

# Lecture 7: Sedimentary Rocks

1. Read: Chapter 8
2. Homework #7 due Thursday 12pm
3. Midterm #1 Thursday, September 24

## iClicker assignments – pick yours up

001 Abreu	013 Comilla	027 Higa	039 Lockett	067 Peahu
003 Agena	014 Cuadrado	028 Hipolito	040 Manion	068 Santiago
004 Albert	015 Dang	090 Inserra	041 McTigue	069 Shigemitsu
006 Araki	016 Duncan	031 Jadu	042 Meyers	070 Soares
091 Atiburcio	080 Fujihara	030 Johnasen	043 Mitamura	084 Teramura
008 Buck	018 Ganther	034 Kaaihue	044 Morikawa	086 Tomaszek
010 Byce	021 Guerrero	036 Keanini-White	047 Nassiri	073 Wu
011 Clements	022 Haupt	037 Kipi	048 Ota	074 Yamamoto
012 Colle	025 Hedden	089 Lee	088 Pavao	075 Yanagi
				077 Yokota
				079 Zoller

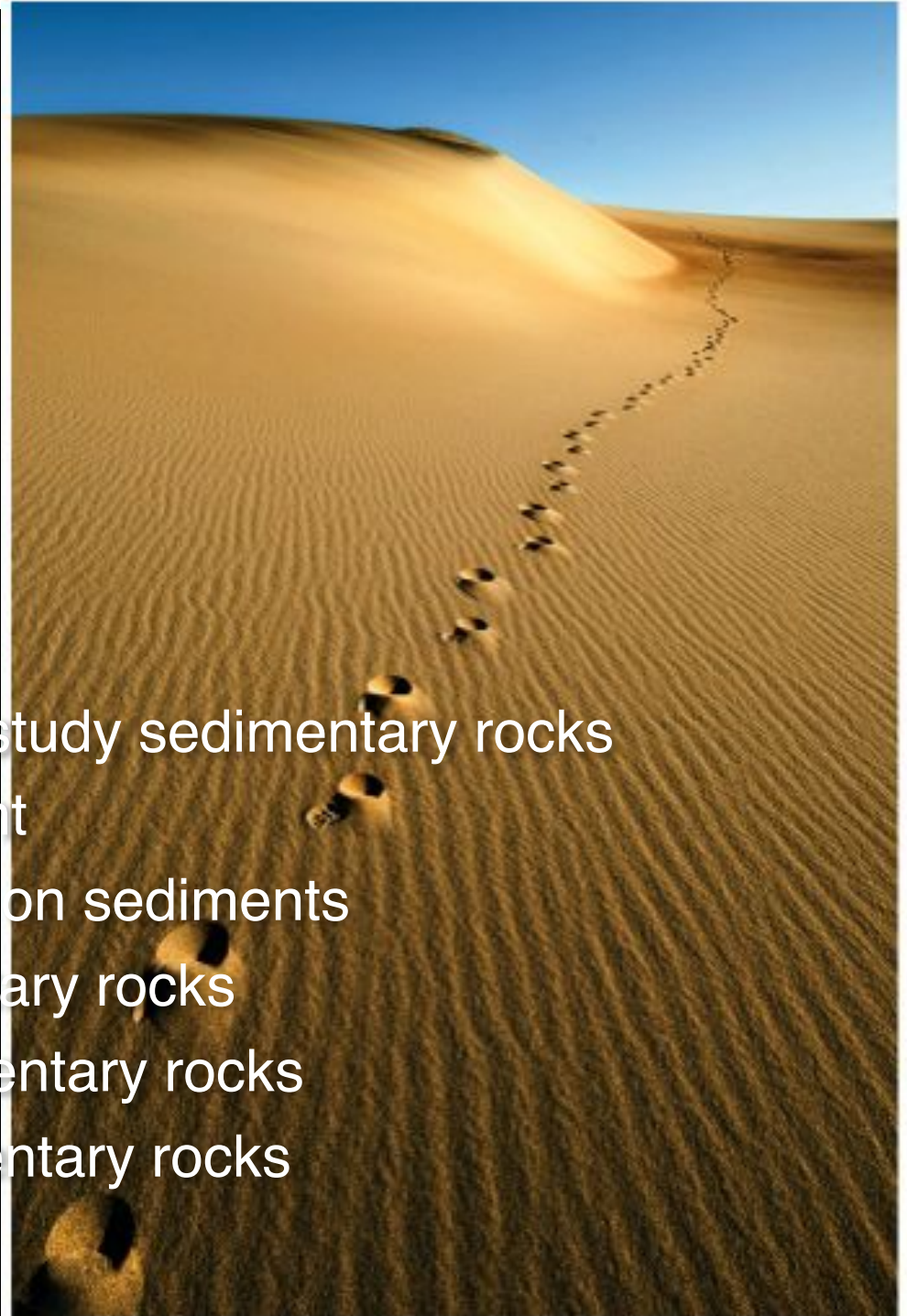
## Learning Objectives (LO)

# Lecture 7: Sedimentary Rocks

**\*\* Chapter 8 \*\***

What we'll learn today:

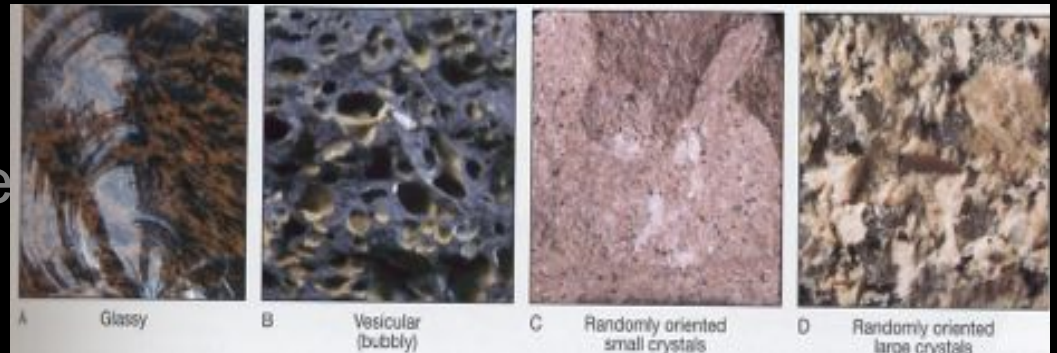
1. Understand why geologists study sedimentary rocks
2. Compare 3 types of sediment
3. Describe processes that act on sediments
4. List primary clastic sedimentary rocks
5. List primary chemical sedimentary rocks
6. List primary biogenic sedimentary rocks



