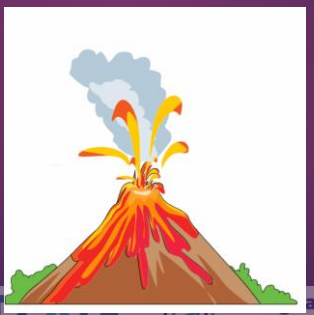
Getting to know volcanoes

LOOKING AT VOLCANIC ACTIVITY IN THE IRISH CONTEXT



True or False

Instructions: Read the statements and use your knowledge to decide if the statement is true or false.

1. A dormant volcano has not erupted in many hundreds of years but may erupt again	T	F
2. The Ring of Fire stretches in a north-south direction in the Atlantic Ocean	T	F
3. Volcanic activity has never taken place in Ireland	T	F
4. Mount Etna is an active volcano	T	F
5. The lighter the colour of the lava, the runnier it is.	T	F

True or False

Instructions: Read the statements and use your knowledge to decide if the statement is true or false.

1. A dormant volcano has not erupted in many hundreds of years but may erupt again	True	F
2. The Ring of Fire stretches in a north-south direction in the Atlantic Ocean	T	False
3. Volcanic activity has never taken place in Ireland	T	False
4. Mount Etna is an active volcano	True	F
5. The lighter the colour of the lava, the runnier it is.	True	F

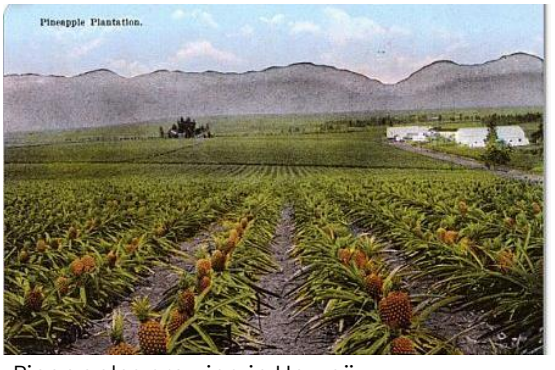
Why should we care about volcanoes?

What is their effect on society and our planet?

Footage of La Palma eruption

Positive impact on Society – Fertile soil

Vines growing on Mt Etna



Pineapples growing in Hawaii

Positive impact on Society – Geothermal energy

Geothermal energy plant near Reykjavik

Geothermal energy uses in Iceland

1. To produce electricity & provide hot water for heating
2. To keep pavements and car parks ice-free
3. To heat greenhouses
4. To dry fish and seaweed
5. In fish farms
6. To heat swimming pools/hot pools/spas

