

# Physical Environment of Scotland



# Course Overview

## Physical Environment

Allow you to interpret landscape and explain the physical environment ...

- ◆ Learn about the long & varied story of the formation of Scotland's rocks
- ◆ Link these rocks with the development of Scotland's landscape
- ◆ Appreciate that every pebble, boulder and grain of sand is a real 'historical' artefact that has a story to tell

# Logistics

- ◆ Eight sessions on four Fridays 5:30-7pm & 7:30-9pm in this room.
- ◆ Informal course
- ◆ Bring pictures, questions & rocks if you want
- ◆ Further Reading List
- ◆ Visit to Holyrood Park tomorrow ...



# Recommended Maps & Books

- 1:625,000 scale Bedrock Geology Map – UK North, published by the British Geological Survey
- Richard Fortey, *“The Hidden Landscape”*
- Con Gillen, *“Geology and Landscapes of Scotland”*
- McKirdy, Gordon & Crofts *“Land of Mountain and Flood”*
- SNH Landscape Fashioned by Geology series

# Holyrood Park

## Sat 6 December 9:30am-1pm

Meet: Public entrance to the Scottish Parliament, 9:30 am. We'll follow a clockwise circular route through the park, climbing close to the summit of Arthur's Seat and returning along the Radical Road at the base of Salisbury Crags. Bring warm waterproof clothing, stout footwear and something to eat and drink.

