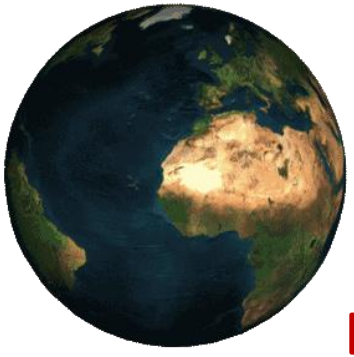

ES 212_303

Earth and Environmental Sciences

(2nd and 3rd Year)

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School of Engineering Sciences

30th Jan 2019

Mahindra Ecole Centrale

College of Engineering

Team

Faculty

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Dr. Somsubhra Chattopadhyay

Research Assistant

Bharat P

Rakesh K

Contents

1. **The Earth System** *Earth in the solar system. Earth layers, Continental Drift Theory, Tectonic Plates, Earthquakes, Atmosphere and oceans: Origin and evolution; Atmosphere-ocean interaction; Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions.*

2. **Environment and Environmental Studies** *Definition and Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Environmental Degradation, Multidisciplinary nature of the Environment studies, its scope and importance in the present day Education System.*

3. **Ecology and Ecosystems** *Ecology- Objectives and Classification, Concept of an ecosystem- structure and functions of ecosystem, Components of ecosystem- Producers, Consumers, Decomposers. Bio-Geo- Chemical Cycles- Hydrologic Cycle, Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions, Carbon cycle, Energy Flow in Ecosystem, Food Chains, Food webs, Ecological Pyramids Major Ecosystems: Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine Ecosystem*

Contents

4. Population and Economic Growth *The nature of human population growth, population parameters, industrialisation, urbanisation, sustainable development, sustainable consumption, health and the environmental impacts. Environmental pollution: Types of Environmental Pollution: Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution: Industrial Agricultural, Municipal; Classification of water pollutants, Effects of water pollutants, Eutrophication Marine pollution- Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO2, NOX, Natural & Anthropogenic Sources, Effects of common air pollutants Land Pollution: Land uses Land degradation: causes, effects and control, soil erosion. Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects Thermal Pollution: Causes and effects, Role of individual in the prevention of pollution.*

5. Social Issues and the Environment *From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization. Environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, and ozone layer depletion, nuclear accidents and holocaust, case studies. Wasteland reclamation – consumerism and waste products. Environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.*

Evaluation of Course

- Minor-1 15%
- Minor-2 15%
- End Sem 30%
- Project & Assignments 30%
- Random quizzes 10%

Home / Courses / ESS 1: Introduction to Earth System Science

- Information
- Week 1
- Week 2
- Week 3
- Week 4
- Week 5
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- Week 7
- Week 8
- Week 9
- Week 10

ESS 1: Introduction to Earth System Science (English)

Course Information

This course introduces Earth System Science, which, at its core, involves viewing Earth's environment in a holistic fashion. Topics covered in the course include: the origin and evolution of the Earth, its atmosphere, and oceans, from the perspective of biogeochemical cycles, energy use, and human impacts on the Earth system.

Earth System Science Dept. | Physical Sciences Sch. | University of California, Irvine

Keywords: earth system science,evolution,earth,oceans,biogeochemical cycles,energy use,Human Impacts on Earth,atmosphere —

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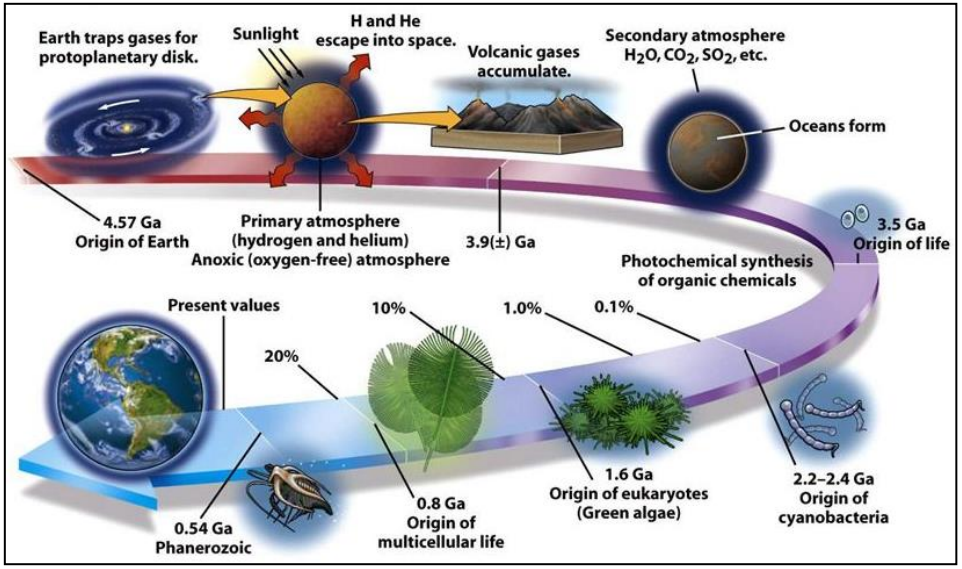
Author:
Julie Ferguson
Title:
Lecturer
Department:
Earth System Science

http://ocw.uci.edu/courses/ess_1_introduction_to_earth_system_science.html

Atmosphere Formation and Evolution



Minerals vs Rocks

Developed societies depend on mineral resources

Metals - Iron, copper, lead, zinc, nickel, aluminium, etc.