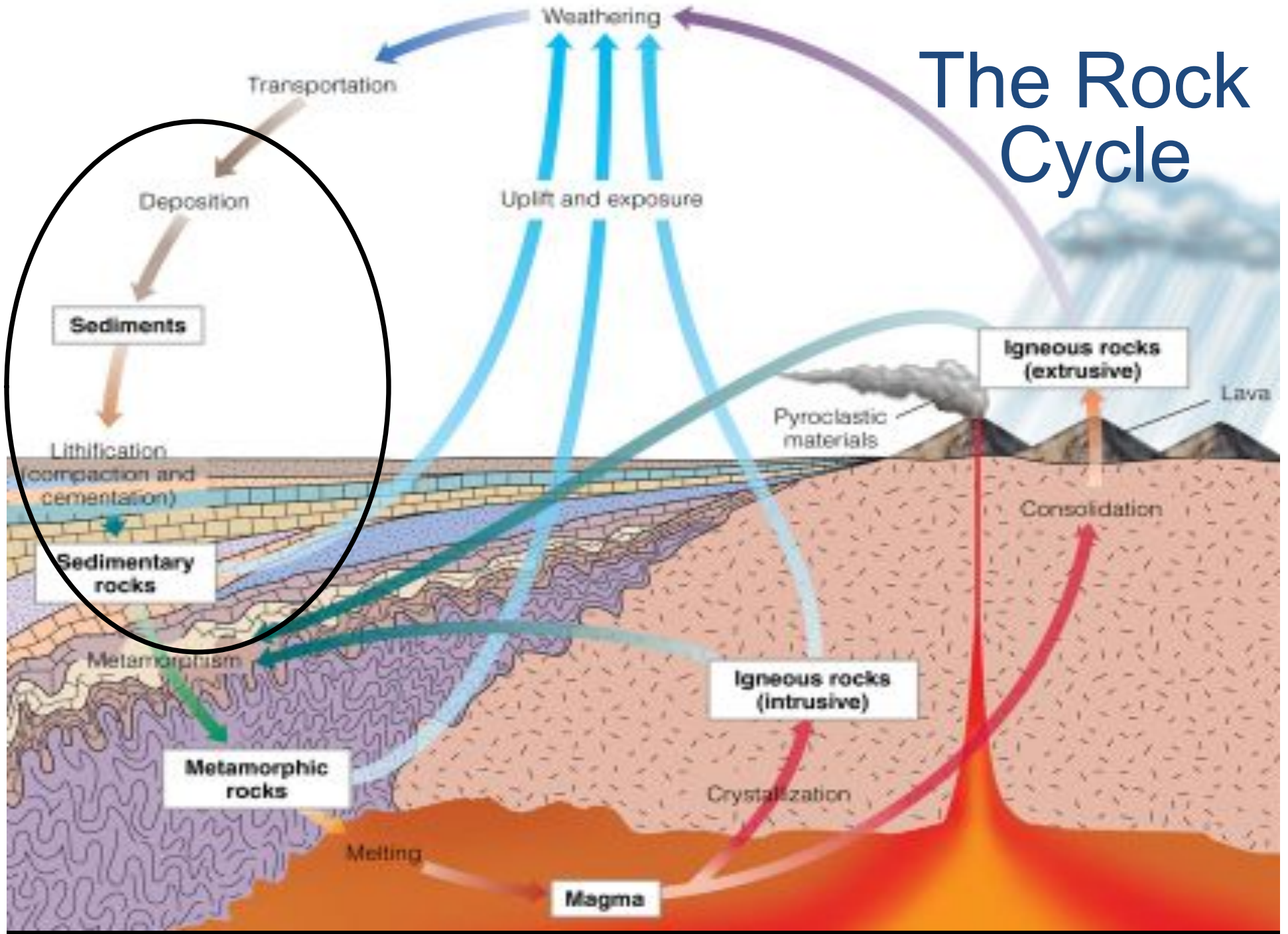


# Fundamental Rock Types

- Igneous Rocks:  
form when magma solidifies
- Sedimentary Rocks:  
form when sediment becomes cemented into solid rock
- Metamorphic rocks:  
form when heat, pressure, or hot water alter a rock



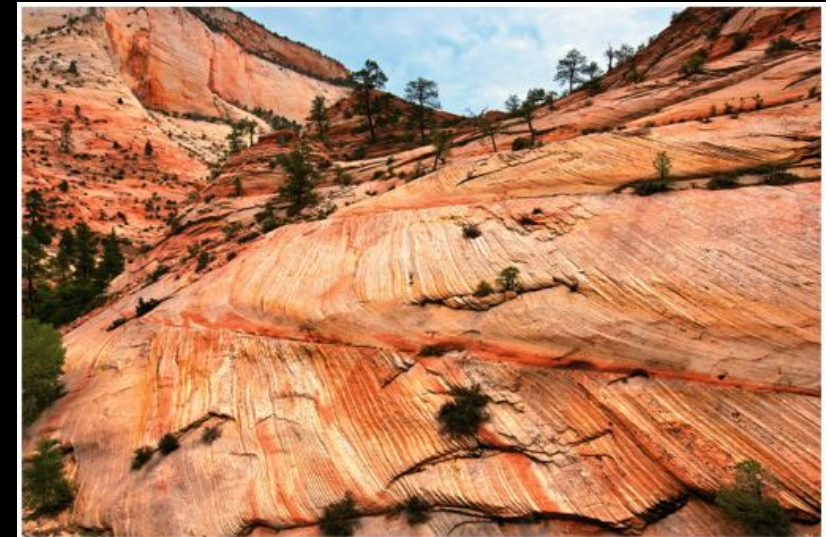
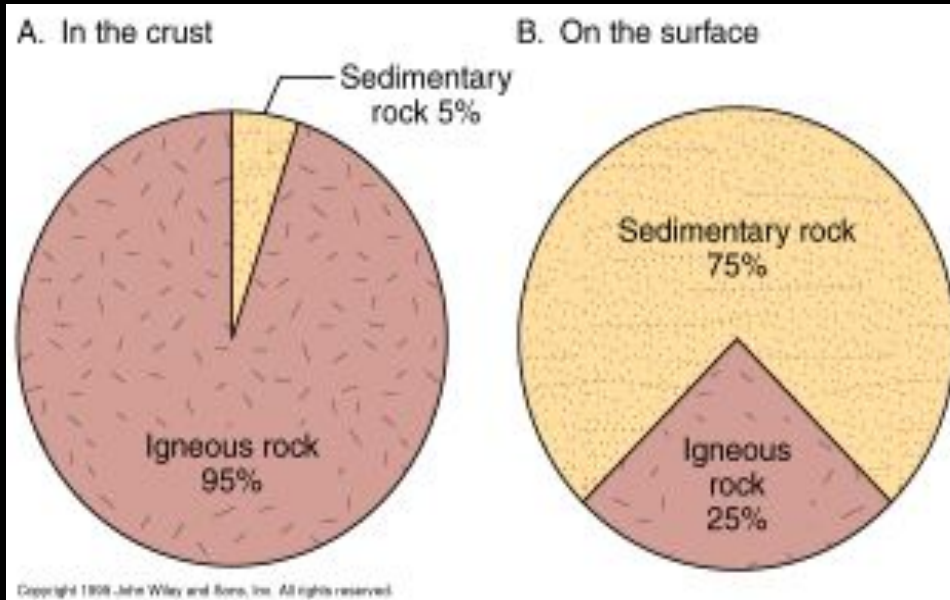
# The Rock Cycle





# Sedimentary Rocks

- Generally, made from older rocks
- Make up only ~5% of Earth's crust, but.....
- Make up 75% of all rocks exposed at the surface





# Why Study Sedimentary Rocks?

- Reflect physical and chemical characteristics of source environments
- Contain direct and indirect evidence of life
- Can be interpreted to recreate Earth history
- May contain important minerals
- Source of “fossil fuels”





# Sedimentary Rocks Preserve Evidence of Past Environments



# Sedimentary Rock Types

- **Clastic** – broken down rocks (clasts)

Ex.: sandstone



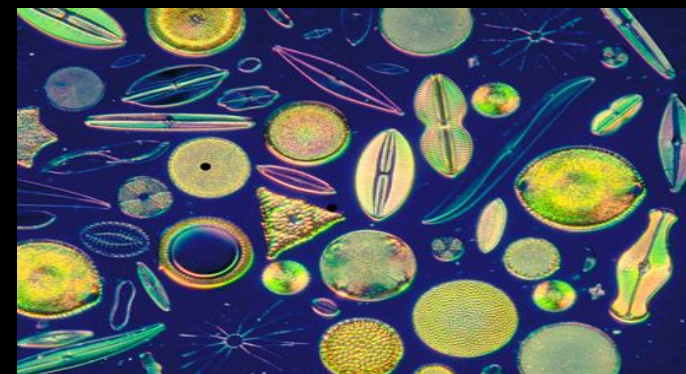
- **Chemical** – directly precipitates out of water

