Course: Earth, Astronomy and Space

Grade: 10 Academic Year: 1st Semester, 2020-2021

Course Code: SC31161 Instructor: Mr. Elmar Rubio

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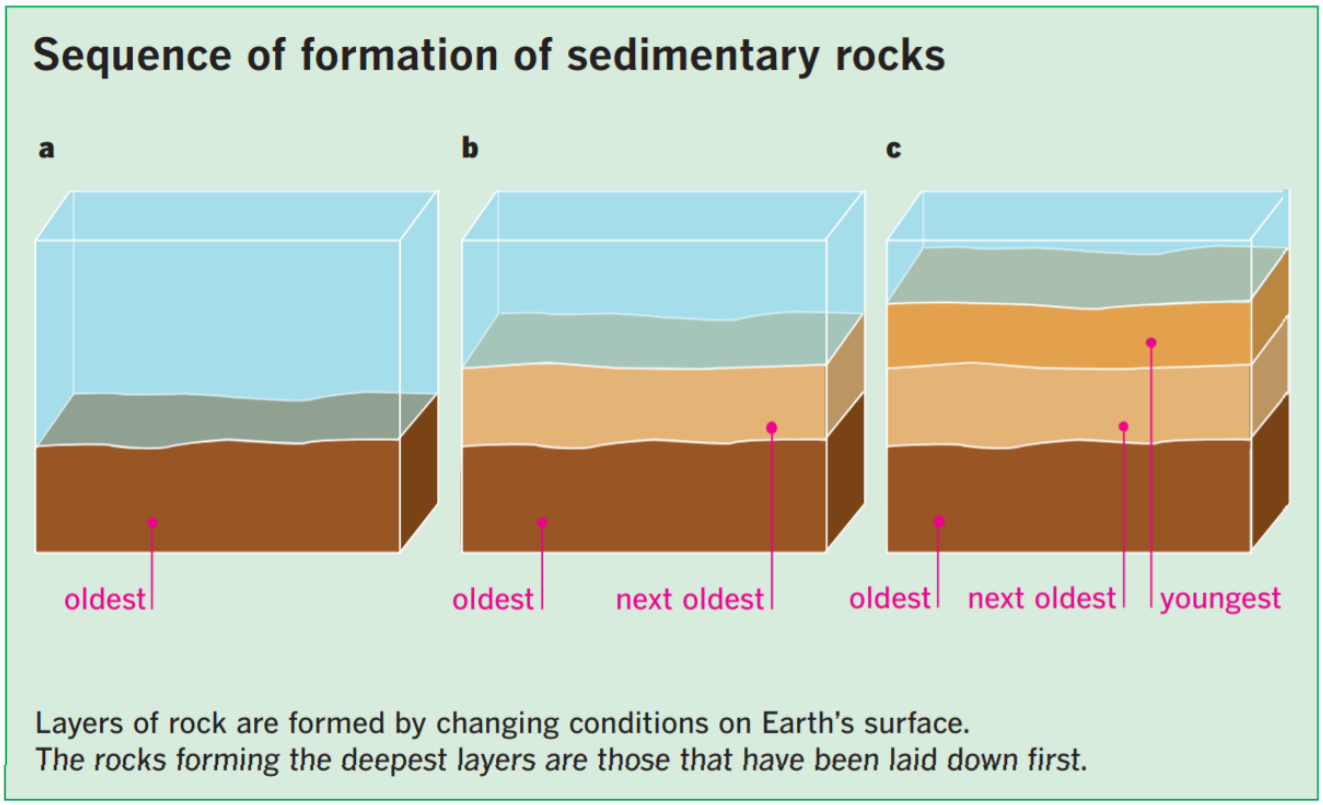
Topic: Geological Evidences: Events of Evolution

Standard: Understanding the changing of Earth, geology disaster and effects to mankind and environment, including the education about rock's layer, natural resources, map and usefulness.

Learning outcome: Analyze the evidences that were related to the events in the past.

Vocabulary:

Superposition



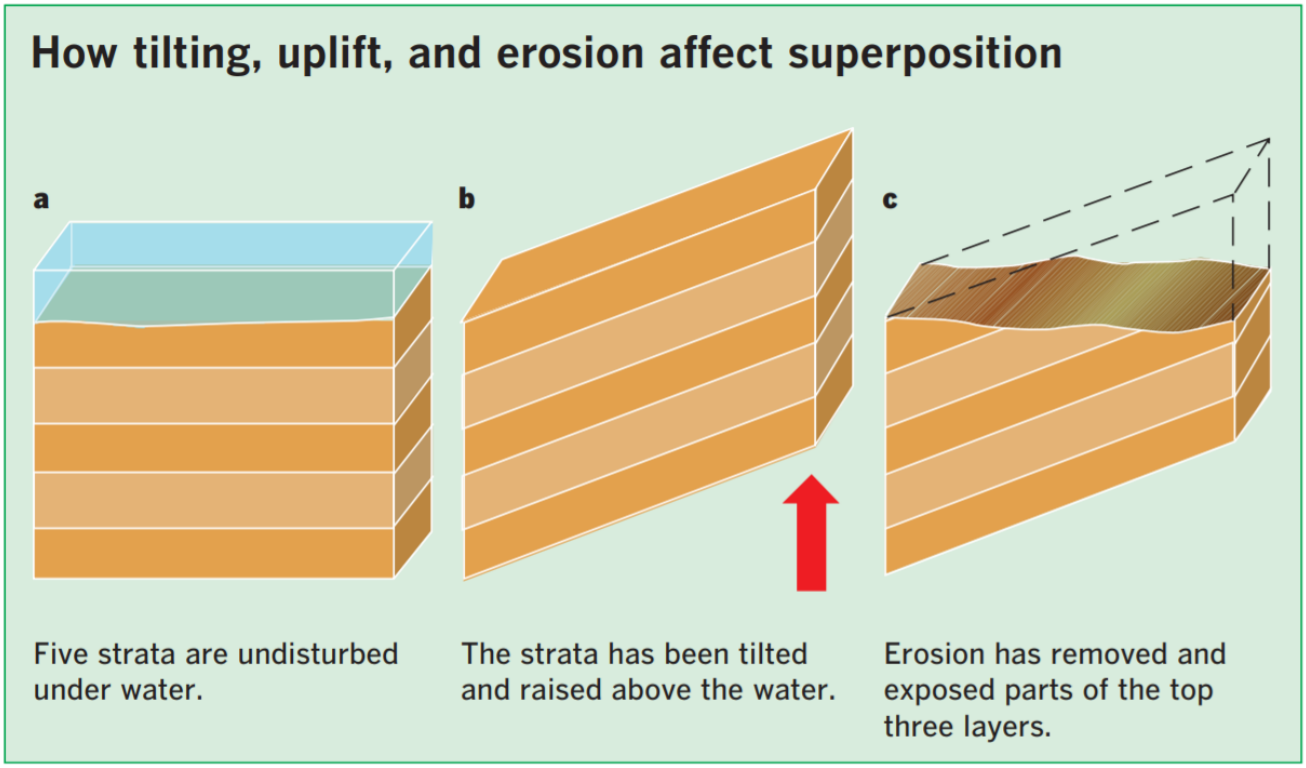
The principle of superposition states that in an undisturbed sequence of strata the lowest stratum is the oldest and the highest is youngest.