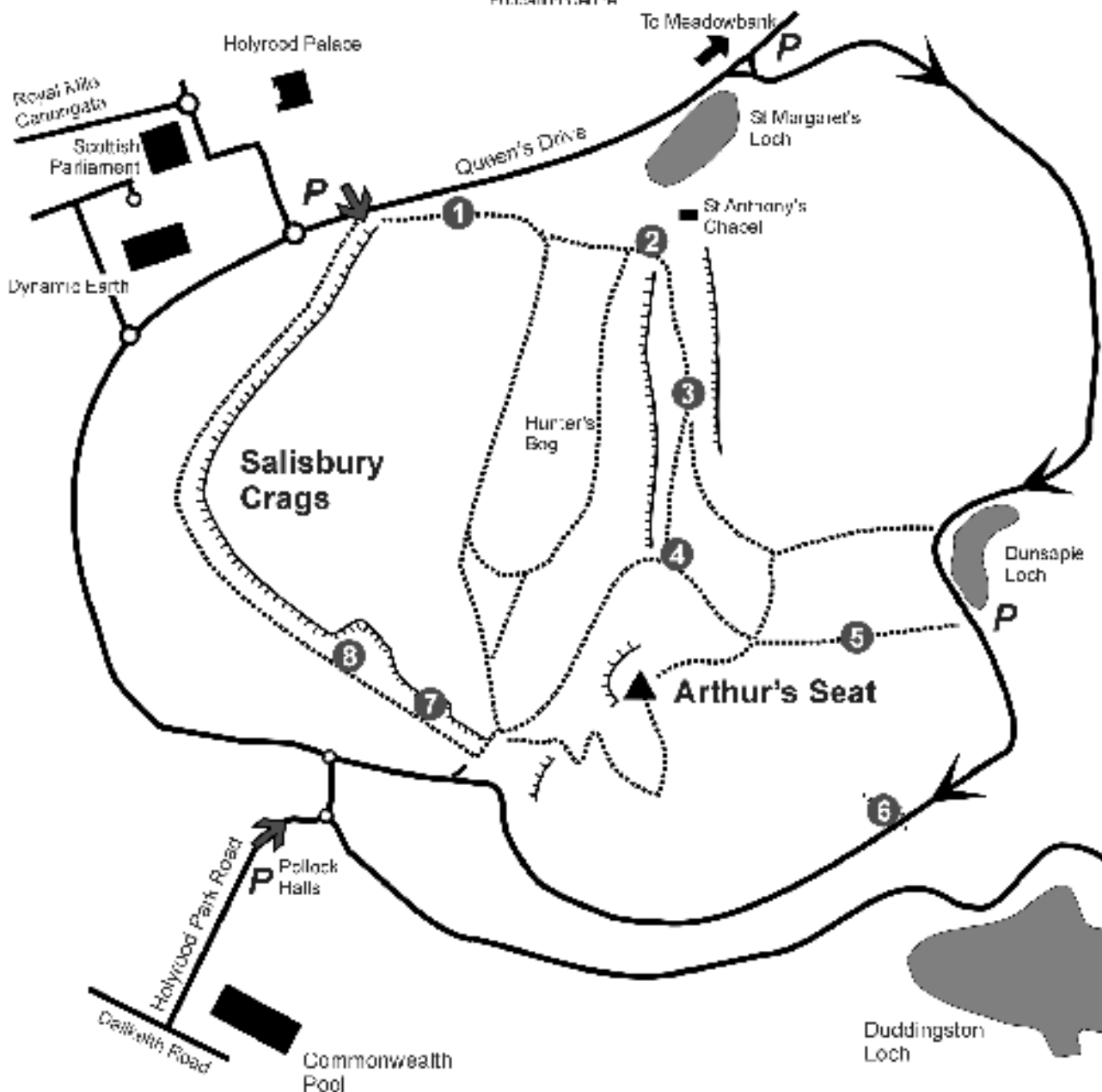


# OUTLINE MAP OF HOLYROOD PARK

Historic Scotland  
Ranger Service  
Educational Centre

## POINTS OF INTEREST:

1. General view of Edinburgh's hills and valley
2. Glacial erratic boulder, lava flow and local b stone used for St Anthony's Chapel.
3. Valley of the Dry Dam - layers of softer volc ash sandwiched between lava flows.
4. Vent of the Arthur's Seat volcano. The magi pushed up to the surface disrupting existing rc blasted skywards, leaving a bit of a mess behi Later quieter lava extrusion prevailed.
5. Agricultural terraces, just some of the many features of the park that show a long history o use.
6. Other side of the Arthur's Seat vent, cliffs al road give a glimpse of the chaotic conditions v the crater when the volcano was erupting
7. Hutton's Section, Salisbury Crags. Junction between the older sedimentary rocks and you dolerite intrusion of the Crags - used as eviden "a succession of former worlds" to support the of James Hutton (1726-1797) that the earth w long-lasting machine where natural forces cre and destroyed rocks.
8. Quarry in Salisbury Crags, where dolerite w extracted to be used for road stone.



