
بسم الله الرحمن الرحيم

GEO 435

Oceanography

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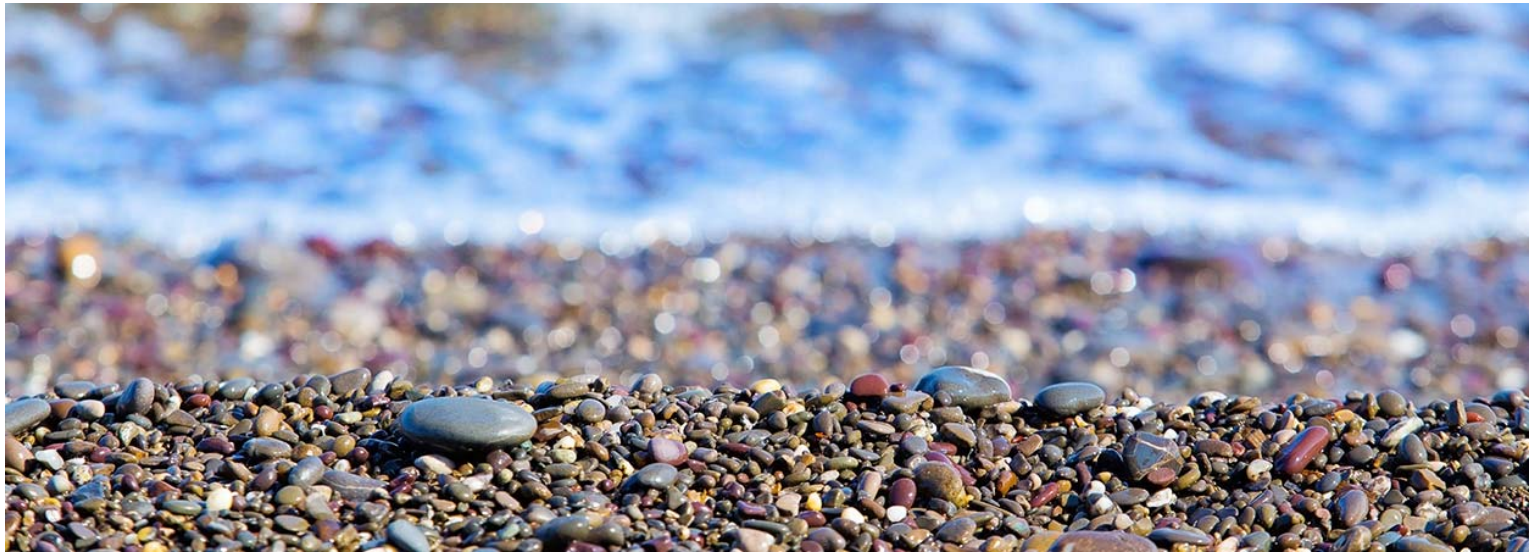
Marine Sediments:

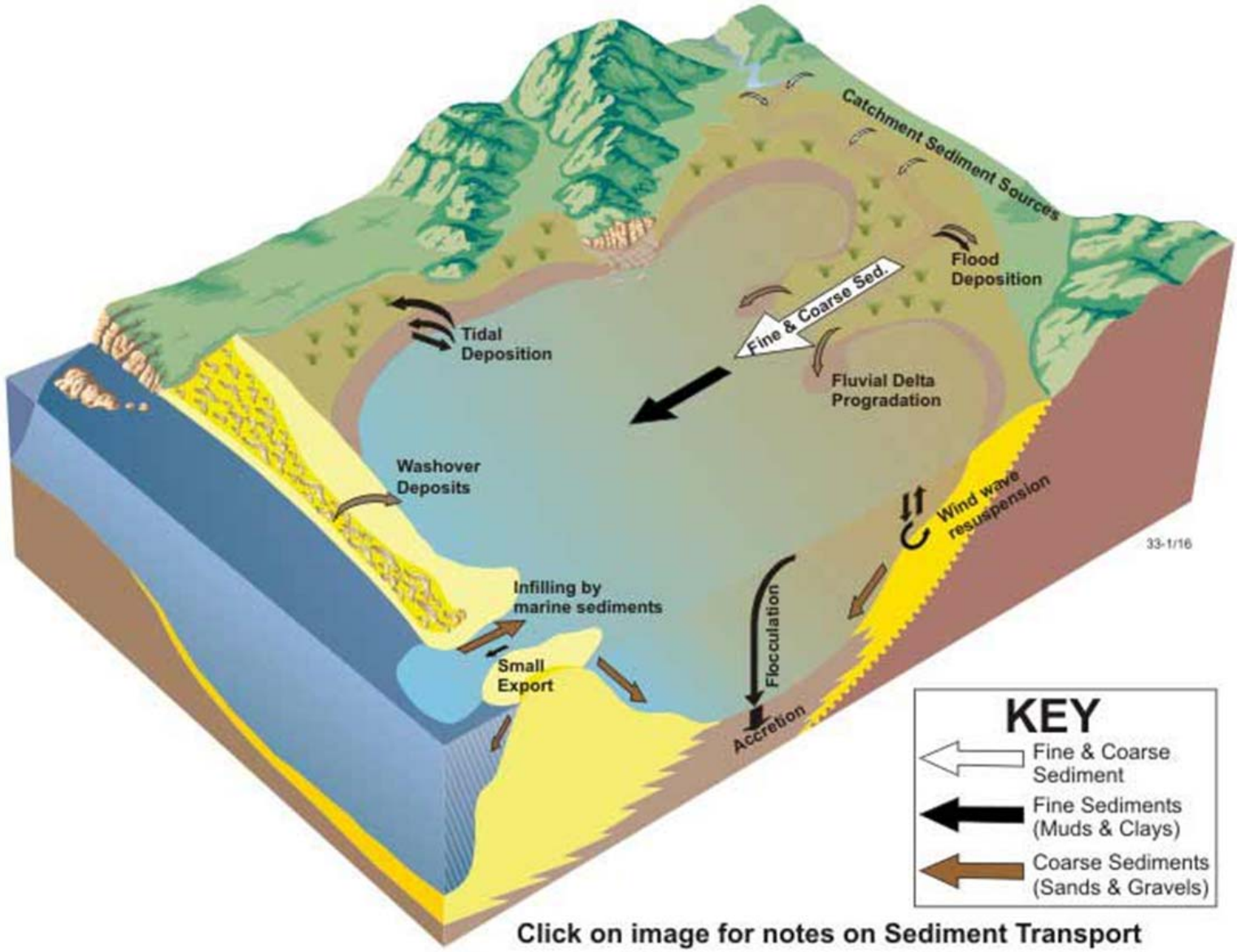
- Definition of sediments.
- Importance of sediments.
- Types of marine sediments.
- Recourses of ocean sediments provide.

