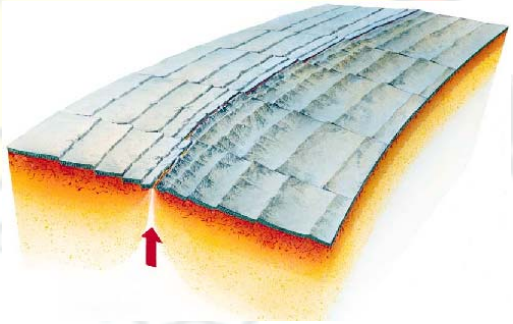
1. Explain the correlation between plate tectonics and earthquakes with the help of suitable examples.

Introduction:

According to the theory of plate tectonics, the earth's lithosphere is broken into distinct plates which are floating on a ductile layer called asthenosphere (upper mantle). The tectonic plates) vary from minor plates to major plates, continental plates (Arabian plate) to oceanic plates (Pacific plate), sometime a combination of both continental and oceanic plates (Indo-Australian plate).

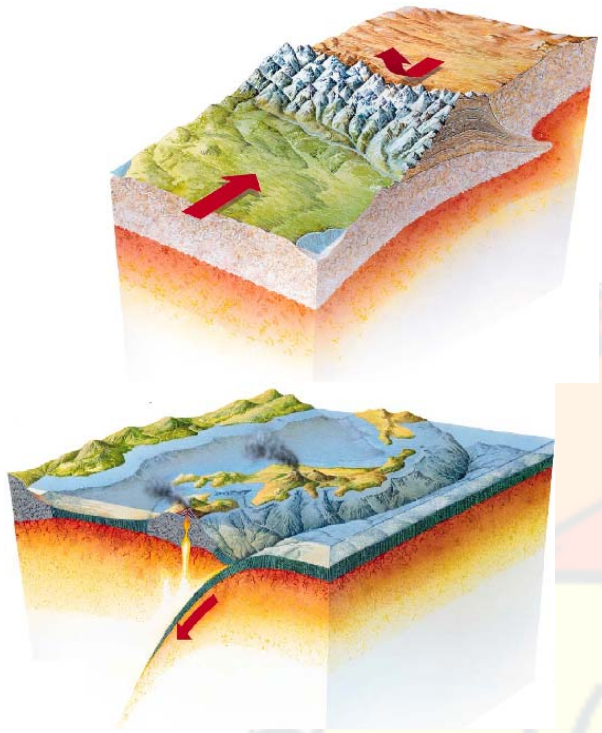
Body:

The movement of these crustal plates causes the formation of various landforms and is the principal cause of all earth movements. Earthquakes are a direct consequence of interaction between various lithospheric plates.



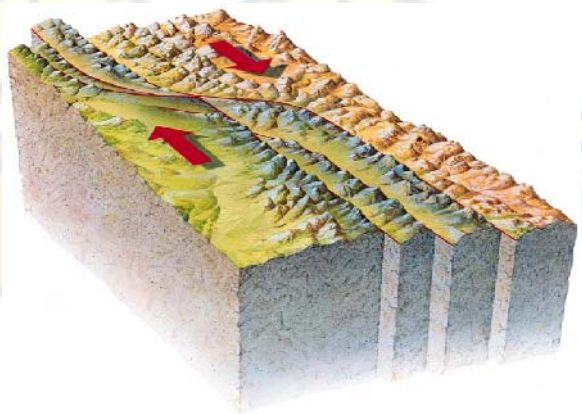
Divergence forming divergent edge or the constructive edge:

- The plates diverge or move away from each other. Here, the basaltic magma erupts and moves apart giving rise to sea floor spreading.
- Earthquakes (shallow focus) are common along divergent edges.
- Example: East African Rift Valley, Mid-Atlantic Ridge, minor earthquakes near Azores and Iceland etc.