Positive impact on Society – New land

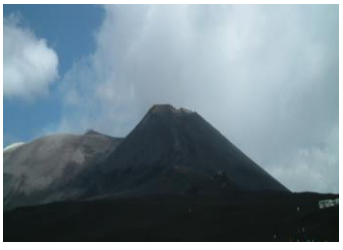
La Palma

Surtsey Island

Positive impact on Society – Building materials

Giant Causeway Visitor Centre consists of 209 basalt columns

Positive impact on Society – Tourism



Mt Etna

Pompeii

Old Faithful in Yellowstone

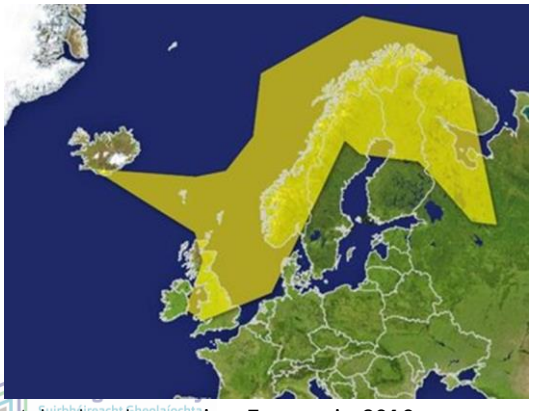
Negative impacts - Deaths

Pompeii
20,000 deaths in 7AD

Nevado del Ruiz lahar in Colombia
22,000 deaths in 1985

Mt St Helens
57 deaths in 1980

Negative impact – Ash clouds disrupt air travel

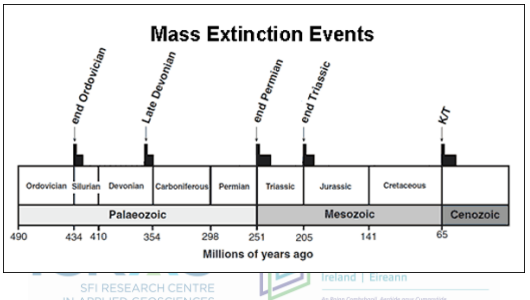


Ash cloud covering Europe in 2010

Impact on the Planet - volcanoes caused mass extinctions

The Big 5

In each event > 50 % of Earth's species became extinct



Impact on the Planet - volcanoes caused mass extinctions

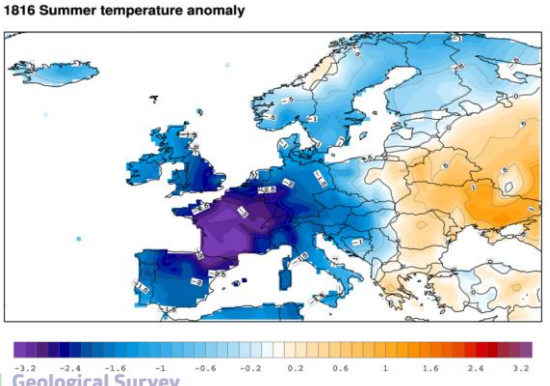
Dinogorgan

- The Dinogorgon vanished in the greatest mass extinction ever around 252 Mya (the Permian-Triassic) along with about nine of every ten plant and animal species on the planet.
- Likely caused by the eruption of the Siberian Traps, an immense volcanic complex that erupted more than 720,000 cubic miles of lava across what is now Siberia.

Impact on the Planet – volcanoes can cause global climate change

Mount Tambora 1816

- Ejected ash and aerosols into the atmosphere.
- Sky darkened and the sun was blocked from view over the following months.
- Had an effect on climate worldwide as Earth's average global temperature dropped 3°C.
- 1816 known as "The Year Without a Summer" in Europe and North America.
- Snow fell in New England. Cold rain fell in Europe. Cold, stormy and dark - not like typical summer weather.



Map of unusual cold temperatures in Europe during the summer of 1816

Impact on the Planet – volcanoes can cause global climate change

- Volcanic eruptions can produce vast amounts of **sulphuric acid aerosols** and **CO_2** that can cause global climate changes.
- The Siberian Traps, an immense volcanic complex that erupted during the Permian-Triassic Period, released more than 720,000 cubic miles of lava which triggered the release of at least 14.5 trillion tons of carbon.
- Magma from the Siberian Traps infiltrated coal basins on its way toward the surface, probably releasing even more greenhouse gases such as methane.
- In the million years after the event, seawater and soil temperatures rose between 25 to 34 degrees Fahrenheit (-3.8°C to 1.1°C)
- At the time, almost no fish lived near the equator.

Volcanoes

NOT JUST ONE TYPE

Volcanoes

- **Four types**
  - Cinder cone
  - Composite volcano
  - Lava dome
  - Shield volcano

