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Chapter 7

Volcano disaster in India, mitigation and their impacts

Desastres volcánicos en India, mitigación y sus efectos

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ABSTRACT

The volcano is a natural disaster. Volcanoes erupt from the interior of the Earth. This consists of many gases, liquids, and solids. Due to this, it gets jammed in the upper part of the earth in the form of lava and emits harmful gas. There are 4 types of volcanoes namely cinder cone, composite volcano, shield volcano, and lava volcano. Volcanoes are divided into categories: extinct, active, and dormant. Barren Island has become active in India in 2017. The history of volcanic eruptions in India so far is as follows: Border Island, Deccan Traps, Narcondam Island, Baratang, Dhinodhar Hill, Dhosi Hill, and Tosham Hill. Human health is affected by the toxic gases produced by volcanic eruptions. This review discusses in detail the causes, types, damage, history, and mitigation of volcanic eruptions.

KEYWORDS: Volcanoes, causes, *historic,* WHO response, *and mitigation.*

RESUMEN

El volcán es un desastre natural. Los volcanes brotan del interior de la Tierra. Se compone de muchos gases, líquidos y sólidos. Debido a esto, se atasca en la parte superior de la tierra en forma de lava y emite gases nocivos. Hay 4 tipos de volcanes, a saber, cono de ceniza, volcán mixto, volcán en escudo y volcán de lava. Los volcanes se dividen en categorías: extintos, activos e inactivos. Barren Island se ha vuelto activo en India en 2017. La historia de las erupciones volcánicas en la India hasta el momento es la siguiente: Isla Seema, Deccan Jal, Isla Narcondam, Baratang, Colina Dhinodhar, Colina Dhosi y Colina Tosham. La salud humana se ve afectada por los gases tóxicos producidos por las erupciones volcánicas. Esta revisión analiza en detalle las causas, los tipos, los daños, la historia y la mitigación de las erupciones volcánicas.

PALABRAS CLAVE: Volcanes, causas, histórico, respuesta de la OMS y mitigación.

INTRODUCTION

Volcanism can affect the environment on time scales (days to weeks) and climate (months to years). Over the past 250 years, scientists and non-scientists have observed and documented the atmospheric and climatic effects of various volcanic eruptions. Volcanism can affect the environment on time scales (days to weeks) and climate (months to years). Over the past 250 years, scientists and non-scientists have observed and documented the atmospheric and climatic effects of various volcanic eruptions. A volcano is an opening on the earth's surface through which magma and associated gases erupt, as well as the cone formed by eruptions. A volcano is considered active if it is about to erupt or if it shows signs of unrest (earthquakes, gas emissions) [1]. A volcano that is not currently active but could become active again is considered dormant. Extinct volcanoes are considered unlikely to erupt again. Volcanic eruptions are among the most dramatic and violent changes on Earth. They present significant geological hazards because their eruptions and associated activities can affect large areas and last for long periods of time. Or e Many kinds of volcanic activity can endanger the lives of people and property, and the effects of these activities are felt both close to and far away from the volcano. Explosive eruptions can spread lava, gas, and other materials over a wide area, and may drastically alter the landscape. Slow eruptions or flows can also alter landscapes, while associated earthquakes, atmospheric effects, landslides, and floods may damage or destroy property and threaten human lives [1]. Volcanism can affect the environment on time scales (days to weeks) and climate (months to years). Over the past 250 years, the atmospheric and climatic effects of various volcanic eruptions have been observed and documented by scientists and non-scientists alike [2, to 5]. Volcanic eruptions are multi-dangerous events that have a range of consequences ranging from total devastation and deaths of land masses to minor nuisances to society [6, to 10]. Eruptions can last anywhere from minutes to decades and can cause simultaneous, sequential, and/or recurring dangers. In general, the most severe shocks are close to the mouth, although in some cases the destructive risks can move from 10 km from the mouth [11, 12]. In historical times, events and sightings have been written for posterity, and mathematical models have been created in recent decades to understand and predict volcanic hazards. For all natural hazards, the modern loss mitigation strategy is based on understanding the risks and impacts, often mathematically, and making decisions about land use planning, insurance policy terms, and government policy based on the results of these models [7].

Figure: 1 Barren Island, in the Andaman Islands, India, spews smoke and ash into the air in January 2014.