Ex.: rock salt



- **Biogenic** – remains of living organisms

Ex.: limestone, chalk, coal





# Clastic Sedimentary Rock Formation

Four steps:

#1

Weathering  
and Erosion

#2

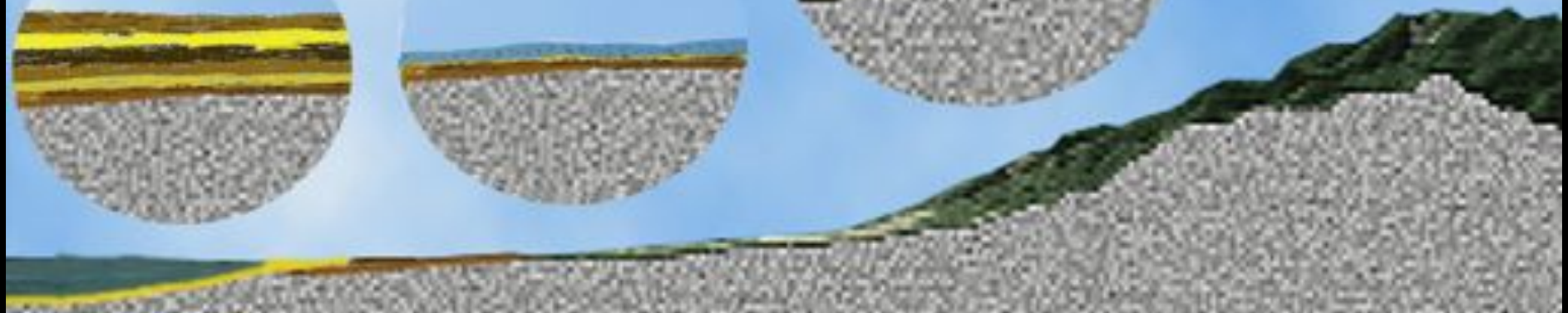
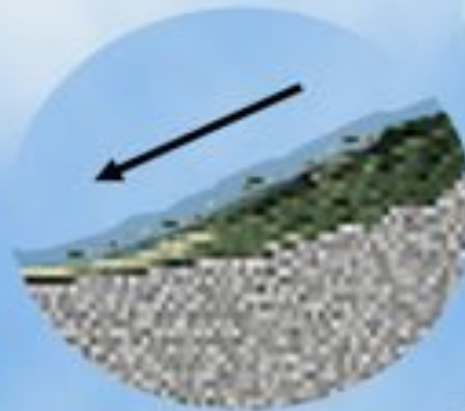
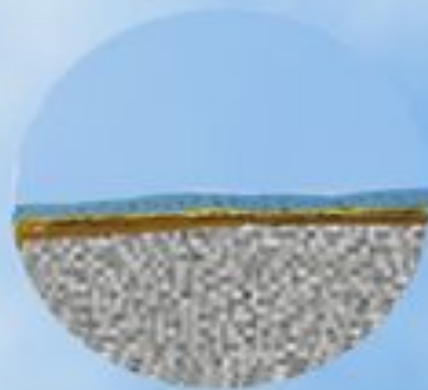
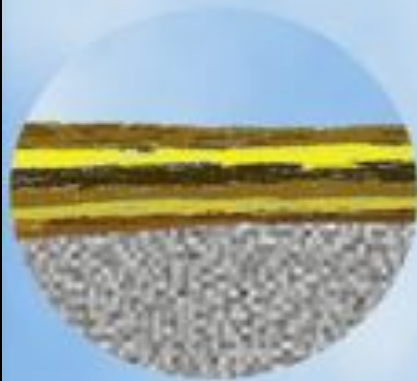
Transport

#3

Deposition

#4

Lithification

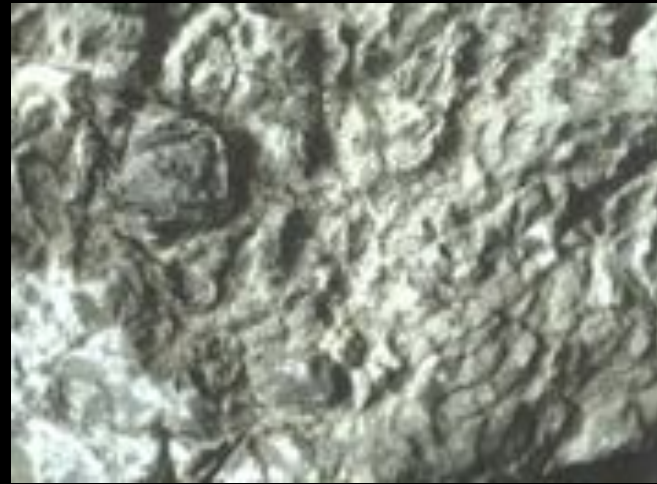


# Step 1: Weathering

- Breaks down a pre-existing rock
  - Physical
  - Chemical
- Turns rock into sediment
  - Gravel, sand, silt, clay



Physical



Chemical



# Clastic Sedimentary Rock Formation

Four steps:

#1

Weathering  
and Erosion

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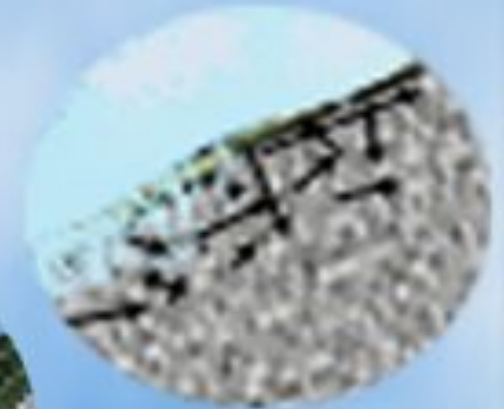
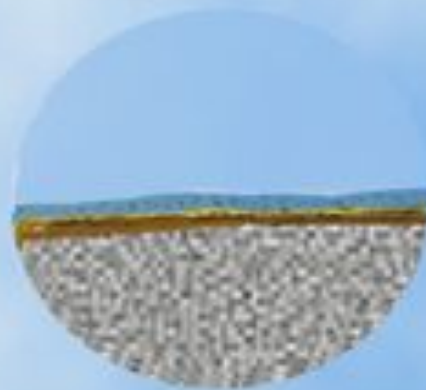
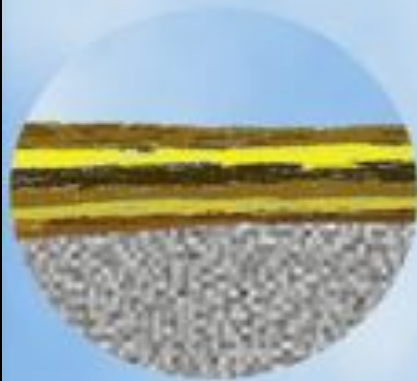
Transport

#3

Deposition

#4

Lithification



# Step 2: Transport of Sediment

- Sediment carried by
  - Wind
  - Water
  - Ice





## Step 2: Transport of Sed. (cont.)

- Indicators of distance traveled:
  - Rounding
  - Sorting



Rounded?



Sorted?

