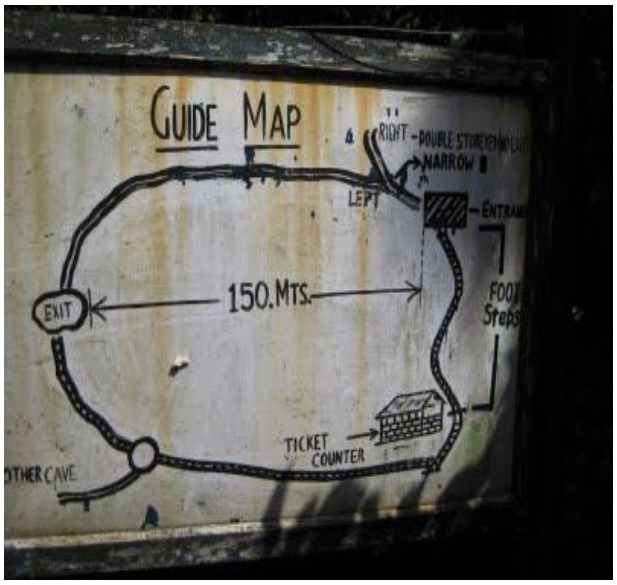

Figure:**1.2** Guide map
Source: The Dept. of Tourism, Govt. of Meghalaya

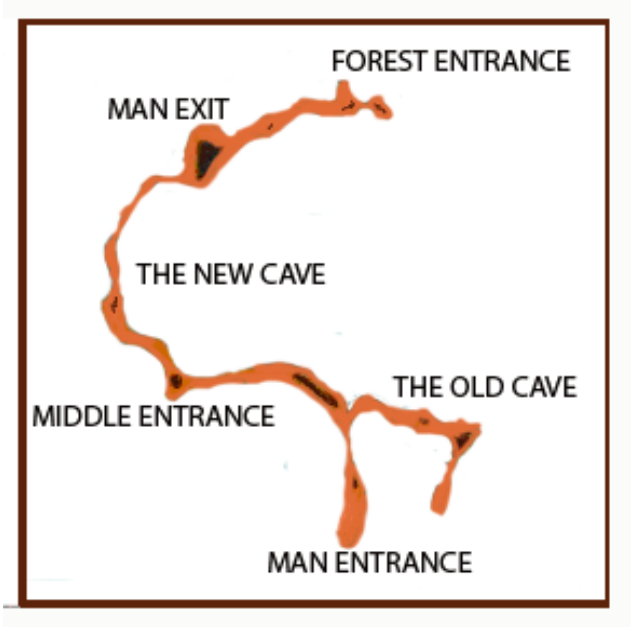

Figure:1.3 Profile of the cave
Source: The Dept. of Tourism, Govt. of Meghalaya

Geology:

Geologically the State of Meghalaya is also known as the "Meghalaya Plateau". It consists mainly of Archean rock formations. These rock formations contain rich deposits of valuable minerals like coal, limestone, uranium and sillimanite. Meghalaya has many rivers. Most of these are rainfed and are therefore seasonal. In the southern Khasi Hills Region, where the Mawsmai cave exists, rivers have created deep gorges and several beautiful waterfalls(Roy,Deb,1981).

The elevation of the plateau ranges between 150 m to 1961 m. Meghalaya with its wealth of mineral deposits is a storehouse of industrial potential. There are extensive deposits of coal, limestone, granite, clay and other minerals as follows-

From the Table No 1.1 it is seen that amongst the minerals limestone is dominated(2,537.000 million tones) and it is mainly found in the east Khasi hill region where the Mawsmai cave exists.