A rock layer is laid down under water on the floor of a sea, lake, or river (a).

A second layer of sedimentary rock is laid down on top of the first (b).

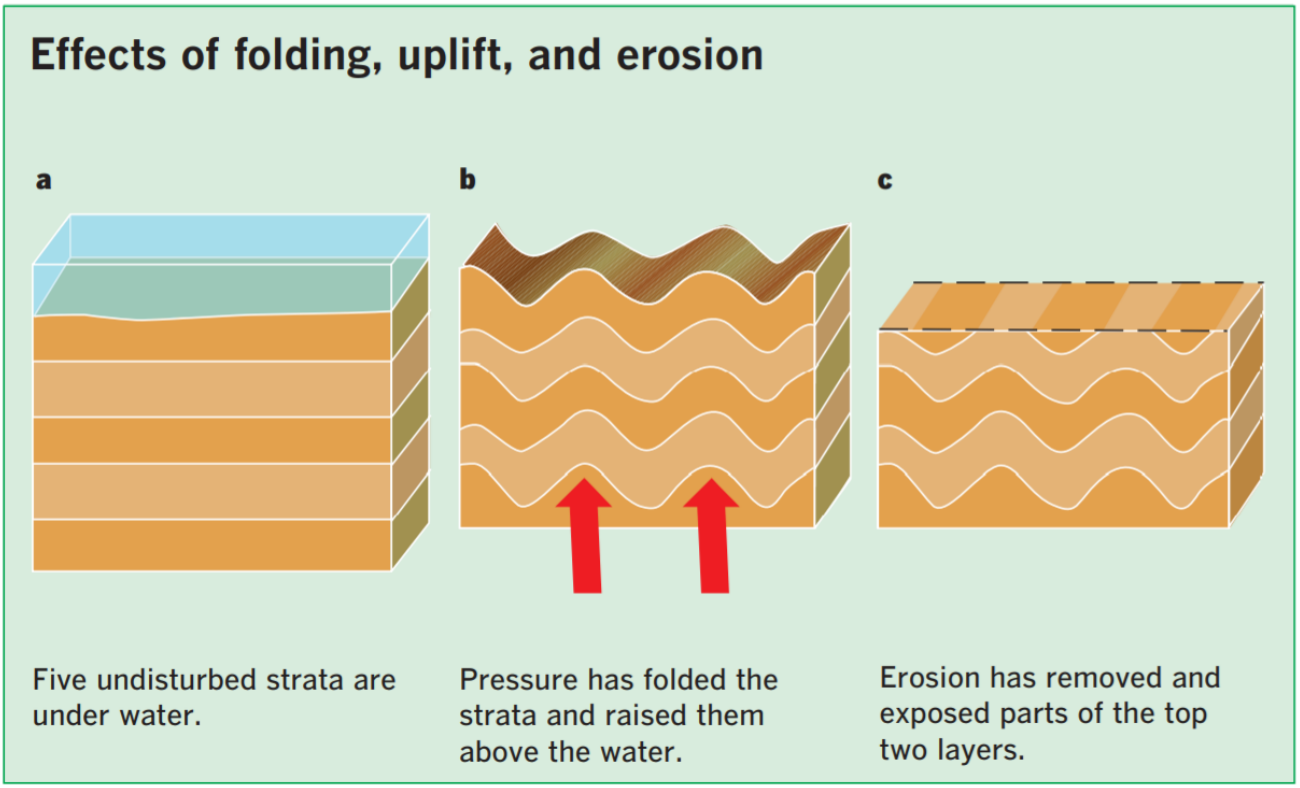
A third layer is laid down on the second. In this undisturbed sequence, three horizontal sedimentary rock layers lie stacked on top of each other in the order in which they formed (c).

