INSTITUTE OF AERONAUTICAL ENGINEERING
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DISASTER MANAGEMENT

(ACE551) IARE-R16

B.Tech V SEM

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COURSE OUTLINE

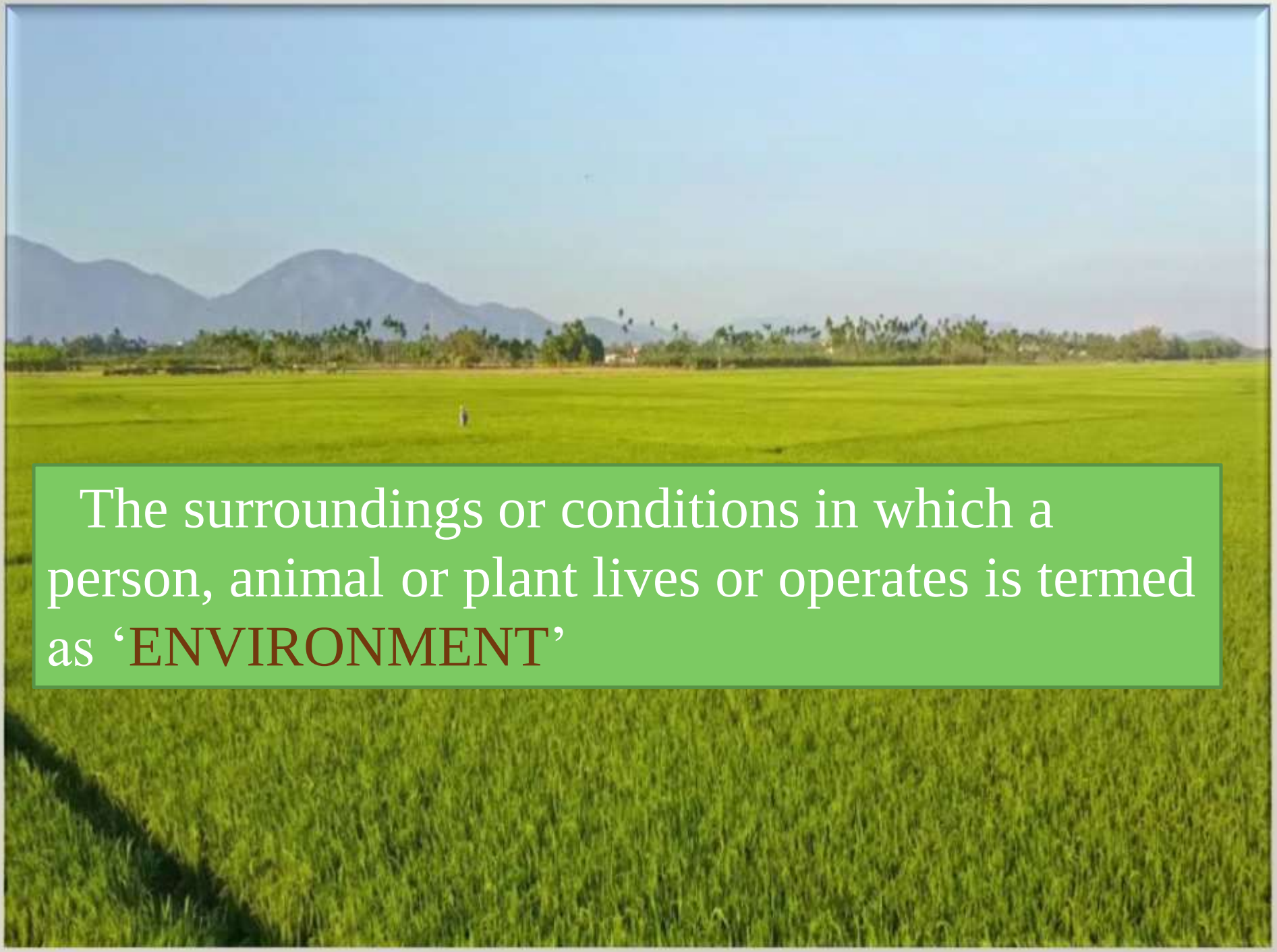
UNIT	TITLE	CONTENTS
I	**Environmental Hazards & Disasters:**	Meaning of Environmental hazards, Environmental Disasters and Environmental stress. Concept of Environmental Hazards, Environmental stress &Environmental Disasters. Different approaches & relation with human Ecology Landscape Approach - Ecosystem Approach - Perception approach – Human ecology & its application in geographical researches.
II	**Types of Environmental hazards & Disasters: Natural hazards and Disasters –**	Man induced hazards & Disasters Natural Hazards- Planetary Hazards/ Disasters – Extra Planetary Hazards/ disasters - Planetary Hazards- Endogenous Hazards - Exogenous Hazards

III IV	**Endogenos Hazards**	Endogenous Hazards - Volcanic Eruption – Earthquakes – Landslides - Volcanic Hazards/ Disasters – Causes and distribution of Volcanoes - Hazardous effects of volcanic eruptions – Environmental impacts of volcanic eruptions - Earthquake Hazards/ disasters – Causes of Earthquakes – Distribution of earthquakes - Hazardous effects of - earthquakes – Earthquake Hazards in India - - Human adjustment, perception &mitigation of earthquake.
	Exogeneous hazards and disasters	Exogenous hazards/ disasters, infrequent events, cumulative atmospheric hazards/ disasters, infrequent events: Cyclones, lightning, hailstorms; Cyclones: Tropical cyclones & local storms (causes, distribution human adjustment, perception & mitigation), cumulative atmospheric hazards/ disasters: Floods, droughts. cold waves; heat waves floods: Causes of floods, flood hazards India, flood control measures (human adjustment, perception & mitigation), droughts, impacts of droughts, drought hazards in India- drought control measures, extra planetary hazards/ disasters, man induced hazards /disasters, physical hazards/ disasters, soil erosion

V	**Emerging approaches of disaster management**	Emerging approaches in Disaster Management- Three Stages 1. Pre- disaster stage (preparedness) 2. Emergency Stage 3. Post Disaster stage-Rehabilitation

CHAPTER-1

ENVIRONMENTAL HAZARDS AND DISASTERS



The surroundings or conditions in which a person, animal or plant lives or operates is termed as ‘ENVIRONMENT’

HAZARDS

HAZARDS: Any phenomenon that has the potential to cause disruption or damage to people & the environment.

A Environmental Hazard is an event which has the capability of threatening the surrounding natural environment or adversely affect people's health including pollution and natural disasters such as storms and earthquakes.

TYPES OF HAZARDS

Hazards can be categorized in four types

a. Chemical Hazards
b. Physical Hazards
c. Biological Hazards
d. Psychosocial Hazards

CHEMICAL HAZARDS

- A chemical accident is the unintentional release of one or more hazardous substances which could harm human health or the environment.
- Chemical hazards are systems where chemical accidents could occur under certain circumstances

PHYSICAL HAZARDS

- Physical work hazards are workplace hazards that can affect the body.
- They may include radiation and excessive noise levels, falls or poorly communicated excavation routes.
- Examples include:- Unguarded machinery, exposed moving parts, constant loud noise hazards, vibrations, working from ladders, scaffolding or heights


DISASTER
MANAGEMENT
FIRST AID

DEFINITIONS OF DISASTER

- "A disaster can be defined as any occurrence that cause damage, ecological disruption, loss of human life, deterioration of health and health services on a scale, sufficient to warrant an extraordinary response from outside the affected community or area". (W.H.O.)

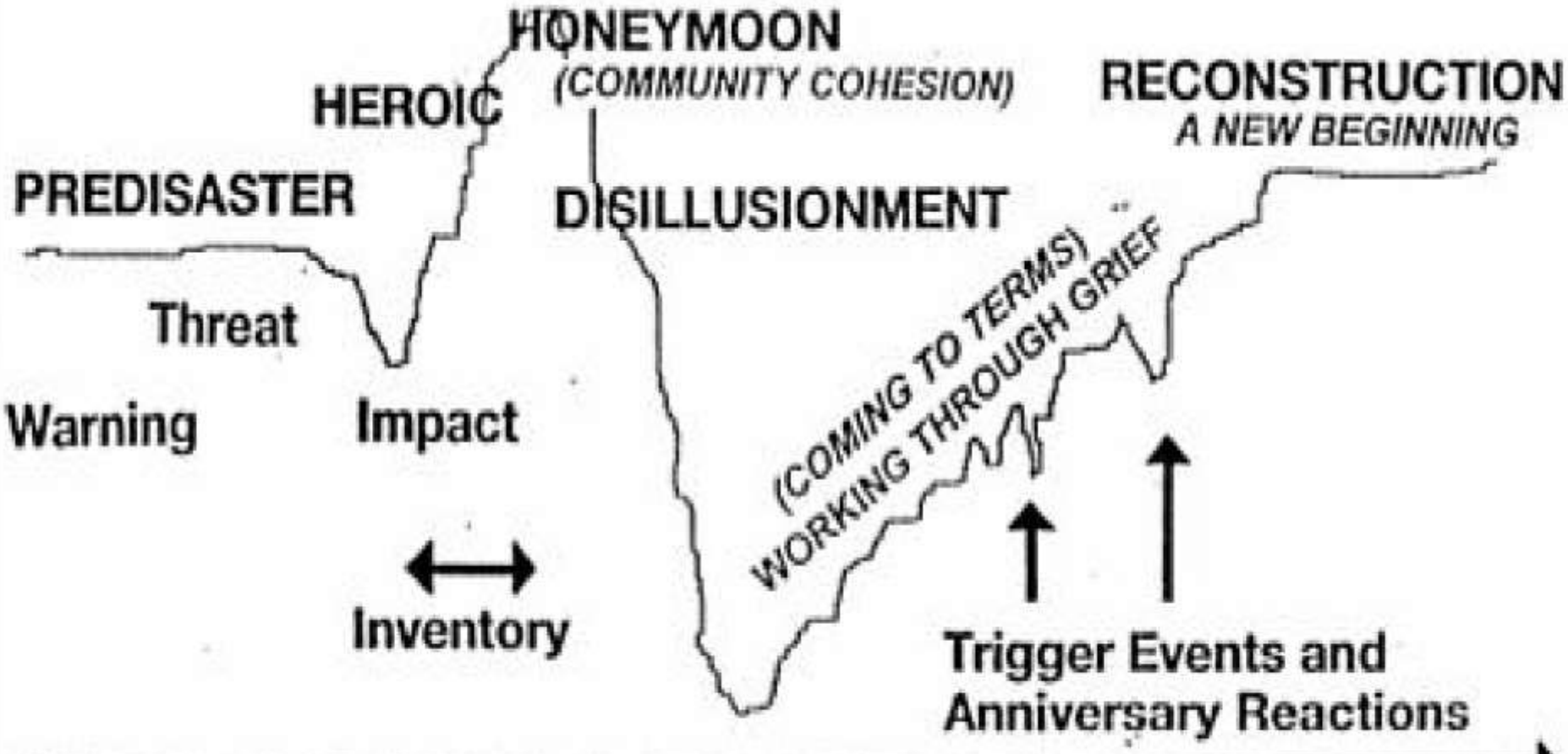
- A disaster can be defined as an occurrence either nature or manmade that causes human suffering and creates human needs that victims cannot alleviate without assistance". American Red Cross (ARC)

CHARACTERISTIC OF DISASTER

- Predictability
- Controllability
- Speed of onset
- Length of forewarning
- Duration of impact
- Scope and intensity of impact

PHASES OF DISASTER

Phases of Disaster



PRINCIPLES OF DISASTER MANAGEMENT

- Disaster management is the responsibility of all spheres of government
- Disaster management should use resources that exist for a day-to-day purpose.
- Organizations should function as an extension of their core business
- Individuals are responsible for their own safety.
- Disaster management planning should focus on large-scale events.

Contd….

- Disaster management planning should recognize the difference between incidents and disasters.
- Disaster management operational arrangements are additional to and do not replace incident management operational arrangements
- Disaster management planning must take account of the type of physical environment and the structure of the population.
- Disaster management arrangements must recognise the involvement and potential role of non- government agencies.

PHASES OF DISASTER MANAGEMENT

- Disaster Preparedness
- Disaster impact
- Disaster Response
- Rehabilitation
- Disaster Mitigation

Disaster Preparedness

Preparedness should be in the form of money, manpower and materials

- Evaluation from past experiences about risk
- Location of disaster prone areas
- Organization of communication, information and warning system
- Ensuring co-ordination and response mechanisms
- Development of public education programme
- Co-ordination with media
- National & international relations
- Keeping stock of foods, drug and other essential commodities.

E.g.: Indian Meteorological department (IMD) plays a key role in forewarning the disaster of cyclone-storms by detection tracing. It has 5 centres in Kolkata, Bhubaneswar, Vishakapatanam, Chennai & Mumbai. In addition there are 31 special observation posts setup a long the east coast of India.

The International Agencies which provides humanitarian assistance to the disaster strike areas are United Nation agencies.

- Office for the co-ordination of Humanitarian Affair (OCHA)
- World Health Organization (WHO)
- UNICEF
- World Food Programme (WFP)
- Food & Agricultural Organisation (FAD)

E.g.: Non Governmental Organizations

- Co-Operative American Relief Every where (CARE)
- International committee of Red cross
- International committee of Red cross

Disaster impact

Triage

- Golden hour
- Immediate or high priority:
- Delayed or medium priority:
- Minor or minimal or ambulatory patients:
- Expectant or least priority:
- Colour code:

Disaster response

- Epidemiologic surveillance and disease control
- Vaccination
- Nutrition

Rehabilitation phase

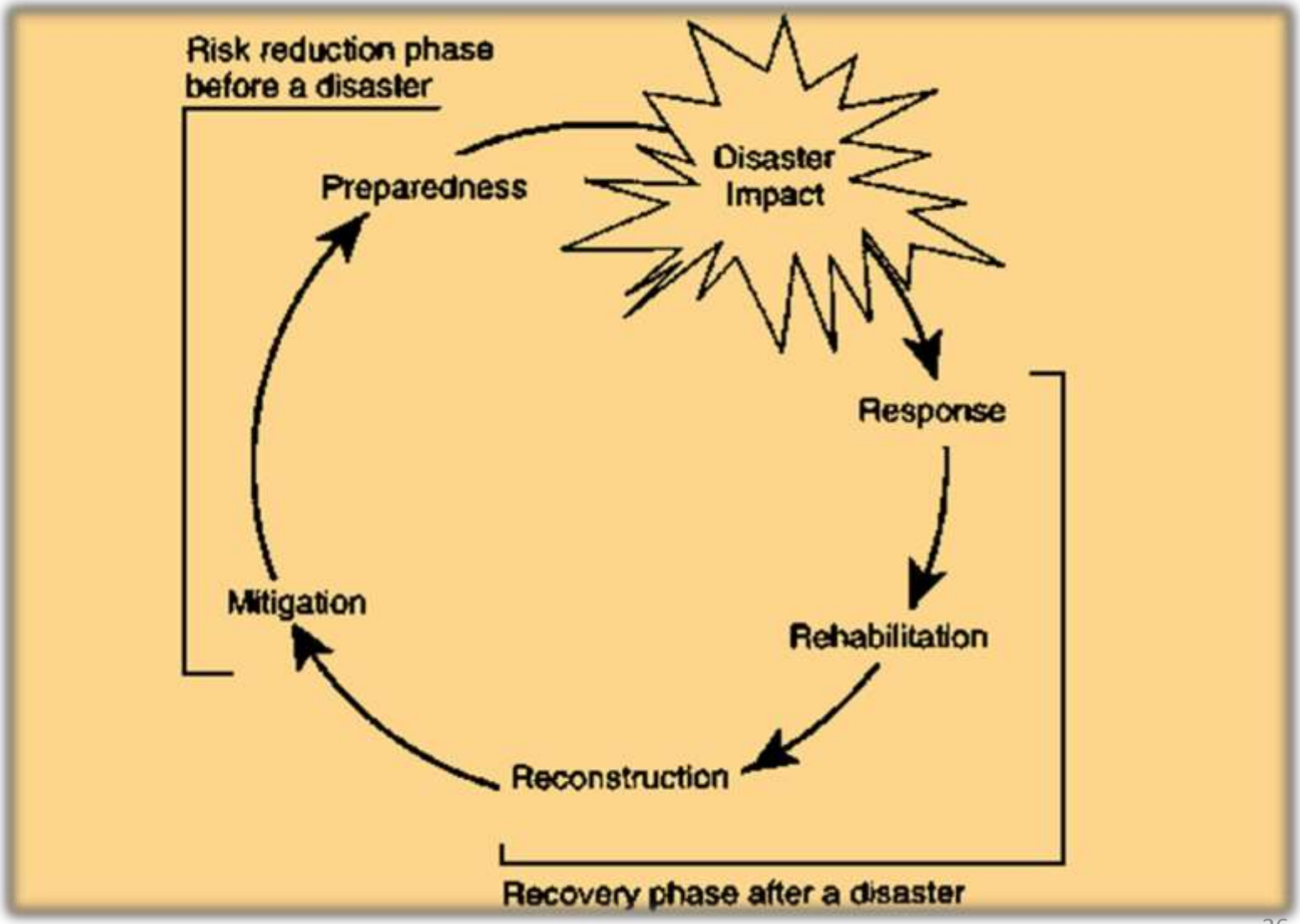
- Water supply
- Food safety
- Basic sanitation and personal hygiene
- Housing

Disaster mitigation

- This involves lessening the likely effects of emergencies. These include depending upon the disaster, protection of vulnerable population and structure.

- For examples, improving structural qualities of schools, houses and such other buildings so that medical causalities can be minimized. Similarly ensuring the safety of health facilities and public health services including water supply and sewerage system to reduce the cost of rehabilitation and reconstruction. This mitigation compliments the disaster preparedness and disaster response activities.

DISASTER MANAGEMENT CYCLE



DISASTER-EFFECTS

- Deaths
- Disability
- Increase in communicable disease
- Psychological problems
- Food shortage
- Socioeconomic losses
- Shortage of drugs and medical supplies.
- Environmental disruption

DISASTER DRILL

- A disaster drill is an exercise in which people simulate the circumstances of a disaster so that they have an opportunity to practice their responses.

ROLE OF NURSE IN DISASTER MANAGEMENT

DISASTER PREPAREDNESS

- To facilitate preparation with community
- To provide updated record of vulnerable populations within community
- Nurse leads a preparedness effort
- Nurse play multiroles in community
- Nurse should have understanding of community resources
- Disaster Nurse must be involved in community organization

DISASTER RESPONSE

- Nurse must involve in community assessment
- Once rescue workers begin to arrive at the scene, immediate plans for triage should begin
- Nurse work a member of assessment team
- To be involved in ongoing surveillance

DISASTER RECOVERY

- Successful Recovery Preparation
- Be vigilant in Health teaching
- Psychological support
- Referrals to hospital as needed
- Remain alert for environmental health
- Nurse must be attentive to the danger

UNIT-2

TYPES OF ENVIRONMENTAL HAZARDS & DISASTERS

Natural Disasters

Why is this important?

- Natural disasters are important, because they don't only effect buildings and land, they affect human beings. They can severely injure or kill. They tare families apart.

- Natural disasters caused the death of 295,000 people in 2010

Who is effected?

- Natural disasters can effect everyone, everywhere. Even if it didn't happen in your state or area, the cost effects the nation as a whole.
- In 2009, natural disasters cost insurers about $110 billion. In 2010, the cost was double that, at $218 billion.

The Effects

- 10,000 people have died in Japan's latest Tsunami/earthquake

- Katrina caused about $81 billion dollars in property damage alone

- There were about 454,000 living in metropolitan New Orleans in 2001. Only this year has New Orleans recently surpassed 350,000 citizens.

- 80% of New Orleans was flooded, with some parts under 15 feet of water. total property damage was estimated at $81 billion

How to Prevent

- Natural disaster are something that can not be stopped, or prevented, but we can do some thing's before and after disasters to help reduce the amount of trauma caused by these disasters.

<u>Ways to Help:</u>

- Donate to organizations that deal with natural disaster relief
- Volunteer with these organizations
- Help rebuild cities
- Many organizations that are based around helping, supporting, and rescuing victims, are places that you can donate to and where they raise money.

The Aftermath

- Natural disasters don't just create damage when it hits. The effects after can be worse. Many of them can cause lose ground, creating landslides. Some can start fires in your homes, also it can cause the loss of everything you know.

The Cost of Disasters

- This year Obama has set aside $850 billion for natural disasters.
- In the past $3 trillion budget intended for an infrequent purpose: federal dollars to help victims of floods, hurricanes, tornadoes and other natural disasters

Something needs to be done…


MAN-MADE
DISASTERS

MAN MADE DISASTERS

We are now living in a civilized society. The days of illiteracy and ignorance have gone. Man has made much progress in the field of science and technology. Man has created wealth out of natural resources for his comfortable living. Man has cut forests recklessly to clear the land for cultivation and along with this ENVIRONMENTAL DEGRADATION has taken place, which also affects his life. Man is becoming his own enemy because he has also created weapons of mass destruction and these weapons are used against humanity, which further brings sorrow, and suffering to mankind. This is just example of manmade disaster which shows in daily news paper and well known to people

TYPES OF MAN MADE DISASTERS

- NUCLEAR ACCIDENTS
- CHEMICHAL DISASTERS
- BIOLOGICAL DISASTERS
- GLOBAL WARMING
- TERRORIST ATTACKS
- POLLUTION

BIOLOGICAL DISASTERS

- Biological disaster spreads through the organism that is developed in the form of BACTERIA or MICROBES. Biological agent spread fast in the environment and then makes an attack on the human beings. The people inhale these microbes. When these microbes find themselves a host body, they start affecting the immune systems of the body. Microbes' also entire human body through open wounds or cuts.
- The attack of these microbes is generally slow but once they are spread in the body, it becomes different to control them. It takes the life of the affected persons. Many a time, it becomes difficult to diagnose the illness caused by these microbes and it proves to be fatal.
- Whenever we learn or hear of type of danger of communicable diseases through official announcements on radio or TV, then we can adequate preventive and protective measures.
- We aware that you are one of few, who have quite often tried to help in taking this type of noble cause and solve the problem of affected people, please let us to help in certain time of disaster or create fund for this uncertain event. Therefore we have taken the liberty of appealing to you that if any kind of donation or charity for such type future uncertain event we would be than thank full

GLOBAL WARMING

- Global warming is the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation. Since the early 20th century, Earth's mean surface temperature has increased by about 0.8 °C (1.4 °F), with about two-thirds of the increase occurring since 1980.
- Warming of the climate system is unequivocal, and scientists are more than 90 certain that it is primarily caused by increasing concentrations of greenhouse gases produced by human activities such as the burning of fossil
  fuels and deforestation.
- These findings are recognized by the national science academies of all major industrialized nations The effects of an increase in global temperature include arise in sea levels and a change in the amount and pattern of precipitation, as well a probable expansion of subtropical deserts.
- Warming is expected to be strongest in the Arctic and would be associated with the continuing retreat of glaciers, permafrost and sea ice. Other likely effects of the warming include a more frequent occurrence of extreme- weather events including heat waves, droughts and heavy rainfall, ocean acidification and species extinctions due to shifting temperature regimes. Effects significant to humans include the threat to food security from decreasing crop yields and the loss of habit from industrialized nations

TERRORIST ATTACKS

- terrorist attack - a surprise attack involving the deliberate use of violence against civilians in the hope of attaining political or religious aims

- terrorist act can be defined as the calculated use of violence (or the threat of violence) against civilians in order to attain goals that are political or religious or ideological in nature; this is done through intimidation or coercion or instilling fear

WORST TERRORIST ATTACKS

- Mumbai terrorist attack is also referred to as November 26 or 26/11 and this terrorist attack targeted India's largest city Mumbai. It was actually a series of 10 coordinated shooting and bombing attacks across Mumbai by Islamic terrorists who are believed to have come from Pakistani Seawaters and backed by ISI, Pakistani secret service agency. It affected the Indo-Pak relation immensely and the bilateral relations were debilitated which have never returned to normalcy since

- There was a series of coordinated attacks by Al-Qaeda on America on September 11, 2001. Four commercial passenger jet airliners were hijacked by 19 Al-Qaeda members and they intentionally steered two of the planes towards the Twin Towers of World Trade Center, consequently bringing them down to earth. The third airliner was crashed into The Pentagon in Arlington, Virginia, just outside Washington, D.C. and the fourth one crashed into a field near Shanksville in rural Pennsylvania. There were no survivors from any of the flights. This event triggered many changes in the world as a whole and was the beginning of a very horrendous film for the humans across the globe because humans had to pay a very heavy price of this terrorist attack and this fact is conspicuous from the current state of affairs

- This incident took place on April 19, 1995 and it was an attack on the Alfred P. Murrah Federal Building in downtown Oklahoma City. It was the most deadly terrorist attack on the American soil until 9/11,and it claimed 168 lives, including 19 children under the age of 6,[1] and injured more than 680 people.

