

GEOLOGIC TIME

GEOLOGY IN THE NEWS: Seismic waves were used to study the inner core. This revealed that the inner core is divided into 2 sub-layers. The iron crystals in each sub-layer have different properties from each other.

Q: Why do we care about geologic time?

A: Time is a major question in many studies?

I. RELATIVE DATING METHODS

A. Intro & Unconformities

- Dating Methods
 - o There are 2 approaches to dating in earth science
 - **Relative**- assign a qualitative age to something
 - Ex: dinosaurs lived before humans did
 - Often cheaper and easier than absolute
 - **Absolute**- assign a quantitative age to something
 - Ex: dinosaurs went extinct ~65 mya
 - These methods were mainly developed over last century; some are expensive
- Relative Dating
 - o The key to relative dating is studying **fossils** (preserved remains of ancient life)
 - o To understand fossils, you have to study the strata they are found in (fossils are only found in sedimentary rocks)
 - o Why don't you find them in other rock types?
 - Sedimentary rocks form at Earth's surface, where organisms live
 - Fossils would be destroyed in igneous environments
 - Very few fossils survive metamorphism
 - o **Stratigraphy**- the study of strata
 - Based on principles devised during the 1600s-1800s

- If you know how old each layer is, you know how old the fossils are
- Unconformities
 - o No one place on earth has a continuous record of strata from all of Earth's history; strata everywhere contain gaps that represent missing time
 - o **Unconformity (UCF)**- a gap in the stratigraphic record
 - o Why do UCFs occur?
 - Run out of sediment to deposit in a basin
 - Run out of accommodation space in a basin
 - Start eroding more sediment than you deposit
 - o Cause problems for geologists
 - Not always easy to identify in the field
 - How much time got lost in the gap?
 - o There are 3 types of UCFs- classified by strata relations
- Types of unconformities
 - o 1- **Disconformity**- sedimentary rocks above and below the UCF
 - o 2- **Nonconformity**- sediments overlie igneous or metamorphic rocks
 - o 3- **Angular Unconformity**- strata above the UCF are horizontal, strata below the UCF are inclined at an angle; takes a long time to form; several steps
 - 1: the lower strata are deposited as flat, horizontal layers
 - 2: those layers get tilted via folding, tectonic uplift, etc.
 - 3: part of the uplifted strata are eroded away
 - 4: new strata are deposited as horizontal layers on top

B. Stratigraphic Principles

- **Principle of Original Horizontality**- strata are initially formed as horizontal layers
 - o Can't pile loose sediment on a slope or straight up

- o Useful because when you see strata that are not horizontal you know they were altered after they formed
- **Principle of Superposition**- the bottom layer is oldest and each layer above it gets successively lower
 - o Assigning qualitative dates to strata
- **Principle of Cross-Cutting**- when 2 geologic features intersect, the one that cuts through the other is the youngest
- **Principle of Faunal Succession**- since each species of fauna went extinct at certain times, the order of fossils in strata is predictable
 - o Important because it allows strata in different places to be linked in time (**correlation**)

C. Correlation

- Fossils are the most common way of correlating strata
- Not all fossils are great for correlation
 - o Ex: cockroaches have been around for a very long time so a cockroach fossil won't tell you much about the age
- **Index fossils**- fossils that are very helpful for correlation
 - o For a species to be a good index fossil it needs certain traits
 - Numerous- you want to find lots of that fossil
 - Widespread- you want to find that fossil in lots of places
 - Went extinct quickly- the shorter the time increment represented by the species, the more useful for correlation
 - Easy to identify- misidentification could mess up entire correlation
- There are ways to correlate without using fossils; good because not all strata contain index fossils
 - o **Lithostratigraphy**- correlate by rock type; must have the same layer
 - o **Sequence stratigraphy**- use sets of UCFs to correlate