Source: https://www.news18.com/news/buzz/did-you-know-india-has-an-active-volcano-its-located-in-andamans-barren-island-4413956.html

CAUSES OF VOLCANIC ACTIVITY:

Radioactive substances inside the earth repeatedly generate a large amount of heat through decomposition and chemical reactions. As a result, matter inside the earth is in constant motion. This molten, semi-molten, and sometimes gaseous material appears on Earth at the first opportunity. This possibility is offered by weak areas along the earth's surface. For example, earthquakes can expose fault zones through which magma can escape. Due to the high pressure inside the Earth, magma and gases escape at great speed when the pressure is released from the eruptions [14].

Categories of Volcanoes

Volcanoes are categorised into three main categories:

- Active
- Dormant
- Extinct

An *active volcano* has recently erupted and there is a possibility that it may erupt soon.

A *dormant volcano* has not erupted in a long time but there is a possibility it can erupt in the future.

An *extinct volcano* erupted thousands of years ago and there's no possibility of an eruption. [15].

TYPES OF VOLCANOES

Volcanoes are grouped into four types:

- Cinder cones
- Composite volcanoes
- Shield volcanoes
- Lava volcanoes

Cinder Cones: Cinder cones are round or oval cones made up of small pieces of lava from a single vent. Slag cones arise from eruptions mostly small pieces of slag and pyroclastics that build up around the vent. Most Cinder cones only erupt once. Cinder cones can form as vents on the flanks of larger volcanoes or occur on their own [15].

Composite Volcano: Composite volcanoes are steep volcanoes composed of many layers of volcanic rock, usually consisting of highly viscous lava, ash, and rocky debris. These types of volcanoes are high conical mountains composed of lava flows and others ejected in alternating layers, the layers that give rise to the name. Composite volcanoes are made of ash, ash, and lava. Embers and ash accumulate, and the lava flows over the ash, where it cools and hardens, then the process repeats [15].

Shield Volcano: Shield volcanoes are bowl-shaped or shield-shaped volcanoes in the center with long sloping slopes created by basaltic lava flows. These are formed by the eruption of low viscosity lava that can flow a great distance from a vent. They usually don't explode catastrophically. Because low-viscosity magma is generally low in silica, shield volcanoes are more common in oceanic environments than continental ones. The Hawaiian volcanic chain consists of a series of cone shields, also common in Iceland [15].

Lava Domes: Lava domes form when erupting lava is too thick to flow, forming a steep mound when lava accumulates near the volcanic vent. They are formed by slow eruptions of very viscous lava. They sometimes form in the crater of a previous volcanic eruption. Like a compound volcano, they can produce violent and explosive eruptions, but their lava usually does not flow far from the originating vent [15].

VOLCANIC EXPLOSIVITY INDEX

The Volcanic Explosivity Index (VEI) is a relative measure of the explosiveness of volcanic eruptions. It was conceived in 1982 by Chris Newhall of the United States Geological Survey and Stephen Self of the University of Hawaii. The volume of the products, the height of the eruptive cloud, and the qualitative observations (using terms ranging from "soft" to "mega-colossal") are used to determine the explosive value. The shell is open with the largest eruptions in history given a magnitude of 8. A value of 0 is given for non-explosive eruptions, defined as less than 10,000 m3 (350,000 cubic feet) of ejected tephra; and 8 represents a mega-colossal explosive eruption that can eject 1.0 × 1012 m3 (240 cubic miles) of tephra and has a cloud column height of over 20 km (66,000 ft). The

scale is logarithmic, with each interval on the scale representing a tenfold increase in the observed reject criteria, except between VEI-0, VEI-1, and VEI-2 [16, 17].