Pollution

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution.

The Blacksmith Institute issues an annual list of the world's worst polluted places. In the 2007 issues the ten top nominees are located in Azerbaijan, China, India, Peru, Russia, Ukraine and Zambia.

FORMS OF AIR POLLUTION

The major forms of pollution are listed below along with the particular contaminant relevant to each of them:

- Air pollution:- the release of chemicals and particulates into the atmosphere. Common gaseous pollutants include carbon monoxide, sulfur dioxide, chlorofluorocarbons (CFCs) and nitrogen oxides produced by industry and motor vehicles. Photochemical ozone and smog are created as nitrogen oxides and hydrocarbons react to sunlight. Particulate matter, or fine dust is characterized by their micro meter size PM10 to PM2.5.
- Light pollution:- includes light trespass, over-illumination and astronomical interference.
- Littering:- the criminal throwing of inappropriate man-made objects, un removed, on to public and private properties.
- Noise pollution:- which encompasses roadway noise, aircraft noise, industrial noise as well as high-intensity sonar.
- Soil contamination occurs when chemicals are released by spill or underground leakage. Among the most significant soil contaminants are hydrocarbons, heavy metals, herbicides, pesticides and chlorinated hydrocarbons.

- Radioactive contamination, resulting from 20th century activities in atomic physics, such as nuclear power generation and nuclear weapons research, manufacture and deployment.

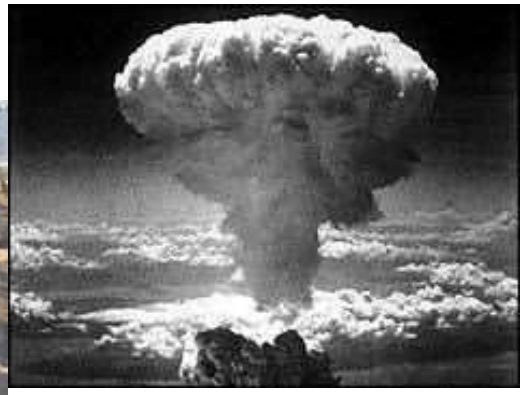
- Thermal pollution, is a temperature change in natural water bodies caused by human influence, such as use of water as coolant in a power plant.

- Visual pollution, which can refer to the presence of overhead power lines, motorway billboards, scarred landforms (as from strip mining), open storage of trash, municipal solid waste or space debris.

- Water pollution, by the discharge of wastewater from commercial and industrial waste (intentionally or through spills) into surface waters; discharges of untreated domestic sewage, and chemical contaminants, such as chlorine, from treated sewage; release of waste and contaminants into surface runoff flowing to surface waters (including urban runoff and agricultural runoff, which may contain

- chemical fertilizers and pesticides); waste disposal and leaching into groundwater; eutrophication and littering.

SOME MAN MADE DISASTERS

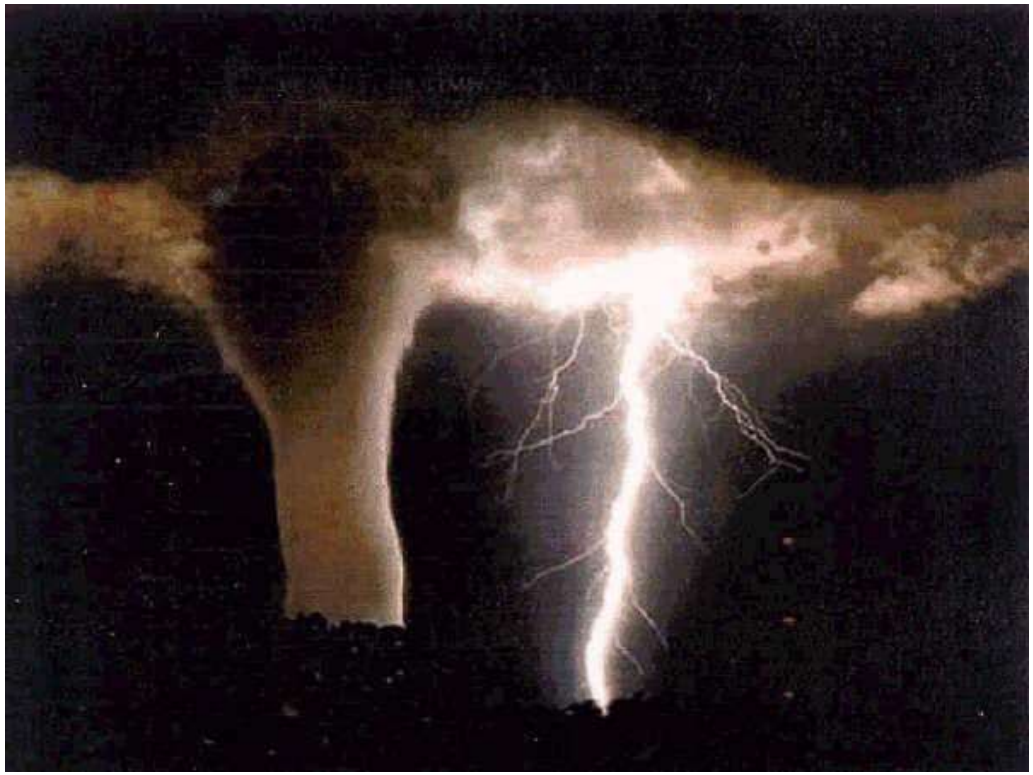


- In October 2001, there was a danger of anthrax germs being used as biological weapons. Anthrax was the cause of death for some people in USA.US authorities also confirmed that a postal worker in the city of Washington DC was tested positive for anthrax infection. Anthrax is a deadly disease caused by bacillus, most common in sheep and cattle but also communicable to mankind.

- In December 1984, the leakage of gas from the Union Carbide factory at Bhopal in Madhya Pradesh caused 2,500 deaths and more than 3 lakes people of Bhopal suffered the disastrous effects of the poisonous gas.

- The worst type of man-made disaster is caused by the use of nuclear weapons. If we go back to the history of 1945, we come to know the history of 1945; we come to know the worst type of nuclear disaster the world had witnessed. On August 6, 1945 an atom bomb was dropped on HIROSHIMA in Japan, which devastated the entire town killing 66,000 people and injuring nearly 69,000. On August 9, 1945 another atom bomb was dropped on NAGASAKI. This bomb killed nearly 39,000 people and injured more than 25,000.

NATURAL DISASTERS



Disaster Database

- Avalanche
- Earthquakes
- Hurricanes
- Landslides
- Thunderstorms
- Tornados
- Tsunami
- Volcanoes

AVALANCHES

- Avalanches Happen on every continent
- Avalanche “eason is during the “winter time” or December-April in the United States
- A large scale can release up to 300,000 cubic yards of snow
- Avalanches are more commonly released by recreationists than by natural causes
- The biggest factor of avalanche possibility is the accumulation snow over the winter season
  - More snow = bigger avalanche

Earthquakes

- Earthquakes are caused by the release of built up pressure caused by the shifting of tectonicplates
- Earthquakes usually occur on fault lines, or areas where tectonic plates meet
- The size of an earthquake is measured using the logarithmic based Richter scale

Hurricanes

- A hurricane is a tropical storm with winds over 74mph
- Hurricanes occupy the most intense level of the three levels of tropical storms
- Hurricanes rotate or circulate counter-clockwise in the northern hemisphere
- Hurricanes can only occur over the Atlantic ocean, Caribbean sea, and gulf of Mexico

Landslides

- Landslides are the movement of land down a slope by gravity
- Landslides are mother nature's way of redistributing land
- They can be triggered by rain, floods, and earthquakes as well as man- made factors such as slope grading or mining
- Landslides have the potential to happen anywhere a steep slope is present

Thunder Storms

- Every Thunderstorm produces lightning
- There is wet thunder and dry thunder, the difference being whether or not rain in produced
- Warm humid conditions favor thunderstorms
- Only 10% of thunderstorms are classified as severe
- Your chance of being struck by lightning is 1 in 600,000

Tornados

- A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground
- Tornados are found in almost every part of the world
- Tornados are most common in the United States, just east of the Rocky Mountains in an area called Tornad Ally
- Waterspouts are weak tornados over water and can move inland an become tornados

Tsunamis

- On the seafloor, volcanic eruptions, earthquakes, and even landslides can lead to tsunamis
- Tsunamis can travel over 300mph
- Tsunamis can have an amplitude of up to 32ft
- Hawaii is the most vulnerable place in the world for tsunamis

Volcanoes

- Volcanoes are lava filled mountains that erupt when the pressure becomes to great for them to hold it inside
- The contents that a volcano spews forth is called magma when it's below the surface and lava once it reaches the surface
- Only a fraction of the world's volcanoes are actually on land, the rest are on the ocean floor
- Indonesia has the most volcanoes of all the countries in the world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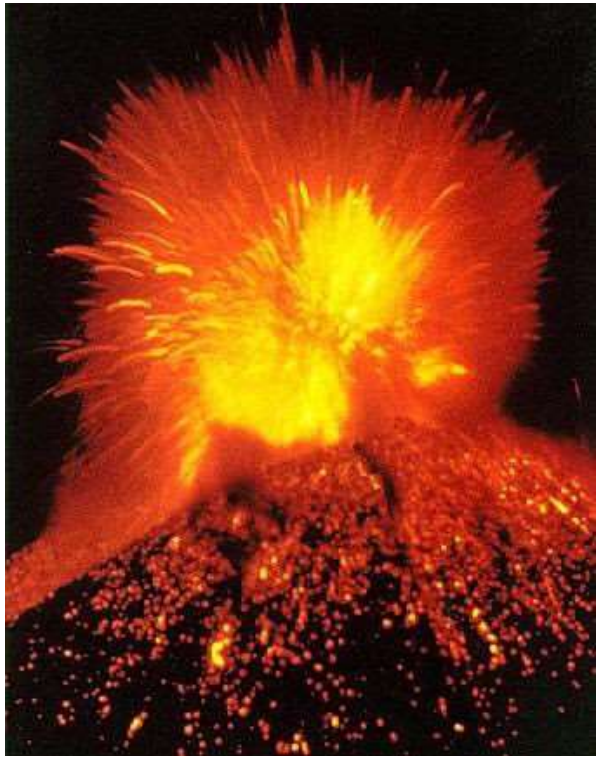
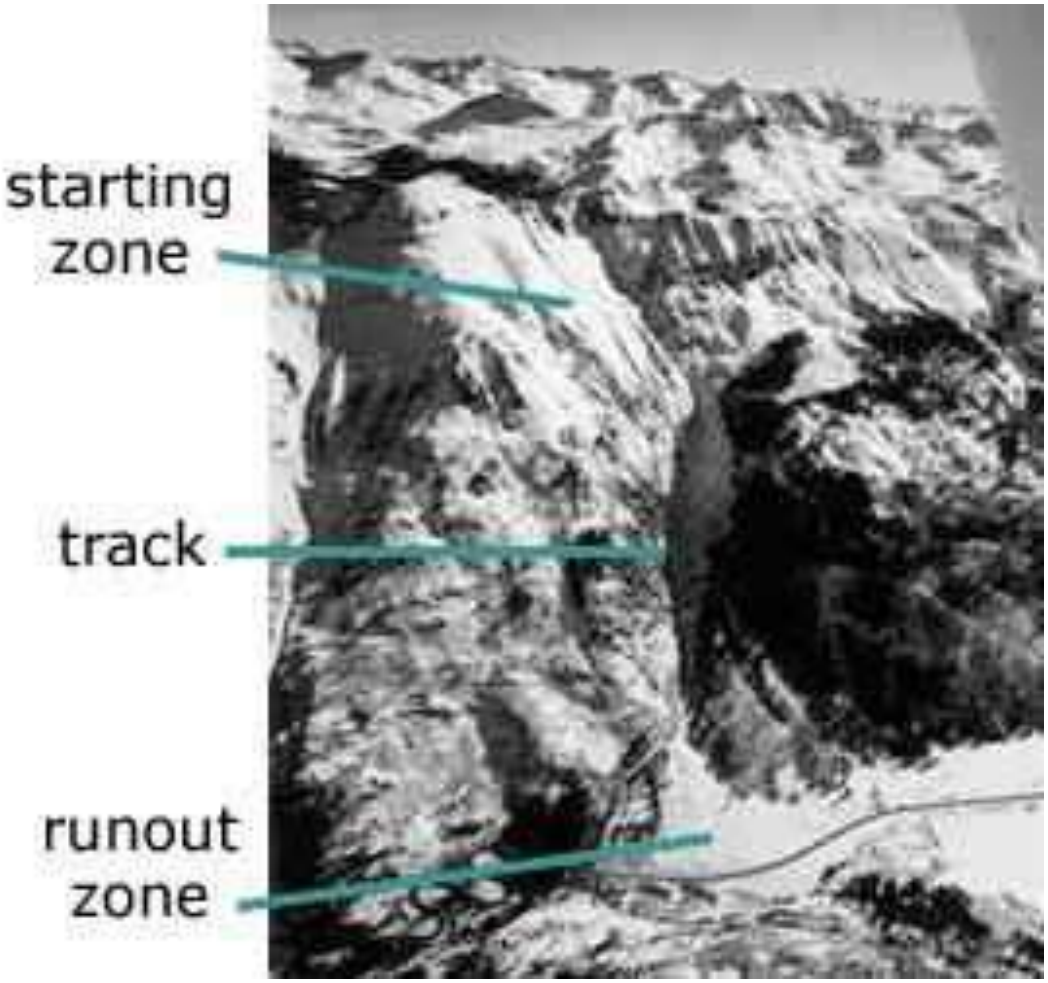



starting
zone
track
runout
zone

UNIT-3
Endogenous Hazards

A Tragedy To Life And Property

INTRODUCTION

Earthquakes constitute one of the worst natural hazards which often turn into disaster causing widespread destruction and loss to human life.

The effects of earthquake vary upon the magnitude and intensity. Earthquakes occur every now and then all round the world, except in some places where earthquakes occur rarely. The devastation of cities and towns is one of the effects of earthquake.

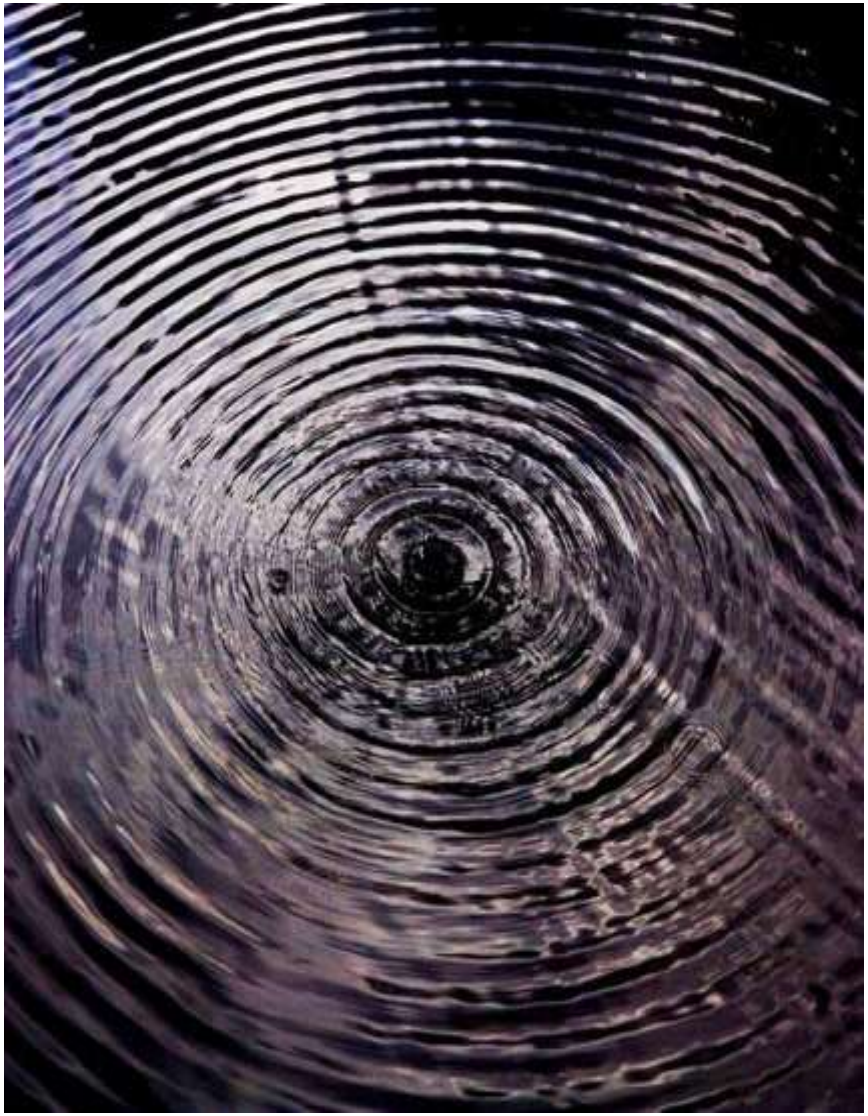
What is Earthquake?

- An Earthquake is the result of a sudden release of energy in the earth's crust that creates seismic waves.
- The seismic activity of an area refers to the frequency,type and size of earthquakes experienced over a period of time

For example:

If you throw stone in a pond of still water,series of waves are produced on the surface of water,these waves spread out in all directions from the point where the stone strikes the water.

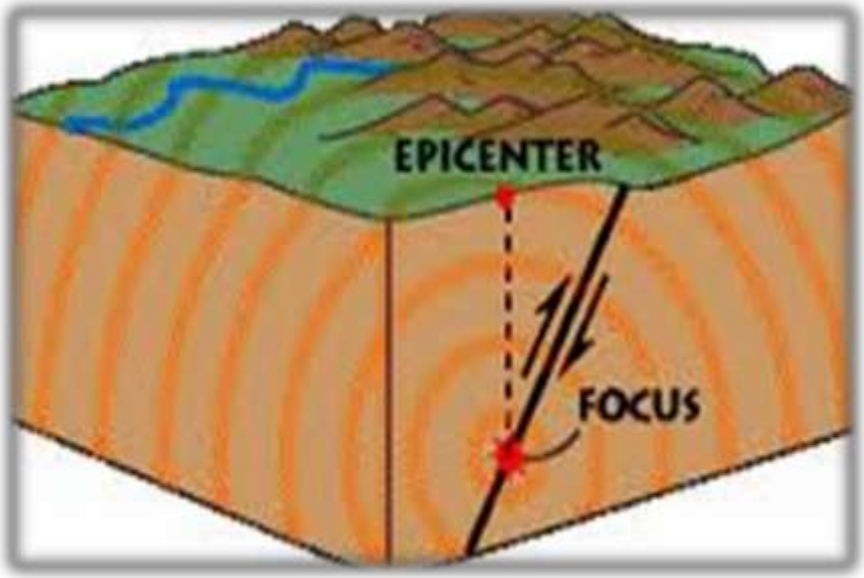
similarly, any sudden disurbances in the earth's crust may produce vibration in the crust which travel in all direction from point of disturbances.



TERMS RELATED TO EARTHQUAKE

Focus(Hypocenter):

Focus is the point on the fault where rupture occurs and the location from which seismic waves are released.



Epicenter:

Epicenter is the point on the earth's surface that is directly above the focus ,the point where an earthquake or underground explosion originates.

Cont…

Fault Line:

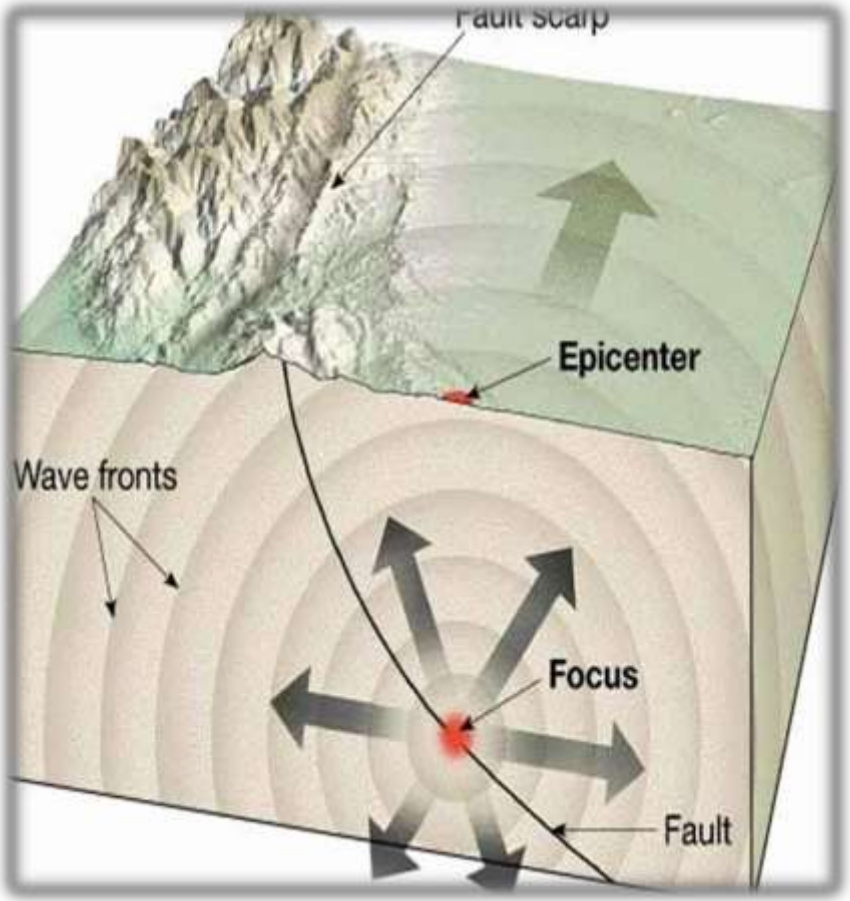
A Fault line is the surface trace of a fault, the line of intersection between the earth's surface.

