

# Rocks as archives of Earth's history



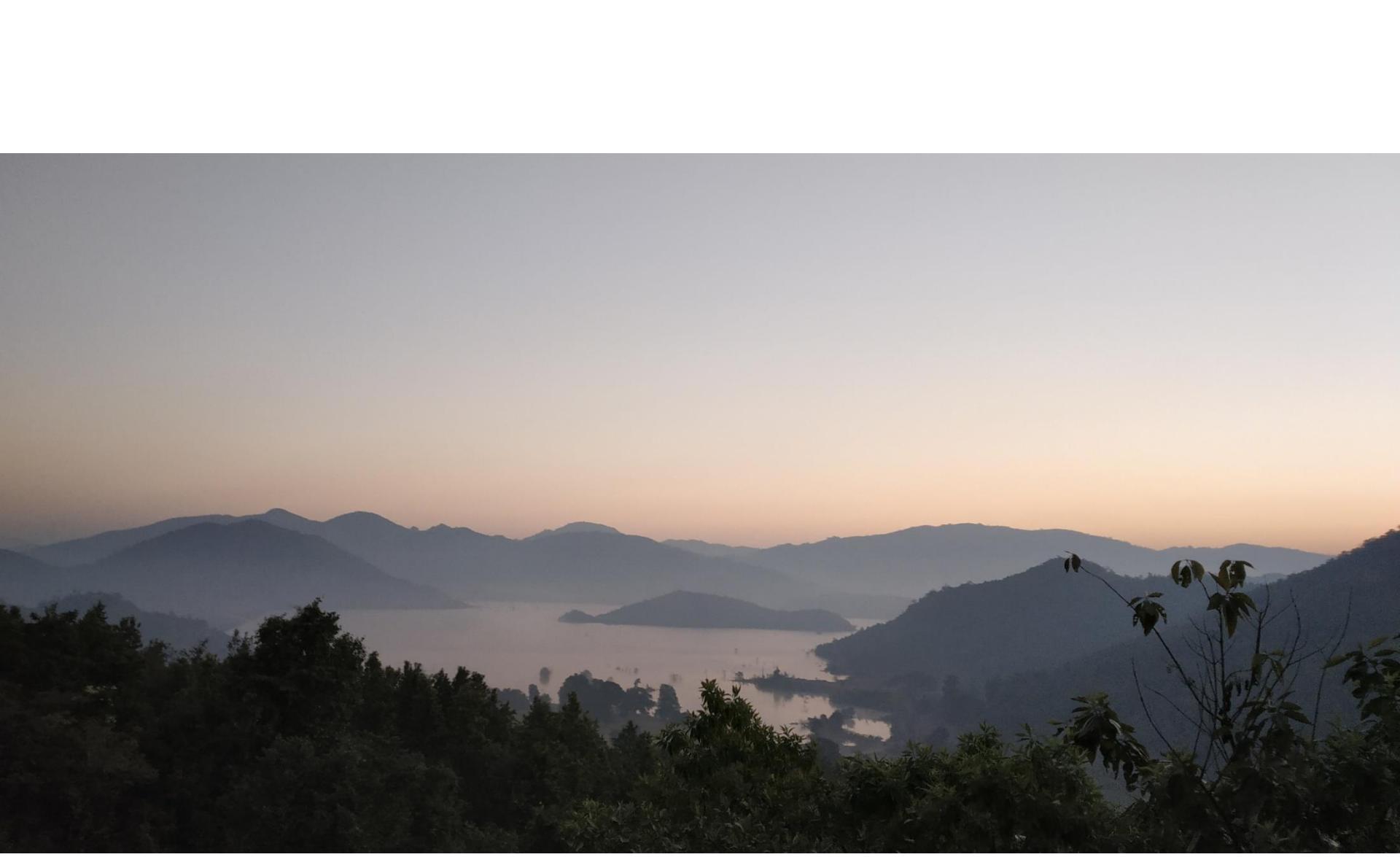
Labrador, Canada



Bushveld, S. Africa



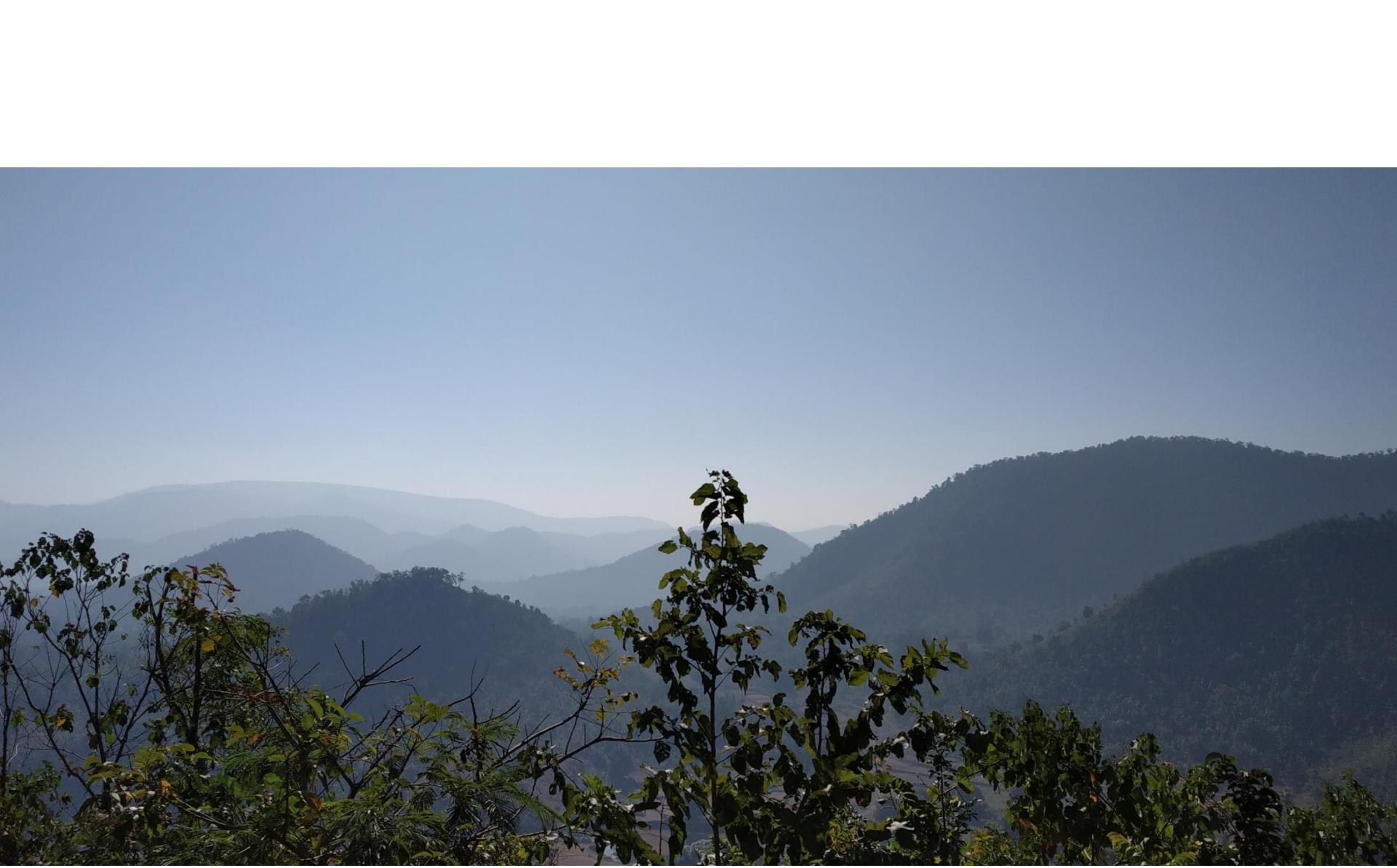
Clark Friend and Vickie Bennett: lunch on the outcrop, Greenland, 1997. *Photo by Allen Nutman.*













# **Stratigraphy/ Historical geology:**

**Stratum** (Latin): Layer

**Graphia** (Greek): Description

- ✓ Stratigraphy is the study of rock layers (strata) and their relationship with each other.
  
- ✓ Stratigraphy provides simple principles used to interpret geologic events.

- **Basic principles**

- ✓ Principle of original horizontality
