

Geological Work of Underground Water

(Part-2)

Date- 05/09/2023



- **Ponor/Swallow Holes**- Ponors or swallow holes represent fissures in the karst landforms through which the water sinks underground. A ponor is a natural opening where surface water enters into underground passages; they may be found in karst landscapes where the geology and the geomorphology is typically dominated by porous limestone rock. Ponors can drain stream or lake water continuously or can at times work as openings from where springs originates, similar to estavelles. Morphologically, ponors come in forms of large pits and caves or large fissures and caverns.

NOTES

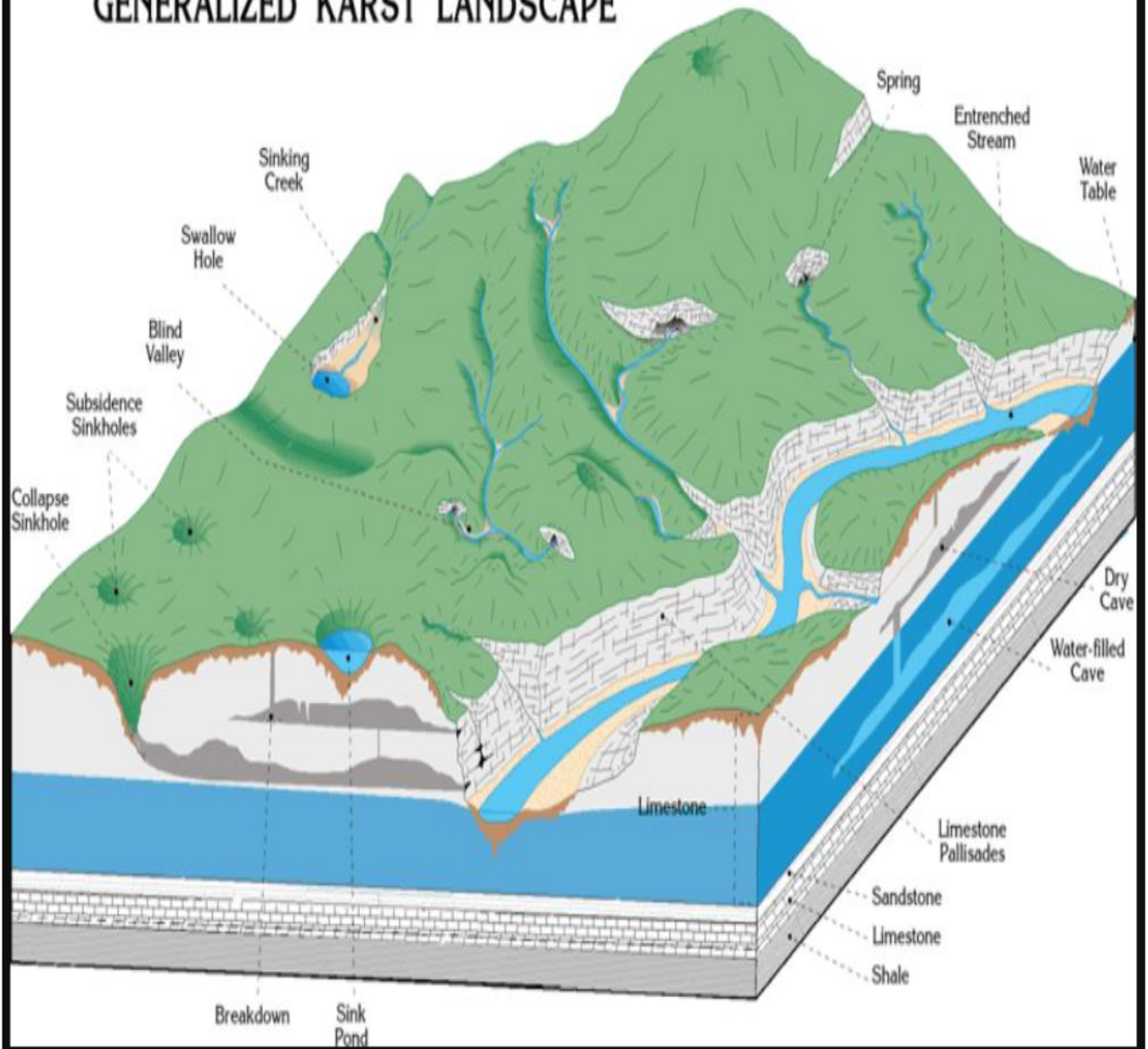
Springs- Springs are formed when groundwater flows onto the surface. This typically happens when the water table reaches above the surface level, or if the terrain depresses sharply. Springs may also be formed as a result of karst topography, aquifers or volcanic activity. A **spring** is a natural exit point at which groundwater emerges out of the aquifer and flows onto the top of the Earth's crust to become surface water. It is a component of the hydrosphere, as well as a part of the water cycle. Springs are driven out onto the surface by various natural forces, such as gravity and hydrostatic pressure. A spring produced by the emergence of geothermally heated groundwater is known as a **hot spring**.