Non-metals - Gypsum, limestone, clay

Must be

- Naturally formed
- inorganic
- solid

Must have a

- specific chemical composition
- characteristic crystal structure

Minerals vs Rocks

Developed societies depend on mineral resources

Metals - Iron, copper, lead, zinc, nickel, aluminium, etc.

Non-metals - Gypsum, limestone, clay

Minerals vs Rocks

What is rock

Naturally formed
Non-living
Solid
Aggregate mass of one or more mineral

Rocks

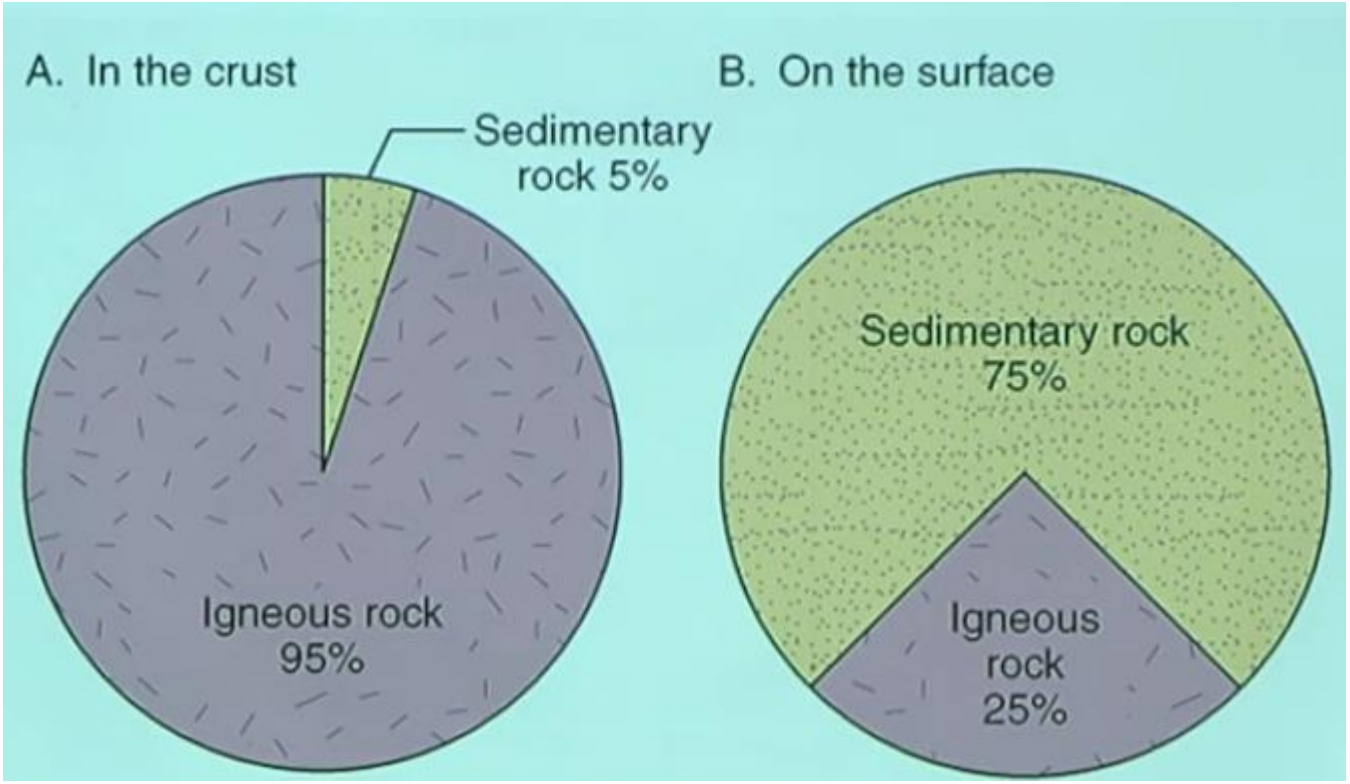
Three Types

Igneous rocks: formed by cooling and consolidation of magma

Sedimentary rocks : formed by chemical precipitation of dissolved material or by deposition of mineral particles transported by water, wind or ice

Metamorphic rocks: igneous or sedimentary rock that has been changed as a result of high temperatures, high pressures or both

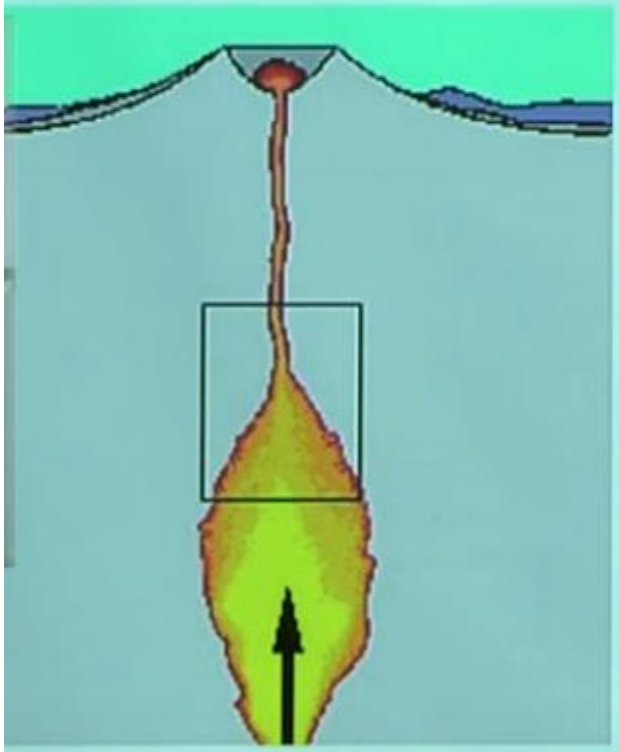
What types of rock make up the crust



Magma

"mixture of molten rock, suspended mineral grains, and dissolved gases that forms in the crust or mantle"

(**Lava =** magma that reaches the surface)



Characterized by

1. Composition
2. Viscosity (ability to flow)
3. Temperature

Volcanoes

Any vent hole or opening from which lava, solid rock debris, or gases are erupted.