- ✓ Principle of superposition
- ✓ Principle of cross-cutting relationships

# 1. Principle of Original Horizontality: Most sedimentary rocks formed originally in close-to-horizontal layers



Undeformed strata

Deformed strata  
(tilted)

(although many have since been moved from their original position)



# Banded Iron Formation layers near Chikmagalur, Karnataka





inclined rock layers must have been moved into that position after deposition.

## **Principle of superposition:**

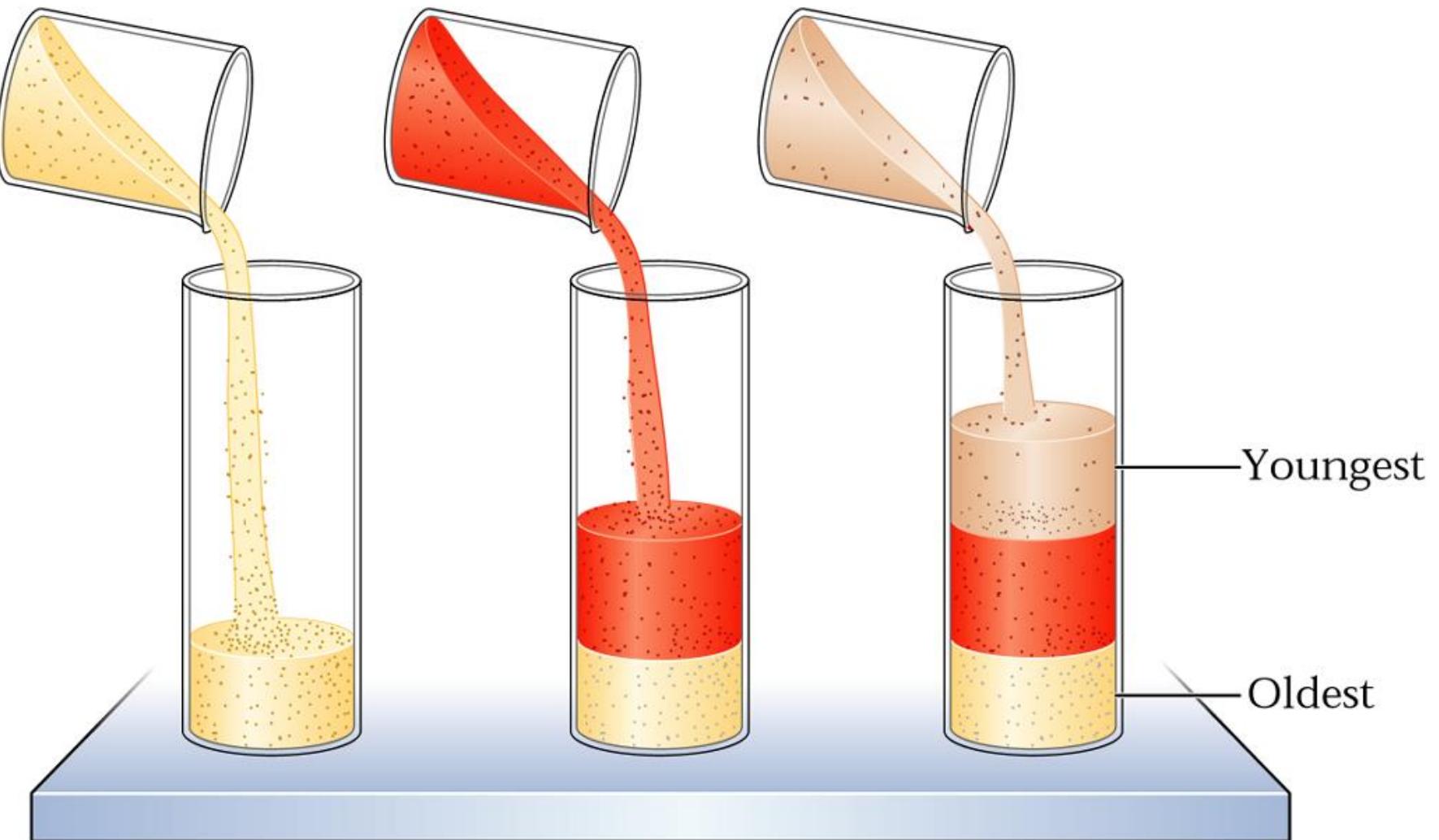
In an undeformed sequence of sedimentary rocks, each bed is older than the one above and younger than the one below.

