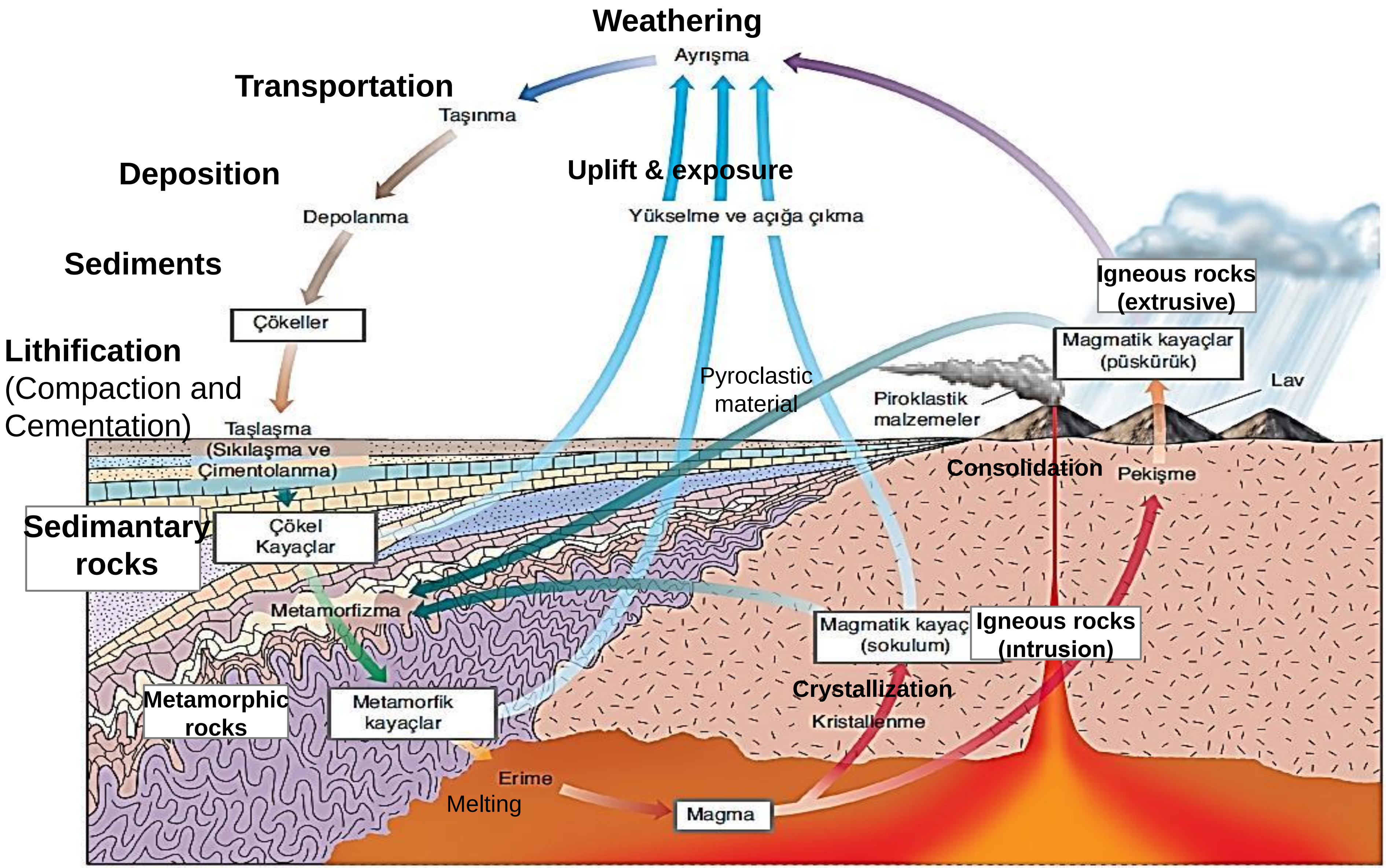
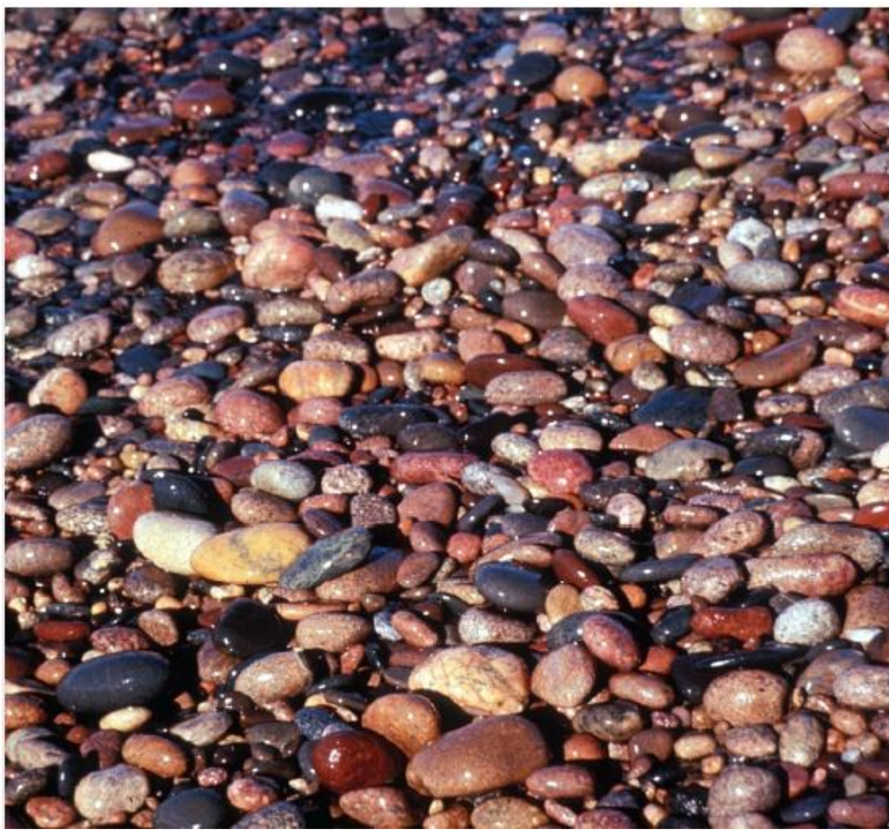

Weathering
Ayrışma
Transportation
Taşınma
Deposition
Depolanma
Sediments
Çökeller
Lithification
(Compaction and
Cementation)
Taşlaşma
(Sıkılaşma ve
Çimentolanma)
Uplift & exposure
Yükselme ve açığa çıkma
Pyroclastic
material
Piroklastik
malzemeler
Igneous rocks
(extrusive)
Magmatik kayaçlar
(püskürük)
Lav
Consolidation
Pekişme
Sedimantary
rocks
Çökel
Kayaçlar
Metamorfizma
Magmatik kayaç
(sokulum)
Igneous rocks
(ıntrusion)
Crystallization
Kristallenme
Metamorphic
rocks
Metamorfik
kayaçlar
Erime
Melting
Magma

Sediments and Sedimentary Rocks

The term **sediment** refers to **(1)** all solid particles of preexisting rocks yielded by mechanical and chemical weathering, **(2)** minerals derived from solutions containing materials dissolved during chemical weathering and **(3)** minerals extracted from sea water by organisms to build their shell. **Sedimentary rock** is simply any rock composed of sediments.



James S. Monroe

Sedimentary rocks cover about two thirds of the continents and most of the seafloor. All rocks are important to understand the Earth history, but sedimentary rocks play a special role because **they preserve evidence of surface processes responsible for them**. By studying sedimentary rocks we can determine past distribution of streams, lakes, deserts, glaciers, and shorelines. They also make interferences about ancient climates and biosphere. In addition, some sediments and sedimentary rocks are themselves natural resources, or they are the host for resources such as petroleum and natural gas.

Depositional Processes **(Çökelme Süreçleri)**

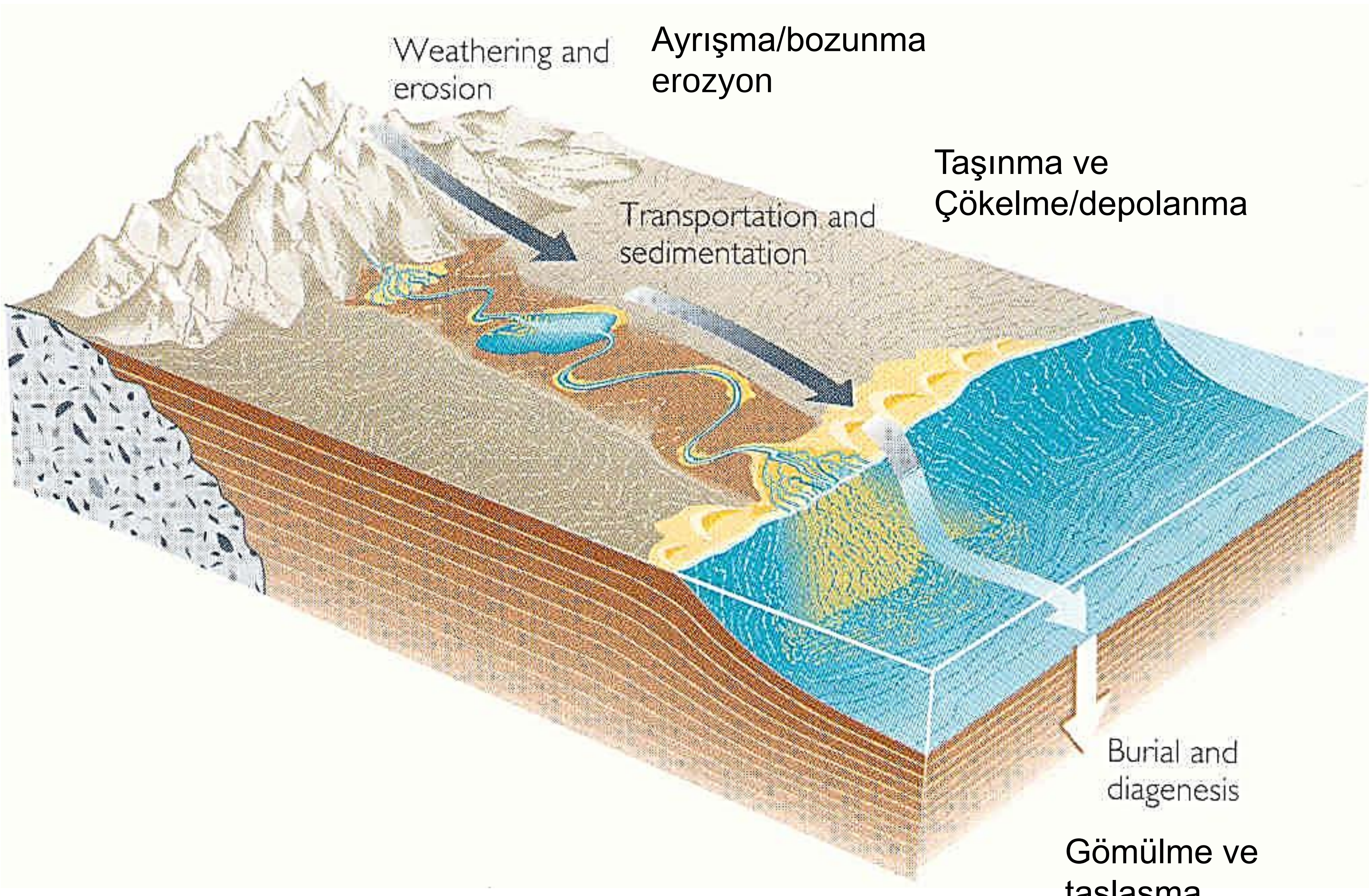
Weathering & Erosion, Transportation, Deposition

/ Sedimentation and Diagenesis.

Weathering & Erosion

Weathering and erosion are the fundamental processes in the origin of sediment.

During this process, two types of sediments are produced: **detrital sediments** and **chemical sediments**.


