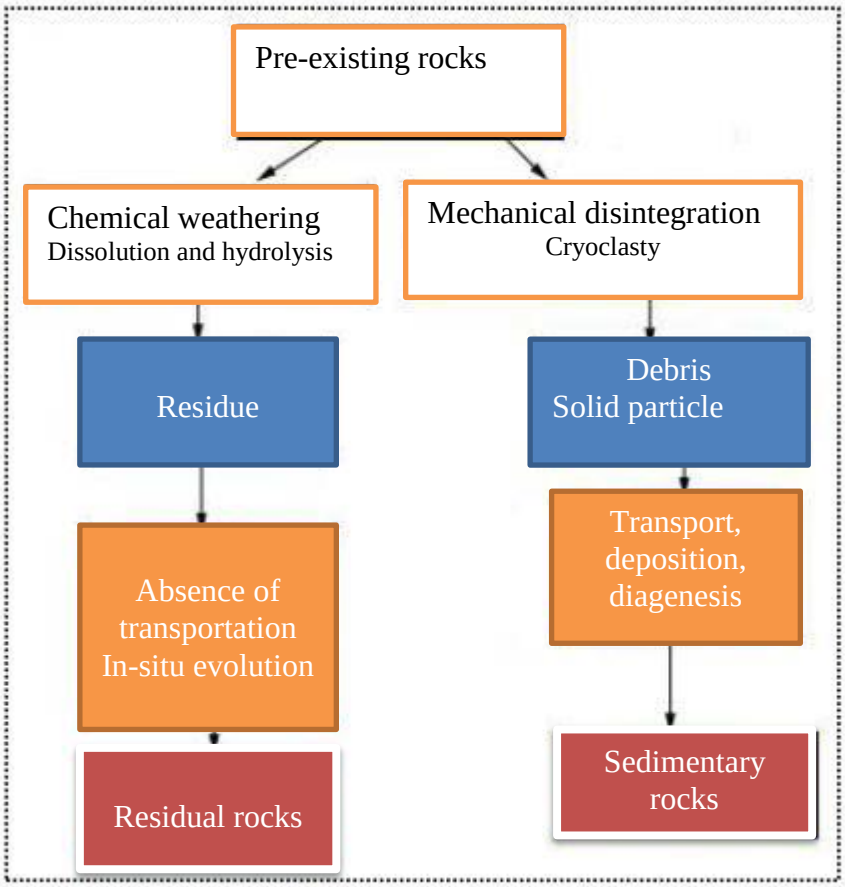
**Introduction to Sedimentary Petrology**

## 1. Definitions

- **Petrology:** This is the branch of geology that studies rocks and their formation conditions.
    - *Petro* = Rock, *logy* = Study, science, *graphy* = Describe
- **Petrology vs. Petrography:** The study of rocks has two aspects:
    - *Interpretation:* Understanding rock formation conditions and evolution—the focus of petrology.
    - *Description:* Analyzing rock characteristics, leading to classification—the focus of petrography.
- **Sedimentology:** A discipline in geology focused on studying sediments.
- **Sedimentary Petrology:** The study of sedimentary rocks, which helps reconstruct:
    - Paleoenvironments
    - Paleogeographies
    - Paleoclimates near the deposition site.
- **Sedimentary Rocks:** Unlike endogenous rocks (magmatic and metamorphic), sedimentary rocks (also called exogenous) form on the Earth's surface. They constitute only 5% of the Earth's crust by volume but cover around 75% of its surface.