Table-1.1 – Mineral, reserves and areas where found

Mineral	Reserves(In million Tonnes)	Areas where found
Limestone		
Khasi Hills	2,537.000	Cherrapunjee, Laitryngew, Mawlong, Ishamati, Komorrah, Shella, Borsora
Jaintia Hills	1,050.000	Lumshnong, Sutnga, Nongkhlieh, Lakadong, Syndai, Nongtalang
Garo Hills	560.000	Darrang-Ear-Aning, Siju-Artheka, Chokpot
Meghalaya	4,147.000	
Coal		
Khasi Hills	164.500	Laitryngew, Cherrapunjee, Laitduh, Mawbehlarkar, Mawsynram, Lumdidom, Langrin, East Darrangiri, Pynursla, Lyngkyrdem, Mawlong-Shella-Ishamati and Borsora
Jaintia Hills	40.000	Bapung, Lakadong, Sutnga, Jarain, Musiang Lamare, Toksi, Khliehriat
Garo Hills	359.000	West Darranggiri, Siju, Pemdemgri-Balphakram, Selsela
Meghalaya	563.500	
Kaolin		
Khasi Hills	1.300	Mawkriah-Mawphlang, Smit, Laitlyngkot
Jaintia Hills	1.940	Thadlaskein, Shangpung, Mulieh, Mynsngat
Garo Hills	1.200	Daruggiri
Meghalaya	4.440	
Clay		
Khasi Hills	2.470	Cherrapunjee, Kut Madan, Mahadek, Sohrarim, Umsten
Jaintia Hills	0.500	Larnai, Tongseng
Garo Hills	78.000	Nangwalbibra, Nengkrah, Dobu, Rewak, Damukgithim, Tura, Rongram, Khobal, Rongrenggiri-Kherra, Songsak
Meghalaya	80.970	
Sillimanite		
Khasi Hills	2.045	Sonapahar, Nongstoin, Mawpomblang
Jaintia Hills	-	-
Garo Hills	0.001	Dapsi-Thologiri
Meghalaya	0.046	
Glass Sand		
Khasi Hills	2.400	Umstew, Kreit
Jaintia Hills	-	-
Garo Hills	0.140	Tura
Meghalaya	2.540	
Quartz		
Khasi Hills	0.020	Hahim, Mairang, Nongkhlaw
Jaintia Hills	-	-
Garo Hills	0.057	Tura, Bonsomgiri, Rombhagiri, Nengkhra
Meghalaya	0.077	
Feldspar		
Khasi Hills	0.020	Hahim, Mairang, Nongkhlaw
Jaintia Hills	-	-
Garo Hills	0.057	Tura, Bonsomgiri, Rombhabiri, Nengkhra
Meghalaya	0.128	

Source: Technical Data on Minerals, Directorate of Mineral resources, Meghalaya

Physiography:

The East Khasi Hills District of Meghalaya is mostly hilly with deep gorges and ravines on the southern portion. The most important physiographic features of the district is the Shillong Plateau interspersed with river valley, then fall sharply in the southern portion forming deep gorges and ravine in Mawsynram and Shella-Bholaganj bordering Bangladesh. Shillong peak lying 10 Kms. from the city, offer a panoramic view of the scenic country side and is also the highest point in the district as well as in the State. In the evening , the city lights below appears like a star studded abyss(Wikipedia).

The terrain in and around Cherrapunjee is undulating grassland with pockets of shrubbery. The steep slopes in the gorges are covered by tropical rain forests. In many places in and around Cherrapunjee there is hardly an inch of topsoil or it is exposed rocks. The condition of topsoil in most other places is rocky and is not conducive for supporting vegetation. Geologists feel that the table land of Cherrapunjee must have been thickly forested once upon a time. Progressive deforestation and the local system of 'jhum' cultivation involving slashing and burning of forests for shifting cultivation together with heavy rainfall over a very long period of time washing away the top soil must have contributed to its current barrenness. Writings dating back to 1840s comment on the barrenness of the place. Now, the land in and around Cherrapunjee cannot support cultivation.

Beautiful visitor attraction near the famous Cherrapunji is Mawsmai Cave. This is the first show cave in Meghalaya, with entrance fees and opening times. Khasi Hills are partly formed of limestone. As this area gets some of the heaviest rains in the world, here form numerous caves. Mawsmai Cave is just one of more than 200 caves in this area and it is comparatively short - approximately 250 m. But this is very beautiful cave, richly adorned with stalactites, stalagmites, columns and layered with sparkling calcite crystals. Entry in the cave leads through rather narrow vertical opening. First - old - part of the cave is lighted, it contains several larger rooms including Mughal Room - more than 25 m wide, 25 m high and some 75 m long.Further on there is the so called "new" part which does not have lighting. Inside the cave there is a "window" opening upwards, with jungle in sight. The stalactite, stalagmite, pillar, helicites, heligmites etc are the principle geomorphic features found in the cave.