# **Course Outline**

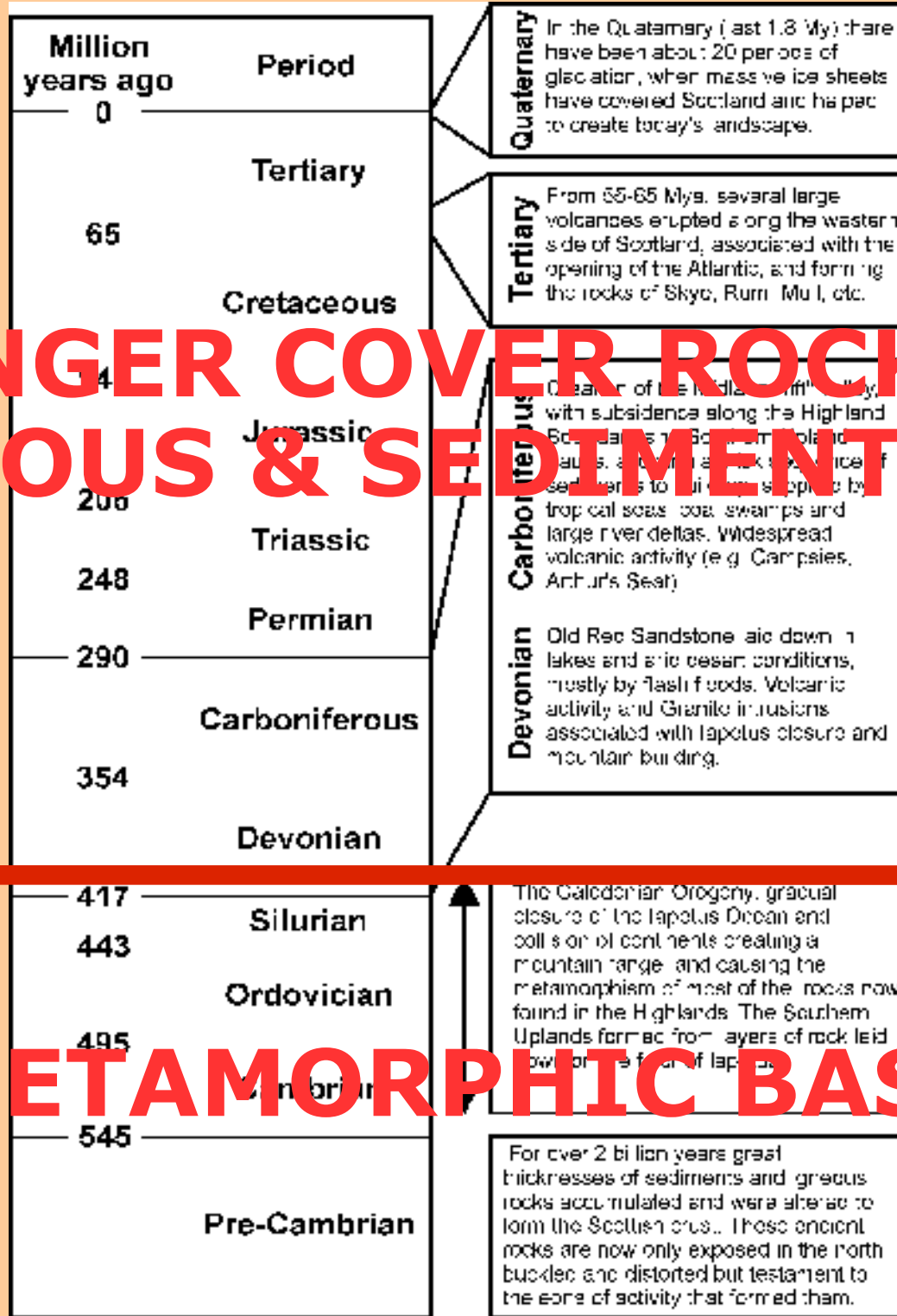
## **Physical Environment**

- 1. Introduction to geology, geological time and the processes that form the landscape**
- 2. Plate tectonics and the geology of Scotland**
- 3 & 4. Rocks of the Highlands**
- 5. Southern Scotland**
- 6. Midland Valley**
- 7. Shaping the bedrock: Erosion & Glaciation**
- 8. Synthesis – why are Scotland's landscapes so varied?**

# Geological Time

- the Earth formed 4,600 million years ago (mya)
- Oldest rocks in Scotland are around 2,900 mya
- Main diversification of life started only 600 mya
- Time since 550 mya is divided into -
  - Cainozoic (last 65 million years)
  - Mesozoic (Triassic, Jurassic, Cretaceous)
  - Palaeozoic (Cambrian – Permian)
- Scotland's rocks formed in three main phases -
  - basement rocks formed before 400 mya
  - cover of sedimentary rocks formed in Devonian & Carboniferous times (some more recent)
  - Cainozoic (Tertiary) volcanic activity

# YOUNGER COVER ROCKS - IGNEOUS & SEDIMENTARY



# OLD METAMORPHIC BASEMENT



# Rock Types

Rocks can be classified into three types:

IGNEOUS



METAMORPHIC



SEDIMENTARY

# Sedimentary Rock

Rock formed by the consolidation of sediment which has been transported by water or wind, and deposited usually in flat layers (beds). The sediment grains derive mainly from the erosion of older rocks; but particles in sedimentary rocks include shell and plant fragments.

*e.g.*, sandstone, limestone, coal.

# Igneous Rock

Formed from magma (molten rock) that is usually derived from melting of the upper mantle. Includes

(1) volcanic rock where magma comes to the surface and is emitted as lava and ash from volcanoes, and

(2) magma which cools underground, forming coarse-grained rocks

*e.g.*, basalt, granite.