Volcanoes

Any vent hole or opening from which lava, solid rock debris, or gases are erupted.

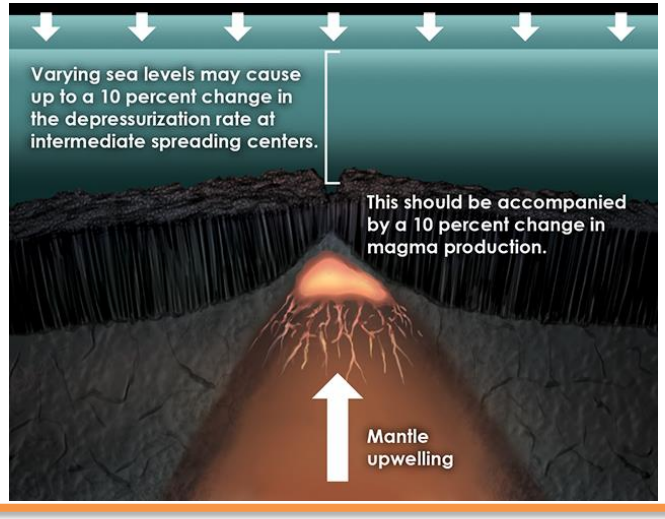
Important for Earth and Environmental Science because

- reveal inner earth structure and processes

- influence gaseous composition of atmosphere

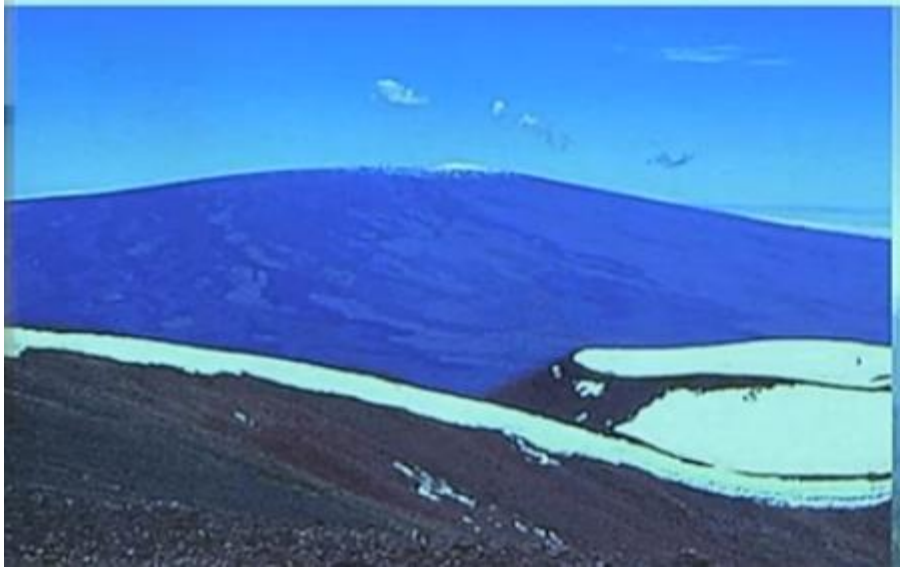
- particles can change radiative balance

- re-distribute energy through the earth system (mid-ocean ridges)

