

**First year of Geomatics Department  
Engineering Geology 2018  
Lecture 6**

**SEDIMENTARY ROCKS**



**Dr. Eng. Hassan Mohamed**

# SEDIMENTARY ROCKS

Sedimentary rocks are formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding.

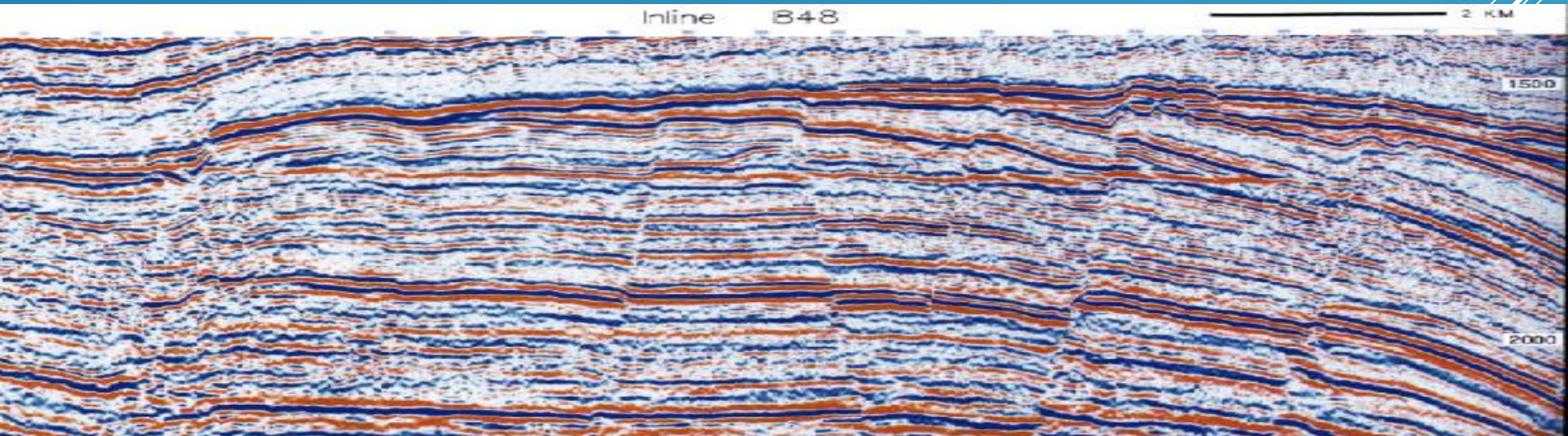
Common sedimentary rocks include sandstone, limestone, and shale. These rocks often start as sediments carried in rivers and deposited in lakes and oceans. When buried, the sediments lose water and become cemented to form rock. Comprise ~ 5% of Earth's upper crust. About 75% of rocks at surface.



# WHAT IS THE ECONOMIC IMPORTANCE OF SEDIMENTARY ROCKS?

They are important for economic reasons because they contain

- ▶ **Coal**
- ▶ **Petroleum and natural gas**
- ▶ **Iron, aluminum, uranium and manganese**
- ▶ **Geologists use them to read Earth's history**



# CLASSIFICATION OF SEDIMENTARY ROCKS

- Sedimentary rocks usually originate in water environments, either oceans, lakes, or river beds.
- Sedimentary rocks are grouped as;
  - 1) Clastic
  - 2) Chemical
  - 3) Organic
- Clastic and chemical are the most common and make up the majority of sedimentary rocks found on Earth's surface.

# THREE CLASSES OF SEDIMENTARY ROCKS

## 1.) Clastic sedimentary rocks

- Mechanical rock weathering byproducts are transported to new location, cement together

## 2.) Chemical sedimentary rocks

- Soluble material, dissolved by chemical weathering, precipitates by organic or inorganic processes

## 3.) Biochemical sedimentary rocks

- These rocks form as a result of once living organisms accumulating to form solid rock.