Weathering and erosion
Ayrışma/bozunma
erozyon
Transportation and sedimentation
Taşınma ve
Çökelme/depolanma
Burial and diagenesis
Gömülme ve
taşlaşma

Detrital Sediments are all particles derived from any type of weathering.

All detrital sediment is transported some distance from its source, where as chemical sediments forms in the area where it is deposited. Important **transporting agents are streams, wind, glaciers and waves.**

Size Classification of Sediment Particles

Size	Name of Particle		
>2 mm	Gravel Çakıl		
1/16–2 mm	Sand Kum		
1/256–1/16 mm	Silt Silt	Çamur*	Mud
<1/256 mm	Clay Kil		

During the transport of detrital sediments, ***abrasion*** reduces the size of the particles and the sharp corners and edges are worn smooth, a process called, ***rounding***, as pieces of gravels and sand collide with one another.

Sorting refers to the size distribution of the particles in sediment or sedimentary rocks. Sediment is ***well sorted*** if all the particles are about the same size, and ***poorly sorted*** if the range of size is wide.

Chemical Sediments. is made up of solid particles derived by inorganic chemical processes, such as evaporation of sea water, as well as the activities of organisms.

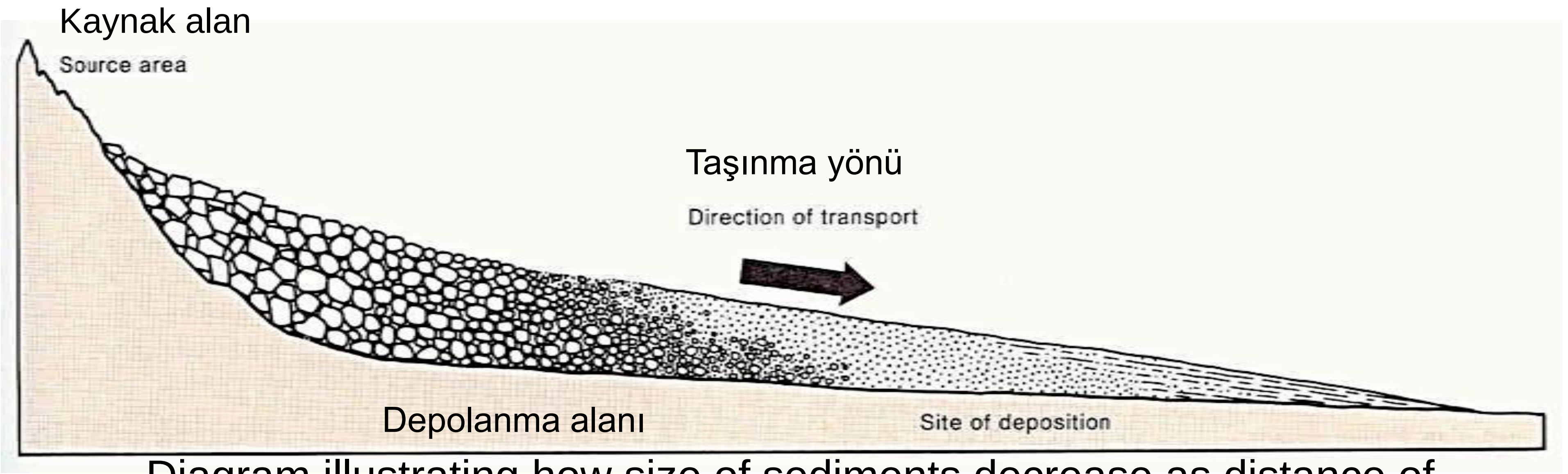
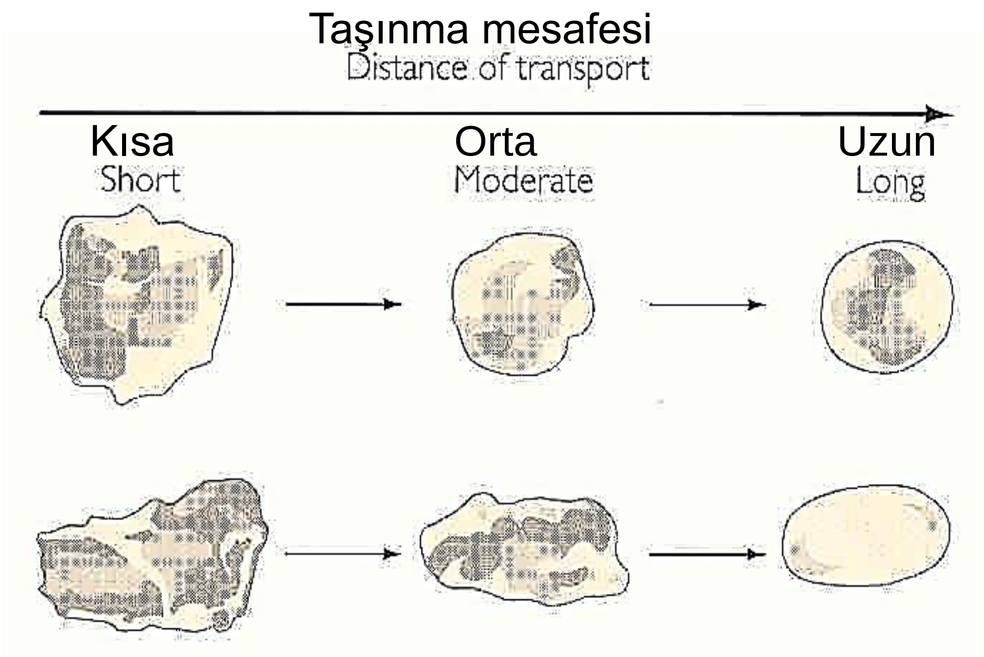


Diagram illustrating how size of sediments decrease as distance of transport increase.

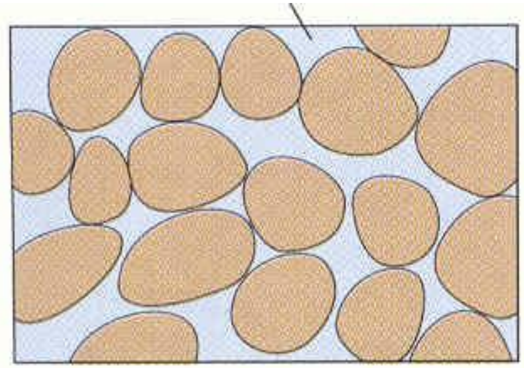


Relation between distance of transport and roundness.

Rounding and sorting in sediments.

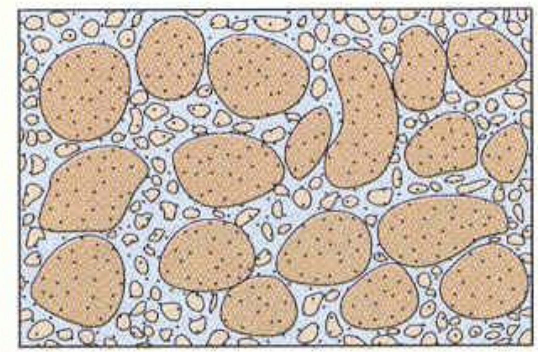
Well rounded

Well sorted&rounded



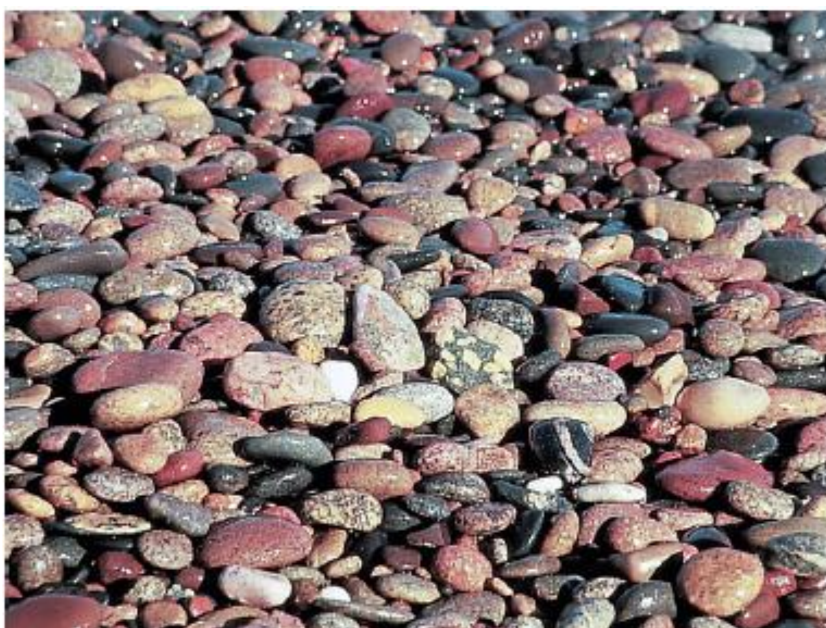
(a)

Poorly sorted



(b)

Well sorted & rounded gravel



Angular & Poorly sorted gravel

James S. Monroe

Deposition and Depositional Environments

(Depolanma / çökelme / birikme ve Depolanma ortamları)

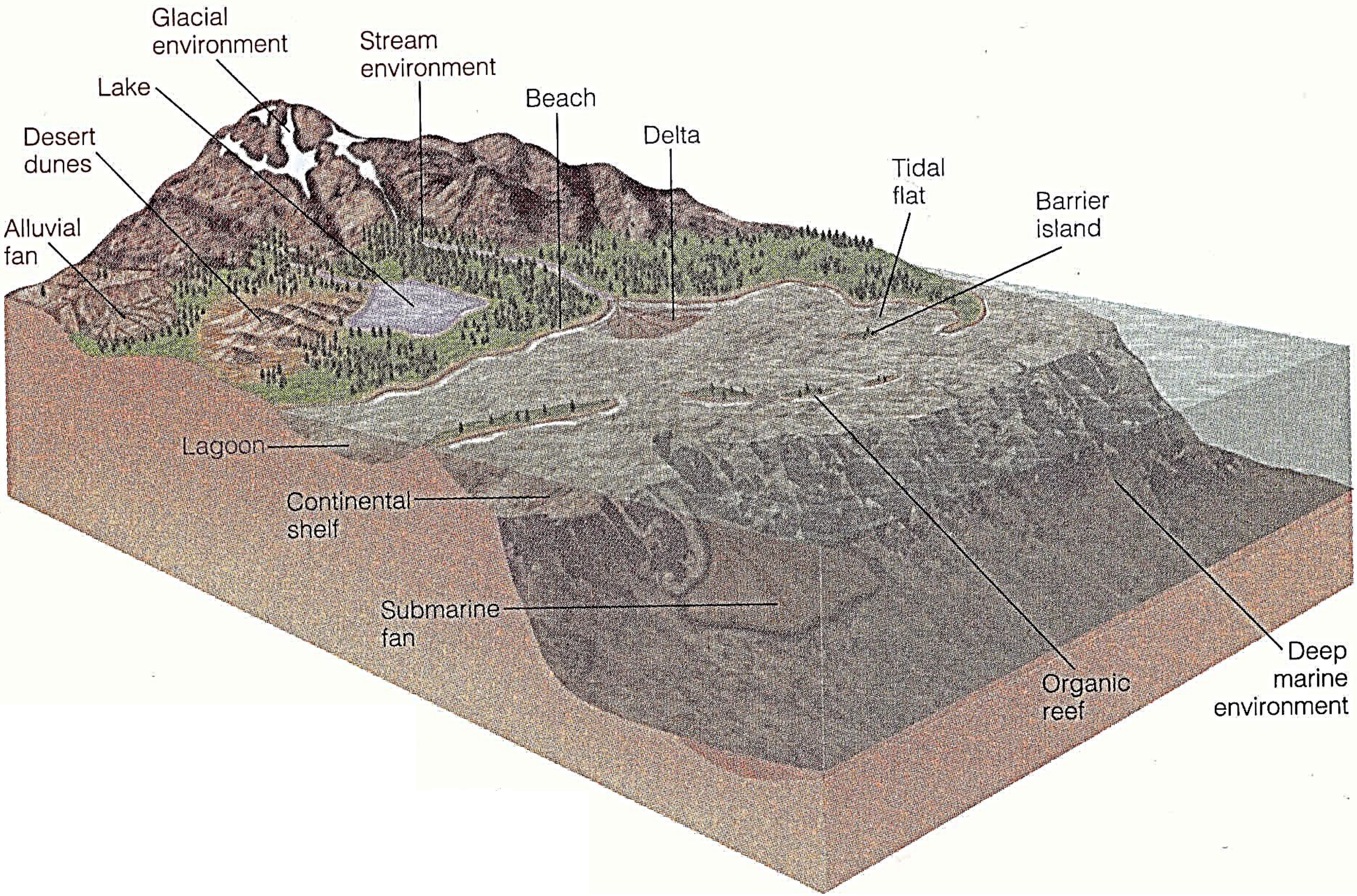
The transport distance for sediments is variable, but regardless of transport mechanism or distance, all sediment is eventually deposited; that is, it accumulates in a specific area.