Estavelles- In karst regions, **estavelle** is a ground orifice which, depending on weather conditions and season, can serve either as a sink or as a source of fresh water (i.e, spring). In other words it can act as a sinkhole or ponor .

- **Tufa beds** - Tufa is a variety of porous limestone beds formed when carbonate minerals precipitate out of water in unheated rivers or lakes due to evaporation. Geothermally heated hot springs sometimes produce similar (but less porous) carbonate deposits, which are known as **travertine**.
- **Limestone Pallisades** - A palisade, sometimes called a stake-wall or a paling, is typically a row of closely placed, high vertical standing walls on the sides of polies or solution valleys.

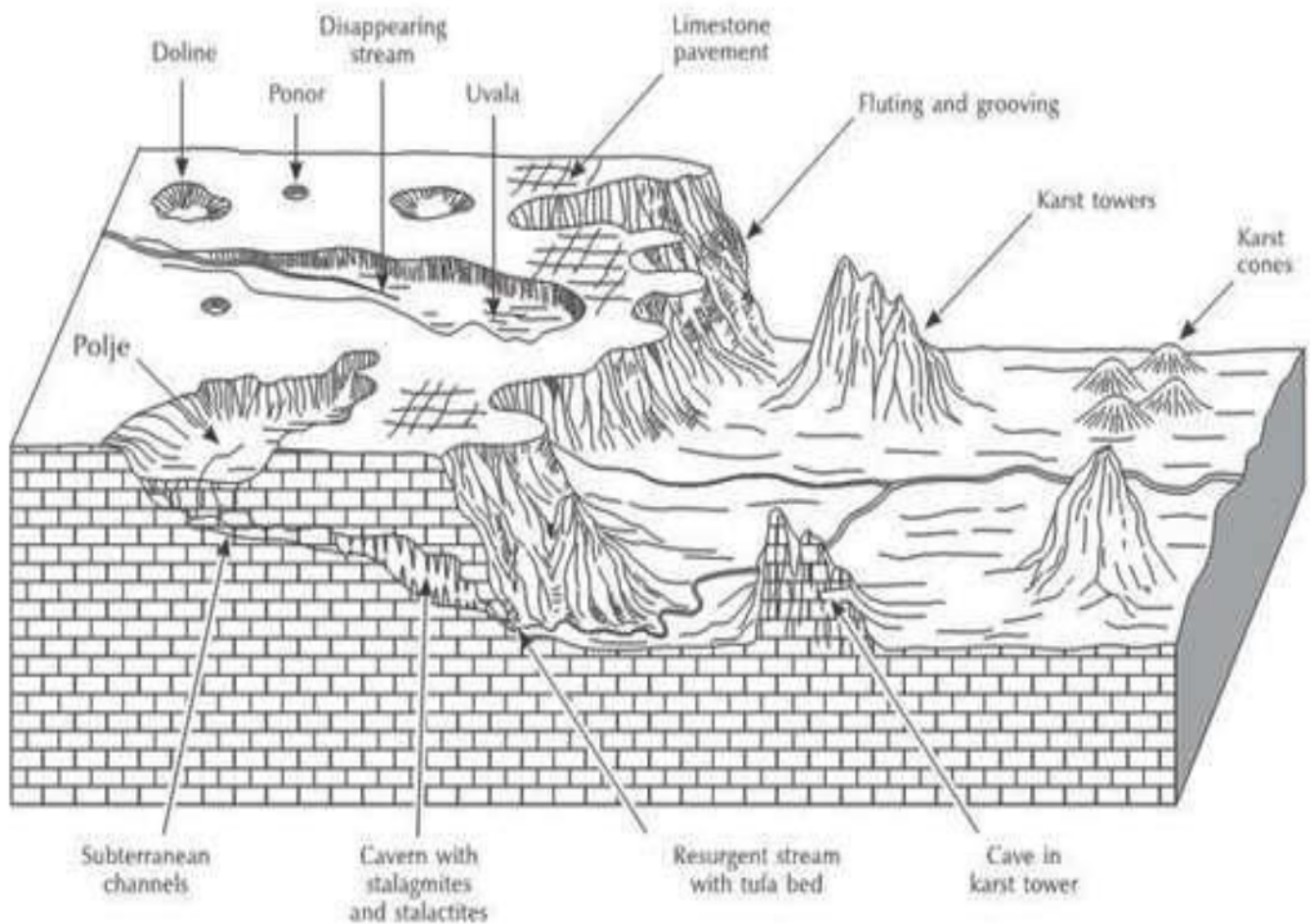
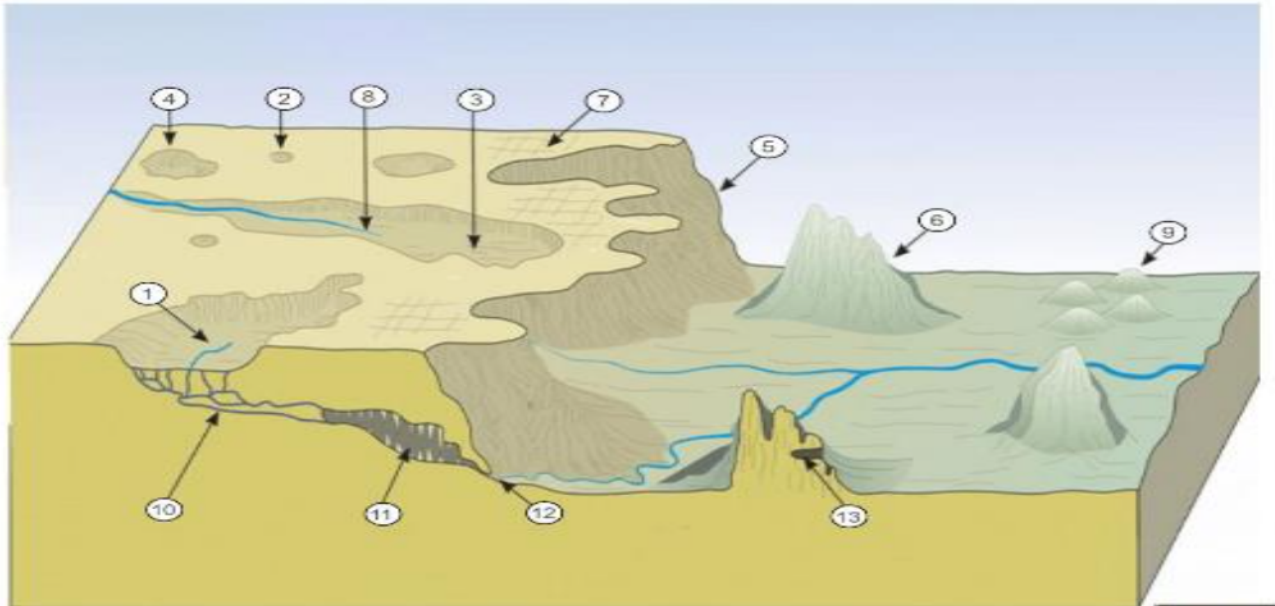


GENERALIZED KARST LANDSCAPE





Karst Topography Quiz



Geological Work of Glaciers

Part-1

Date-05/09/2023

Glaciers-

Glacier is slowly moving mass or body of ice formed by the accumulation and compaction of snow on mountains or near the poles. In other words, a glacier is a large, perennial (lasting or existing for a long or apparently infinite time or several years) accumulation of crystalline ice, snow, rock, sediment, and often liquid water that originates on land and moves down slope under the influence of its own weight and gravity.

