Stratigraphy laws

Steno's Laws

1. Principle of Superposition - Oldest rocks on the bottom Younger rocks on top
2. Principle of Original Horizontality - Sediments are deposited in flat, horizontal layers.
3. Principle of Original Lateral Continuity Sediments are deposited over a large area in a continuous sheet.

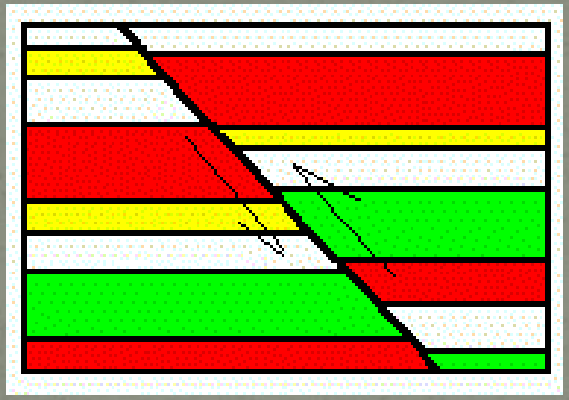
Stratigraphy

Steno's Laws are the basis of stratigraphy, the study of layered rocks.

Stratigraphy allows geologists place rock units into a sequence, to help interpret Earth history.

Principle of Cross-Cutting Relationships - Faults

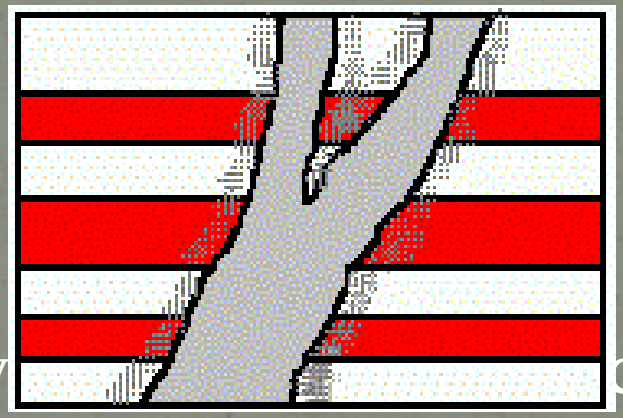
Where a fault cuts across a sequence of sedimentary rock, *the fault is younger than the rocks it cuts*.



The sedimentary rocks are older than the fault which cuts them, because they had to be there first, before they could be faulted.

Principle of Cross-Cutting Relationships - Intrusions

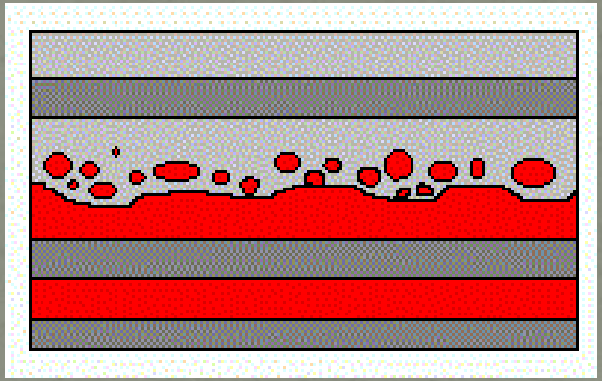
Where an igneous intrusion cuts across a sequence of sedimentary rock, *the sedimentary rocks are older than the igneous rock which intrudes them.*



The intrusion is y cks it cuts.

Principle of Cross-Cutting Relationships - Unconformities

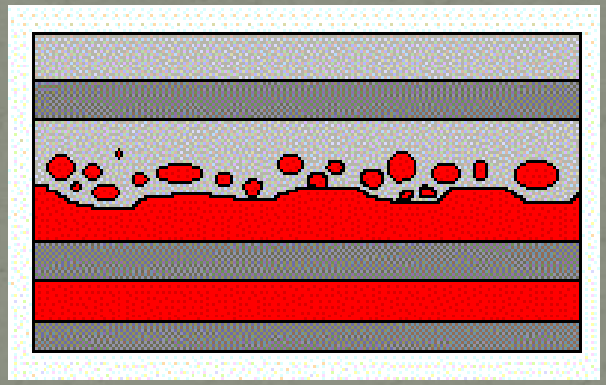
The irregular erosional surface is an unconformity.



The unconformity is younger than the rocks that have been eroded.

The Principle of Inclusions – Sedimentary Rocks

Fragments of eroded rock overlie the unconformity. These are gravel clasts or inclusions.