The rule also applies to other surface-deposited materials such as lava flows and volcanic ashes.

TIME 1

TIME 2

TIME 3



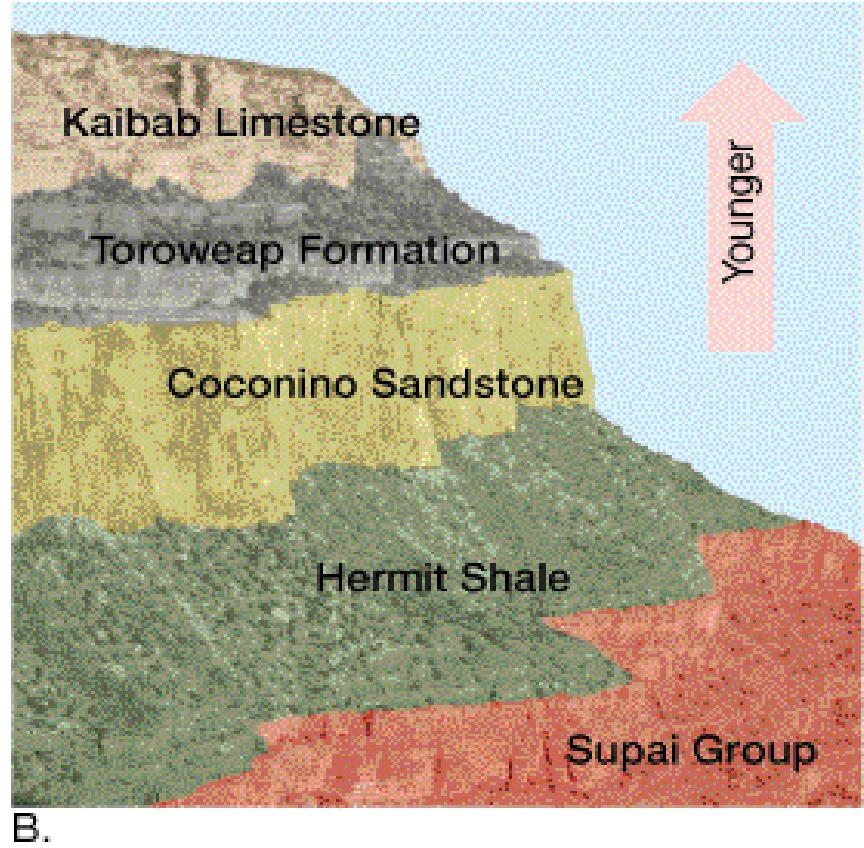
2. Principle of superposition.



# Grand Canyon



A.

