— University of Mosul —
College of Petroleum & Mining Engineering

General Geology 1

Lecture 5

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Sediments الرواسب

Sediments are particles of rock, minerals, organic materials, or other debris that have been broken down through processes like weathering and erosion. These particles are transported by wind, water, ice, or gravity and eventually accumulate in layers on the surface of the Earth. Over time, these sediments can be compacted and cemented together to form sedimentary rocks. Sediments can range in size from tiny clay particles to large boulders and are often categorized based on their
size (e.g., sand, silt, gravel).

تطلق كلمة راسب على المواد **الصلبة المتراكمة** مع بعضها مع **مرور الزمن** سواء كانت هذه **الرواسب على اليابسة** او في **بيئات مائية** (بحرية ، نهرية ، بحيرات، جليد).

Type of Sediments أنواع الرواسب

Sediments are typically categorized based on their size, origin, and composition. The main types of sediments include

1. Clastic sediments رواسب فتاتيه

Definition: Composed of fragments of pre-existing rocks and minerals.

Examples:

Clay: Fine particles less than 0.004 mm in diameter.

Silt: Particles between 0.004 and 0.06 mm in diameter.

Sand: Particles between 0.06 and 2 mm in diameter.

Gravel: Particles larger than 2 mm, including pebbles, cobbles, and boulders.

تترسب المواد المنقولة والناتجة عن عمليات التجوية الميكانيكية Mechanical Weathering عندما تضعف قدرة العامل الناقل (الماء أو الهواء) مثل وجود عوائق في مجرى النهر أو قلة سرعة الجريان فتسقط الحمولة وتكون ما يسمى بالرواسب الفتاتية Clastic sediments وهي الحصى والرمل والطين.

2. رواسب كيميائية Chemical sediments

2. Chemical Sediments
Definition: Formed from the precipitation of minerals from water, often in evaporating environments like lakes or seas.
Examples:
Limestone: Composed primarily of calcium carbonate.
Gypsum: Formed from the evaporation of saline waters.
Halite: Also known as rock salt, forms from evaporating saline water.

- رواسب كيميائية Chemical Sediments

الترسيب الكيميائي Chemical deposition يحصل بواسطة تفاعلات كيميائية لنواتج التجوية الكيميائية (الايونات الذائبة) في المحاليل الناقلة وفي بيئات ترسيب معينة وحسب ظروف ملائمة. ومن أمثلة الترسيب الكيميائي ترسيب معدن الهلايت NaCl والكالسايت CaCO3 و هذه الرواسب تسمى رواسب غير فتاتية Non-clastic او رواسب كيميائية، وبعد تصلبها تكون صخور رسوبية كيميائية مثل الحجر الجيري Limestone المؤلف من الكالسايت وصخور الملح من معدن الهلايت

3. رواسب حياتية (عضوية)

3. Biogenic (Organic) Sediments

Definition: Made up of the remains of plants and animals, or organic material.

Examples:

Chalk: Formed from the shells of microscopic organisms.

Coal: Formed from plant material in swampy environments over long periods.

Coquina: A rock made entirely of shell fragments.

تقوم بعض الكائنات الحية مثل اللافقريات البحرية باستخلاص بعض المواد او المحاليل الذائبة من الماء وتستخدمها في بناء اصدافها الكلسية أو السليكية أو الفوسفاتية وبعد موت تلك الاحياء تترسب هياكلها مكونة ترسبات كيميائية حياتية ثم تتعرض هذه الترسبات لعمليات التصخر لتحولها إلى صخور كيميائية حياتية.

2. Wind (Aeolian Transport):

Wind can transport fine particles like sand, silt, and dust over great distances. This process occurs mostly in arid and semi-arid regions, forming features like sand dunes.

3. Ice (Glacial Transport):

Glaciers carry sediments of all sizes, from fine particles to large boulders, embedded in the ice. These sediments are deposited as the glacier moves and melts, creating features like moraines.

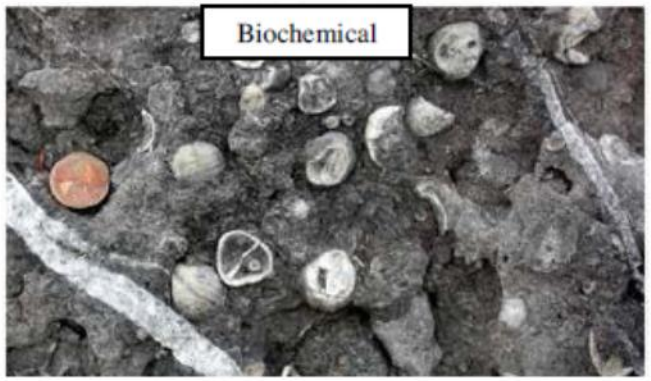
4. Gravity (Mass Wasting):

Sediments can move downhill due to gravity in processes such as landslides, rockfalls, and mudflows.