Tilting, Uplift, and Erosion



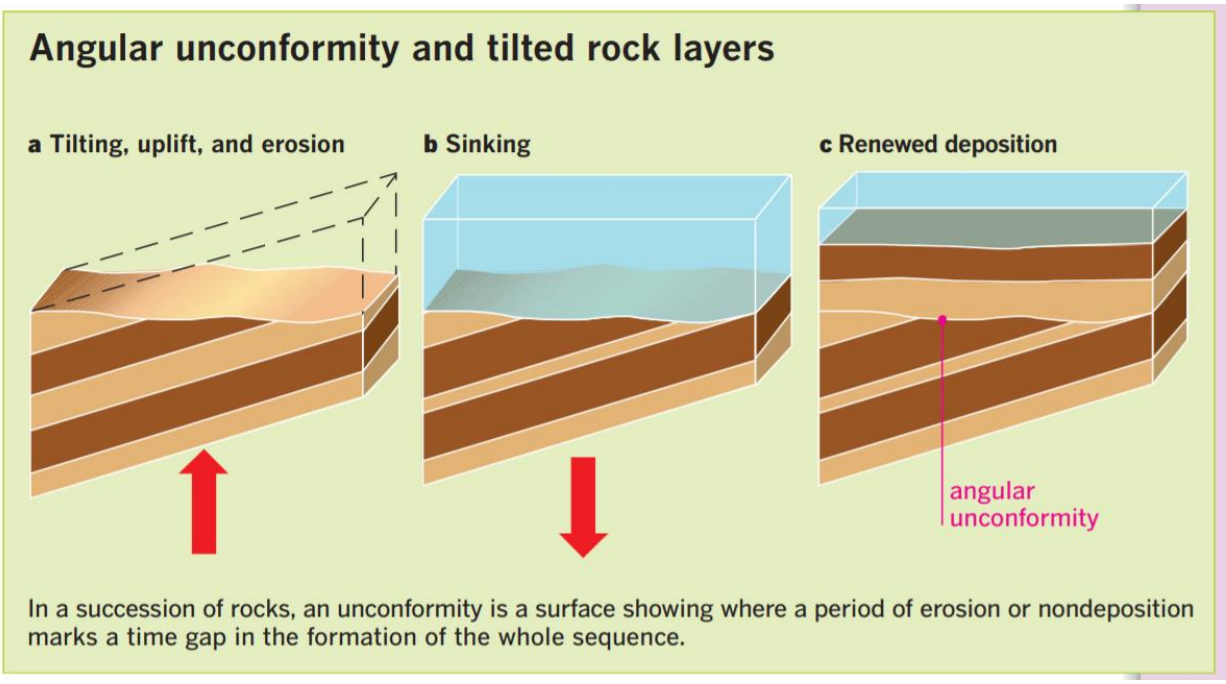
- Strata are affected by tilting and erosion:
- Different layers of rock are laid down over millions of years (a).
- Pressure from within Earth causes movement of these layers (b).
- The upper surface may subsequently be eroded, leaving different layers of rock exposed (c).

Folding, Uplift, and Erosion



- Strata can be affected by folding and erosion:
- Horizontal layers (a) are sometimes disturbed by Earth's internal pressures (b).
- The layers are folded and creased, resulting in uplifts of some areas.
- Subsequent erosion reveals different types of rock on Earth's surface (c).

Unconformities



Angular Unconformities and Tilted Rock Layers

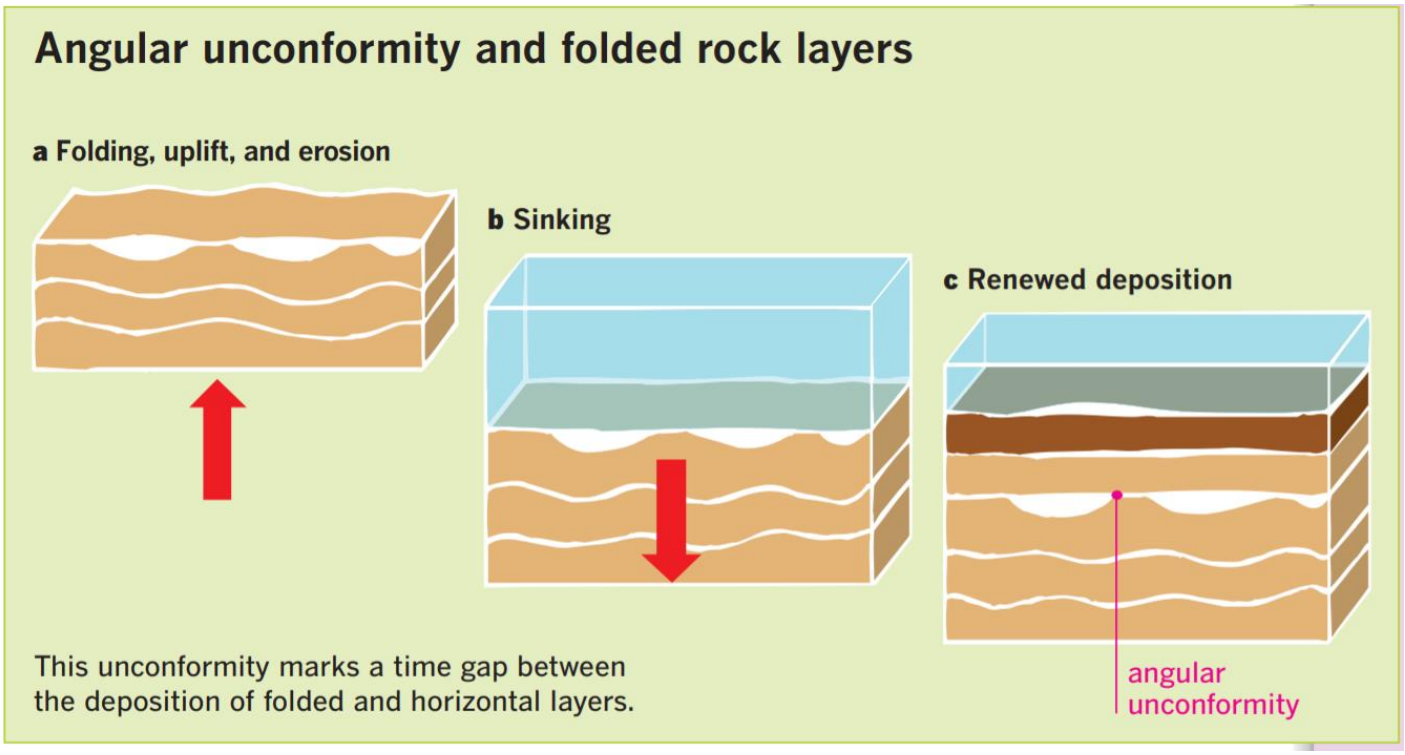
● Rock layers overlying an angular unconformity show different dips or strikes from those of the rocks below. In angular unconformity, horizontal strata overlie tilted strata:

● First, a horizontal sequence of sedimentary rocks laid down under water is tilted and uplifted (a). Erosion then exposes several layers.