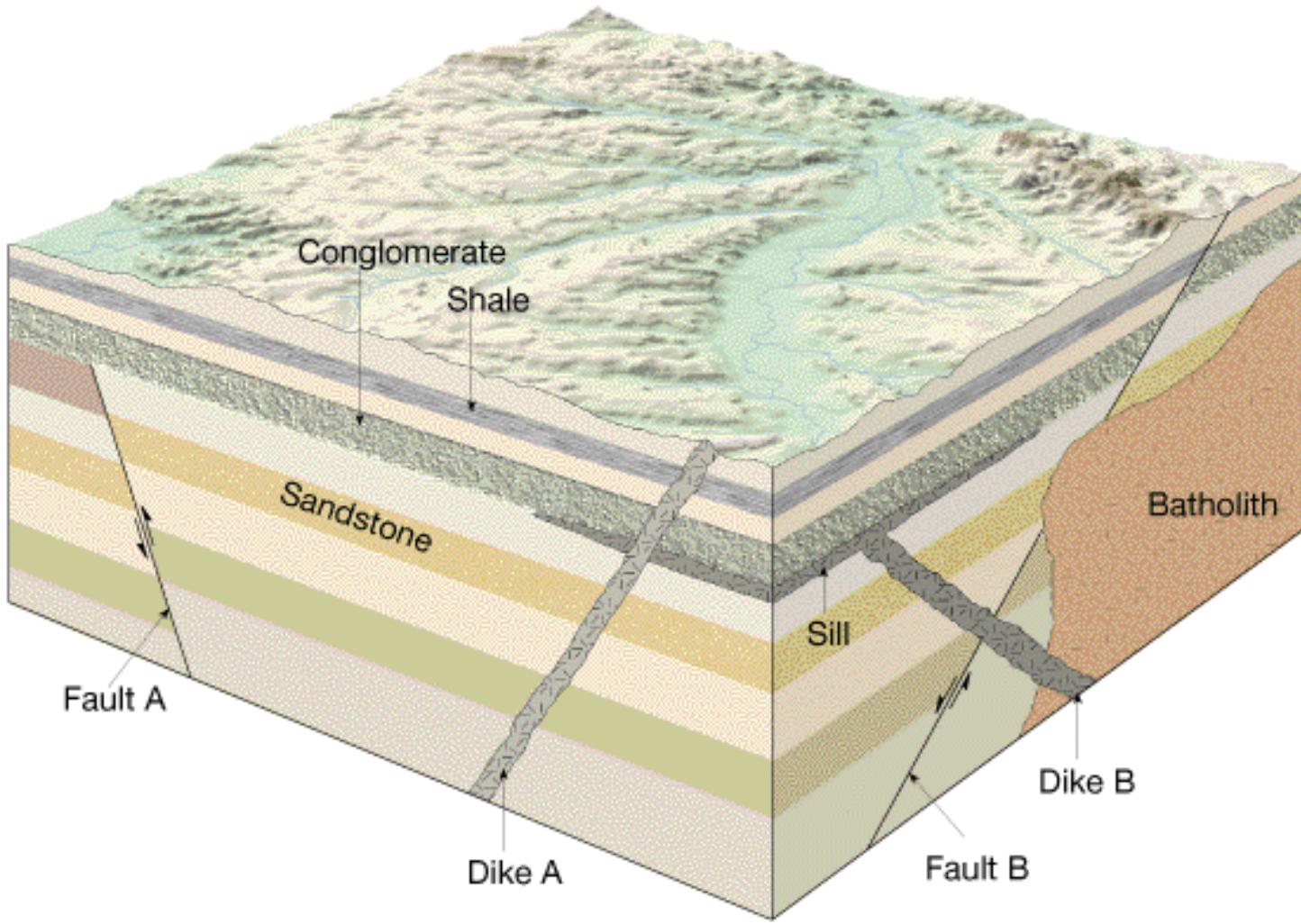


B.

- Applying the law of superposition in Grand Canyon
- the Supai Group is the oldest & the Kaibab Limestone is the youngest.

- **Principle of cross-cutting relationships:**

When a fault cuts through rocks,  
when magma intrudes,  
fault or intrusion is younger than the rocks affected



- Cross-cutting relationships: An intrusive rock body is younger than the rocks it intrudes. A fault is younger than the rock layers it cuts.

- **Unconformities: Markers of missing time**

When layers of rock formed without interruption, we call them **conformable**.

An **unconformity** represents a period of non-deposition and/or erosion.

✓ Angular unconformities

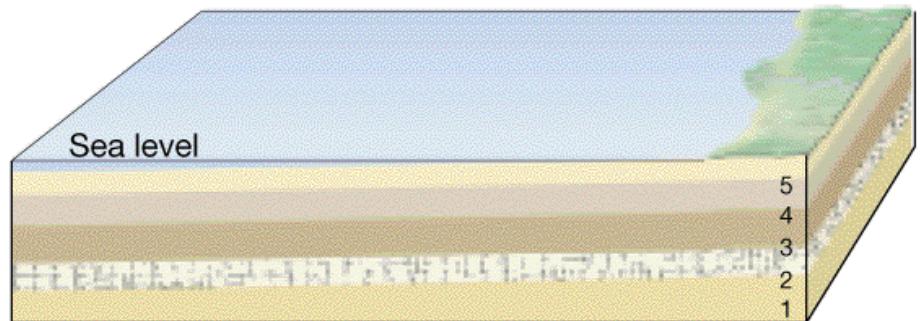
✓ Disconformity

✓ Nonconformity

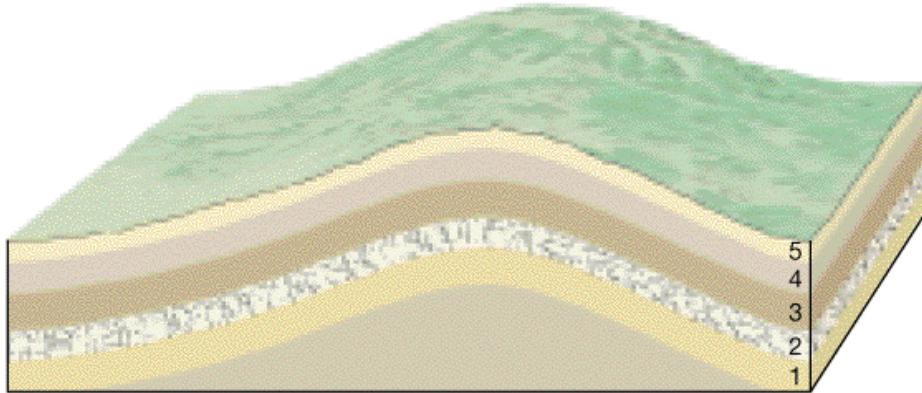
- **Angular unconformities:**

An angular unconformity consists of tilted or folded sedimentary rocks that are overlain by younger, more flat-lying strata.

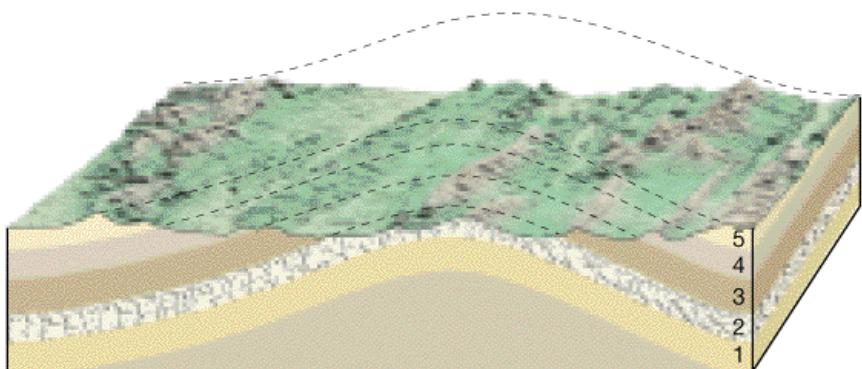
It indicates a long period of rock deformation and erosion.