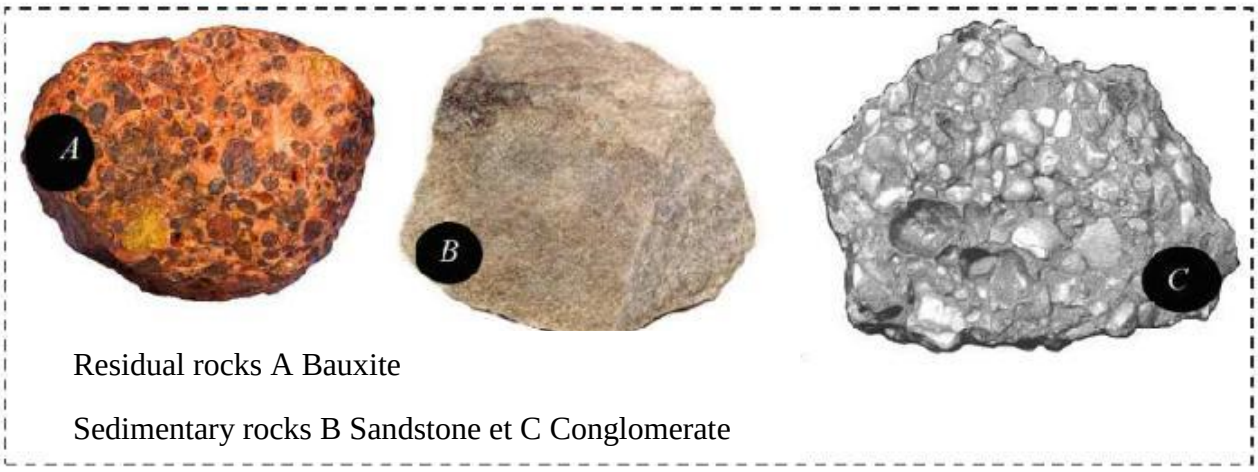
The sedimentary rock formation cycle includes four processes: weathering, erosion, transportation, deposition (sedimentation), and diagenesis. Fig 1 et 2

Materials resulting from weathering and erosion are called alteration products. In some cases, they remain in place, forming residual rocks. In other cases, transported by agents like water or wind, they deposit in specific environments, forming sedimentary rocks.




**Distinction between Sediment and Sedimentary Rock:**

- *Sediment:* Consists of materials with completely independent particles.
- *Sedimentary Rock:* Constitutes tightly bonded components. The transformation from loose sediment to hardened rock results from cementation or sediment compaction.