Sedimentary Rocks

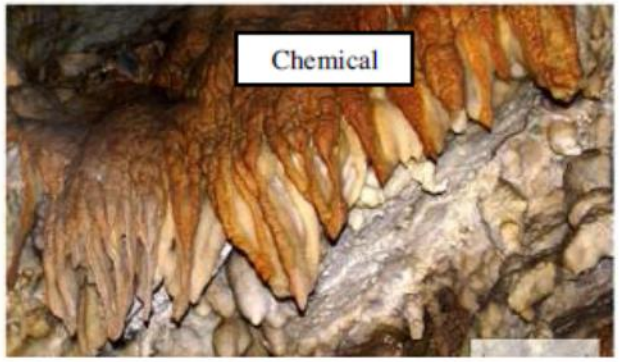
Four major classes:

1) **Clastic**: cemented solid fragments/ grains from pre-existing rocks.



2) **Biochemical**: made up of the shells of organisms.

3) **Organic**: carbon-rich sedimentary rocks.



4) **Chemical**: made up of minerals precipitated from water.

Classification of Sedimentary Rocks تصنيف الصخور الرسوبية

Sedimentary rocks are classified based on their composition and the processes that form them. They are divided into three main categories:

1. Clastic (Detrital) Sedimentary Rocks صخور رسوبية فتاتية

These are formed from the accumulation of fragments of pre-existing rocks (clasts) that are transported by wind, water, or ice and then deposited and compacted. They are classified based on the size of the particles.

Conglomerate: Made of rounded gravel-sized particles.

Breccia: Similar to conglomerate, but with angular gravel-sized particles.

Sandstone: Comprised mainly of sand-sized particles.

Shale: Formed from fine clay or silt-sized particles that settle in calm water.

2. Chemical Sedimentary Rocks صخور رسوبية كيميائية

These form when minerals precipitate from water, typically in areas with high evaporation rates or from biological activity.

Limestone: Mostly composed of calcium carbonate ($CaCO_3$), often formed in marine environments.

Chert: Formed from silica (SiO_2) precipitation.

Evaporites: Include rocks like gypsum and halite, formed by evaporation of water, leaving mineral deposits behind.

3. Organic Sedimentary Rocks صخور رسوبية عضوية

These rocks are formed from the accumulation of organic material, such as plants or animal remains.

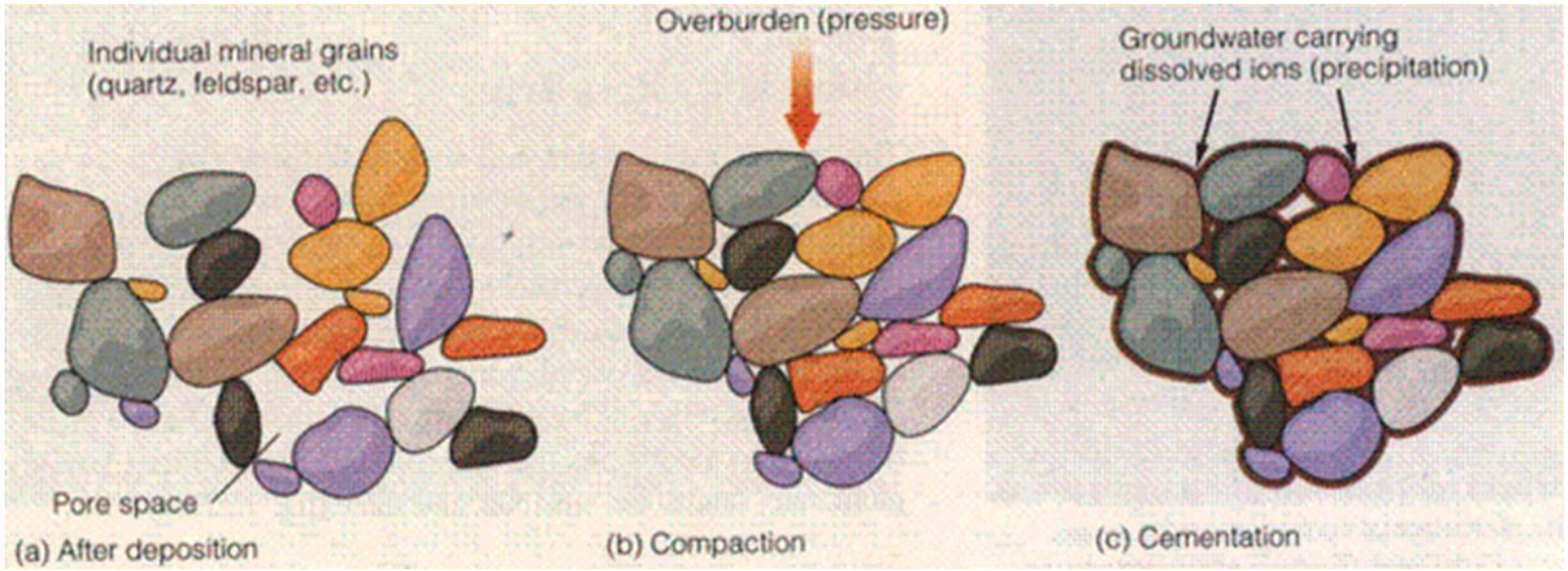
Coal: Formed from compressed plant material in swampy environments.