# CLASTIC SEDIMENTARY ROCKS

- **Consist of solid particles from weathered rocks. These rock fragments include pebbles, sand, silt and clay.**
- **Rock fragments are a result of physical weathering.**
- **These rocks usually form in water environments such as, rivers, lakes, oceans, but can also form in deserts.**
- **Geologist use particle size to distinguish between clastic sedimentary rocks, as seen in the table below.**

<b>Particle Name</b>	<b>Sediment Name</b>	<b>Rock Name</b>
<b>Boulder Pebble</b>	<b>Gravel (Round or Angular)</b>	<b>Conglomerate or Breccia</b>
<b>Sand</b>	<b>Sand</b>	<b>Sandstone</b>
<b>Silt / Clay</b>	<b>Mud</b>	<b>Siltstone/Shale</b>

# CLASTIC SEDIMENTARY ROCKS

**Mud rocks: less than .063 mm**

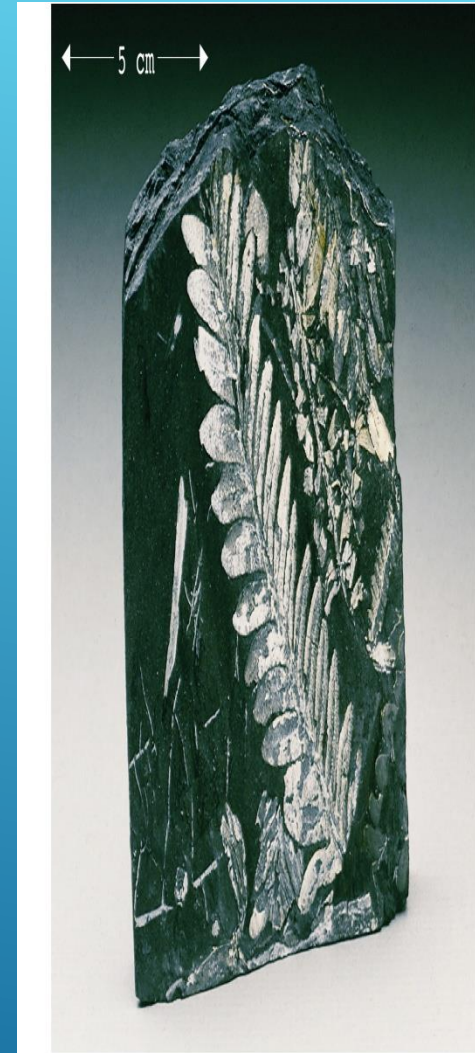
- ▶ **1. Mud:** small particles easily kept in suspension
- ▶ Settles in quiet water
- ▶ **Includes Shale:** mud-sized particles  $<.004$  mm deposited in thin bedding layers called laminae

Most common sedimentary rock

**2. Larger mud rock grains called silts**

silt-sized particles .004-.063 mm

Gritty grains can be felt

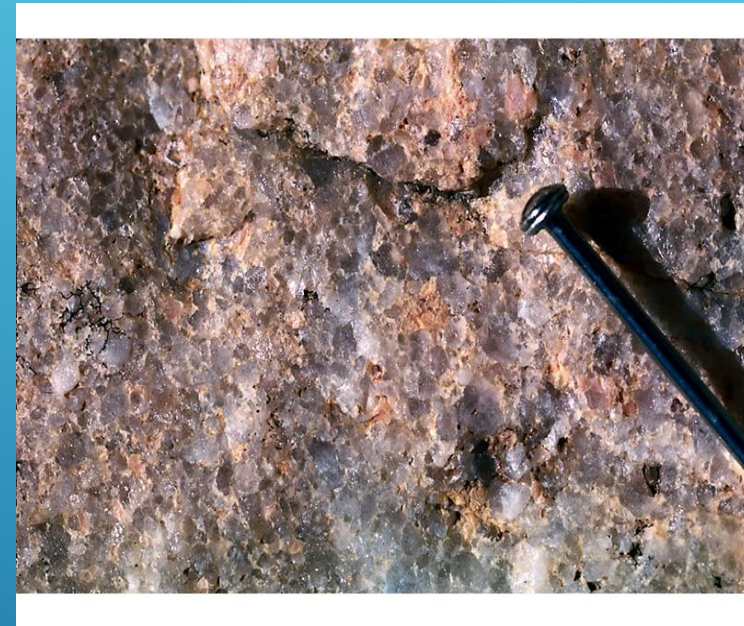


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# CLASTIC SEDIMENTARY ROCKS

## ▶ Sandstone

- ▶ Made of sand-sized particles larger than .063 mm and less than 2mm
- ▶ Forms in a variety of environments
- ▶ Sorting, angularity and composition of grains can be used to interpret the rock's history
- ▶ Quartz is the predominant mineral (due to its durable nature)



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# CLASTIC SEDIMENTARY ROCKS

## ▶ Conglomerate and breccia

▶ Both composed of particles  
> 2mm in diameter

▶ Conglomerate consists  
largely of rounded clasts.