Convergence forming convergent edge or destructive edge:

- Plates move towards each other at a boundary. This type of is called a convergent boundary.
- There are mainly three ways in which convergence can occur: between an oceanic and continental plate; between two oceanic plates; and between two continental plates.
- These boundaries tend to produce most of the earthquakes that have magnitudes greater than 6.0, and subduction zones produce the deepest earthquakes.
- Examples include deep ocean trenches like the Peru–Chile trench, Himalayan Boundary Fault, Andes etc.

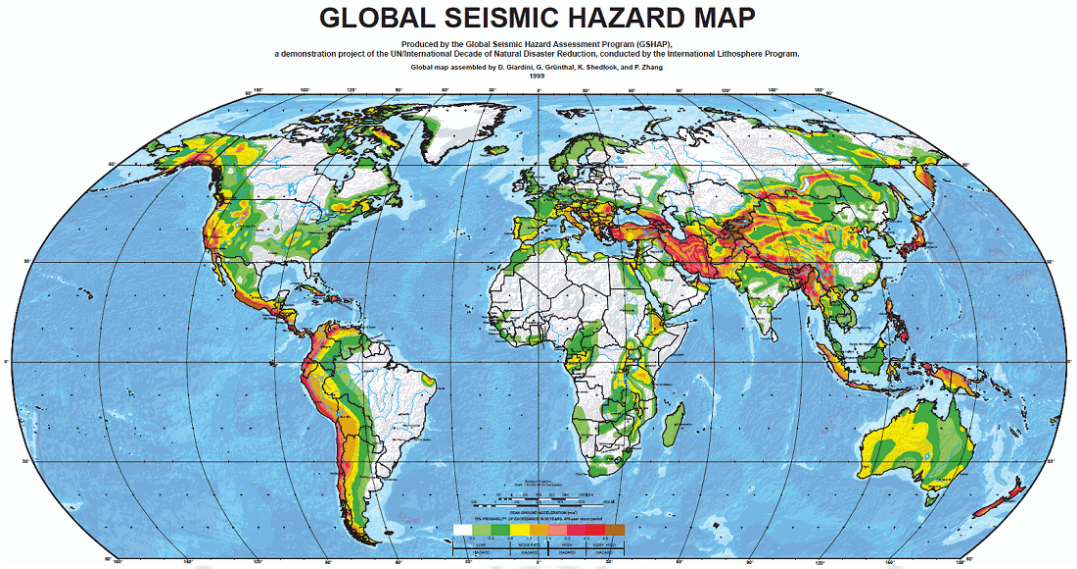


Conservative edge or transform fault:

- In this kind of interaction, two plates grind against each other and there is no creation or destruction of landform but only deformation of the existing

landform. [Crust is neither produced nor destroyed as the plates slide horizontally past each other].

- Transform boundaries typically produce large, shallow-focus earthquakes. Although earthquakes do occur in the central regions of plates, these regions do not usually have large earthquakes.
- Examples include the San Andreas Fault and the Anatolian fault, earthquakes close to and in California.



Conclusion:

Seismologists associate different kinds of seismic activity with what is happening at different types of plate boundaries. The theory of plate tectonics can be used to provide a simplified explanation of the global distribution of earthquakes, their evolution and provide a background research for sustaining loss and resistive measures.

2. What are blizzards? How do they get originated? How are they different from avalanches? Discuss.

Introduction

A blizzard is a severe snowstorm with strong and powerful winds in excess of 35 mph for more than 3 hours and visibility of less than a 1/4 mile. During a blizzard, the temperature is often below 0 degrees, because of this frostbite and hypothermia are common.

Body

Origination of blizzards:

- **Cold air (below freezing):** In order for there to be snowfall, the air temperature both up in the clouds and down at ground level must be cold. If the air temperature is warm near the ground, the snow will melt before the reaches the ground causing rain instead.
- **Moisture:** This is known as water vapour. An excellent source of water vapour is when the air must blow across a large body of water, such as the ocean. As the airs blows over the water, some water is evaporated into the air. This is water vapour.
- **Warm, rising air:** Warm air must rise over cold air in order for a blizzard to form. This can happen in two ways. The wind can pull warm air from the equator towards the poles, and cold air from the poles towards the equator. When warm and cold air meet, a front is formed which results in precipitation. If warm air rises up a mountaintop it can cool as it rises, forming clouds and blizzard snows.