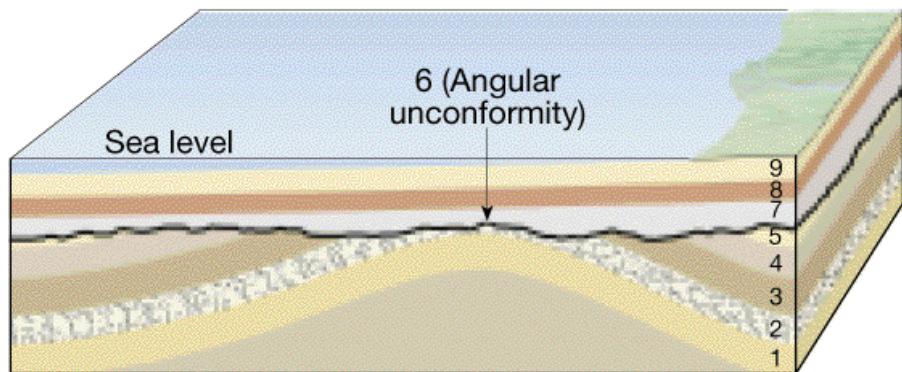
A. Deposition



B. Folding and uplifting



C. Erosion



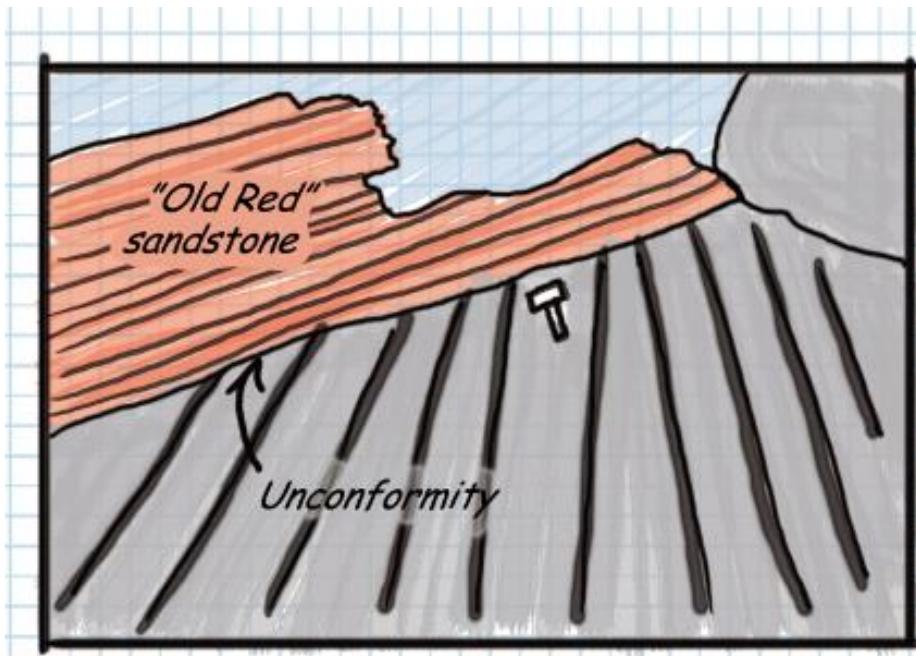
D. Subsidence and renewed deposition

Formation of an angular unconformity. An angular unconformity represents an extended period during which deformation and erosion occurred.