Any geographic area in which sediment accumulates is a depositional environment, where physical, chemical, and biological processes impart distinctive characteristics to sedimentary deposits.

i. **Continental environment** **(Karasal ortamlar).** Stream / fluvial env., Lake / lacustrine env., floodplain env., Glacial env., Desert env.

ii. **Transitional environments** **(Geçiş ortamı).** Deltas, beaches, tidal flats, barrier island.

iii. **Marine environments** **(Denizel ortam).** Continental shelf (Kıta sahanlığı), Continental slope (Kıta yamacı), Deep marine (Derin deniz)

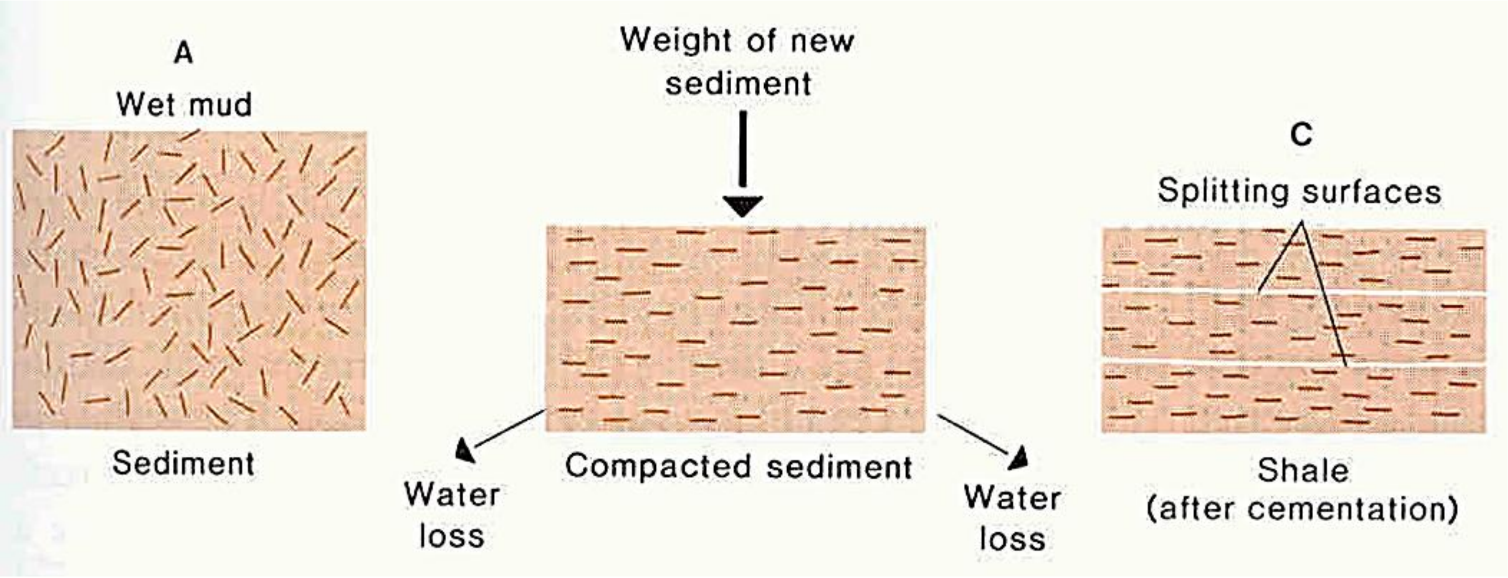

Glacial environment
Stream environment
Lake
Beach
Desert dunes
Delta
Tidal flat
Barrier island
Alluvial fan
Lagoon
Continental shelf
Submarine fan
Organic reef
Deep marine environment

HOW DOES SEDIMENT BECOME SEDIMENTARY ROCK?

When detrital sediment is deposited, it consists of a loose aggregate of particles. Mud accumulating in lakes, and sand and gravel in stream channels or on beaches are good examples. To convert these aggregates of particles into sedimentary rocks requires ***lithification*** by ***compaction***, ***cementation,*** or ***both***, and ***recrystallization***.

Compaction (Çökellerin/Sedimanların sıkılaşması)

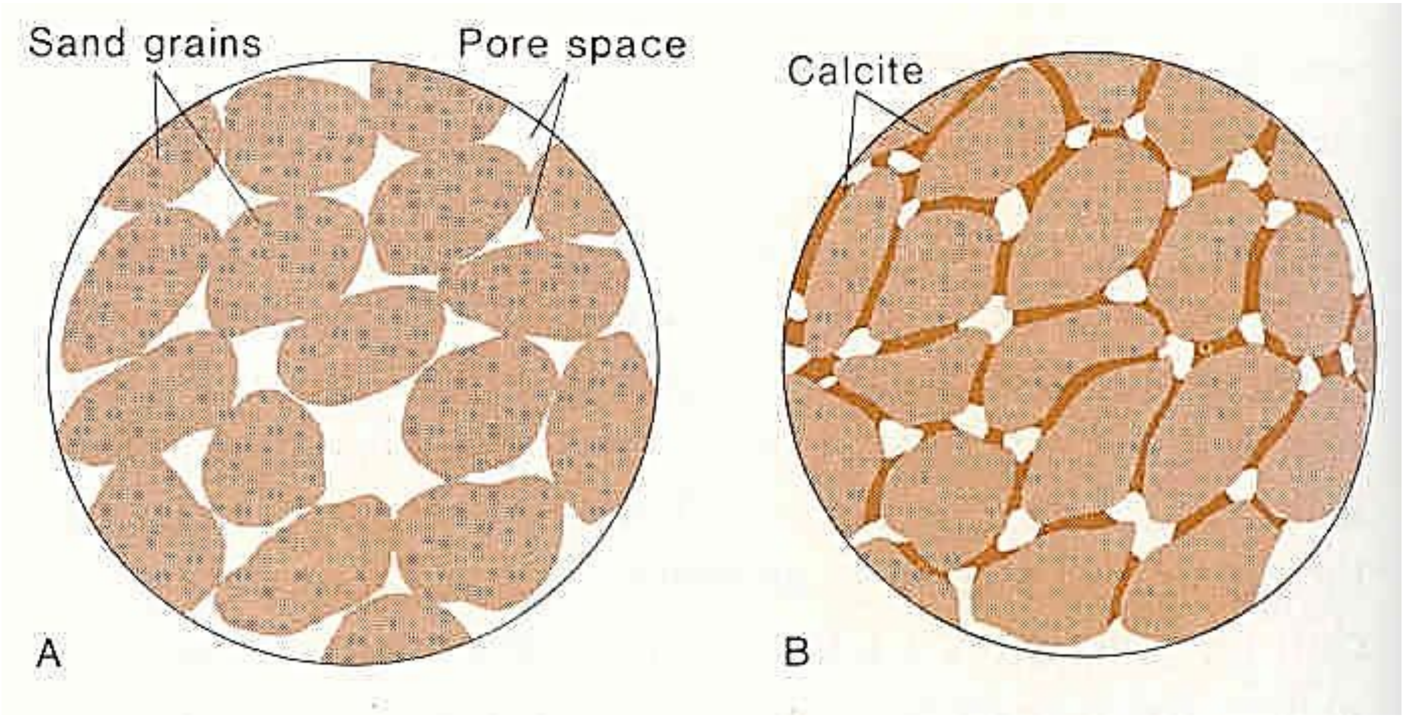
The sediment consists of solid particles and ***pore spaces***, the voids between them. These deposits are subjected to compaction from their own weight and weight of any additional sediment deposited on top of them, thereby reducing the amount of pore space and the volume of deposit. So that, the grains fit more tightly together.



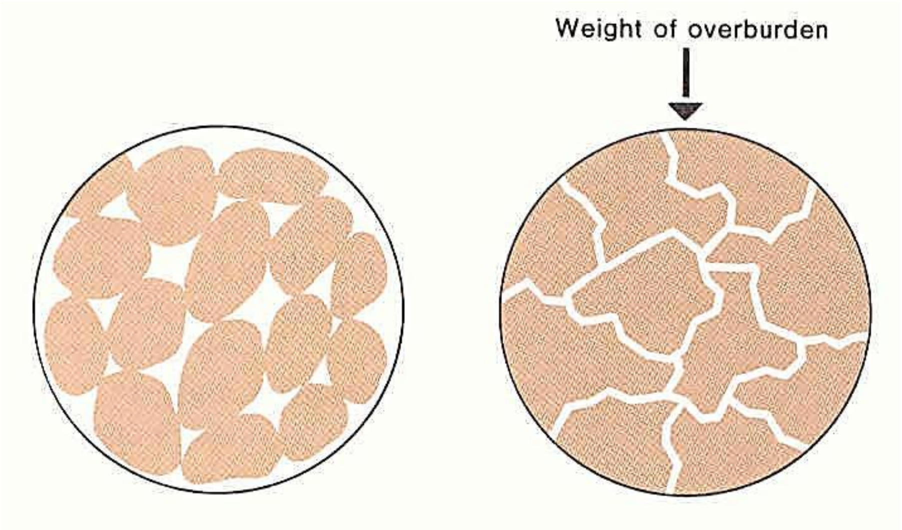
Cementation (Çökellerin/Sedimanların çimentolanması)

Compaction alone is sufficient for lithification of mud, but for sand and gravel, **cementation**, involving ***precipitation of minerals in pore spaces*** is also necessary.

The cement in the form of calcium carbonate ($CaCO_3$), silicon dioxide (SiO_2), and iron oxides and hydroxides, such as hematite (Fe_2O_3) and limonite (Feo(OH).nH2O), are the most common chemical cements.



