

Classification of Sedimentary Rocks



The classification may be based on :

- 1. Sediments (sedimentary materials)**
- 2. Minerals**
- 3. Textures**






Sedimentary materials (sediments)

We can generally classify sedimentary materials into four major categories to their origins:

- 1. Detritus (Clastic)**
- 2. Chemical precipitates (Solids derived from ions carried in solutions)**
- 3. Organic materials (biogenic or organically derived sediments)**
- 4. Volcanic materials.**

Main groups of sedimentary rocks

CLASTIC ROCKS	CHEMICAL- BIOGENIC ROCKS	RESIDUAL ROCKS	CARBONACEOUS ROCKS
Psephites Psammites Pelites	Limestones Siliceous rocks Saline rocks Phosphate rocks Ferriferous rocks	Kaolin Bauxite	Peat Lignite Bituminous coal Anthricite

Detrital Sedimentary Rocks				Chemical Sedimentary Rocks				
Clastic Texture Particle Size		Sediment Name	Rock Name	Composition	Texture	Rock Name		
Coarse (over 2 mm)		Gravel (Rounded particles)	Conglomerate	Calcite, CaCO_3	Nonclastic: Fine to coarse crystalline	Crystalline Limestone		
		Gravel (Angular particles)	Breccia			Travertine		
Medium (1/16 to 2 mm)		Sand	Sandstone		Clastic: Visible shells and shell fragments loosely cemented	Coquina	B l o c h e s t i c a l	
		(If abundant feldspar is present the rock is called Arkose)			Clastic: Various size shells and shell fragments cemented with calcite cement	Fossiliferous Limestone		
Fine (1/16 to 1/256 mm)		Mud	Siltstone		Clastic: Microscopic shells and clay	Chalk		
Very fine (less than 1/256 mm)		Mud	Shale					
					Quartz, SiO_2	Nonclastic: Very fine crystalline	Chert (light colored) Flint (dark colored)	
					Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Nonclastic: Fine to coarse crystalline	Rock Gypsum	
					Halite, NaCl	Nonclastic: Fine to coarse crystalline	Rock Salt	
					Altered plant fragments	Nonclastic: Fine-grained organic matter	Bituminous Coal	

▲ **FIGURE 7.17** Identification of sedimentary rocks. Sedimentary rocks are divided into two major groups, detrital and chemical, based on their source of sediment. The main criterion for naming detrital sedimentary rocks is particle size, whereas the primary basis for distinguishing among chemical sedimentary rocks is their mineral composition.

The first order of classification is into:

A. Clastic (detrital)

B. Non-Clastic

The adjective “clastic” comes from the Greek word **Klastos=meaning **broken**.**

It describes a sediment consisting of particles removed individually from a parent rock source.

Clastic sediments can be further divided into:

- 1. Pyroclastic Sediments (volcanic)**
- 2. Detrital Sediments**

They can also be divided into:

- A. Inorganic Clastic Sedimentary Rocks**
- B. Organic Clastic Sedimentary Rocks**

B. The non-clastic division itself includes two basic subdivisions:

- 1. Chemical precipitates**
- 2. Organically derived sediments**

Chemical precipitate (hydrogenic sediments) are inorganic compounds representing solid mineral matter **precipitated** from an aqueous solution in which that matter has been transported.

The **organically derived (biogenic)** sediments consist of both produced by the activities of **plants and animals** and the remains of plants and animals themselves.

Clastic sedimentary rocks

A. Inorganic Clastic Rocks:

They are classified based on:

- 1. grain size,**
- 2. grain rounding (shape) and**
- 3. size sorting.**

CLASTIC SEDIMENTARY ROCKS

A. Inorganic Clastic Rocks:

They are classified based on grain size, grain rounding and size sorting.

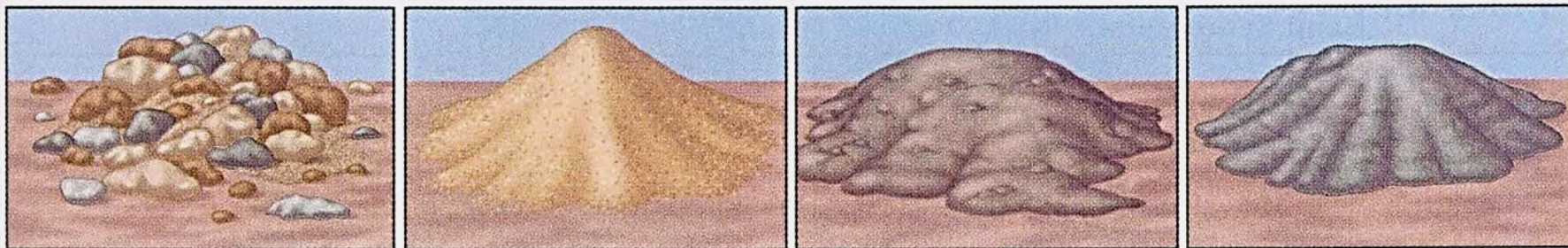
Size: Boulder, Cobble, Pebble size: >2 mm in diameter

Sand size: between 2 and 0.062
(coarse, medium and fine)