Fault plane:

Fault plane are the crackes or sudden slips of the land .

Fault Scrap:

A Fault scrap is the topographic expression of faulting attributed to the displacement of the land surface by movement along faults.



CAUSES OF EARTHQUAKE

The primary cause of an earthquake is **faults** on the crust of the earth.

"A Fault is a break or fracture b/w two blocks of rocks in response to stress."

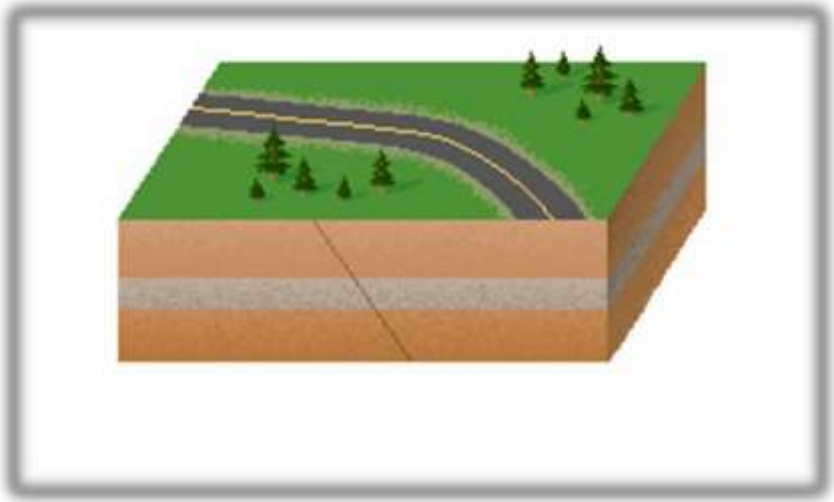
- This movement may occur rapidly, in the form of an **earthquake** or may occur slowly, in the form of **creep.**

- Earth scientists use the **angle of the fault** with respect to the surface (known as the dip) and the **direction of slip** along the fault to classify faults.

Classification of Faults

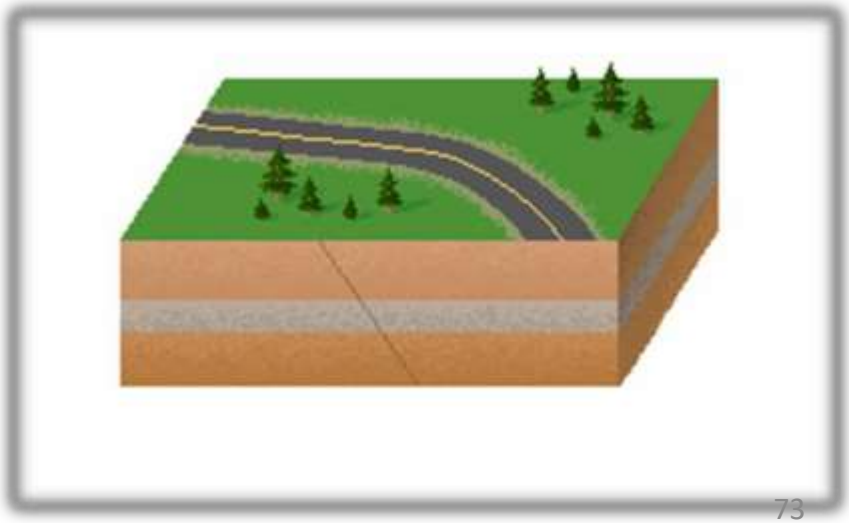
Normal fault:

a dip-slip fault in which the block above the fault has moved downward relative to the block below.



Thrust (reverse)fault:

a dip-slip fault in which the upper block, above the fault plane, moves up and over the lower block.



Strike-slip fault:

- **A left-lateral strike-slip fault :**

It is one on which the displacement of the far block is to the left when viewed from either side.

- **A right-lateral strike-slip fault:**

It is one on which the displacement of the far block is to the right when viewed from either side.

Some major causes of earthquakes on basic of its causes are:

- Surface causes
- Volcanic causes
- Tectonic causes

Surface cause:

Great explosions, landslides, slips on steep coasts, dashing of sea waves , avalanches , railway trains, heavy trucks, some large engineering projects cause minor tremors. some of them are man made, other are natural.

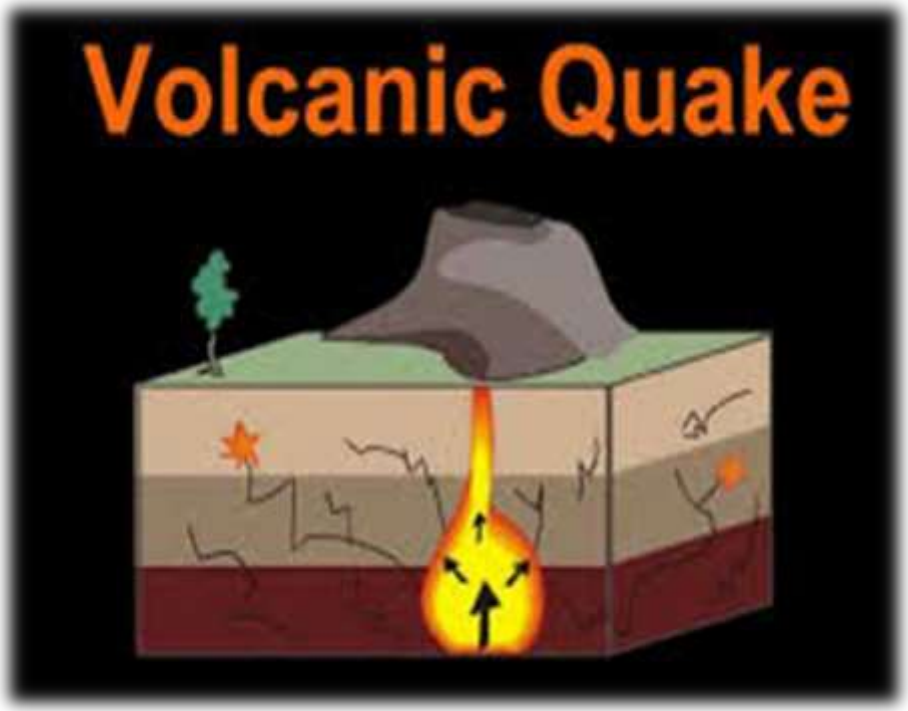
Volcanic cause:

Volcanic eruptions produce earthquakes. Earthquakes may precede, accompany and frequently follow volcanic eruptions.

They are caused by sudden displacements of lava within or beneath the earth crust.

There are two general categories of earthquakes that can occur at a volcano:

- volcano-tectonic earthquakes
- long period earthquakes.



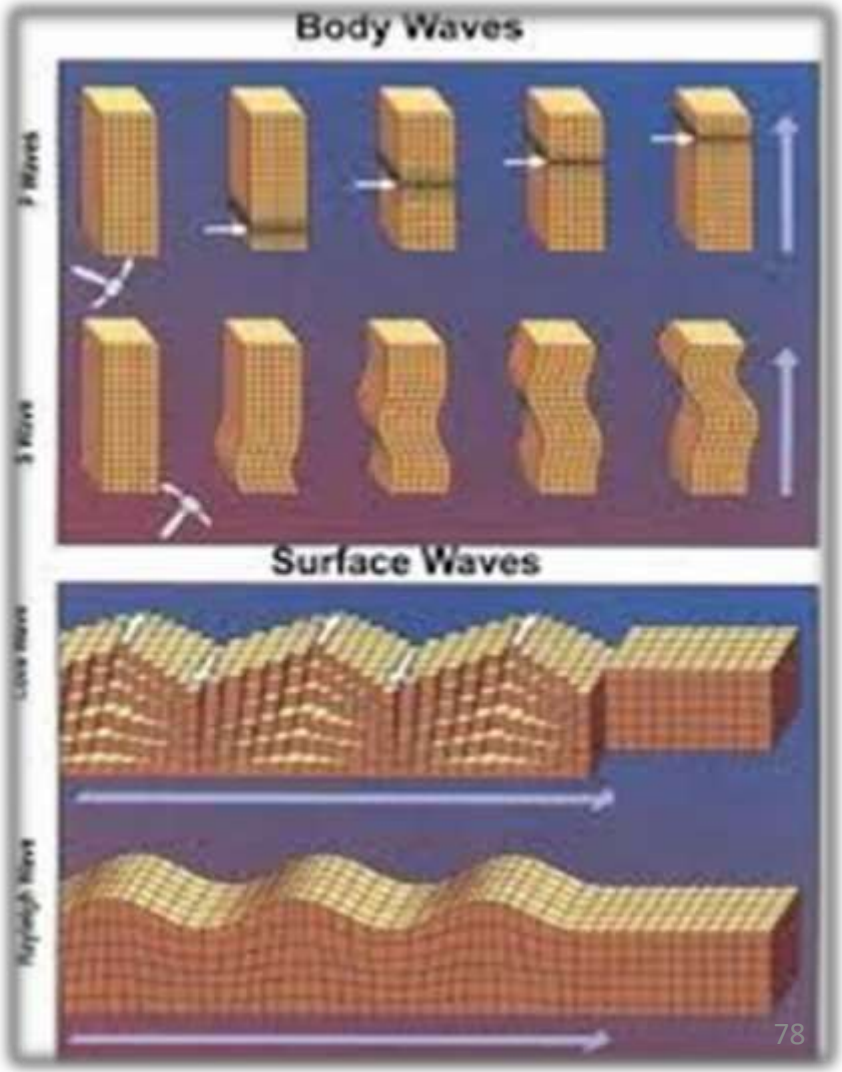
Tectonic cause:

Structural disturbances resulting in the parts of the lithosphere is the main cause of this type of earthquake. Most of the disastrous earthquakes belong tothis category and occur in areas of great faults and fractures. Sudden yielding to strain produced on the rocks of accumulating stress causes displacements especially along old fault zones known as great transform faults.

WAVES PRODUCED DUE TO EARTHQUAKE

Seismic waves produced due to earthquake are basically divided into two major types:

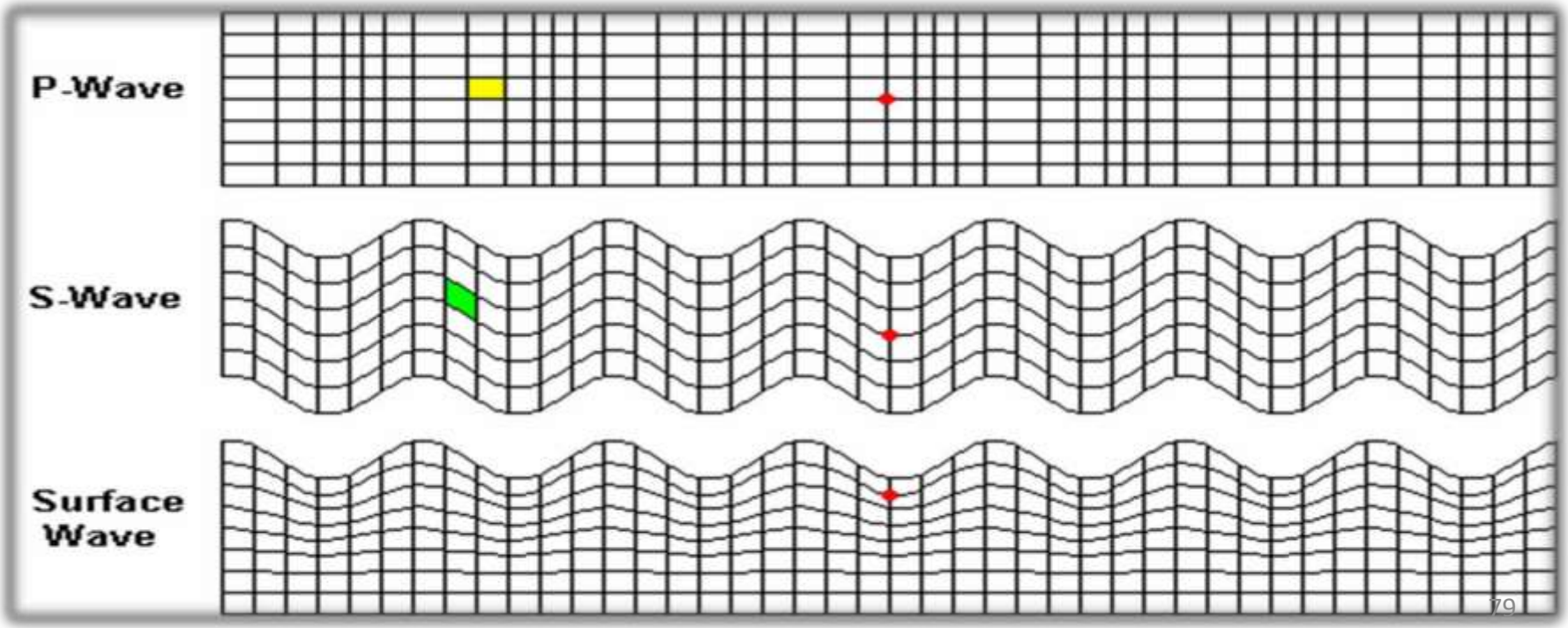
- Body waves
- Surface waves



Body waves:

Body waves travels through the interior(body) of earth as they leave the focus. Body waves are further divided into following types:

- **Primary (P) waves**
- **Secondary(S) waves**

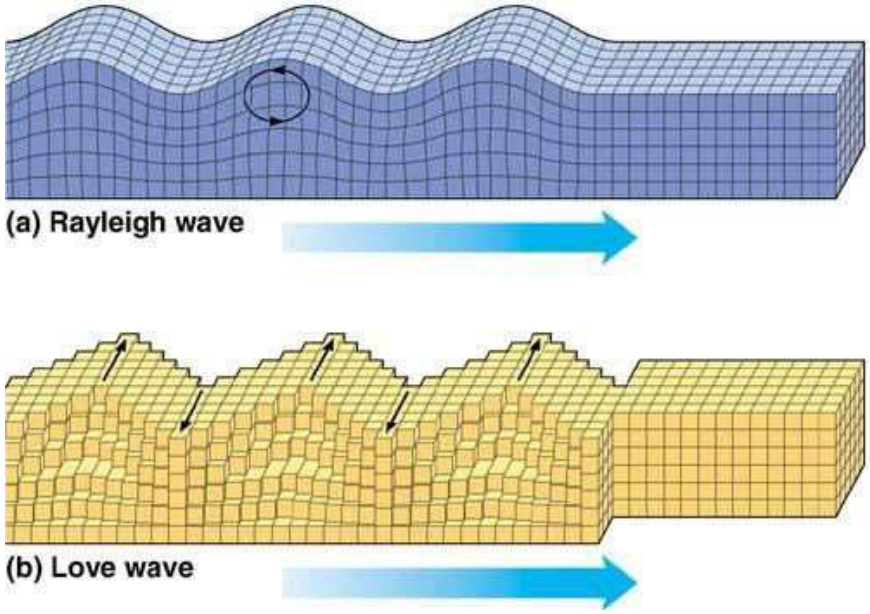


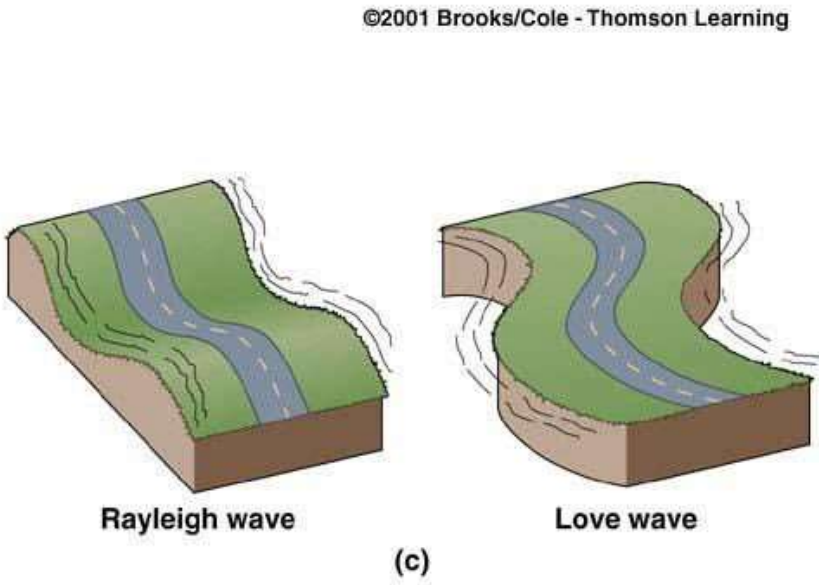
Primary Waves (P-waves)	Secondary Waves(S-wave)
High frequency	High frequency
Short Wavelength	Short Wavelength
Longitudinal waves	Transverse waves
Pass trough both solids and liquids	Can not move through liquids
Move forwards and backwards as it compressed and decompressed	Move in all direction from their source
P-wave is faster	S-wave is more slower than P-wave
First P-wave arrive	After P-wave,S-wave is arrive

Surface Wave:

Surface waves travels parallel to the earth's surface and these waves are slowest and most damaging. Surface wave are divided into following types:

- **Love waves**
- **Rayleigh waves**





Love Waves	Rayleigh wave
Guided waves	Guided waves
Displacement is parallel to the free surface	Displacement is perpendicular to love-wave displacement
Love wave is faster	Rayleigh wave is slower
Causes horizontal shifting of the earth surface.	Ground move in circular motion.

STRENGTH OF EARTHQUAKE

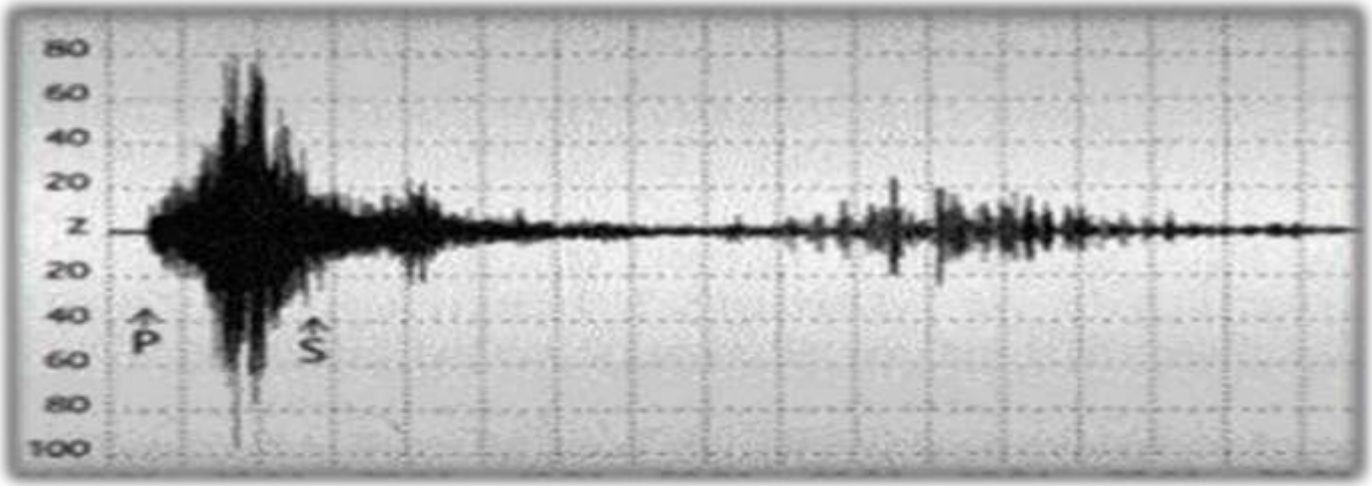
• The intensity and strength of an earthquake is measured on Richter scale, the scale invented by Charles Richter California, USA in 1935. It categories earthquake on the basis of energy released

Defintion:

"the logarithm to base ten of the maximum seismic-wave amplitude recorded on a standard seismograph at a distance of 100 kilometers from the earthquake epicenter."

Scientists measure the strength of earthquakes using machines known as seismographs.

❑ **Seismology** is the scientific study of earthquakes and the propagation of elastic waves through the Earth.



GROUP	MAGNITUDE
Great	8 and Higher
Major	7-7.9
Strong	6-6.9
Moderate	5-5.9
Light	4-4.9
Minor	3-3.9
Very Minor	<3.0

Amount of energy released during different Earthquake:

Intensity Of Earthquake On Richter Scale:	Energy Release (Amount Of TNT):
1.0	170 Grams
2.0	6 Kilogram
3.0	179 Kilogram
4.0	5 Metric Tons
5.0	179 Metric Tons
6.0	5643 Metric Tons
7.0	179100 Metric Tons
7.5	1 Mega Tons
8.0	564300 Metric Tons

Seismometers- The measurement of Earthquake

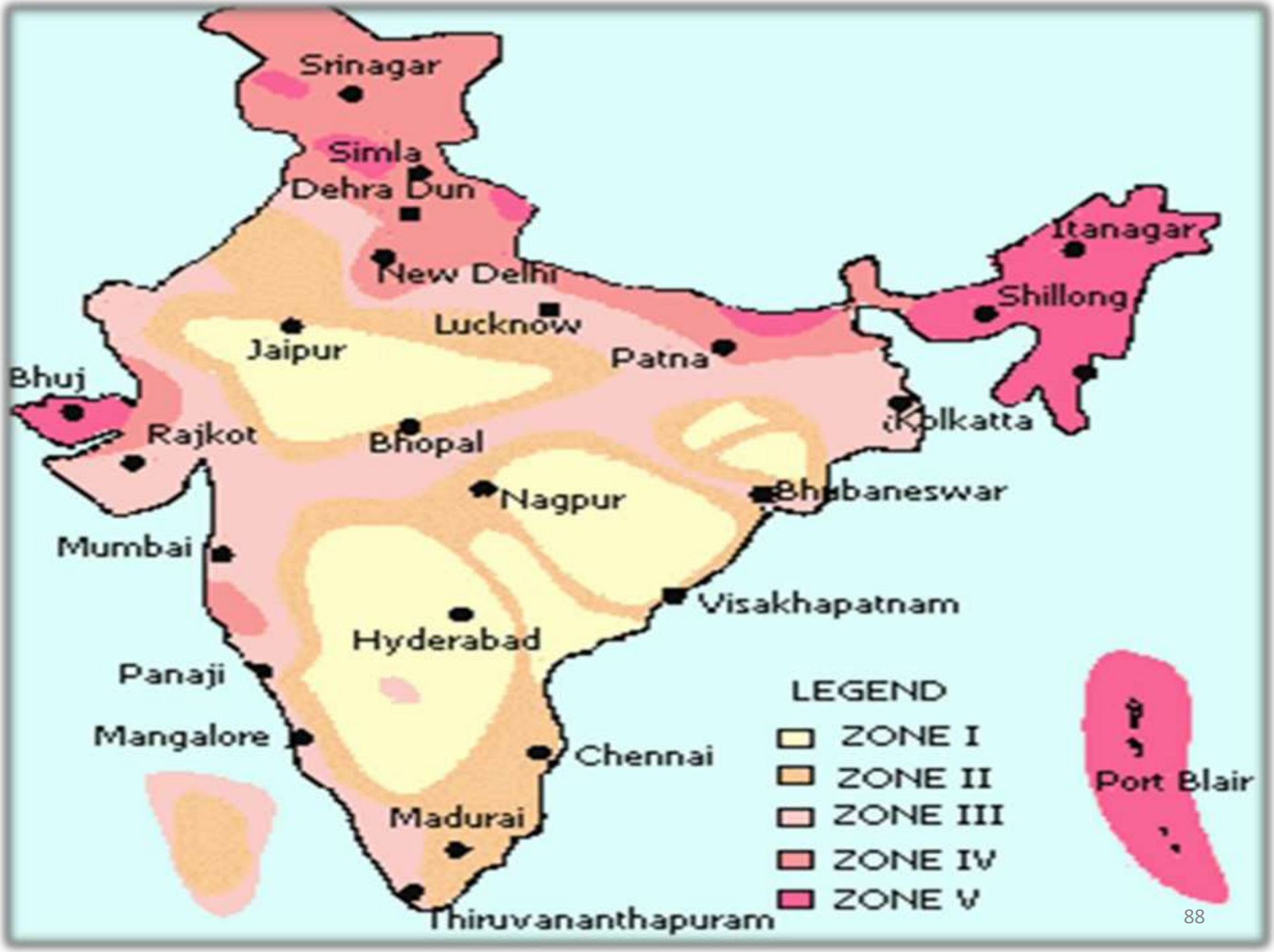
- **Seismometers** are instruments that measure motions of the ground, including those of seismic waves generated by earthquakes, volcanic eruptions, and otherseismic sources.