Effects of Blizzards

- A blizzard has the ability to put a city into standby, sometimes even for days. It can make driving conditions impossible and results in kids not being able to get to school as well as adults not being able to get to work. This in turn means school and businesses close and people are housebound.
- Low air pressure during a blizzard can make breathing difficult for some people.
- Electrical wires can be damaged resulting in a loss of electricity to homes. People are left without the use of computers, TV's, appliances, and lights.
- Blizzards are life threatening and people have lost their lives because of them.
- 8. Blizzards hurt the economy as businesses lose money when people can't get to work.
- 9. When transport routes and shops close during a blizzard there is a chance of food and water scarcity if the blizzard lasts for an extended period of time.

Blizzard	**Avalanche**
• It is a severe snowstorm, especially with strong winds and greatly reduced visibility. • Rarely occurs. • Blizzard is a very strong, bitterly cold. wind accompanied by masses of powdery snow or ice crystals often with poor visibility. • Blizzards are at higher altitude.	• It is an event that occurs when a cohesive slab of snow lying upon a weaker layer of snow fractures and slides down a steep slope. • Frequently occurs. • Avalanche is a swift movement of snow, ice, mud, or rock or a mixture of them down a mountainside or slope. • Avalanches are can be seen at lower altitude too.

• Occur only in winter. • Causes: (1) cold air (2) moisture (3) warm air. • Main types: mountain blizzard, ground blizzard and large scale frontal blizzard	• Can occur in spring, autumn and winter. • Causes: (1) a pre-existing weak layer, and (2) a trigger. • Main types: loose-snow (or sluff)avalanches and slab avalanches

Conclusion

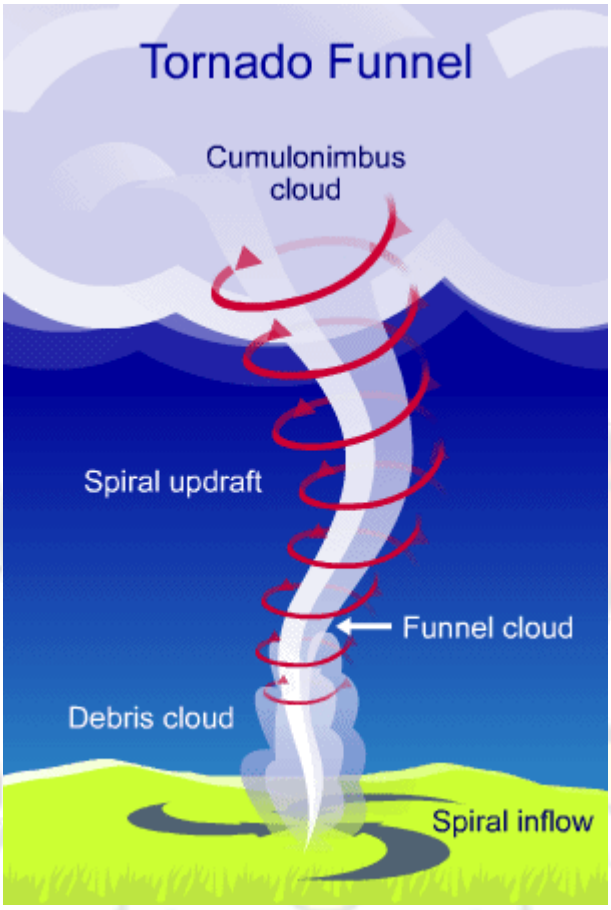
Under the effects of climate change, mountainous regions across globe are undergoing fast and well-perceptible evolutions, which are attracting the growing attention of people, scientists and managers. To cope better with the hazards and vulnerabilities specific targets and long term plans are must.