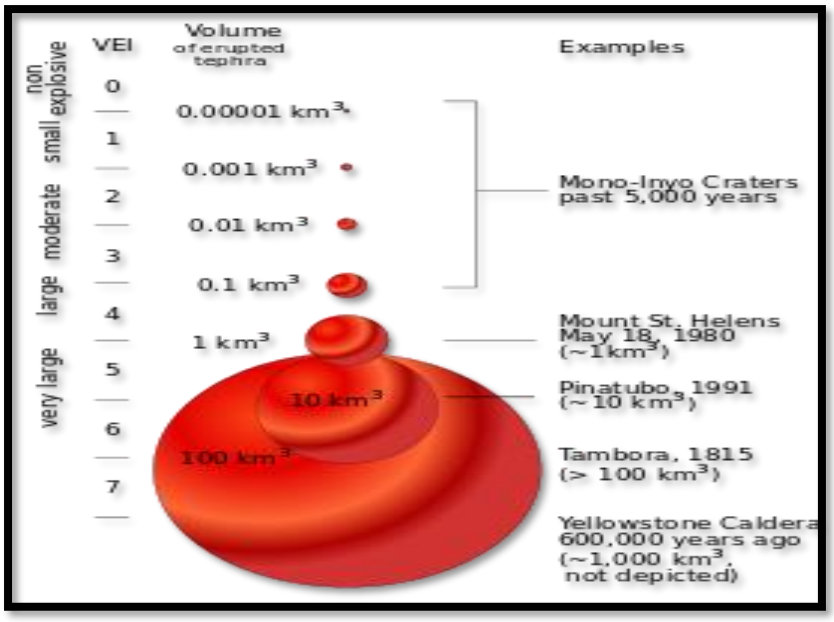

Figure: 2 VEI and ejecta volume correlation

Source: https://en.wikipedia.org/wiki/Volcanic_Explosivity_Index

Limitations: Under VEI, Ash, Lava, Lavabombs, and Ignimbrite are all treated equally. The density and vesicularity (gas bubbles) of the volcanic products in question are not taken into account. Conversely, the DRE (dense rock equivalent) is sometimes calculated to give the actual amount of magma that is erupted. Another weakness of the VEI is that it does not take into account the power of an eruption, making it extremely difficult to determine the VEI with prehistoric or unobserved eruptions. Although the VEI is quite suitable for classifying the explosive extent of eruptions, the index is not as significant as sulfur dioxide emissions when quantifying their atmospheric and climatic impact [17, 18].

HISTORIC VOLCANOES IN INDIA

Barren Island- 2017

Barren Island is a confirmed active volcano in South Asia. It is located in the Andaman Sea. Its first and last eruptions occurred in the years 1787 and 2017 respectively. One can easily reach Barren Island from Port Blair, which is around 138 kilometers away, either by seaplane or by boat/ ship [20].

Deccan Traps - 2007

They are located on the Deccan plateau, Maharashtra. They cover an area of about 500,000 square kilometers.Their formation resembles steps or stairs and solidifies flood basalts. If you want to explore this place more, you can reach the destination via road [20].

Narcondam Island- 1681

It is a small volcanic island that occupies an area of about 6.8 square kilometers. It is situated in the Andaman Sea. Well, it's a fairly remote island and has very poor connectivity, and is hard to reach. Till now, there had been only eight visits [20].

Baratang -2003

Baratang Island or Ranchiwalas Island is an island in the Andaman Islands covering an area of 242.6 square kilometers. It only contains mud volcanoes that have erupted in the past. If you are one of those who wish to visit this place, you must take a local bus or a taxi that will take you to Nilambur pier. From there you have to take a boat ride which takes about 15 minutes and will take you to the desired location [20].

Dhinodhar Hill - 500 Ma BP (millions of years ago)

Dhinodhar Hill in Gujarat is an inactive volcano. Its height is about 386 meters. This extinct volcano is accessible from Bhuj, the Devpur-Vithon road, or the NakhatranaVirani road. The place is about 75 kilometers from Bhuj [20].

Dhosi Hills - 750 Ma BP (millions of years ago)

The Dhosi Hills are part of the Aravalli mountain range which features igneous rock formation. It is located in the state of Haryana. Dhosi Hills is easily accessible by road [20].

Tosham Hills - 732 Ma BP (millions of years ago)

Tosham Hill Volcano is an extinct volcano with an average elevation of 207 meters. The rock formation occurs in igneous rocks and is part of the Aravalli Mountains. Tosham Hill is safe and easily accessible by road [20].

Table: 1 This is a list of active, dormant, and extinct volcanoes in India

Name	State	Last eruption	Type	Source
Barren Island	Andaman Islands	Active since 2017	Stratovolcano, Active	[19]
Deccan Traps	Maharashtra	2007	Caldera	[20]
Baratang Island	Andaman Islands	Active since 2003	Mud volcanoes, Active	[19]
Narcondam	Andaman Islands	1681	Stratovolcano, Dormant	[19]
Deccan Plateau	Central India	25 Ma BP (Million years ago)	Caldera	[19]

Dhinodhar Hills	Gujarat	500 Ma BP (Million years ago)	Extinct	[19]
Dhosi Hill	Haryana	750 Ma BP (Million years ago)	Extinct	[19]
Tosham Hills	Haryana	732 Ma BP (Million years ago)	Extinct	[19]
Loktak Lake	Manipur	100 Ma BP (Million years ago)	Supervolcanic caldera, status unknown	[19]

MAJOR HEALTH RISKS FROM VOLCANIC ERUPTION

Volcanoes spew out hot and dangerous gases, ash, lava, and rocks that are powerfully destructive. People have died from volcanic eruptions. Volcanic eruptions can lead to additional health risks such as floods, mudslides, power outages, drinking water pollution, and wildfires. Health issues after a volcanic eruption include infectious diseases, respiratory illnesses, burns, injuries from falls, and road accidents related to slippery and foggy conditions caused by the ash. If the warnings are heeded, the likelihood of health problems from a volcanic eruption is very low [21].