● Next, Earth movements lower the eroded tilted rocks below sea level (b).

● Horizontal layers of sedimentary rocks form on top of the eroded tilted rocks (c).

● An angular unconformity marks the boundary between the tilted and horizontal sedimentary rock layers.



Angular Unconformities and Folded Rock Layers

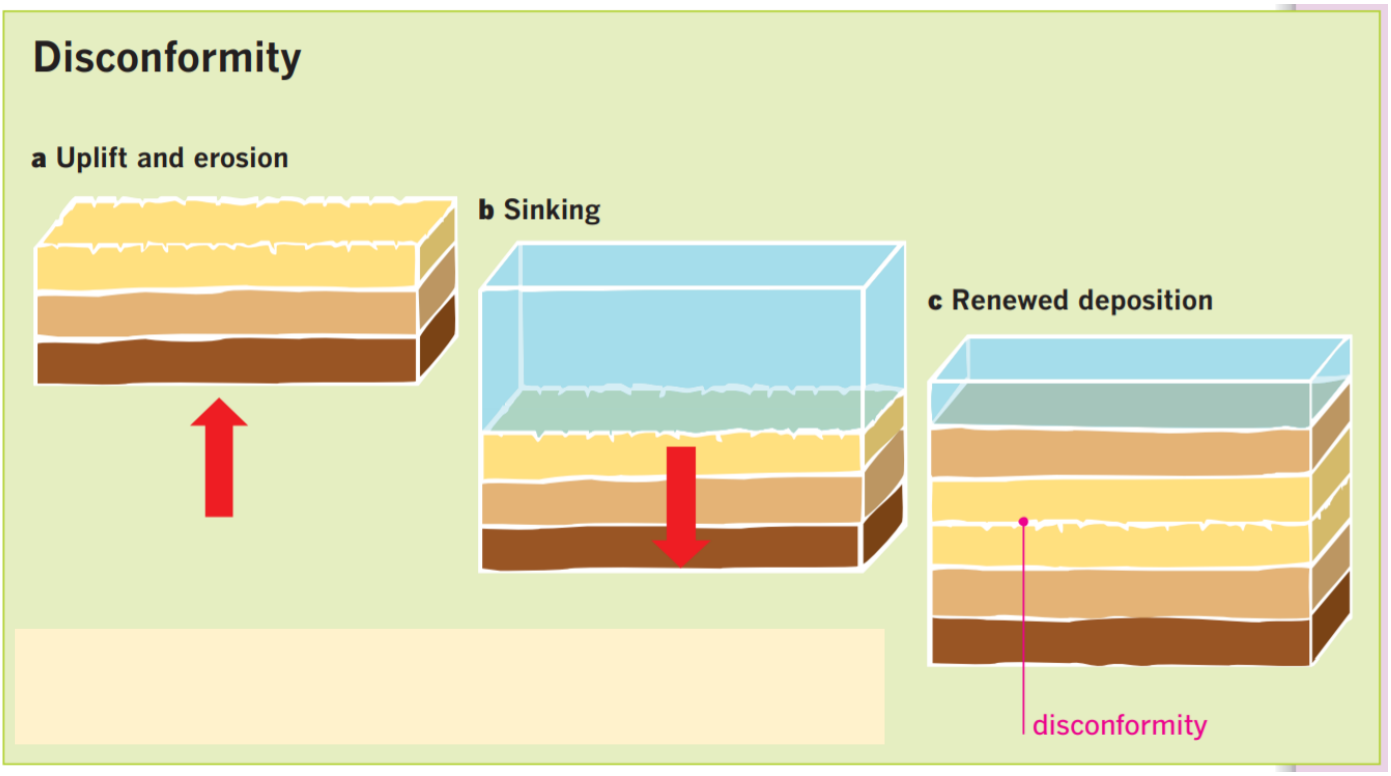
Angular unconformities also often occur where horizontal strata overlie folded strata:

● First, a horizontal sequence of sedimentary rocks laid down under water is folded and uplifted **(a).** Erosion lays bare several layers.

● Next, Earth movements lower the eroded folded rocks until they lie below sea level **(b).**

● Horizontal layers of sedimentary rocks form on top of the eroded folded rocks.

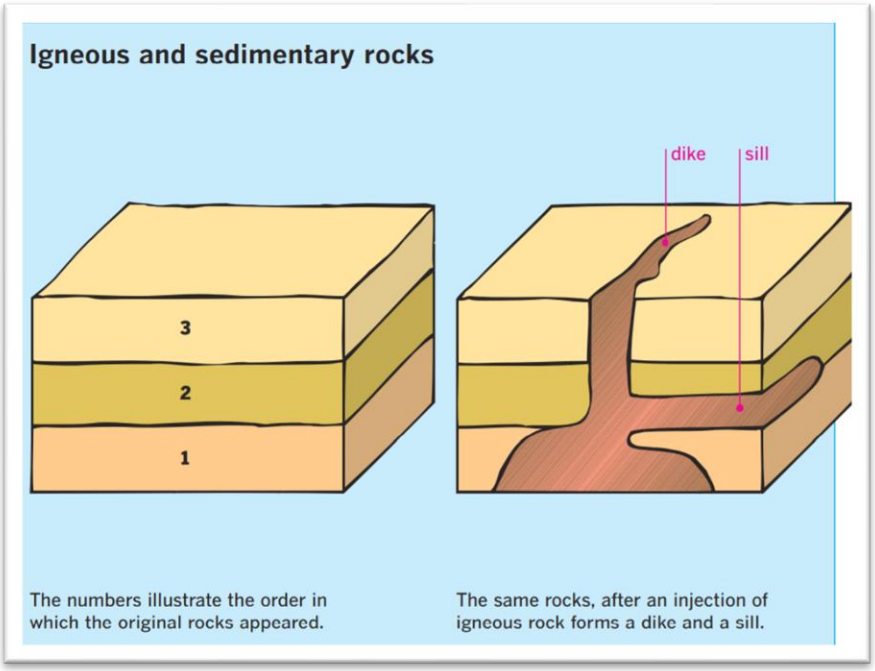
● An angular unconformity marks the boundary between the tilted and horizontal sedimentary rock layers **(c).**



A **disconformity** is an unconformity where an erosion surface (a) marks a time gap between the formation of the rock layers above and below it (b), but both sets of layers lie horizontally (c).