3. What are tornadoes? How do they originate? Aren't they similar to cyclones? Examine.

Introduction

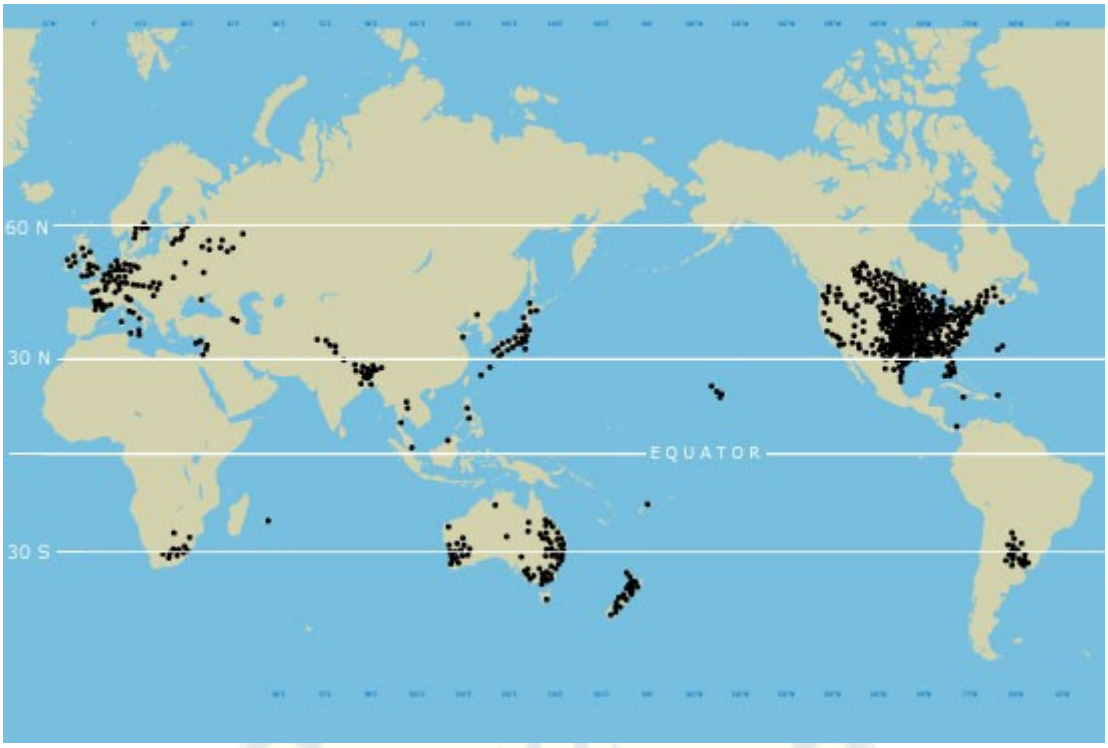
A tornado is a violently rotating column of air that extends from a thunderstorm to the ground. It is a vortex of rapidly moving air. A tornado forms when changes in wind speed and direction create a horizontal spinning effect within a storm cell. This effect is then tipped vertical by rising air moving up through the thunderclouds.

Body



Winds within the tornado funnel may exceed 500kmph. High velocity winds cause most of the damage associated with these weather events. Tornadoes also cause damage through air pressure reductions. The air pressure at the tornado centre is approximately 800 millibars (average sea-level pressure is 1013 millibars) and many human made structures collapse outward when subject to pressure drops of this magnitude.

Distribution of Tornadoes in the world:



Origin:

- Tornado formation typically needs the four ingredients: shear, lift, instability, and moisture.
- Wind shear is the most important factor that plays into the creation of tornadoes. When there is wind shear, sometimes these winds begin to roll into a horizontal column of air.
- Once you get a strong updraft of air being transported from the ground to the atmosphere, that column of air becomes vertical. That is when a storm usually develops in this scenario.
- As the storm develops, it turns into a supercell thunderstorm much of the time. These supercell thunderstorms are separate, discrete cells that are not part of a line of storms. Also, supercells are storms that rotate and spin. With both the vertical, rotating column of air and the supercell thunderstorm together, that may bring down a tornado from the storm cloud
- Tornadoes are most common in spring and least common in winter. Spring and fall experience peaks of activity as those are the seasons when stronger winds, wind shear, and atmospheric instability are present. Tornado occurrence is highly dependent on the time of day, because of solar heating.
- United States has the most violent tornadoes. At any moment there are approximately 1,800 thunderstorms in progress throughout the world.