- Seismometers may be deployed at Earth's surface, in shallow vaults, in boreholes, or underwater.

Types of Zones

The earthquake zoning map of India divides India into 4 seismic zones Based on the observations of the affected area due to Earthquake india divided into four types of zones:

- Zone - II: This is said to be the least active seismic zone.
- Zone - III: It is included in the moderate seismic zone.
- Zone - IV: This is considered to be the high seismic zone.
- Zone - V: It is the highest seismic zone.


Srinagar
Simla
Dehra Dun
New Delhi
Lucknow
Jaipur
Patna
Bhuj
Rajkot
Bhopal
Nagpur
Mumbai
Hyderabad
Visakhapatnam
Panaji
Mangalore
Chennai
Madurai
Thiruvananthapuram
Itanagar
Shillong
Kolkatta
Bhubaneswar
Port Blair
LEGEND
ZONE I
ZONE II
ZONE III
ZONE IV
ZONE V

Earthquake Prediction

Earthquake prediction is usually defined as the specification of the time , location , and magnitude of a future earthquake within stated limits.

But some evidence of upcoming Earthquake are following:

- Unusual animal behavior
- Water level in wells
- Large scale of fluctuation of oil flow from oil wells
- Foreshocks or minor shocks before major earthquake
- Temperature change
- Uplifting of earth surface
- Change in seismic wave velocity

Effect of Earthquake

- Loss of life and property
- Damage to transport system i.e. roads, railways, highways, airports, marine
- Damage to infrastructure.
- Chances of Floods – Develop cracks in Dams
- Chances of fire short-circuit.
- Communications such as telephone wires are damaged.
- Water pipes, sewers are disrupted
- Economic activities like agriculture, industry, trade and transport are severely affected.

Cont…

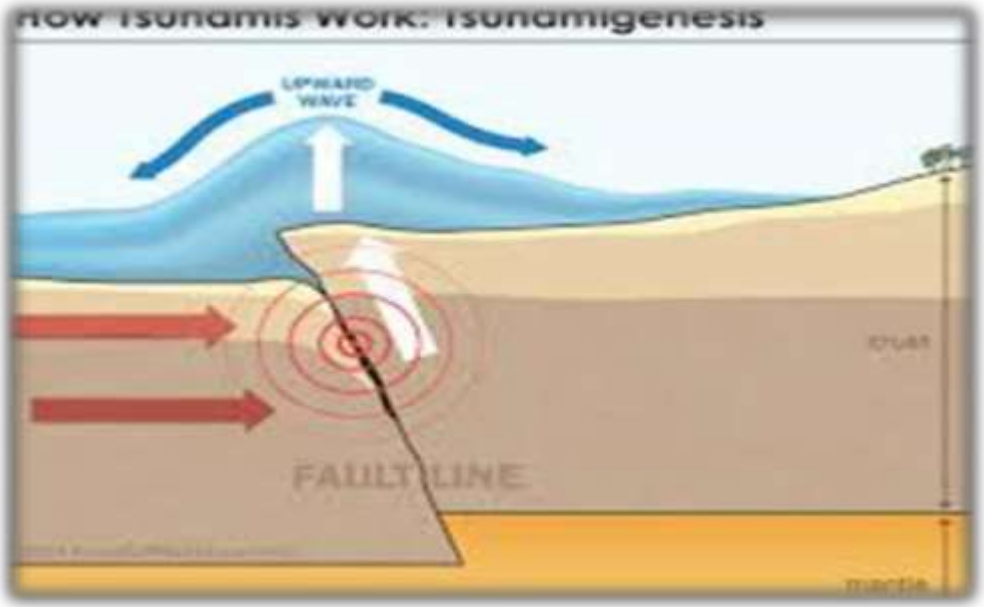
Landslides

Shaking and ground rapture

Fires

Soil liquefaction

Tsunami



Floods

Earthquake Safety Rules

If you are in house;

• Don’t use lift for getting down from building.

• Be prepared to move with your family.

If you are in shop ,school or office;

• Don’t run for an exit.

•Take cover under a disk/table.

•Move away from window glass.

•Do not go near electric point and cable. Keep away from weak portion of the building and false ceiling.

If you are outside;

•Avoid high buildings , walls , power lines and other objects that could fall and create block.

• Don’t run through streets.

•If possible , move on to an open area away from hazard including trees.

If you are in vehicle;

• Stop in a safe open place.

• Remain inside vehicle.

• Close window , doors and vents.

After An Earthquake

- Keep calm, switch on the transistor radio and obey instructions.
- Keep away from96 beaches and low banks of river. A huge wave may sweep in
- Do not re enter badly damaged buildings and do not go near damage structures.
- Turn off the water, gas and electricity.
- Do not smoke, light match or use a cigarette lighter
- Do not turn on switches there may be gas leak or short circuit
- If there is any fire, try to put it out or call fire brigade.

Contd…

Do not drink water from open containers without having examined it.

If you aware of people have been buried, tell the rescue team. Do not rush and try not to worsen the situation.

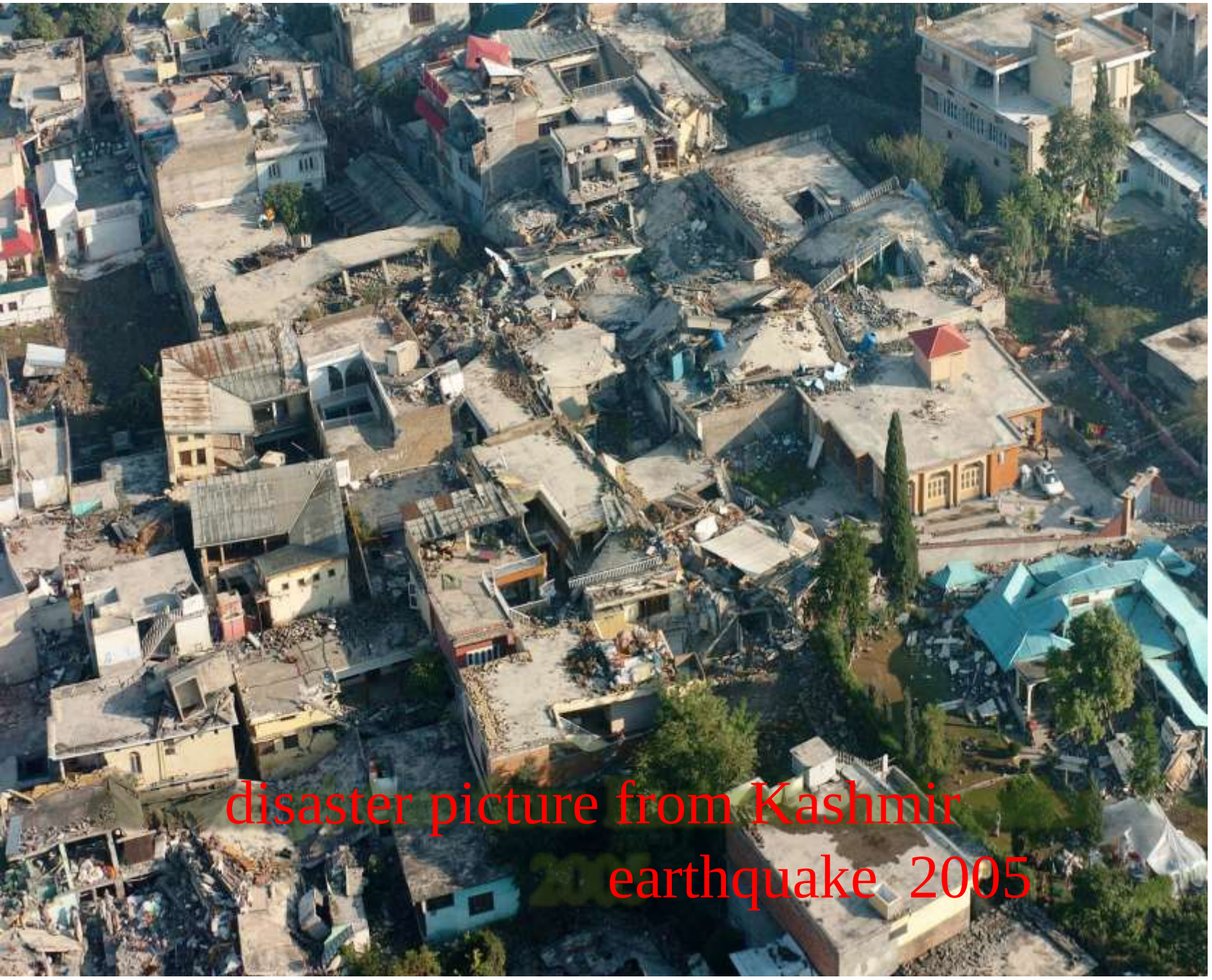
Avoid places where there are loose electric wires and do not come in contact with any metal object.

Eat something. You will better and more capable of helping other.

Do not walk around the streets to see what is happening. Keep the streets clear so rescue vehicles can access the roads easily.

Date	Place	Scale	Damage
Sept 2, 1993	Latur (maharashtra)	6.3	Large areas of Maharashtra rocked. 10,000 people lost lives.
May 22, 1997	Jabalpur (Maharashtra)	6.0	40 person killed and over 100 injured.
March 29, 1999	Nandprayag	6.8	widespread destruction in chamoli , rudraprayag and other areas. Massive loss of human life.
Jan. 26, 2001	Bhuj (gujrat)	7.8	Tremors left by India and its neighboring countries. Over 1 lakh people killed. Huge loss to property and infrastructure.
Oct. 8, 2005	Muzzaffarabad in Pakistan occupied Kashmir	7.4	Heavy damage to life and property. Death toll about one lakh in Pakistan and nearly 2000 in India.

Picture Of Search And Rescue Phase Of Latur Earthquake 1993


disaster picture from Kashmir
earthquake 2005

Earthquake Case study: Bhuj Earthquake 26th January 2001

- Date: 26th January ,2001
- Origin line: 08 hrs.46 min. 42.9 sec. IST
- Epicenter: Latitude 23.40° N Longitude 70.28°E
- Magnitude: 7.7
- Focal Depth: 25 kms.


Pakistan
New Delhi
Nepal
Hyderabad
Bhachau
Bhuj
Ahmedabad
India
Bombay
Arabian
Sea

- On the morning of **January 26, 2001**, the Nation's 52nd Republic Day, a devastating earthquake occurred in the **Kutchh** district of the state of Gujarat.

- The earthquake was felt as far away as Delhi in the north, Kolkata in the east.

- **Bhuj town** and the village **Bhachau,** 60 km east of Bhuj, were the worst affected and many other areas of Gujarat including its state headquarters Ahmedabad, were badly affected.

DAMAGE ASSESSMENT

- There were more than 20,000 deaths and 167,000 people injured Four districts of Gujarat lay in ruin and altogether, 21 districts were affected.

- Around 300,000 families and at least 3 million children under 14 aged were affected.

- Around 600,000 people were left homeless.

- In the city of Bhuj, more than 3,000 Population of the city lost their lives; the main hospital was crushed and close to 90% of the buildings was destroyed.

- There was significant damage to infrastructure with facilities such as hospitals, schools, electric power and water systems, bridges and roads damaged or destroyed.


Damage to high rise building in Bhuj
Paras Shah / AP

5 year old girl recovers at a hospital in Bhuj on Monday after Friday's massive earthquake.

LOCAL RESPONSE

- The response within India was immediate. The national and state governments quickly provided assistance in many forms including cash, medical supplies, communication teams, shelters, food, clothing, transport and relief workers.
- There were more than 185 non-government organizations (NGOs), mostly Indian charities, which undertook earthquake-related activities

INTERNATIONAL RESPONSE

- Search and Rescue teams soon arrived from Switzerland, United Kingdom, Russia and Turkey to find and rescue survivors buried under debris.

- Relief teams and supplies soon followed from 38 countries as well as United Nations agencies and many international NGOs such as the Red Cross.

- The world bank and Asian development bank sanction loans in less than three months after the earthquake.

RELIEF AND RECONSTRUCTION

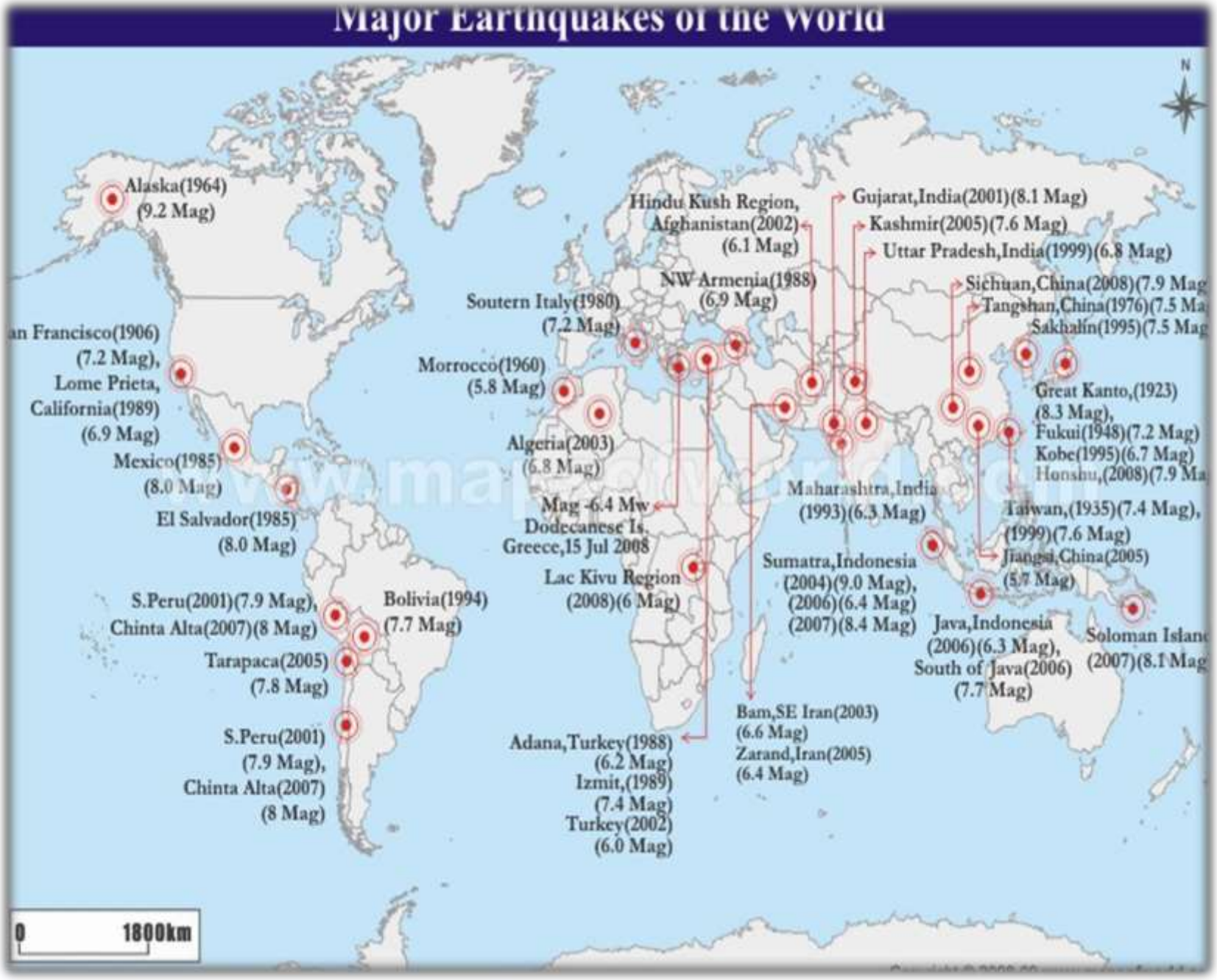
- Gujarat earthquake emergency reconstruction project (GEERP) was started by GSDMA(Gujrat State Disaster Management Authority), with financial help from world bank, Asian development bank, govt of India and other donor agencies.

- Several state government came forward to Participate in, the reconstruction work in different villages.

- The UN system, multilateral and bilateral agencies, NGOs and the corporate sector participated in the relief and reconstruction work.

Cont…

- Government of Gujarat provided assistance in the form of materials and cash to about 218,000 families.
- NGOs supplemented the efforts by providing shelter to about 7000 families.
- About 65 NGOs were active in kutch alone who adopted 211 villages and constructed 32,297 houses at the cost of Rs. 185.80 crores.
- The technical support was made available to the owners who were provided loan to reconstruct the houses.


Major Earthquakes of the World
N
Alaska(1964)
(9.2 Mag)
an Francisco(1906)
(7.2 Mag),
Lome Prieta,
California(1989)
(6.9 Mag)
Mexico(1985)
(8.0 Mag)
El Salvador(1985)
(8.0 Mag)
S.Peru(2001)(7.9 Mag),
Chinta Alta(2007)(8 Mag)
Bolivia(1994)
(7.7 Mag)
Tarapaca(2005)
(7.8 Mag)
S.Peru(2001)
(7.9 Mag),
Chinta Alta(2007)
(8 Mag)
Hindu Kush Region,
Afghanistan(2002)
(6.1 Mag)
Gujarat,India(2001)(8.1 Mag)
Kashmir(2005)(7.6 Mag)
Uttar Pradesh,India(1999)(6.8 Mag)
NW Armenia(1988)
(6.9 Mag)
Soutern Italy(1980)
(7.2 Mag)
Morrocco(1960)
(5.8 Mag)
Algeria(2003)
(6.8 Mag)
Mag -6.4 Mw
Dodecanese Is.
Greece,15 Jul 2008
Lac Kivu Region
(2008)(6 Mag)
Adana,Turkey(1988)
(6.2 Mag)
Izmit,(1989)
(7.4 Mag)
Turkey(2002)
(6.0 Mag)
Bam,SE Iran(2003)
(6.6 Mag)
Zarand,Iran(2005)
(6.4 Mag)
Sichuan,China(2008)(7.9 Mag
Tangshan,China(1976)(7.5 Ma
Sakhalin(1995)(7.5 Mag
Great Kanto,(1923)
(8.3 Mag),
Fukui(1948)(7.2 Mag)
Kobe(1995)(6.7 Mag)
Honshu,(2008)(7.9 Ma
Maharashtra,India
(1993)(6.3 Mag)
Taiwan,(1935)(7.4 Mag),
(1999)(7.6 Mag)
Jiangxi,China(2005)
(5.7 Mag)
Sumatra,Indonesia
(2004)(9.0 Mag),
(2006)(6.4 Mag)
(2007)(8.4 Mag)
Java,Indonesia
(2006)(6.3 Mag),
South of Java(2006)
(7.7 Mag)
Soloman Islan
(2007)(8.1 Mag
0
1800km

Landslides

- Main Factors that cause landslides

1. Slope
2. Precipitation
3. Vegetation
4. Soil

- Different Types of Landslides
- Bad Place to Build

Main Factors

- There are four main factors that contribute to a landslide:

1. Slope
2. Precipitation
3. Vegetation
4. Soil

Slope

- The first factor that contributes to a landslide is the slope. The slope of a landform is a major factor in determining whether a landslide is likely to occur. The steeper the slope, the larger the threat.

Precipitation

- The second factor that contributes to a landslide is precipitation. Soil is typically more mobile when it is wet. This is not always the case, but most of the time it is. A large amount of precipitation that a landform is not used to receiving can trigger a landslide.

Vegetation

- The third factor is vegetation. A slope that has little to no vegetation is typically less stable. Large trees and plates act as an anchor on a hill. They absorb some of the water and also keep the sediment from eroding down the hill.

Soil

- The fourth and final main factor is soil. There are some sediments that are typically more mobile than others. Rocks and sand do not typically cause landslides. Clay, silt, and mud are typically the sediments that are most mobile.

Different Kinds of Landslides

- Rotational Slump – very slow to moderate
- Rockslide – very slow to very rapid
- Debris Slide – very slow to very rapid
- Earth Flow – very slow to fast
- Creep – very slow
- Debris Avalanche – moderate to very fast

Bad Place to Build

- This is what happens if slopes are not examined before cities are built next to them

VOLCANIC ERUPTION

VOLCANO

A volcano is an opening, or rupture, in a planet's surface or crust, which allows hot magma, volcanic ash and gases to escape from below the surface.

Volcanoes are generally found where tectonic plates are diverging or converging. A mid-oceanic ridge, for example the Mid-Atlantic Ridge, has examples of volcanoes caused by divergent tectonic plates pulling apart; the Pacific Ring of Fire has examples of volcanoes caused by convergent tectonic plates coming together. By contrast, volcanoes are usually not created where two tectonic plates slide past one another. Volcanoes can also form where there is stretching and thinning of the Earth's crust in the interiors of plates, e.g., in the East African Rift, the Wells Gray-Clearwater volcanic field and the Rio Grande Rift in North America. This type of volcanism falls under the umbrella of "Plate hypothesis" volcanism.