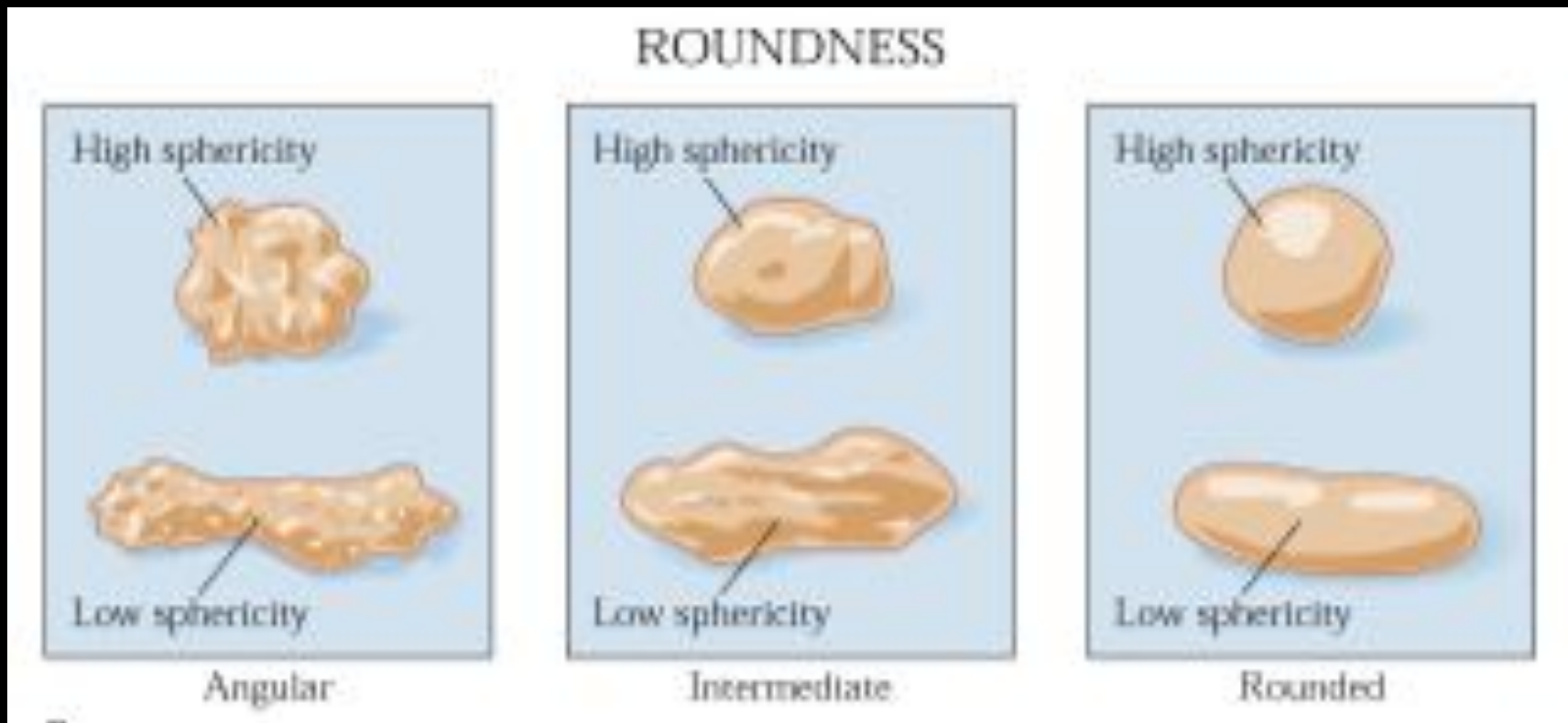
# Sediment Roundness

- The longer a sediment is transported, the rounder it gets

Short distance



Long distance





# Sorted Sediment

- The longer a sediment is transported, the more sorted it becomes

Short distance



Long distance



Poorly sorted sediment



Well-sorted sediment

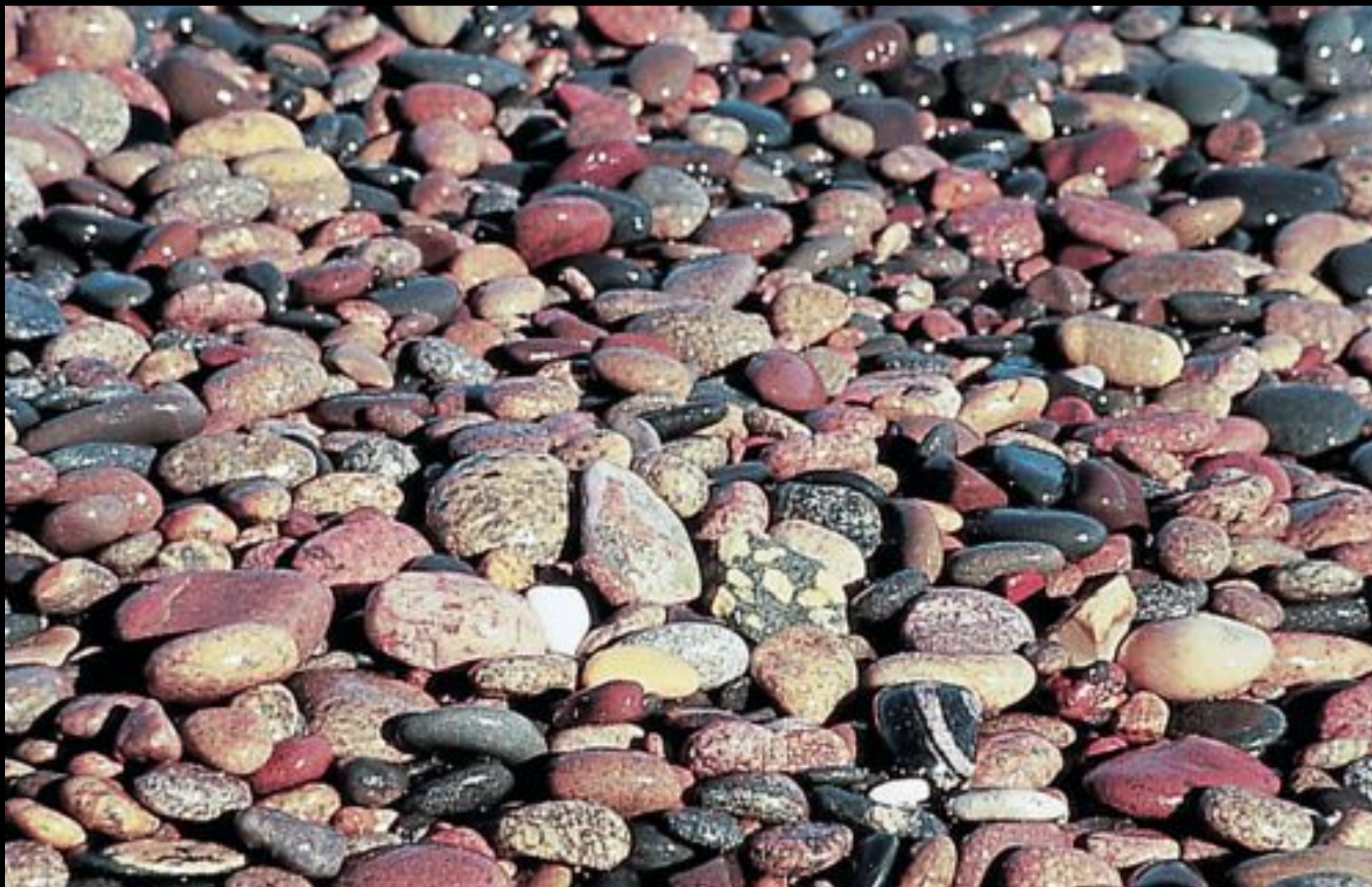
# Distance Traveled?