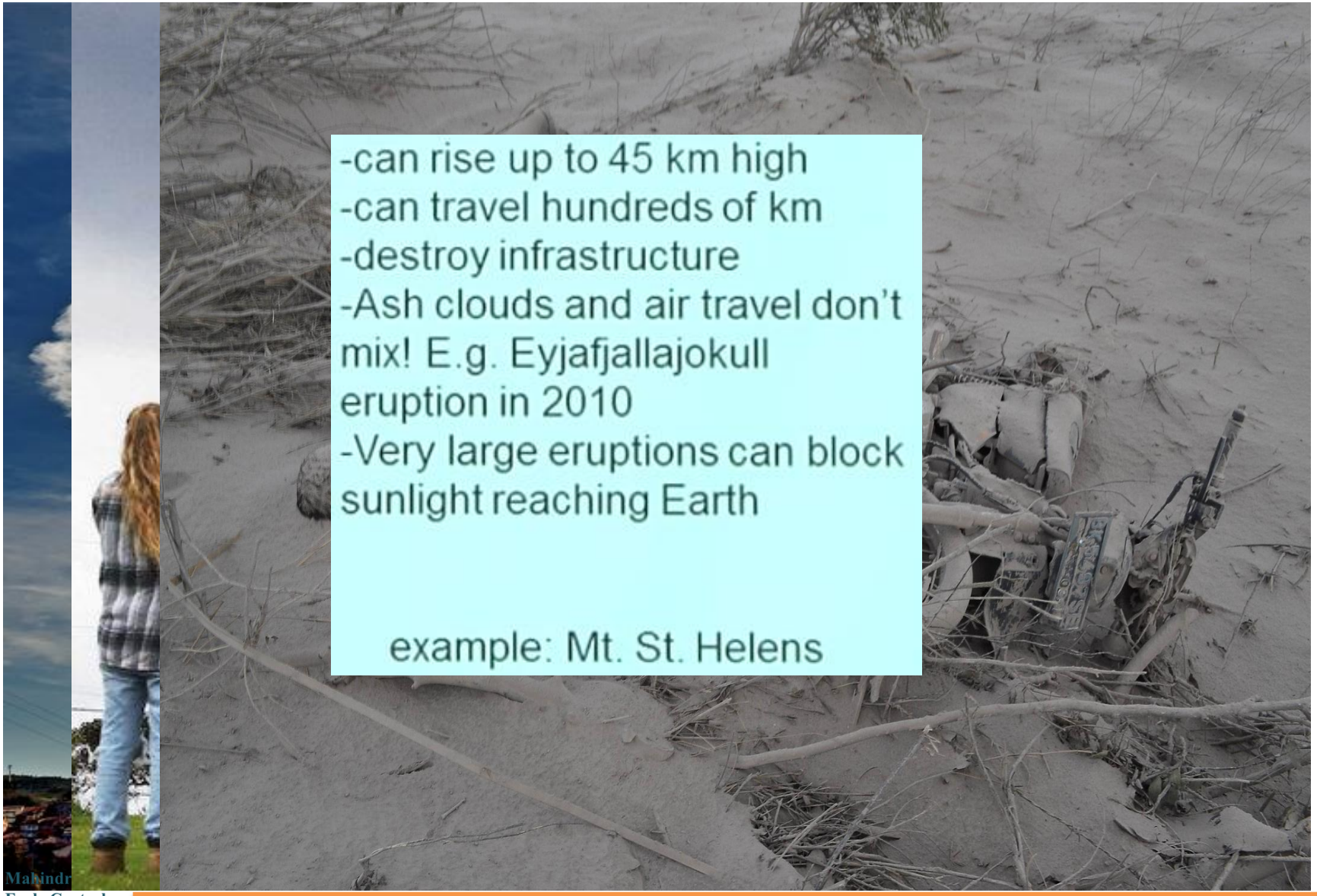


Types of Volcanoes

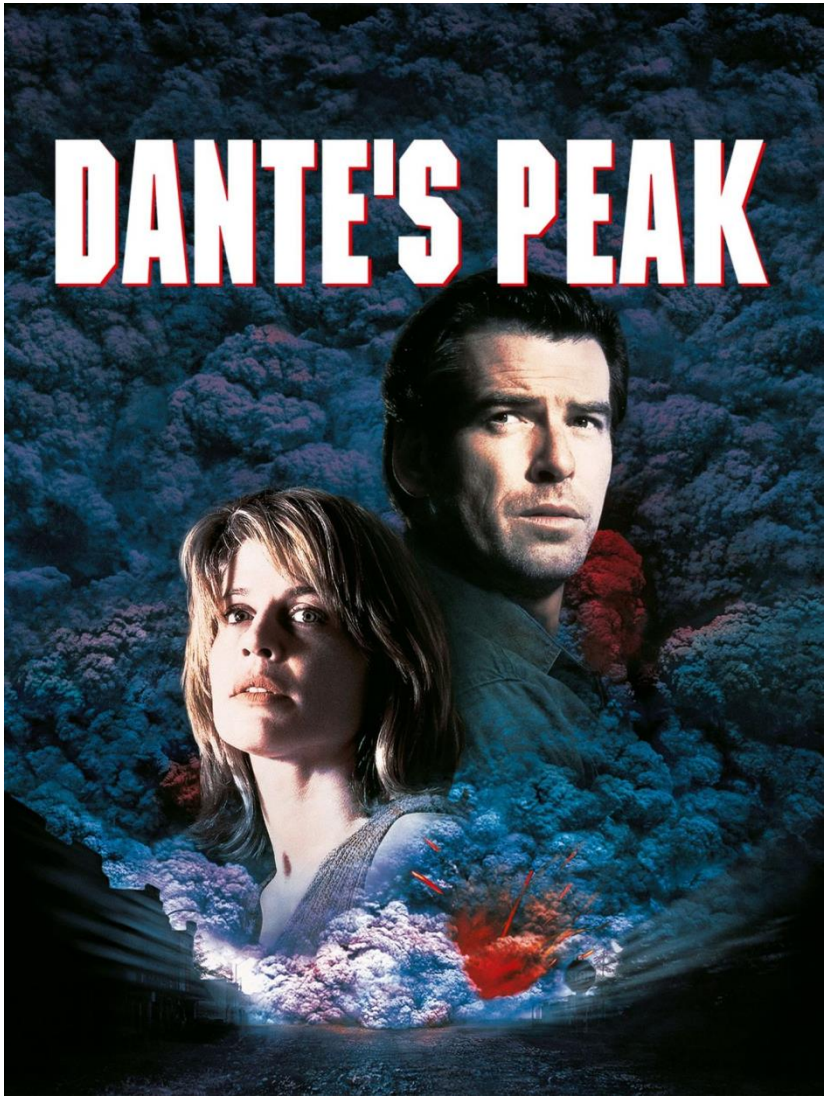
1. Shield volcanoes	2. Stratovolcanoes
- Formed from basaltic lava flows	- Formed from andesitic/rhyolitic lava flows and tephra
- Non-explosive eruptions	- Explosive eruptions
- Low angle slopes	- High angle slopes and BIG
- Low amounts of ash/tephra	- Lots of ash/tephra