ETYMOLOGY

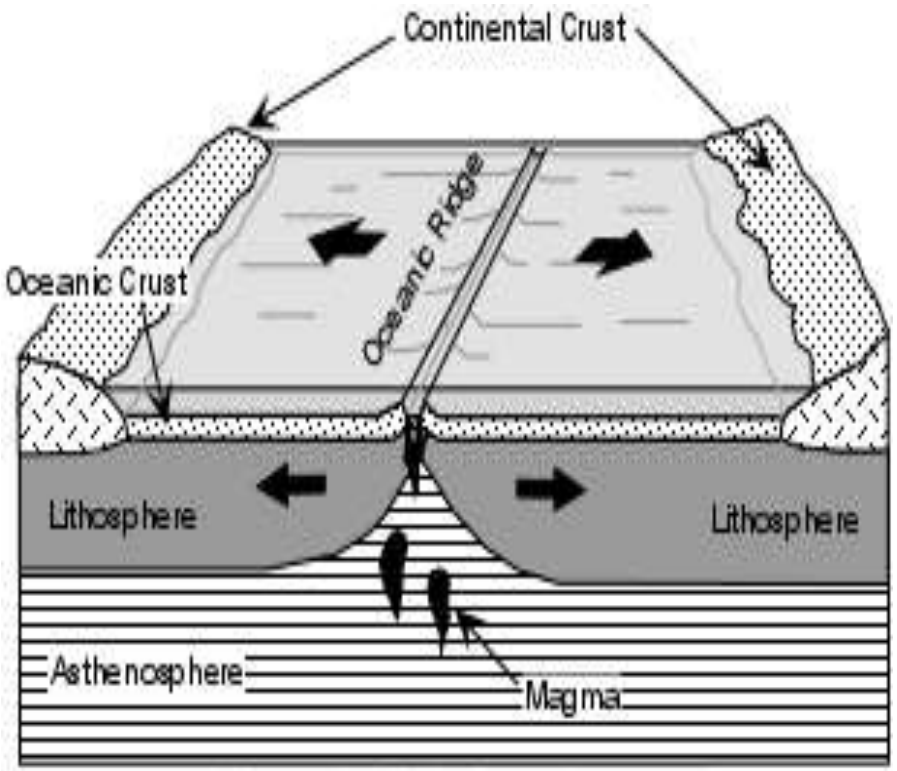
The word volcano is derived from the name of Vulcano, a volcanic island in the Aeolian Islands of Italy whose name in turn originates from Vulcan, the name of a god of fire in Roman mythology. The study of volcanoes is called volcanology, sometimes spelled vulcanology.

Volcano's, Aeolian islands. Vulcano's Island

PLATE TECTONICS

2.1 Divergent plate boundaries

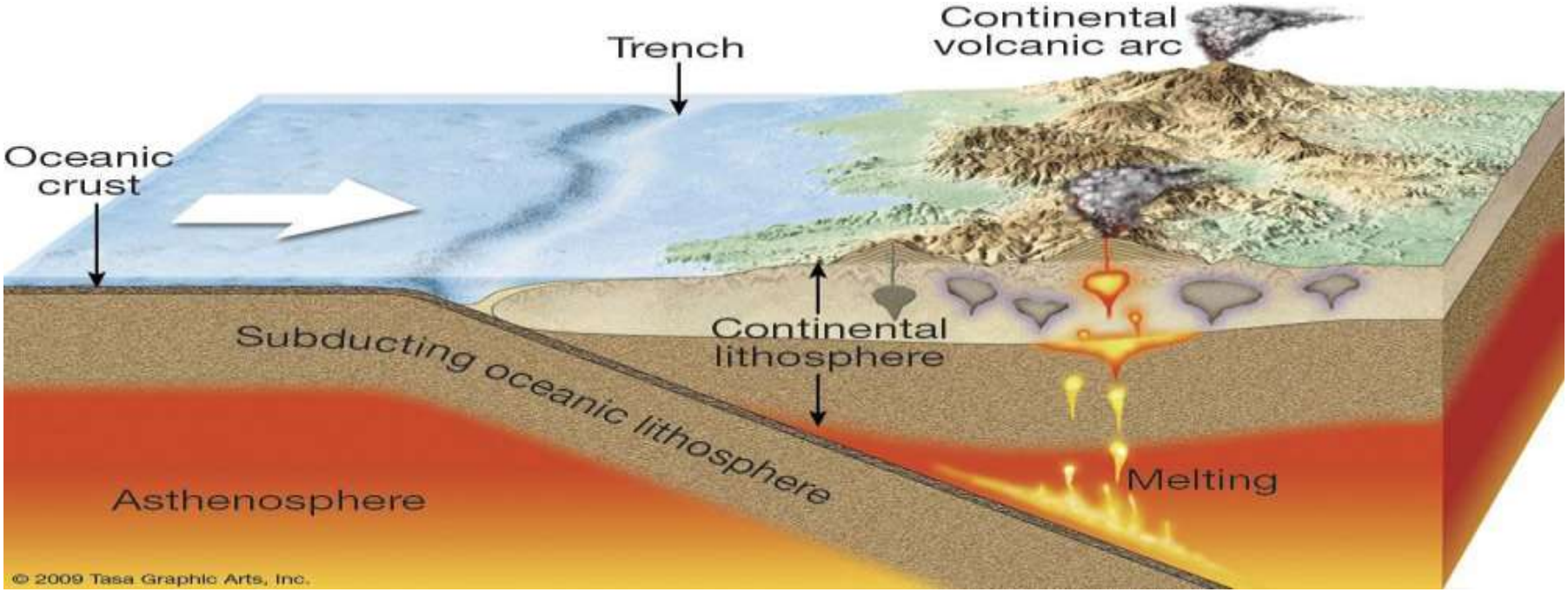
At the mid-oceanic ridges, two tectonic plates diverge from one another. New oceanic crust is being formed by hot molten rock slowly cooling and solidifying. The crust is very thin at mid- oceanic ridges due to the pull of the tectonic plates. The release of pressure due to the thinning of the crust leads to adiabatic expansion, and the partial melting of the mantle causing volcanism and creating new oceanic crust. Most divergent plate boundaries are at the bottom of the oceans, therefore most volcanic activity is submarine, forming new seafloor. Black smokers or deep sea vents are an example of this kind of volcanic activity. Where the mid-oceanic ridge is above sea-level, volcanic islands are formed, for example, Iceland.



Diverging Plate Boundary
Oceanic Ridge - Spreading Center

CONVERGENT PLATE BOUNDARIE

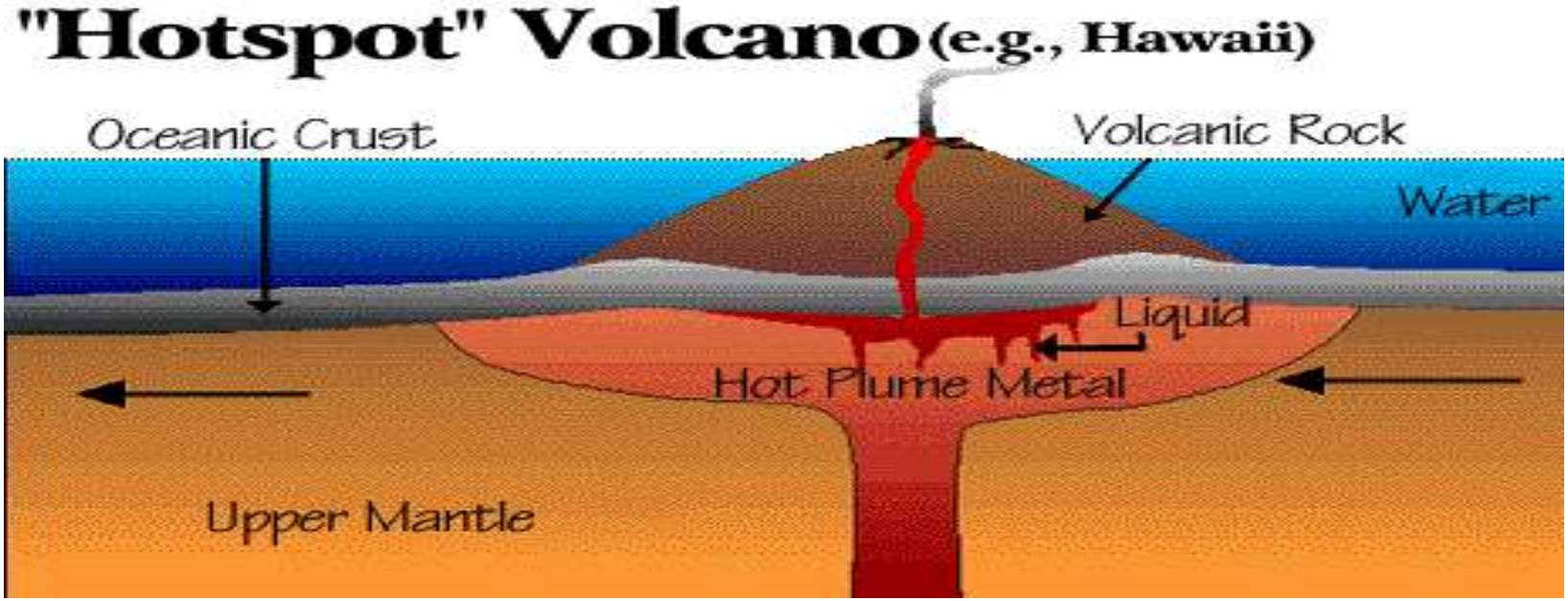
Subduction zones are places where two plates, usually an oceanic plate and a continental plate, collide. In this case, the oceanic plate subducts, or submerges under the continental plate forming a deep ocean trench just offshore. Water released from the subducting plate lowers the melting temperature of the overlying mantle wedge, creating magma. This magma tends to be very viscous due to its high silica content, so often does not reach the surface and cools at depth. When it does reach the surface, a volcano is formed. Typical examples for this kind of volcano are Mount Etna and the volcanoes in the Pacific Ring of Fire.



Convergent plate boundaries

HOTSPOTS

"Hotspots" is the name given to volcanic provinces postulated to be formed by mantle plumes. These are postulated to comprise columns of hot material that rise from the core-mantle boundary. They are suggested to be hot, causing large- volume melting, and to be fixed in space. Because the tectonic plates move across them, each volcano becomes dormant after a while and a new volcano is then formed as the plate shifts over the postulated plume. The Hawaiian Islands have been suggested to have been formed in such a manner, as well as the Snake River Plain, with the Yellowstone Caldera being the part of the North American plate currently above the hot spot. This theory is currently under criticism, however.



VOLCANIC FEATURES

The most common perception of a volcano is of a conical mountain, spewing lava and poisonous gases from a crater at its summit. This describes just one of many types of volcano, and the features of volcanoes are much more complicated. The structure and behavior of volcanoes depends on a number of factors. Some volcanoes have rugged peaks formed by lava domes rather than a summit crater, whereas others present landscape features such as massive plateaus. Vents that issue volcanic material (lava, which is what magma is called once it has escaped to the surface, and ash) and gases (mainly steam and magmatic gases) can be located anywhere on the landform. Many of these vents give rise to smaller cones such as Pu‘u ‘O‘o on a flank of Hawaii's Kilauea.

Other types of volcano include cry volcanoes (or ice volcanoes), particularly on some moons of Jupiter, Saturn and Neptune; and mud volcanoes, which are formations often not associated with known magmatic activity. Active mud volcanoes tend to involve temperatures much lower than those of igneous volcanoes, except when a mud volcano is actually a vent of an igneous volcano.

FISSURE VENTS

Volcanic fissure vents are flat, linear cracks through which lava emerges.

A fissure vent opened on Hawaii's Kilauea volcano.

SHIELD VOLCANOES

Shield volcanoes, so named for their broad, shield-like profiles, are formed by the eruption of low-viscosity lava that can flow a great distance from a vent, but not generally explode catastrophically. Since low-viscosity magma is typically low in silica, shield volcanoes are more common in oceanic than continental settings.

The Hawaiian volcanic chain is a series of shield cones, and they are common in Iceland, as well.

Skjaldbreiður, a shield volcano whose name means "Ōroad shield”

LAVA DOMES

Lava domes are built by slow eruptions of highly viscous lavas. They are sometimes formed within the crater of a previous volcanic eruption (as in Mount Saint Helens), but can also form independently, as in the case of Lassen Peak. Like Stratovolcanoes, they can produce violent, explosive eruptions, but their lavas generally do not flow far from the originating vent.

January 2009 ,the rhyolitic lava dome of Chaitén Volcano, southern Chile during its 2008–2009 eruption

CRYPTODOMES

Cryptodomes are formed when viscous lava forces its way up and causes a bulge. The 1980 eruption of Mount St. Helens was an example. Lava was under great pressure and forced a bulge in the mountain, which was unstable and slid down the north side.

sample of the dacite Cryptodomes from the 1980 eruption

VOLCANIC CONES (CINDER CONES)

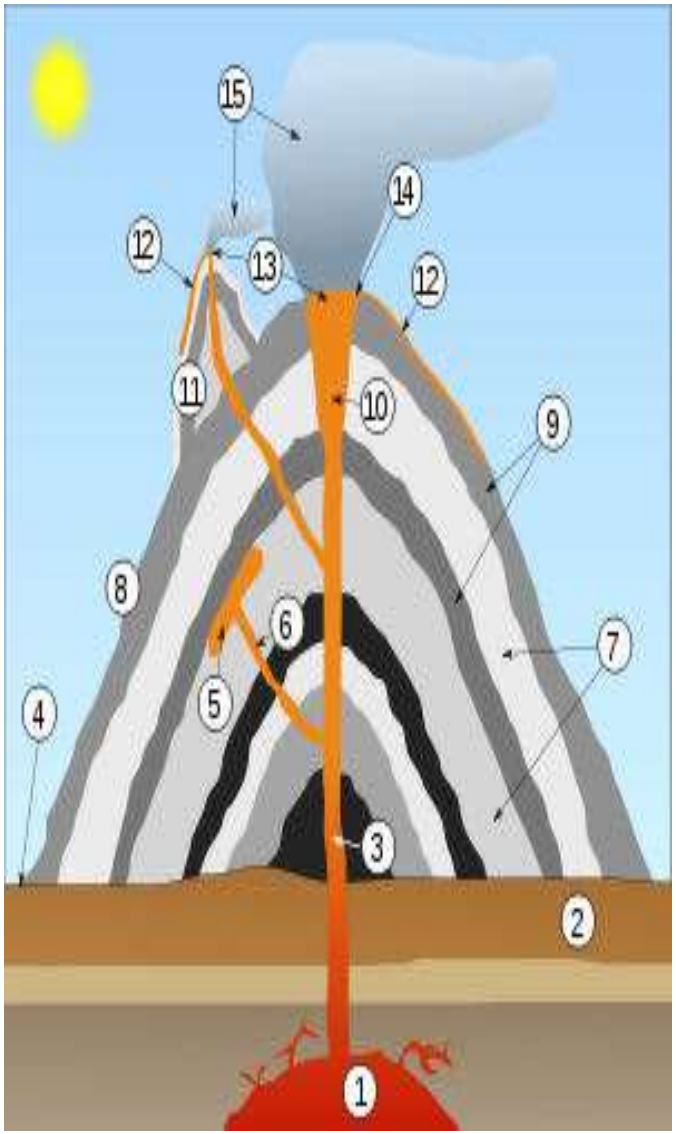
Volcanic cones or cinder cones are the result from eruptions that erupt mostly small pieces of scoria and pyroclastics (both resemble cinders, hence the name of this volcano type) that build up around the vent. These can be relatively short-lived eruptions that produce a cone-shaped hill perhaps 30 to 400 meters high. Most cinder cones erupt only once. Cinder cones may form as flank vents on larger volcanoes, or occur on their own. Parícutin in Mexico and Sunset Crater in Arizona are examples of cinder cones. In New Mexico, Caja del Rio is a volcanic field of over 60 cinder cones.

Holocene cinder cone volcano on State Highway 18 near Veyo, Utah

STRATOVOLCANOES (COMPOSITE VOLCANOES)

Stratovolcanoes or composite volcanoes are tall conical mountains composed of lava flows and other ejecta in alternate layers, the strata that give rise to the name. Stratovolcanoes are also known as composite volcanoes, created from several structures during different kinds of eruptions. Strato/composite volcanoes are made of cinders, ash and lava. Cinders and ash pile on top of each other, lava flows on top of the ash, where it cools and hardens, and then the process begins again. Classic examples include Mt. Fuji in Japan, Mayon Volcano in the Philippines, and Mount Vesuvius and Stromboli in Italy.

In recorded history, explosive eruptions by Stratovolcanoes have posed the greatest hazard to civilizations, as ash is produced by an explosive eruption. No supervolcano erupted in recorded history. Shield volcanoes have not an enormous pressure build up from the lava flow. Fissure vents and monogenetic volcanic fields (volcanic cones) have not powerful explosive eruptions, as they are many times under extension. Stratovolcanoes (30–35°) are steeper than shield volcanoes (generally 5–10°), their loose tephra are material for dangerous lahars



Cross-section through a Stratovolcanoes (vertical scale is exaggerated):

1. Large magma chamber
2. Bedrock
3. Conduit (pipe)
4. Base
5. Sill
6. Dike
7. Layers of ash emitted by the volcano
8. Flank
9. Layers of lava emitted by the volcano
10. Throat
11. Parasitic cone
12. Lava flow
13. Vent
14. Crater
15. Ash cloud

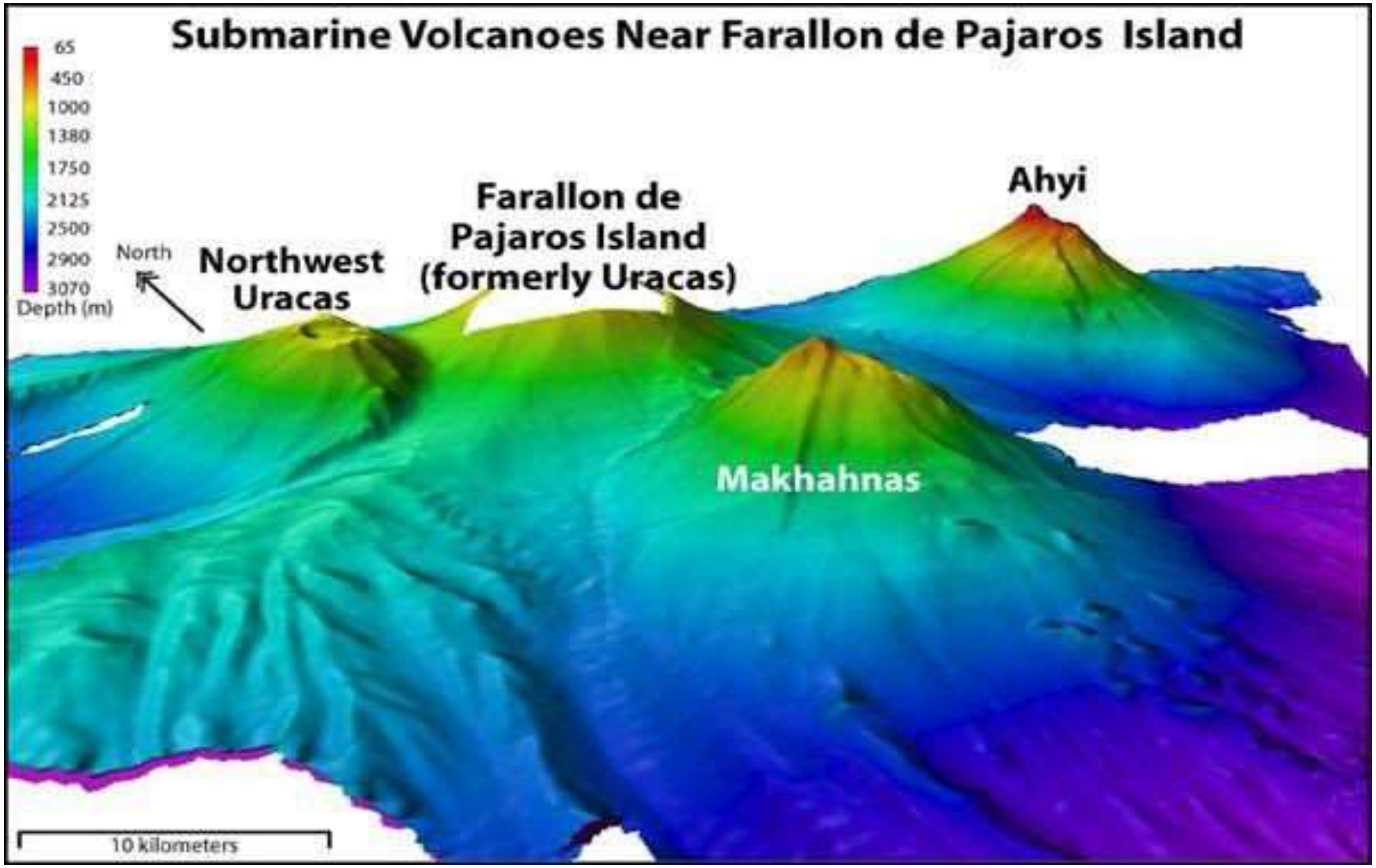
SUPER VOLCANO

A super volcano is a large volcano that usually has a large caldera and can potentially produce devastation on an enormous, sometimes continental, scale. Such eruptions would be able to cause severe cooling of global temperatures for many years afterwards because of the huge volumes of sulfur and ash erupted. They are the most dangerous type of volcano. Examples include Yellowstone Caldera in Yellowstone National Park and Valles Caldera in New Mexico (both western United States), Lake Taupo in New Zealand, Lake Toba in Sumatra, Indonesia and Ngorogoro Crater in Tanzania, Krakatoa near Java and Sumatra, Indonesia. Supervolcanoes are hard to identify centuries later, given the enormous areas they cover. Large igneous provinces are also considered supervolcanoes because of the vast amount of basalt lava erupted, but are non-explosive.

super volcano

SUBMARINE VOLCANOES

Submarine volcanoes are common features on the ocean floor. Some are active and, in shallow water, disclose their presence by blasting steam and rocky debris high above the surface of the sea. Many others lie at such great depths that the tremendous weight of the water above them prevents the explosive release of steam and gases, although they can be detected by hydrophones and discoloration of water because of volcanic gases. Pumice rafts may also appear. Even large submarine eruptions may not disturb the ocean surface. Because of the rapid cooling effect of water as compared to air, and increased buoyancy, submarine volcanoes often form rather steep pillars over their volcanic vents as compared to above-surface volcanoes. They may become so large that they break the ocean surface as new islands. Pillow lava is a common eruptive product of submarine volcanoes. Hydrothermal vents are common near these volcanoes, and some support peculiar ecosystems based on dissolved minerals.



Bathymetry data of three submarine volcanoes in the Farallon de pajaros islands

SUBGLACIAL VOLCANOES

Subglacial volcanoes develop underneath icecaps. They are made up of flat lava which flows at the top of extensive pillow lavas and palagonite. When the icecap melts, the lavas on the top collapse, leaving a flat-topped mountain. These volcanoes are also called table mountains, tuyas or (uncommonly) mobergs.

Very good examples of this type of volcano can be seen in Iceland, however, there are also tuyas in British Columbia. The origin of the term comes from Tuya Butte, which is one of the several tuyas in the area of the Tuya River and Tuya Range in northern British Columbia.

Tuya Butte was the first such landform analyzed and so its name has entered the geological literature for this kind of volcanic formation. The Tuya Mountains Provincial Park was recently established to protect this unusual landscape, which lies north of Tuya Lake and south of the Jennings River near the boundary with the Yukon Territory.

Grimsvotn volcano, Vatnajokull Ice Cap, Iceland

MUD VOLCANOES

Mud volcanoes or mud domes are formations created by geo-excreted liquids and gases, although there are several processes which may cause such activity. The largest structures are 10 kilometers in diameter and reach 700 meters high.