Think: roundness?





# Distance Traveled?



Think: roundness? sorting?



# Distance Traveled?



Think: roundness? sorting?



# Clastic Sedimentary Rock Formation

Four steps:

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Weathering  
and Erosion

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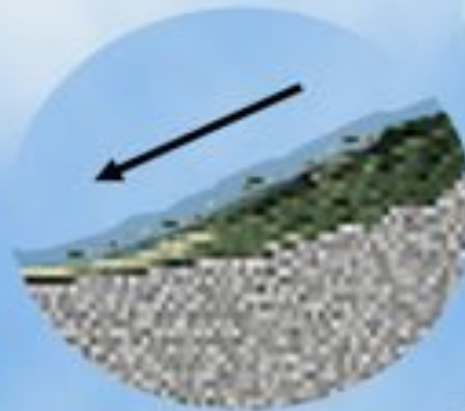
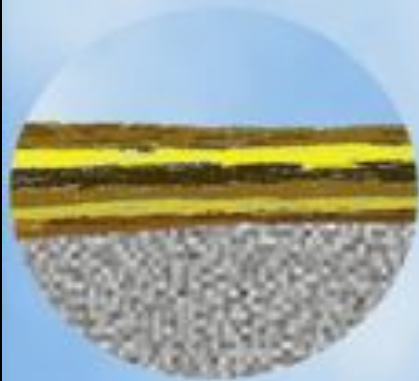
Transport

#3

Deposition

#4

Lithification



# Step 3: Deposition

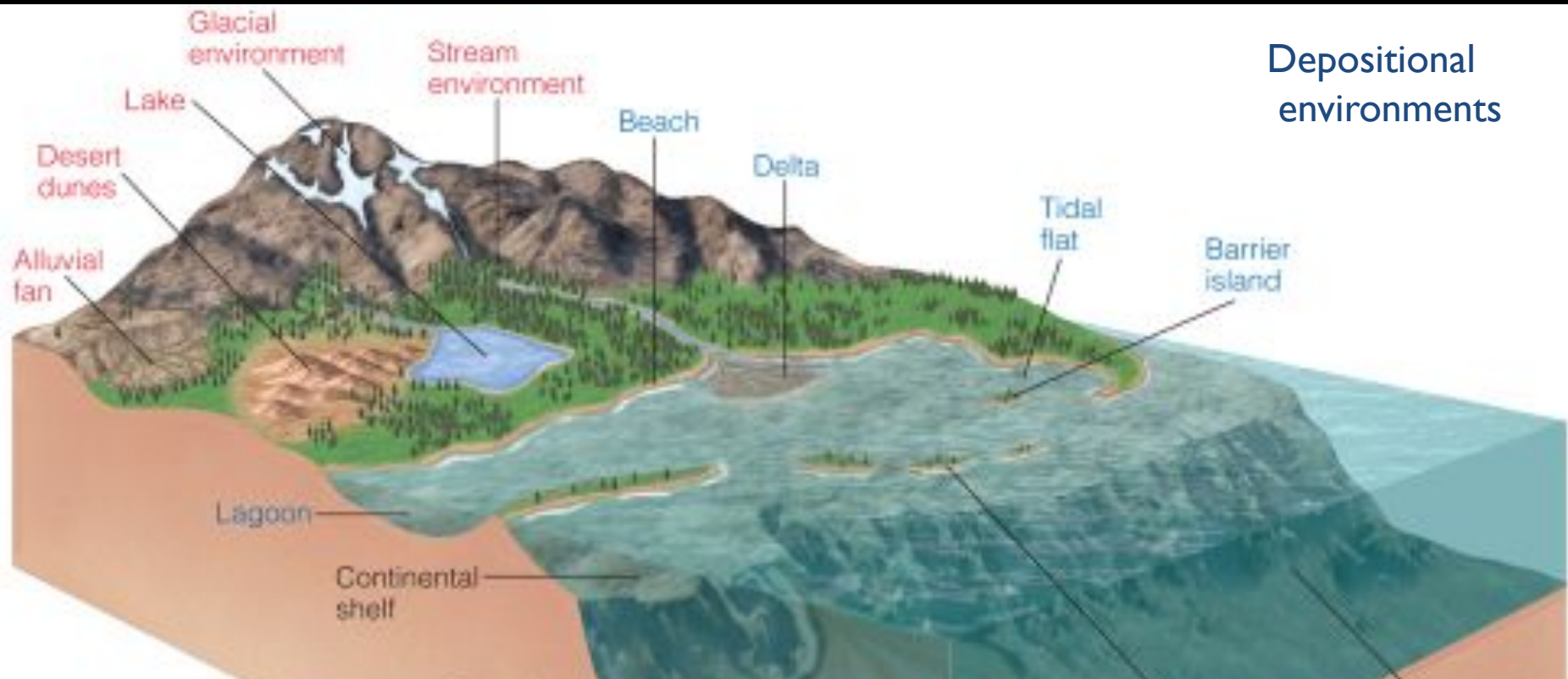
- Layering of sediments by any natural agent (water, wind, ice, etc.)





# Particle Size & Depositional Environment

- Large particles deposited in higher energy environments
  - *Gravel* - need fast moving water, glaciers
  - *Sand* - wind, wave action (beaches), rivers
  - *Silt & Clay* - lakes, swamp, deep oceans



# Clastic Sedimentary Rock Formation

Four steps:

#1

Weathering and Erosion

#2

Transport

#3

Deposition

#4

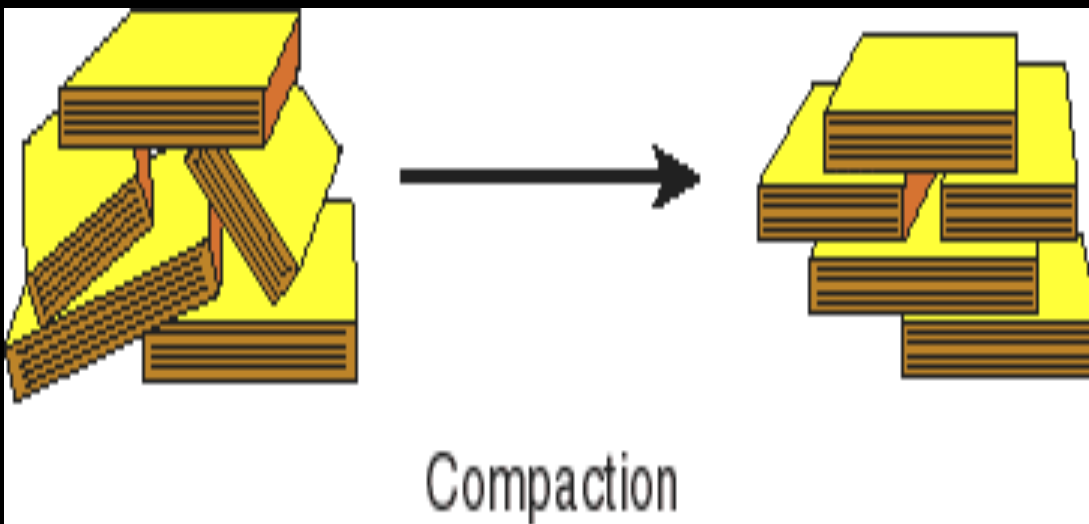
Lithification





# Step 4: Lithification

- Def.: when loose sediment becomes compacted & cemented
  - **Compaction:** pressure of overlying sediments packs grains & squeezes water from pores
  - **Cementation:** pore spaces fill with ions that precipitate from water (calcite, quartz, iron oxide)