Volcanic Ash: Contact with ash may be harmful. Young children, the elderly, and people with respiratory conditions such as asthma, emphysema, and other chronic lung conditions may have problems when inhaling volcanic ash. The ash is gritty, abrasive, sometimes caustic, and always unpleasant. Small ash particles can abrade (scratch) the front of the eye. Ash particles can contain crystalline silica, a material that causes a respiratory disease called silicosis [21].

Gases: Most gases from a volcano are quickly blown out. However, in low areas, heavy gases such as carbon dioxide and hydrogen sulfide can accumulate. The most common volcanic gas is water vapor, followed by carbon dioxide and sulfur dioxide. Sulfur dioxide can cause breathing problems in healthy people and people with asthma and other breathing problems. Other volcanic gases are hydrogen chloride, carbon monoxide, and hydrogen fluoride. The quantities of these gases vary widely from volcanic eruption to volcanic eruption [21].

While the gases usually blow away quickly, people close to the volcano or those in low-lying areas downwind can be exposed to levels that can affect health. At low levels, the gases can irritate the eyes, nose, and throat. At higher levels, the gases can cause rapid breathing, headache, dizziness, swelling, and spasm of the throat, and choking [21].

Positive Effects: Volcanic ash and dust are very fertile for farms and orchards. Volcanic rock, when weathered and broken down, results in very fertile soil. Although the steep volcanic slopes prevent extensive agriculture, forestry provides valuable timber resources. Volcanic activity adds vast plateaus and volcanic mountains to our land. Mineral resources, especially metallic ores, are conspicuously absent from volcanoes and

lava flows, unless subsequent geological events have led to the intrusion of minerals into the volcanic rocks. Sometimes copper and other minerals fill the cavities of the gas bubbles [22].

WHO Response: WHO is working with the Member States to build resilient and proactive health systems that can anticipate needs and challenges during emergencies, so they are more likely to reduce risks and respond effectively when necessary [23].

The scale of physical and human costs of volcanoes can be reduced if adequate prevention, preparedness, response and recovery measures are implemented in a sustainable and timely manner. This includes the provision of early warning systems, population assessment, and awareness of the risks of volcanic activities [23].

As the health cluster takes the lead in global emergencies, WHO works with partners to respond to:

- Provide adequate nutritional supplementation;
- Restoration of primary care, such as vaccinations, maternal and child health, and mental health;
- Build mobile health and awareness teams;
- Carry out epidemic surveillance, early warning, and response;
- Request for emergency funding to support health actions [23].

VOLCANIC MITIGATION

Volcanic eruption mitigation measures usually include the implementation of control structures to mitigate the effects of floods; land destination and evacuation; and strengthen the building. We will discuss mitigation aspects in more detail in later lessons, but you need to think about the different customization choices appropriate to mitigate the volcanic risk: event modification, leak modification, and vulnerability modification. An important distinction can be made between the choices available to people in developed and less developed countries - compare, for example, the choices made in the 1980 eruption of Mount Sant'Elena (USA) and the Nevado Del event., Ruiz in 1985 (Colombia) [24].

There are four ways we can try to mitigate volcanic hazards:

1. Volcanic hazard assessment
2. Volcanic monitoring and eruption prediction
3. Geological engineering activities to reduce volcanic hazard
4. Civil evacuation of hazardous areas [24].

CONCLUSION

The volcano is a natural disaster. Volcanoes erupt from within the Earth. This is made up of many gases, liquids, and solids. Due to this, it gets jammed in the upper part of the earth in the form of lava and emits harmful gas. The history of volcanic eruptions in India so far is as follows: Seema Island, Deccan Jal, Narcondam Island, Baratang, Dhinodhar Hill, Dhosi Hill, and Tosham Hill. Human health is being affected by the toxic gases produced by volcanic eruptions.

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