Q. What is sediment?

Sediment is:

1. Naturally occurring material.
2. Broken down by processes of weathering and erosion.
3. Transported by the action of wind, water, or ice, and/or by the force of gravity.

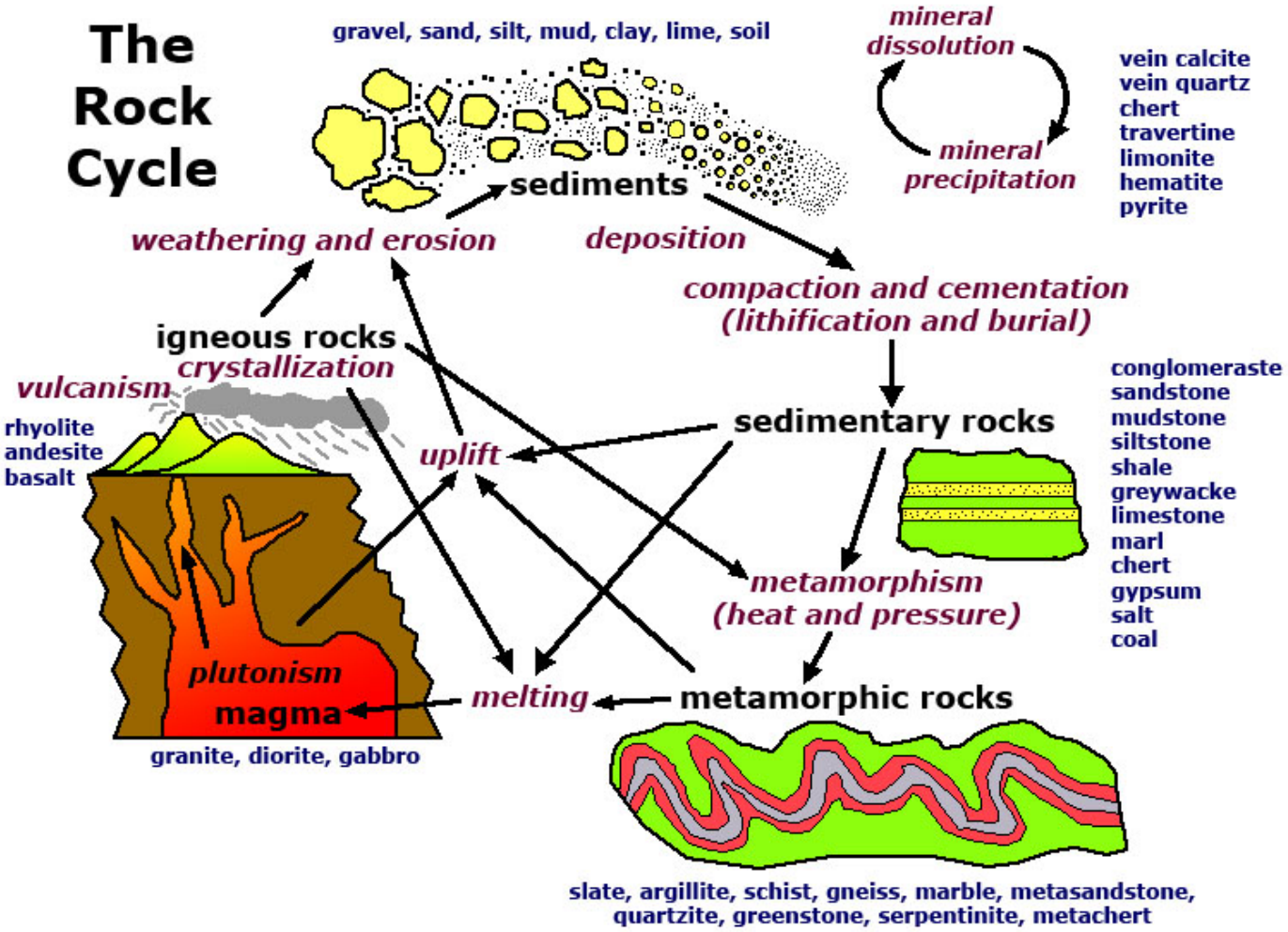



Catchment Sediment Sources
Flood Deposition
Fine & Coarse Sed.
Tidal Deposition
Fluvial Delta Progradation
Washover Deposits
Wind wave resuspension
33-1/16
Infilling by marine sediments
Flocculation
Small Export
Accretion
KEY
Fine & Coarse Sediment
Fine Sediments (Muds & Clays)
Coarse Sediments (Sands & Gravels)
Click on image for notes on Sediment Transport

Sediments provide:

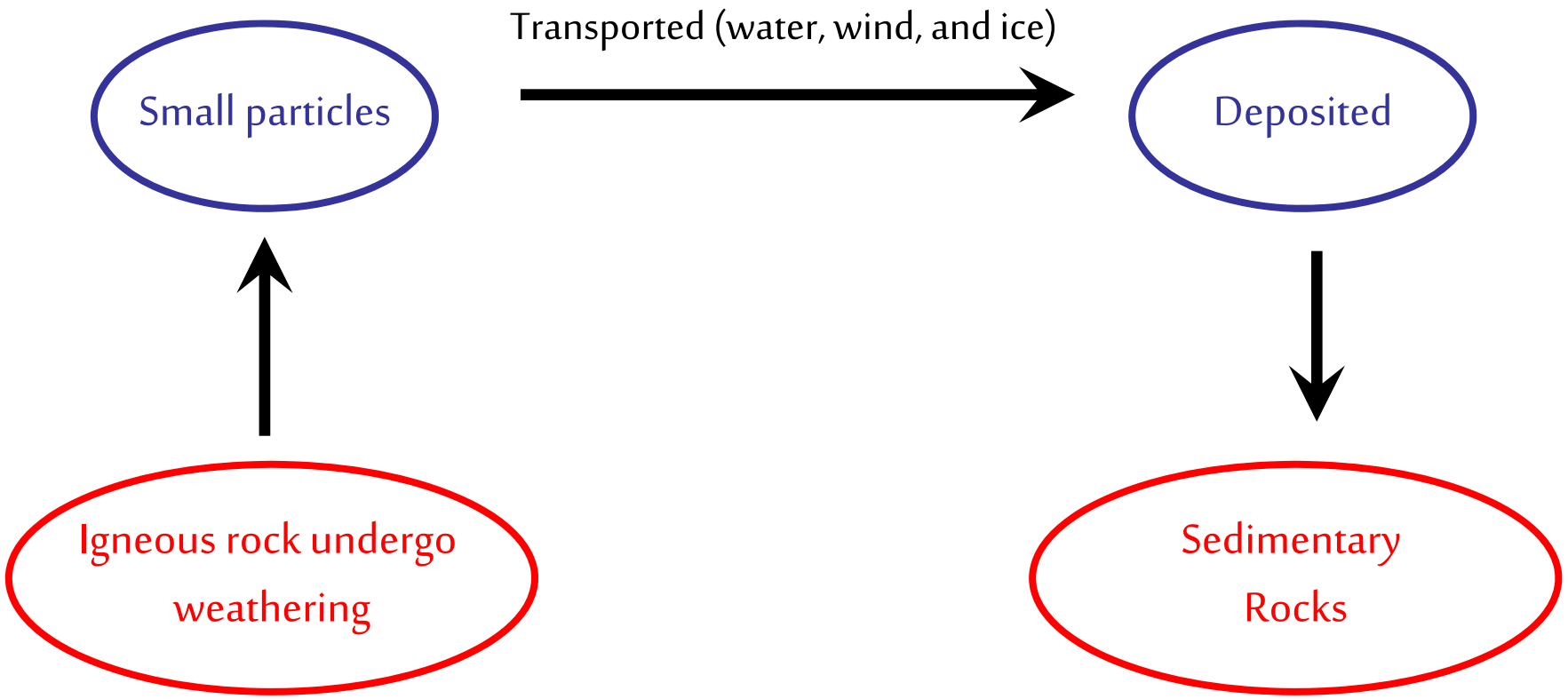
1. Evidences to past climates
2. Movements of the ocean floor
3. Ocean circulation patterns.
4. Nutrient supplies for marine organisms.
5. Most of earth's past geology, climate, and biology has been learned through studying ancient marine sediments.