Rounded pebbles in high velocity areas

▶ Breccia is composed of  
large angular particles



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# SEDIMENT PARTICLES AND CLASTIC SEDIMENTARY ROCKS

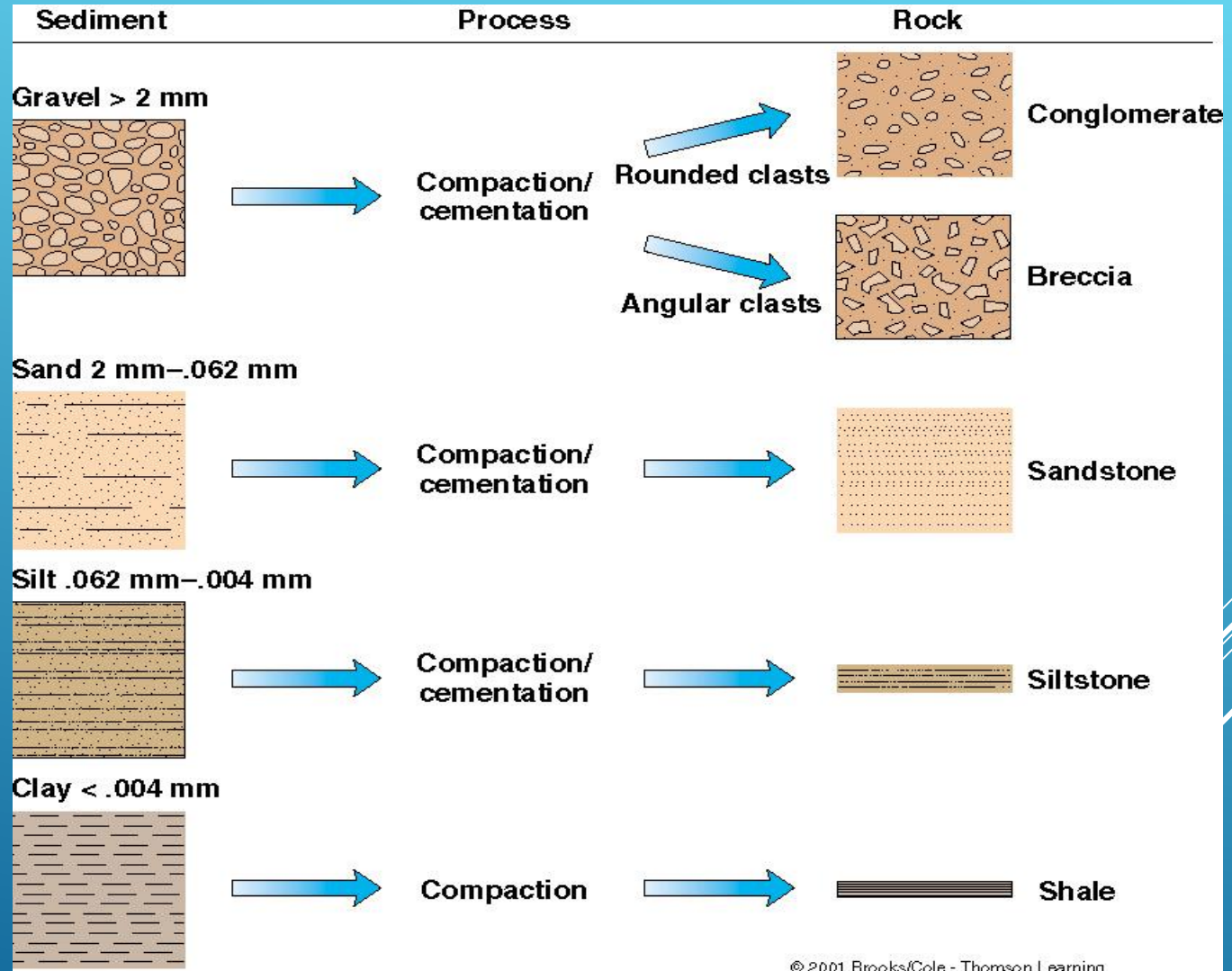
Diameter (mm)	Sediment		Sedimentary Rock
256	Boulder	Gravel	<b>Breccia</b> (angular particles) or <b>Conglomerate</b> (rounded particles)
64	Cobble		
2	Pebble		
$\frac{1}{16}$	Sand		<b>Sandstone</b>
$\frac{1}{256}$	Silt	"Mud"	Siltstone (mostly silt) <b>Shale</b> or mudstone (mostly clay)
	Clay		

Sandstone and shale are quite common; the others are relatively rare.