Plate No1.1 Geomorphic Features

Plate No 1.2 Stalactite as Ganesh

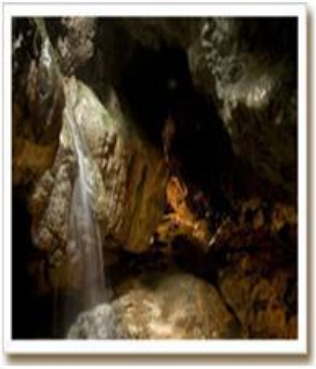

Plate No 1.3 Karst Window

Drainage:

There is no such river influencing directly on the cave but the cave is situated in the Kynshi River Basin. Though the river mainly flows along the West Khasi Hill but some streams are coming from the Esat Khasi Hill which have an interaction with the Mawsmai cave.

Kynshi River, also known as Jadukata, is one of the important rivers in Meghalaya. This 143 km long river irrigates over 2000 sq km of area. The main tributaries of Kynshi are Umrilang (60 km long) and Um-mawblei (71 km long). Kynshi River is known as Kynshiang at the confluence with Umkyrtha. Nongkhnum Island, the biggest river island in Meghalaya, has been formed by the bifurcation of the Kynshi River into two rivers namely- Phanliang River and Namliang River. At the point of bifurcation, there is a charming sandy beach called Wei-Phanliang, about 100 sq m in area. Kynshi is an important river for angling.

Close to this cave, on the ledge of the Mawsmai Ridge stands a conspicuous Observation-Tower, from where one gets an unforgettable view of the famed Mawsmai Falls whose waters

cascade down for over seven hundred feet to join the swift river below, leaving an indelible impression on every visitor. The falls are also known as Nohsngithiang Falls. After the Nohsngithiang Falls ,The Nong khnum river creates an island, said to be one of the biggest river island in Asia, covering a geographical area of five square kilometers, is twelve kilometers from Nongstoin, the district headquarters of West Khasi Hills. Nongkhnum Island is the biggest River Island in Meghalaya and the second biggest island in Asia, after Majuli Island in Assam.

In the Mawsmai cave region there are several rills and gullies. The small rills and gullies are flowing over the roof and due to seepage the water penetrates down through the roof of the cave. The seepage is continuing hours and hours from the roof and drops down to the floor of the cave due to its location in the world's highest rainfall region. The water is percolating down the towards the ground. Somewhere the water remains stagnant in the cave floor. In the cave floor so many rills and gullies are formed which are coming down through the cave wall as spring.

Climate:

With average annual rainfall as high as 1200 cm in some areas, Meghalaya is the wettest place on the Earth. The maximum temperature in this region rarely goes beyond 28 °C (82 °F), whereas winters temperatures of sub-zero degrees are common.

The town of Cherrapunji in the Khasi Hills south of capital Shillong holds the world record for most rain in a calendar month, while the village of Mawsynram, near the town of Cherrapunji, holds the distinction of seeing the heaviest yearly rains. The best time to visit Meghalaya is during the months of March to July. The British and Assam Tea Estate owners would shift here during the summer months to escape the heat of the Indian Plains(Roy,Deb,1981).

Table No.-1.2: AVERAGE ANNUAL RAINFALL IN CHERRAPUNJI, MEGHALAYA

	Temperature(°C)			**Precipitation(m.)**
Months	**Normal**	**Warmest**	**Coldest**	**Normal**
January	11.5	15.7	7.2	2
February	13.1	17.3	8.9	3
March	16.5	20.5	12.5	9
April	18.1	21.7	14.5	19
May	19.3	22.4	16.1	22
June	20.3	22.7	17.9	25
July	20.1	22.0	18.1	29
August	20.6	22.9	18.2	26
September	20.2	22.7	17.5	21
October	19.3	22.7	15.8	10
November	16.4	20.4	12.3	3
December	12.7	17.0	8.3	1

Source: Cherrapunji weather station: 1313 m.a.s.l., 6,0 km away from Cherrapunji
News from yr.no