What a common man sees

What geologists see



Find the unconformity





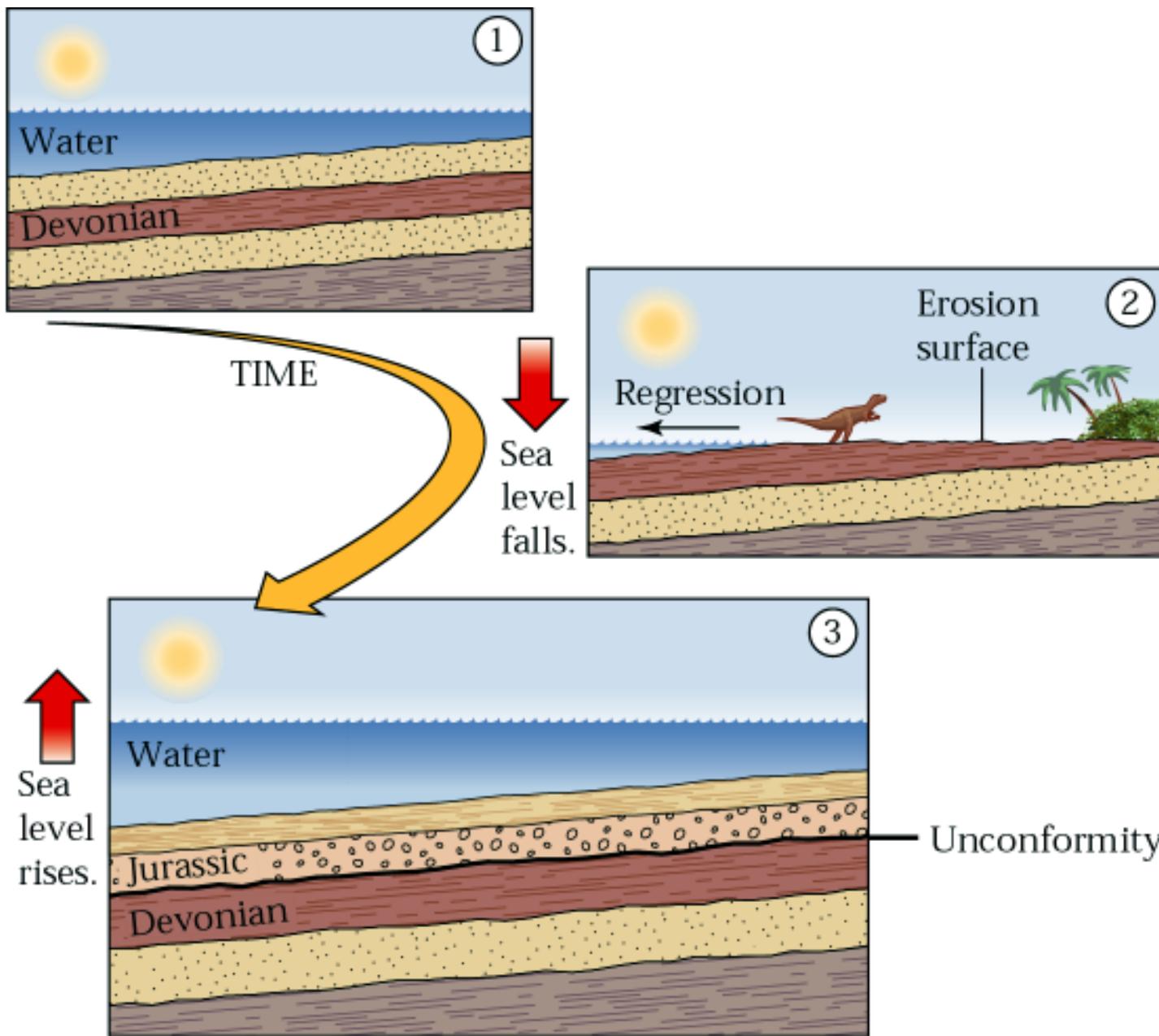
Find the unconformity

- **Disconformity:**

A minor irregular surface separating parallel strata on opposite sides.

Indicates

- uplifting above water level
- undergoing erosion
- lowering below the water level again



Formation of disconformity.

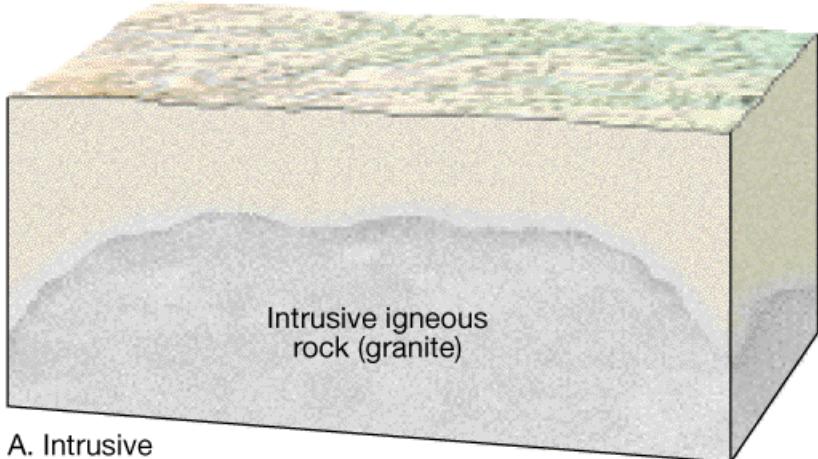


- **Disconformities** do not show angular discordance, but an erosion surface separates the two rock bodies. The channel in the central part of this outcrop reveals that the lower shale units were deposited and then eroded before the upper units were deposited.