# Metamorphic Rock

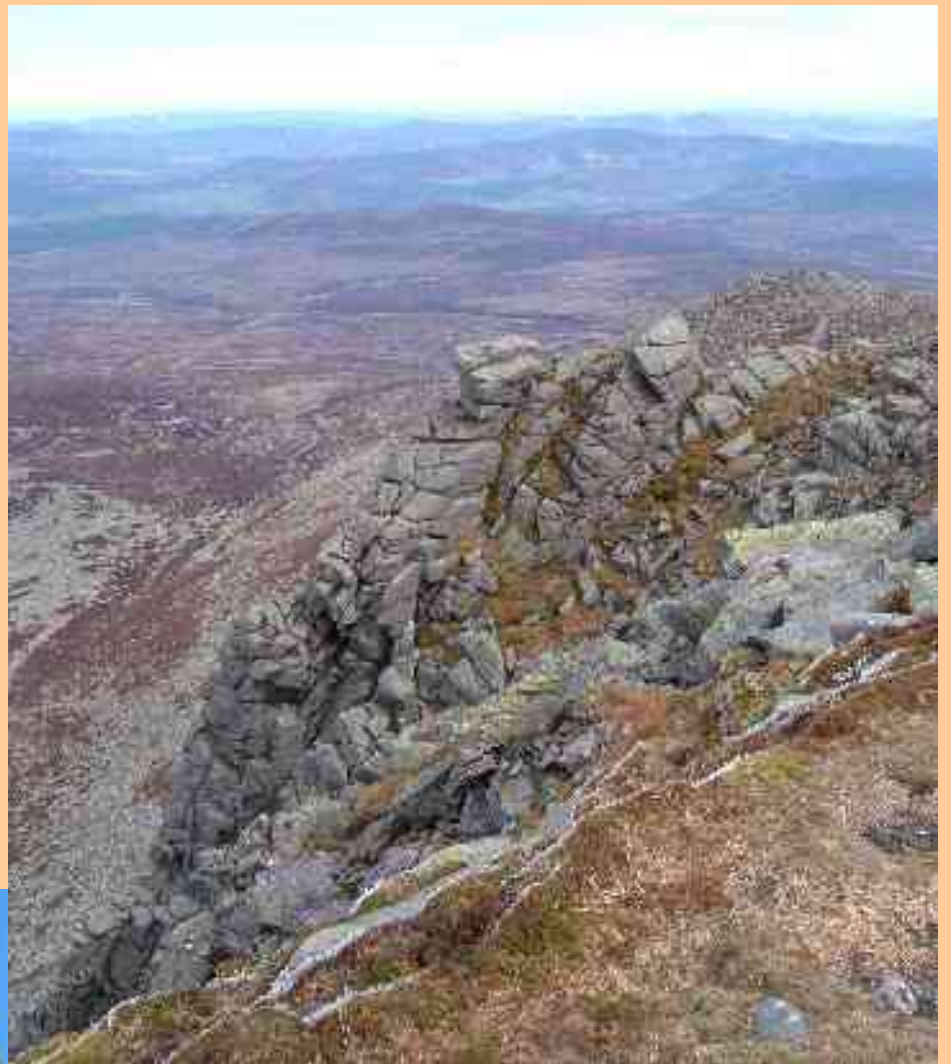
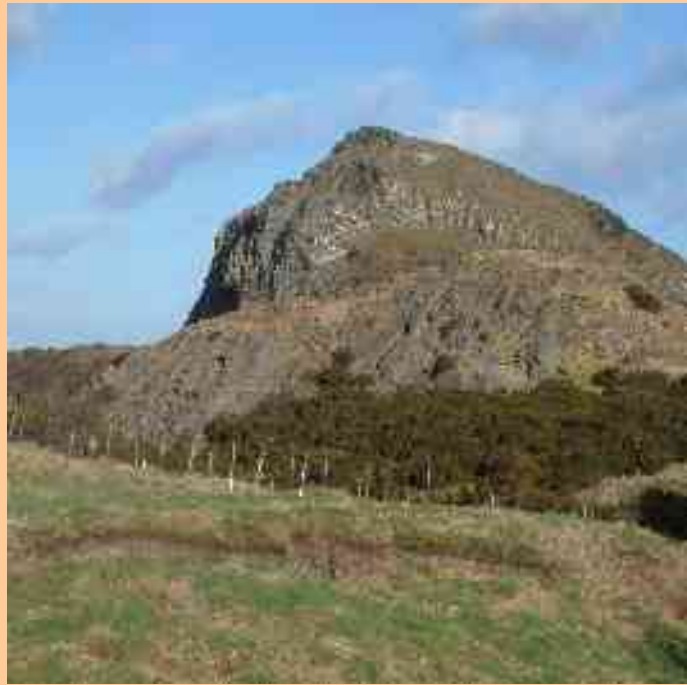
Formed by distortion of either sedimentary or igneous rocks, by burial and heating. Metamorphic effects range from slight changes to the rock fabric, to complete changes in the mineral content and structure.

"Regional metamorphism" is wide-scale deformation caused by heat and pressure.

"Contact metamorphism" describes the localised changes in the country rock caused by the heat from igneous intrusions.

*e.g.*, schist, gneiss, marble.







## **Dumyat & the Ochil Fault**

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# James Hutton 1726-1797

## Father of Modern Geology



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Thus we have shown, that, from the top of the mountain to the shore of the sea, which are the two extremities of our land, every thing is in a state of change; the rock and solid strath dissolving, breaking, and decomposing, for the purpose of becoming soil; the soil travelling along the surface of the earth, in its way to the shore; and the shore wearing and wasting by the agitation of the sea, an agitation which is essential to the purposes of a living world. Without those operations ... the surface of the earth would become sterile. But showers of rain and fertile soil are necessarily required in the system of this world; consequently, the dissolution of the rocks, and solid strata of the earth, and the gradual, flow, but sure destruction of the present land, are operations necessary in the system of this world; so far from being evils, they are wisely calculated, in the system of nature, for the general good.

*Theory of the Earth , Volume 2, 1795*

# James Hutton's "former worlds"

But if the succession of worlds is established in the system of nature, it is in vain to look for any thing higher in the origin of the earth.

The result, therefore, of this physical inquiry is, that we find no vestige of a beginning,—no prospect of an end.

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# The Rock Record

Where do rocks form?

