VOLCANIC ERUPTION

Physical Geography | Undergraduate Study Notes

1. Introduction

A volcano is an opening or vent in the Earth's crust through which magma, gases and other materials reach the surface. When magma erupts at the surface, it is called lava. Volcanic activity is an important process that forms and modifies Earth's landforms.

2. What is a Volcanic Eruption?

A volcanic eruption is the release of molten rock, gases, ash and other materials from a volcano. Eruptions occur when magma and gases rise through the crust and pressure becomes sufficient to overcome the resistance of surrounding rocks.

3. Causes of Volcanic Eruptions

- Magma formation and buoyancy: magma is less dense than surrounding solid rock and may rise.
- Gas pressure: gases dissolved in magma expand as magma rises and pressure decreases.
- Tectonic activity: plate boundaries and crustal fractures provide pathways for magma.
- Magma composition and temperature: these affect viscosity and how easily gas escapes.

4. Types of Volcanic Eruptions

Effusive eruption: Relatively gentle outpouring of lava, often associated with fluid basaltic magma and lower gas pressure.

Explosive eruption: Violent eruption that ejects ash, pumice, gases and pyroclastic material; often linked to viscous, gas-rich magma.

Phreatic eruption: Steam-driven explosion caused when water is heated by magma or hot rocks, sometimes without fresh magma reaching the surface.

Phreatomagmatic eruption: Explosive interaction between magma and water, producing fine ash and fragmented material.

5. Materials Released During an Eruption

Lava: Molten rock flowing on the Earth's surface.

Volcanic ash: Fine fragments of rock, minerals and volcanic glass; ash is not soft combustion ash.

Volcanic gases: Water vapour, carbon dioxide, sulfur dioxide and other gases.

Pyroclastic material: Fragments such as ash, lapilli, pumice and volcanic bombs.

Pyroclastic flow: A fast-moving, hot mixture of gas and volcanic particles flowing along the ground.

6. Major Volcanic Landforms

Shield volcano: Broad, gently sloping volcano formed mainly by repeated flows of fluid lava.

Composite / stratovolcano: Tall, steep-sided cone built from alternating layers of lava and pyroclastic deposits.

Cinder cone: Small, steep-sided cone made mostly of loose pyroclastic fragments.

Lava plateau: Extensive elevated area formed by repeated widespread lava flows.

Caldera: Large volcanic depression formed by collapse after major eruption or withdrawal of magma.

Volcanic dome: Rounded mound formed by the extrusion and accumulation of viscous lava.

7. Distribution of Volcanoes

Volcanoes are concentrated mainly along tectonic plate boundaries, especially subduction zones and divergent boundaries, and also occur at some intraplate hotspots. The Pacific Ring of Fire is a major zone of volcanic activity. Not all volcanoes occur at plate boundaries.

8. Effects of Volcanic Eruptions

Positive effects: fertile soils, creation of new land, geothermal energy, mineral resources and tourism.

Negative effects: loss of life, destruction of buildings and infrastructure, ash-related respiratory and transport problems, lava damage, pyroclastic flows, lahars, air pollution and temporary climate effects from some large eruptions.

9. Volcanic Hazards and Risk Reduction

- Monitor seismicity, ground deformation and gas emissions.
- Use hazard maps, evacuation plans and public warning systems.
- Avoid valleys and channels during lahars; follow official evacuation instructions.
- Protect eyes and respiratory system from ash and avoid driving during heavy ash fall.
- Follow instructions from local emergency authorities.

10. Quick Revision Table

Term	Meaning
Magma	Molten rock beneath the Earth's surface
Lava	Magma that reaches the surface
Effusive	Gentle lava outpouring
Explosive	Violent release of ash, gases and fragments
Caldera	Large collapse-related volcanic depression
Lahar	Volcanic mudflow of water and sediment
Ring of Fire	Major belt of volcanoes around the Pacific

11. Short Questions for Practice

- Define volcanic eruption.
- Explain the causes of volcanic eruptions.
- Differentiate between effusive and explosive eruptions.
- Describe the major types of volcanoes.
- What is a caldera?
- Discuss the positive and negative effects of volcanic eruptions.
- What is the Pacific Ring of Fire?