# CLASTIC SEDIMENTARY ROCKS

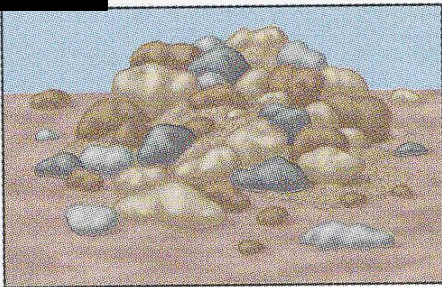
This figure shows how clastic sediment of various sizes will, after compaction and cementation, form different types of **detrital sedimentary rocks**.

The process of sediment turning into rock is called **lithification**.

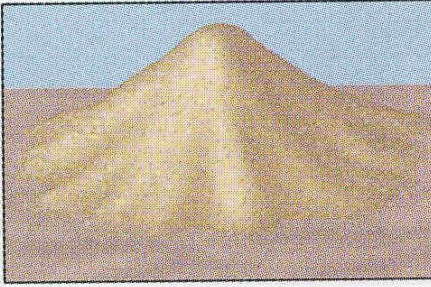


© 2001 Brooks/Cole - Thomson Learning

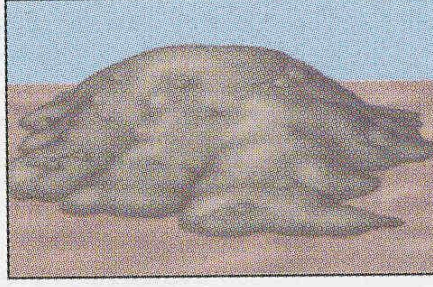
**sediments**



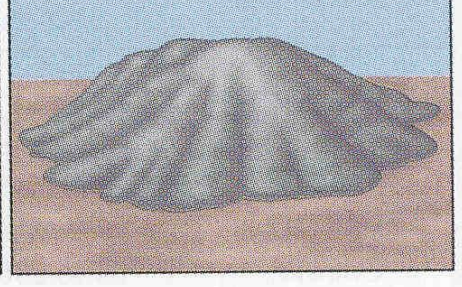
gravel



sand

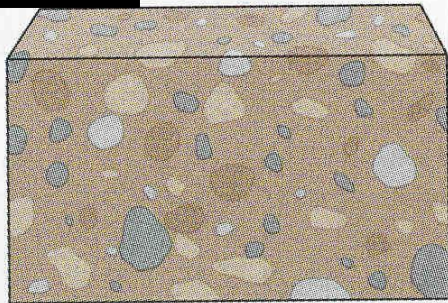


silt

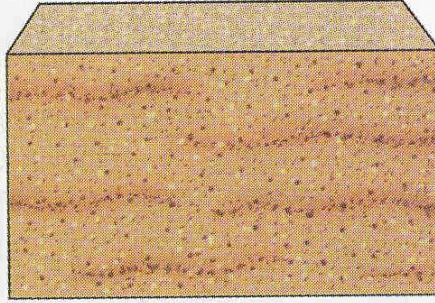


clay

**sedimentary rocks**



conglomerate



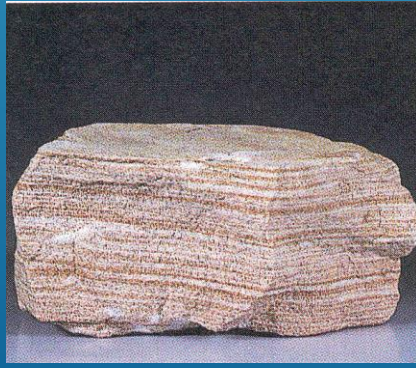
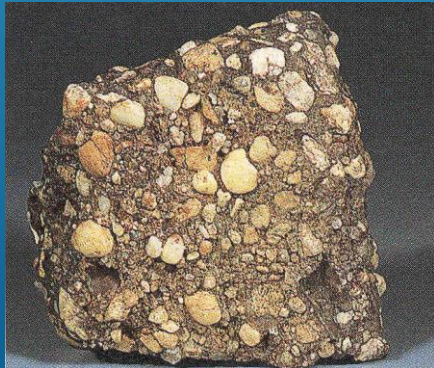
sandstone



siltstone



shale



## 2) CHEMICAL SEDIMENTARY ROCKS

- These rocks form as a result of chemical weathering dissolving chemicals and transporting it in solution. When conditions are right, these dissolved chemicals change back into a solid through the processes of precipitation and evaporation.