Differences between Tornado and cyclone

	Tornado	cyclone
Definition	A tornado is a rotating column of air ranging in width from a few yards to more than a mile and whirling at destructively high speeds, usually accompanied by a funnel-shaped downward extension of a cumulonimbus cloud. Winds 40-300+ mph.	A cyclone is an atmospheric system of rapidly circulating air massed about a low-pressure centre, usually accompanied by stormy often destructive weather. Storms that begin in the Southern Pacific are called cyclones
Rotation	Clockwise in the southern hemisphere and counter clockwise in the northern hemisphere	Clockwise in the southern hemisphere and counter clockwise in the northern hemisphere.
Forms of precipitation	rain	Rain, sleet, and hail
Frequency	The United States records about 1200 tornadoes per year, whereas the Netherlands records the highest number of tornadoes per area compared to other countries. Tornadoes occur commonly in spring and the fall season and are less common in winters	10-14 per year
Location	Tornados have been spotted in all continents except Antarctica	Southern Pacific Ocean, Indian Ocean. Cyclones in the northwest Pacific that reach (exceed) 74 mph are "typhoons".
Occurrence	Places where cold and warm fronts converge. Can be just almost anywhere.	warm areas

Conclusion

Tornadoes as well as cyclones both occur in India. However, unlike cyclones the frequency of tornado outbreak is very low. Cyclones originate in the Bay of Bengal region as well as in the Arabian Sea region where as Tornadoes of weak strength

occur in north-western and north-eastern region of the country causing significant damage to man and material.

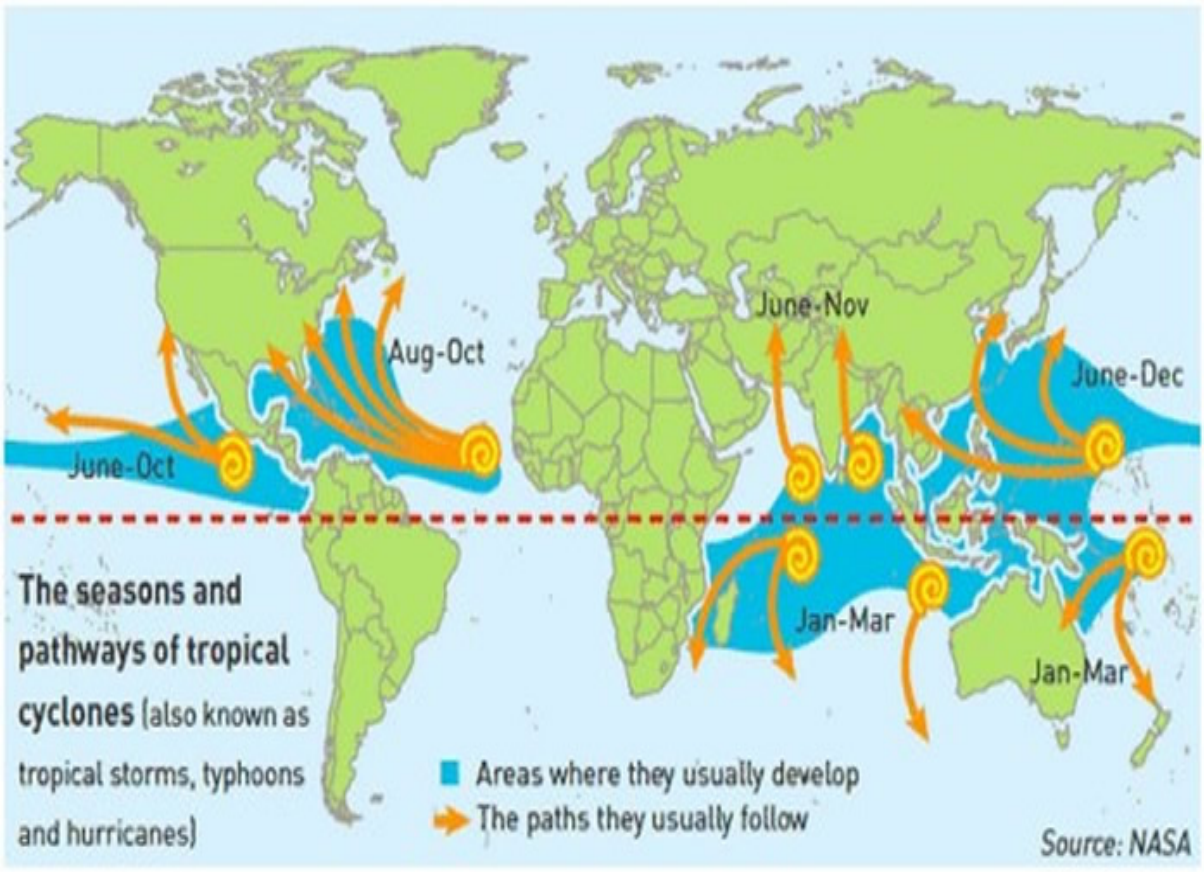
4. Which part of the globe are more susceptible to damage by cyclones and why? Explain with the help of suitable examples.