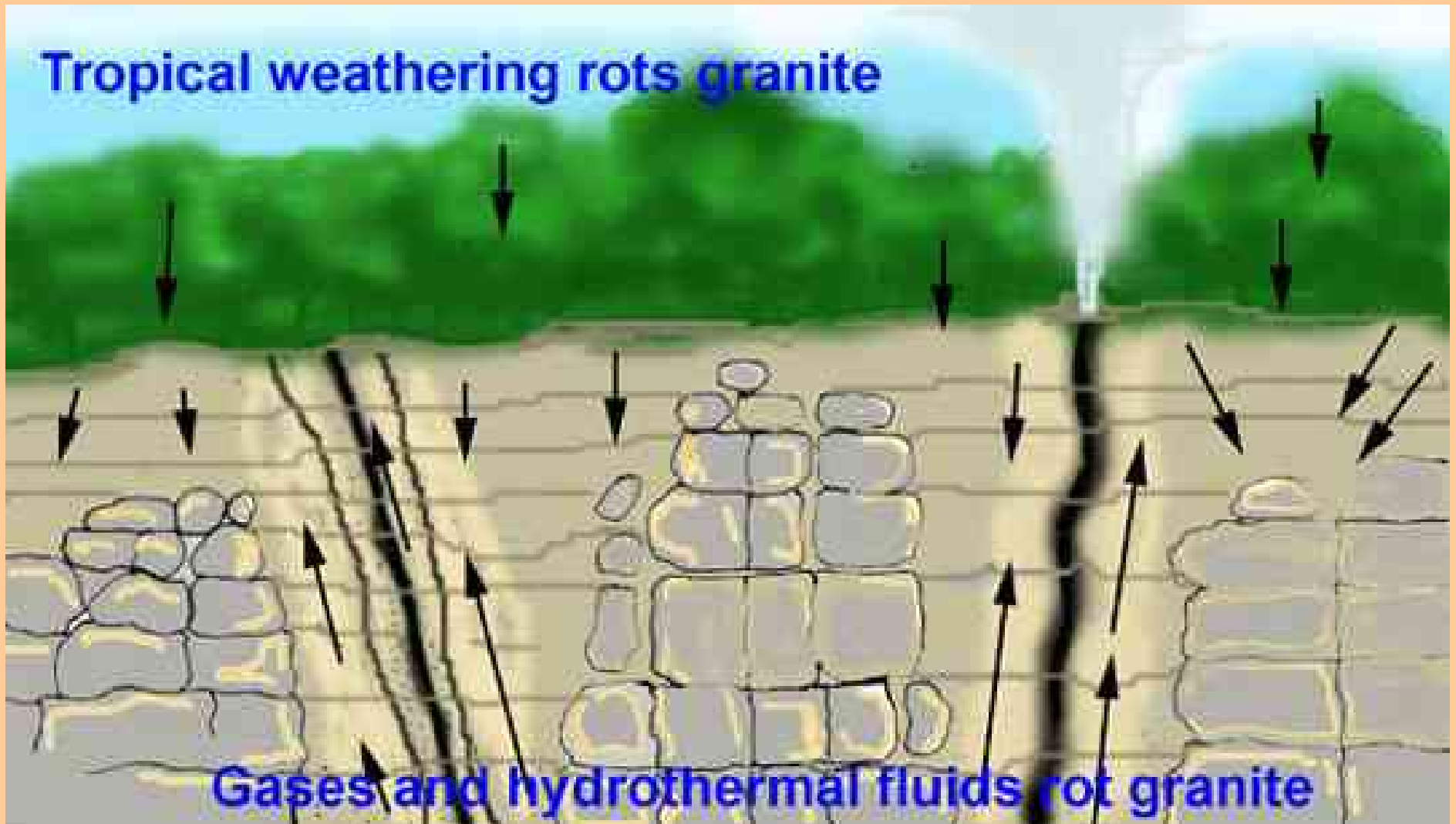
How do they get preserved?