- Precipitation:

Process where chemicals dissolved on solution, fall out of solution and forms a solid material. Most common in shallow water environments.

- Evaporation:

Process where there is a change in state from a liquid to a gas. Chemicals dissolved in the liquid (water) are left behind as a solid material.

## 2) Chemical Sedimentary Rocks

- **Precipitation may occur as a result of physical processes, or indirectly through life processes of water-dwelling organisms. Sedimentary rock formed in this way is referred to as Biochemical.**
- **Many organisms excrete dissolved minerals to form shells and when they die the shells accumulate on the sea floor and form a rock called Coquina.**
- **Note: Evaporation and Precipitation often work together. As water evaporates, chemicals in solution will precipitate. Example: Rock Salt (Halite)**

## 2) CHEMICAL SEDIMENTARY ROCKS

- **These rocks usually form in water environments such as lakes and shallow seas or oceans.**
- **Some examples of chemical sedimentary rocks include;**
  - 1) **Limestone (Calcite) - (form by precipitation)**
  - 2) **Rock Gypsum - (form by precipitation and evaporation)**
  - 3) **Rock salt (Halite) – (from by evaporation)**
  - 4) **Coquina - (form by biochemical processes)**



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### **3) ORGANIC SEDIMENTARY ROCKS**

- **These rocks form as a result of once living material accumulating to form solid rock.**
- **The most common organic rock is coal, which forms when plant material in water saturated environments (swamps) die and accumulate to form peat. As peat is buried it compresses and eventually changes to form coal.**

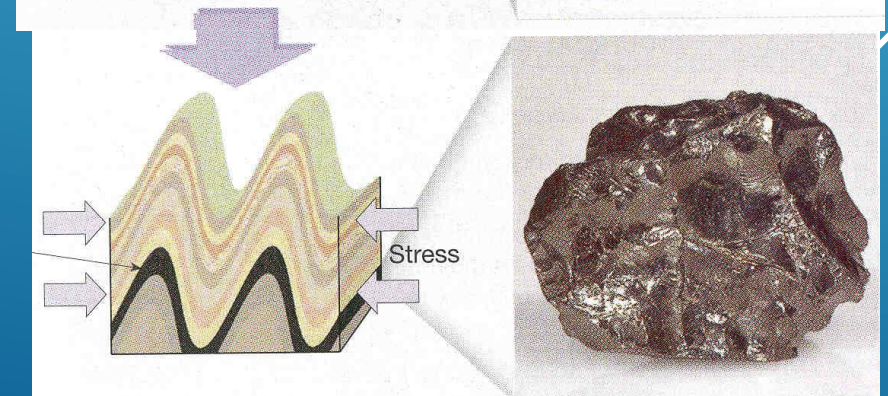
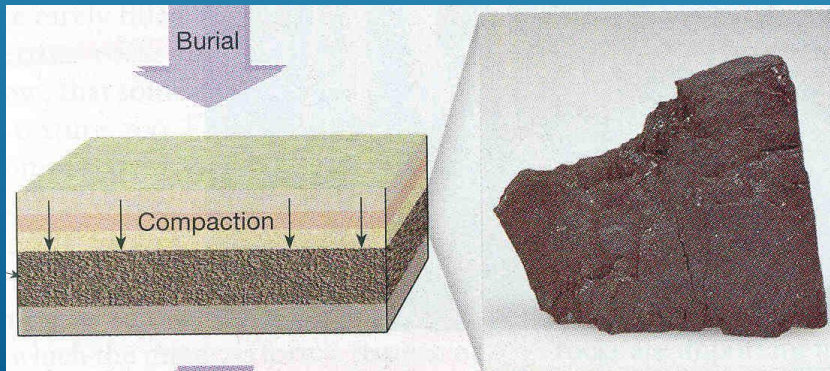
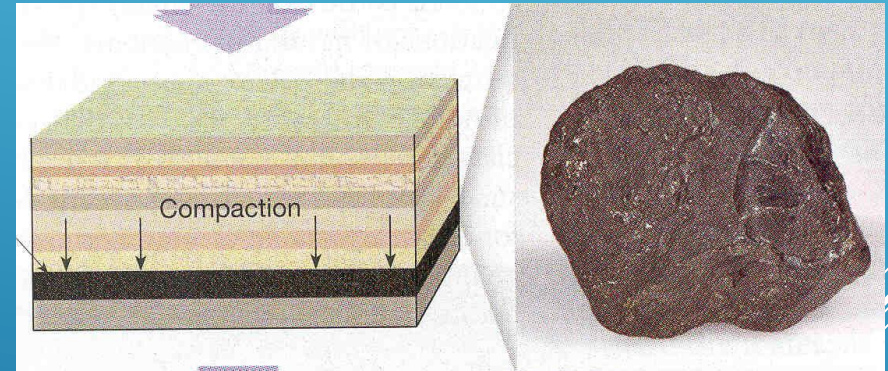
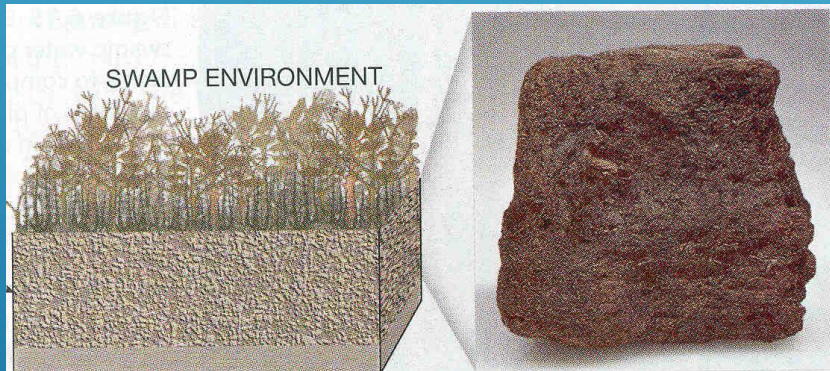