Silt size: between 0.062 and 0.005mm

Clay size: <0.005 mm

A. Sediment



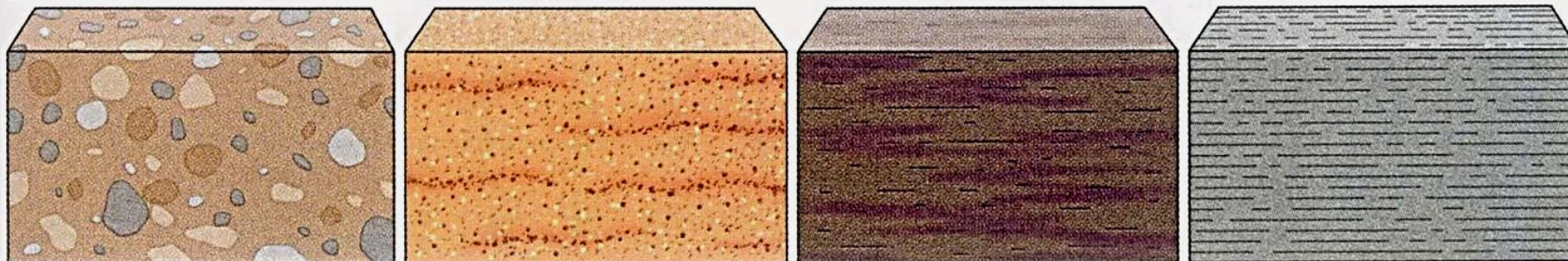
Gravel

Sand

Silt

Clay

B. Sedimentary rock



Conglomerate

Sandstone

Siltstone

Shale

Figure 6.2 Clastic Sediments and Clastic Sedimentary Rocks The main kinds of clastic sediments and the sedimentary rocks formed from them.

Rounding:

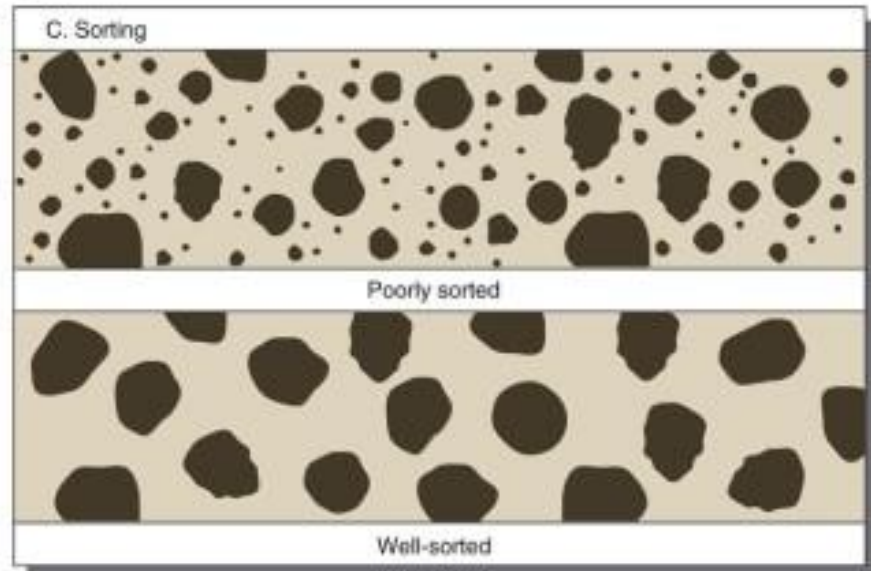
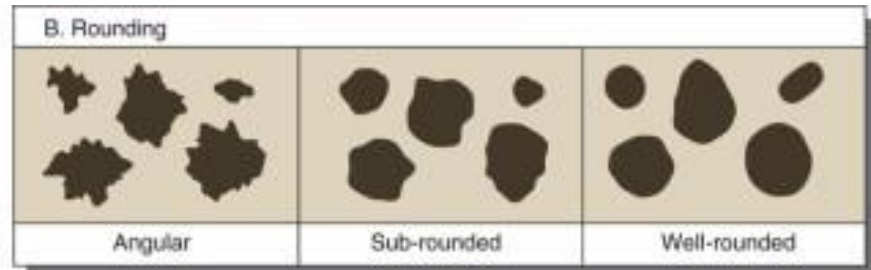
Very angular to well rounded

Size Sorting:

Well sorted (grains of uniform size)

Poorly sorted (grains of various size)

A. Grain size	
Gravel > 2mm	Pebbles 4–64 mm
	Granules 2–4 mm
	Coarse sand 0.5–2 mm
	Medium sand 0.25–0.5 mm
	Fine sand 0.06–0.25 mm
	Silt 0.004–0.06 mm
	Clay < 0.004 mm



Rock Types

1. Large-grained rocks:

Conglomerate (poorly sorted, rounded to sub-rounded grains)

Breccia (poorly sorted, angular grains)

2. Sand-sized rocks:

Quartz sandstone

Arkose (quartz + at least 15% orthoclase)

Graywacke (poorly sorted, quartz, rock fragments)

3. Silt-sized rocks:

Silt stone

4. Clay-sized rocks:

Clay stone/Shale

Detrital Sedimentary Rocks

Size-based classification

Clasts	Size in mm	Rock name
Boulder (>256mm), Cobble (64-256 mm), Pebble (2-64 mm) size:	>2 mm in diameter	<i>Conglomerate</i> (poorly sorted, rounded to sub-rounded grains) <i>Breccia</i> (poorly sorted, angular grains)
Sand size:	between 2 and 0.062 (coarse- 0.5-0.25; medium-0.25-0.075; and fine- 0.075-0.062)	Quartz sandstone Arkose (quartz + at least 15% orthoclase)
Silt size:	between 0.062 and 0.005mm	Silt stone
Clay size:	<0.005 mm	Clay stone/Shale