Over time, sediments become lithified turned to rock and form sedimentary rock.



Q. What is the difference between lithifcation and crystallization?

Lithification



Crystallization

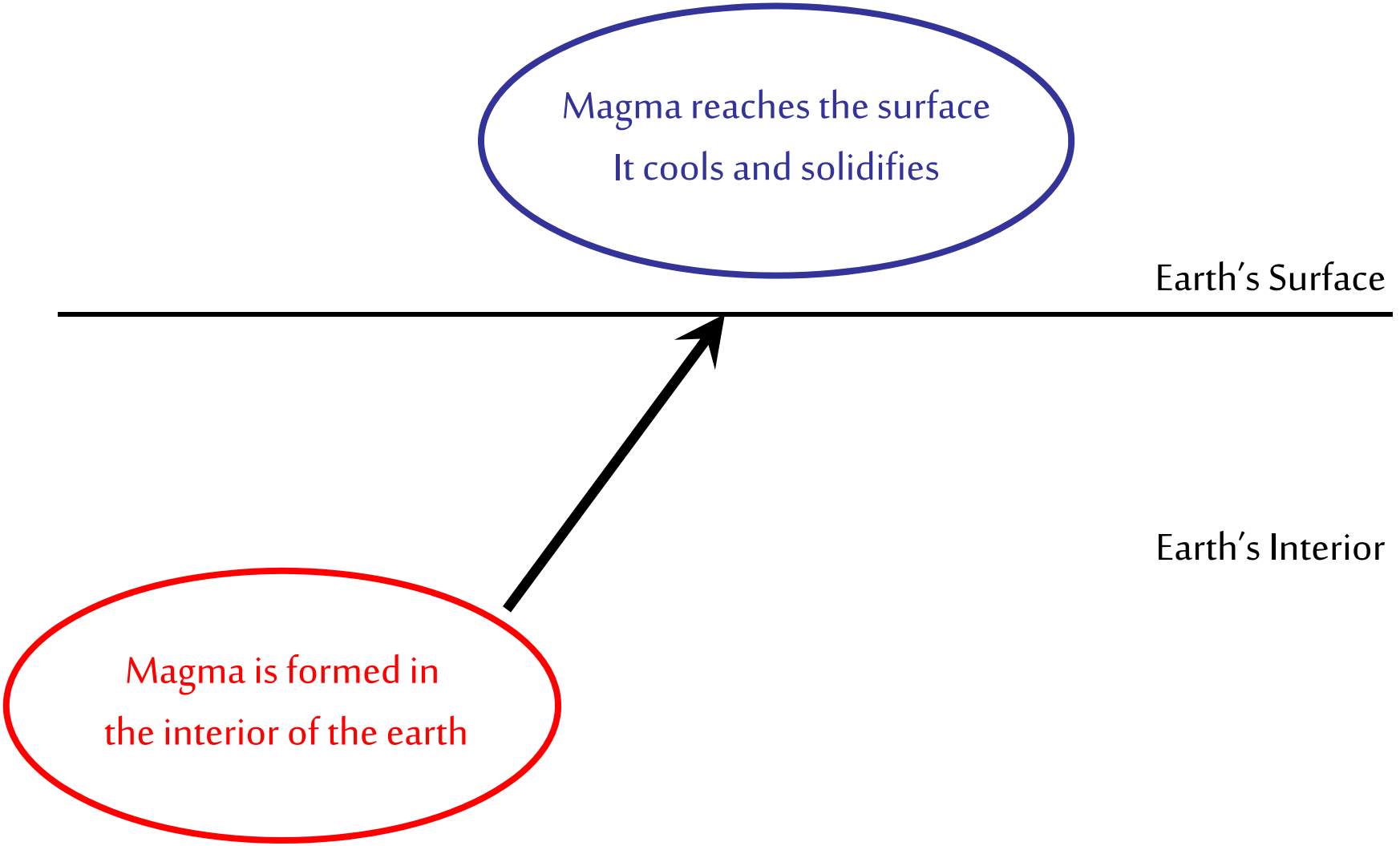
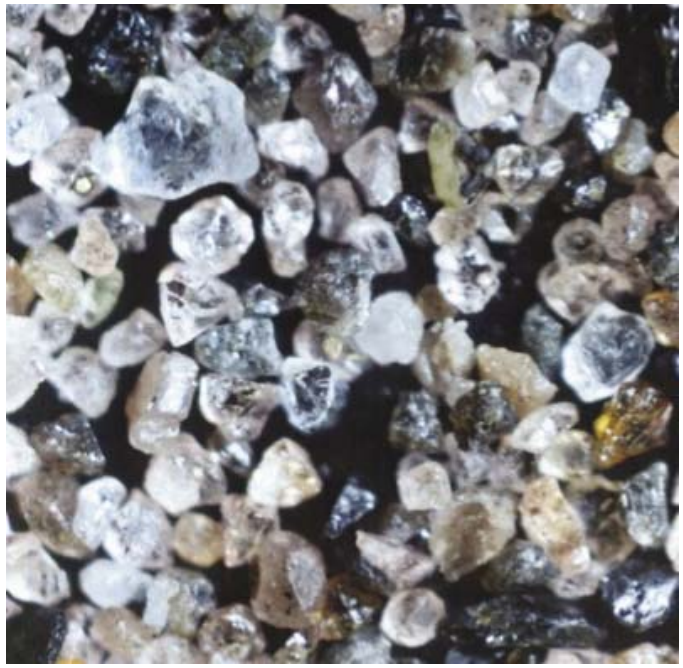