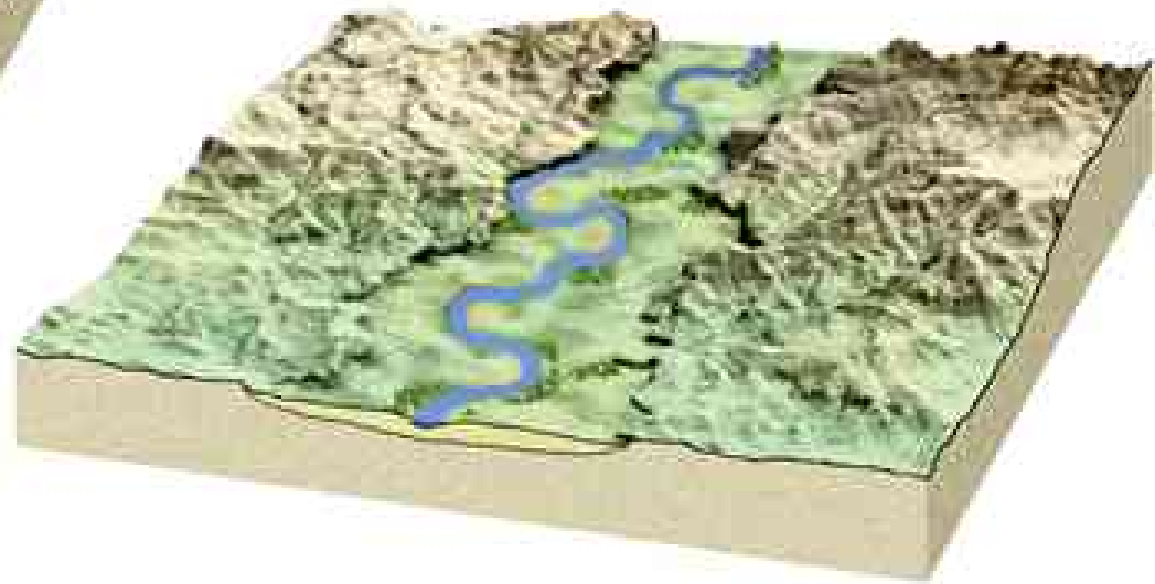
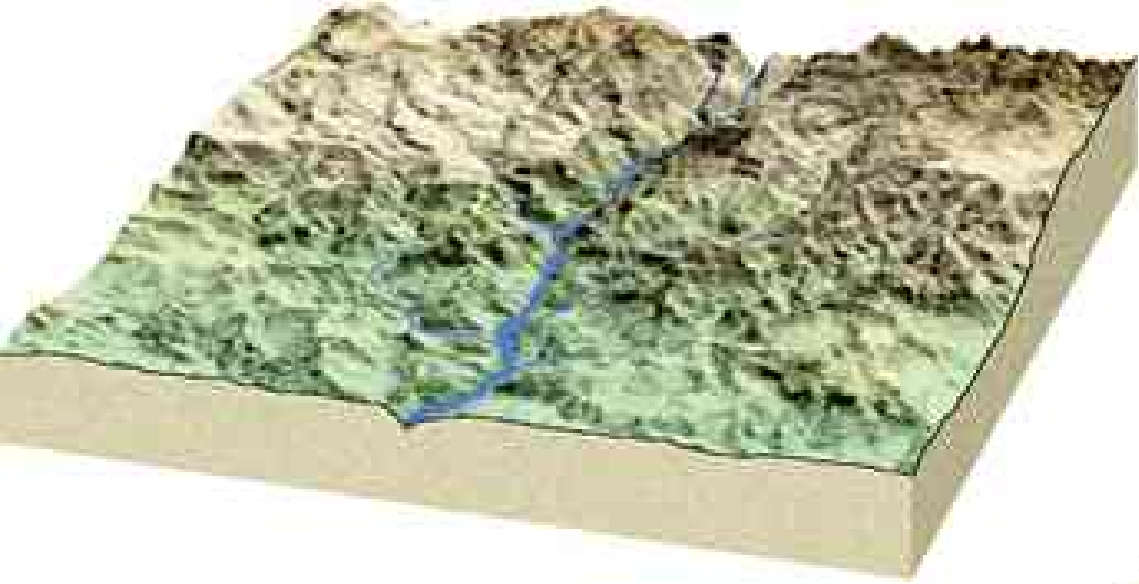
When will we see them again ...

Rocks give us a patchy record of the past:

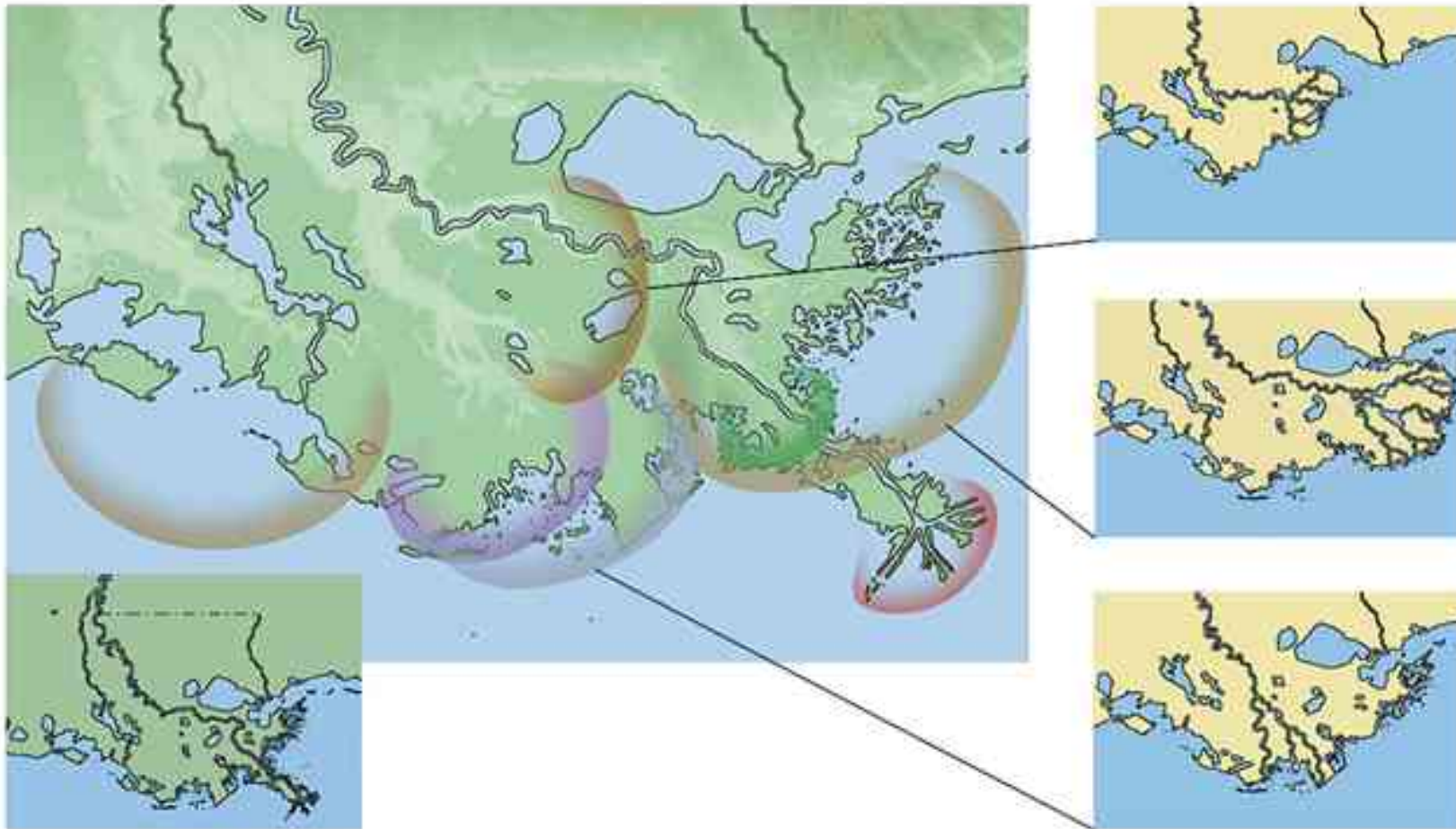
- ❖ Rocks are only created part of the time
- ❖ a smaller fraction gets preserved
- ❖ An even smaller fraction is available to see