Complex Rocks Sequence

Key words: dike, faulting, folding, igneous rock, intrusion, nonconformity, sill, tilting



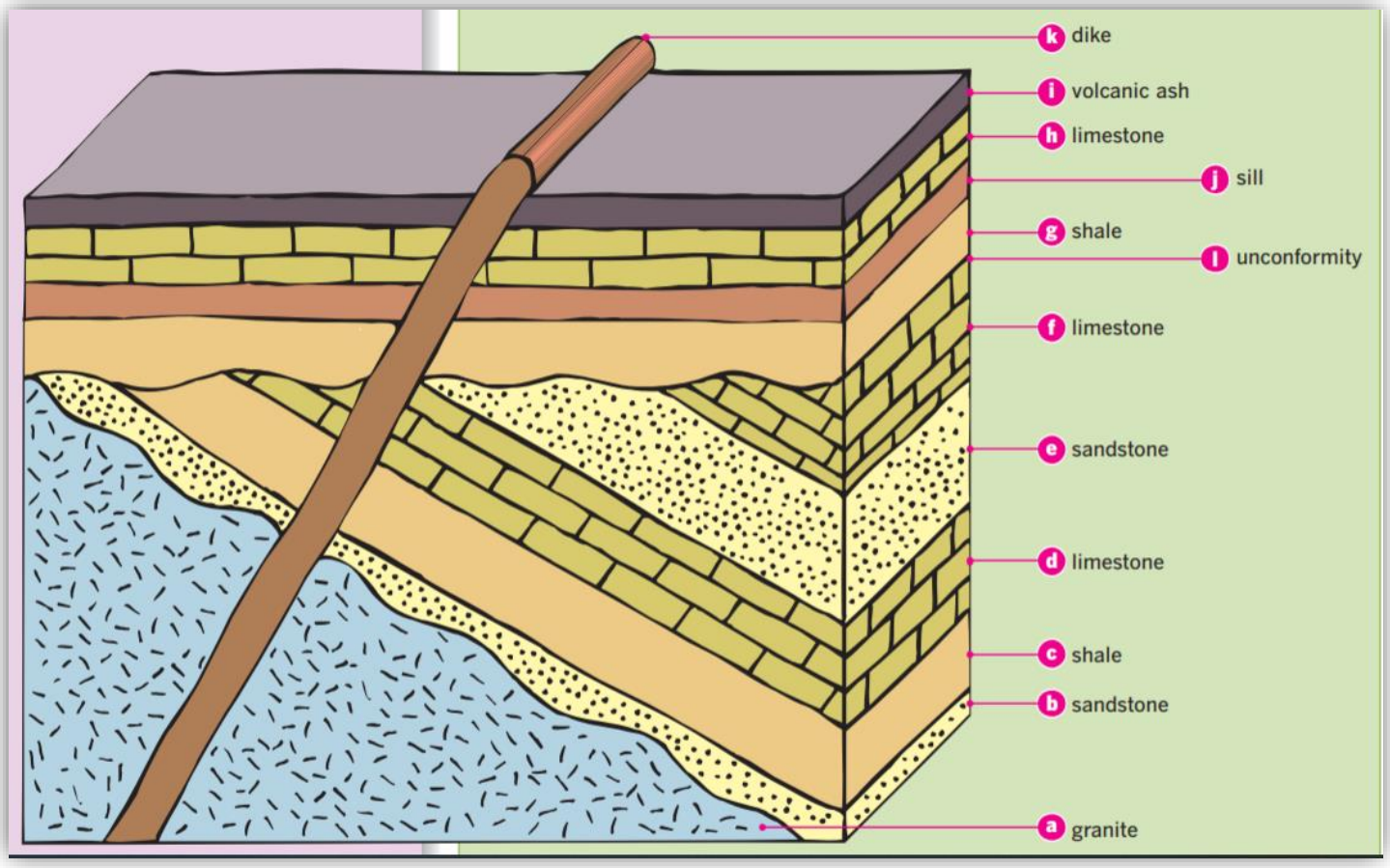
- A sequence of sedimentary rocks may be interrupted by molten igneous rock intruded as a sill or a dike.
- A sill is a horizontal sheet of igneous rock injected between layers of rock.
- A dike is a wall of igneous rock injected through a crack in rocks.

Complex sequences

● A section through part of Earth's crust may reveal tilting, folding, faulting, igneous intrusions, and a ***nonconformity***—an unconformity where sedimentary rock overlies granite or another igneous or metamorphic rock.

