

# GEOLOGIC HISTORY

## Relative Time:

- Ages of events are placed in order of occurrence.
- No exact date is identified.
  - Ex. WWI and WWII
  - "I am the second child in my family."

## Absolute Time- identifies the exact date of an event.

- Ex. 65 Million Years Ago
- 1990

## Finding age with relative time:

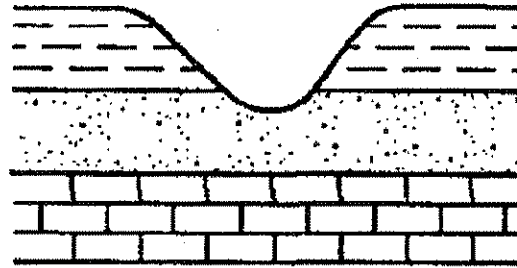
1. **The Law of Superposition-** in a sequence of undisturbed sedimentary rocks, the oldest rocks will be at the bottom.
2. **The law of cross-cutting relationships-** an igneous rock is younger than the rocks that it has intruded into. This also applies to faults.
3. **The law of included fragments-** the individual fragments that make up a rock are older than the entire sample.
4. **The Law of Folds or tilts in rocks** are younger than the rocks themselves.
5. **Original Horizontality-** Rocks are usually deposited flat and level.

## Other Guidelines for figuring out a sequence:

- Sedimentary rocks are usually formed under water.
- Weathering and erosion usually happen above water (on dry land).

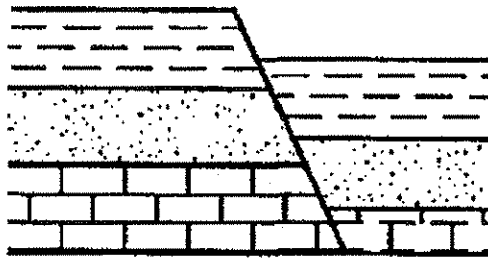
### Sequence 1: Uplift & Erosion

1. Limestone deposited
2. Sandstone deposited
3. Shale Deposited
4. Uplift
5. Erosion



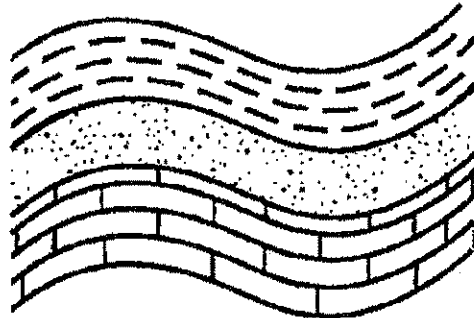
### Sequence 2: Faulting

1. Limestone deposited
2. Sandstone deposited
3. Shale deposited
4. Faulting



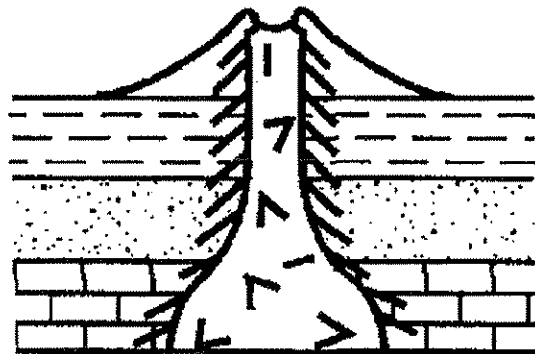
### Sequence 3: Folding

1. Limestone deposited
2. Sandstone deposited
3. Shale deposited
4. Folding of all the layers together



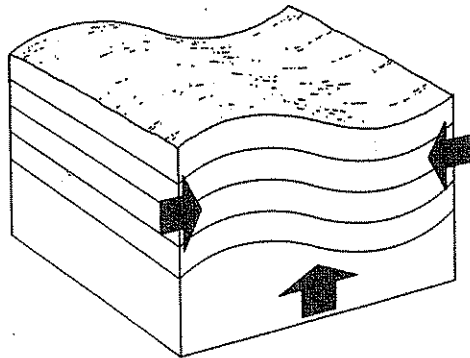
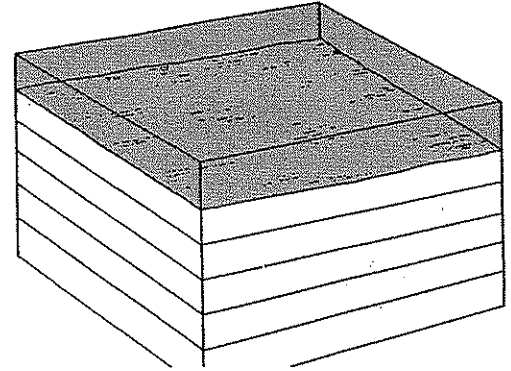
### Sequence 4: Igneous Intrusion