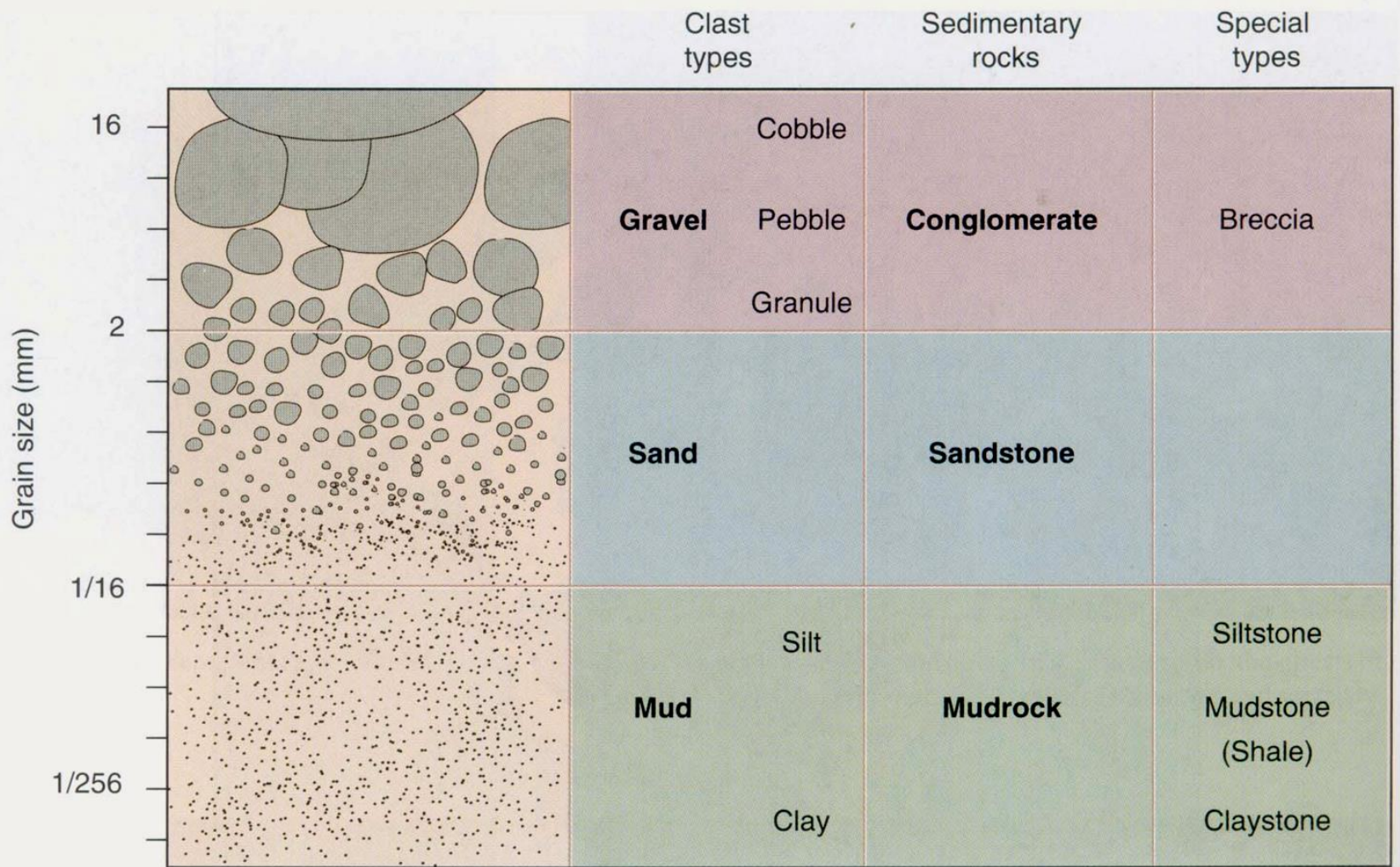


FIGURE 5.4 The classification of common clastic sedimentary rocks is based primarily on grain size and secondarily on textural and compositional variations.






Detrital Sedimentary Rocks			
Clastic Texture (particle size)		Sediment Name	Rock Name
Coarse (over 2 mm)		Gravel (Rounded particles)	Conglomerate
		Gravel (Angular particles)	Breccia
Medium (1/16 to 2 mm)		Sand (If abundant feldspar is present the rock is called Arkose)	Sandstone
Fine (1/16 to 1/256 mm)		Mud	Siltstone
Very fine (less than 1/256 mm)		Mud	Shale or Mudstone

Fig. 7.20: Identification of sedimentary rocks. Sedimentary rocks are divided into three groups, detrital, chemical and organic. The main criterion for naming detrital sedimentary rocks is particle size, whereas the primary basis for distinguishing among chemical sedimentary rocks is their mineral composition.

Breccia and **conglomerate** are both composed of gravel-sized grains and are often poorly sorted or moderately sorted.

But the grains in breccia are angular, and the grains in conglomerate are rounded or well rounded.