Complex Rock Sequence

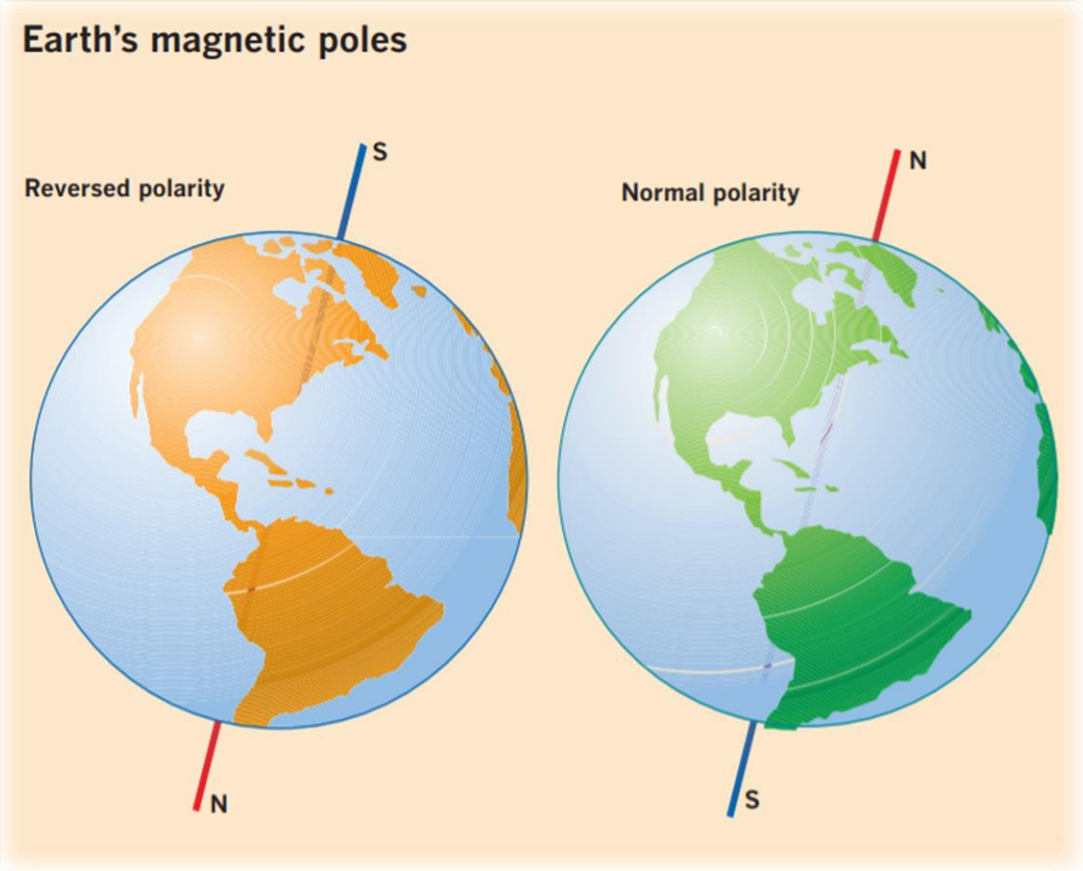
Here, molten igneous rocks have inserted a sill and dike into horizontal rocks overlying older tilted rocks.



Key: (a-k) order in which rocks appeared

Paleomagnetic Dating

A known sequence of past changes in polarization recorded in rocks enables scientists to date rocks and fossils formed tens of millions of years ago.

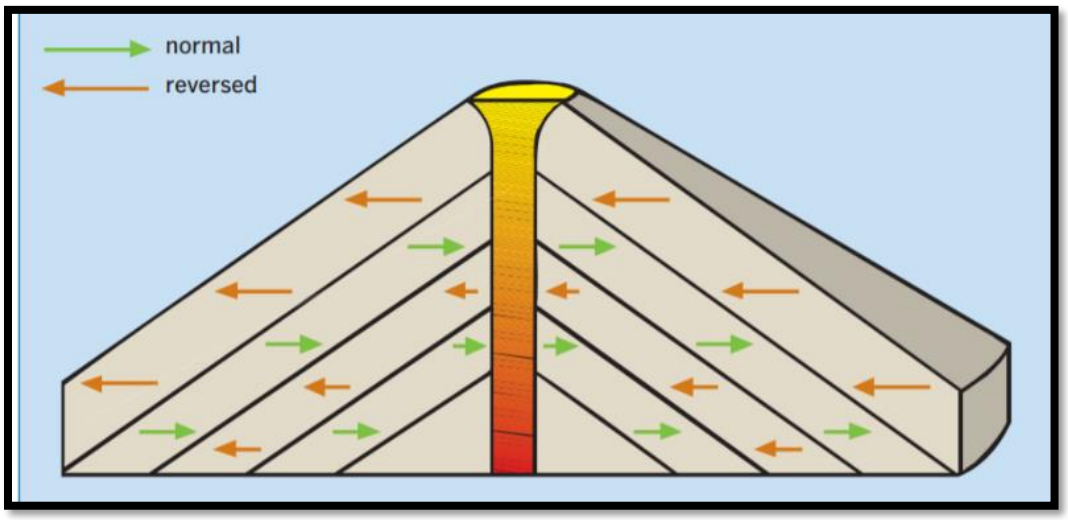


Pole Reversals

From time to time through geologic time, Earth's magnetic field has suddenly become reversed, switching its magnetic poles around. At each reversal, what had been the south magnetic pole becomes the north magnetic pole and vice versa.