TABLE 4.1 CLASSIFICATION OF MARINE SEDIMENTS

Type		Composition	Sources		Main locations found
Lithogenous	*Continental margin*	Rock fragments	Rivers; coastal erosion; landslides		Continental shelf
		Quartz sand	Glaciers		Continental shelf in high latitudes
		Quartz silt	Turbidity currents		Continental slope and rise; ocean basin margins
		Clay			
	Oceanic	Quartz silt	Wind-blown dust; rivers		Deep-ocean basins
		Clay			
		Volcanic ash	Volcanic eruptions		
Biogenous	*Calcium carbonate ($CaCO_3$)*	Calcareous ooze (microscopic)	*Warm surface water*	Coccolithophores (algae); Foraminifers (protozoans)	Low-latitude regions; sea floor above CCD; along mid-ocean ridges and the tops of volcanic peaks
		Shell coral fragments (macroscopic)		Macroscopic shell-producing organisms	Continental shelf; beaches
				Coral reefs	Shallow low-latitude regions
	Silica ($SiO_2 \cdot nH_2O$)	Siliceous ooze	*Cold surface water*	Diatoms (algae); Radiolarians (protozoans)	High-latitude regions; sea floor below CCD; upwelling areas where cold, deep water rises to the surface, especially that caused by surface current divergence near the equator
Hydrogenous		Manganese nodules (manganese, iron, copper, nickel, cobalt)	Precipitation of dissolved materials directly from seawater due to chemical reactions		Abyssal plain
		Phosphorite (phosphorous)			Continental shelf
		Oolites ($CaCO_3$)			Shallow shelf in low-latitude regions
		Metal sulfides (iron, nickel, copper, zinc, silver)			Hydrothermal vents at mid-ocean ridges
		Evaporites (gypsum, halite, other salts)			Shallow restricted basins where evaporation is high in low-latitude regions
Cosmogenous		Iron–nickel spherules Tektites (silica glass)	Space dust		In very small proportions mixed with all types of sediment and in all marine environments
		Iron–nickel meteorites	Meteors		Localized near meteor impact structures

1) Lithogenous Sediments

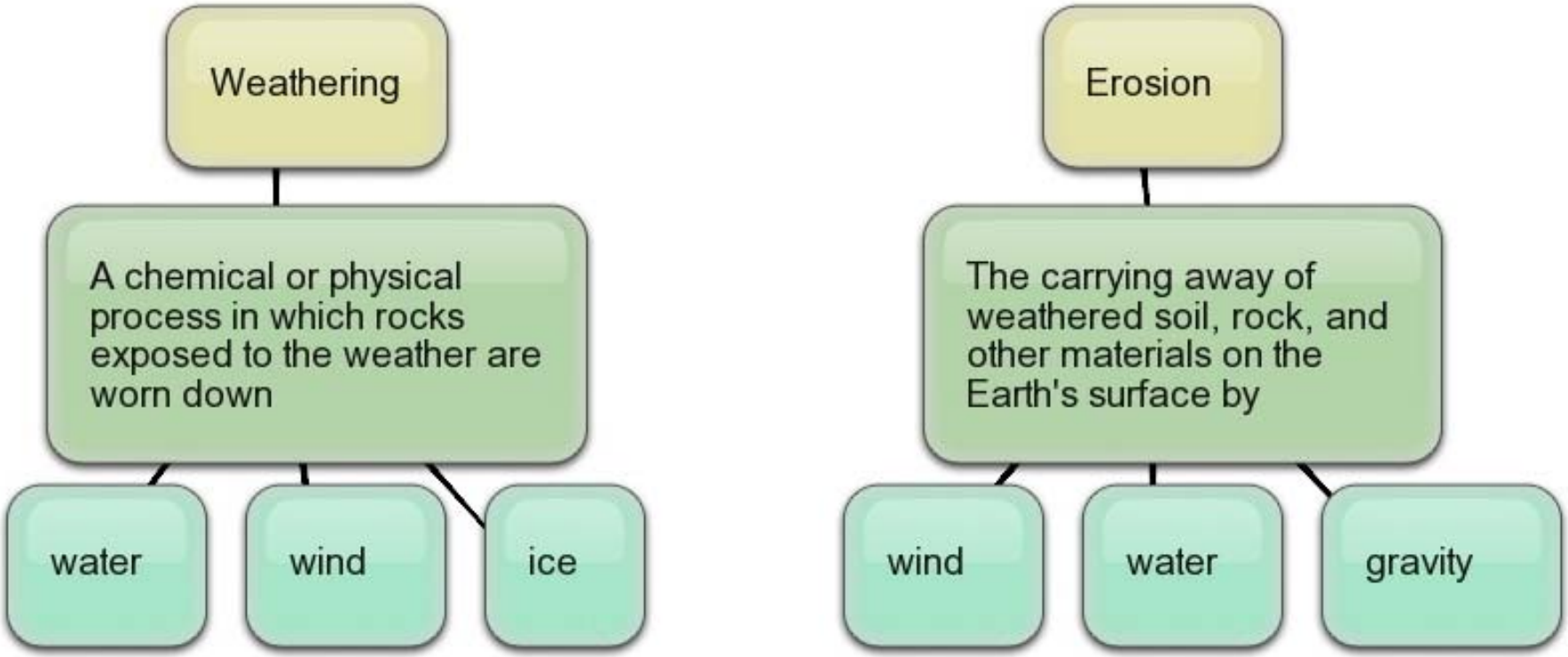
- Lithogenous sediment is derived from preexisting rock material, it is also called terrigenous sediments.
- Volcanic island in the open ocean are importance source of lithogenous sediments.