Sandstone

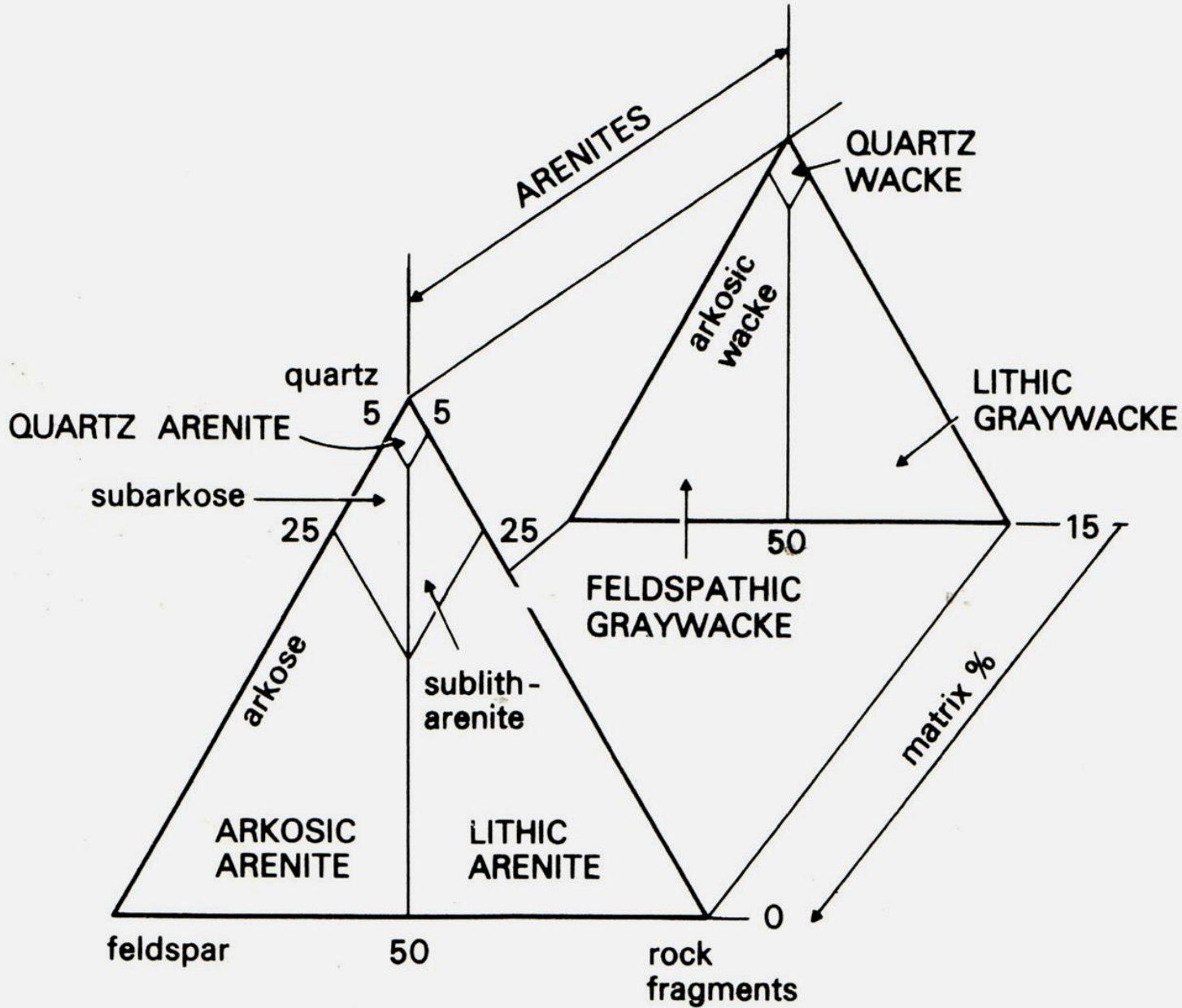


Figure 6.6 Classification of sandstones. After Dott (1964); Pettijohn, Potter and Siever (1973).