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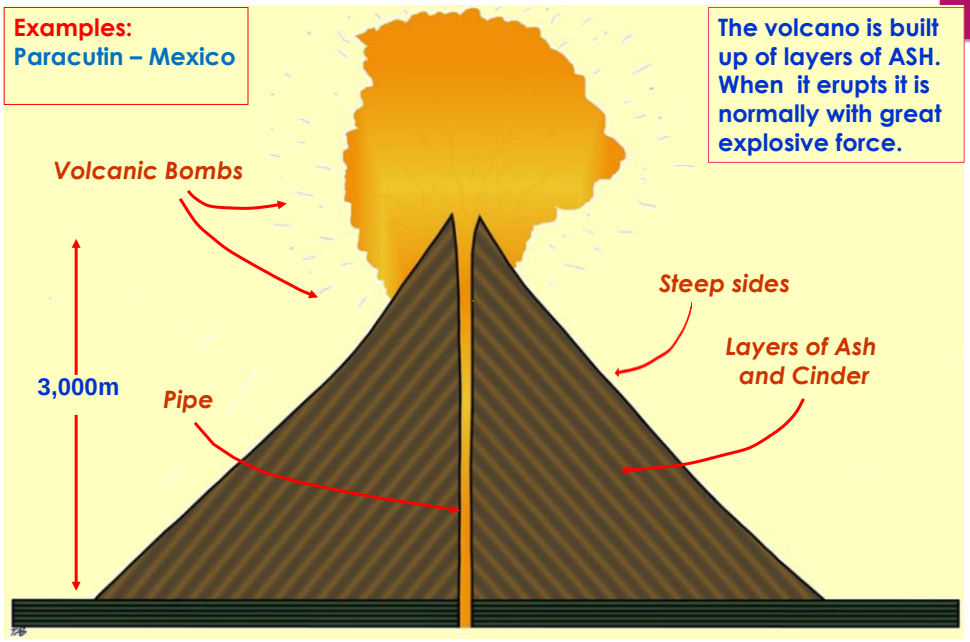
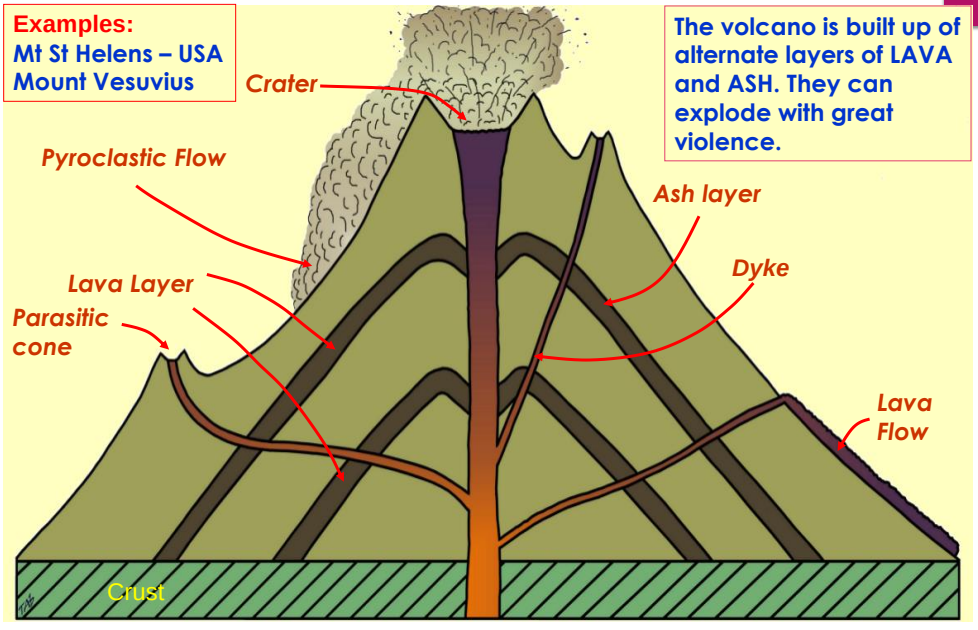
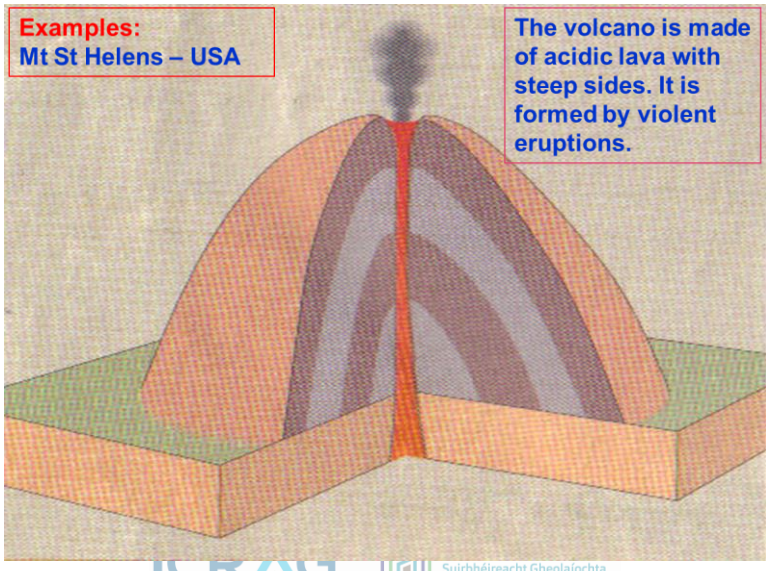
1. Cinder Cone



2. Composite (Strato-) Volcano



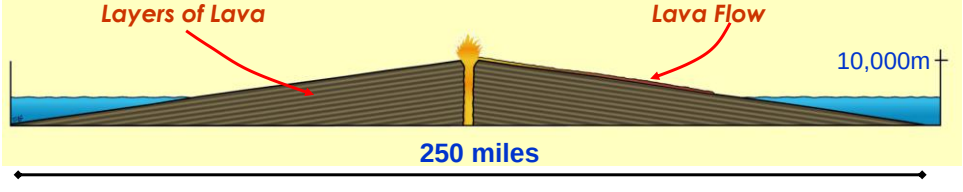
3. Lava Dome



4. Shield Volcano

Examples:
Mauna Loa Hawaii –USA

Volcano made of layers of basic lava with gentle slopes and a wide/broad base. They tend not to erupt violently.