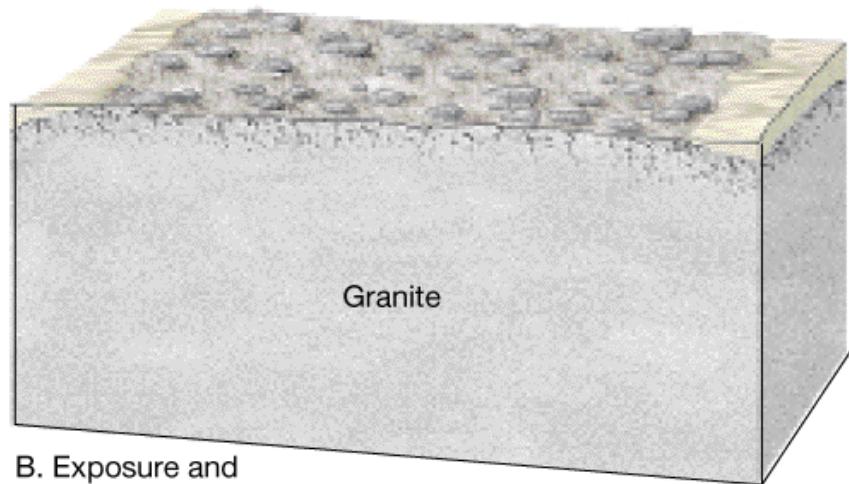


Find the disconformity

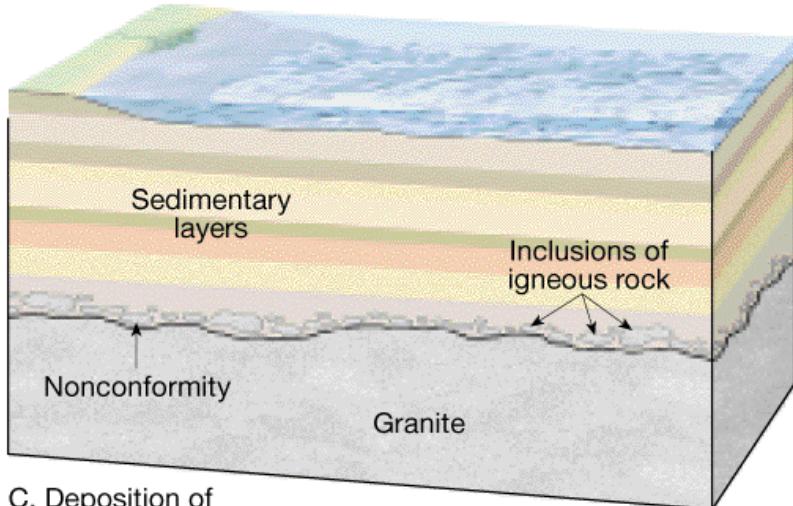
# Nonconformity



A. Intrusive igneous rock



B. Exposure and weathering of granite

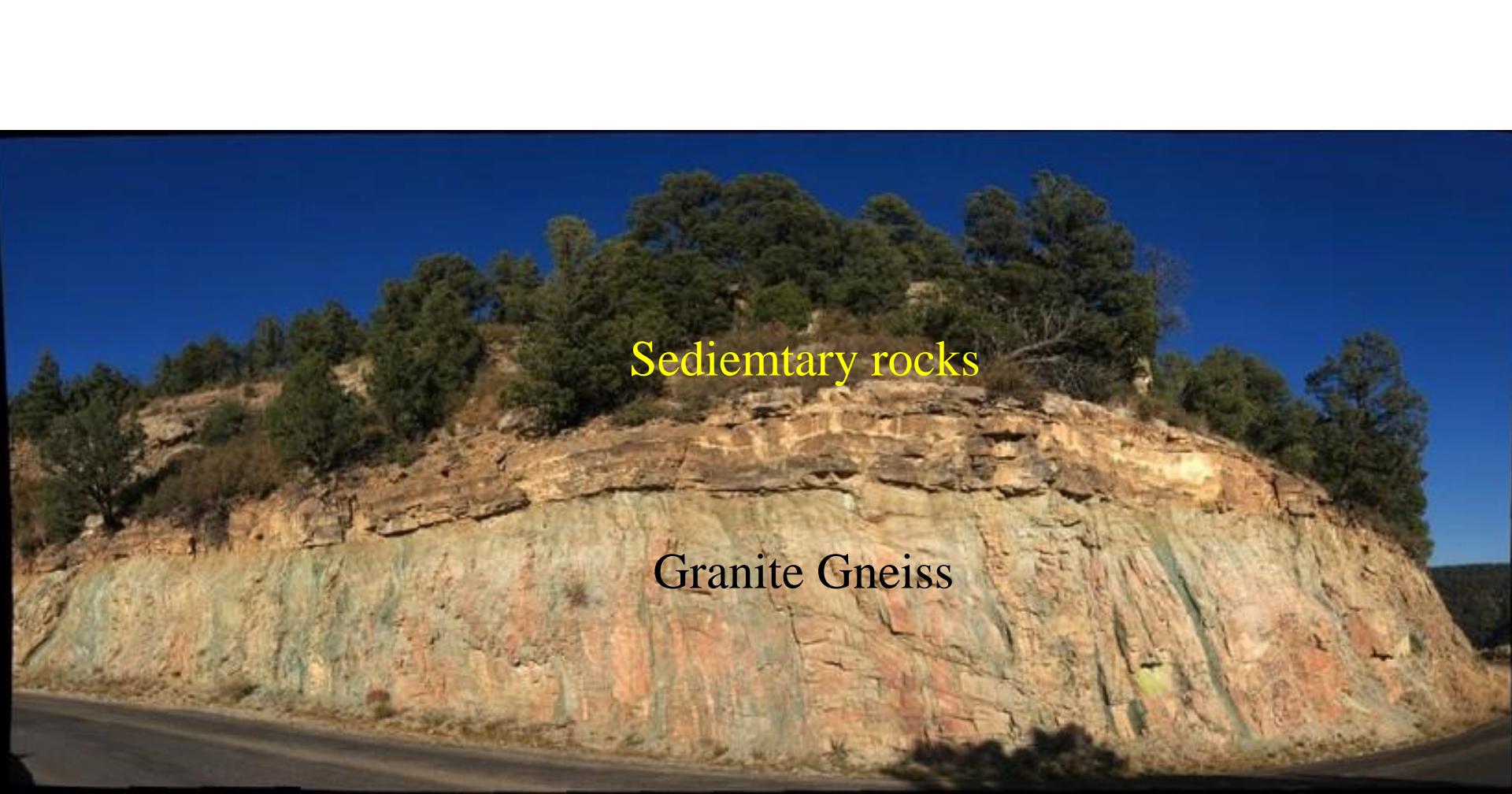


C. Deposition of sedimentary layers

An unconformity surface that developed when igneous or metamorphic rocks were exposed to erosion, and younger sedimentary rocks were subsequently deposited above the erosion surface.