*"Mountains begin to die as soon as they are born"* Richard Fortey





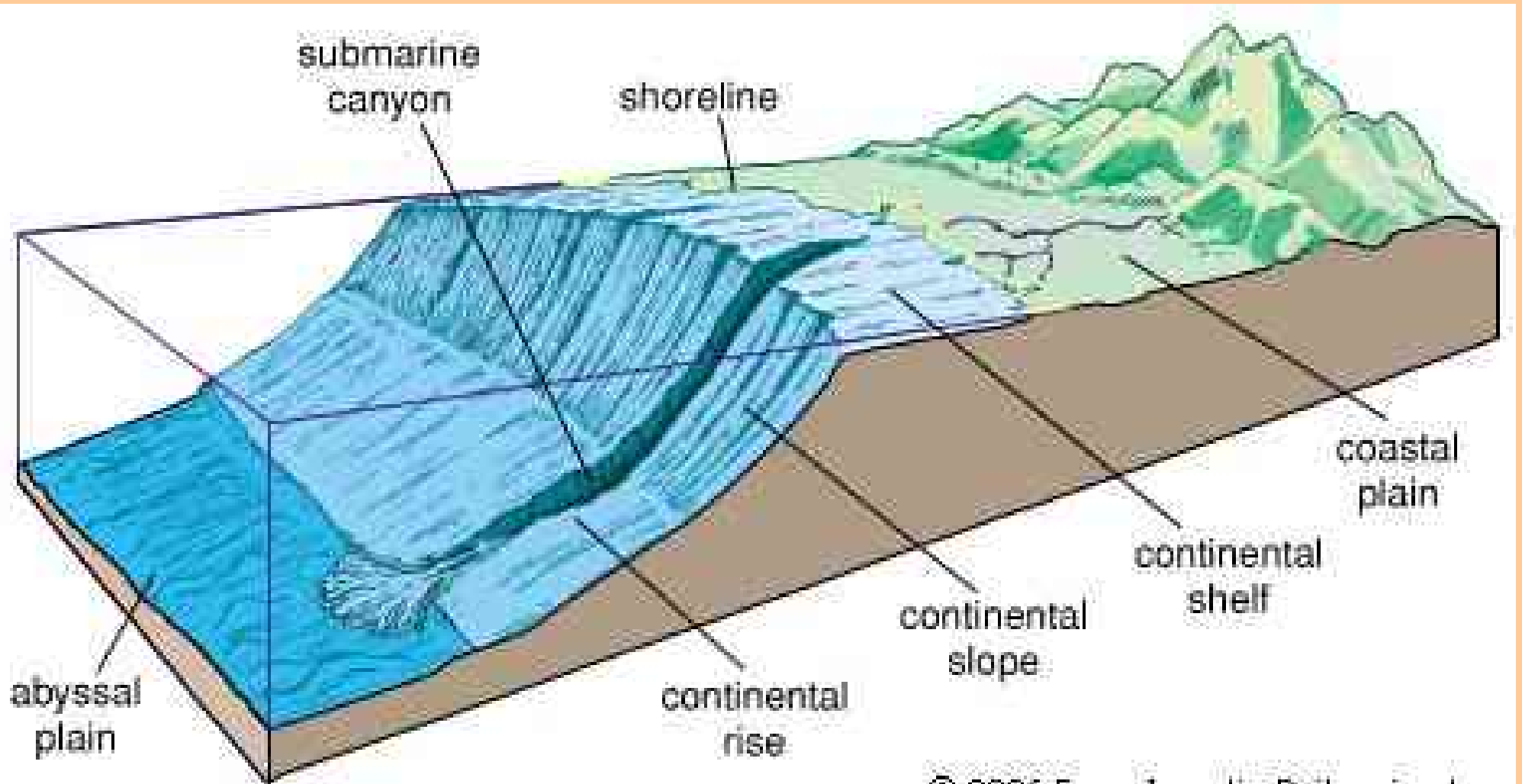
# River Delta



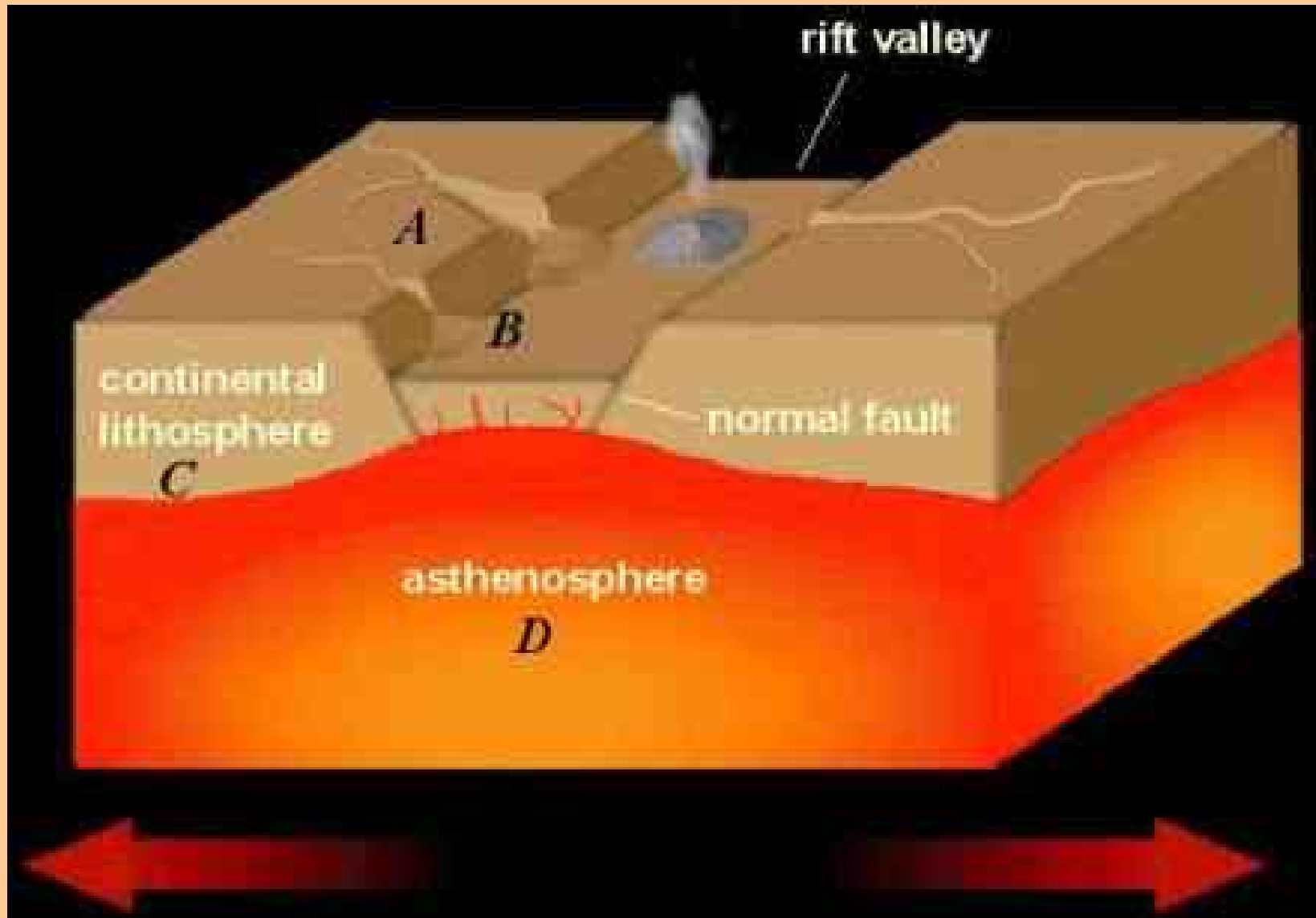
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- New rock forms where sediment gathers

# Continental Shelf



# Rift Valley



# Scotland's rocks

So ... the geological record is patchy, only parts of the story are preserved.

New rocks are only created and preserved when the conditions are right.

Dry land erodes, removing the most recent rocks from the surface and exposing older ones.