— University of Mosul —
College of Petroleum & Mining Engineering

General Geology 1

Lecture 4

Prof. Dr. Majid Majdi Al-Mutwali

Petroleum and Refining Engineering Department

Email: majidmutwaly@uomosul.edu.iq

• MINERALS

The solid part of the Earth is made up of rocks. Rocks are made up of minerals. A mineral is a naturally occurring inorganic Solid. It has as specific chemical composition and characteristic crystal structure.

المعدن (Mineral): هو مادة صلبة طبيعية تتكون عبر عمليات جيولوجية. المعادن تكون ي عضوية الأصل تملك تركيبا كيميائيا محددا وشكلا بلوريا منتظما وخواص فيزيائية معينة. ويتم تصنيفها بنااا على تركيبها البلوري والكيميائي. الصخرة اما تتكون من معدن واحد ، او من عدة معادن

Quartz

Here are some examples of common minerals:

1. Quartz – One of the most abundant minerals on Earth, composed mainly of silicon dioxide.(SiO_2)
2. Feldspar – A group of silicate minerals that make up a large portion of the Earth's crust, used in ceramics and glassmaking. Wit the general formula$(K,Na,Ca)(AlSi_3O_8)$.The main type is Orthoclase (Potassium feldspar) ($KAlSi_3O_8$)
3. Mica – A silicate mineral known for its shiny, flaky appearance, used in electrical and thermal insulation. Muscovite $KAl_2(AlSi_3O_{10})(OH)_2$
cement and building **4. Calcite** – A calcium carbonate mineral found in limestone and marble, used in materials.($Caco_3$)
5. Pyrite – Also known as "fool's gold," it is an iron sulfide with a metallic luster.(FeS_2)
6. Gypsum – A soft sulfate mineral used to make plaster and drywall.($CaSo_4.2H_2o$)
7. Hematite – An iron oxide mineral, one of the main ores for iron extraction.(Fe_2O_3)
8. Galena – A lead sulfide mineral and the primary ore of lead. (PbS)
9. Magnetite – A magnetic iron oxide mineral, important for iron production.Fe_3O_4
10. Talc – A soft mineral used in talcum powder and cosmetics.$Mg_3Si_4O_{10}(OH)_2$

These minerals have diverse industrial and practical uses, from construction to electronics.

The Rocks

A rock or stone is a natural substance a solid aggregate of one or more minerals.
Rocks are broadly classified into three groups based on **their process of formation.** The three major rock types are:

1. Igneous rocks
2. Sedimentary rocks
3. Metamorphic rocks

وعلى هذا الأساس، تتكون ثلاثة أصناف من الصخور المكونة للأرض كنتيجة طبيعية للعمليات المذكورة. هذه الأصناف هي:

(1)الصخور النارية Igneous Rocks:

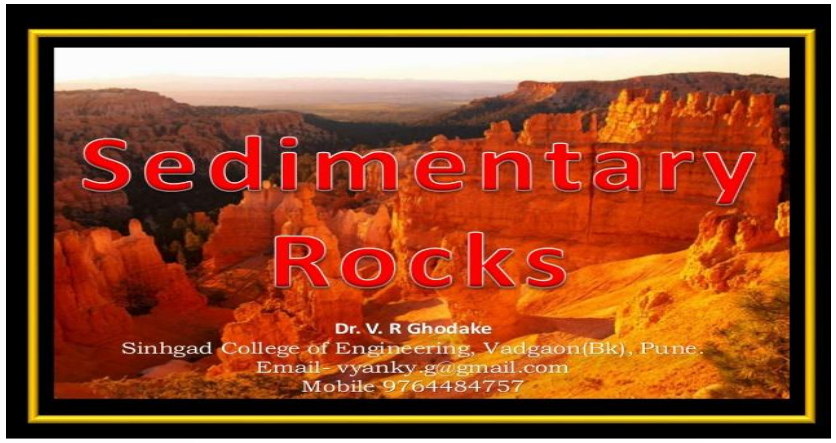
الصخور التي تتكون من تبلور المواد الصخرية المذابة تحت سطح الأرض والتي تسمى بالصهارة **Magma** حيث تحدث هذه العملية نتيجة التبريد الحاصل للصهير أثناء اختراقه طبقات القشرة الأرضية.

(2) الصخور الرسوبية Sedimentary rocks:

هي الصخور التي تكونت نتيجة عمليات متعاقبة من التجوية والنقل والترسيب في بيئات ترسيب مختلفة (بحرية ، قارية ، نهرية ...الخ) .