Recrystallisation (Yeniden kristallenme)

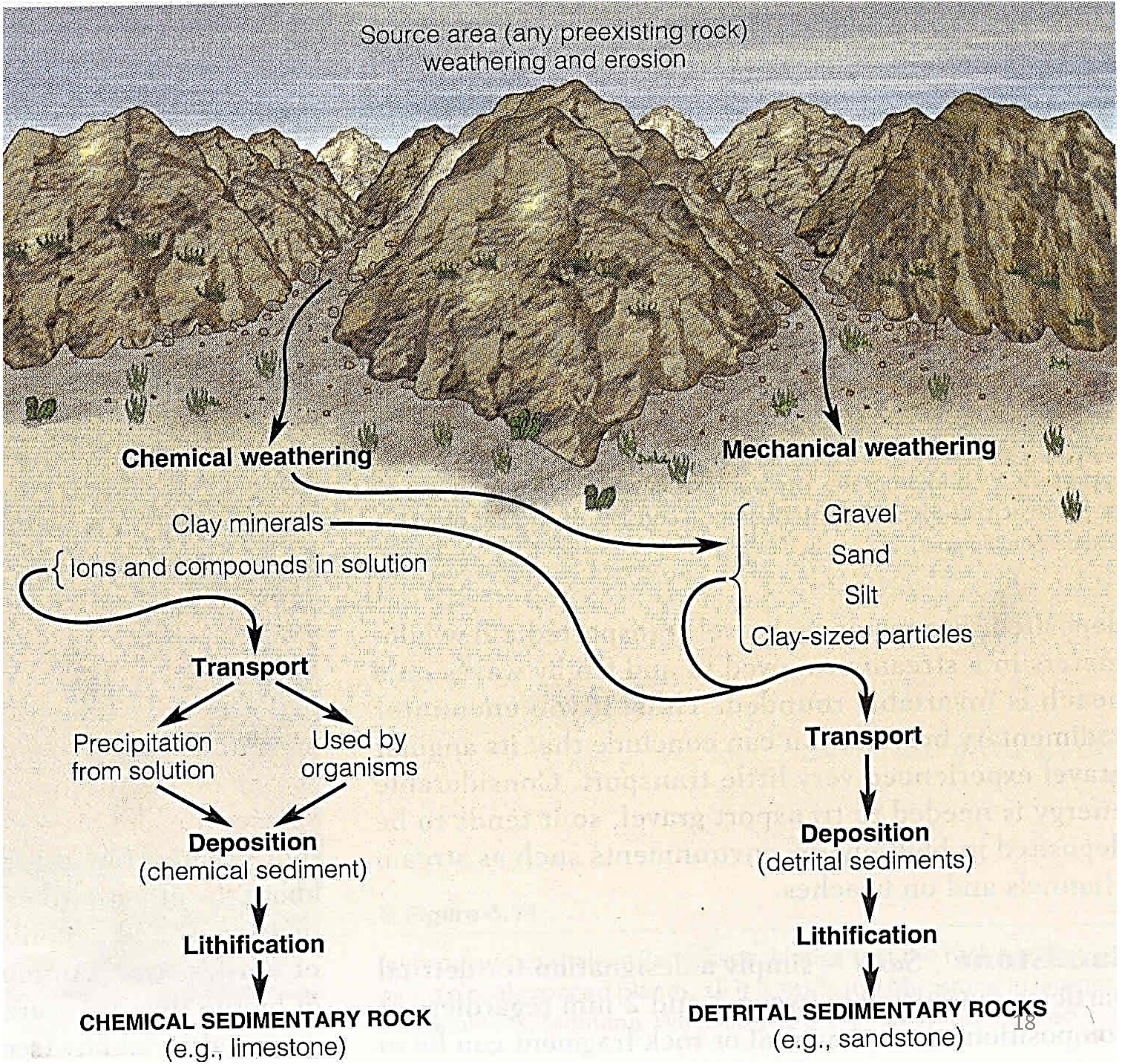


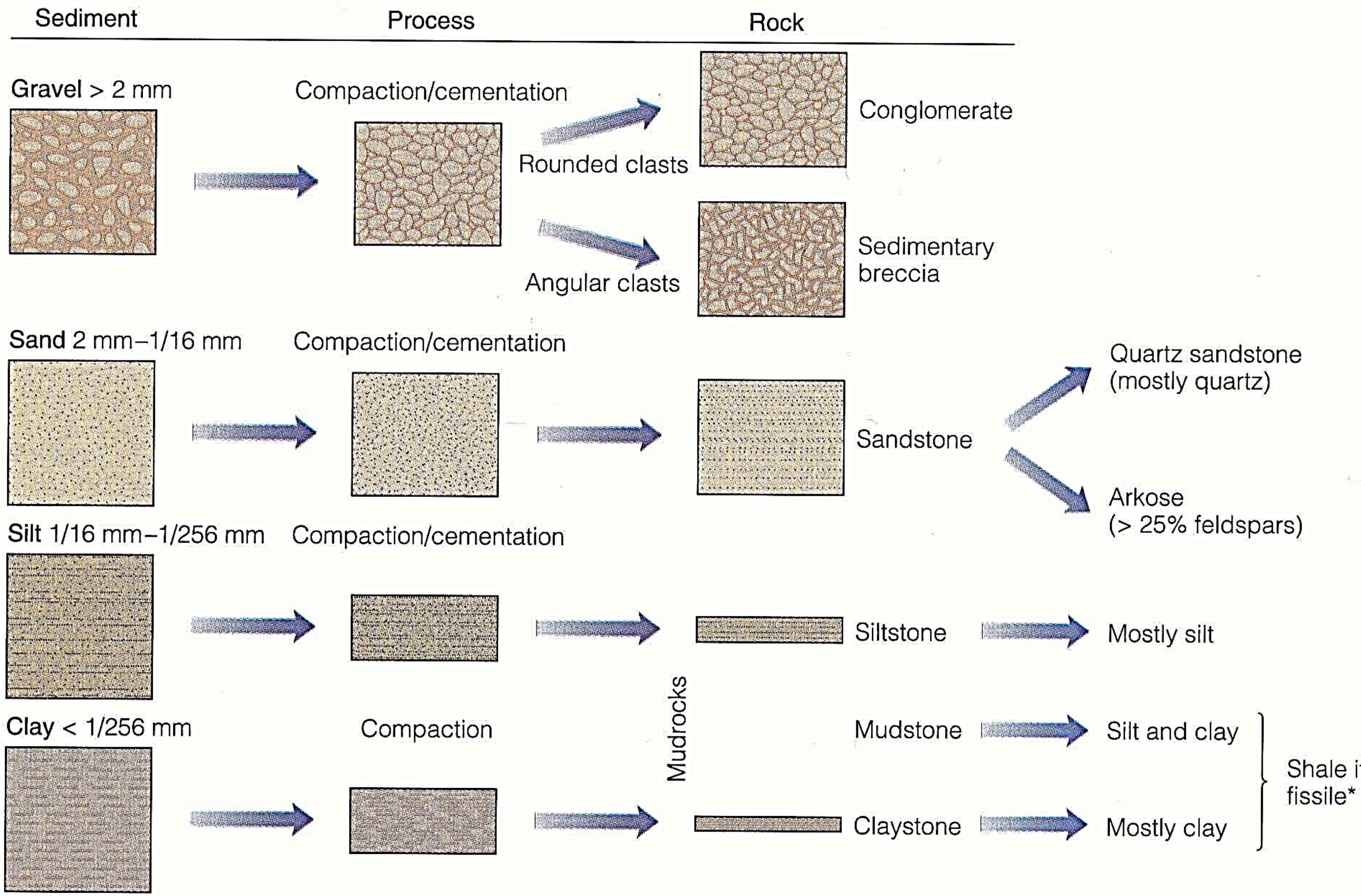
TYPES OF SEDIMENTARY ROCKS

There are two types of sedimentary rocks: ***Detrital sedimentary rocks*** and ***chemical sedimentary rocks***.

Detrital sedimentary rocks are made up of ***detritus***, the solid particles such as gravel, sand and mud derived from preexisting rocks by mechanical and chemical weathering. They have a ***clastic texture***, meaning they are composed of fragments known as ***clasts***. Detrital sedimentary rocks are classified primarily by the size of their constituent particles.

The derivation of sediment from pre-existing rocks. Whether derived by chemical or mechanical weathering, solid particles and materials in solution are transported and deposited as sediment, which if lithified becomes detrital or chemical sedimentary rock.




Sediment
Process
Rock
Gravel > 2 mm
Compaction/cementation
Rounded clasts
Conglomerate
Angular clasts
Sedimentary breccia
Sand 2 mm–1/16 mm
Compaction/cementation
Sandstone
Quartz sandstone (mostly quartz)
Arkose (> 25% feldspars)
Silt 1/16 mm–1/256 mm
Compaction/cementation
Siltstone
Mostly silt
Mudrocks
Clay < 1/256 mm
Compaction
Mudstone
Silt and clay
Claystone
Mostly clay
Shale if fissile*

Classification of Chemical and Biochemical Sedimentary Rocks

Texture	Composition	Rock Name	
CHEMICAL SEDIMENTARY ROCKS			
Varies	Calcite ($CaCO_3$)	Limestone	Carbonate rocks
Varies	Dolomite [$CaMg(CO_3)_2$]	Dolostone	Carbonate rocks
Crystalline	Gypsum ($CaSO_4 \cdot 2H_2O$)	Rock gypsum	Evaporites
Crystalline	Halite (NaCl)	Rock salt	Evaporites
BIOCHEMICAL SEDIMENTARY ROCKS			
Clastic	Calcite ($CaCO_3$) shells	Limestone (various types such as chalk and coquina)	
Usually crystalline	Altered microscopic shells of SiO_2	Chert (various color varieties)	
—	Carbon from altered land plants	Coal (lignite, bituminous, anthracite)	

Hand specimen

Photomicrograph (X5)

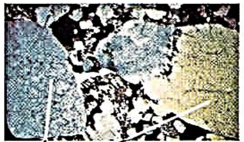
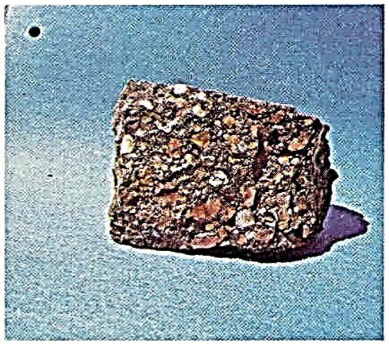


Figure 78. Conglomerate

Hand specimen



Photomicrograph (X5)

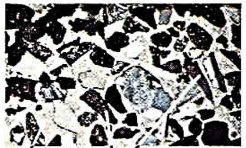
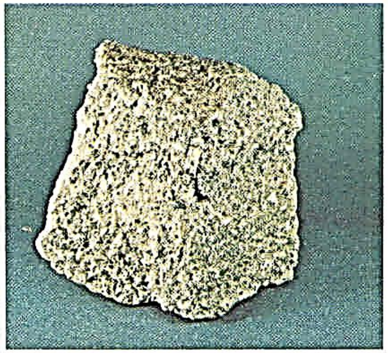


Figure 79. Breccia

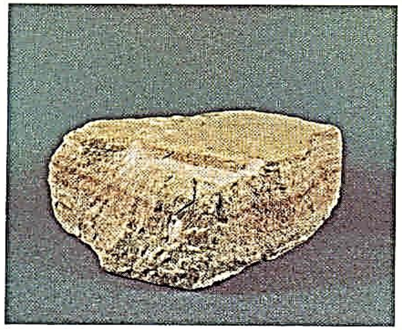
Hand specimen



Photomicrograph (X5)

Figure 80. Arkose

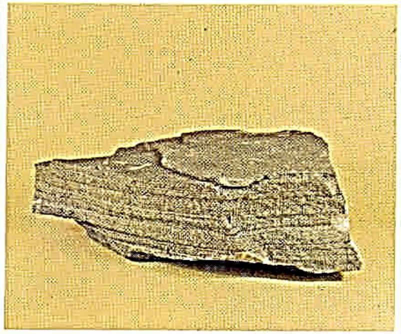
Hand specimen



Photomicrograph (X5)

Figure 81. Quartz Sandstone

Hand specimen



Photomicrograph (X5)

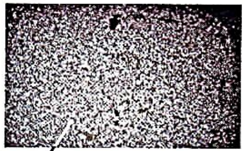
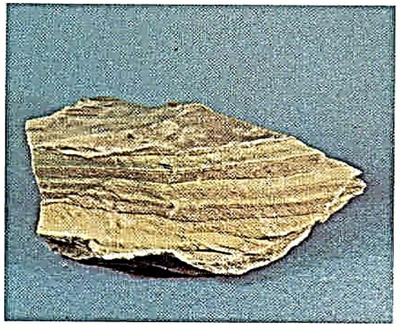


Figure 82. Siltstone

Hand specimen



Photomicrograph (X5)