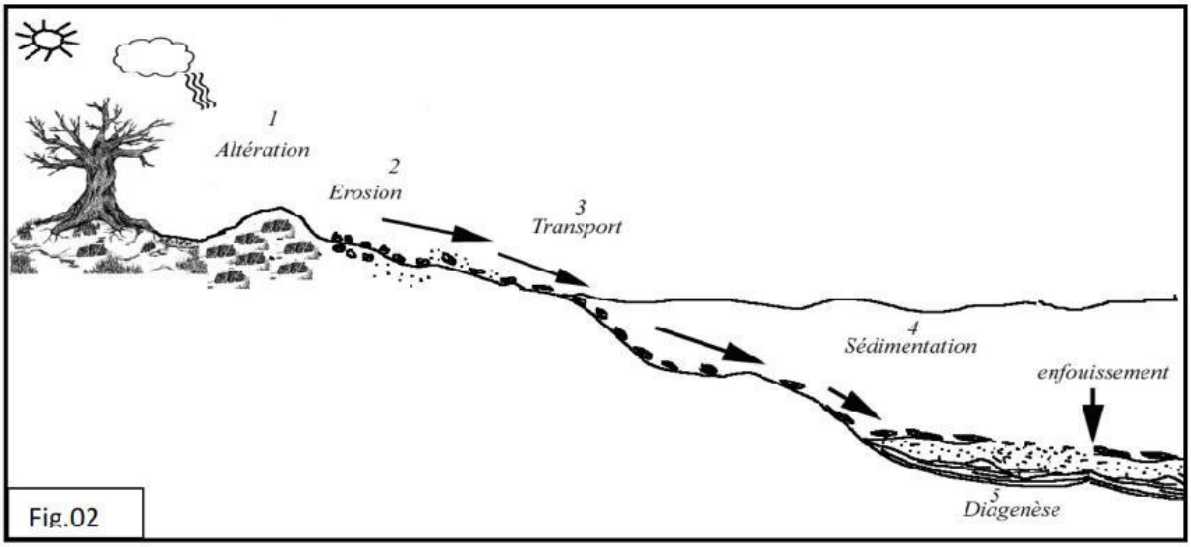



Residual rocks A Bauxite

Sedimentary rocks B Sandstone et C Conglomerate

## 2. Formation of Sedimentary Rocks

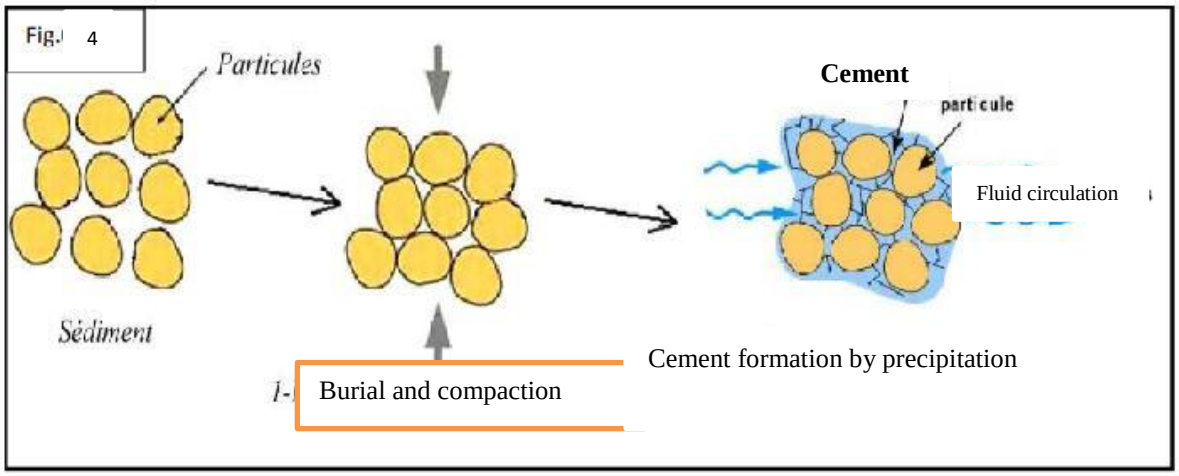
The sedimentary rock formation cycle includes five processes: Fig 3




1. **Weathering:** This is the initial phase of the sedimentary cycle and involves the degradation and fragmentation of surface rocks through physical, chemical, or biological processes, leading to alteration products.
    - *Physical (Mechanical) Weathering:* Rock fragmentation without changing its chemical composition, driven by mechanisms like:
        - *Freeze-thaw cycles (cryoclasty):* Water expansion and contraction in rocks due to freezing and thawing.
        - *Thermal stress (thermoclasty):* Expansion and contraction of minerals from temperature changes.
        - *Abrasion:* Rock wear through water, wind, or biological action (e.g., tree roots causing rock fissures).
    - *Chemical Weathering:* Alters the chemical composition of the parent rock through agents such as:
        - Rainwater (hydrolysis: water dissociates into H+ and OH– ions that replace other ions in minerals; dissolution: partial or total solution of certain minerals)
        - Oxygen (oxidation)