# Sedimentary rocks

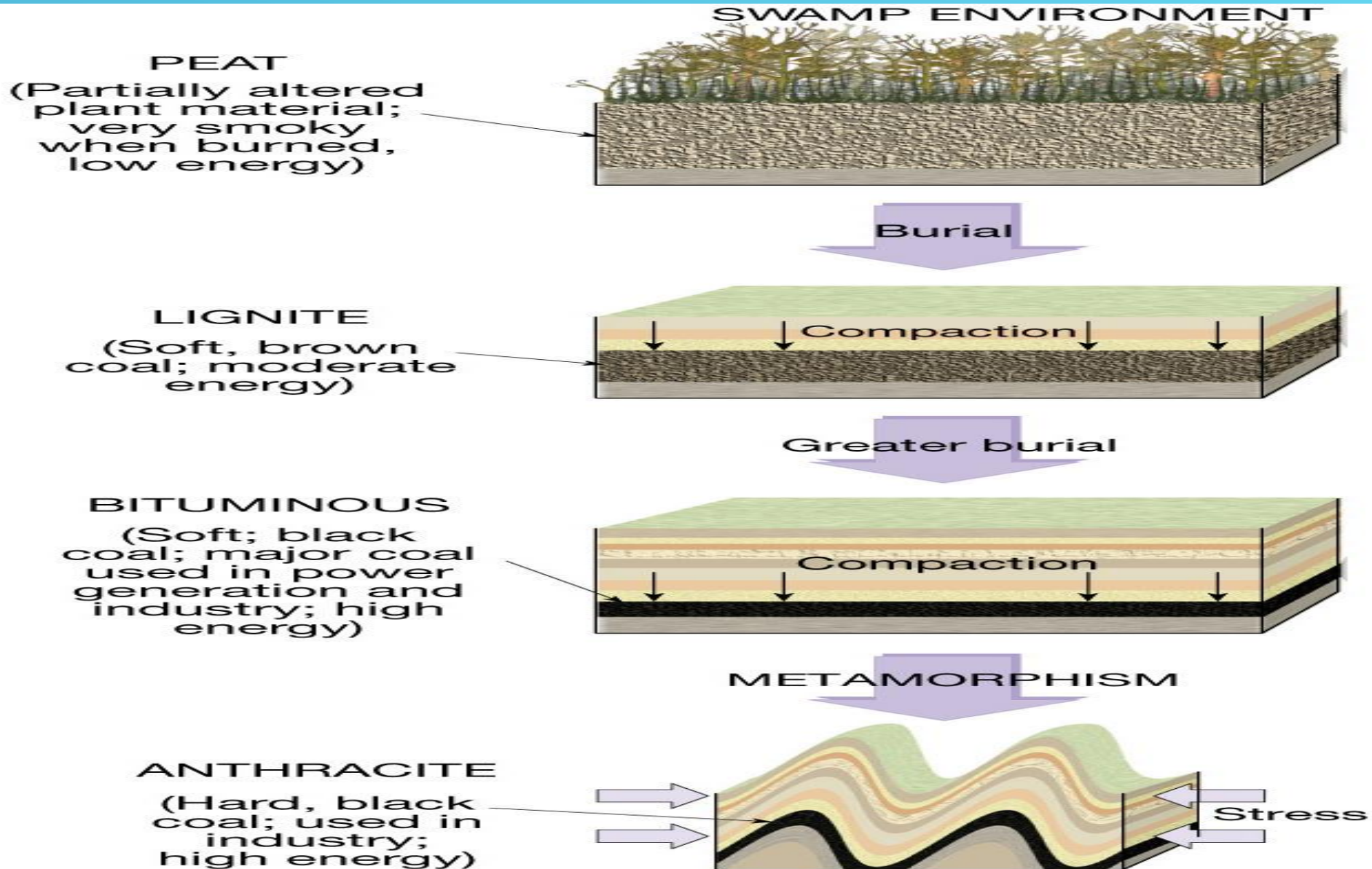
## Organic sedimentary rocks

### Coal

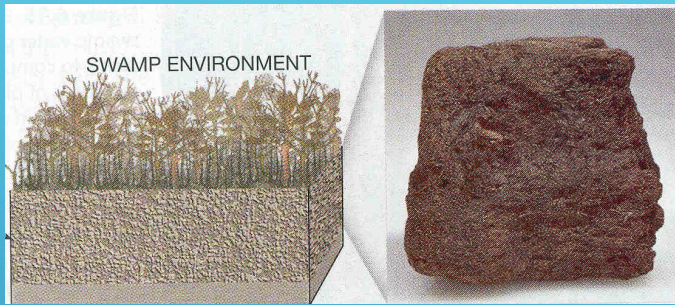
- buried and compacted plant material
- different kinds of coal, depending on formation process



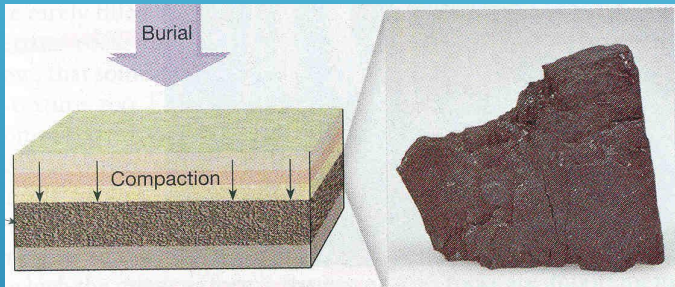