# Types: Clastic Sedimentary Rocks

- Composition - mostly quartz, feldspars, & clay
- Classified by particle size (= its travels)

## Size Classification of Sedimentary Particles

Size	Sediment Name
$> 2$ mm	Gravel
$\frac{1}{16}$ – $2$ mm	Sand
$\frac{1}{256}$ – $\frac{1}{16}$ mm	Silt
$< \frac{1}{256}$ mm	Clay
	} Mud*

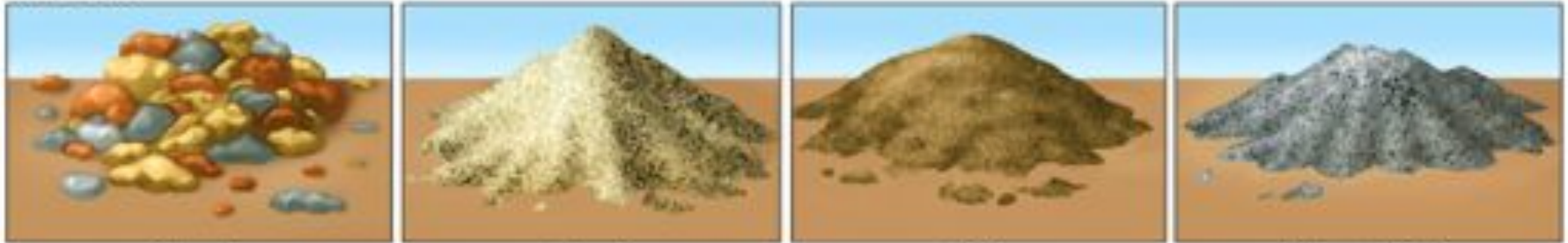
\*Mud is a mixture of silt and clay-sized particles.



# From Sediments to Rocks

- sediment + compression + time = rock

## Sediment



Gravel

Sand

Silt

Clay and silt

Sedimentary  
rock



Conglomerate



Sandstone



Siltstone



Shale

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Figure 8.17

# Conglomerate

- Lithified gravel
- Origins:
  - Fast moving river
  - Severe storm in shallow ocean
  - “bulldozed” by glacier





# Sandstone

- Lithified sand
- Origins:
  - River
  - Beach
  - Dune field



# Shale

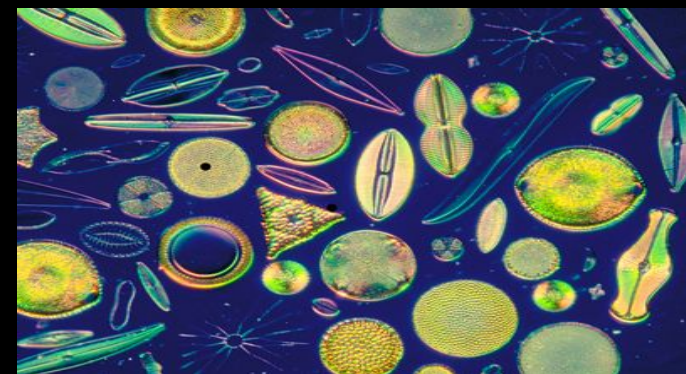
- Lithified silty mud
- Origin:
  - Deep ocean
  - Quiet, deep lake





# Sedimentary Rock Types

- Clastic – broken down rocks (clasts)  
Ex.: sandstone
- **Chemical** – directly precipitates out of water  
Ex.: rock salt
- Biogenic – remains of living organisms  
Ex.: limestone, chalk, coal



# Types: Chemical Sedimentary Rocks

- Precipitation of minerals from a solution
- Ex.: Salt, gypsum



salt



Salt deposit



gypsum



# Types: Chemical Sedimentary Rocks

rock salt



rock gypsum



limestone



travertine



micrite



dolostone



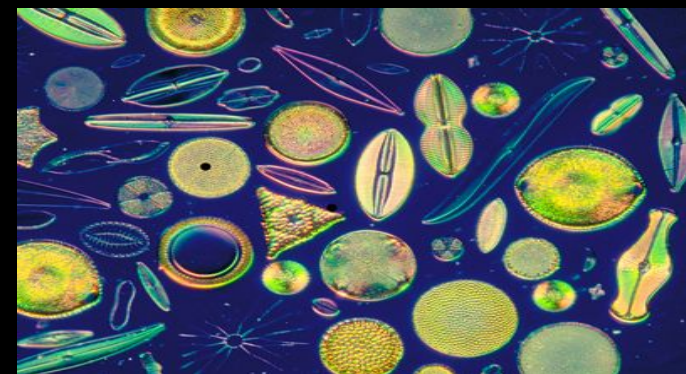
chert

**TABLE 8.4 Chemical Sedimentary Rocks**

Rock	Texture	Composition
Chert	Crystalline	Microcrystalline silica
Dolostone	Crystalline	Dolomite
Limestone	Can be crystalline or microcrystalline	Calcite
Micrite	Microcrystalline	Carbonate mud
Rock gypsum	Crystalline	Gypsum
Rock salt	Crystalline	Halite
Travertine	Microcrystalline	Calcite from saturated fluids

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Ex.: sandstone
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# Types: Biogenic Sedimentary Rocks

- Lithification of “organic” (plants, etc.) material
- Ex.: Coal is formed from preserved plant material in swamps



Coal swamp forest



coal



chert

# How is oil made?

<https://www.youtube.com/watch?v=8YHsxXEVB1M>



# Fracking Shale Video

**WHAT IS FRACKING?**

<https://www.youtube.com/watch?v=6qKadxymOYY#t=27>

# Types: Biogenic Sedimentary Rocks

skeletal limestone



coal



chalk



coquina



**TABLE 8.5 Biogenic Sedimentary Rocks**

<b>Rock</b>	<b>Texture</b>	<b>Composition</b>
Chalk	Clay or mud	Skeletal coccolithophorids
Coal	Massive, blocky	Concentrated carbon
Coquina	Sand or gravel	Shell fragments
Limestone	Visible or microscopic skeletal fragments	Calcite