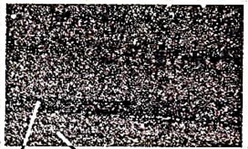
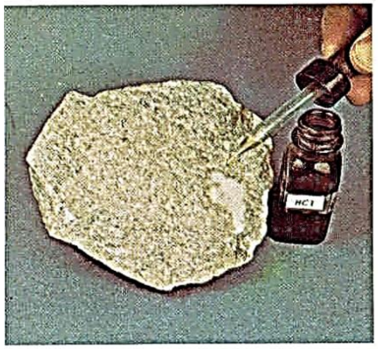


Figure 83. Shale

Hand specimen



Photomicrograph (X5)

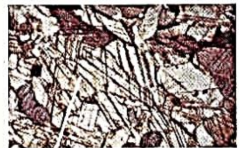
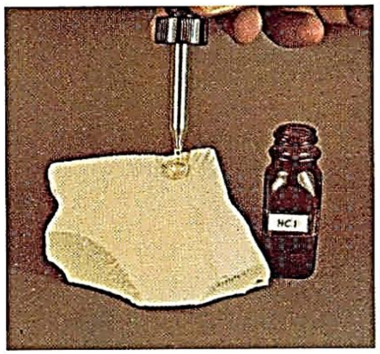


Figure 84. Crystalline Limestone

Hand specimen



Photomicrograph (X5)

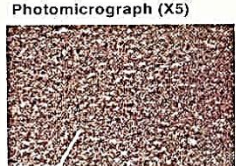
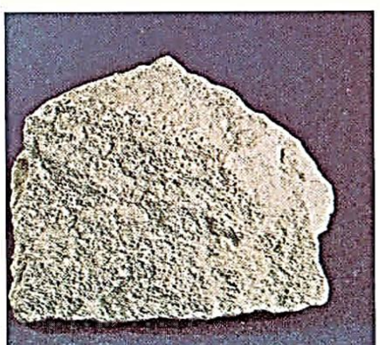


Figure 85. Microcrystalline Limestone

Hand specimen



Photomicrograph (X5)

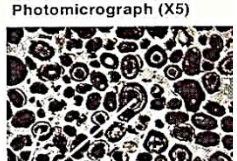


Figure 86. Oolitic Limestone

Hand specimen

Photomicrograph (X5)

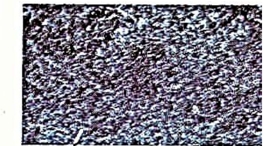
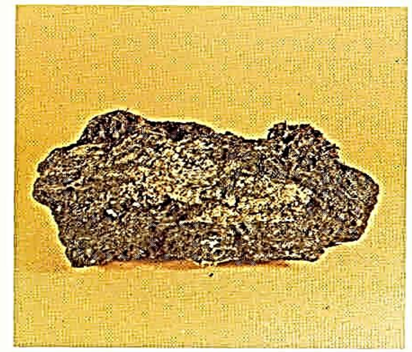


Figure 93. Chert

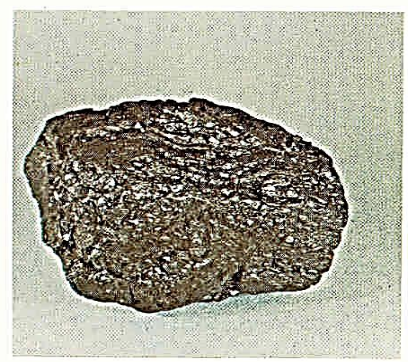
Hand specimen



Photomicrograph (X5)

Figure 94. Peat

Hand specimen



Photomicrograph (X5)

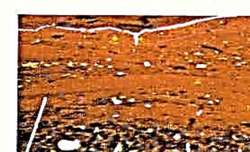


Figure 95. Coal

Hand specimen

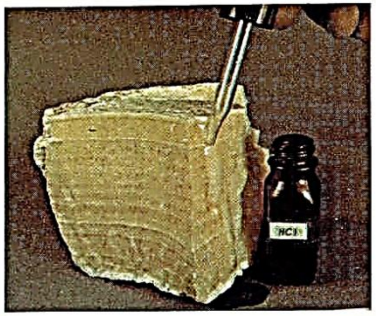
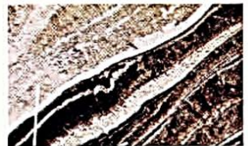


Figure 90. Travertine

Photomicrograph (X5)

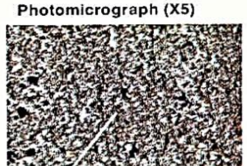


Calcite

Hand specimen

Figure 91. Gypsum

Photomicrograph (X5)



Small gypsum crystals

Hand specimen

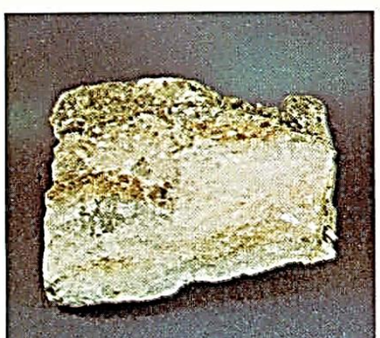
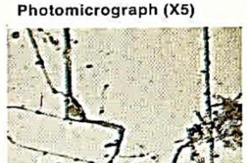


Figure 92. Rock Salt

Photomicrograph (X5)



Halite crystals

Hand specimen

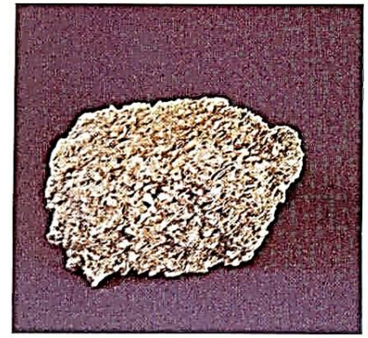


Figure 87. Coquina

Photomicrograph (X5)

Shell fragments

Hand specimen

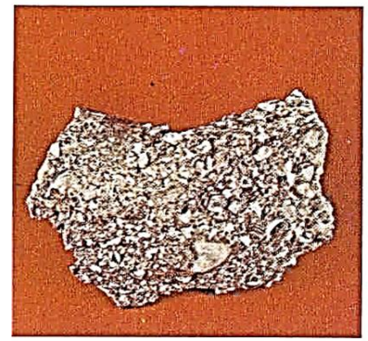


Figure 88. Fossiliferous Limestone

Photomicrograph (X5)

Shell fragments

Hand specimen

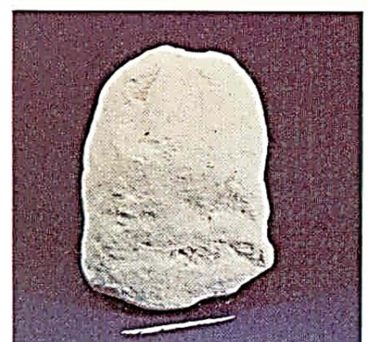
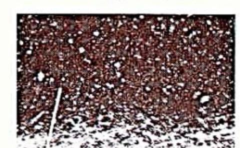


Figure 89. Chalk

Photomicrograph (X5)



Clay and microscopic shells

Coal, a biochemical sedimentary rock, consist of compressed, altered remains of land plants. It forms in swamps and bogs where the water is oxygen deficient or where organic matter accumulates faster than it decomposes.

Partly altered plant remains form organic muck, which, when buried and compressed, becomes **peat** ***(turba***). It contains 50% carbon.

If the peat is more deeply buried and compressed, and especially if it is heated too, it is converted to black or brown coal called **lignite** ***(linyit)***. It contains 70% carbon.

Bituminous coal, which contains about 80% carbon, is dense and black. It is higher grade coal than lignite because it burns more efficiently.

The highest-grade coal is **anthracite**, a metamorphic type of coal with up to 98% carbon.

(a) Turba

(c) Bitumlu kömür

(b) Linyit

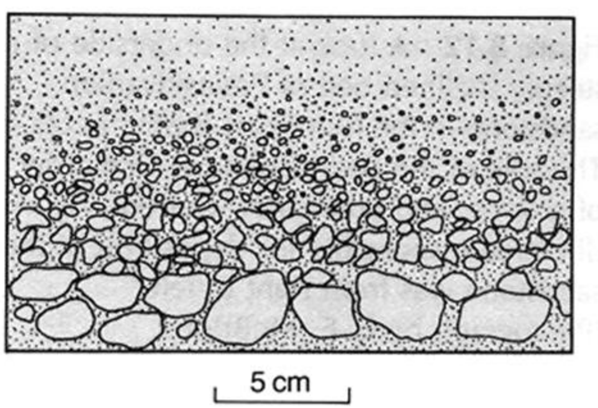
(a) Peat (turba) is partly decomposed plant material. It represents the first stage in the origin of coal.
(b) Lignite (linyit) is a dull variety of coal in which plant remains are still visible.
(c) Bituminous coal (bitümlü kömür) is shinier and darker than lignite and only rarely are plant remains visible.

SEDIMENTARY STRUCTURES

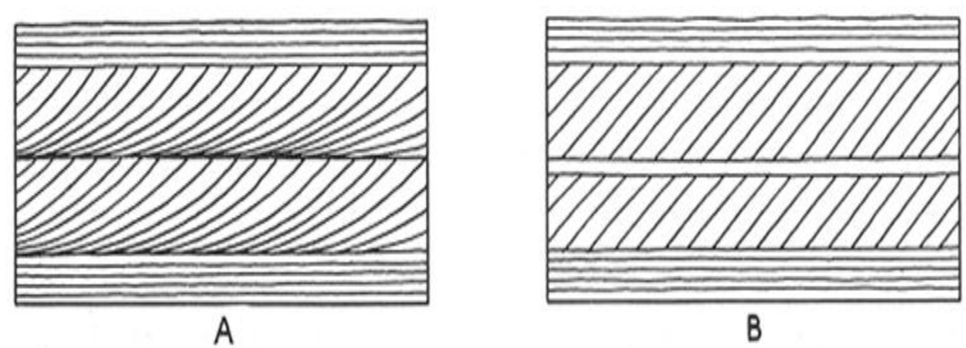
When sediment is deposited, it has variety of features known as **sedimentary structures** ***that formed as a result of physical and biological processes operating in the depositional environment.***

One of the most common of these sedimentary structures is **strata**, or **bed**. Sedimentary rock layers are separated from one another by surfaces known as **bedding planes**, above and below which the rocks differ markedly in composition, grain size, color, or a combination of features.

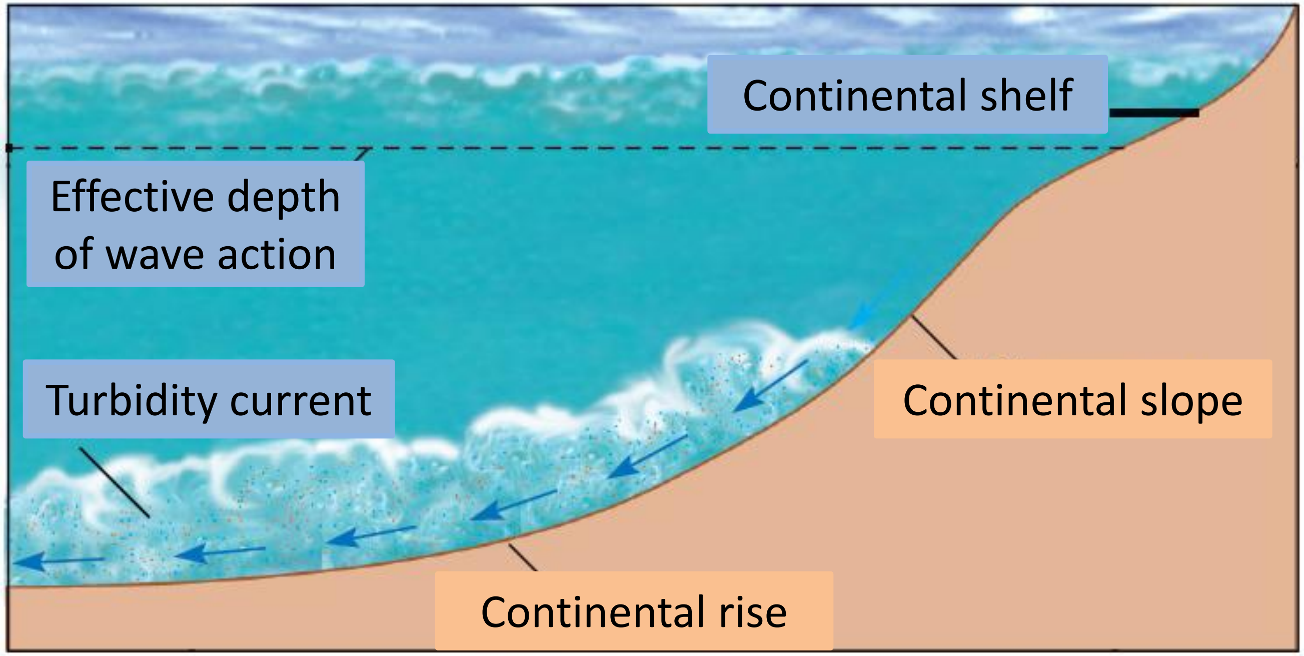
Two types of sedimentary structures present in a bed: **cross-bedding** and **graded bedding**.