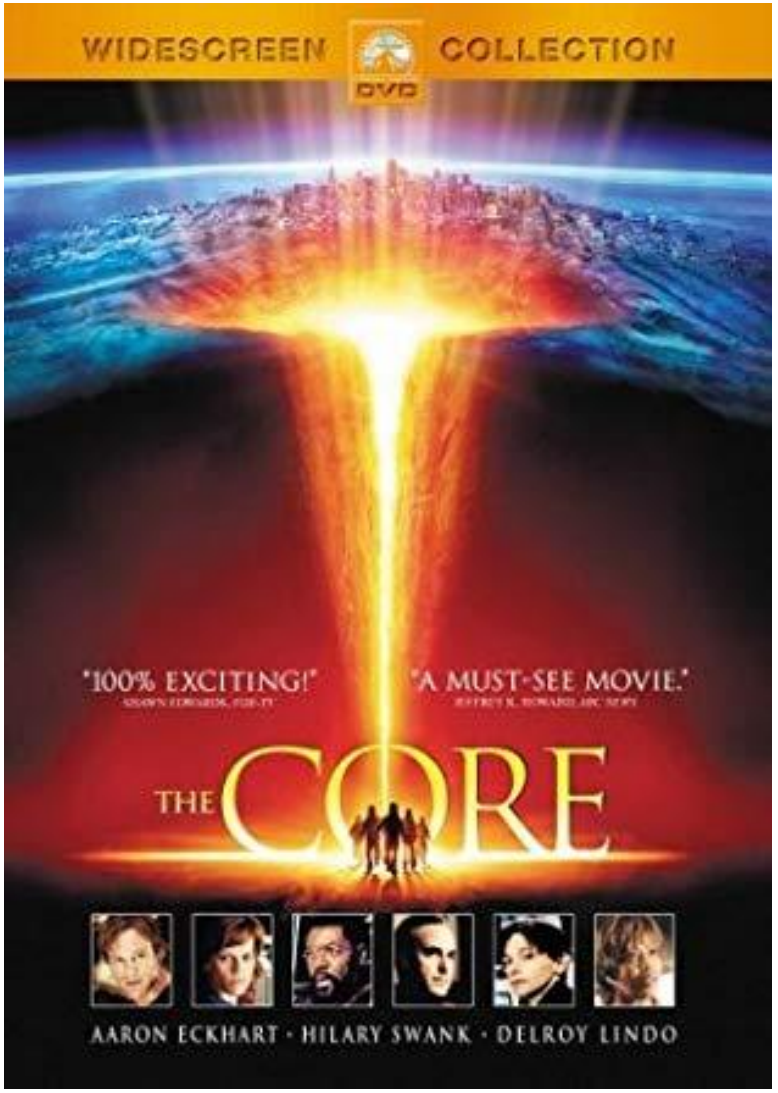


Volcanic ash



Hollywood


DANTE'S PEAK


WIDESCREEN COLLECTION
DVD
"100% EXCITING!"
"A MUST-SEE MOVIE."
THE CORE
AARON ECKHART · HILARY SWANK · DELROY LINDO

Earth System

The Earth system has five main spheres:

Atmosphere - mixture of gases (N, O, Ar, CO_2, H_2O vapor) that surrounds the earth.

Hydrosphere - all of Earth's water e.g. Oceans, lakes, underground water, snow and ice (Cryosphere)

Geosphere - Solid earth (rock and regolith)

Biosphere - all of Earth's organisms + any organic matter which has not decomposed

Anthroposphere - part made or modified by humans

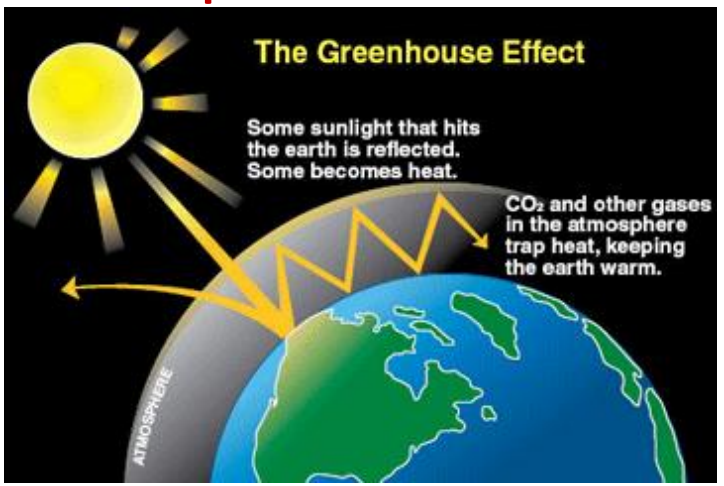
Atmosphere

"the gaseous envelope that surrounds a planet or other celestial body"

Air - mixture of gases and suspended particles that surrounds Earth.