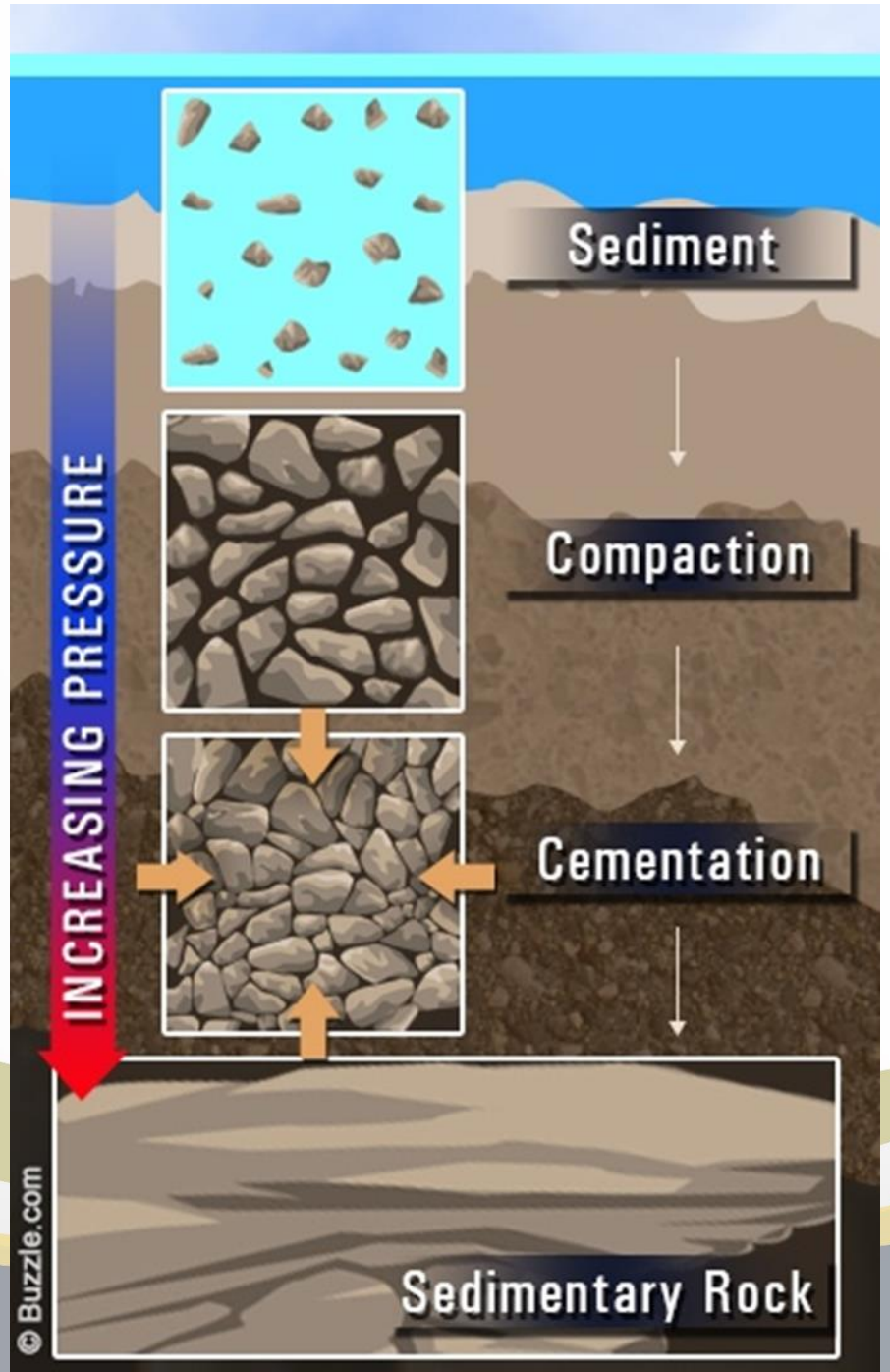
Chalk: A type of limestone formed from the microscopic skeletons of marine organisms.

