Case studies: topic 3

Rocks and weathering

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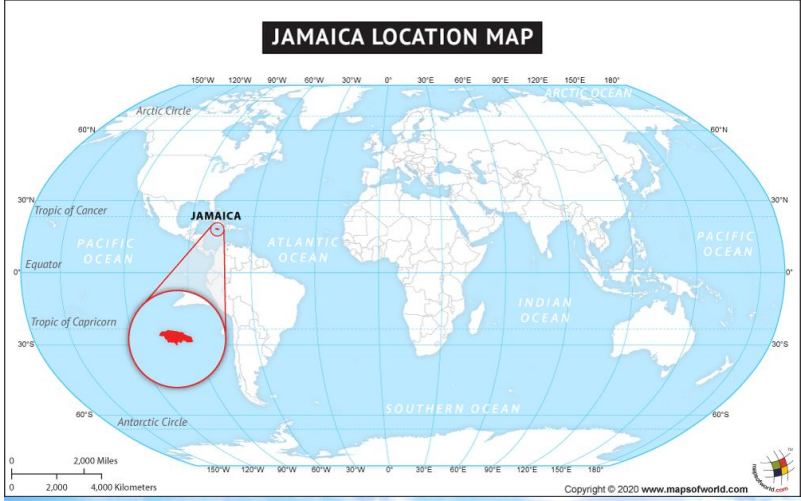
Bauxite mining in Cockpit country – Jamaica

It is an island-within-an-island and contains especially adapted animals and plants.

- About 22000 ha is a designated Forest Reserve
- Alcoa minerals of Jamaica and Clarendon Alumina Production applied to renewal of a Special Exclusive Prospecting Licence, which was first granted in **May, 2004.**

➔ Roads are needed to bring in drilling equipment
➔ Vegetation of the surface of the land would be removed
➔ Increased surface runoff and possibly impede infiltration to the groundwater
➔ Underground streams are very prone to damage
➔ Flooding of previously safe areas
➔ Reduction in the volume of major rivers
➔ Deforestation and greenhouse gas emissions
➔ Biological diversity would be lost forever



Landslide in Hong Kong

- Hong Kong is one of the most densely populated urban areas worldwide with a population of over 7 million (2015).
- natural steep terrain and hills - upper slopes steeper than 30°
- The population density of Hong Kong in 2018 was 6,641.20 people per square kilometer

Damage:

- In June 1966, rainstorms triggered massive Landslides that killed 64 people. Over 2500 people were made homeless and a further 8000 were evacuated.Over 700 landslides were recorded in Hong Kong that month.

Solutions:

- If private owners does not comply with the regulations - prosecution will lead to a HK$50000 fine, and to imprisonment for up to one year.
- The third solution is greening techniques.
- The mulching system.
- Long-rooting grass
- Fibre reinforced soil system

Causes:

- Washout
- Sheetflows
- Debris avalanches
- Rockslides
- With urban development landslides are triggered by excavation and building works
- 1650mm rainfall in 15 days, causing 700 landslides

https://znotes.org/caie/as/geography-9696/case-studies/human-activity-on-slopes/

Convergent plate boundary (Mount Sinabung)

south -east Asia

Mount Sinabung North of Sumatra

- ➔ has more than 17000 islands
- ➔ Volcano was dormant over 400 years
- ➔ September 2013
- ➔ February 2014
- ➔ Last time, toxic gas and ash came out
- ➔ EuroAsian and Indonesian plate - convergent movement /niileh/
- ➔ Island spread over the ring of fire

Advantages:

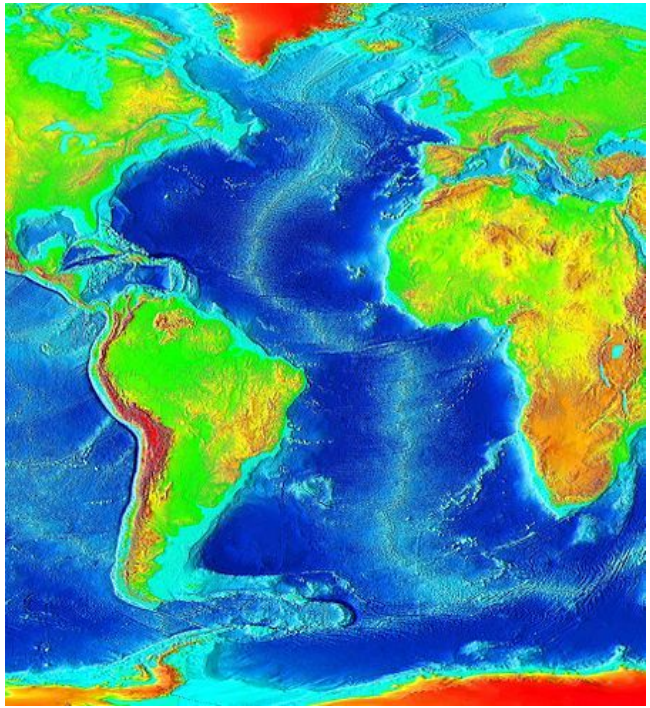
- ➔ Plants coffee, rice, chili, cocoa in volcanic area