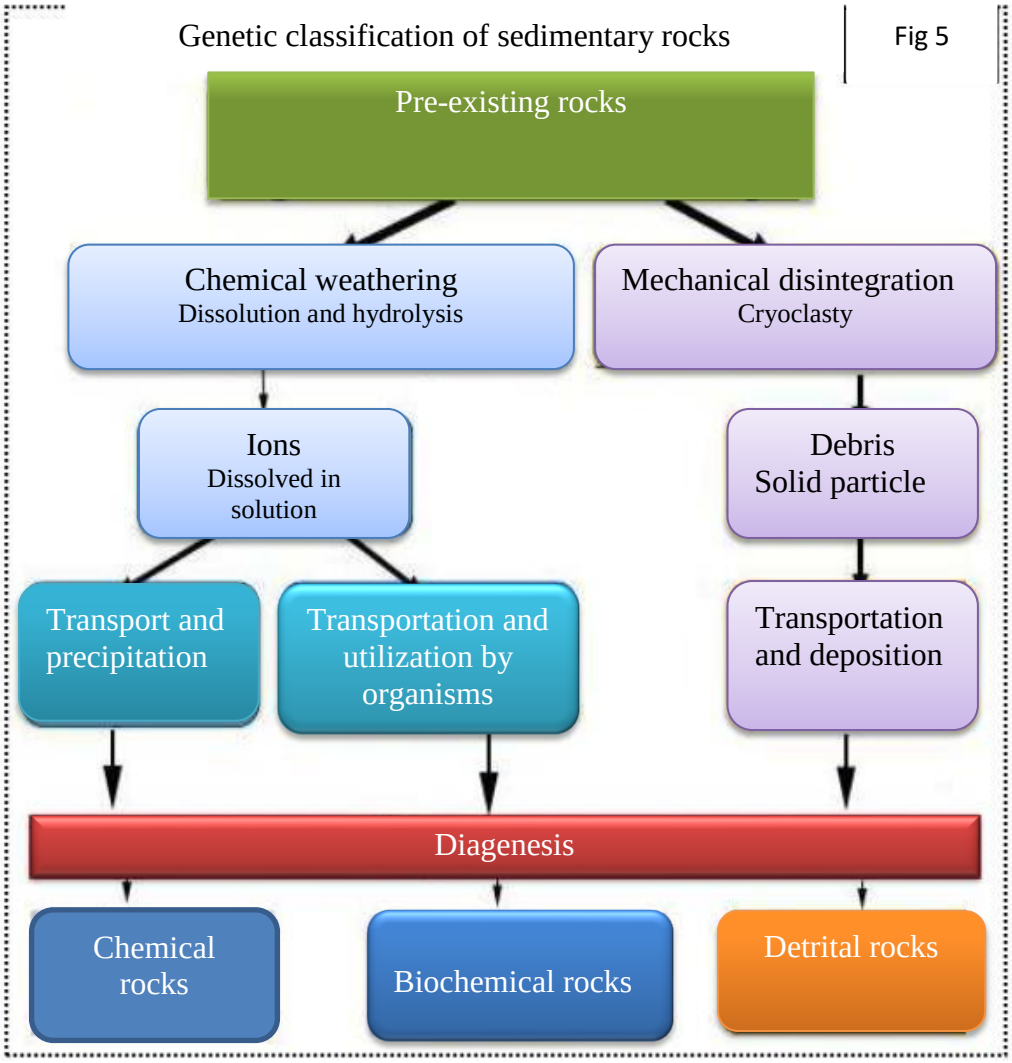
- *Biological Weathering:* Involves organisms (bacteria, plants, fungi) contributing to rock alteration by extracting minerals or introducing oxygen and carbon dioxide.

2. **Erosion:** Materials produced during weathering are transported from their production site by agents such as water and wind.
3. **Transport:** This involves the movement of weathering products (debris and dissolved elements) to sedimentation environments by water, wind, or ice. Transport can occur via solution, suspension, or as large particles dragged along the bottom.
4. **Sedimentation:** Transported materials accumulate in sedimentary basins (e.g., marine environments) to form deposits.
5. Sedimentary deposits are stratified, and sedimentary rocks inherit this lamination as sediments are deposited in successive layers.
6. **Diagenesis:** This is the transformation of sediment into sedimentary rock through chemical and mechanical processes that affect deposits after their formation.




Diagenesis begins in the deposition environment and continues as sediments are buried under additional layers. Processes include compaction, cementation, dissolution, recrystallization, and mineral replacement. Fig 4

## 3. Classification of sedimentary rocks




The group of exogenous rocks is subdivided into residual rocks (Residual rocks form in place, after the alteration the original materials do not undergo any transport (example: laterites, bauxite...) and sedimentary rocks. These have varied chemical and mineral composition; they are often made up of mixtures and their origin is often multiple. Therefore, it is difficult to propose a satisfactory classification.

**3.1. Based on their origin (genetic classification),** rocks are categorized into detrital, chemical, and biochemical types.

**Detrital rocks**

They are formed from mineral particles resulting from the weathering of preexisting rocks. Since they originate from continents, they are also known as terrigenous rocks; and when they are mainly composed of quartz fragments, they are called siliciclastic rocks.

Detrital rocks are typically classified based on the particle size of their constituents. They make up approximately 85% of all sedimentary rocks.

**Chemical rocks**

Chemical rocks result from the purely physicochemical precipitation of minerals. For example, evaporites (anhydrite, halite, gypsum...) form through the evaporation of brines in a supersaturated environment. Carbonates like oolitic limestones also represent another type of chemical rocks.