Activity 1
"Guess what type of volcano"

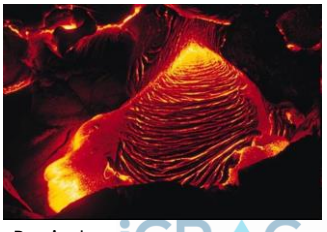
- Get into groups of 4
- 2 different colours of play dough per student – one representing lava, the other cinders
- Using a worksheet, each student selects a volcano and makes their own volcano
- Students discuss the differences and similarities between the types of volcanoes
- The class tries to guess what volcanic cone the student has made

Volcanic products

- Lava
- Basalt
- Pumice
- Material ejected into the air (Tephra)
  - Ash
  - Lapilli/Cinders
  - Bombs

Lava

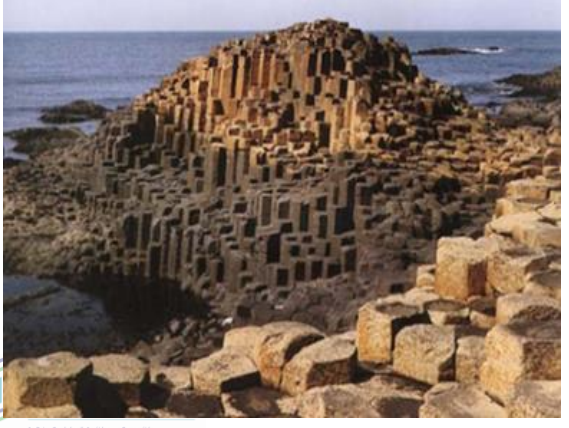
- There are 2 types of lava, classified on its ability to flow.
- 1. Basic lava - low in silica and very runny.
- 2. Acidic lava - high in silica and is pasty.



Basic lava

Acidic lava

Basalt – Volcanic Rock



Pumice – Volcanic Rock

Pumice

- is lava mixed with air causing it to fill up with air bubbles.
- is extremely light and brittle.
- Was full of hot gas bubbles.
- Rock is full of holes
- Can float in water
- Used as an exfoliator to help tub off dead skin.

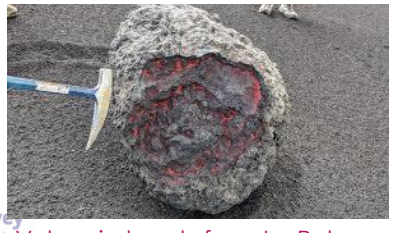
Tephra – Volcanic Ejecta

Classification is purely based on grain size of the ejected material

Volcanic ash < 2 mm | Lapilli 2 mm to 64 mm | Bombs > 64 mm

Volcanic ash from Mt St. Helens

Cinders/Lapilli



Volcanic bomb from La Palma

Tephra - Ash

River and homes covered in volcanic ash

Fact:
A volcano gave us the bike!

Mount Tambora in Indonesia was the direct reason we got the bike 200 years ago.

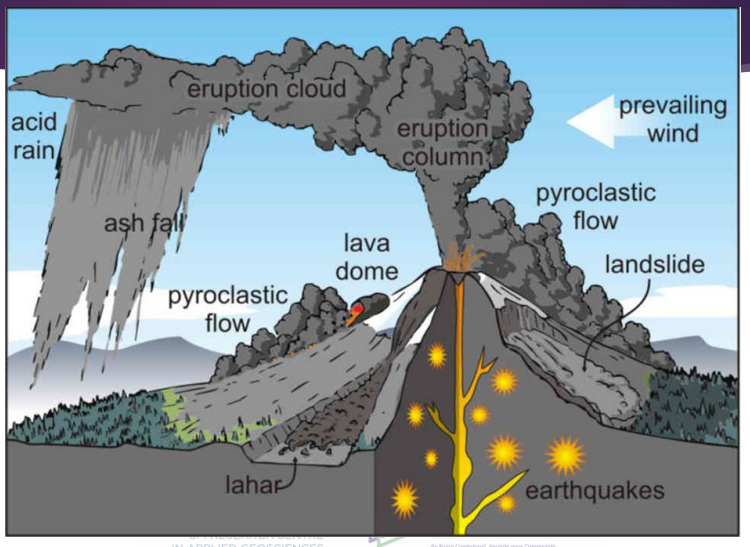
Tephra - Bombs

U.S. Geological Survey scientist examines volcanic bombs from Mount St. Helens eruption.

Fact:

When Mount Kelud in East Java erupted on 14/2/14 it sent bombs flying 10 miles into the air!

Volcanic hazards



Pyroclastic Flow

- A mixture of hot lava, ash and volcanic gases that travel down a volcano at great speeds (200 to 700 km/h).