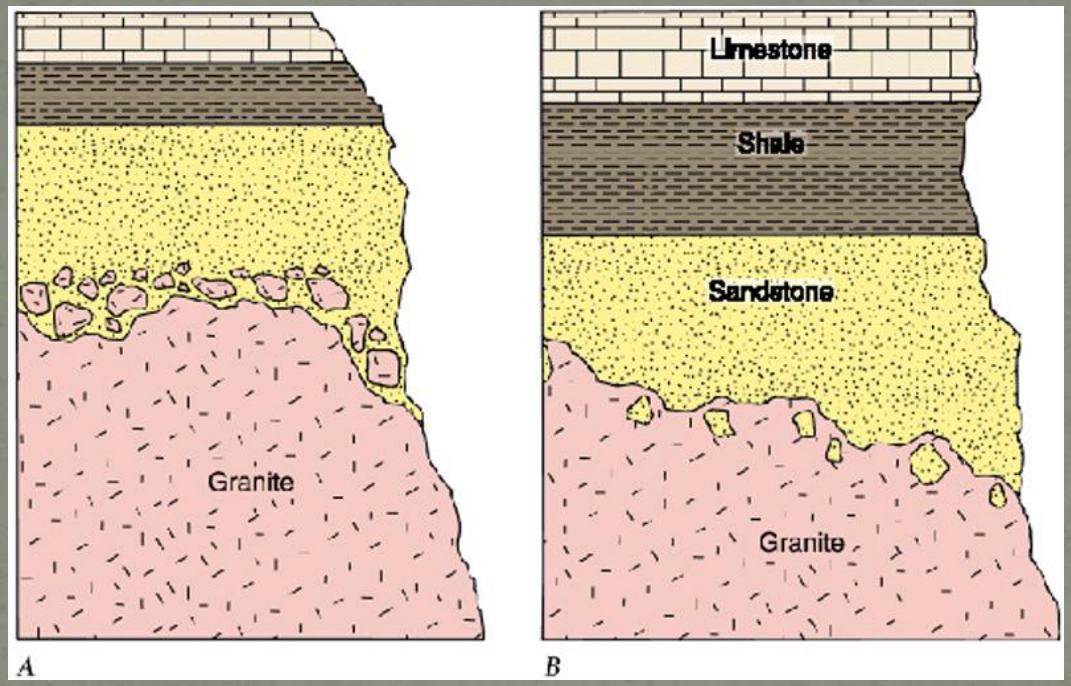
The pieces of gravel are older than the bed in which they are found.

The Principle of Inclusions – Igneous Rocks

A xenolith is a fragment of the surrounding rock which has broken off during an intrusion and fallen into the magma.

The xenolith is older than the igneous rock which contains it.

Comparison of inclusions in a sedimentary rock (A) with inclusions in an igneous rock (B).



Which are gravel clasts and which are xenoliths?

Uniformitarianism

James Hutton:

1. Saw Earth as a dynamic, ever changing place where rocks and mountains form slowly, and are slowly weathered and eroded.
2. Recognized that "the present is the key to the past".
3. Recognized uniform natural laws govern geologic processes, later called uniformitarianism.

Uniformitarianism

Uniformitarianism means that geologic processes are uniform through time.

Physical and chemical laws that govern nature are uniform.

Uniform natural laws govern weathering, erosion, glacial movement, earthquakes, volcanic eruptions, and the transport of sediment by moving water.

Actualism

- Many geologists prefer to use the term actualism, to emphasize the importance of natural laws to the concept of uniformitarianism.
- Actualism is the principle that natural laws governing past and present processes on Earth have been the same.

Principle of Fossil Succession

- William Smith (1769-1839) was an English surveyor and civil engineer who was working to site canals to transport coal in England.
- He saw that layers of rocks occurred in a definite order, and that rock units could be differentiated on the basis of the fossils they contain.

Principle of Fossil Succession

Fossils occur in a consistent vertical order in sedimentary rocks all over the world. This is the **Principle of Fossil Succession**.

Geologists interpret fossil succession to be the result of evolution - the natural appearance and disappearance of species through time.

Plate Tectonics

The Earth's surface or lithosphere is divided into **plates** (about 7 large plates and 20 smaller ones).