Mud volcano on Taman Peninsula, Russia

ERUPTED MATERIAL

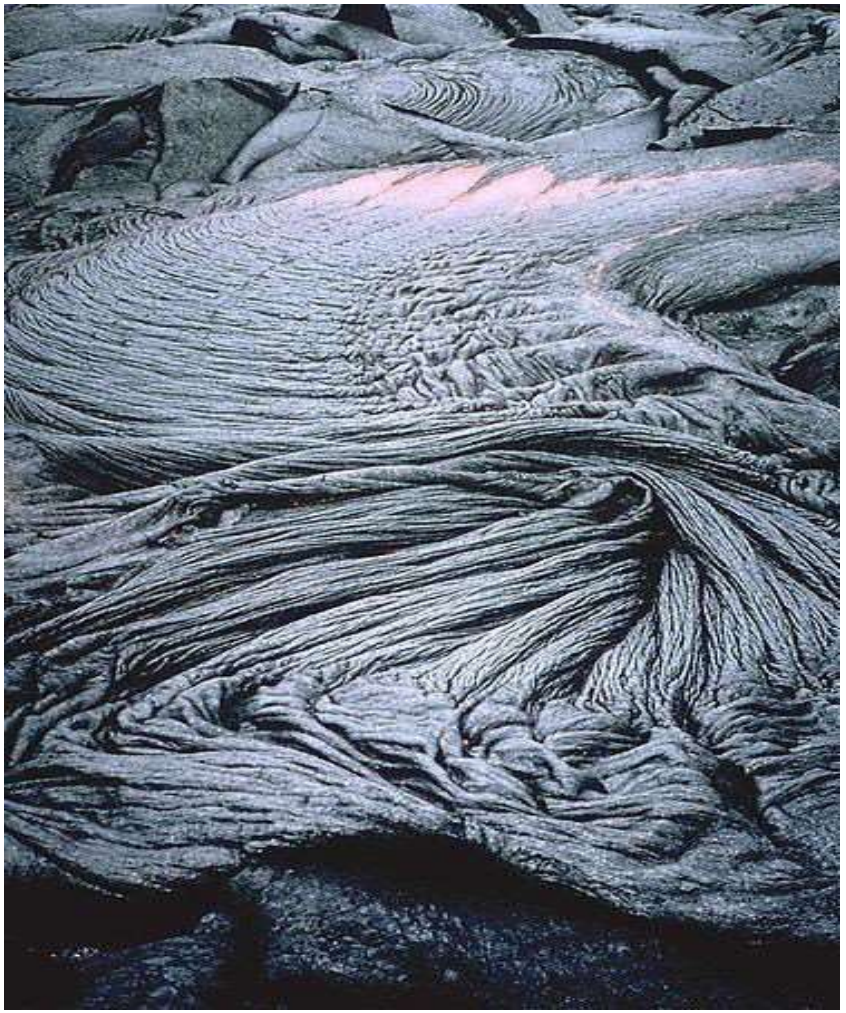
4.1 Lava composition

Another way of classifying volcanoes is by the composition of material erupted (lava), since this affects the shape of the volcano. Lava can be broadly classified into 4 different compositions (Cas & Wright, 1987):

If the erupted magma contains a high percentage (>63%) of silica, the lava is called felsic

Felsic lavas (dacites or rhyolites) tend to be highly viscous (not very fluid) and are erupted as domes or short, stubby flows.

Viscous lavas tend to form Stratovolcanoes or lava domes. Lassen Peak in California is an example of a volcano formed from felsic lava and is actually a large lava dome.



Pāhoehoe lava from Kīlauea, Hawaii

Because siliceous magmas are so viscous, they tend to trap volatiles (gases) that are present, which cause the magma to erupt catastrophically, eventually forming Stratovolcanoes. Pyroclastics flows (ignimbrites) are highly hazardous products of such volcanoes, since they are composed of molten volcanic ash too heavy to go up into the atmosphere, so they hug the volcano's slopes and travel far from their vents during large eruptions. Temperatures as high as 1,200 °C are known to occur in pyroclastics flows, which will incinerate everything flammable in their path and thick layers of hot pyroclastics flow deposits can be laid down, often up to many meters thick. Alaska's Valley of Ten Thousand Smokes, formed by the eruption of Novarupta near Katmai in 1912, is an example of a thick pyroclastics flow or ignimbrite deposit. Volcanic ash that is light enough to be erupted high into the Earth's atmosphere may travel many kilometers before it falls back to ground as a tuff.

If the erupted magma contains 52–63% silica, the lava is of intermediate composition. These "andesitic" volcanoes generally only occur above subduction zones (e.g. Mount Merapi in Indonesia).

Andesitic lava is typically formed at convergent boundary margins of tectonic plates, by several processes: Hydration melting of peridotite and fractional crystallization Melting of subducted slab containing sediments Magma mixing between felsic rhyolitic and mafic basaltic magmas in an intermediate reservoir prior to emplacement or lava flow.

If the erupted magma contains <52% and >45% silica, the lava is called mafic (because it contains higher percentages of magnesium (Mg) and iron (Fe)) or basaltic. These lavas are usually much less viscous than rhyolitic lavas, depending on their eruption temperature; they also tend to be hotter than felsic lavas. Mafic lavas occur in a wide range of settings:

At mid-ocean ridges, where two oceanic plates are pulling apart, basaltic lava rupts as pillows to fill the gap;

Shield volcanoes (e.g. the Hawaiian Islands, including Mauna Loa and Kilauea), on both oceanic and continental crust; As continental flood basalts.

Some erupted magmas contain <=45% silica and produce ultramafic lava. Ultramafic flows, also known as komatiites, are very rare; indeed, very few have been erupted at the Earth's surface since the Proterozoic, when the planet's heat flow was higher. They are (or were) the hottest lavas, and probably more fluid than common mafic lavas.

LAVA TEXTURE

Two types of lava are named according to the surface texture: ʻAʻa (pronounced and Pāhoehoe ([paːˈhoˌeˈhoˌe]), both Hawaiian words. ʻAʻa is ōharaōterized Ōy a rough, clinkery surface and is the typical texture of viscous lava flows.

However, even basaltic or mafic flows ōan Ōe erupted as ʻAʻa flows, particularly if the eruption rate is high and the slope is steep.

Pāhoehoe is ōharaōterized Ōy its smooth and often ropey or wrinkly surface and is generally formed from more fluid lava flows. Usually, only mafiō flows will erupt as Pāhoehoe, since they often erupt at higher temperatures or have the proper chemical make-up to allow them to flow with greater fluidity.

Lava texture

VOLCANIC ACTIVITY

5.1 Popular Classification of Volcanoes

5.1.1 Active

A popular way of classifying magmatic volcanoes is by their frequency of eruption, with those that erupt regularly called active, those that have erupted in historical times but are now quiet called dormant, and those that have not erupted in historical times called extinct. However, these popular classifications—extinct in particular—are practically meaningless to scientists. They use classifications which refer to a particular volcano's formative and eruptive processes and resulting shapes, which was explained above.

There is no real consensus among volcanologists on how to define an "active" volcano. The lifespan of a volcano can vary from months to several million years, making such a distinction sometimes meaningless when compared to the lifespans of humans or even civilizations. For example, many of Earth's volcanoes have erupted dozens of times in the past few thousand years but are not currently showing signs of eruption. Given the long lifespan of such volcanoes, they are very active. By human lifespans, however, they are not

Scientists usually consider a volcano to be erupting or likely to erupt if it is currently erupting, or showing signs of unrest such as unusual earthquake activity or significant new gas emissions. Most scientists consider a volcano active if it has erupted in Holocene times. Historic times is another timeframe for active. But it is important to note that the span of recorded history differs from region to region. In China and the Mediterranean, recorded history reaches back more than 3,000 years but in the Pacific Northwest of the United States and Canada, it reaches back less than 300 years, and in Hawaii and New Zealand, only around 200 years. The Smithsonian Global Volcanism Program's definition of active is having erupted within the last 10,000 years (the 'holocene' period).

Presently there are about 500 active volcanoes in the world – the majority following along the Pacific 'Ring of Fire' – and around 50 of these erupt each year. The United States is home to 50 active volcanoes. There are more than 1,500 potentially active volcanoes. An estimated 500 million people live near active volcanoes.

May 1980

Mount St. Helens the eruption of 18

Damavand

fumaroles

solfatara

Extinct

Extinct volcanoes are those that scientists consider unlikely to erupt again, because the volcano no longer has a lava supply. Examples of extinct volcanoes are many volcanoes on the Hawaiian – Emperor seamount chain in the Pacific Ocean, Hohentwiel, Shiprock and the Zuidwal volcano in the Netherlands. Edinburgh Castle in Scotland is famously located atop an extinct volcano. Otherwise, whether a volcano is truly extinct is often difficult to determine. Since "supervolcano" calderas can have eruptive lifespans sometimes measured in millions of years, a caldera that has not produced an eruption in tens of thousands of years is likely to be considered dormant instead of extinct.

Fourpeaked volcano, Alaska, in September 2007, after being thought extinct for
over 10,000 years

Dormant

It is difficult to distinguish an extinct volcano from a dormant one. Volcanoes are often considered to be extinct if there are no written records of its activity. Nevertheless, volcanoes may remain dormant for a long period of time. For example, Yellowstone has a repose/recharge period of around 700 ka, and Toba of around 380 ka.[10] Vesuvius was described by Roman writers as having been covered with gardens and vineyards before its famous eruption of AD 79, which destroyed the towns of Herculaneum and Pompeii. Before its catastrophic eruption of 1991, Pinatubo was an inconspicuous volcano, unknown to most people in the surrounding areas. Two other examples are the long-dormant Soufriere Hills volcano on the island of Montserrat, thought to be extinct before activity resumed in 1995 and Fourpeaked Mountain in Alaska, which, before its September 2006 eruption, had not erupted since before 8000 BC and had long been thought to be extinct.

Technical classification of volcanoes

5.2.1 Volcanic-alert level

The three common popular classifications of volcanoes can be subjective and some volcanoes thought to have been extinct have announced to the world they were just pretending. To help prevent citizens from falsely believing they are not at risk when living on or near a volcano, countries have adopted new classifications to describe the various levels and stages of volcanic activity.Some alert systems use different numbers or colors to designate the different stages. Other systems use colors and words. Some systems use a combination of both.

5.2.2 Volcano warning schemes of the United States

The United States Geological Survey (USGS) has adopted a common system nationwide for characterizing the level of unrest and eruptive activity at volcanoes. The new volcano alert-level system classifies volcanoes now as being in a normal, advisory, watch or warning stage. Additionally, colors are used to denote the amount of ash produced. Details of the US system can be found at Volcano warning schemes of the United States.

Notable Volcanoes

The 16 current Decade Volcanoes are:

- Avachinsky- Koryaksky, Kamchatka, Russia
- Nevado de Colima, Jalisco and Colima, Mexico
- Mount Etna, Sicily, Italy
- Galeras, Nariño, Colombia
- Mauna Loa, Hawaii, USA
- Mount Merapi, Central Java, Indonesia
- Mount Nyiragongo, Democratic Republic of the Congo
- Mount Rainier, Washington, USA
- Sakurajima, Kagoshima Prefecture, Japan
- Santa Maria/Santiaguito, Guatemala
- Santorini, Cyclades, Greece
- Taal Volcano, Luzon, Philippines
- Teide, Canary Islands, Spain
- Ulawun, New Britain, Papua New Guinea
- Mount Unzen, Nagasaki Prefecture, Japan
- Vesuvius, Naples, Italy

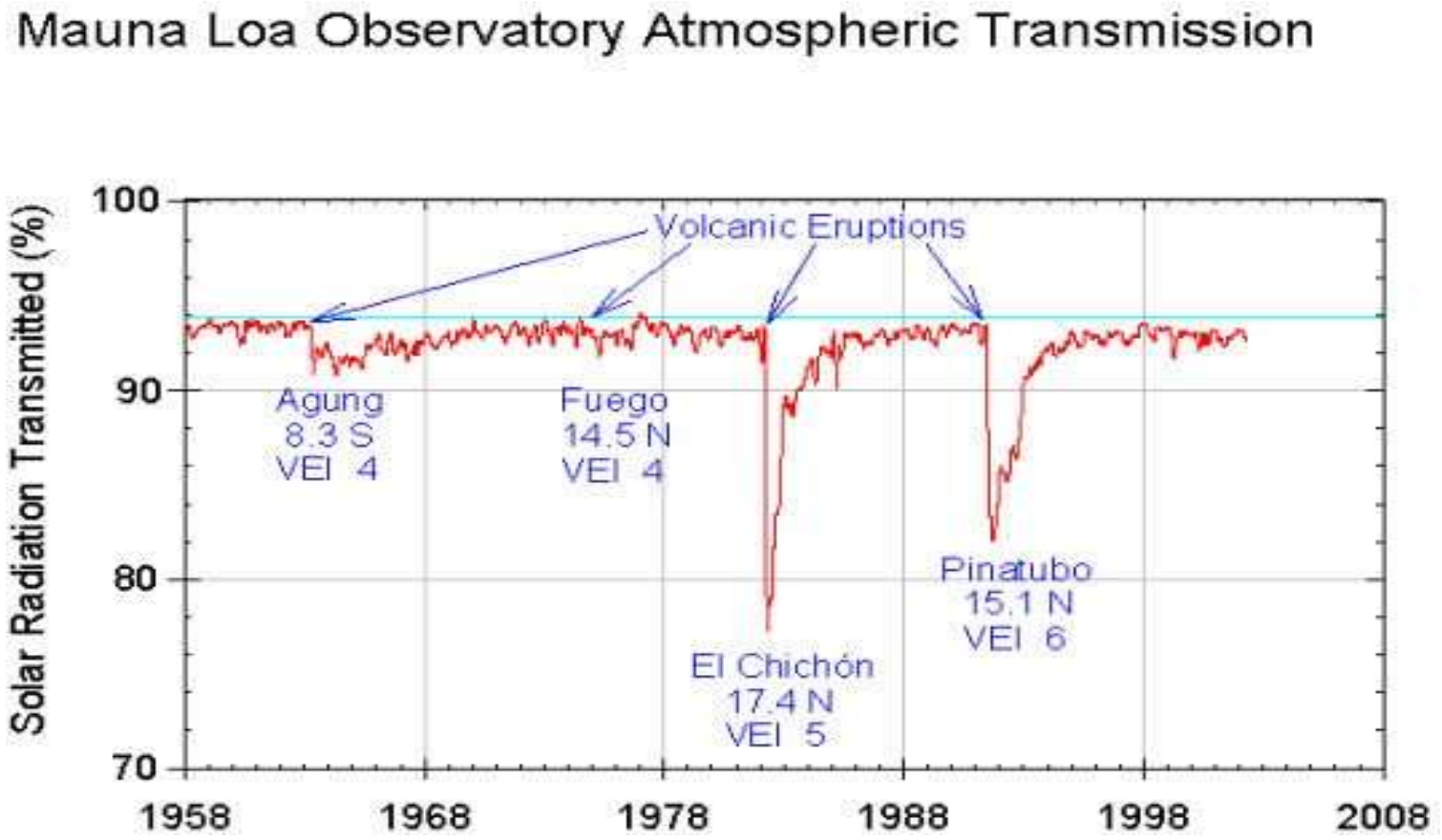
Effects of Volcanoes

There are many different types of volcanic eruptions and associated activity: phreatic eruptions (steam-generated eruptions), explosive eruption of high-silica lava (e.g., rhyolite), effusive eruption of low-silica lava (e.g., basalt), pyroclastics flows, lahars (debris flow) and carbon dioxide emission. All of these activities can pose a hazard to humans. Earthquakes, hot springs, fumaroles, mud pots and geysers often accompany volcanic activity.

The concentrations of different volcanic gases can vary considerably from one volcano to the next. Water vapor is typically the most abundant volcanic gas, followed by carbon dioxide and sulfur dioxide. Other principal volcanic gases include hydrogen sulfide, hydrogen chloride, and hydrogen fluoride. A large number of minor and trace gases are also found in volcanic emissions, for example hydrogen, carbon monoxide, halocarbons, organic compounds, and volatile metal chlorides.

Large, explosive volcanic eruptions inject water vapor (H_2O), carbon dioxide (CO_2), sulfur dioxide (SO_2), hydrogen chloride (HCl), hydrogen fluoride (HF) and ash (pulverized rock and pumice) into the stratosphere to heights of 16–32 kilometers (10– 20 mi) above the Earth's surface. The most significant impacts from these injections come from the conversion of sulfur dioxide to sulfuric acid (H_2SO_4), which condenses rapidly in the stratosphere to form fine sulfate aerosols. The aerosols increase the Earth's albedo—its reflection of radiation from the Sun back into space – and thus cool the Earth's lower atmosphere or troposphere; however, they also absorb heat radiated up from the Earth, thereby warming the stratosphere. Several eruptions during the past century have caused a decline in the average temperature at the Earth's surface of up to half a degree (Fahrenheit scale) for periods of one to three years — sulfur dioxide from the eruption of Huaynaputina probably caused the Russian famine of 1601 - 1603.

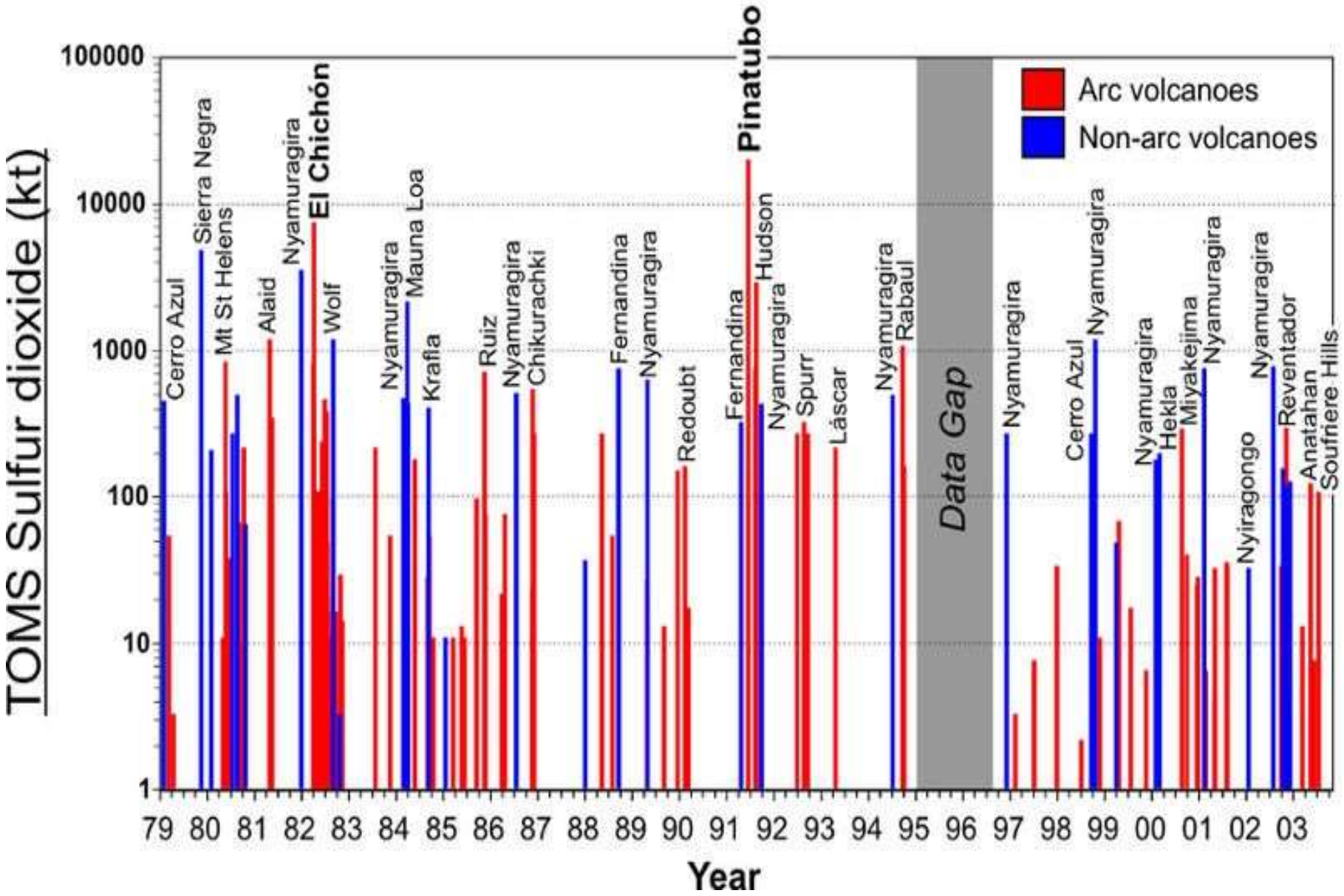
One proposed volcanic winter happened c. 70,000 years ago following the supereruption of Lake Toba on Sumatra island in Indonesia. According to the Toba catastrophe theory to which some anthropologists and archeologists subscribe, it had global consequences, killing most humans then alive and creating a population bottleneck that affected the genetic inheritance of all humans today. The 1815 eruption of Mount Tambora created global climate anomalies that became known as the "Year Without a Summer" because of the effect on North American and European weather. Agricultural crops failed and livestock died in much of the Northern Hemisphere, resulting in one of the worst famines of the 19th century.The freezing winter of 1740–41, which led to widespread famine in northern Europe, may also owe its origins to a volcanic eruption.



Solar radiation reduction from volcanic eruptions

It has been suggested that volcanic activity caused or contributed to the End-Ordovician, Permian-Triassic, Late Devonian mass extinctions, and possibly others. The massive eruptive event which formed the Siberian Traps, one of the largest known volcanic events of the last 500 million years of Earth's geological history, continued for a million years and is considered to be the likely cause of the "Great Dying" about 250 million years ago, which is estimated to have killed 90% of species existing at the time.

The sulfate aerosols also promote complex chemical reactions on their surfaces that alter chlorine and nitrogen chemical species in the stratosphere. This effect, together with increased stratospheric chlorine levels from chlorofluorocarbon pollution, generates chlorine monoxide (ClO), which destroys ozone (O_3). As the aerosols grow and coagulate, they settle down into the upper troposphere where they serve as nuclei for cirrus clouds and further modify the Earth's radiation balance. Most of the hydrogen chloride (HCl) and hydrogen fluoride (HF) are dissolved in water droplets in the eruption cloud and quickly fall to the ground as acid rain. The injected ash also falls rapidly from the stratosphere; most of it is removed within several days to a few weeks. Finally, explosive volcanic eruptions release the greenhouse gas carbon dioxide and thus provide a deep source of carbon for biogeochemical cycles.