Mount Pinatubo, Phillipines, 1991

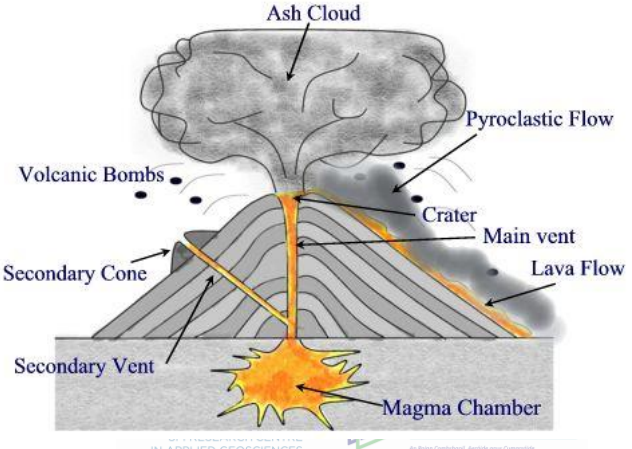
Mayon Volcano, Phillipines, 1984

Lahar

Nevado del Ruiz lahar in Colombia in 1985

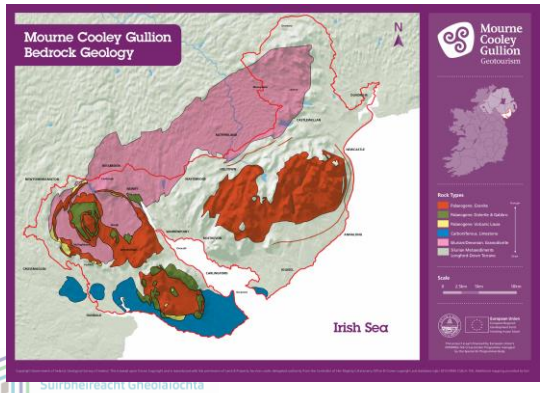
- volcanic mudflow
- caused by prolonged rain-fall or melting of snow and ice
- can flow down slopes at speeds of up to 200 km/hr

Cross section of a volcano



Magma Chamber

- The ring dykes of Slieve Gullion and Cooley were formed by the collapse of the magma chamber underneath.



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Activity 2

Rock identification

Be a Rock Detective

- Get into pairs
- Look at the rock samples
- Students have to place the rocks into the blank spaces
- Fill in information into fact sheets
- Students discuss the differences and similarities between the rocks

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Volcanic activity in the Irish context

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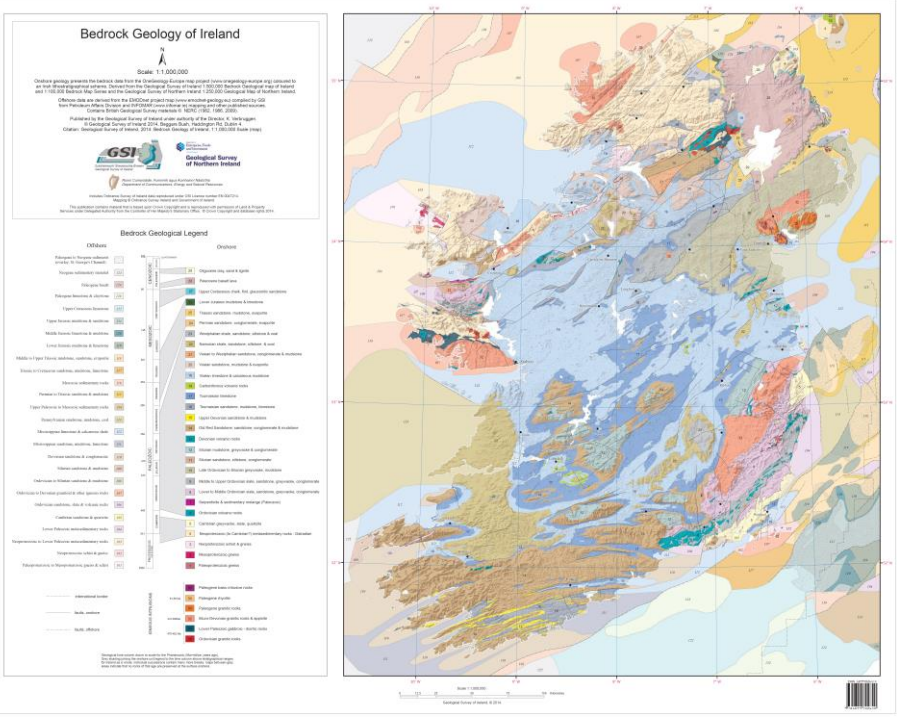
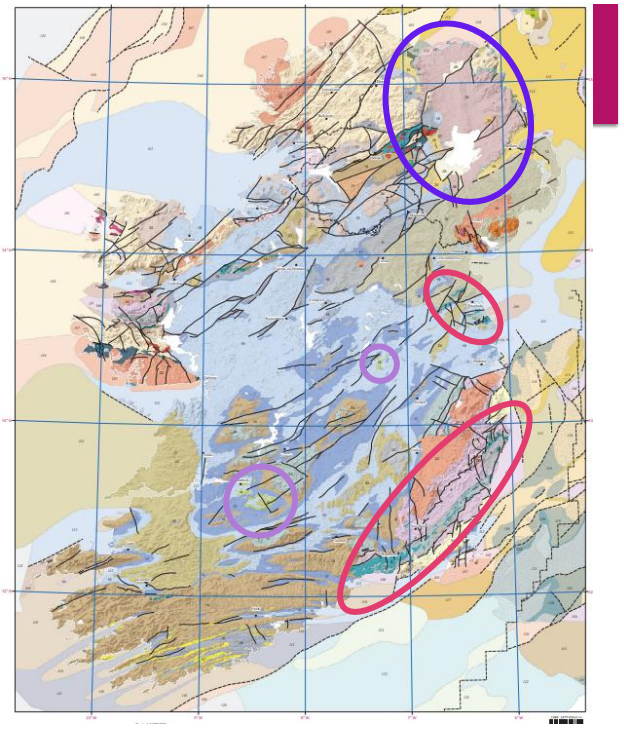
An Roinn Comhshaoil, Aeráide agus Cumarsáide
Department of the Environment, Climate and Communications