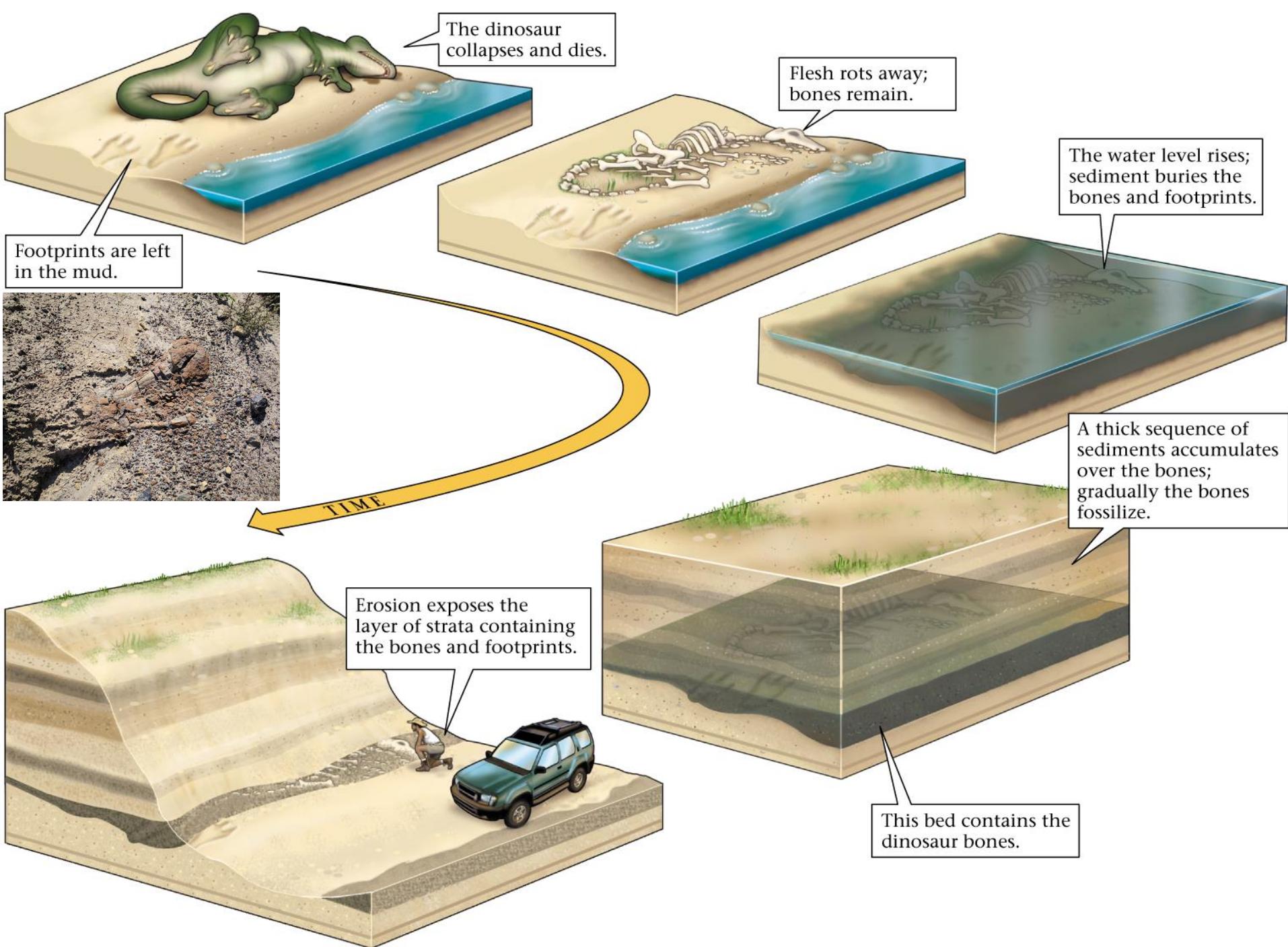


- A **nonconformity** at the Grand Canyon. The metamorphic rocks were formed at great depths and subsequently uplifted and eroded. Younger sedimentary layers were then deposited on the eroded surface of the metamorphic terrain.

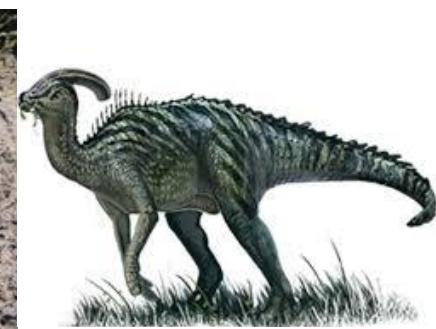
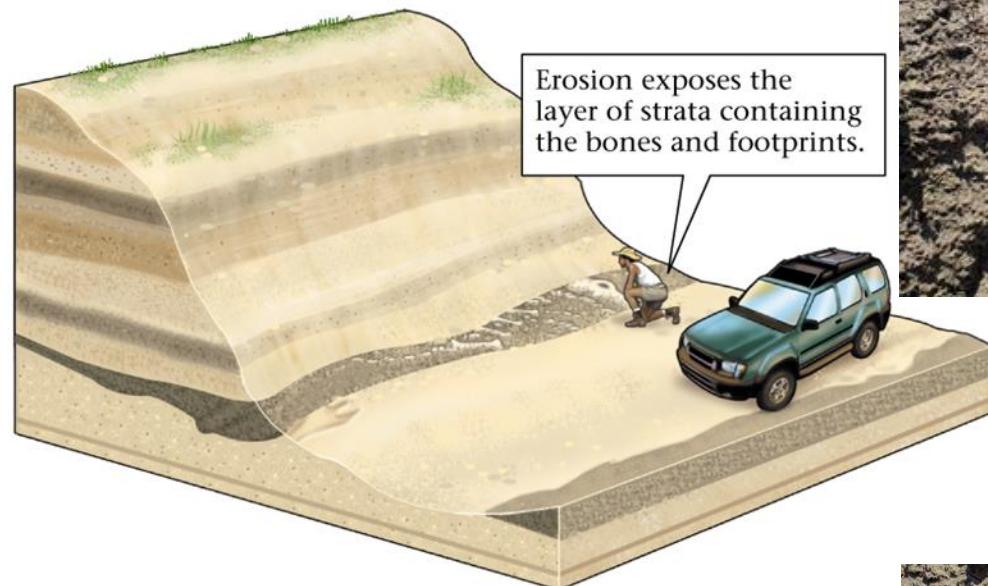
A photograph of a large, layered rock outcrop under a clear blue sky. The base of the outcrop is composed of light-colored, horizontally-layered sedimentary rocks. Above this, there is a thick, greenish-yellow layer with prominent vertical streaks of reddish-brown, which is identified as Granite Gneiss. The top of the outcrop is covered with dark green coniferous trees. A paved road runs along the base of the outcrop.

Sedimentary rocks

Granite Gneiss



# Hadrosaurid leg bone



Dinosaur bone