Alignment of Magnetized Minerals

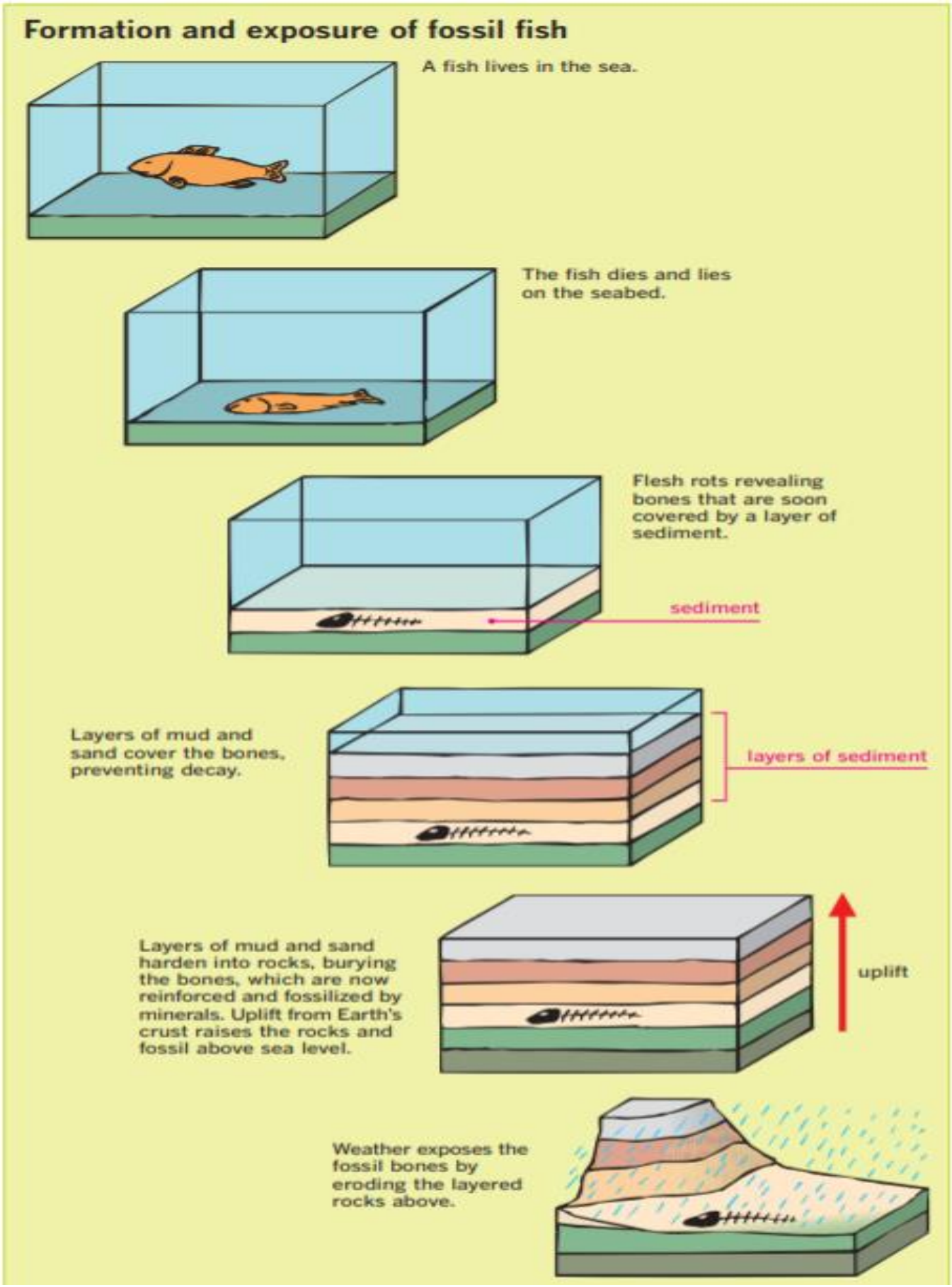
The alignment of magnetized minerals in successive lava flows records reversals in Earth's magnetic field.



The Traces of Geologic Time

Certain particles in volcanic and some other rocks remain aligned according to Earth's magnetic field at the time they were formed. This polarization of minerals such as magnetite and hematite help geologists to determine their geologic ages.

Fossils Formation



Types of Fossil

● Most fossils are the remains of the hard parts of ancient organisms that were preserved soon after death by sediments that later turned to rock.

● Dissolved minerals permeate dead organisms or completely replace them.

● Rarely, soft tissues are preserved—as carbonaceous films, or in fine-grained sediments, peat, or permafrost.

● Buried organisms that dissolve away completely may leave fossils in the form of molds or casts.

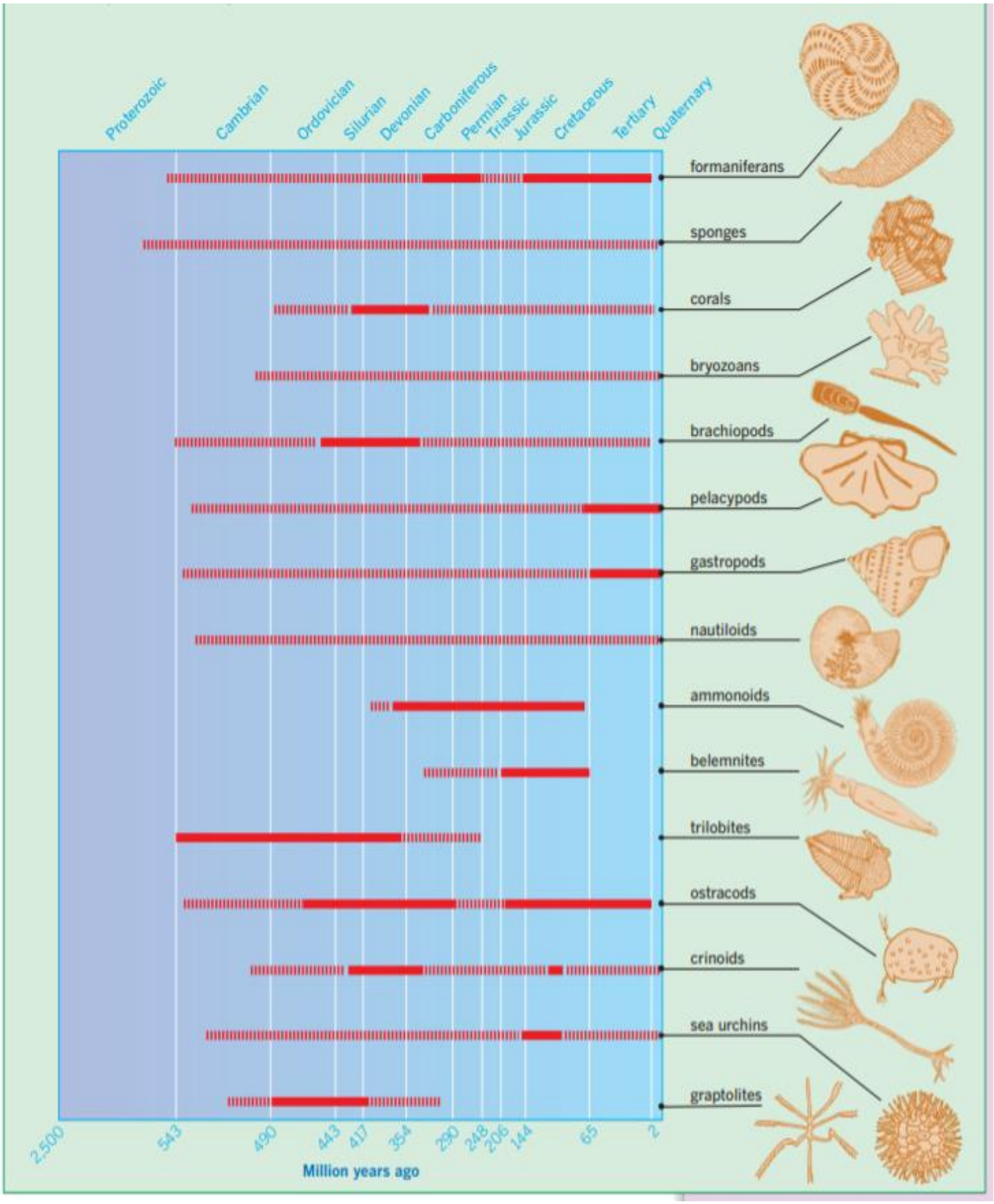
● Fossil traces left by living organisms also include footprints, burrows, and coprolites (fossil droppings).