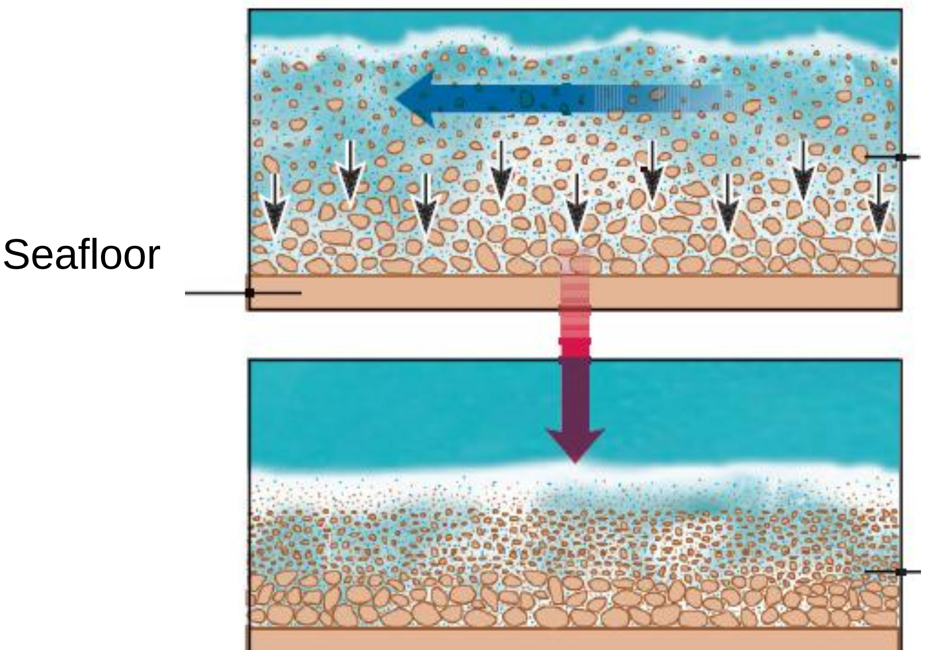
graded bedding



cross bedding

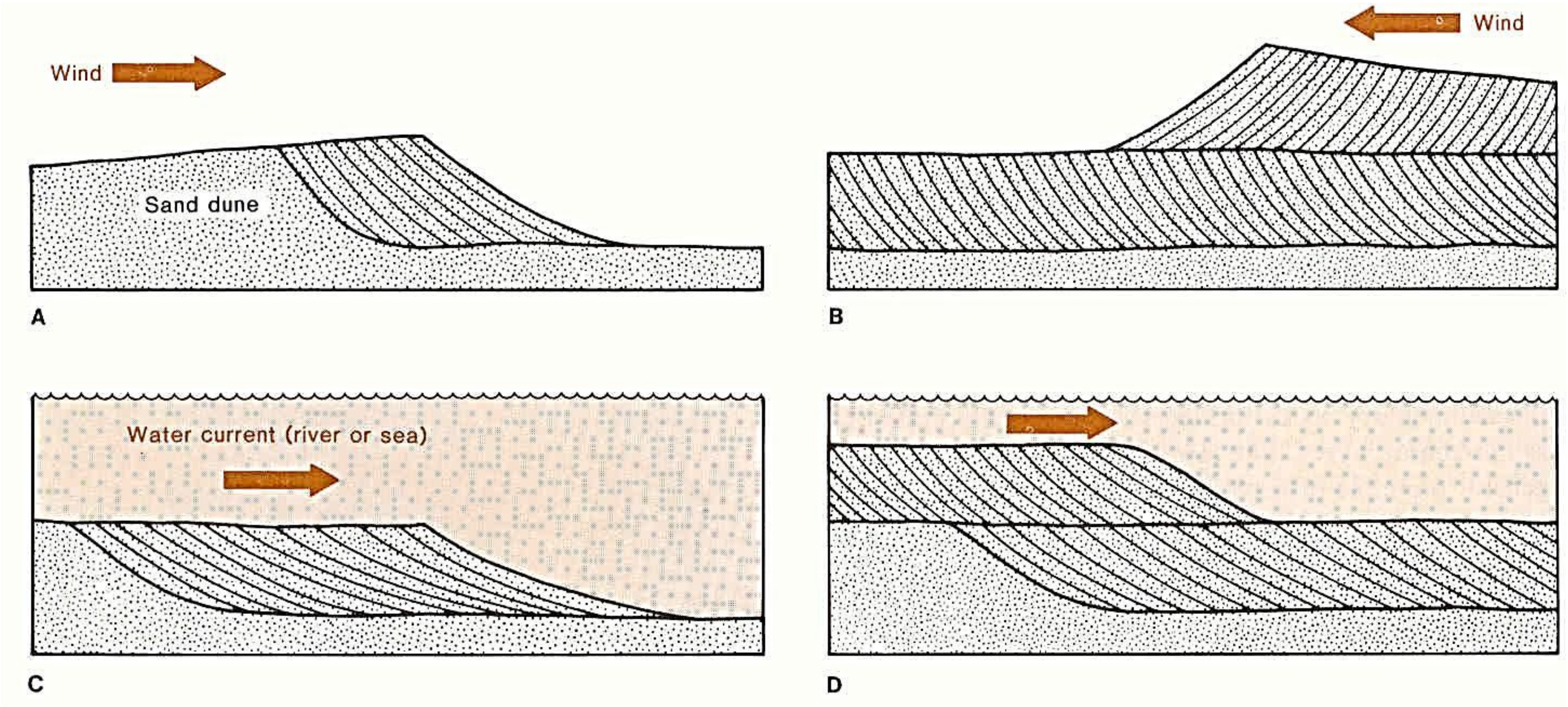


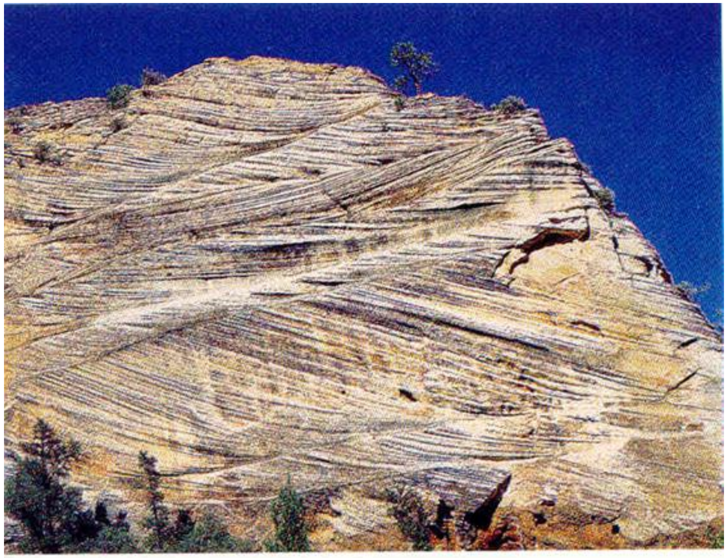
Turbidity current flow downslope along the seafloor because they are denser than sediment-free water.



As turbidity current slows, largest particles settle followed by smaller particles

A graded bed


Wind
Sand dune
A
Wind
B
Water current (river or sea)
C
D

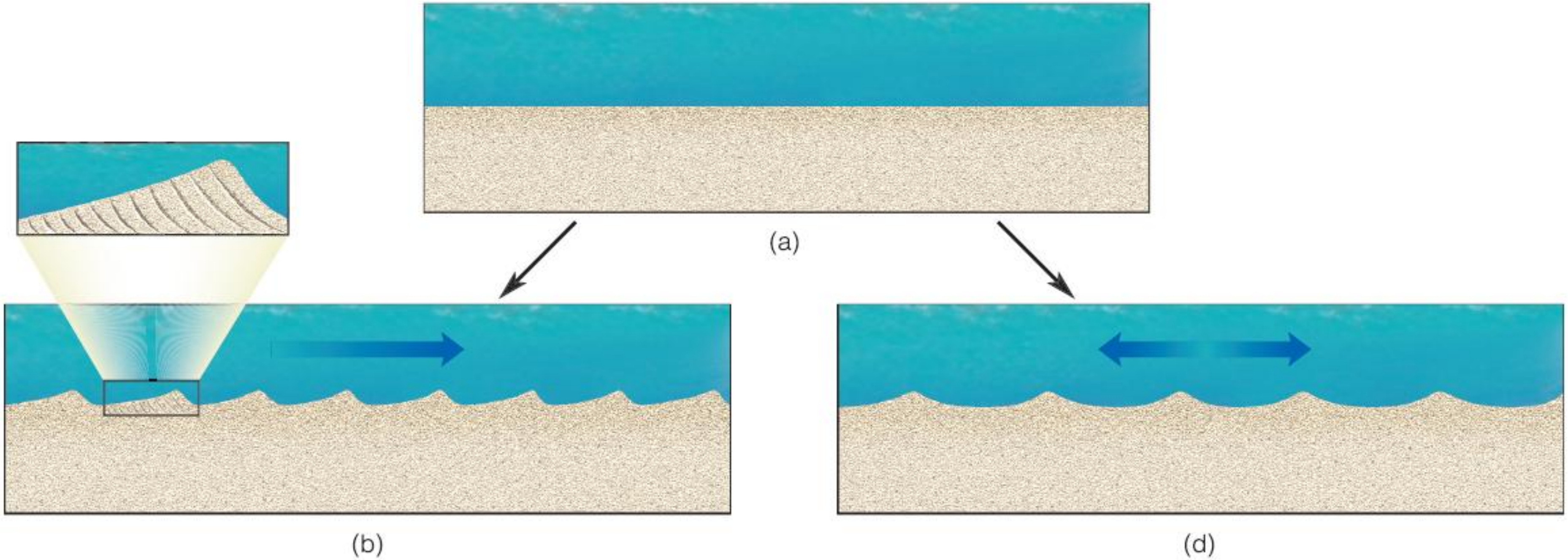


Ripple Marks

They are small-scale ridge like features seen on the surface of bed, and formed by wave or current.