# ORGANIC SEDIMENTS: COAL



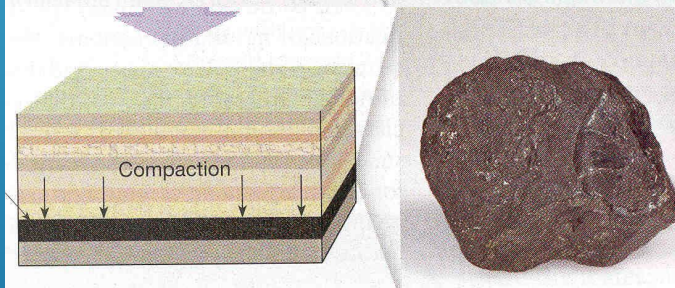
# Stages of coal formation



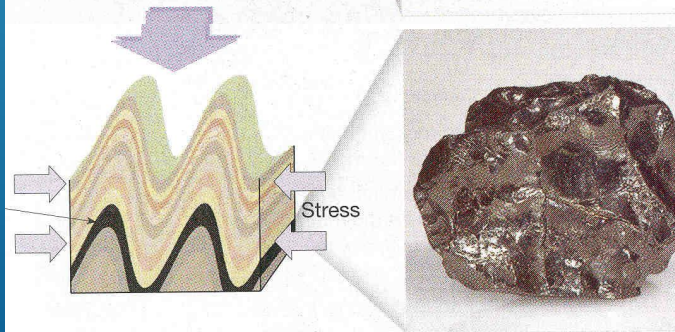
PEAT



LIGNITE



BITUMINOUS



ANTHRACITE

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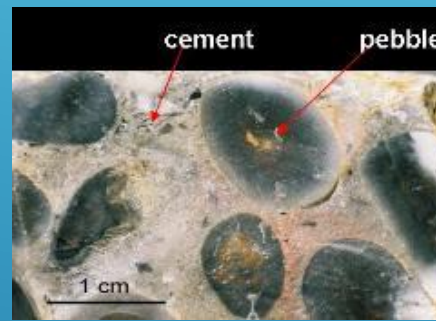
# Coal