(3) الصخور المتحولة Metamorphic rocks:

هي صخور تكونت من تحول صخور هي بالأصل نارية أو رسوبية أو حتى متحولة قديمة بفعل عوامل التحول من ضغط وحرارة وعوامل كيميائية تعمل على إعادة تبلور تلك الصخور الاصلية المسماة بالصخور الام وهي في حالة صلبة بشرط ان لا تنصهر.

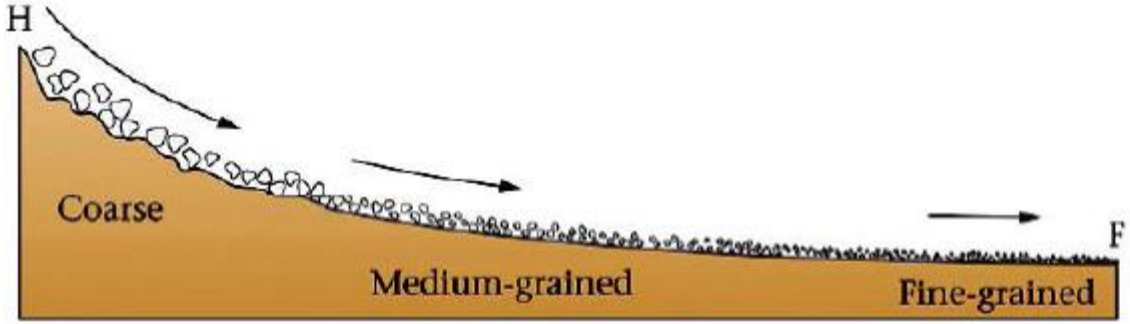


Sedimentary rocks are types of rocks formed by the accumulation and compaction of sediments, which are small particles of minerals, organic matter, or other rocks. These sediments are often deposited by water, wind, or ice and gradually compacted and cemented over time to form solid rock layers. Sedimentary rocks typically form in layers and often contain fossils. Examples include sandstone, limestone, and shale

Sedimentary Rocks الصخور الرسوبية

الصخور الرسوبية تكونت نتيجة لعمليات التجوية الكيميائية والفيزيائية Chemical or Physical weathering لصخور سابقة (نارية، رسوبية، متحولة) ونقلت الفتاتات أو العناصر المذابة من هذه الصخور عن طريق عمليات التعرية Erosion (المائية ، الهوائية ، الجليدية) إلى مناطق أخرى ثم حدث عمليات ترسيب هذه المواد بشكل رواسب (فتاتية ، كيميائية ، عضوية) وذلك عندما تقل قدرة عامل النقل او زيادة تركيز العناصر المذابة أو بفعل الكائنات الحية وبعد ذلك تتعرض هذه الرواسب إلى عمليات تصخر Lithofication تحول هذه الترسبات الهشة إلى صخور صلبة Rocks تسمى بالصخور الرسوبية Sedimentary Rocks

Clastic Sedimentary Processes



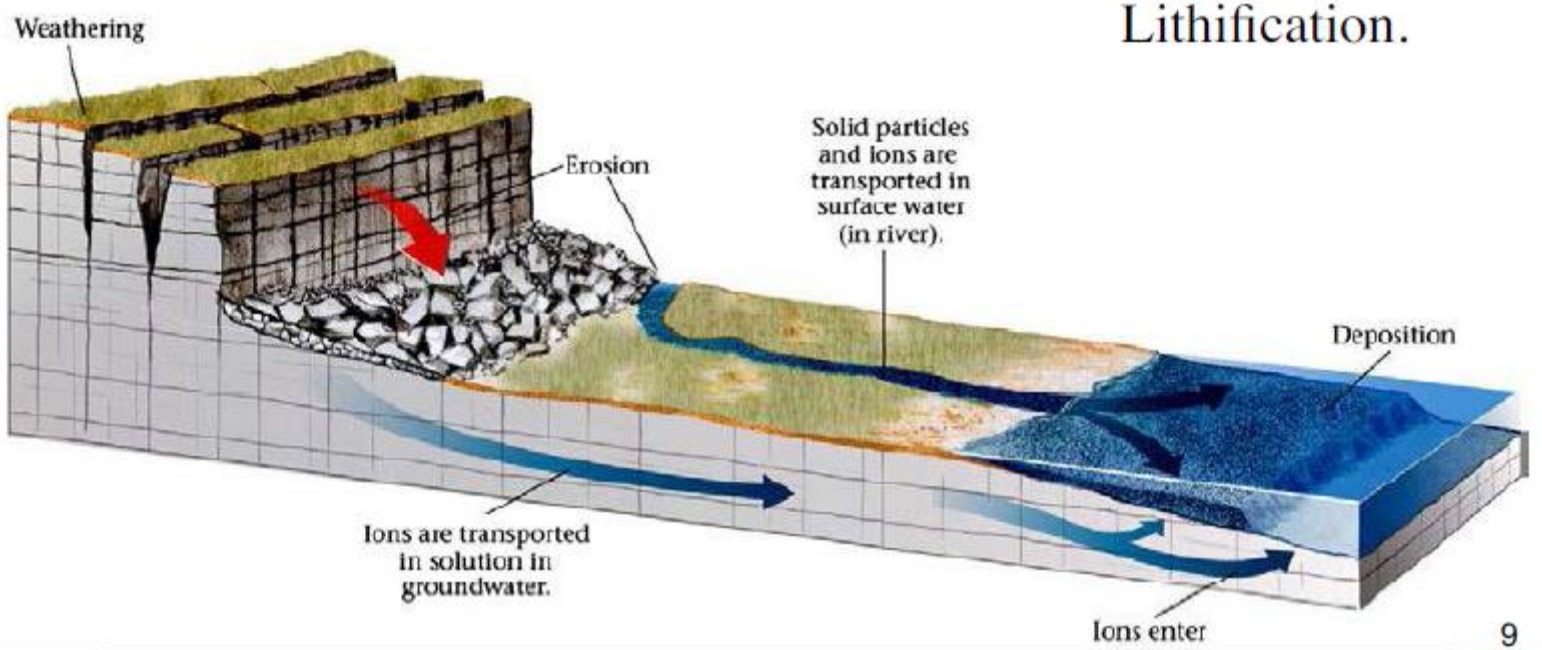
Weathering;