From Table No 1.2 one can assume about the rainfall occurs surrounding the Mawsmai cave which is situated in the Cherrapunji climatic region. During the month of June rainfall exceeds over 2500cm and continues for three months. The temperature differs form outer side to inner side of the cave. In the outer side of the cave temperature does not exceeds 25°C.Where as in the inner side it reaches upto 39°C and create suffocation for the people visit there. Sometimes the amount of oxygen decreases in the cave interior and the visitor fell exhaustion. The humidity is also very high in the interior but rainfall like the outside does not occur in the cave due to absence of cloud.

Genesis of the Cave:

A cave is a natural opening or cavity within the earth, generally extending from the earth's surface to beyond the zone of light. Three generic classes of caves can be recognized according to the major sculpturing process: (1) caves formed by pressure or flow, (2) caves

carved by erosion, and (3) caves dissolved by solution. The caves dissolved by solution are the familiar limestone caverns or caves. Limestone caves are, by far, the most common type of caves.

Due to presence of huge amount of limestone in its womb Cave formation in the East Khasi Hill begins when rainwater absorbs carbon dioxide as it falls through the atmosphere. Rain water must have carbon dioxide to become acidic. It must be acidic to chemically react to the limestone bedrock. Rainwater is absorbed by the soil into the ground.

As rainwater comes through the soil it absorbs more carbon dioxide that is being produced by plants that are dead. This changes the ground water to a weaker form of carbonic acid(H_2O + $CO_2 = H_2CO_3$). As it travels down through the ground it comes to solid rock. When the rock is limestone or dolomite caves can form. Solution cave chemistry can be simply stated: limestone and dolostone, the host rocks for most caves, are dissolved by natural acids (carbonic, sulfuric, and various organic acids) which occur in groundwater. Calcite ($CaCO_3$), the principal mineral comprising limestone, is dissolved in the presence of acid to produce calcium ion (Ca^{++}) and bicarbonate ion (HCO_3^-). Dolomite [$CaMg(CO_3)_2$], the most important mineral in dolostone, is dissolved by acid to produce calcium ion (Ca^{++}), magnesium ion (Mg^{++}), and bicarbonate ions (HCO_3^-). If the acid is able to flow through the rock, ions will be removed and a cavity or solution conduit will form

The water reacts chemically with limestone and slowly a larger and larger space will form. This happens because the rocks are made of calcium carbonate ($CaCO_3$). This is what you call chemical erosion. As the space becomes larger and larger the water can flow through. As it flows it erodes. Physical erosion washes away rock and sand. This is what makes a cave larger and forms an underground stream. Finally over hundreds of thousands of years or even millions of years the cave is formed.

The problem is that we are attempting to understand the origin of a cavity for which the evidence of the events forming it has been largely dissolved. Two basic types of theories concern the water conditions when the cave formed. These are the *vadose* and *phreatic* theories. The vadose theory suggests that solution of the cavity occurred while the limestone was above the level of groundwater (water table) and that the cavity was largely filled with air. The phreatic theory claims that the cavity formed when it was below the level of groundwater when it was completely filled with water(Austin,1980). East Khasi Hill as well as the Mawsmai ridge consists higher altitude and limestone in the surface and subsurface zone. Thus it can be assumed that the Mawsmai cave is formed according to the Vadose theory.