Factors On Which The Ice Formation From Snow Depends-

Typically, glaciers exist and may even form in areas where the-

1. mean annual temperatures are close to the freezing point;
2. winter precipitation produces significant accumulations of snow;
3. temperatures throughout the rest of the year do not result in the complete loss of the previous winter's snow accumulation;
4. rate of snow accumulation is greater than the rate of melting of ice;
5. existence of suitable landscape and relief of the area.

Some Important Terminologies :

➤ **Snow field-** The regions in the upper reaches of a mountain valley where the mean annual temperatures are close to the freezing point during most of the year. These are areas where glaciers originates.

Regelation Proce & Firm Formation- Regelation is defined as the phenomenon in which the ice melts to the water below 0°C on the application of pressure and refreezes back to ice on the removal of pressure. Regelation demonstrates the idea of compressing the ice and turning it into water under pressure and when the pressure is removed, it solidifies again. As the snow fall occurs in higher altitudes when temperature is below 0°C , the precipitates in the form of snow-flakes occurs, that consists of hexagonal-shaped ice crystals. These newly fallen snows are porous in nature and has low specific gravity. With continued precipitation of snow layers are formed. The lower layers get compressed by the overlying layers of snow, due to which the pressure increases and melting point decreases at these lower segments. Hence they are partially melted. Now

as the temperature rises during day time in summers the surface snows starts to melt (thaw). The melt water from the surface they percolates into subsurface through cracks or fissures with the layers. During night as the temperature drops the melt water refreezes around the snow crystals thus assuming the shape of a grain, thus forming ice granules. As the snow becomes granular its porosity decreases and specific gravity increases. The granular masses of ice then coalesce to form an irregular, structure less, dull white and impermeable form of ice called firn. This overall process of conversion of snowflakes into ice is called as regelation.

A few of the examples of regelation are:

- ✚ Glacier acts as a source of a river due to regelation. The mass of the glacier exerts pressure on the lower surface lowering the melting point of the ice at its base. This results in the melting of ice and propels the glacier to slide over the liquid. Under appropriate conditions, liquid water flows from the base of the glacier to lower altitudes when the temperature of the air is above the freezing point of water.
 - ✚ Preparation of an ice ball – The ice slab is shredded into pieces, and the shredded pieces are pressurized around the tip of a stick to prepare the ice ball. If two small pieces of ice are taken and pressed against each other, they stick to each other.
 - ✚ It is due to regelation that skating is possible on snow due to the formation of water. Water is formed due to the increase of pressure and it serves as a lubricant.
- **Snow Lines-** Snow line represents the lower topographic limit of permanent snow cover. The snow line is an irregular line of equilibrium, located along the ground surface where rate of accumulation of snowfall equals the rate of ablation (melting and evaporation) of ice. This line varies greatly in altitude and depends on climatic conditions.

On windward slopes and those facing the afternoon sun, the snow line may be as much as a kilometre higher than on opposite slopes. Over larger areas, summer temperatures and the amount of snowfall determine the position of the snow line. Where temperatures are low, as near the poles, the snow line is quite low in elevation; where temperatures are high, as near the Equator, the snow line is very high in elevation.

Glaciers Movement-

The retreat and advance of glaciers traditionally refers to changes in the position of a glacier terminus over time. It depends on the amount of snow precipitation in the upper parts and rate of ablation in the lower reaches of glacial valley.

1. Glacier advance - When the the rate of snow precipitation in the upper parts of the glacier is greater than the rate of ablation in the lower parts, then a mountain glacier's terminus extends farther downvalley than before over time; In other words during glacier advance a glacier flows downvalley at a faster rate than the rate of ablation at its terminus.