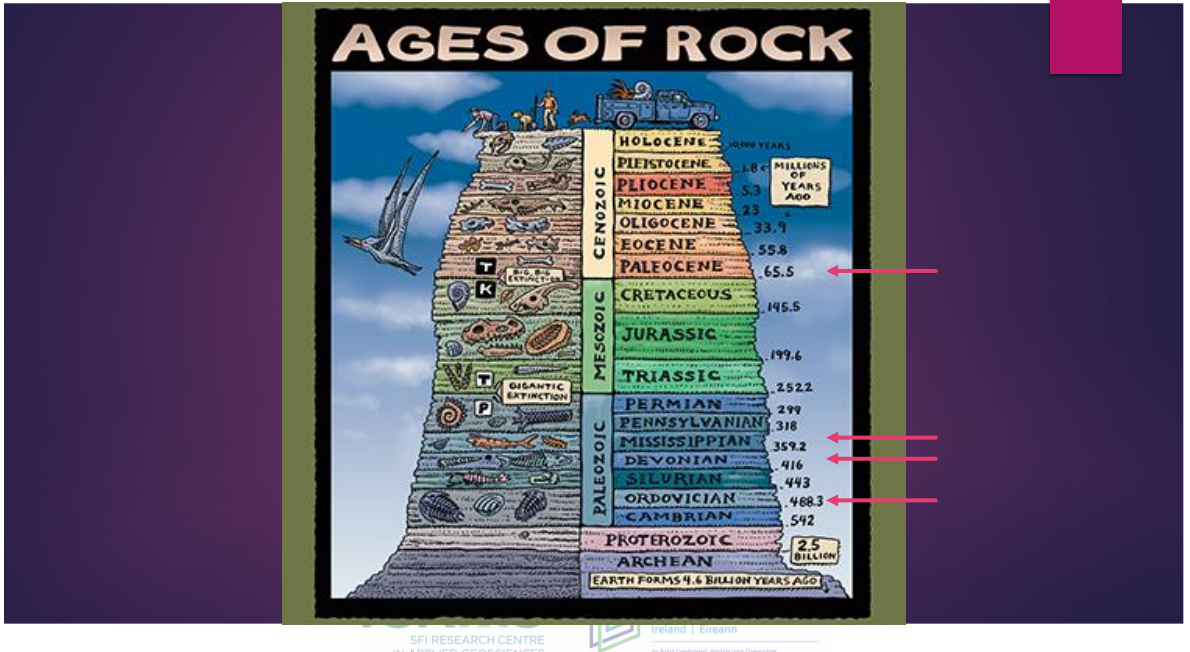
Using the legend, where do you find major volcanic rocks in Ireland?



Where do we find Irish volcanic rocks?