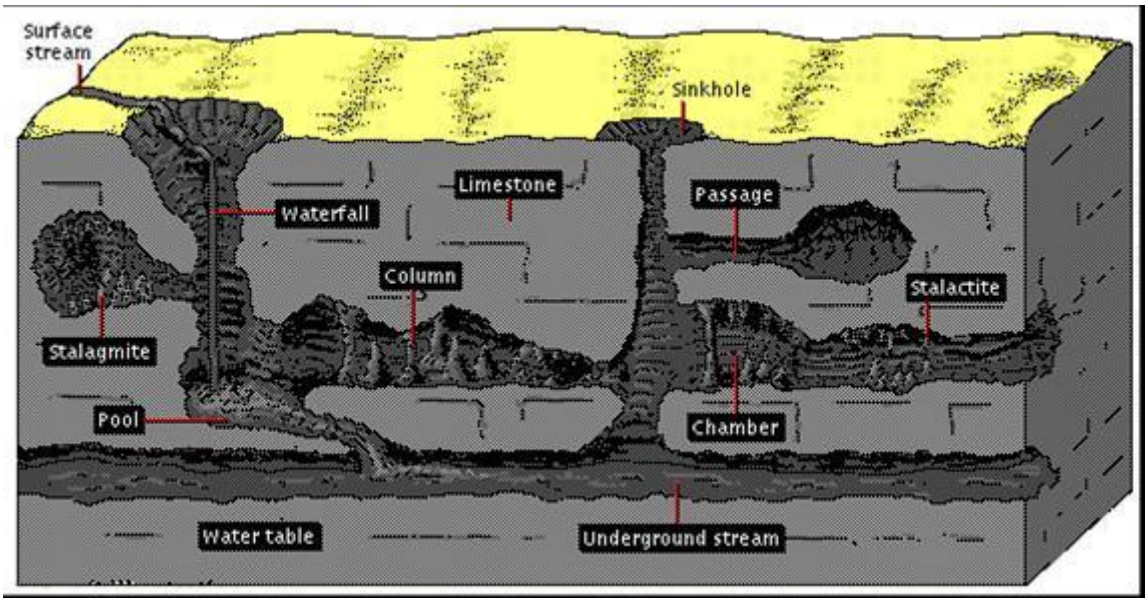

Figure - 1.4 Formation of Cave

Flora and fauna:

Outside the cave, as per the State of Forest Report 2003, published by the Forest Survey of India, Meghalaya has a forest cover of 9,496 km², which is 42.34% of the total geographical area of the state. The Meghalayan subtropical forests have been considered among the richest botanical habitats of Asia. These forests receive abundant rainfall and support a vast variety of floral and faunal biodiversity. A small portion of the forest area in Meghalaya is under what is known as “sacred groves” (see Sacred groves of India). These are small pockets of ancient forest that have been preserved by the communities for hundreds of years due to religious and cultural beliefs.

In the cave the flora and fauna are with unique varieties. Due to insufficient light inside photosynthesis does not occur and plants are found only in the cave entrance. Some fungi do well in the cave. The artificial electricity which are projected to make it show cave for the visitors helps to alive and growth of some mosses, algae and ferns. Crustaceans ranging in size from tiny copepods to large crayfish are found inside the cave. The fauna like crickets, cockroaches, insect larvae, birds, cave beetles, spiders, worms, snails, millipedes, centipedes and cave rats are also found inside the cave. Bats are the common features of the cave.

Socio-Economic Impact:

In Old Testament times caves often served as refuge or emergency shelter. Caves are of interest to the student of the Bible because the Bible lands are rich in limestone caves(Austin,1980). The great size and beauty of the limestone caves like Mawsmai have made them features of public amazement and wonder. In the interior of the cave people emarginated different stalactite and stalagmites as the ‘*Shiva Linga’* or sometimes as the ‘*Ganesh*’. The Garo or Khasi people have their superstitious mentality and belief about the architectures created in the cave as their God.

Plate No. 1.4 Shiva Linga

Though in the interior it is restricted but people can easily use the limestone for their domestic purposes which are taken form the surroundings of the cave. People of Meghalaya can earn lot of money from the tourists visited there to enjoy the scenic beauty of the cave.

CONCLUSION

A great deal of scientific interest has been generated by caves. Speleology is a multidisciplinary science which deals with the cave environment: cave discovery, exploration, surveying, archaeology, zoology, botany, paleontology, meteorology, and geology. Mineralogists and gem collectors know that caves contain many large and perfect crystals. Paleontologists have found fossils in caves which shed light on the history of man (e.g., Neanderthal man). Geologists have attempted to answer several theoretical and practical questions posed by caves. One of the most difficult problems has been to interpret the history of limestone caves in relation to the Biblical framework for earth history(Austin,1980).The geographer are trying to solve the problems by describing the caves perfectly and analyzing the reason behind its formation.

The discussion about the Mawsmai cave will help the geographer to go forward in future because of its detailed description and analysis.

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