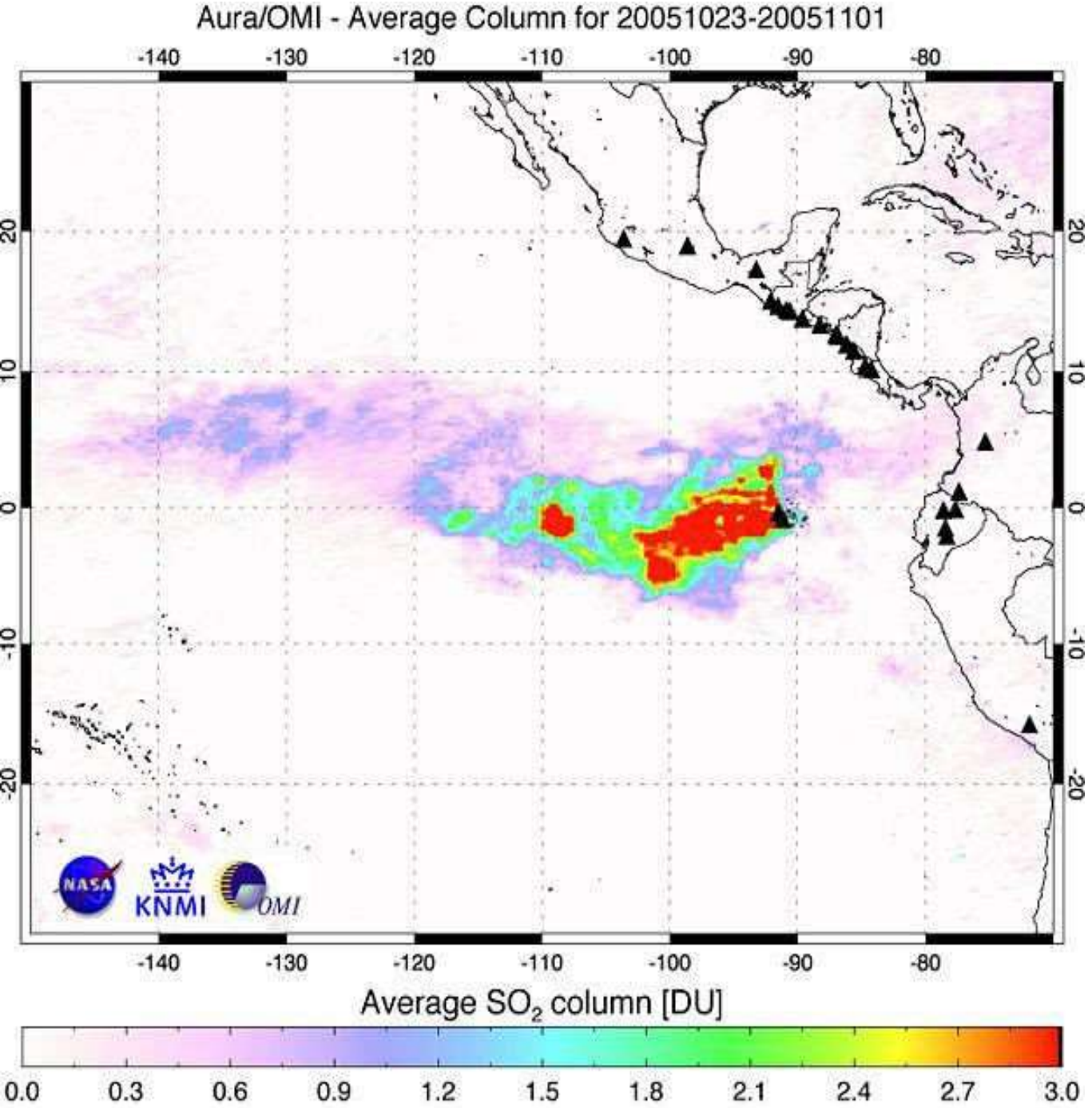
Sulfur dioxide emissions by volcanoes

Rainbow and volcanic ash with sulfur dioxide emissions from Halema`uma`u ven

Gas emissions from volcanoes are a natural contributor to acid rain. Volcanic activity releases about 130 to 230 teragrams (145 million to 255 million short tons) of carbon dioxide each year. Volcanic eruptions may inject aerosols into the Earth's atmosphere. Large injections may cause visual effects such as unusually colorful sunsets and affect global climate mainly by cooling it. Volcanic eruptions also provide the benefit of adding nutrients to soil through the weathering process of volcanic rocks. These fertile soils assist the growth of plants and various crops. Volcanic eruptions can also create new islands, as the magma cools and solidifies upon contact with the water.

Ash thrown into the air by eruptions can present a hazard to aircraft, especially jet aircraft where the particles can be melted by the high operating temperature.

Dangerous encounters in 1982 after the eruption of Galunggung in Indonesia, and 1989 after the eruption of Mount Redoubt in Alaska raised awareness of this phenomenon. Nine Volcanic Ash Advisory Centers were established by the International Civil Aviation Organization to monitor ash clouds and advise pilots accordingly. The 2010 eruptions of Eyjafjallajökull caused major disruptions to air travel in Europe.



Average concentration of sulfur dioxide over the Sierra Negra Volcano (Galapagos Islands) from October 23 – November 1, 2005

There are several extinct volcanoes on Mars, four of which are vast shield volcanoes far bigger than any on Earth. They include Arsia Mons, Ascraeus Mons, Hecates Tholus, Olympus Mons, and Pavonis Mons. These volcanoes have been extinct for many millions of years, but the European Mars Express spacecraft has found evidence that volcanic activity may have occurred on Mars in the recent past as well.

Jupiter's moon Io is the most volcanically active object in the solar system because of tidal interaction with Jupiter. It is covered with volcanoes that erupt sulfur, sulfur dioxide and silicate rock, and as a result, Io is constantly being resurfaced. Its lavas are the hottest known anywhere in the solar system, with temperatures exceeding 1,800 K (1,500 °C). In February 2001, the largest recorded volcanic eruptions in the solar system occurred on Io. Europa, the smallest of Jupiter's Galilean moons, also appears to have an active volcanic system, except that its volcanic activity is entirely in the form of water, which freezes into ice on the frigid surface. This process is known as cry volcanism, and is apparently most common on the moons of the outer planets of the solar system.

In 1989 the Voyager 2 spacecraft observed cry volcanoes (ice volcanoes) on Triton, a moon of Neptune, and in 2005 the Cassini-Huygens probe photographed fountains of frozen particles erupting from Enceladus, a moon of Saturn.[27] The ejecta may be composed of water, liquid nitrogen, dust, or methane compounds.

Cassini-Huygens also found evidence of a methane-spewing cry volcano on the Saturnine moon Titan, which is believed to be a significant source of the methane found in its atmosphere. It is theorized that cry volcanism may also be present on the Kuiper Belt Object Quaoar.

A 2010 study of the exoplanet COROT-7b, which was detected by transit in 2009, studied that tidal heating from the host star very close to the planet and neighboring planets could generate intense volcanic activity similar to Io.

The Tvashtar volcano erupts a plume 330 km (205 mi) above the surface of Jupiter's moon Io

Traditional beliefs about Volcanoes

Many ancient accounts ascribe volcanic eruptions to supernatural causes, such as the actions of gods or demigods. To the ancient Greeks, volcanoes' capricious power could only be explained as acts of the gods, while 16th/17th-century German astronomer Johannes Kepler believed they were ducts for the Earth's tears. One early idea counter to this was proposed by Jesuit Athanasius Kircher (1602–1680), who witnessed eruptions of Mount Etna and Stromboli, then visited the crater of Vesuvius and published his view of an Earth with a central fire connected to numerous others caused by the burning of sulfur, bitumen and coal.

Various explanations were proposed for volcano behavior before the modern understanding of the Earth's mantle structure as a semisolid material was developed. For decades after awareness that compression and radioactive materials may be heat sources, their contributions were specifically discounted. Volcanic action was often attributed to chemical reactions and a thin layer of molten rock near the surface

UNIT-4

Exogenous Hazards

Risk Assessment

- Hazard Identification
- Dose-Response Assessment
- Exposure Assessment
- Risk Characterization
  - Modeling
  - Probability

Major Types of Hazards

- Cultural Hazards
- Chemical Hazards
- Physical Hazards
- Biological Hazards

Chemical Hazards

- Hazardous Chemicals
- Mutagens
- Teratogens
- Carcinogens
- Endocrine disruptors

Hazardous Chemicals

- Flammable or explosive
- Irritant
- Asphixiant
- allergen

Common Chemical Agents with Adverse Health Affects

- Arsenic
- Asbestos
- Benzene
- Chlorine
- Formaldehyde
- Lead
- Mercury
- Dioxins

Biological Agents

- Pathogenicity
- Route of transmission
- Agent stability
- Infectious dose
- Concentration
- Origin
- Data from animal studies
- Prophylaxis

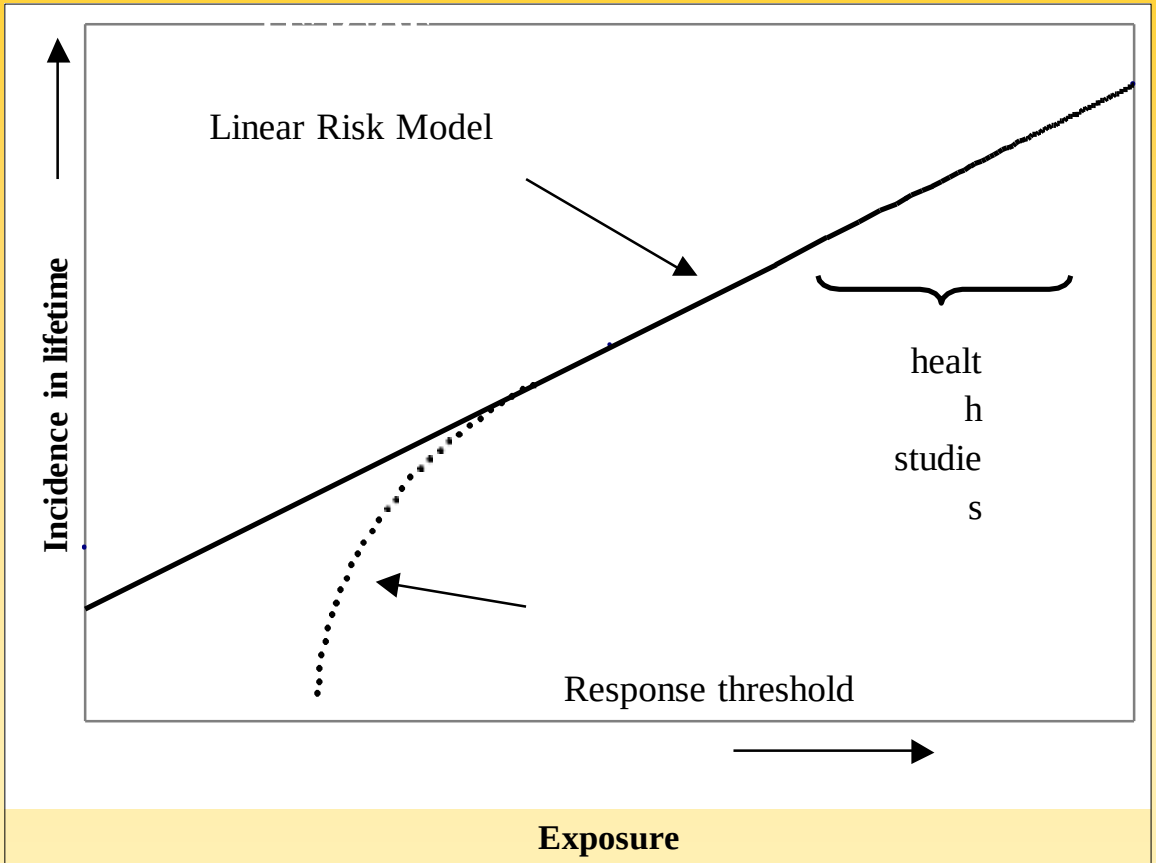
Common Human Diseases

- TB
- Dengue Fever
- Malaria
- Yellow Fever
- Cholera
- Trypanosomiasis
- Cryptosporidosis
- Anthrax
- Encephalitis
- Lassa Fever
- Leprosy
- Giardiasis
- Salmonella
- Plague
- Encephalitis
- Ebola
- Influenza
- Hepatitis

Toxicity: Determining if a chemical is harmful

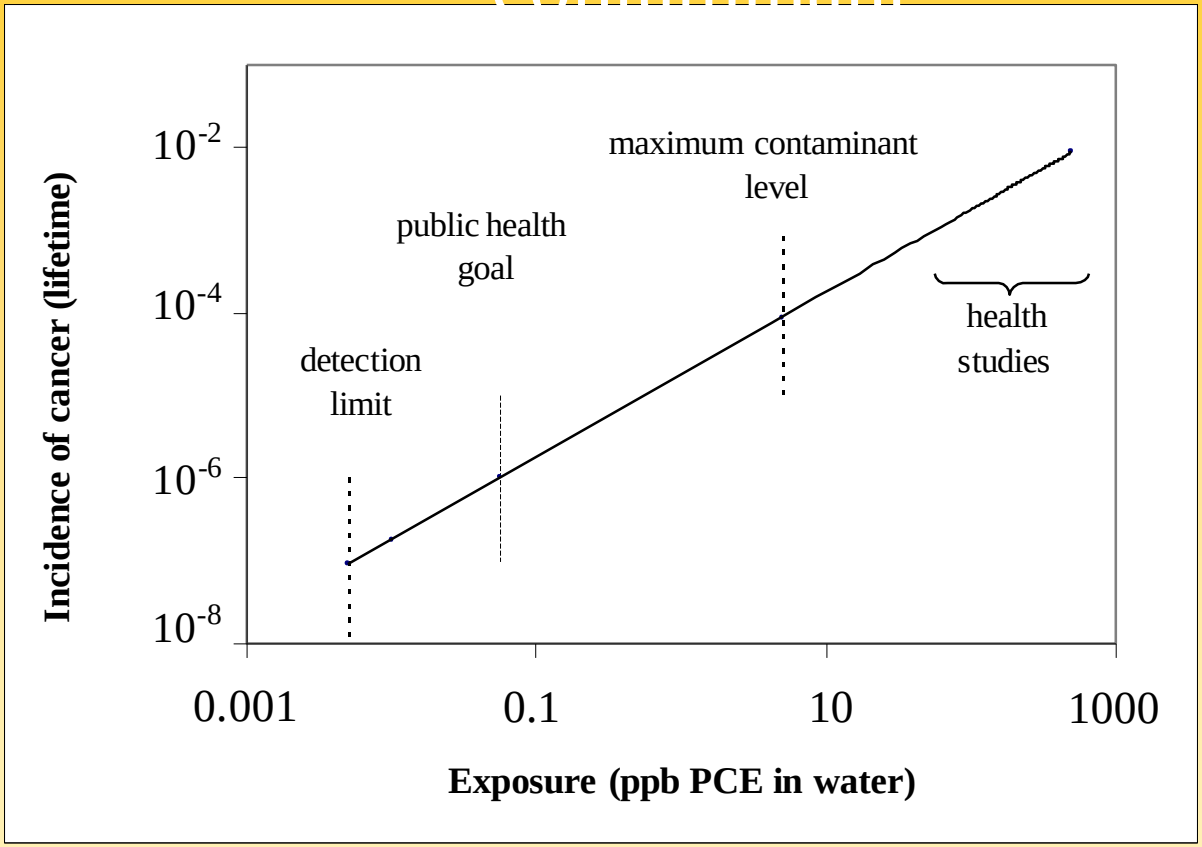
- Size of dose over time
- How often exposure occurs
  - Acute vs. chronic
- Age of person exposed
  - Adult, very old, child, infant
- State of health
  - Immune compromised
  - Body fat
- How well body detoxifies
  - Lungs, liver, kidnies

When does a contaminant become just a harmless environmental

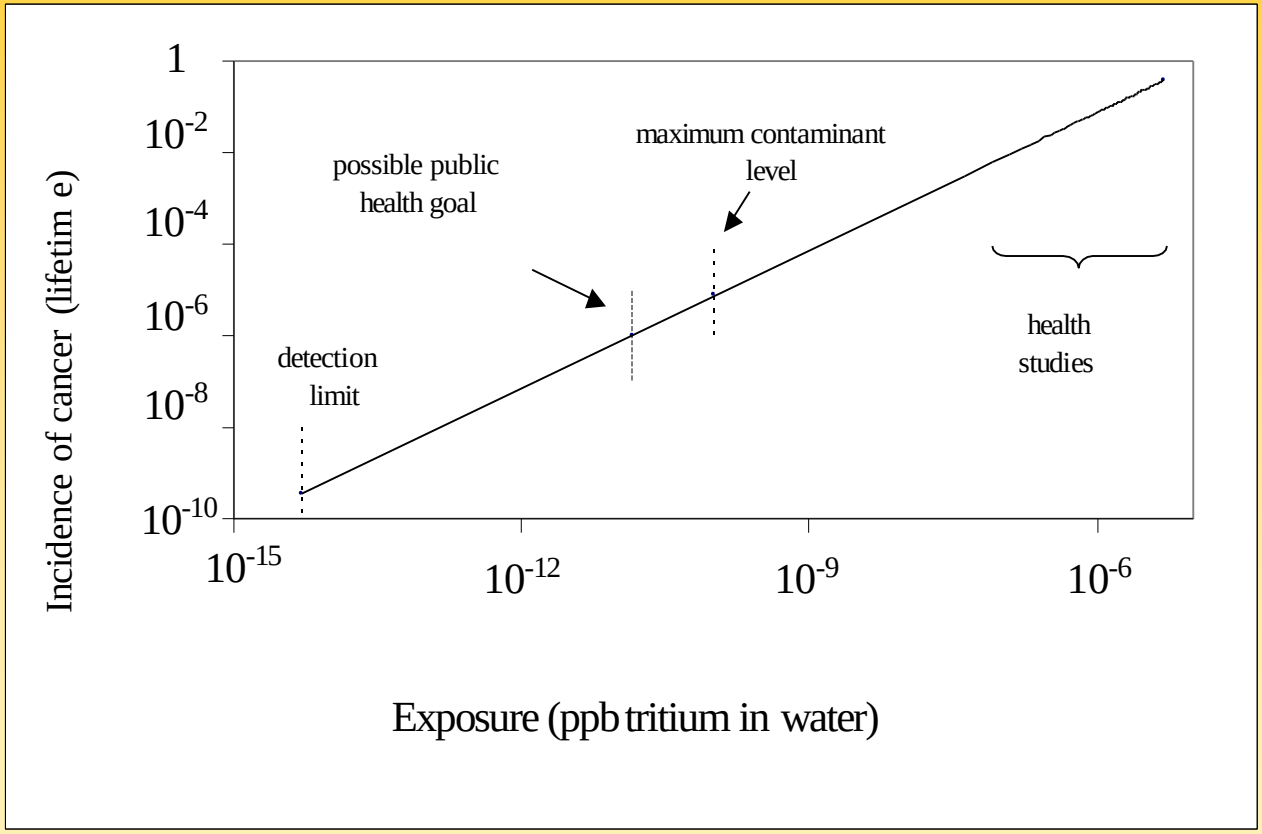


Since we rarely have good data about threshold effects, we assume they are not present

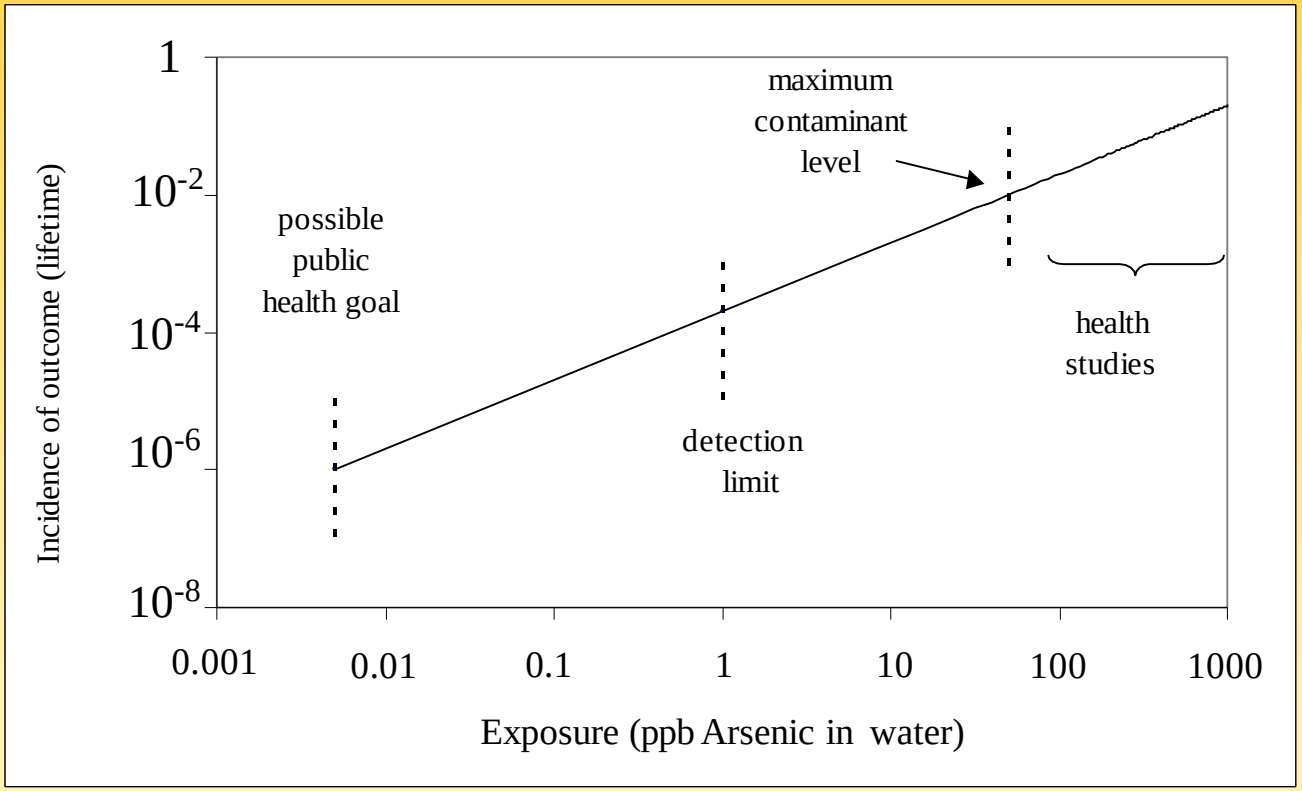
Tetrachloroethylene (PCE, dry cleaning fluid) is a common contaminant



Radioactive tritium (^3H) is of concern at very low concentration and is present in the environment at exceedingly low concentration

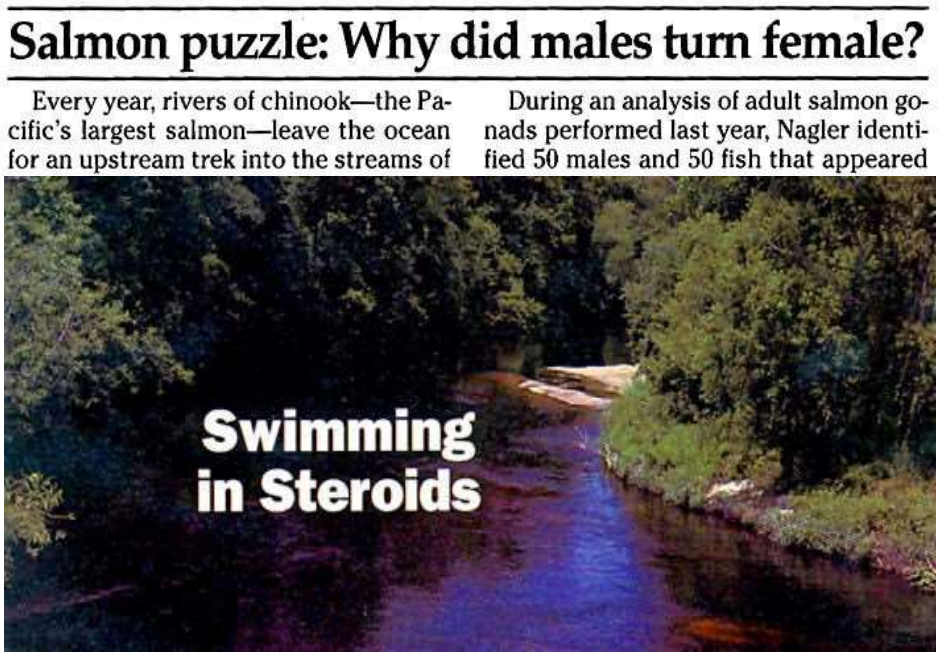


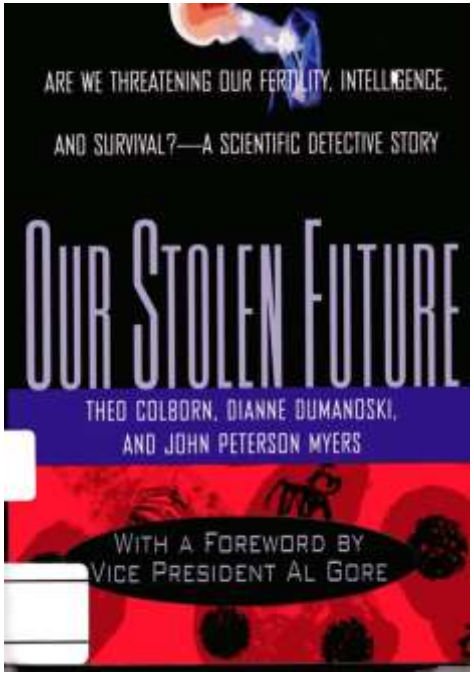
Arsenic is an example of a different pattern where the detection limit is large compared to possible health goals