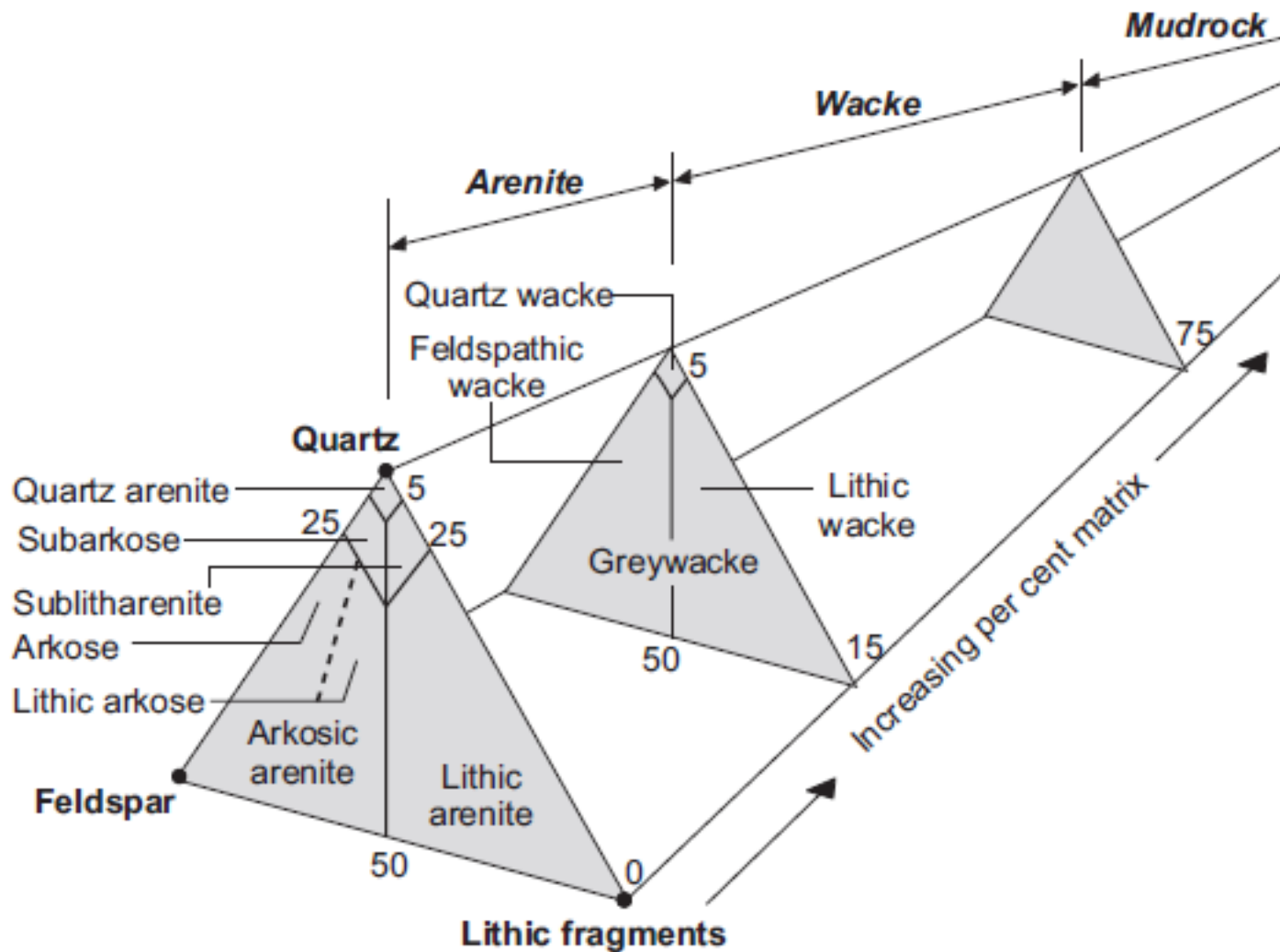
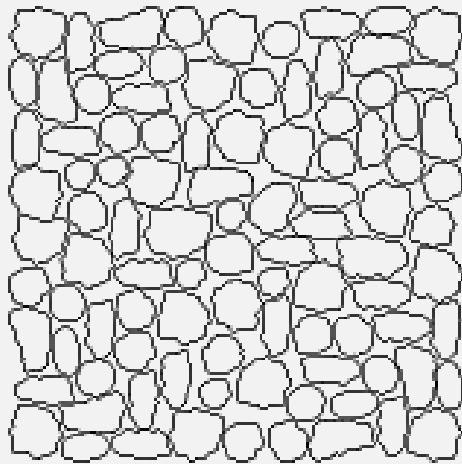
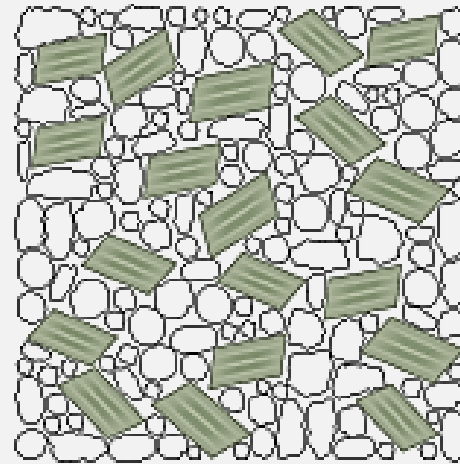


Fig. 2.11 The Pettijohn classification of sandstones, often referred to as a 'Toblerone plot' (Pettijohn 1975).

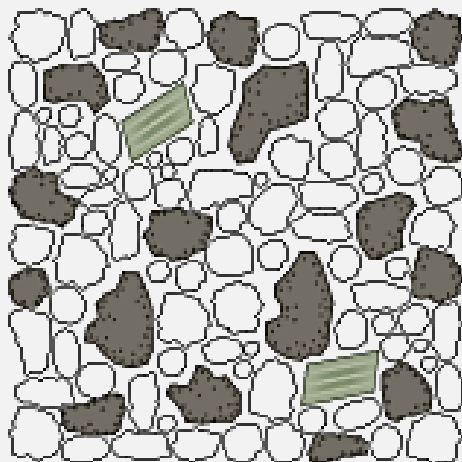
Some sedimentary rocks (sand size-dominated rocks): textures and compositions



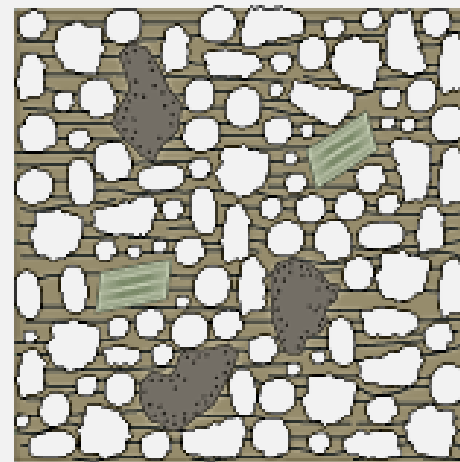
(a) Quartz arenite:
pure quartz



(b) Arkose:
feldspar-rich



(c) Lithic sandstone:
rock-fragment-rich



(d) Graywacke:
matrix-rich

TABLE 7.2

Classification of Sedimentary Rocks

DETRITAL SEDIMENTARY ROCKS		
<i>Sediment Name and Size</i>	<i>Description</i>	<i>Rock Name</i>
Gravel (>2 mm)	Rounded gravel particles	Conglomerate
	Angular gravel particles	Sedimentary breccia
Sand ($1/16$ –2mm)	Mostly quartz sand	Quartz sandstone
	Quartz with >25% feldspar	Arkose
Mud (< $1/16$ mm)	Mostly silt	Siltstone
	Silt and clay	Mudstone*
	Mostly clay	Claystone*
		} Mudrocks
CHEMICAL SEDIMENTARY ROCKS		
<i>Texture</i>	<i>Composition</i>	<i>Rock Name</i>
Varies	Calcite (CaCO_3)	Limestone
Varies	Dolomite [$\text{CaMg}(\text{CO}_3)_2$]	Dolostone
Crystalline	Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)	Rock gypsum
Crystalline	Halite (NaCl)	Rock salt
		} Carbonates
		} Evaporites
BIOCHEMICAL SEDIMENTARY ROCKS		
<i>Texture</i>	<i>Composition</i>	<i>Rock Name</i>
Clastic	Calcium carbonate (CaCO_3) shells	Limestone (various types such as chalk and coquina)
Usually crystalline	Altered microscopic shells of silicon dioxide (SiO_2)	Chert
_____	Mostly carbon from altered plant remains	Coal

*Mudrocks possessing the property of fissility, meaning they break along closely spaced planes, are commonly called *shale*.