Origin of lithogenous sediments

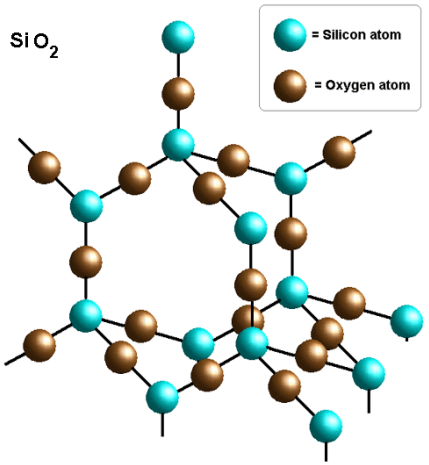
- Lithogenous sediments begins as rocks on continents or islands.
- Over time, weathering and chemical effects break rocks into smaller pieces.
- When rocks are in smaller pieces, they can be more easily eroded and transported.
- This eroded material is the basic component of which all lithogenous sediments is composed.

Q. What is the difference between weathering and erosion?


Weathering
A chemical or physical process in which rocks exposed to the weather are worn down
water
wind
ice
Erosion
The carrying away of weathered soil, rock, and other materials on the Earth's surface by
wind
water
gravity

Composition of lithogenous sediments

- The composition of lithogenous sediments reflects the materials from which it was derived.
- The majority of lithogenous deposits (such as sand) are composed primarily of quartz (SiO_2).
- Quartz can be transported long distances and deposited far from its source area.



The Wentworth scale of grain size

- The Wentworth scale of grain size indicates that particles can be classified as boulder (largest), cobbles, granules, san, silt or clay (smallest).
- Sediments size is proportional to the energy needed to lay down a deposited.

Classification	Particle size (diameter)
Boulder	Above 256 mm
Cobble	64–256 mm
Pebble	4–64 mm
Gravel (or Granule)	2–4 mm
Very coarse sand	1–2 mm
Coarse sand	0.5–1 mm
Medium sand	0.25–0.5 mm
Fine sand	0.125–0.25 mm
Very fine sand	0.062–0.125 mm
Silt	0.004–0.062 mm
Clay	Less than 0.004 mm

Q. Are there any areas of the ocean floor where no sediments is being deposited?

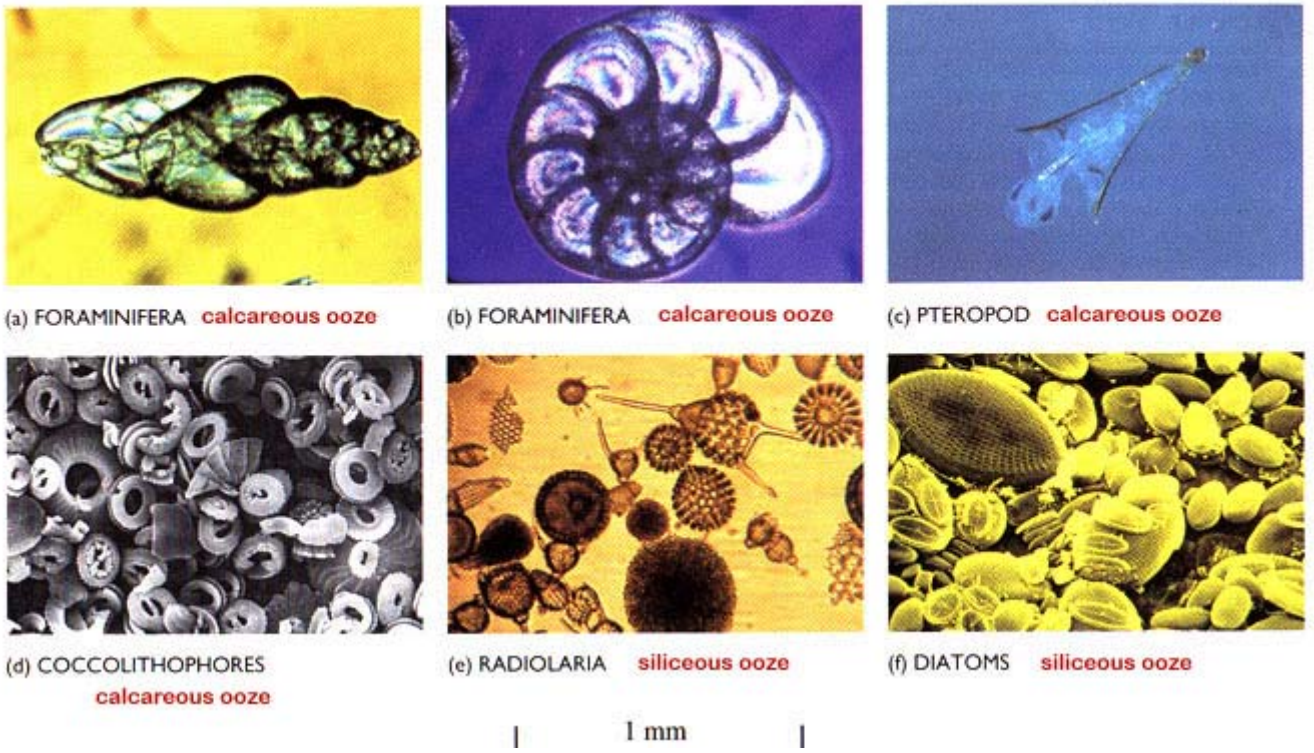
- Various types of sediment accumulate on nearly all areas of the ocean floor.

- Even the deep-ocean floor far from land receives small amounts of sediments.

- However, continental slope and mid-ocean ridges have received very small amounts of sediments.

2) Biogenous Sediments

- Biogenous sediment is resulting from the remains of hard parts of once-living organisms.
- Derived from plants and animals. Mostly shells, some bones.



Origin of biogenous sediments

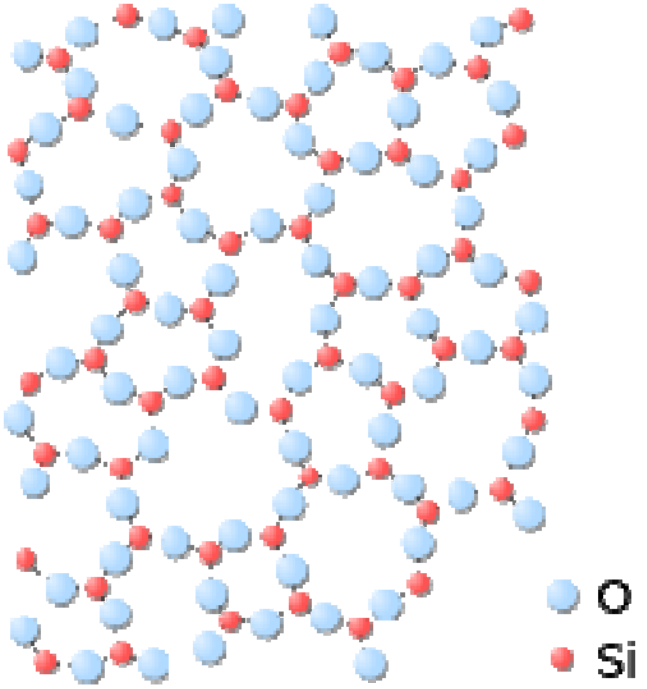
- Biogenous sediments begins as the hard parts (shells, bones, and teeth) of living organisms ranging from minute algae and protozoans to fish and whales.
- When they die, the remains settle onto the ocean floor and can accumulate as biogenous sediments.