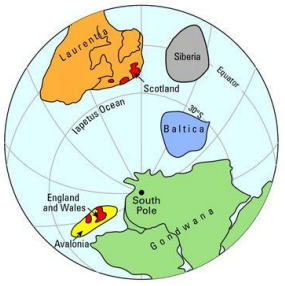
- Ordovician volcanic rocks
- Carboniferous volcanic rocks
- Paleocene volcanic rocks

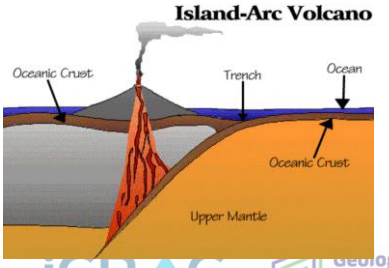


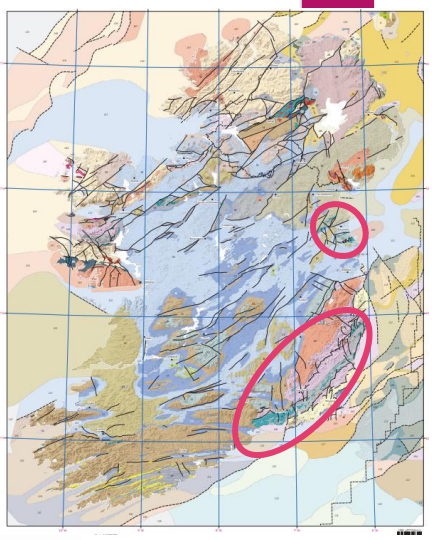


Ordovician Volcanism

- c. 430 to 480 Ma
- North of Ireland (& Scotland) was part of Laurentia (North America & Greenland), South of Ireland (England & Wales) was part of Avalonia
- Resulted in Island-arc volcanism
- created by converging plate boundaries (similar to Japan today)
- submarine volcanoes that tend to be explosive
- Examples: coastline of Waterford, Arklow Head (County Wicklow), Lambay Island

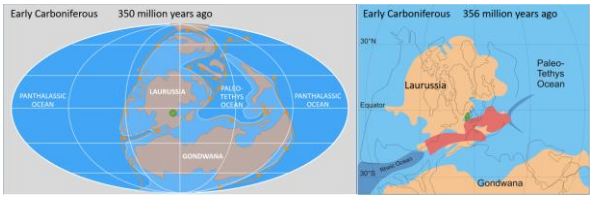


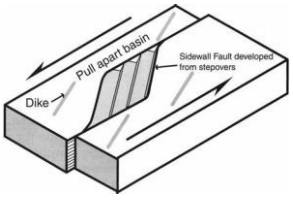


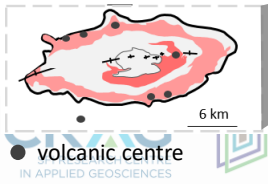


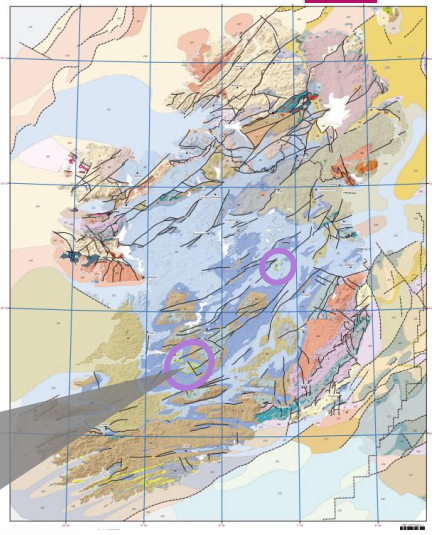
Carboniferous Volcanism

- c. 350 Ma
- Ireland is now one landmass
- Volcanism close to Limerick maybe caused due to the formation of a pull-apart basin → crustal extension / thinning
- 7 volcanic centres in Limerick area
- Other Irish example: Croghan Hill (Co. Offaly)



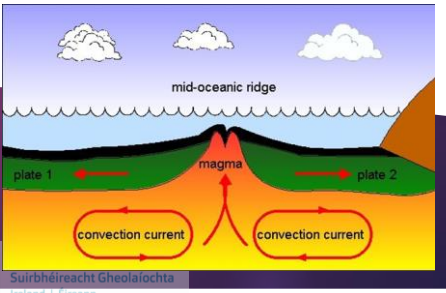






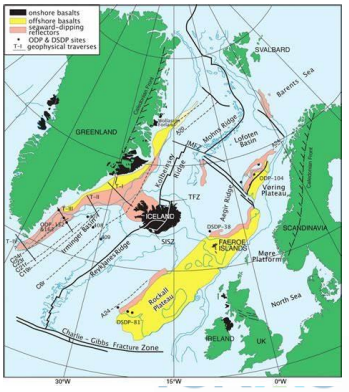
Paleocene Volcanism

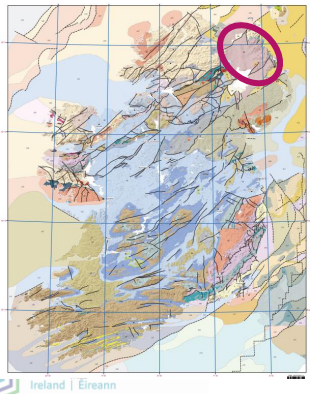
- c. 60 Ma
- Final burst of volcanic activity in Ireland that lasted for about 15 million years.
- volcanoes began to erupt because of an upwelling of hot magma from inside the earth. This is known as mantle plume.
- Ireland was attached to America but a string of volcanoes burst through the crust in a line that ran through Northern Ireland.
- Led to the birth of the Atlantic Ocean.
- Reopening of the Atlantic caused sea floor spreading
- Sea floor spreading caused increased volcanic activity