Sand size 1/16 - 2 mm (0.062 - 2 mm)

0.5 - 0.2 mm

Coarse sand

0.25 - 0.075 mm

Medium sand

0.075 - 0.062 mm

Fine sand

B. Organic Clastic Rocks

1. Carbonates: **Micritic limestone, pelletal limestone, oolitic limestone fossiliferous limestone, chalk**
2. Siliceous rocks: **Chert**
3. Other composition: **Coal**

NONCLASTIC SEDIMENTARY ROCKS

They are Formed by inorganic precipitation of minerals

**Rock salt
Gypsum**

**Travertine
Chert**

Chemical and Organic Sedimentary Rocks

Composition	Texture	Rock Name	
Calcite, CaCO_3	Nonclastic: Fine to coarse crystalline	Crystalline Limestone	Biochemical
		Travertine	
	Clastic: Visible shells and shell fragments loosely cemented	Coquina	
	Clastic: Various size shells and shell fragments cemented with calcite cement	Fossiliferous Limestone	
	Clastic: Microscopic shells and clay	Chalk	
Quartz, SiO_2	Nonclastic: Very fine crystalline	Chert (light colored) Flint (dark colored)	
Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Nonclastic: Fine to coarse crystalline	Rock Gypsum	
Halite, NaCl	Nonclastic: Fine to coarse crystalline	Rock Salt	
Altered plant fragments	Nonclastic: Fine-grained organic matter	Bituminous Coal	

- Sedimentary rocks are divided into three groups;
- detrital,
- chemical and
- organic.
- The main criterion for naming detrital sedimentary rocks is particle size, whereas the primary basis for distinguishing among chemical sedimentary rocks is their mineral composition.



Chemical and Organic Sedimentary Rocks

Composition	Texture	Rock Name	
Calcite, CaCO_3	Nonclastic: Fine to coarse crystalline	Crystalline Limestone	Travertine
	Clastic: Visible shells and shell fragments loosely cemented	Coquina	B i o c h e m i c a l L i m e s t o n e
	Clastic: Various size shells and shell fragments cemented with calcite cement	Fossiliferous Limestone	
	Clastic: Microscopic shells and clay	Chalk	

Chemical and Organic Sedimentary Rocks

Composition	Texture	Rock Name
Quartz, SiO_2	Nonclastic: Very fine crystalline	Chert (light colored) Flint (dark colored)
Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Nonclastic: Fine to coarse crystalline	Rock Gypsum
Halite, NaCl	Nonclastic: Fine to coarse crystalline	Rock Salt
Altered plant fragments	Nonclastic: Fine-grained organic matter	Bituminous Coal



Gypsum



Halite

Biochemical rocks:

The main kinds of biochemical (organic) sedimentary rocks are

- 1. Limestone,**
- 2. Peat, and**
- 3. Bituminous coal.**

1. Biochemical limestone is composed of animal skeletons (usually seashells, coral, or microscopic shells).



**Biochemical
limestone**

2. **Peat** is a compacted deposit of brown plant fragments resembling the peat moss that people place on flower beds.

3. **Bituminous coal** is a black rock composed of charcoal or brittle shiny layers of carbon.



Chemical rocks

There are seven main kinds of chemical (inorganic) sedimentary rocks

1. **Travertine** is layers of intergrown calcite crystals
2. **Oolitic limestone** is comprised mostly of oolites, tiny beadlike spherical grains having concentric layers of microcrystalline aragonite or calcite.



3. **Dolostone** is an aggregate of dolomite crystals that are usually microcrystalline.
4. **Rock gypsum** is an aggregate of gypsum crystals.
5. **Rock salt** is an aggregate of halite crystals.



Dolostone



B. Organic Clastic Rocks

1. **Carbonates:** Micritic limestone, pelletal limestone, oolitic limestone, fossiliferous limestone, chalk