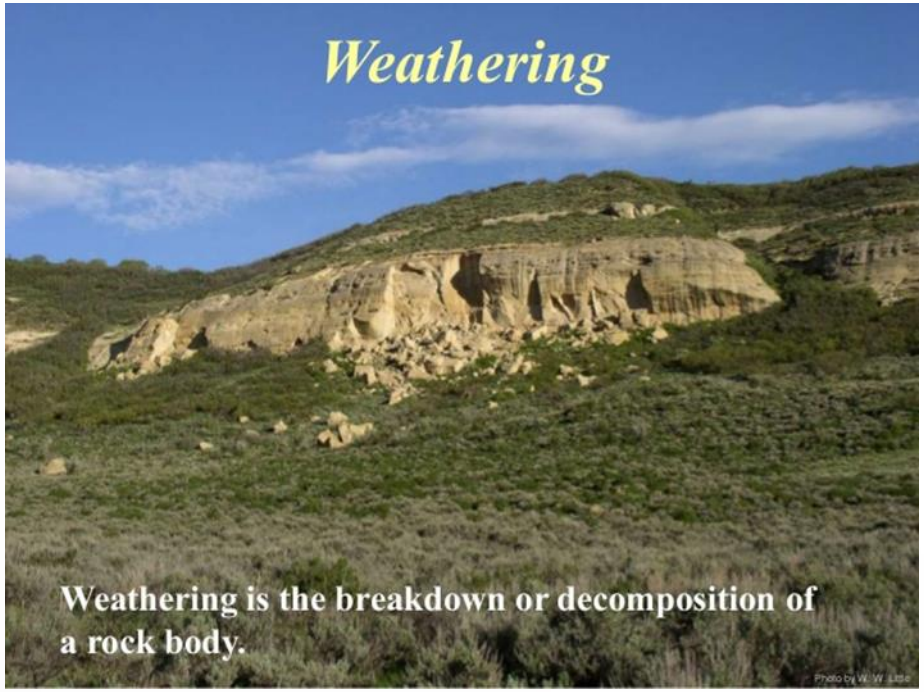
Erosion;

Transportation;

Deposition;

Lithification.





Weathering is the natural process by which rocks, minerals, and soils are broken down or altered by exposure to atmospheric conditions such as air, water, temperature changes, and biological activity. Weathering can occur in two main forms:

1. Physical (Mechanical) Weathering: The breakdown of rocks into smaller particles without changing their chemical composition, often due to temperature fluctuations, freeze-thaw cycles, or abrasion.
2. Chemical Weathering: The alteration of the chemical composition of minerals within rocks, typically caused by water, acids, and gases reacting with the rock materials.

Weathering plays a crucial role in the formation of soil and in shaping landscapes

Erosion is the process by which soil, rock, and other surface materials are worn away and transported from one location to another by natural agents such as wind, water, ice, or gravity. Unlike weathering, which involves the breakdown of materials in place, erosion involves the movement of those materials after they have been broken down.