Fossil Use in Rock Correlation

Marine Fossils

● Fossils of widespread but short-lived marine invertebrate species help geologists match sedimentary rocks' relative ages worldwide.

Many such index fossils belong to groups whose timelines and relative abundances are indicated below.



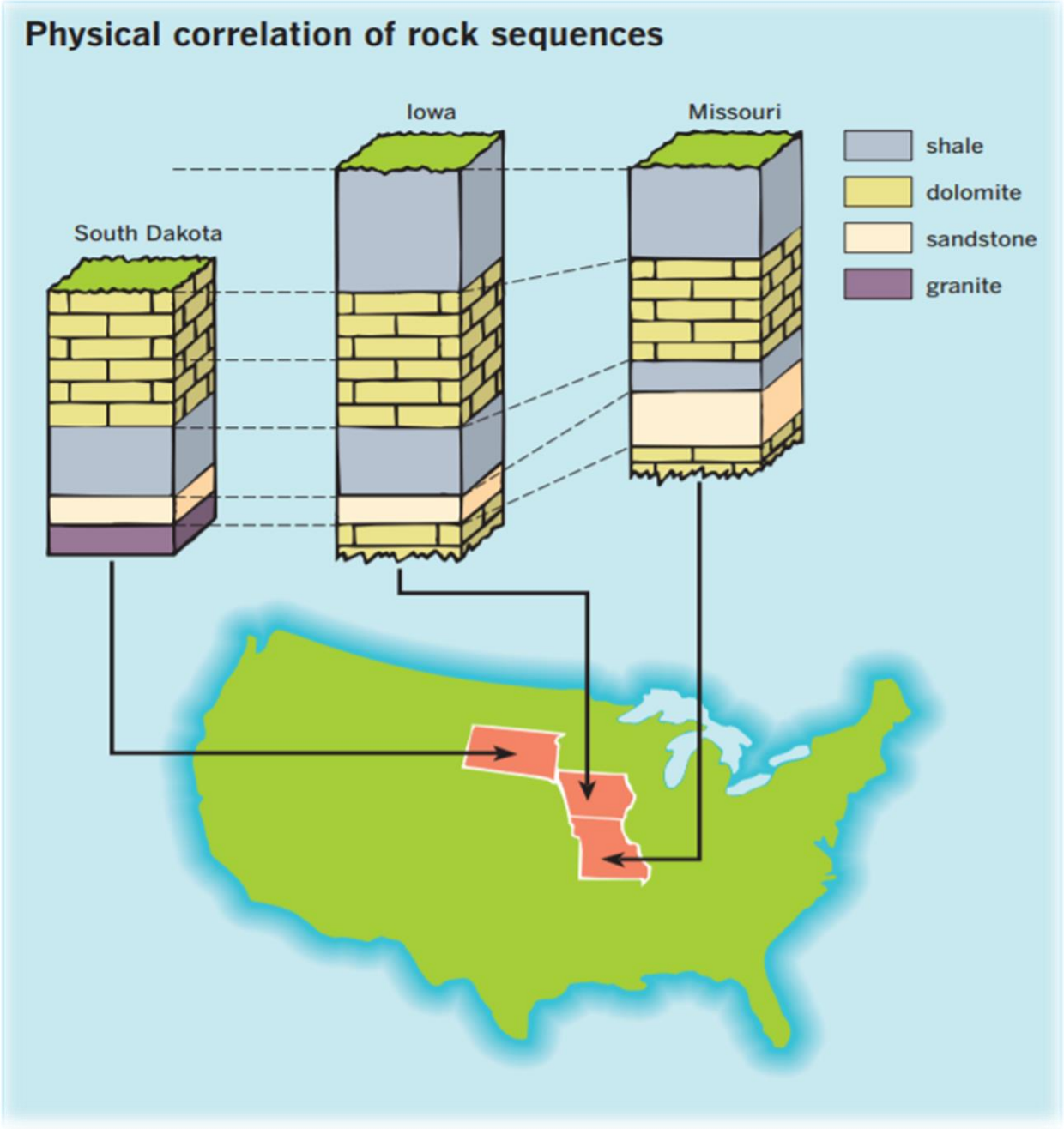
Correlating Rocks

Physical Correlation

● The same sequence of layered rocks found in different places enables geologists to match their relative ages.

● This method of relative dating works best for sedimentary rocks in places where Earth movements have not disturbed or interrupted the sequence in which the rocks have been laid down.

● Complications can arise where a whole rock layer has been worn away, layers have been tilted or inverted, or granite or other igneous rocks have been injected between preexisting layers.



Using Index Fossils

● Most index fossils used in the relative dating of sedimentary rocks are those of marine invertebrates, because most sedimentary rocks were laid down beneath the sea.

● However, land animals preserved in rocks occasionally provide valuable index fossils too.

● A famous example is that of the protohorse between North America and Europe: foot bones of the same kind of proto-horse occur in Eocene epoch rocks laid down in both western North America and Europe. Known as Eohippus in North America and Hyracotherium in Europe, these fossils show a species that evolved while both continents were linked.