Introduction

Cyclones are low pressure centres, surrounded by closed isobars, which involve a closed circulation about the low pressure centre. The air moves anticlock wise in northern hemisphere and clockwise in southern hemisphere.
They can be classified either on the basis of their geographical location (tropical/ temperate cyclones) or on the basis of their nature (cold /warm core cyclone). They play a vital role in exchange of heat between different latitude zones and also transfer humidity form one part of the earth to another.

Body

Regional distribution of tropical cyclones:



There are six regions that are more vulnerable to tropical cyclones:

- **Tropical North Atlantic (Gulf of Mexico, West Indies and Caribbean Sea)**: Cyclones in this region is known as Hurricane, occur mainly during August-October. Main reasons being increased sea surface temperature, convective

instability, low wind shear and other thermodynamic activities. Examples- Hurricane Katrina, Florence etc.

- **Eastern part of the tropical north pacific (Western coast of Mexico and Central America)**: also known as Hurricane, usually observed during June-July. The shifting of Intertropical Convergence Zone (ITCZ) northwards and low pressure formed, aided by northwest movement of wind (due to Coriolis force) favours the formation of Tropical Cyclone in this region.
- **Western part of tropical north pacific (The Philippines, the China Sea and areas around Japan)**: The cyclones in this region are called as Typhoon, occurs during months of June-December. The presence of low vertical wind shear of less than 10 metres/second, monsoon trough and atmospheric instability favours development of tropical Typhoons.
- **Bay of Bengal and Arabian Sea**: They are more frequent during June-September, high sea temperature along with the low pressure regions, sometimes the typhoons originating in western pacific too help in cyclone formation. Ex-Fani, Ochkhi etc
- **Western South Pacific Ocean (regions of Samoa, Fiji Island and the east and north coast of Australia)**: Occur during January-March season. They too are result of high surface temperature and low vertical wind shear that result in atmospheric instability and heavy cloudiness.
- **The south coast of Indian Ocean (coastal regions of Madagascar)**: Occurs during January-March and the westward movement of tropical depression intensified by low vertical wind shear favours cyclone formation. One dangerous recent event is the Idai Cyclone (March 2019) that resulted in more than 1300 deaths and several missing cases.