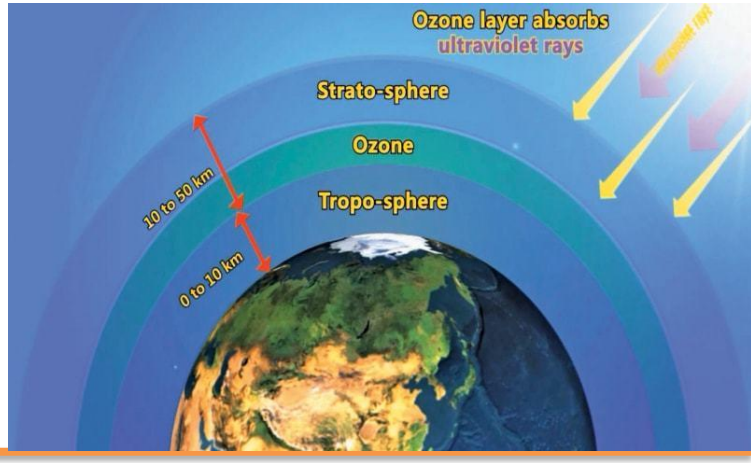
Why is atmospheric Composition important ?

Affects Earth's surface temperature - greenhouse effect because of the presence of gases like water vapor and carbon dioxide



What we breathe - oxygen allows us to exist but atmosphere also contains reactive gases (like ozone) which will react with tissues in your lungs and affect health.

Ozone higher in atmosphere protects life on earth by absorbing UV rays which can damage cells



Aerosols

"tiny liquid droplets or tiny solid particles that are so small they remain suspended in the air"

Smoke

ice-crystals

sea-salt crystals

dust

volcanic emissions

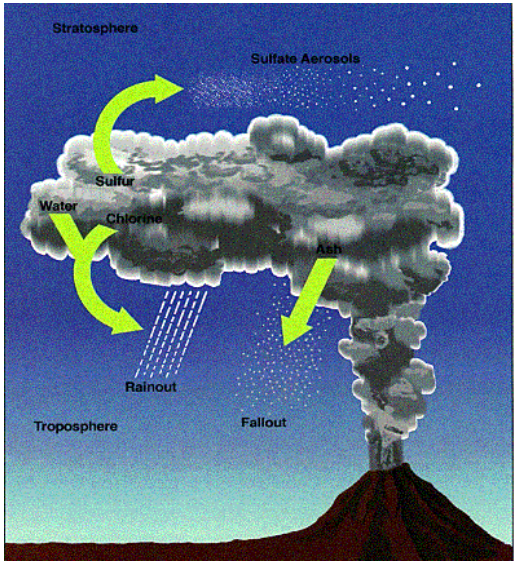
industrial pollution

Climate effects of Aerosols are complicated

Some aerosols directly absorb solar radiation (heat the atmosphere) e.g. soot

Others reflect incoming radiation from space (cooling effect) e.g. sulfur

Some enable easier formation of clouds, which can reflect radiation (cooling) or cause increased absorbtion of infrared radiation (warming) depends on the type of clouds



Earth Spheres

As a rock body builds up through accreation, the energy from the collisions results in some melting which allows different layers to form