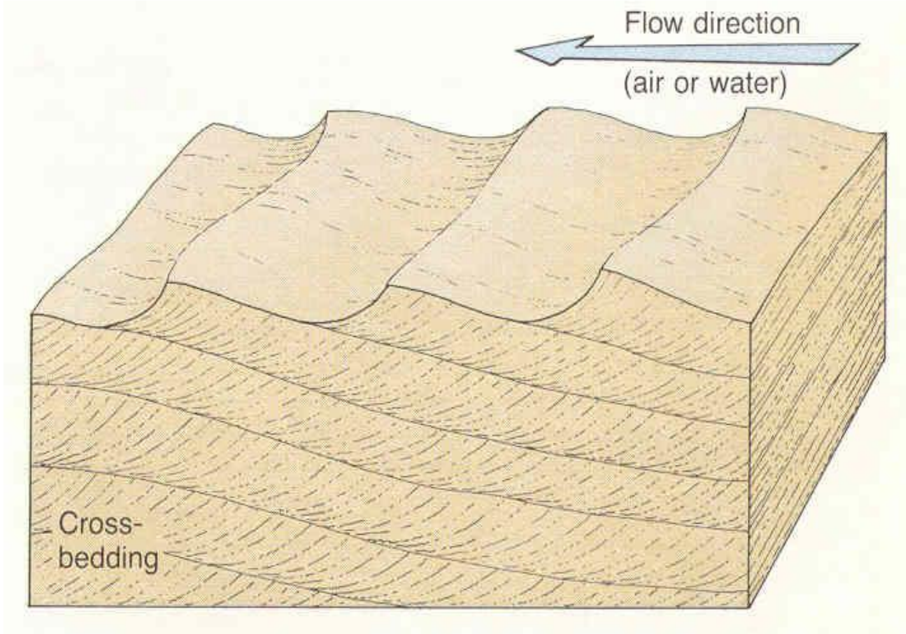
Current ripple marks. Asymmetric in cross section, with a gentle upstream slope and a steep downstream slope. They form as a result of currents that move in one direction as in stream channel.

Wave-formed ripple marks, The to-and-fro motion of waves produces ripples that tend to be symmetric in cross-section. They form mostly in the shallow, nearshore waters of oceans and lakes.