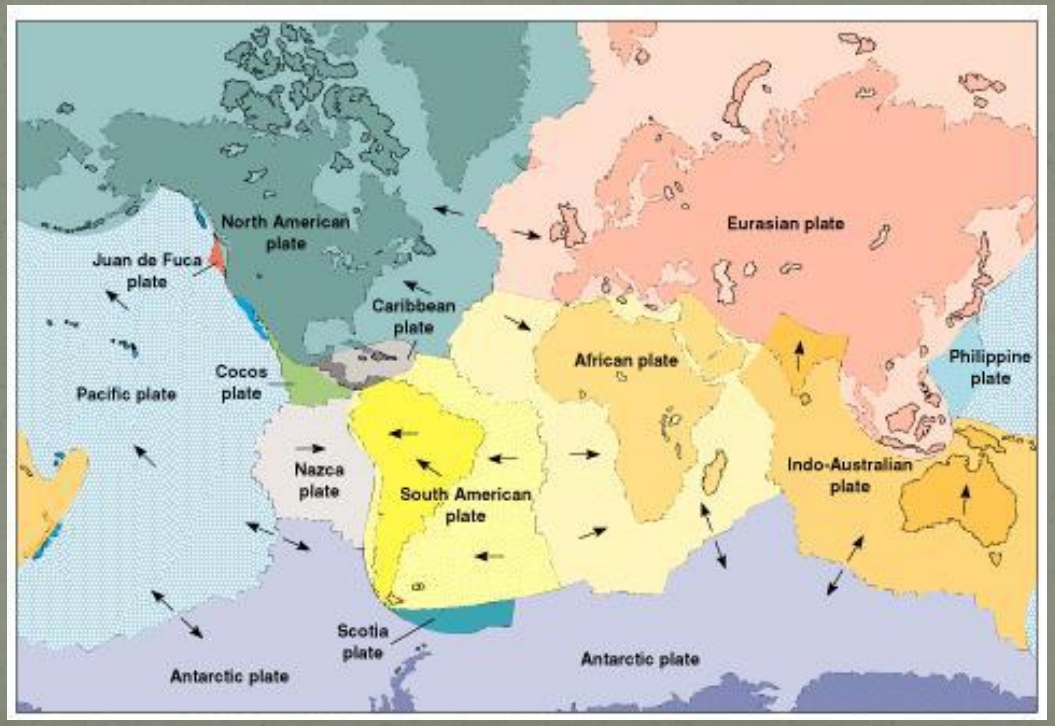


Plate Tectonics

The lithosphere is about 100 km thick and consists of the rigid, brittle crust and uppermost mantle.

Rigid lithospheric plates rest (or "float") on the asthenosphere, the easily deformed, or partially molten part of mantle below the lithosphere.

The plates are moving, but their rates and directions of movement vary.

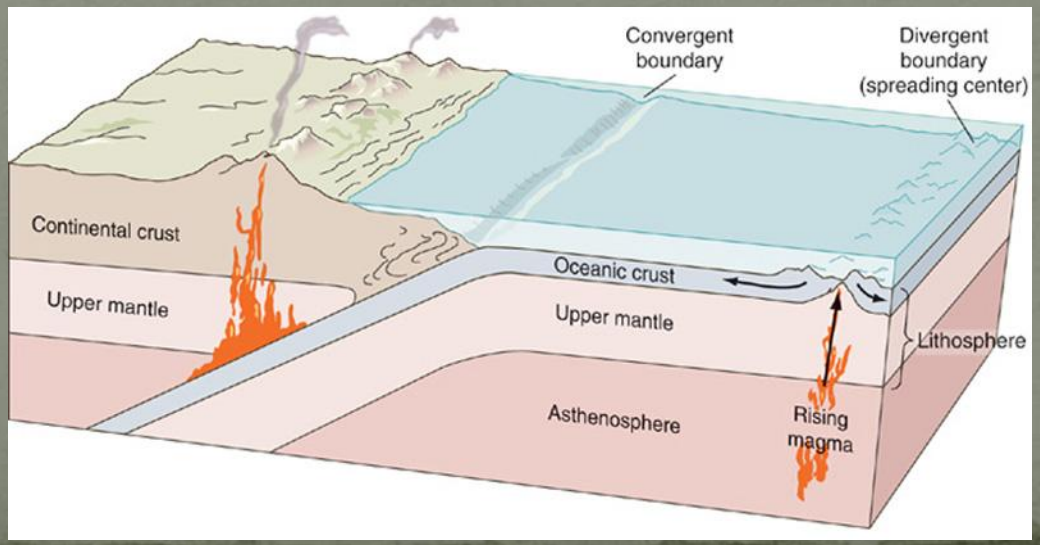
Plate Movements

Plate movement is due to convectional flow (circular movement of the asthenosphere due to hot material rising and cooler material sinking).