1. Limestone deposited
  2. Sandstone deposited
  3. Shale deposited
  4. Igneous Intrusion
- Note: contact metamorphism is the same event as the intrusion.*

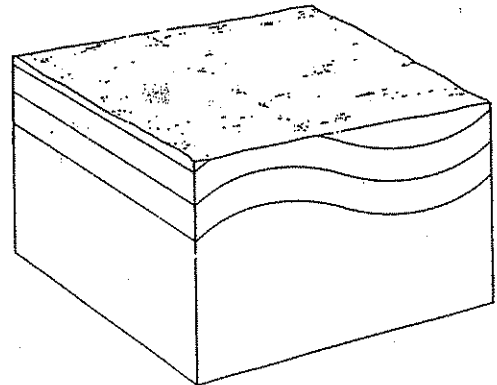


**Formation of an Unconformity-** an unconformity is a "missing layer of rock" or a gap in the record. Simply put, it is a "buried erosional surface."

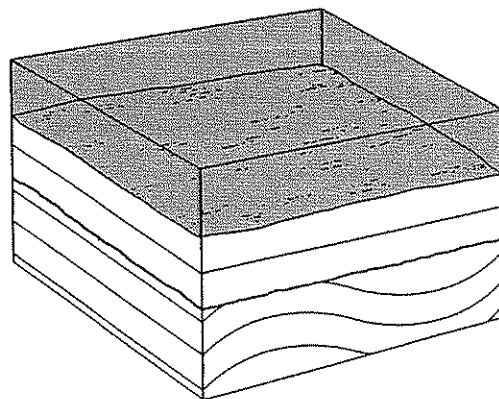
- Layers are formed according to superposition.
- Something happens to uplift the area- (folding, faulting, etc).



- Erosion wears away the uppermost layers



**Area submerges and deposition begins again.**



**Correlation- Matching a layer in one location with a layer formed at the same time in another location.**

**Correlation Techniques:**

- "Walking the outcrop"- following an outcrop and mapping all the structures that it touches.
- Similar rock characteristics- layers can be matched on the basis of similar colors, compositions, a unique feature, or by the same series of rocks "sandwiching" it.
- Index fossils - any animal or plant that is characteristic of a particular span of geologic time or environment.  
2 criteria must be met
- Life form lived over a wide geographic area – horizontal distribution
- Life form existed for a short period of time – short vertical distribution
- Volcanic time markers - a layer of volcanic dust covering layers.

When a violent eruption of a volcano occurs it may send dust high into the atmosphere where it can spread over the entire planet. It settles out of the air and forms a layer over wide regions at the same time.

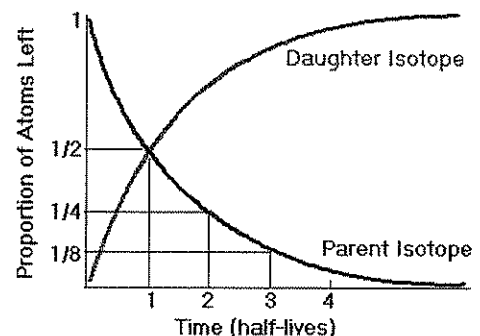
- Asteroid impacts can have the same effect.
  - Example: the layer that marks the extinction of dinosaurs has characteristics of an asteroid impact.

## Radioactive Dating

Radioactive elements decay (fall apart) at steady rates.

Key points of Radioactive Decay:

- One "half-life" of time has passed when exactly half of the element remains.
- Half lives differ from element to element.
- When they fall apart they form a different material.
- A ratio between the original material (parent material) and the decay product (daughter material) can be used to determine how many half-lives the material has undergone.
- Shape of curve similar for each radioactive isotope



- The radioisotope used should have a half - life that is around the age of the object being dated.
  - Ex: C14 is used for objects thousands of years old
  - C14 can be used to date back to around 50,000 years.

Some notes on C14 :

- C14 has a half-life of 5,700 years old.
- It is only used to date organic remains.

**Evolution-** the gradual changing pattern of life forms.

**Natural Selection-**First proposed by Charles Darwin-life forms best adapted to survive will continue to reproduce. Life forms will gradually change over time.

- Life begins as single cells about 3.5 Billion Years ago.
- Humans arrived about 1.6 Million Years ago.
- Most of the life that has evolved (>99.9%) has become extinct. This is not necessarily a bad thing. Many creatures are extinct because they have become something else.
  - Ex.: Cro-Magnon Man is extinct because they evolved into modern Homo-sapiens.

### **Mass Extinctions**

There have been several mass extinctions that have caused widespread endings to species.

Ex.:

- 65 MYA dinosaurs became extinct.
- 245 MYA 70% of all life on the planet became extinct.
- Today Approximately 10 species per day go extinct because of human involvement