2. Glacier retreat- A glacier diminishing or retreating in size over time as a result of less ice accumulating on it or more ice melting is referred to as glacial retreat. Massive amounts of ice that are moving slowly downhill make up the glaciers. A glacier develops anywhere snow falls faster than it melts. As melting overcomes accumulation, the glacier retreats, resulting in the glacier tongue's terminal edge terminating at progressively higher altitudes. As glaciers retreat, they expose landscapes that were only recently covered by ice. This provides an excellent opportunity to explore and understand how glacial landforms and sediments are formed during glacier recessions.

Causes of Glacial Retreat

The phenomena of glacial retreat and melting are mostly the results of human activity. In particular, since the industrial revolution, emissions of greenhouse gases such as carbon dioxide have increased temperatures, even more near the poles, and as a result, glaciers are quickly melting, calving off into the sea, and retreating on land.

- **Global warming:** Greenhouse gases, which affect the warming trend by trapping heat in the atmosphere, have been produced as a result of the burning of fossil fuels. More glaciers melt and recede as temperatures increase, exposing the land underneath.
- **Climate change:** Statistics predict that shortly, glacier loss will be at an all-time high. The faster melting of glaciers is a result of temperature increases brought on by **global warming**. Studies show that the main cause of glacier retreat is human-caused global warming.
- **Oil and gas extraction:** During the process of extracting oil and gas, methane, the main component of natural gas, is also released. The gas also traps heat more efficiently than carbon dioxide, accelerating global warming, and making it more detrimental to the environment.
- **Solar radiation:** The most important of these is the quantity of solar energy that touches the ice, which has an impact on glacier melting and receding. Glaciers lose mass as a result of increased radiation-induced melting.

- **Glacial till:** The unsorted mass of material known as glacial till is gathered by moving glaciers and can include everything from silt to big boulders. The ice is protected by boulders while the weaker ice around it melts.

Impact of Glacial Melting and Retreat

The glacial retreat can have a variety of important environmental effects, such as altered local ecosystems, altered water supply, and a higher risk of natural catastrophes like landslides and floods.

- **Rising sea level and coastal erosion:** When Sea levels rise due to melting glaciers, more frequent and more powerful coastal storms like hurricanes and typhoons are produced. This increases coastal erosion and storm surge. The Antarctic and Greenland ice sheets in particular are the main causes of the rise in sea levels worldwide.
- **Weather patterns:** As this ice melts, darker patches of the ocean start to emerge, eliminating the effect that previously cooled the poles, creating warmer air temperatures and in turn disrupting normal patterns of ocean circulation.
- **Fishing industries:** Industries that thrive on vibrant fisheries will be affected as warmer waters change where and when fish spawn. Coastal communities will continue to face billion-dollar disaster recovery bills as flooding becomes more frequent and storms become more intense.
- **Wildlife:** In the Arctic, as sea ice melts, wildlife like walruses are losing their home and polar bears are spending more time on land, causing higher rates of conflict between people and bears.
- **Fresh water scarcity:** The scarcity of fresh water must be taken into account. There is less water accessible for human usage, whether it is for drinking, hydroelectricity production, or agriculture, the less ice there is.
- **Threat of coral reefs:** To thrive through the process of photosynthesis, coral reefs need sunshine. Due to glaciers melting or retreating, rising sea levels prevent corals from receiving adequate sunlight.

Rapid glacial melt in Antarctica and Greenland also influences ocean currents, as massive amounts of very cold glacial-melt water entering warmer ocean waters are slowing ocean currents. And as ice on land melts, sea levels will continue to rise.

Factors On Which Rate of Glacier Movement Depends-

- (i). Thickness of the glaciers. Gradient of glacier valley.
- (ii). Temperature of ice.
- (iii). Rate of accumulation of snow.
- (iv). Rate of ablation (evaporation and melting).
- (v). The frictional resistance offered by bed rocks and wall rocks to the base and side layers of a glacier.

Surging Glaciers- They are mountain valley glaciers that move downhill at a rapid rate.