Problems:

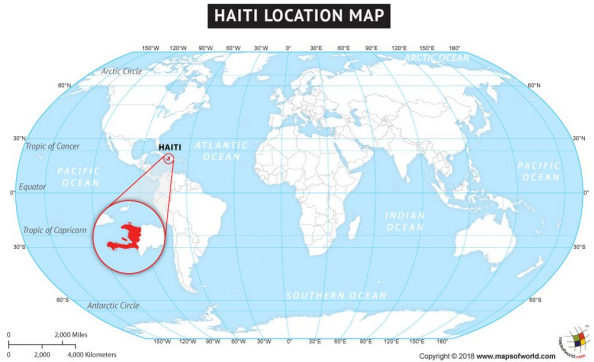
- ➔ Hazardous zone
- ➔ 16 people killed on Feb 2014
- ➔ 70500 evacuees

Divergent plate boundary (constructive)

- Mid-Atlantic ridge: 0.7-1.4cm per year.
- located along the floor of the Atlantic Ocean
- ridge separates the North American from the Eurasian Plate and the African Plate
- 16’000 km long
- 3 km in height above the ocean floor



Conservative plate boundary



South of North America

\+ San Andreas Fault: 3-5cm per year.

➔ Lies on North American and Caribbean plate - conservative movement /zuruh/
➔ 200 years - no disaster
➔ On 12 Jan 2010, 5 p.m
➔ Focus = 10km under ground
➔ Epicentre - 16 km from capital city - Port au Prince
➔ 7.0 magnitude earthquake

Benefits:

➔ Provides workplaces
➔ Got help from other countries

Problems:

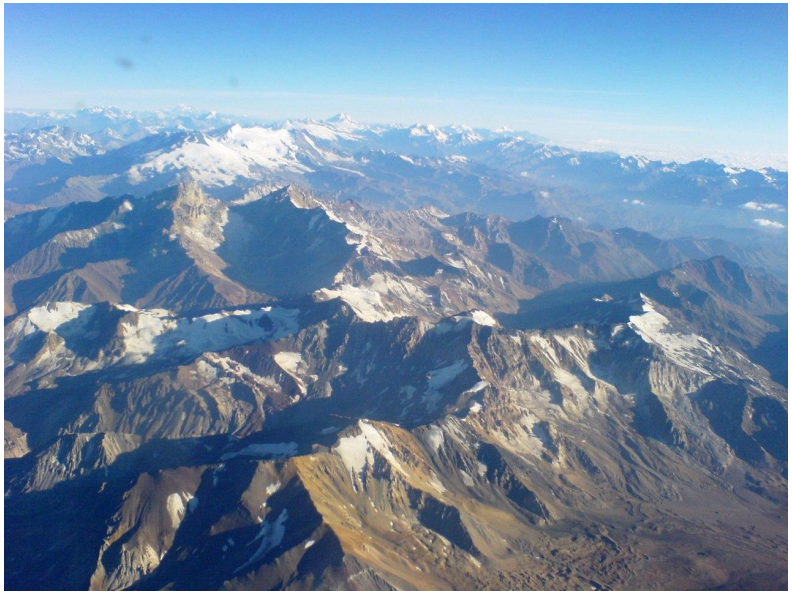
➔ Over 220’000 people killed
➔ Houses, airports, roads and schools destroyed
➔ dirty water causing cholera
➔ Public telephone was not working

Himalayan Mountain Range: 5-6 cm per year

- formed 25 million years ago when the Indo-Australian
- plate collided with the Eurasian plate
- Mount Everest, located in the Himalayan range, is a fold mountain and is the highest mountain on Earth at 8849 metres above sea level.
- It is just one of 30 peaks of the Himalayan range.
- 594,400 sq km of Pakistan, India, Tibet, Nepal and Bhutan.
- grow higher at the rate of 4mm per year
-

The Andes

- located in South America, along the western coast of the continent
- Stretched 7000 km
- Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile, and Argentina.
- The highest peak in South America, at 6962 metres, is Mount Aconcagua
- Nazca plate collided with the South American plate



Mud flows

Location: Sidoarjo Regency, East Java, Indonesia

Date: from May 29, 2006 (It is expected that the flow will continue for the next 25 to 30 years)

Causes:

- Drilling-induced fracturing or fault reactivation (reflecting a man-made event)
- Earthquake-triggered fault reactivation (reflecting a natural event)
- Geothermal processes (reflecting geothermal heating)

Damage:

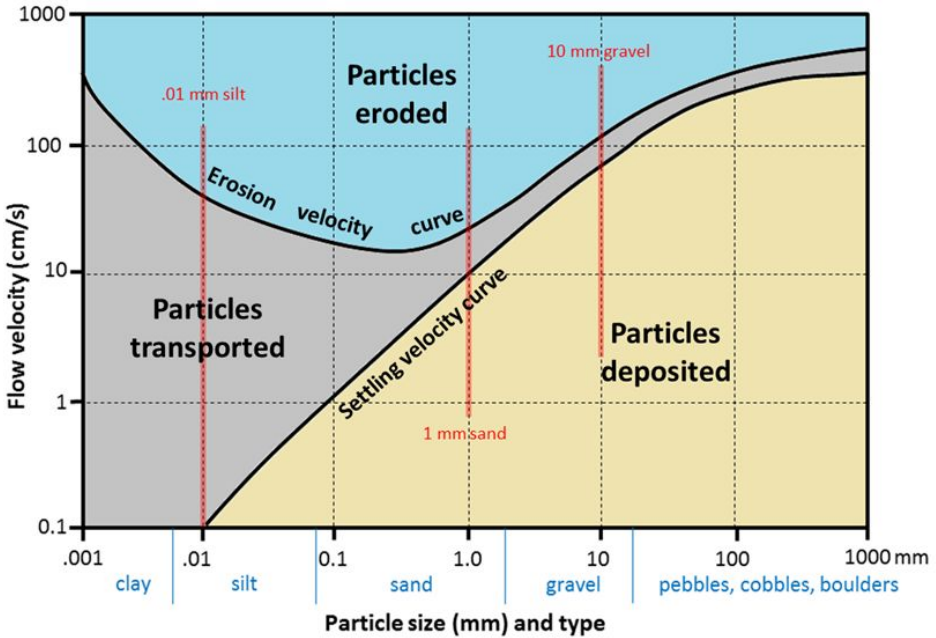
- The mud has drowned 15 villages, several paddy fields, dozens of factories and schools, countless houses, and a long segment of a toll road.
- Catastrophe has internally displaced 39,700 people
- Cost more than USD 2.7 billion in damages.

Rocks

Name_____

TYPES OF ROCK: SOFT – ANSWERS

Igneous	Metamorphic	Sedimentary
Forms when lava (magma) cools and hardens	Rocks that have been changed from heat and pressure	Formed when small pieces of rock are pressed together
Can have crystals, air bubbles or a glassy surface	You can often see minerals in these rocks.	You can often see fossils or other rocks in this rock
Most of the Earth's crust is made up of this rock	Forms deep in the Earth	Often forms at the bottom of bodies of water
 GRANITE	 MARBLE	 CONGLOMERATE
 PUMICE	 GNEISS (pronounced nice)	 SANDSTONE
 OBSIDIAN	 QUARTZITE	 COAL



Carboniferous Limestone

- Fast percolation
- Permeable
- Hardly produces storm hydrograph

Chalk

- Porous
- Permeable

Sandstone

- Porous
- Permeable

Hydration
Clay minerals (such as Anhydrite) expand as they absorb water Anhydrite forms bonds with water to produce hydrates (Gypsum) – causes 0.5% expansion.
Extreme cases result in 1600% expansion, which causes cracking and fractures in the rock.

Carbonation: acid rain breaks down limestone/chalk.

Rocks

Rock Type: some minerals,

- ★ **cements** (in sedimentary rocks) are more resistant to weathering than others.
- ★ **Limestone** is susceptible to carbonation ($CaCO_3$).
- ★ **Sandstone** contains iron, therefore oxidation prone.
- ★ **Quartz** is chemically resistant, cannot be chemically weathered.

Rock Structure:

- ★ **Larger** grain results in **faster** weathering, as there is greater void space and high permeability.
- ★ Natural lines of weakness in rock formations allow water to penetrate – increasing weathering effects.
- ★ Rocks can be **porous/non-porous** (measure of open space between grains) and **permeable/impermeable** (measure of ease of ability to transmit water). More permeable = more weathering

Glacial (Alaska 0.04mm/yr)

- **freeze-thaw** is dominant, but number and duration of cycles is more important than degree of ice.
- Likely slow chemical weathering, but **common hydration**
- **Frost very Important.**
- **fairly high soil leaching**
- **low precipitation, low temperatures**
- **Granular disintegration occurs.**
- **Hydration weathering common due to high moisture.**

Temperate (Askrigg, England 0.5-1.6mm/yr)

- **chemical and biological** processes are dominant due to abundance of moisture and vegetation.
- High organic contents, carbonates deposited at dry areas.
- Both mechanical weathering and chemical weathering occur.
- Iron oxides leached silicate clays formed and altered.
- Deciduous forest areas: abundant bases high nutrient status biological activity moderate to high.

Arid/Semi-Arid: (Egypt 0.0001-2.0mm/yr)

- evaporation exceeds precipitation, so **mechanical** processes are dominant.
- In semi-arid areas thick **organic layers** lead to **leaching** and CaCO3 accumulation.
- Evaporation exceeds precipitation.
- Rainfall low.
- Mechanical weathering - salt weathering, granular dfslntegratlon, dominant

Humid tropical (Florida 0.005mm/yr)

- high seasonal rainfall and high temperatures results in significant **chemical** weathering.
- High rainfall often seasonal.
- Long periods of high temperatures.
- Iron and aluminium are common.