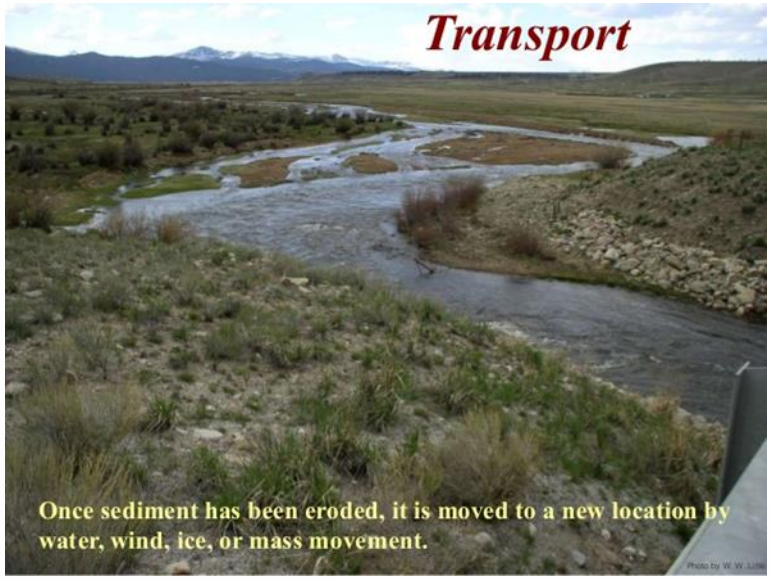
Common types of erosion include:

Water erosion: Caused by rainfall, rivers, and ocean waves.

Wind erosion: Occurs in dry areas where wind carries away loose particles.

Glacial erosion: Caused by the movement of glaciers grinding against rock surfaces.

Gravity erosion: Also called mass wasting, involves the downhill movement of rocks and soil due to gravity, such as landslides.



The transport of sediment refers to the movement of sediment particles from one location to another through natural agents like wind, water, ice, or gravity. This process occurs after sediments are weathered and eroded from rocks or other surfaces. The transport of sediment is a crucial part of the sedimentary cycle and plays a significant role in shaping landscapes.

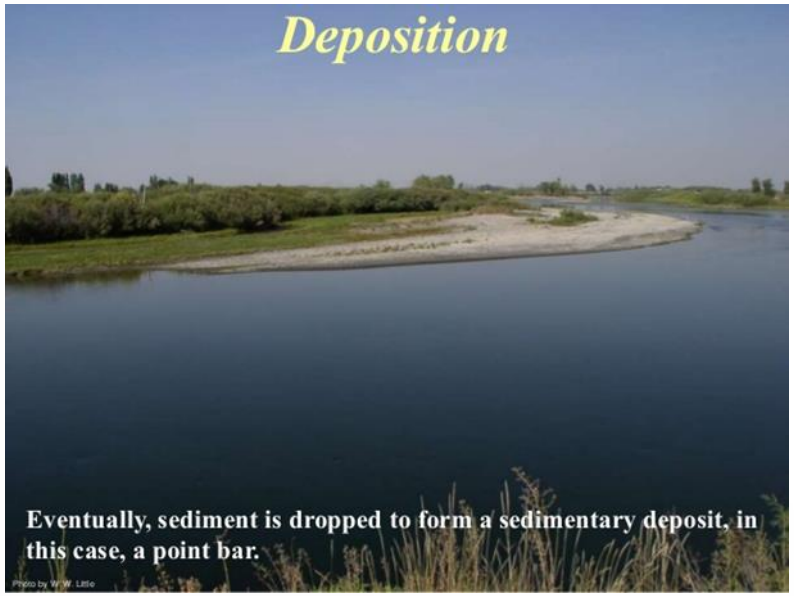
Key Agents of Sediment Transport:

1. Water (Fluvial Transport): Rivers, streams, and oceans carry sediments in suspension or along the bed. This can occur in several forms:

Suspension: Fine particles like silt and clay are carried in the water column.

Bedload: Larger particles, such as sand or gravel, move by rolling, sliding, or bouncing along the riverbed (saltation).

Solution: Dissolved minerals are transported in the water.



Deposition is the geological process in which sediments, soil, and rocks that have been transported by agents of erosion, such as wind, water, or ice, are laid down or accumulated in a new location. This process occurs when the transporting medium (like a river, wind, or glacier) loses energy and can no longer carry the particles, causing them to settle.
Deposition often leads to the formation of various landforms such as:
Deltas (where rivers meet oceans or lakes)
Sand dunes (formed by wind in deserts or coastal areas)
Alluvial fans (created by rivers in mountainous areas)
Deposition is essential in the creation of sedimentary rocks, as the accumulated materials are eventually compacted and cemented over time.