Endocrine-Disrupting Compounds (EDC) in wastewater are a concern

An environmental endocrine disruptor is defined as an *exogenous agent* that interferes with the synthesis, secretion, transport, binding, action, or elimination of *natural hormones* in the body that are responsible for the maintenance of *homeostasis, reproduction, development, and/or behavior*."
(EPA 1997)

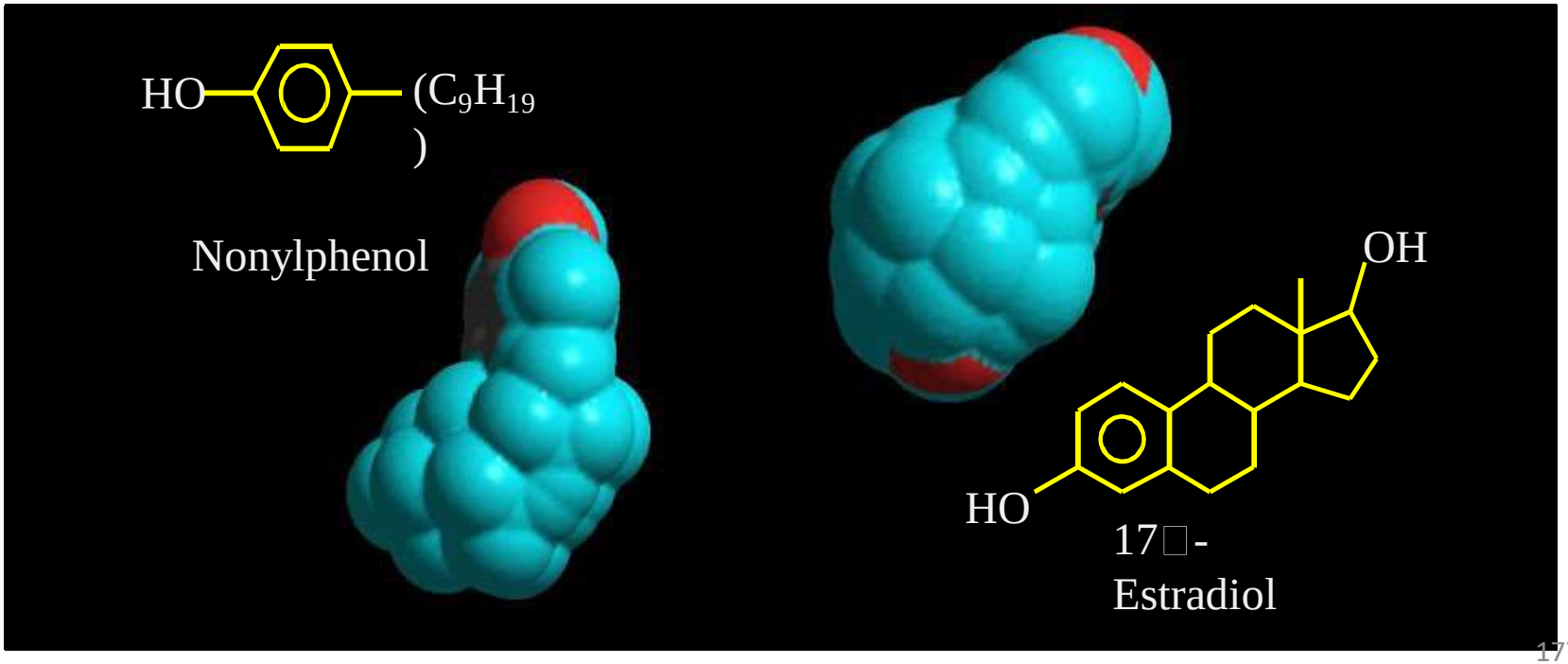




Nonylphenol (NP) is an important EDC

NP is a metabolite of alkylphenol ethoxylate (APEO) surfactants and is commonly detected in treated wastewater (□g/L).

- APEOs are among the most widely used groups of surfactants. Worldwide, about 500,000 tons are produced annually.



UNIT-5

Emerging Approaches of Disaster Management

Environment and Disaster Management

Contents of the presentation:

-Problem Identification

-Natural Disaster, Hazard, Vulnerability, Risk

-Environment and disaster management issues

-Illustrative examples of environment disaster linkages

-Global and local policy environment

What is the problem?

- Environment and disasters are interlinked
- Environmental concerns are not incorporated in disaster management practices and vice versa
- Decisions and actions on environment and disasters are taken separately
- The main issues are:
  - Lack of coordination and inter-linkage of policy and plans
  - Lack of perception and understanding
  - Lack of local actions, and
  - Lack of resource distribution

What is a natural disaster?

- A natural disaster is the consequence of an event, which causes significant loss to human lives and property
- A Disaster is defined as the interaction between an event and human activities
- A Disaster is often described as a function of hazard, risk and vulnerability

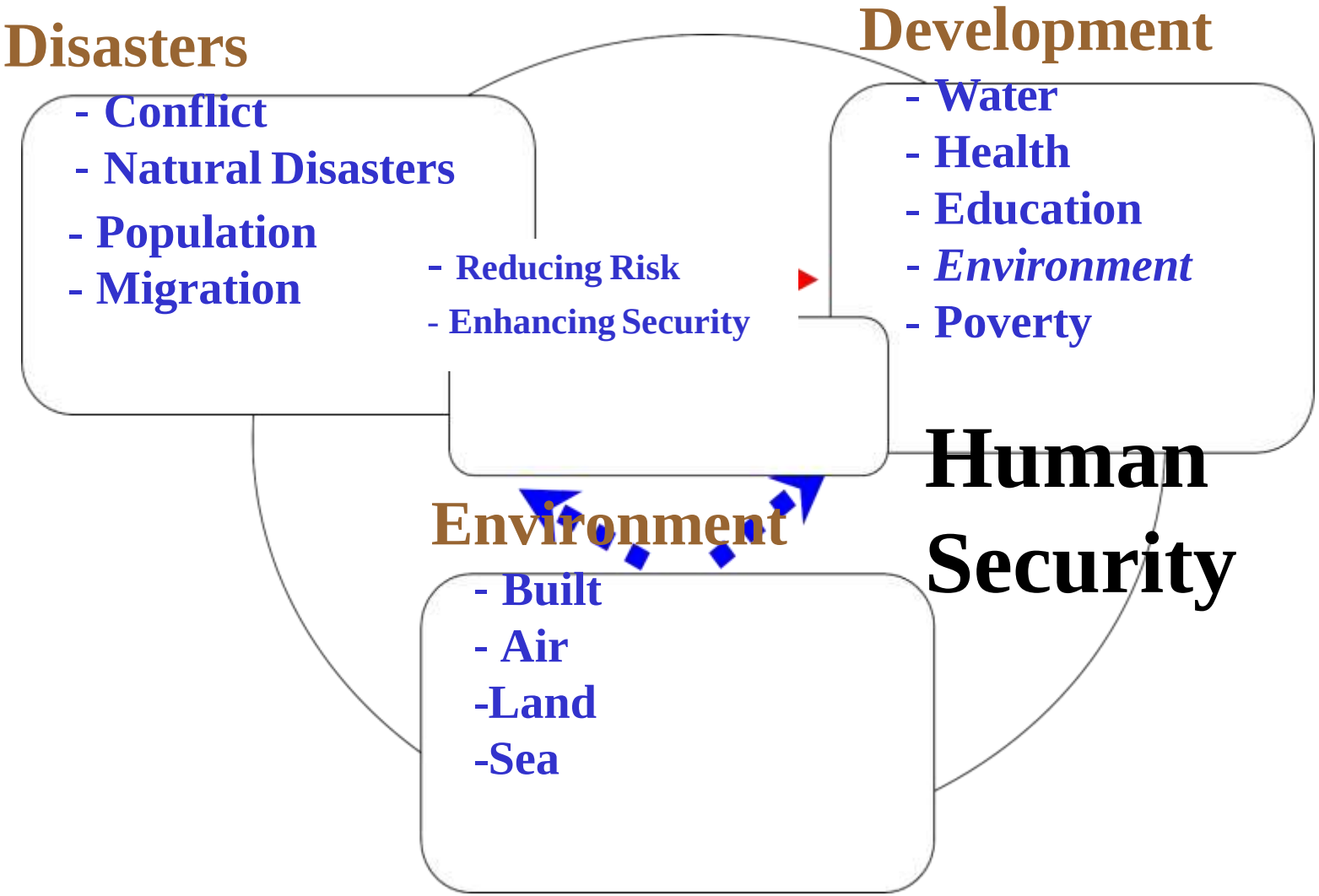
Elements of Risk

Hazard X	Vulnerability =	Risk
(Mostly Natural)	(Man and Built Env.)	(Consequence)
Geological	Physical	Death/Injury
Hydrological	Social/ Cultural	Financial Loss
Meteorological	Economic	Social Loss

Goal of Environment and Disaster Management

- The goal of Environment and Disaster Management is the **safety and sustainability** of human lives
- **Safety** is related to avoiding death and injuries to human lives during a disaster
- **Sustainability** is related to livelihood, socio-economic, cultural, environmental and psychological aspects

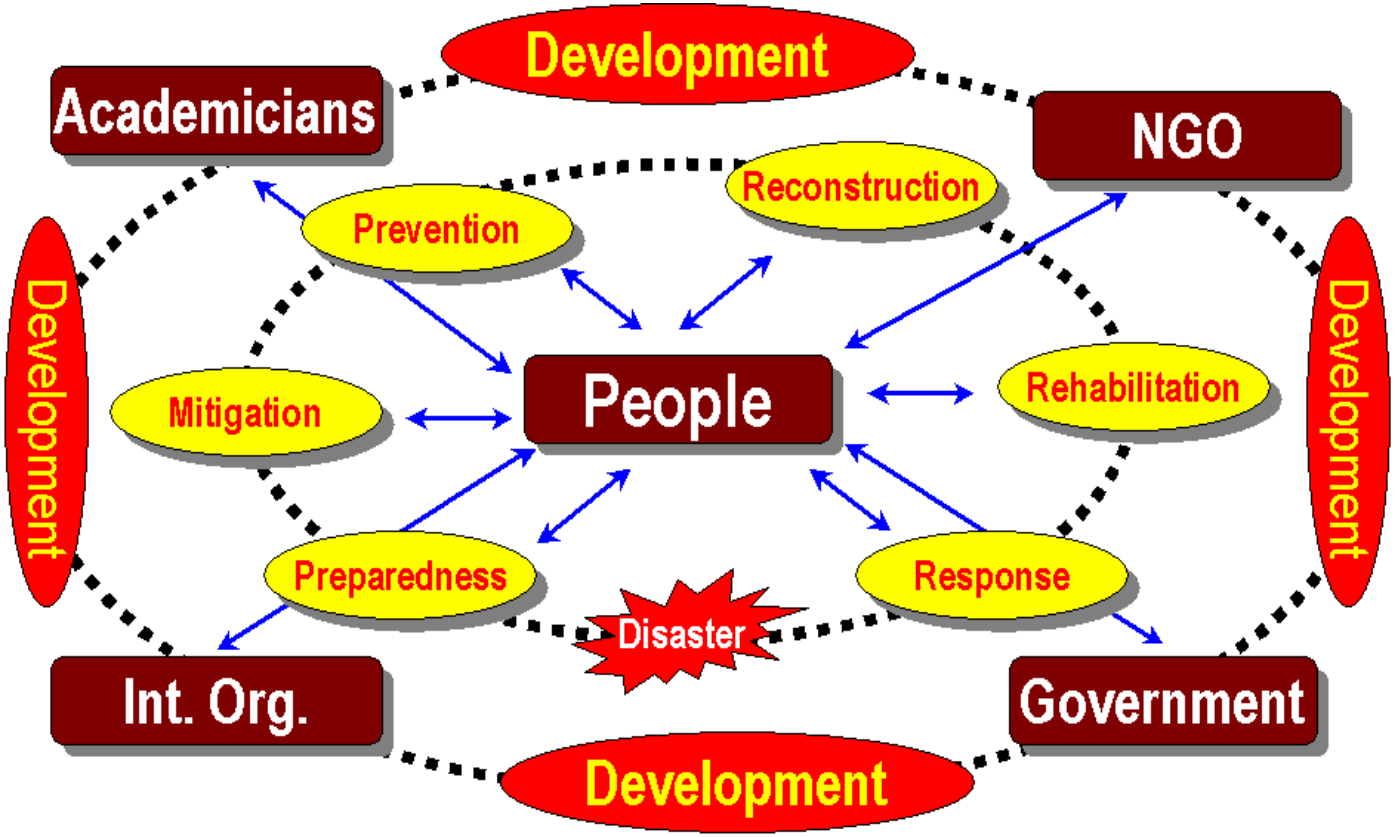
Disaster, Environment, Development

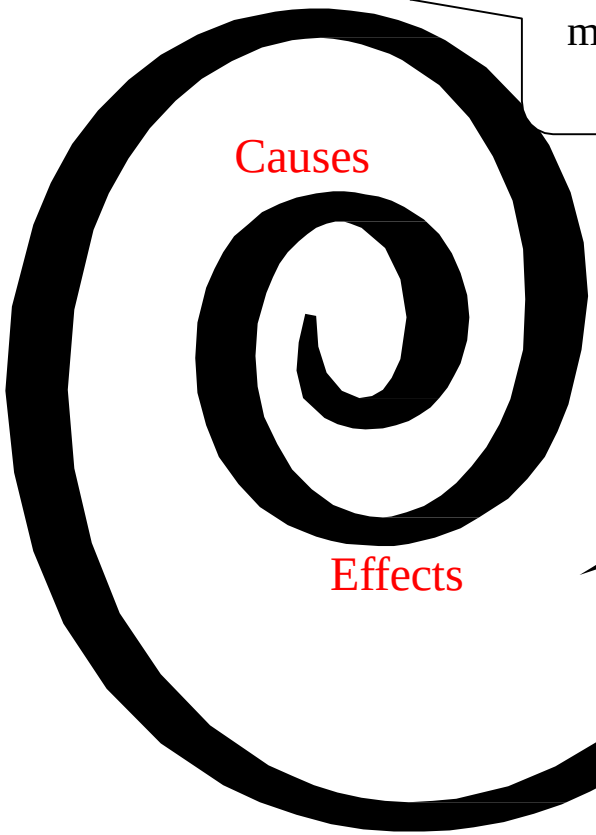


Disasters and Poverty

- Low-income groups are more vulnerable to natural disasters
- In general, floods and cyclones cause maximum damages and casualties in low-income groups, while earthquakes cause more casualties in middle-income groups
- Drought and flood affect most people in low and middle income groups
- Lower income groups are more dependent on the immediate environment
- Understanding how humans use environmental assets is important for good disaster risk mitigation.

Disaster and Development Cycle





Reduced through multi-stakeholder cooperation

Causes

Immediate/ Long -term
Population
De-forestation
High Consumption
Climate Change

Building disaster capacity

The Environment cause-effect cycle

Effects

Waste
Coral Reef Damages Coastal Zone Impacts Ground water contamination Siltation issue
Effect on agriculture land

Reduced through awareness, policies & action

Typhoon 23
(Japan, 2004)

Disaster

Extreme rainfall
Failure of pump system
Collapse of dyke system
Critical timing of rainfall
Low evacuation rate

Environment

Landslide
Waste debris
Electrical waste
Siltation of river and flooding
Blockage of water passage by uprooted trees

Typhoon 23

Infrastructure	Policy, Strategy, Planning	Community
Dyke Management Land-use management River basin management Forest management	Disaster env. Linkages Plans and programs Dissemination Adaptation Implementation Training and Human resource development	Perception and Action Preparedness for Evacuation Self-reliability Public awareness

Coastal Zone Management and Disaster Preparedness

- Indian Ocean Tsunami of 26th December 2004
- Green belt and mangrove in the coastal zone, coral reef protection and coastal regulatory zones are considered as environment protection measures
- However, these elements are strongly linked to tsunami protection in the coastal areas
- Livelihood support to the fisherman, protection of environment in the coastal area, and disaster prevention interface was lacking in most of the places

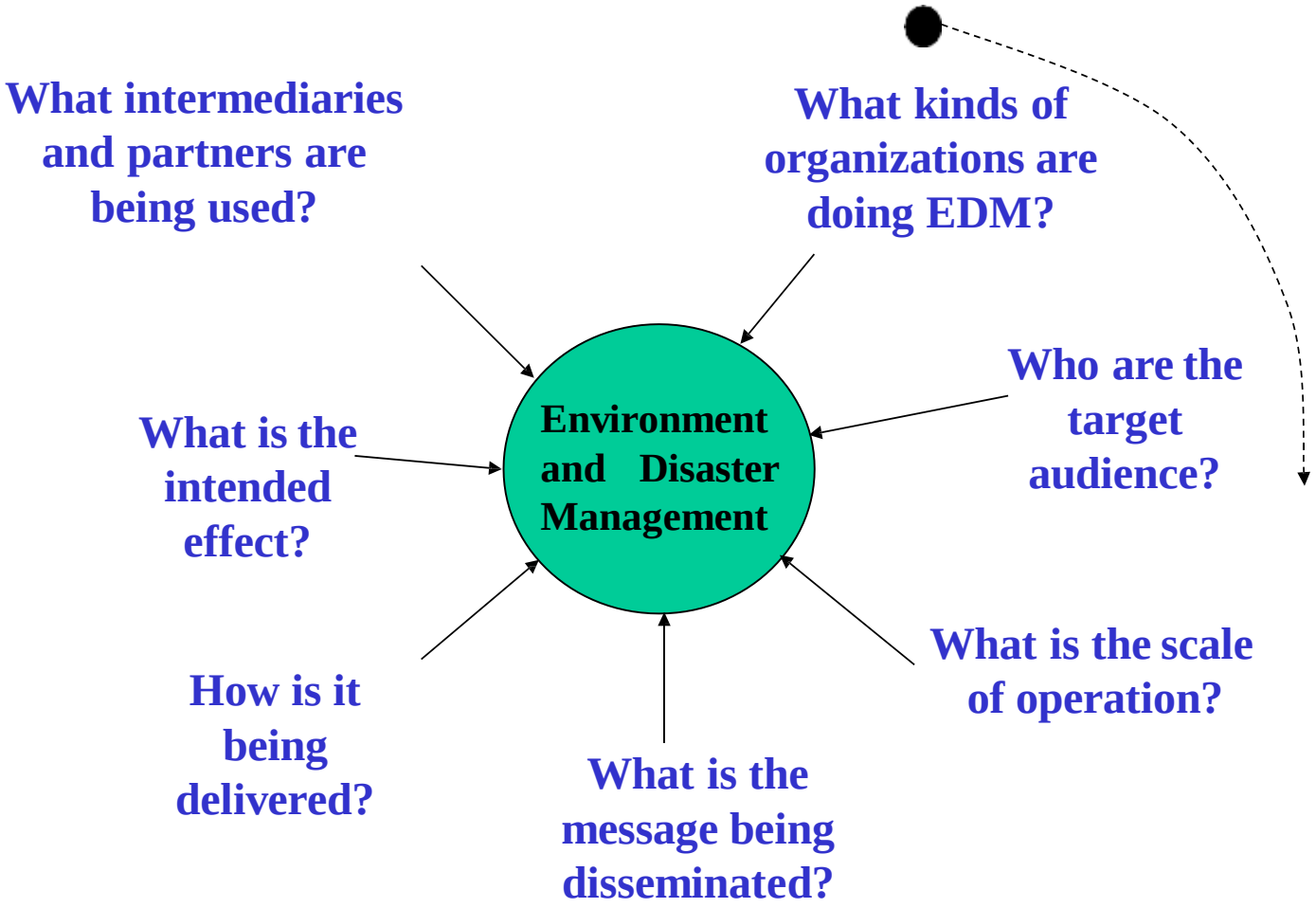
Integrated Waste Management

- Waste is a resource, and waste prevention is better than waste regulation and control.
- Disaster and waste management is closely linked
- Waste causes secondary disasters
- Physical and socio-economic conditions of the concerned communities should be considered in waste management
- Waste management should be part of disaster plans

Climate Change Impacts

- Climate change is considered as an environmental phenomena.
- Climate change impacts are seen in the form of natural disasters like drought, flood etc.
- Livelihoods of the rural communities are directly affected by the climate change impacts
- Adaptation to climate change is becoming increasingly recognized as the key issue (as opposed to mitigation), and it is considered as the pre-disaster preparedness measures.

Issues in Environment and Disaster Management (EDM)



MDG and Disasters: Global Tool

- Millennium Development Goals (MDG) are considered as important development framework, and disaster should be part of that framework.

- Increasing destruction from landslides, floods and other disasters related to environmental and land-use patterns are a clear signal that massive challenges remain in achieving this MDG in environmental sustainability.

- For example, the target of achieving a “significant improvement in the lives of at least 100 million slum dwellers by the year 2020” will be almost impossible without developing policies to enhance their ability to confront high disaster risks associated with earthquakes, tropical cyclones, flooding,drought etc.

Agenda 21: For Local Actions

***Agenda 21 (A21)* is an action programme based on contributions from national governments and international bodies at the Rio Summit of 1991.**

- Social and economic dimension of sustainable development
  - Policy, poverty, consumption, demography, health, settlement, environment

- Conservation and management of resources for development
  - Atmosphere, land resources, deforestation, desertification, mountain, agriculture, bio-diversity, bio-technology, ocean, freshwater, toxic, hazardous, solid, radioactive waste

- Strengthening the role of major groups
  - Women, youth, indigenous people, NGOs, local authorities, trade union, industry, Sc/ Tech, farmers

- Means of implementation
  - Finance, Environment Sound Technology (EST), Science, Education, Cooperation, Institution, Legal and Decision-making

Summary: Environment and Disaster Management

Why?

- Environment and disaster are interrelated and are linked to the sustainable development
- A sound environmental practice can lead to proper disaster mitigation and vice versa

What?

How to integrate environment and disaster issues in the development practices.

Case Studies on specific issues

- Like effects of typhoons, tsunami
- Waste issues,
- Impact of climate change as disasters

Who?

Development Practitioners, Disaster and environment managers