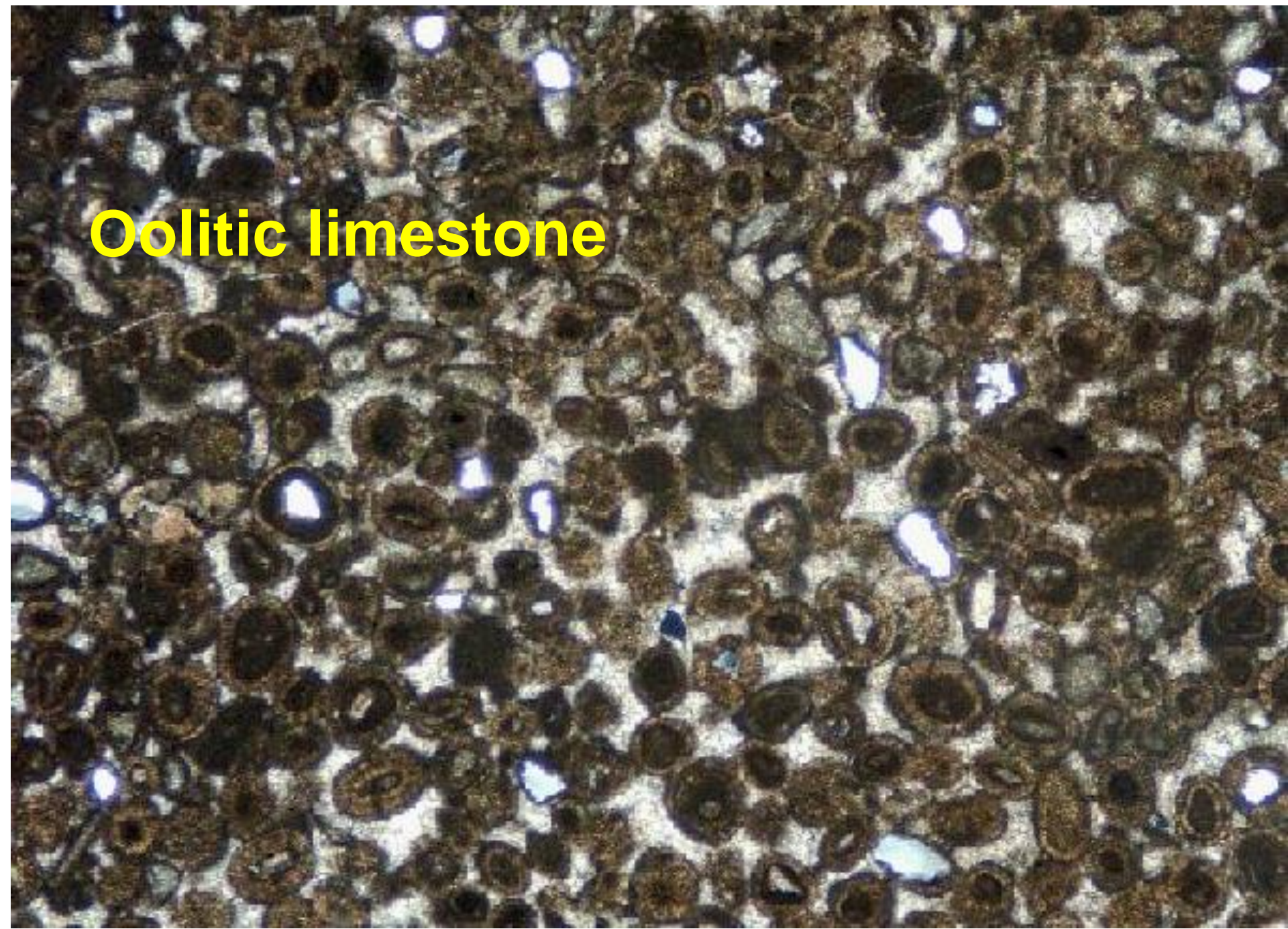
2. **Siliceous rocks:** Chert

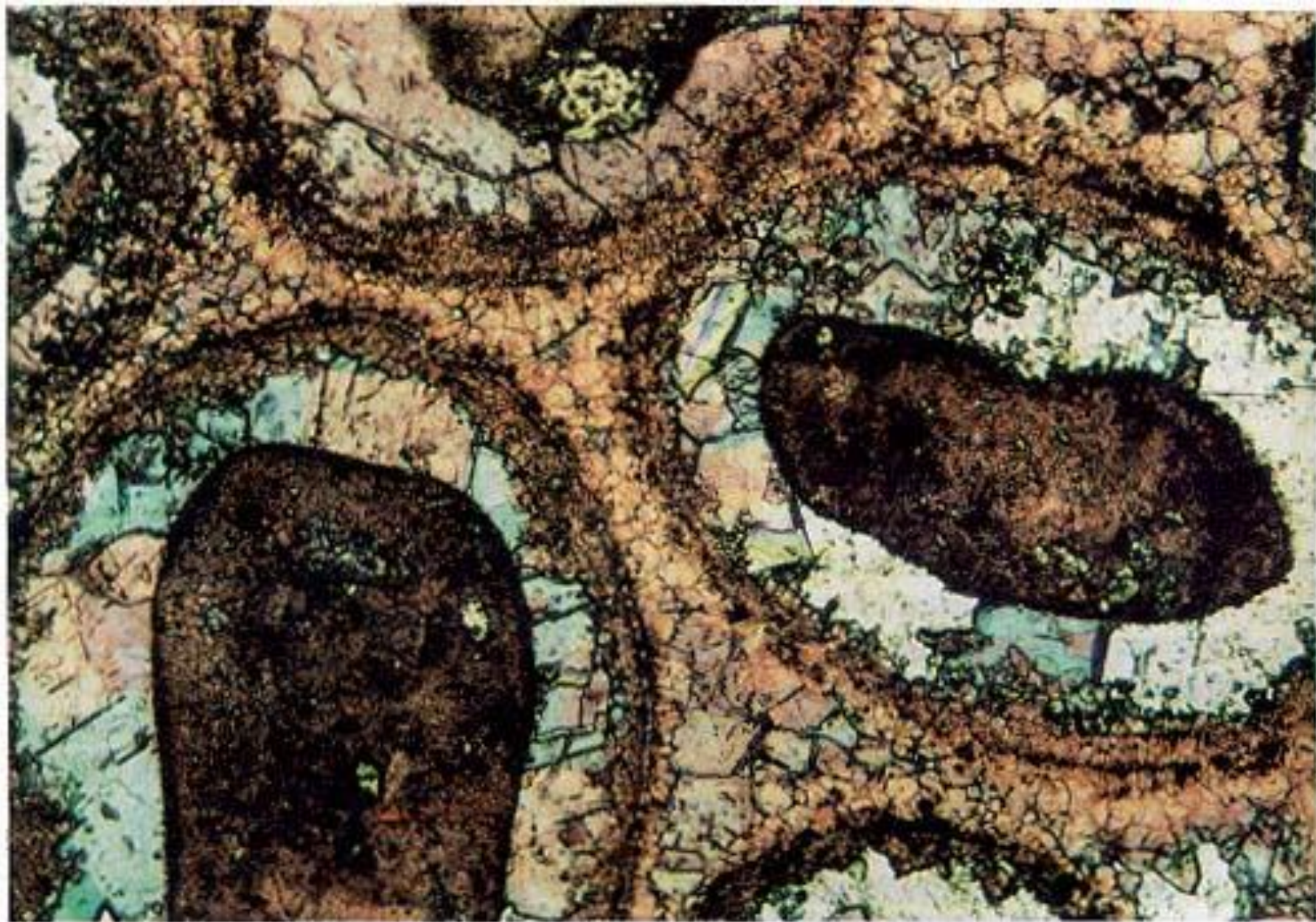
3. **Other composition:** Coal



- **Pelletal limestone:** Pellets lack any internal structure and are remarkably uniform in size and shape in any single limestone sample. They consist either of aggregated carbonate mud, precipitated calcium carbonate, or a mixture of both
- **Micritic limestone:** a solid, consolidated calcareous mud consisting of carbonate grains
- **Oolitic limestone** is made up of small spheres called ooliths that are stuck together by lime mud