Classification of biogenous sediments

1. Macroscopic biogenous sediment: is large enough to be seen without the aid of a microscope (shells, bones and teeth).
2. Microscopic biogenous sediments: particles so small they can only seen well through a microscope.

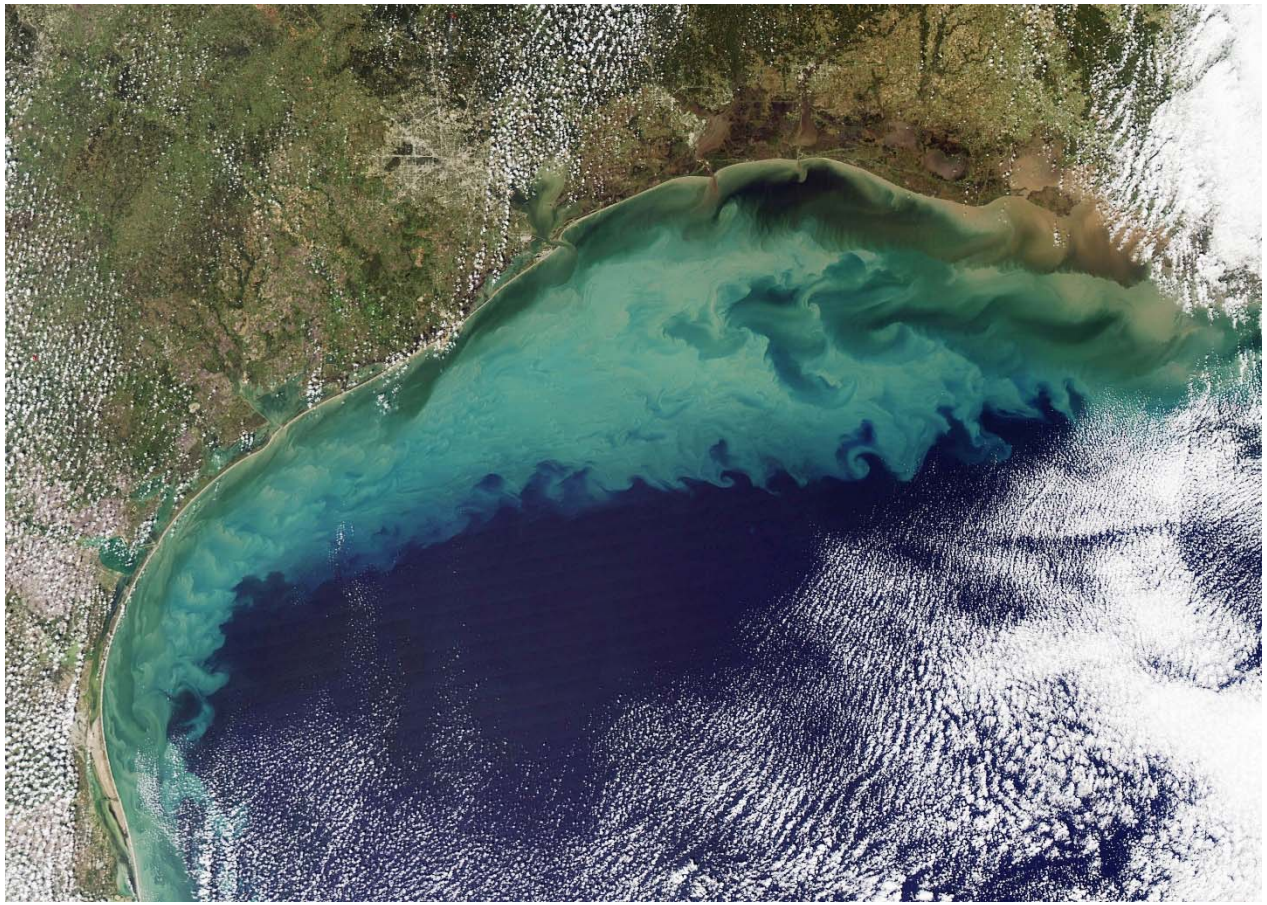
Composition of biogenous sediments

The most common chemical compound of biogenous sediments are calcium carbonate (CaCo3, which forms the mineral calcite) and silica (SiO2).



3) Hydrogenous Sediments

Hydrogenous sediment is derived from the dissolved material in water.