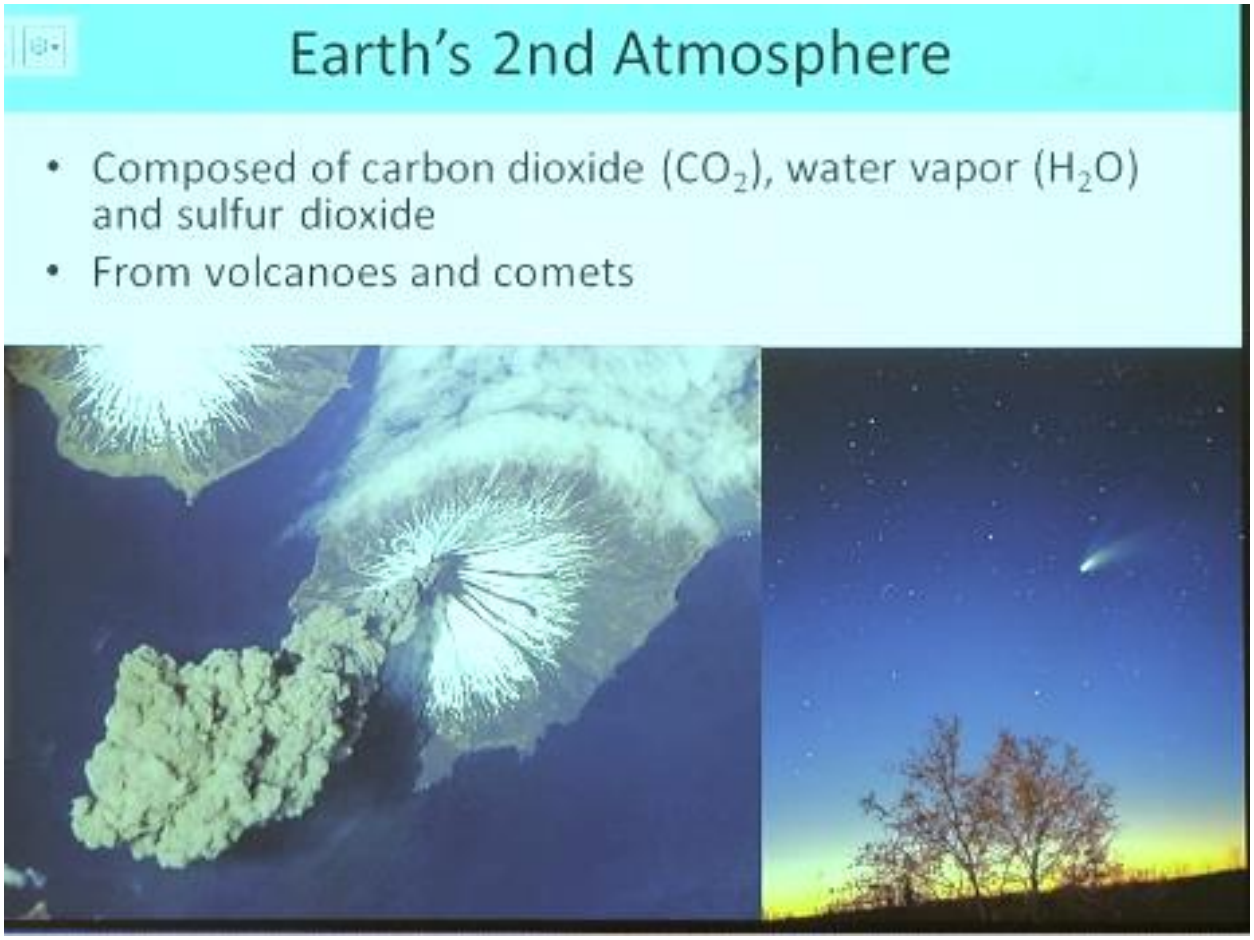
Earth's 1st Atmosphere

- Composed of hydrogen (H) and helium (He) which are most common elements in solar system
- Lost quickly over first 50 Myrs to space because:
  - H and He not retained by gravity
  - Solar wind as Earth did not yet have a magnetic field
  - Collisions

http://www.youtube.com/watch?v=ibV4M
http://www.youtube.com/watch?v=IO45ZiGql8

Earth Spheres

As a rock body builds up through accreation, the energy from the collisions results in some melting which allows different layers to form



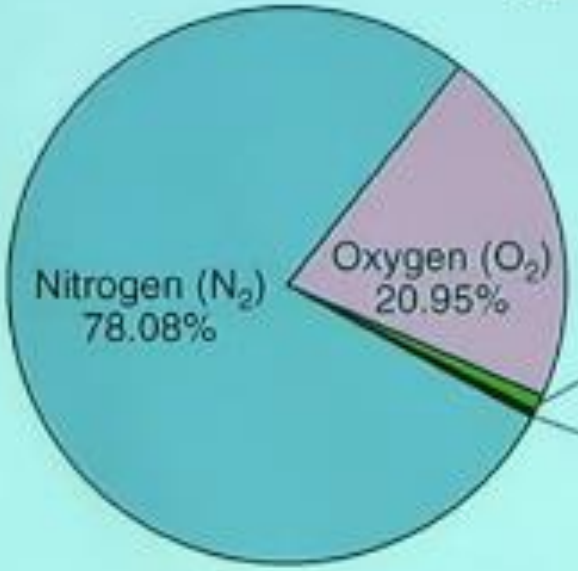
Composition of Volcanic gases

volume percents (from Symonds et. al., 1994)

Volcano	Kilauea Summit	Erta` Ale	Momotombo
Tectonic Style	Hot Spot	Divergent Plate	Convergent Plate
Temperature	1170°C	1130°C	820°C
H_2O (water)	37.1	77.2	97.1
CO_2 (carbon dioxide)	48.9	11.3	1.44
SO_2 (sulfur dioxide)	11.8	8.34	0.50
H_2 (hydrogen gas)	0.49	1.39	0.70
CO (carbon monoxide)	1.51	0.44	0.01
H_2S	0.04	0.68	0.23
HCl	0.08	0.42	2.89
HF	---	---	0.26