Oolitic limestone

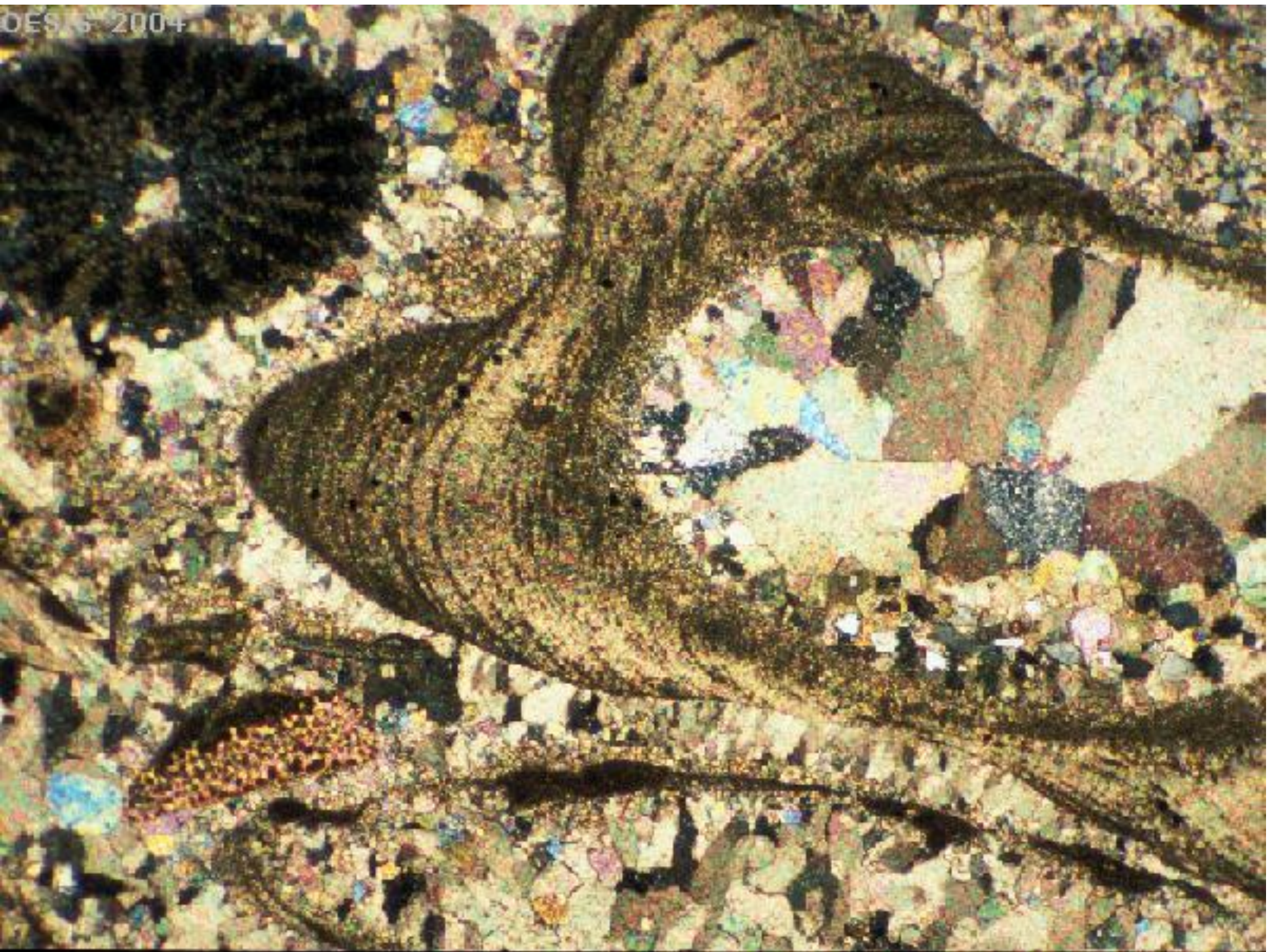




B

$\frac{1}{2}$ mm

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Fossilized shells



Classification of Sedimentary Rocks

DETRITAL SEDIMENTARY ROCKS

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Mud (< $1/16$ mm)	Mostly silt	Siltstone
	Silt and clay	Mudstone*
	Mostly clay	Claystone*

Mudrocks

CHEMICAL SEDIMENTARY ROCKS

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Carbonates

Evaporites

BIOCHEMICAL SEDIMENTARY ROCKS

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