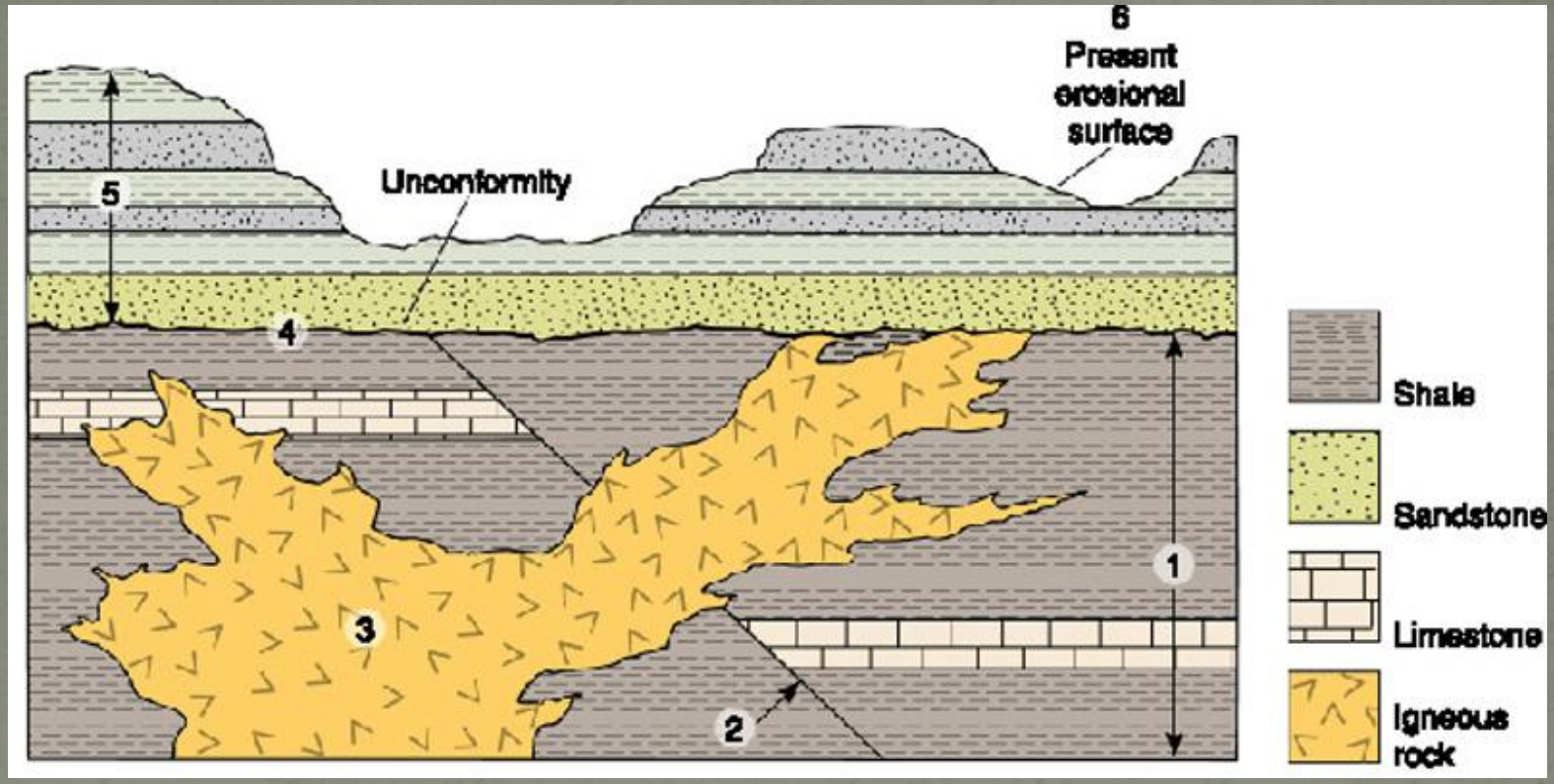
The plates only move a few millimeters per year, about the rate at which your fingernails grow.

Types of plate boundaries:

- Divergent - where plates move apart from one another.
- Convergent - where plates move toward one another.
- Transform - where two plates slide past one another



Interpreting a Sequence of Events



Determine the order in which the geologic events occurred.