# Sedimentary Structures

- Features that developed during or shortly after deposition of sediment



Ripple marks

- Ripple marks

- Cross bedding



Cross bedding

- Mud cracks



Mud cracks

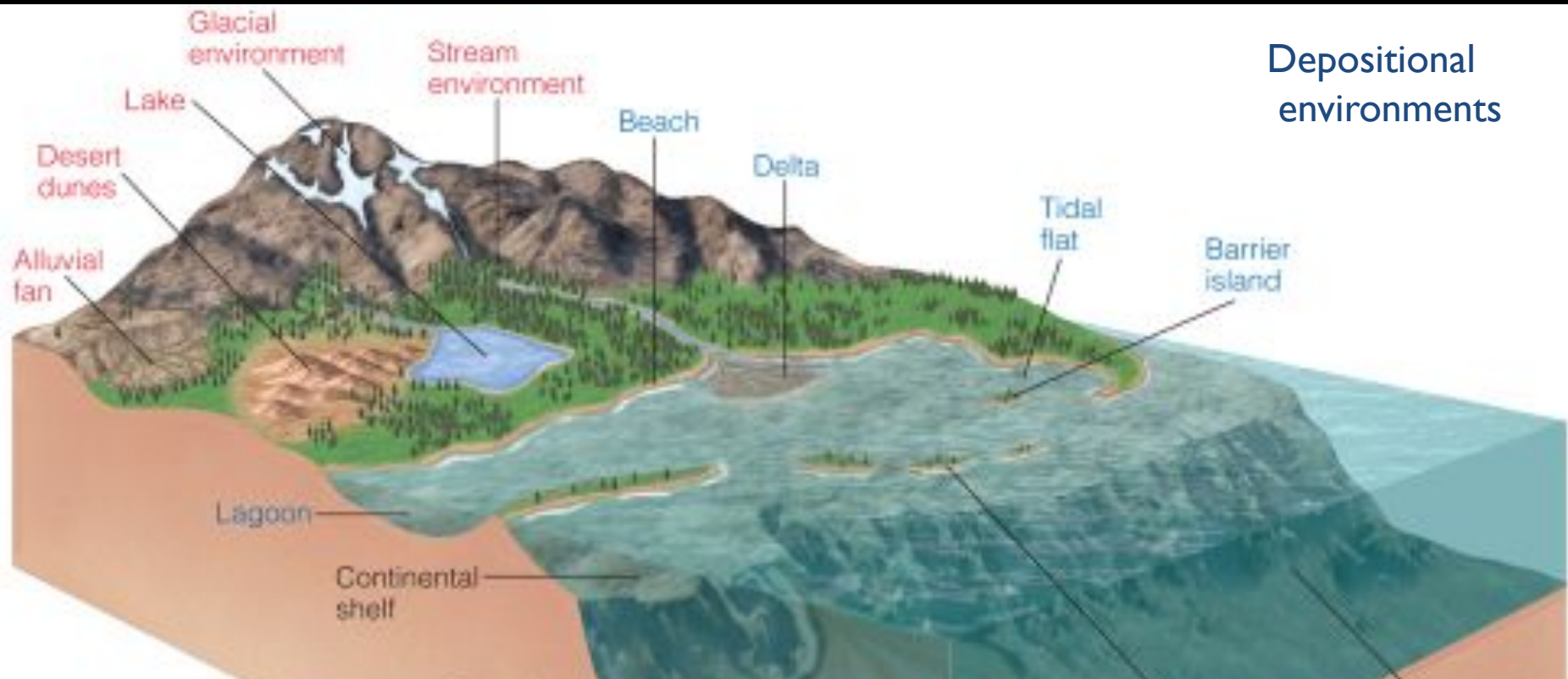
# Development of Ripples

<http://www.youtube.com/watch?v=uY2QdZLLRP8>

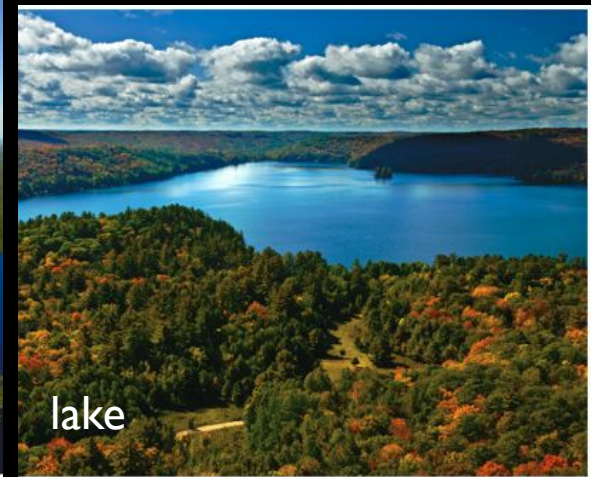
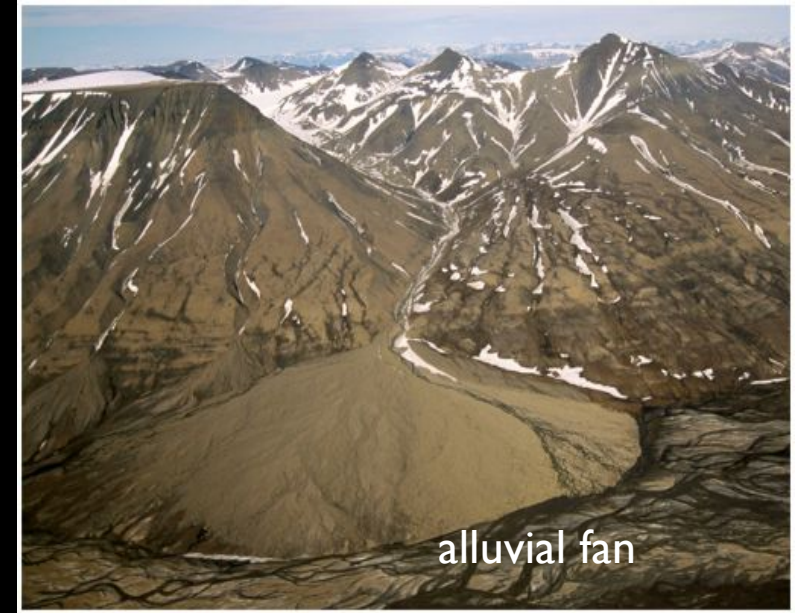


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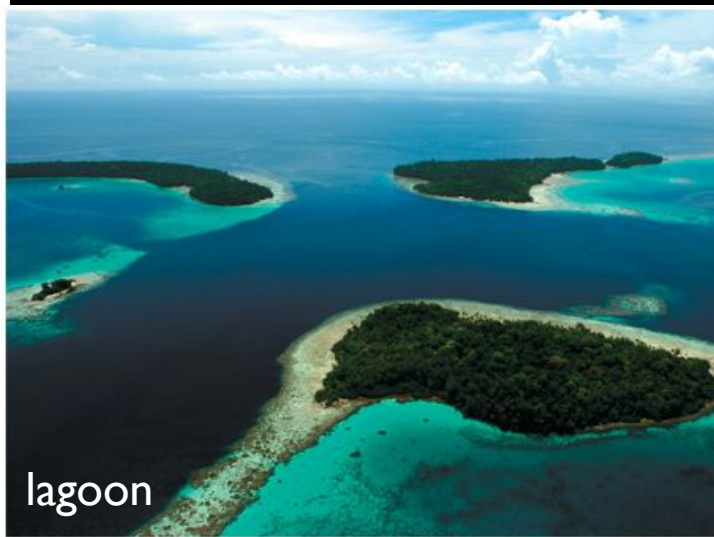