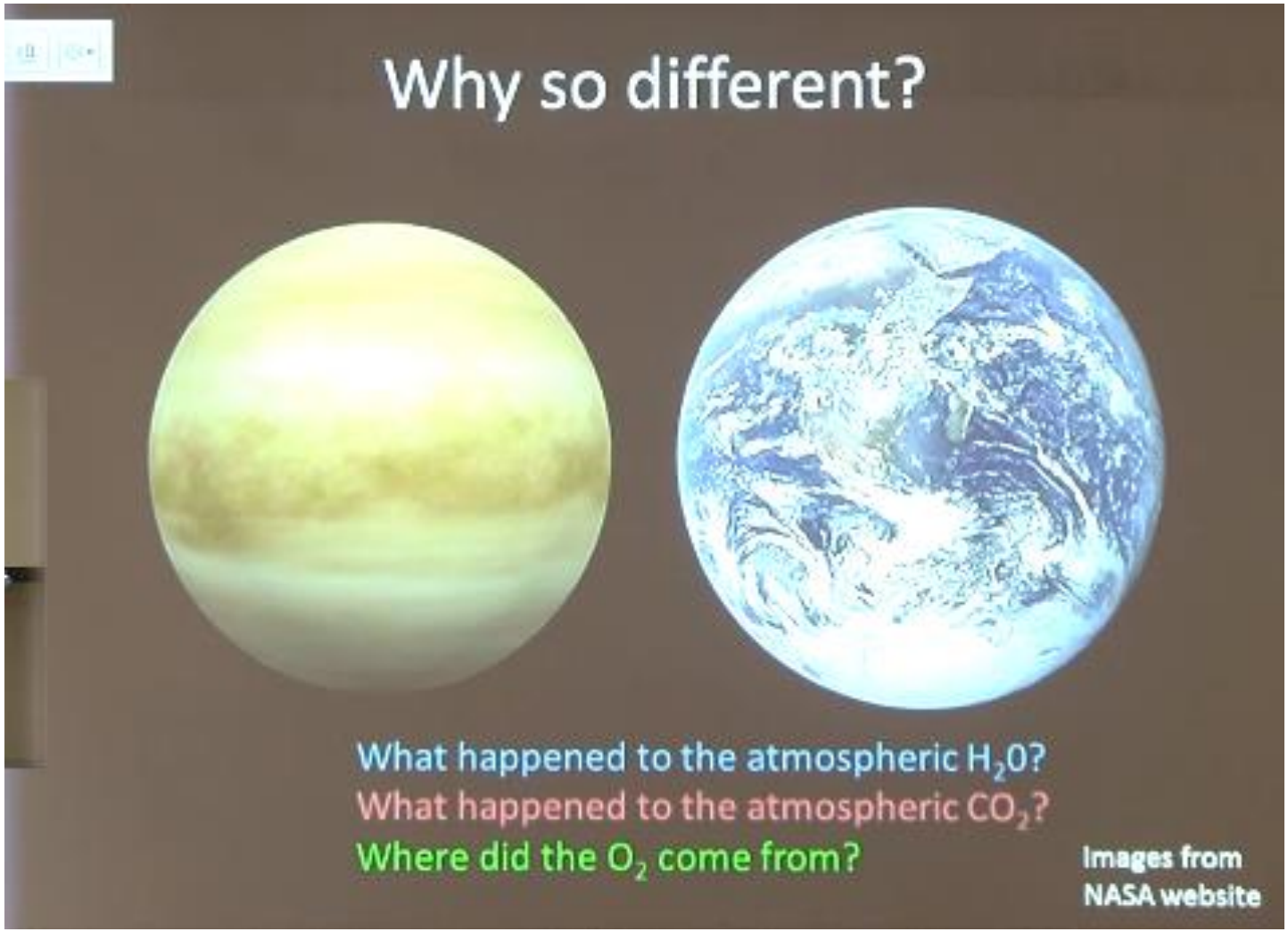
Composition of the (dry) atmosphere today

...+ variable constituents: **H_2O**, and **aerosols**



All other gases, 0.04%	
Carbon dioxide (CO_2)	0.035%
Neon (Ne)	0.0018%
Helium (He)	0.00052%
Methane (CH_4)	0.00014%
Krypton (Kr)	0.00010%
Nitrous oxide (N_2O)	0.00005%
Hydrogen (H_2)	0.00005%
Ozone (O_3)	0.000007%

Earth Spheres



H_2O

- The atmosphere can only hold small fraction of the water vapor injected into it from volcanoes
- Water vapor condensed into clouds and over time formed the oceans.

Table 1.2

An inventory of the hydrosphere[a,b]

Component	Percentage of mass of hydrosphere
Oceans	97.
Ice	2.4
Fresh water (underground)	0.6
Fresh water in lakes, rivers, etc.	0.02
Atmosphere	0.001

[a] Total mass = 1.36×10^{21} kg = 2.66×10^{6} kg m^{-2} over surface of earth.

[b] Based on data given in H. H. Lamb, "Climate: Present, Past and Future," Methuen Co. Ltd., London, 1972, p. 482.

CO_2

- CO_2 removed from the atmosphere by
  - biosphere
  - dissolution in oceans
  - chemical weathering
- Chemical weathering is a process where CO_2 dissolves in rainwater producing weak carbonic acid that reacts with rock to form carbonate compounds
- Over time, carbon was locked away in minerals and rocks (and fossil fuels)

Table 1.3

Inventory of carbon near the earth's surface[a]

Biosphere	marine	1
	nonmarine	1
Atmosphere (in CO_2)		70
Ocean (in dissolved CO_2)		4000
Fossil fuels		800
Shales		800,000
Carbonate rocks		2,000,000

[a] Given in relative units. After P. K. Weyl, "Oceanography," John Wiley & Sons, New York, 1970.

N_2

- Released in small amounts by volcanoes but....
  - Is chemically inert
  - Is not very soluble in seawater
- Amount of N_2 removed from the atmosphere was small
- Over time, with the removal of CO_2, N_2 became the most abundant gas in the atmosphere

Argon

- Radioactive decay in the rocks of the planet added Ar to the atmosphere
- Like N_2 it is chemically inert and insoluble so has built up through time in the atmosphere

Oxygen

- Photosynthesis was primary process which increased oxygen in atmosphere
- Anaerobic photosynthetic bacteria may have appeared as early as 3.5 billion years ago in the oceans
- O_2 appeared in Earth's atmosphere about 2.5 billion years ago at low levels
- Since 550 million years ago O_2 has made up between 15-35% of the atmosphere

The Earth's atmosphere today

- Permanent gases – constant proportion in most of atmosphere
  - 78 % Nitrogen (N_2)
  - 21 % Oxygen (O_2)
  - 1 % Argon (Ar)
- Variable gases – distribution varies with time and location
  - <0.25 %, but important
    - » Water vapour (H_2O)
    - » Carbon dioxide (CO_2)
    - » Methane (CH_4)
    - » Ozone (O_3)
    - » Nitrous oxide (N_2O)


thank you!