**Biochemical rocks**

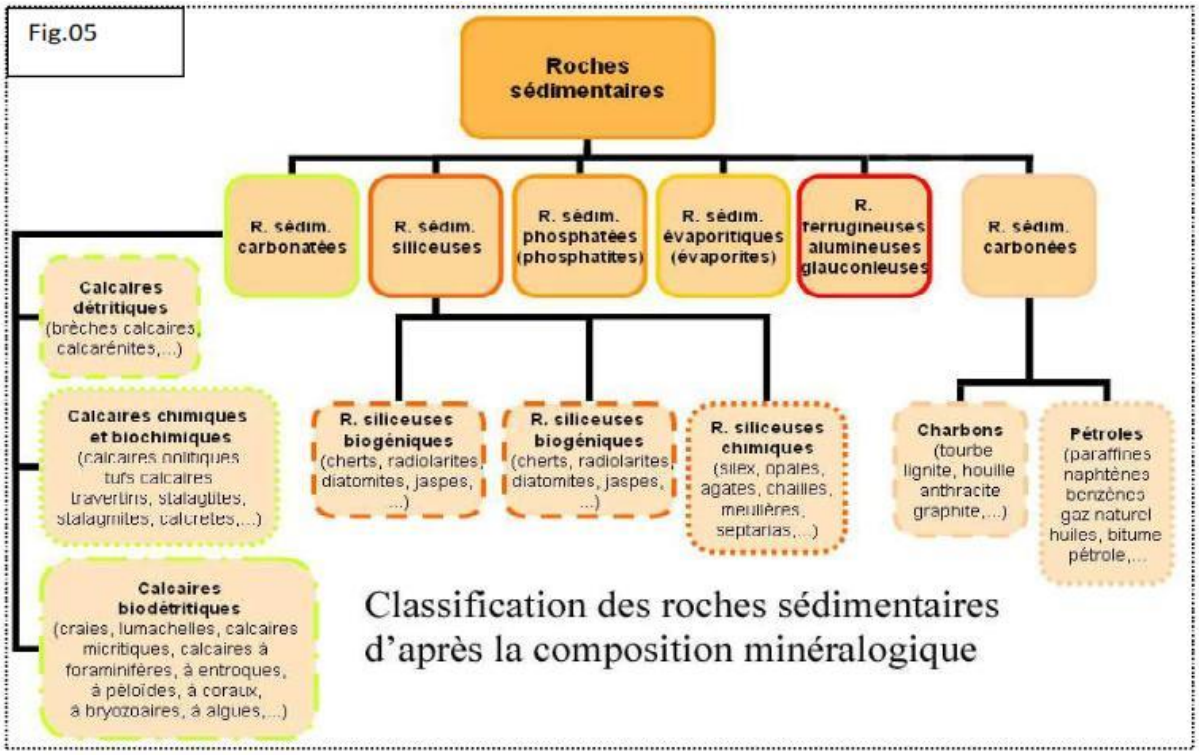
Unlike the previously described group, biochemical rocks, as their name suggests, result from the action of living organisms. These organisms use carbonates, phosphates, and silicates in some cases to build their tests, and through the accumulation of these tests, they form sedimentary rocks (such as biogenic limestones or reefs, radiolarites, diatomites, etc.).

**3.2. According to the composition, we distinguish:**

We distinguish:

- Siliceous rocks (silica)
- Carbonate rocks (calcium and magnesium carbonates)
- Phosphate rocks (calcium phosphates)
- Carbonaceous rocks (coal and hydrocarbons)
- Saline rocks (chlorides, calcium, sodium, potassium sulfates)
- Iron-bearing rocks (iron oxides, hydroxides)

In this classification, we consider the mineralogical composition of the rock.




## 4. **Sedimentation environments**

From the continent to the ocean, the deposition environments of sedimentary rocks are diverse: continental and marine environments.

- Continental Environments: Fluvial, glacial, lacustrine, palustrine, and desert environments.
- Mixed or Intermediate Environments: Located between marine and continental domains, such as deltas and estuaries.
- Marine Environments:
    - The littoral domain (beach and shallow platform).
    - The slope (continental shelf).
    - Basin

# Sedimentary deposition environments