# Continental Deposition Environments



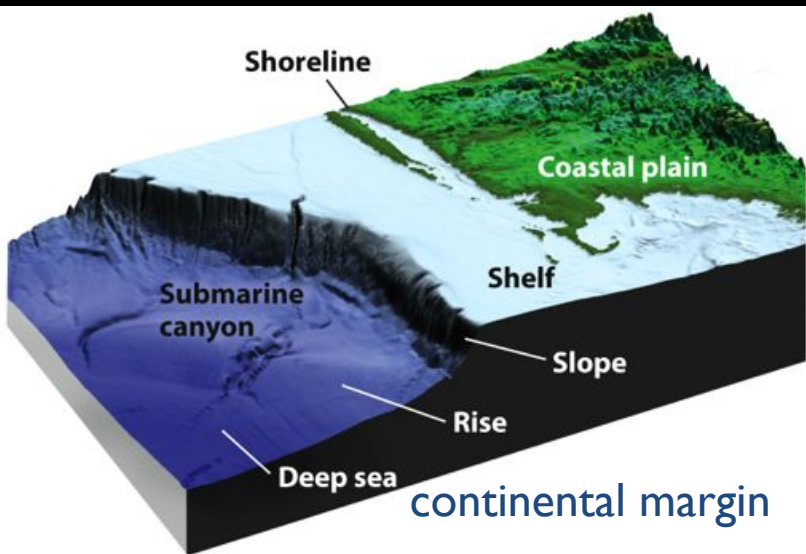
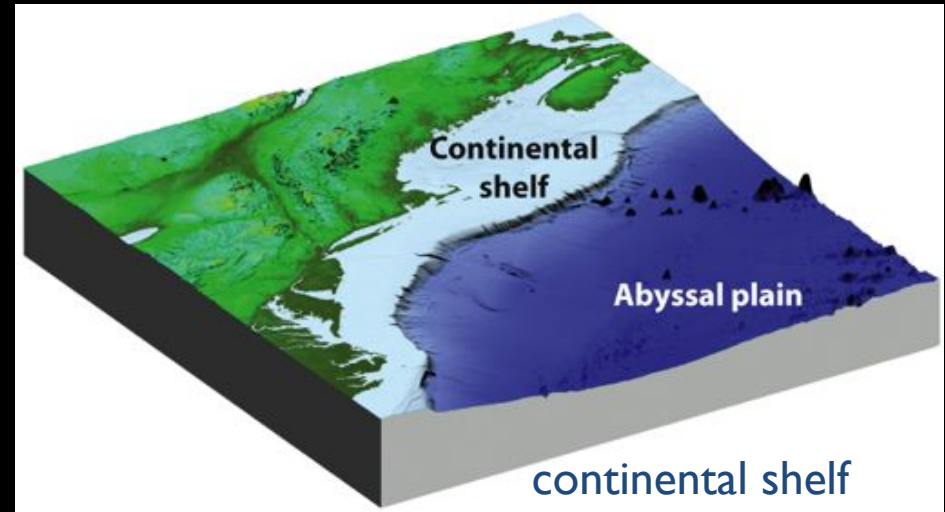


# Coastal Deposition Environments

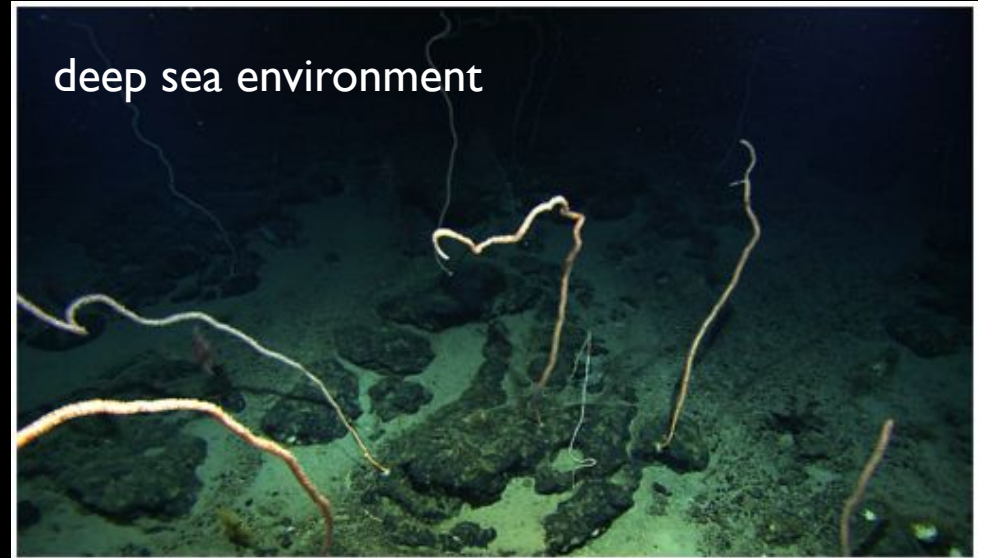


# Marine Deposition Environments

reef

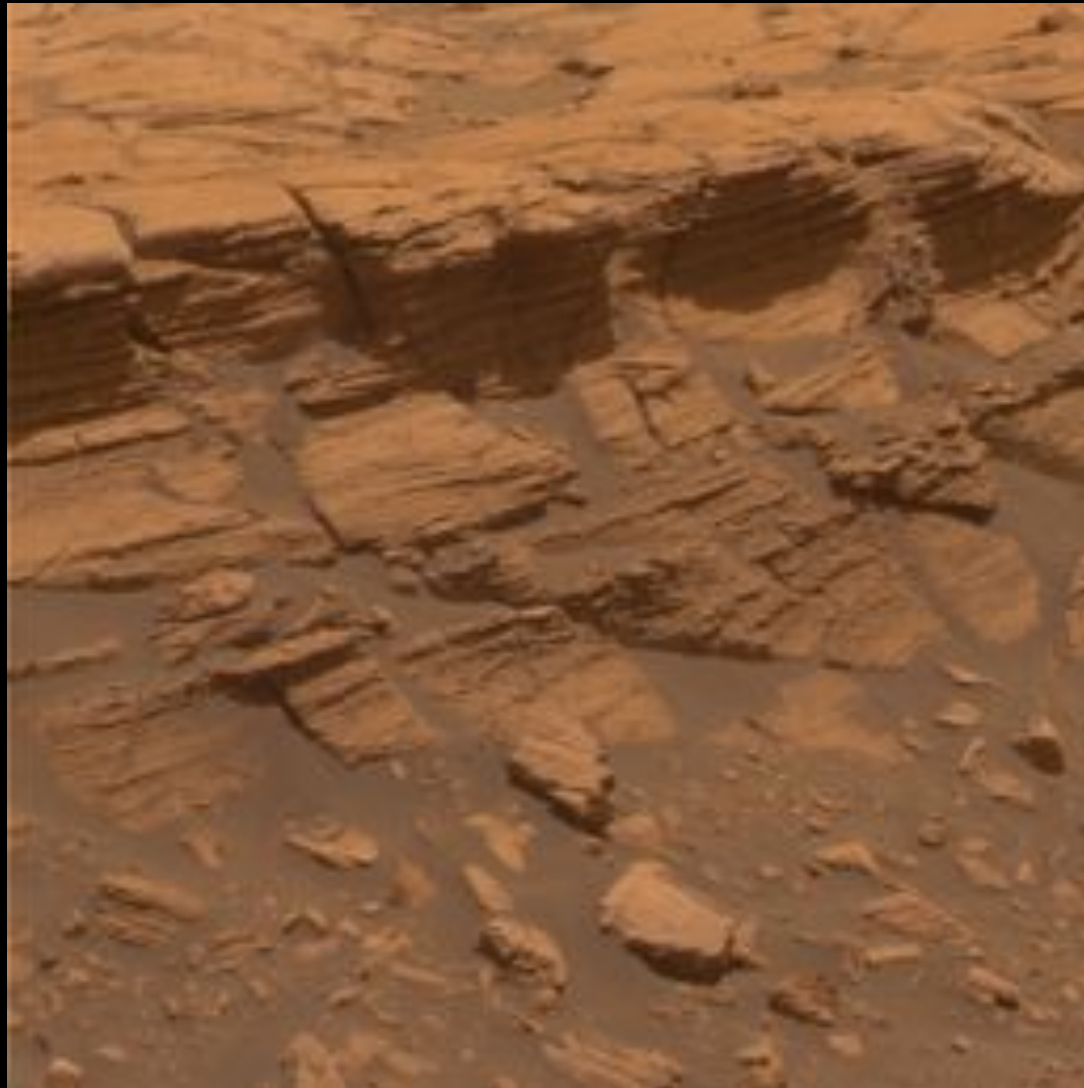


deep sea environment





# Sedimentary Process on Mars!



# Mars Exploration Video

<https://www.youtube.com/watch?v=fpYRQ46fUEM>



## Action Items for Thursday, Sept. 17

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1. Understand why geologists study sedimentary rocks
2. Compare 3 types of sediment
3. Describe processes that act on sediments
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