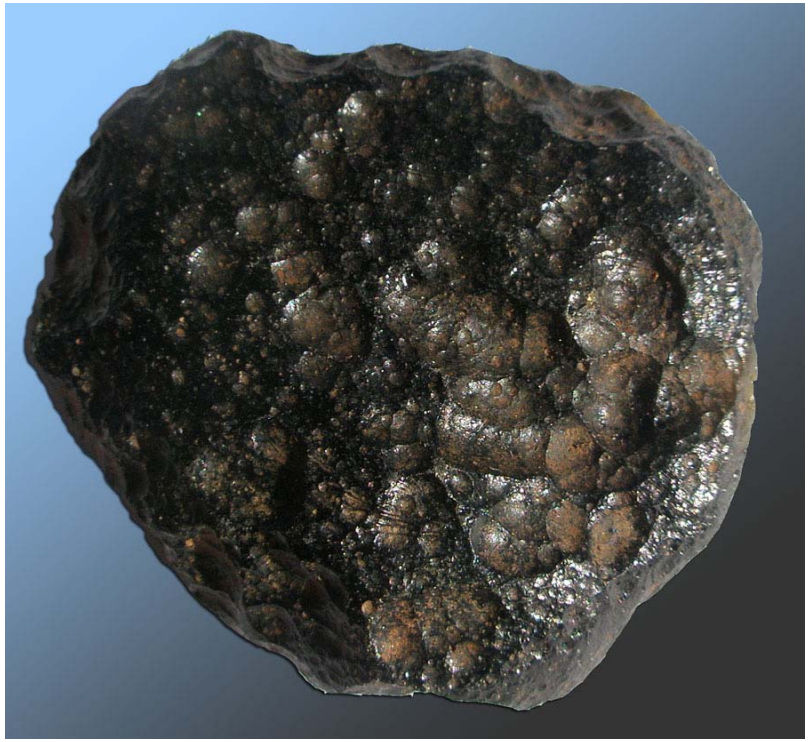


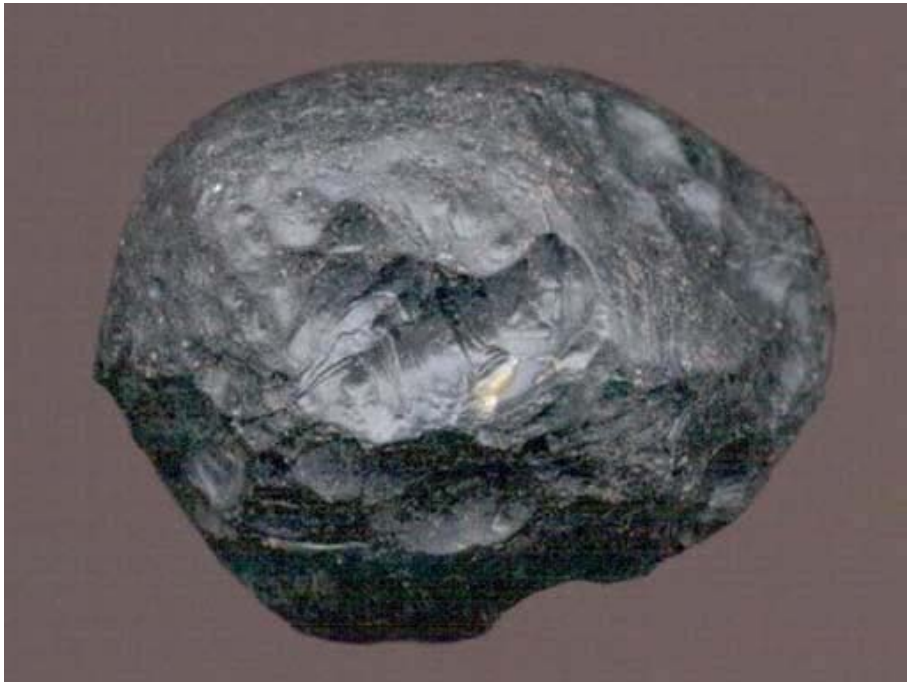
Origin of hydrogenous sediments

- Seawater contains many dissolved materials.
- Chemical reactions within seawater cause certain minerals to come our of solution or precipitate (change from the dissolved to the solid state).
- Precipitation occurs when:
  - Change in temperature.
  - Change in pressure.
  - Addition of chemically active fluids.

4) Cosmogenous Sediments

Cosmogenous sediment is derived from extraterrestrial sources.

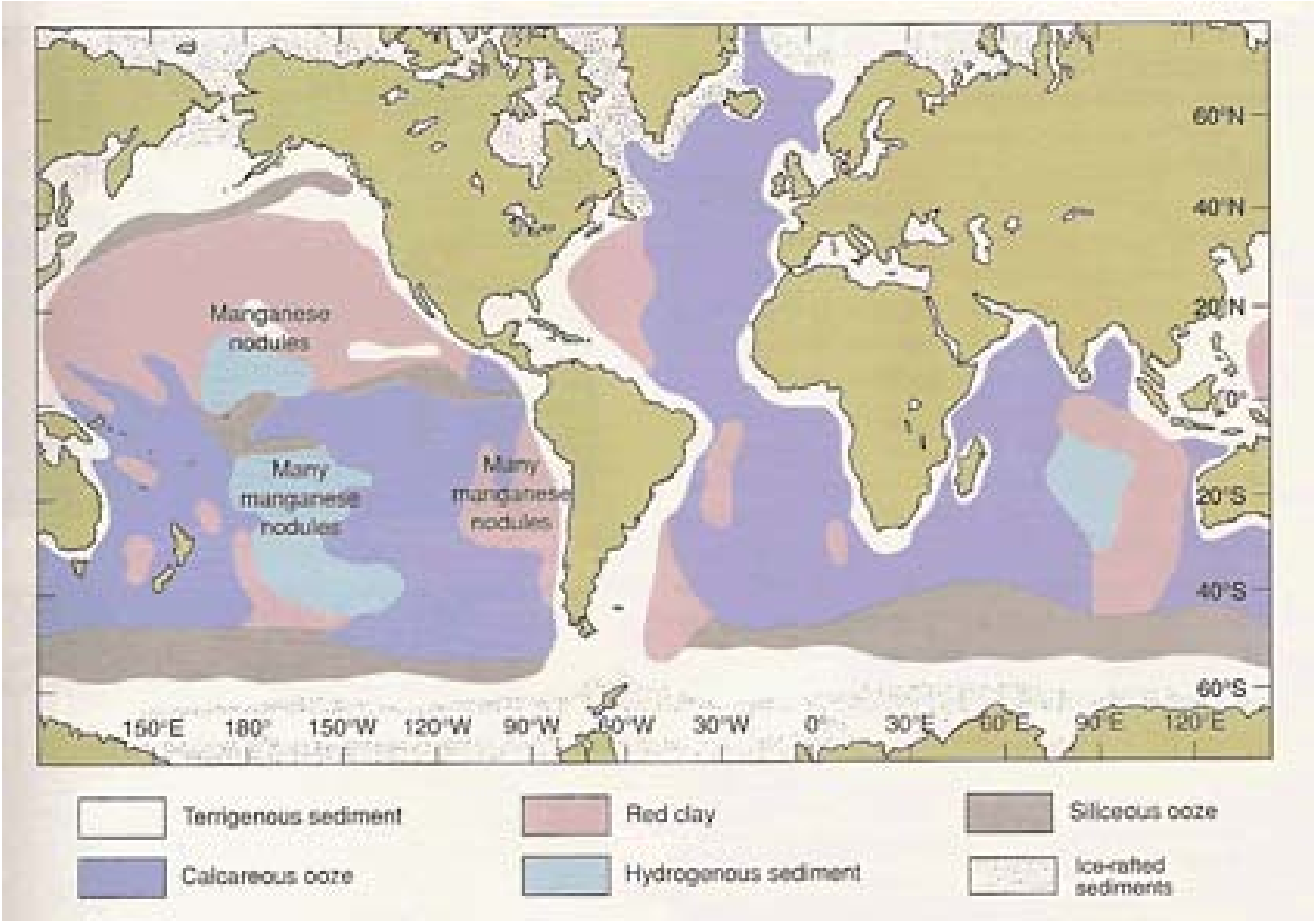




Origin of cosmogenous sediments

Cosmogenous sediments consist of two main types:

1. Microscopic spherules: small globular masses and composed of silicate rock materials.
2. Macroscopic meteor debris: rare on earth but can be found associated with meteor impact sites.