These classifications help geologists understand the environment of deposition and the processes that led to the rock's Formation

4-Biochemical sedimentary rocks صخور رسوبية كيميائية حياتية are formed from the accumulation of biological material, specifically from the remains of living organisms, such as shells, skeletons, and other organic matter, that precipitate or accumulate in aquatic environments. They are a subtype of chemical sedimentary rocks and are mainly composed of minerals derived from biological processes.
Key Types of Biochemical Sedimentary Rocks:

1. Limestone (Biochemical)
Composition: Mainly composed of calcium carbonate ($CaCO_3$), derived from the shells and skeletons of marine organisms like corals, mollusks, and foraminifera.
Formation: Forms in shallow, warm marine environments where organisms extract calcium carbonate from seawater to build their shells.
Examples: Fossiliferous limestone, coquina (composed of shell fragments), and chalk (formed from microscopic plankton).
2. Chert (Biochemical)
Composition: Made of silica (SiO_2), derived from the microscopic skeletons of siliceous plankton like diatoms and radiolarians.
Formation: Occurs in deep marine environments where the silica from dead organisms accumulates on the ocean floor.
3. Coal (Biochemical)
Composition: Mainly carbon, formed from the remains of plant material in swampy or forested environments.
Formation: Forms through the accumulation of plant material that is buried, compacted, and eventually transformed into coal under heat and pressure.
Stages: Peat → Lignite → Bituminous coal → Anthracite (the highest grade of coal).


Individual mineral grains
(quartz, feldspar, etc.)
Pore space
(a) After deposition
Overburden (pressure)
(b) Compaction
Groundwater carrying
dissolved ions (precipitation)
(c) Cementation


Sediment
Compaction
Cementation
Sedimentary Rock
INCREASING PRESSURE
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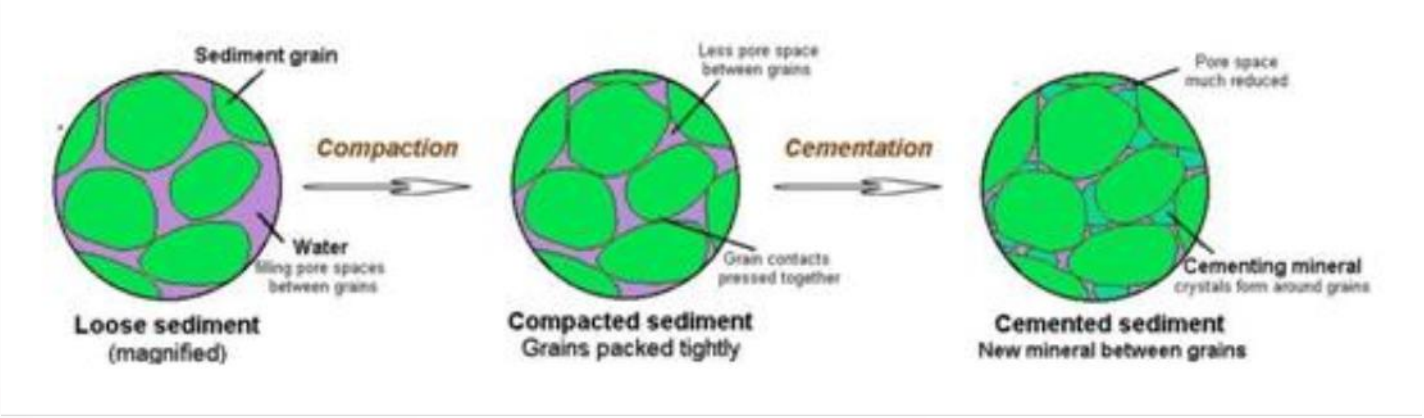
Compaction and Cementation

The processes by which sediments are changed into rock are complex, but can be simplified into two processes, called compaction and cementation



Diagenesis definition, the physical and chemical changes occurring in sediments between the times of deposition and solidification.

العمليات التحويرية Digenesis

كل التغييرات الكيميائية والفيزيائية والحياتية التي تحدث على الرواسب منذ ترسيبها حتى تحولها إلى صخرة صلبة تسمى بالعمليات التحويرية.