Paleocene Volcanism

- North Atlantic Igneous Province was built (Basaltic lava plateau)
  - 1.3 Mio. km^2 in area
  - 6.6 Mio km^3 in volume
- Plateau broke up leaving remnants in Northern Ireland (Giant's Causeway), west Scotland, the Faroe Islands, northwest Iceland, east Greenland, western Norway



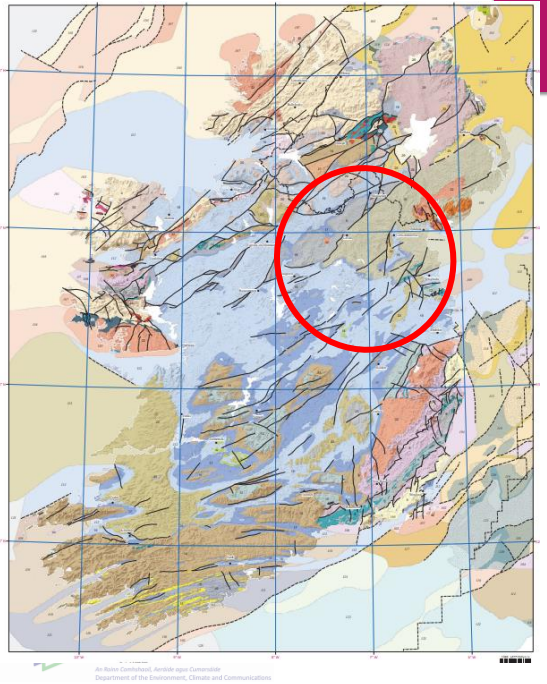


Isle of Staffa – Fingal's Cave

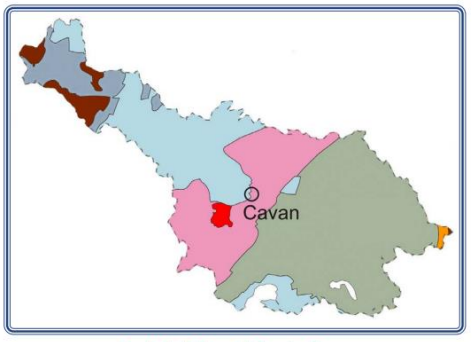
Giant's Causeway

Volcanism around Cavan

- Which one is the closest eruption?
- Eruption Age
- What type of volcanic rocks erupted



County Cavan



Geological Map of County Cavan

Pink: Ordovician; **Red:** Granite; Grey: Ordovician & Silurian; **Dark Blue:** Lower Carboniferous sandstones; Light blue: Lower Carboniferous limestone; **Brown:** Upper Carboniferous shales; **Orange:** Permian & Triassic sediments.

- Geological history The oldest rocks in County Cavan are 417-495 million years old [Ma] and consist of mudstones and volcanic rocks. At that time Ireland lay beneath a deep ocean, on the edge of an ancient continent made up of Scotland, north America and the north of Ireland. A huge ocean separated this continent from the rest of Ireland, England, Wales and Europe. Over millions of years, this ocean closed and the two ancient continents collided, heating and deforming the rocks to form slates. The same rock types occur from Longford, through Cavan, County Down and into the Southern Uplands of Scotland. Plate tectonic movements closed the ocean and the ocean floor rocks were faulted in slivers against the northern side. County Cavan now has these slivers of slate and sandstones stacked up across the southern half of the county. Only where a few graptolite fossils occur in the black slates can we work out the actual age and structure of the rocks.

Three-Two-One!

3 things I learned from today's class
1.
2.
3.

2 things I found most useful from today's class
1.
2.

1 question I have that I want to learn more about from today's class
1.

References

- www.gsi.ie
- https://www.bbc.co.uk/bitesize/guides/z8p9j6f/revision/1
- https://www.nationalgeographic.com/science/article/mass-extinction
- https://scied.ucar.edu/learning-zone/how-climate-works/mount-tambora-and-year-without-summer
- https://www.ringofgullion.org/geology/

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