- major fuel for power plants
- 70% of coal usage: electricity
- many problems: pollution, health, wastelands
- lots more available
- formation: swamps



# CONGLOMERATE

Conglomerate is made of pebbles deposited on beaches or in river channels. The pebbles have become cemented together by minerals precipitated from groundwater after the sediment was laid down.

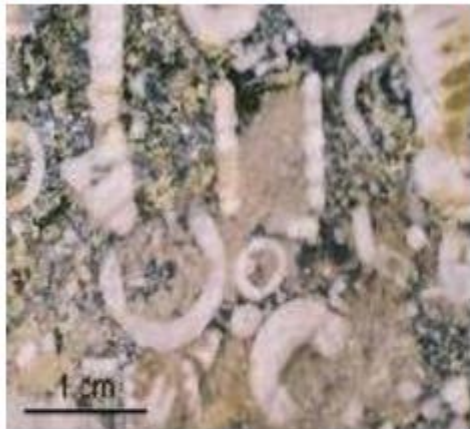


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# LIMESTONE

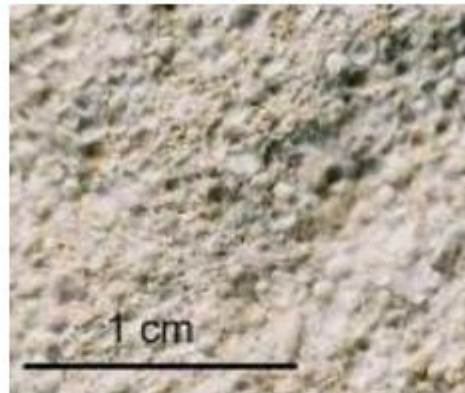
Limestone are made up largely of calcite (calcium carbonate) as their main mineral. Limestone fizz when a drop of dilute hydrochloric acid is placed on them.

**Shelly limestone**



Shelly limestone is made up of the shells and skeletons of invertebrates that live in the sea (or sometimes in fresh water). The shells are not usually whole, as they are broken up by waves.

**Oolitic limestone**



Oolitic limestone is made up of small spheres called ooliths that are stuck together by lime mud. They form when calcium carbonate is deposited on the surface of sand grains rolled (by waves) around on a shallow sea floor.

**Chalk**



Chalk is a soft, white limestone, made up of the microscopic remains (coccoliths) of tiny planktonic organisms, that live in the surface waters of tropical seas. The inset photo was taken using an electron microscope.

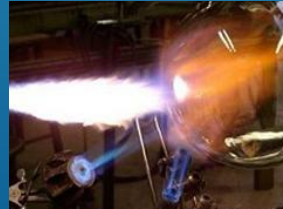
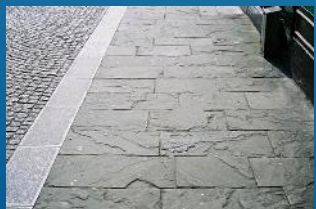
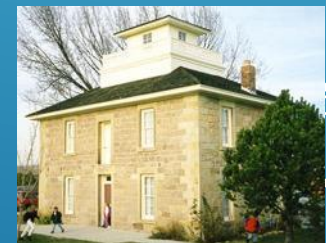


# SANDSTONE

Sandstone is made of sand grains (0.05mm to 2mm) that may have been deposited in the sea, by rivers, or in deserts, and later cemented together by minerals precipitated from groundwater.

Most sandstones are made up largely of quartz grains, because quartz is a very hard and chemically-resistant mineral. Quartzite is a name given to very hard, pure quartz sandstones.

Many sandstones contain some grains of other minerals like calcite, clay, or mica.



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# MUDSTONE

Mudstone is made up of tiny clay particles (less than 0.05mm) that can't be seen with the naked eye. These tiny particles are deposited in quiet low-energy environments like tidal flats, lakes, and the deep sea.



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# THANKS

Please visit the following links:

[https://en.wikipedia.org/wiki/Sedimentary\\_rock](https://en.wikipedia.org/wiki/Sedimentary_rock)

<https://www.youtube.com/watch?v=Etu9BWbuDIY>

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