Temperate cyclones are majorly dynamic in origin (Movement of air masses and coriolis force- Frontogenesis), they occur during winter seasons and are away from equator region. They are largely non-destructive due to slow moving winds, but there might be damage due to flooding. They can occur both on land and water. They occur scattered but irregular intervals throughout the zone of westerlies. They impact mainly in Northern hemisphere (due to less land availability in Southern Hemisphere).

They impact Indian climate in the form of Western disturbances. Though, they are beneficial, as they aid in wheat, saffron cultivation, sometimes they have negative implications too. Excessive rainfall causes landslides, floods, avalanches etc., and occasionally brings cold wave and dense fog like condition that damages the crop in Indo-Gangetic plains.

Conclusion

Around 8 percent of total land area in India is prone to cyclones. The cyclonic storms are associated with heavy rains, thunderstorms, high tides and intense winds that cause heavy destruction in coastal areas. Proper implementation of National Cyclone Risk Mitigation Project(NCRMP) that include improved early warning dissemination

system, capacity building of local communities to respond, and strengthening the rehabilitation mechanism would minimize the damage.

5. What is volcanism? What are the factors that lead to volcanism? What role do volcanoes play in the climate?

Introduction:

Volcanism is the phenomenon of eruption of molten rock (magma) onto the surface of the Earth or a solid-surface planet or moon, where lava, pyroclastics and volcanic gases erupt through a break in the surface called a vent.

Body:

Movement of molten rock in the mantle, caused by thermal convection currents, coupled with gravitational effects of changes on the earth's surface (erosion, deposition, even asteroid impact and patterns of post-glacial rebound) drive plate tectonic motion and ultimately volcanism.

Factors that lead to volcanism:

- **Plate Tectonics:** The majority of volcanoes occur where two lithospheric plates converge and one overrides the other, forcing it down into the mantle to be reabsorbed.
- **Ocean floor spreading:** A major site of active volcanism is along the axis of the oceanic ridge system, where the plates move apart on both sides of the ridge and magma wells up from the mantle.
- **Weak Earth Surface**: Because of high pressure in the earth's interior, the magma and gases escape with great velocity as the pressure is released through eruptions where opportunity is provided by weak zones along the earth's surface.
- **Faults:** Whenever extreme pressure builds in the mantle, along fault lines an eruption is likely to happen next. The earthquakes, for instance, may expose fault zones through which magma may escape.
- **Magma crystallization:** Decreasing temperatures can cause old magma to crystallize and sink to the bottom of the chamber and this movement can force fresh liquid magma up and out - similar to dropping a brick in a bucket of water.
- **A decrease in external pressure:** A decrease in external pressure can trigger an eruption as it may minimize the volcano's ability to hold back by increasing the pressures inside the magma chamber
- **Plate movement:** Volcanism may occur because of plate movement over a "hot spot" from which magmas can penetrate to the surface. Ex. Islands of Hawaii

The gases and dust particles thrown into the atmosphere during volcanic eruptions have effects on climate.

Negative effects: Volcanic eruptions produce hazardous effects for the environment and climate,

- Ashes can stay in the stratosphere for about two to five years, and within this period, there are chemical reactions that destroy the stratospheric ozone molecules.
- Volcanoes contribute about 18%-20% of Chlorine entering the atmosphere, this also destroys ozone.
- Volcanoes also cause global warming by releasing greenhouse gases such as water vapour and carbon dioxide into the atmosphere.
- Lava can kill plants and animals. This also contributes to global warming by reducing carbon sink.

Positive effects: Unlike other natural disasters such as floods, wildfires and earthquakes, volcanoes can have some positive effects.

- Most of the particles spewed from volcanoes cool the planet by shading incoming solar radiation. The cooling effect can last for months to years causing cooling over large areas of the Earth.
- Some ash and lava breakdown become soils that are rich in nutrients and become good areas for crop planting activities and growth of the forest.

Conclusion:

Volcanism helps in the formation of various landforms on the earth's surface and bears both positive and negative effects on the climate, environment and human life. With scientific studies, one can predict the volcanic eruption to much extent. Preparedness for this natural disaster can protect human life and environment to a larger extent.