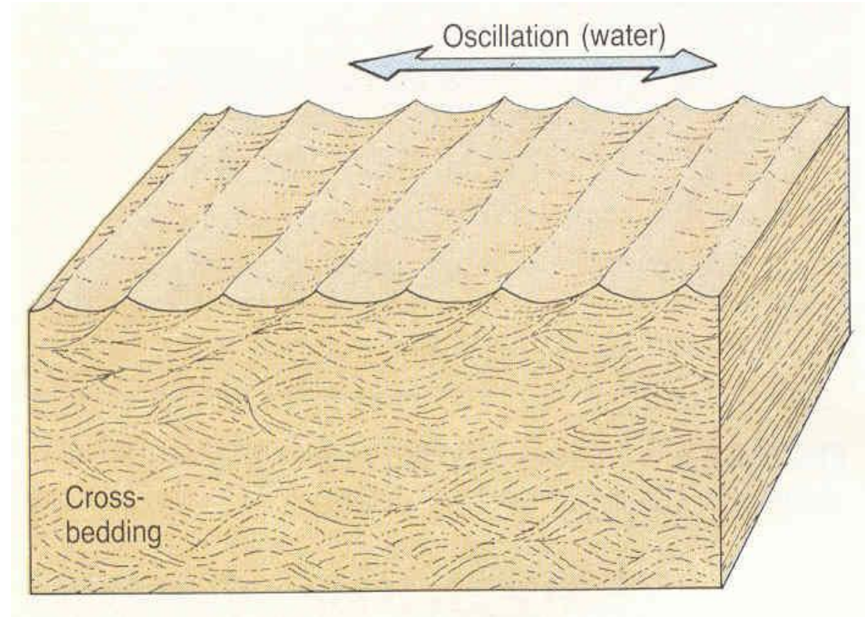


Current ripple marks

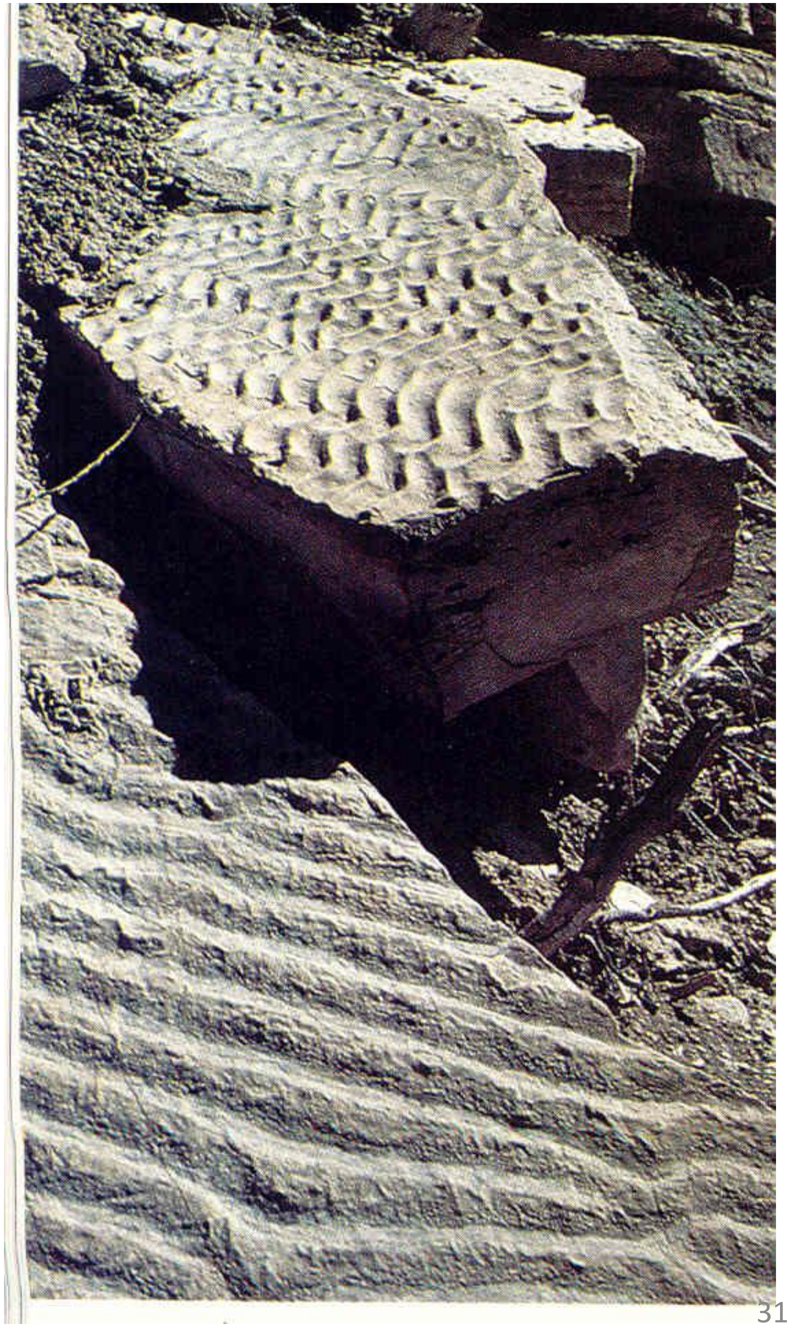
Wave-formed ripple marks



Current ripple marks

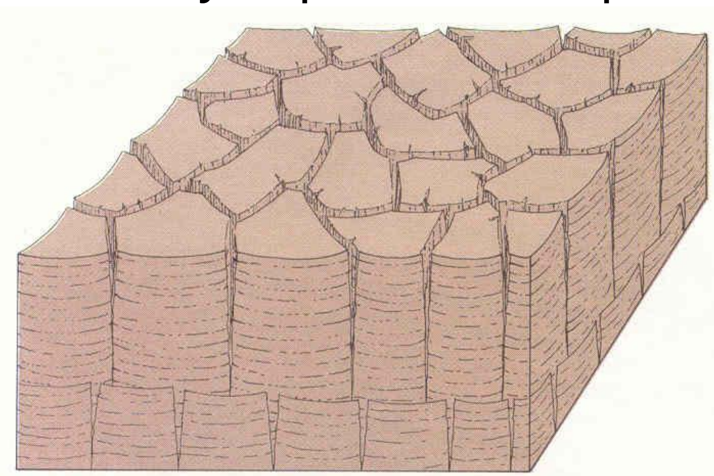


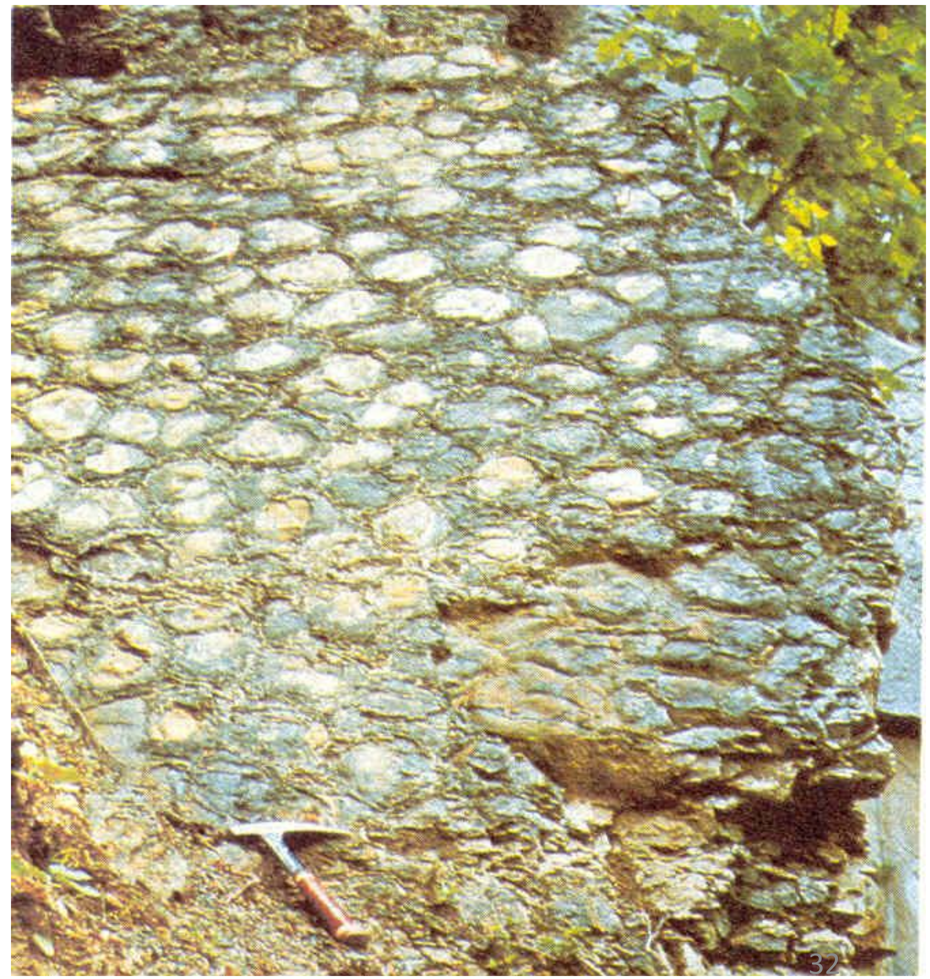
Wave-formed ripple marks

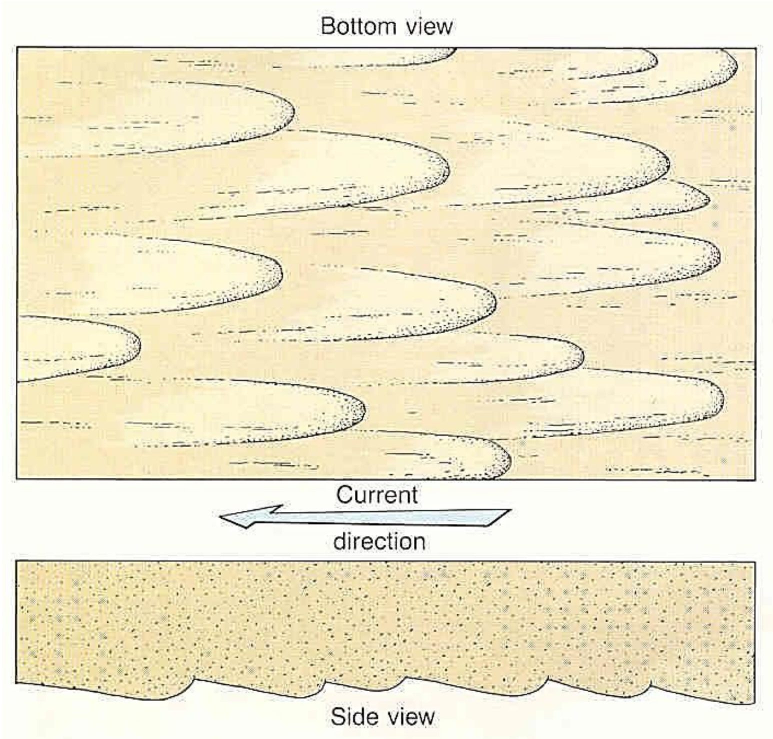


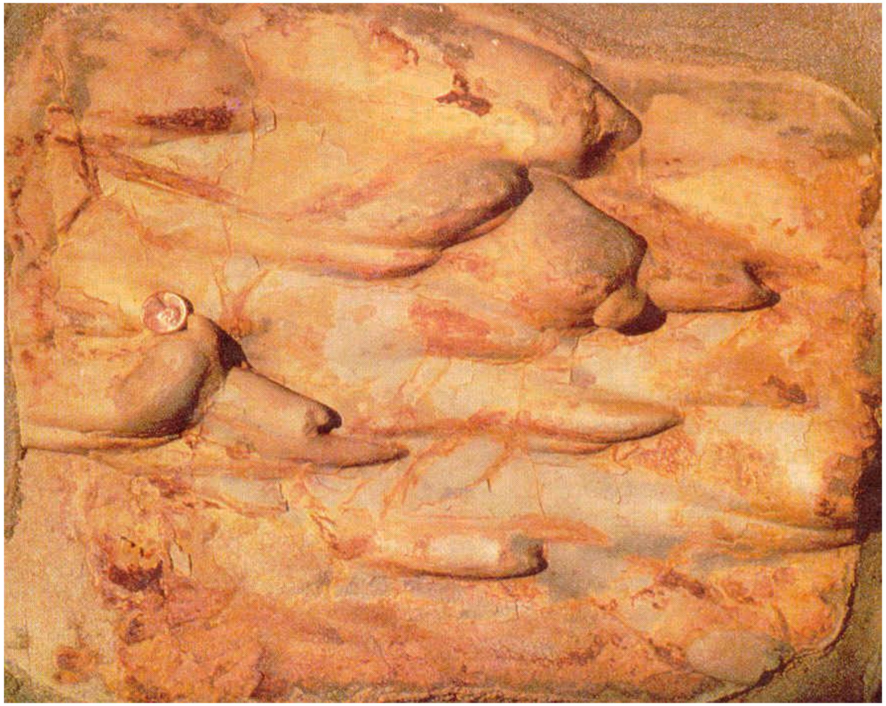
Mud cracks

When clay-rich sediments dries, it shrinks and forms intersecting fractures known as mud cracks. They indicate that the sediment was deposited where periodic drying was possible, as on a river floodplain, near a lakeshore, or where muddy deposits are exposed on marine shorelines at low tide.

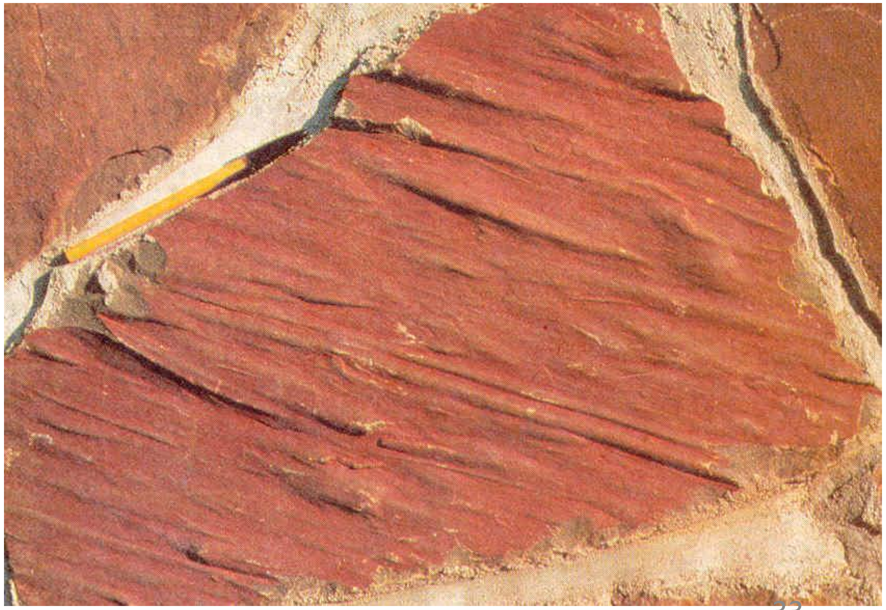




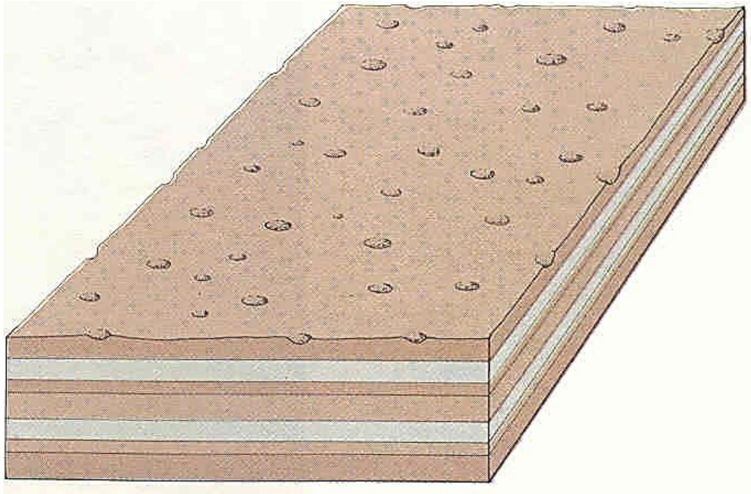




Flute marks

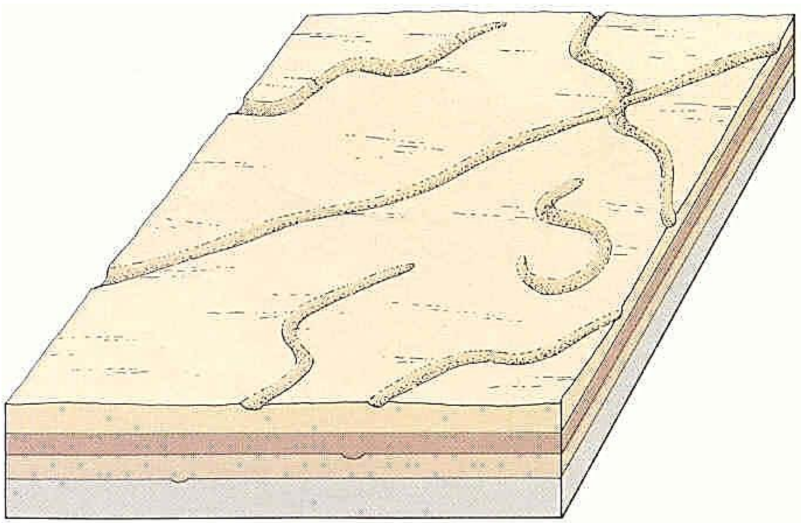


Tool marks

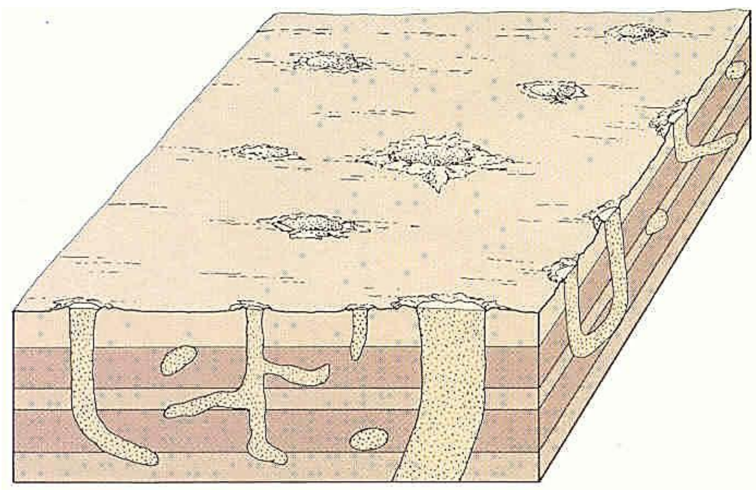


Raindrop prints in mud or shale

Tracks



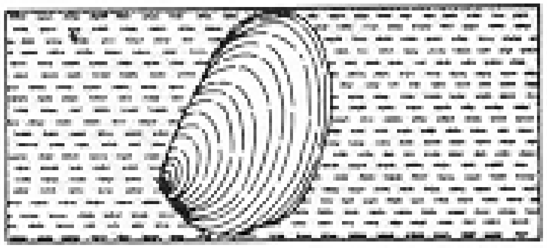
Trails in fine-grained sediments

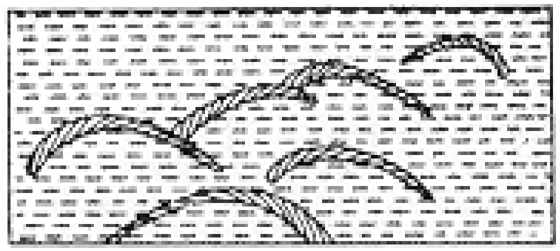


Burrows

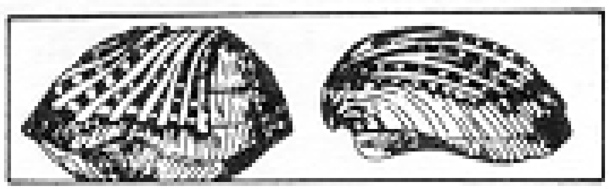
Fossils

The remains or traces of ancient organisms.

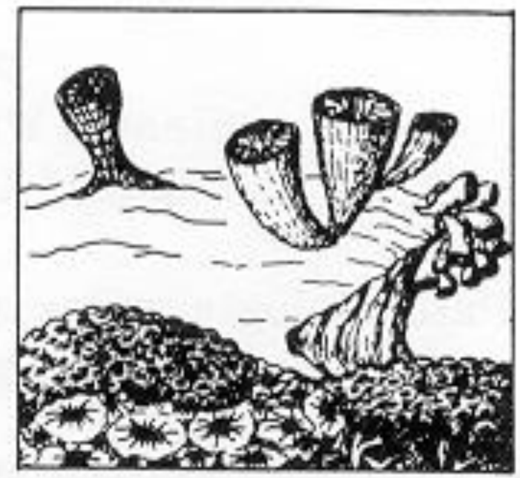

(a)


(b)


(c)


(e)


(f)


(d)


(g)


(h)

IMPORTANT RESOURCES IN SEDIMENTS AND SEDIMENTARY ROCKS

Sand and **gravel** are essential to the construction industry

Pure clay deposits are used for ceramics,

Limestone is used in the manufacture of cement and in blast furnaces where iron is refined to make steel,

Evaporites are the source of **table salt** as well as a number of chemical compounds, and **rock gypsum** is used to manufacture wallboard,

Silica sand (quartz sand) is used for manufacturing glass, refractory bricks for blast furnaces, molds for casting iron, aluminum, and copper alloys.

Placer deposits are surface accumulations resulting from the separation and concentration of materials of greater density from those of less density in streams and on beaches. ***Gold, diamond, tin*** are important placer deposits.

Phosphate-bearing sediment,

Diatomite (light weight-porous sedimentary rock),

Natural gas, Petroleum, Oil shale and Tar sands, Coal

Uranium, Banded iron formation