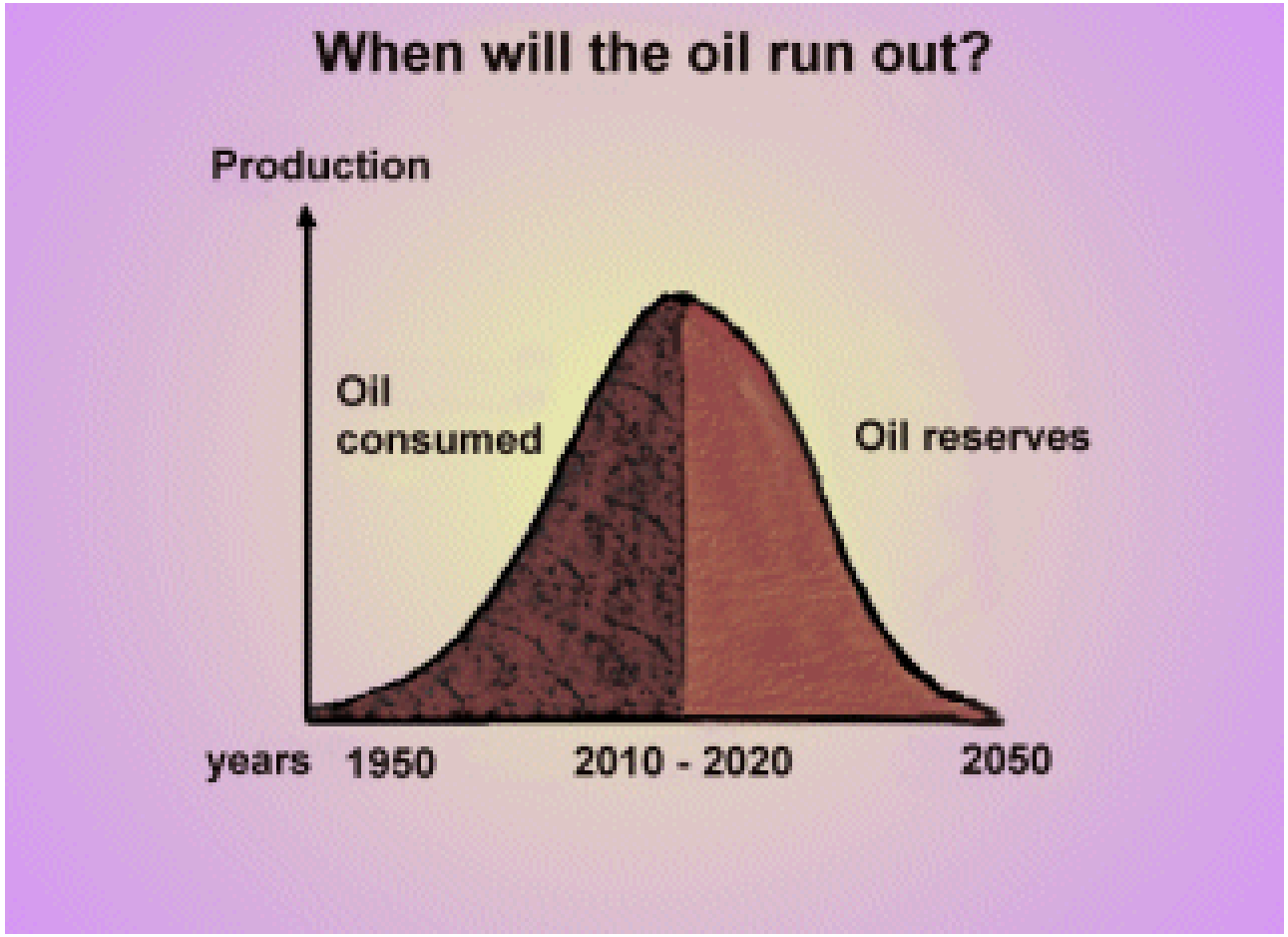
GEO 435 – Marine Sediments

Q. What are the most valuable nonliving resources from the ocean today?

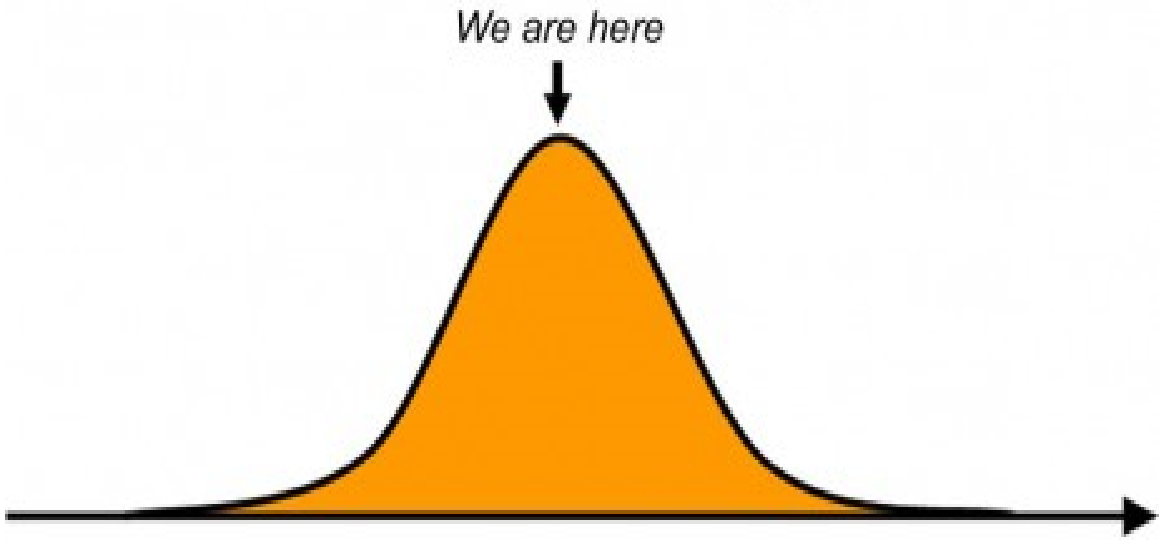
The main energy resources associated with marine sediments are petroleum and gas hydrates. Others are: sand, gravel, evaporative salts, phosphate

Q. When will we run out of oil?

Not any time soon. When the world runs completely out of oil is not as relevant as when production begins to taper off.



Wake up!!!



Peak Oil