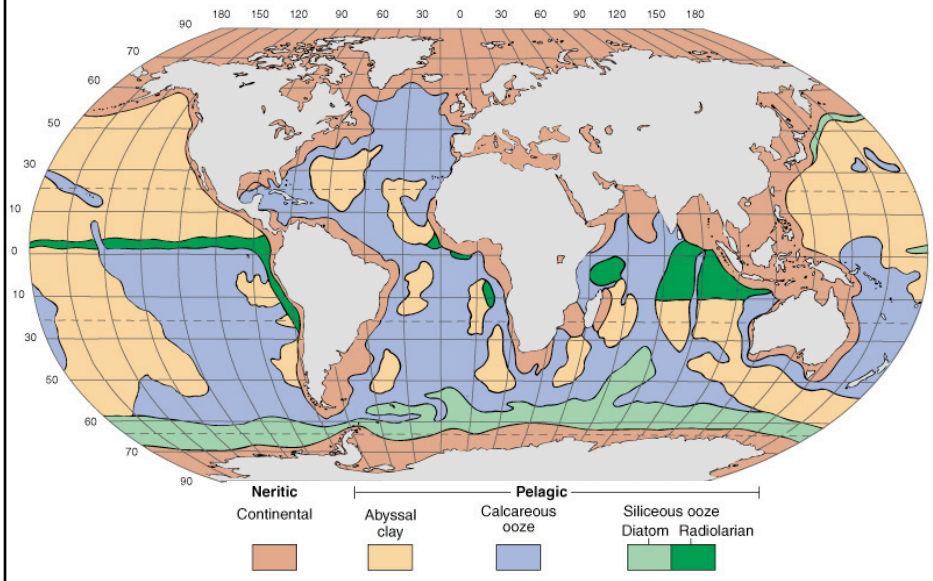
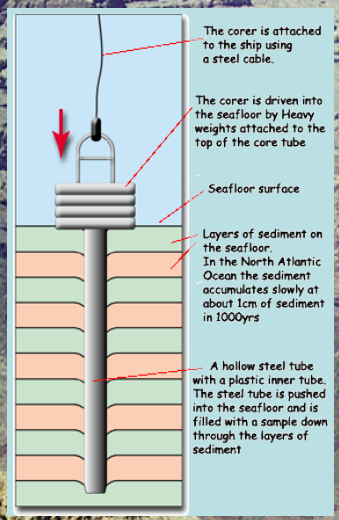
Marine Sediments

EPSS15 Fall 2017 Lab 4



Why Sediments?

- Record of Earth's history
  - Tectonic plate movement
  - Past changes in climate
  - Ancient ocean circulation currents
  - Cataclysmic events

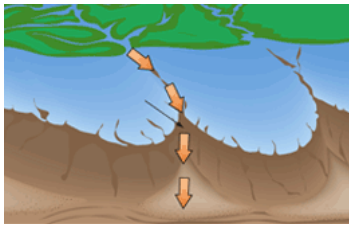


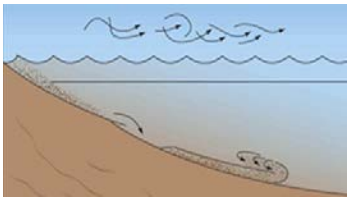
Classification

- Genetic
  - Sediments distinguished according to processes by which they originate:
    - Physical → Terrigenous, Cosmogenous
    - Chemical → Hydrogenous
    - Biological → Biogenous
- Descriptive
  - Sediments distinguished according to differences in physical properties and chemical make-up
    - physical properties → Texture, size
    - chemical make-up → Composition

Terrigenous

- Sediments derived from erosion of continental or island rocks
- Transport mechanisms include rivers, wind, turbidity currents, glaciers
- Terrigenous sediments:
  - Continental margin sediments
    Transported mainly by rivers, wave erosion, turbidity currents
  - Abyssal clays
    Windblown dust prevalent in abyssal plains due to lack of other sediments

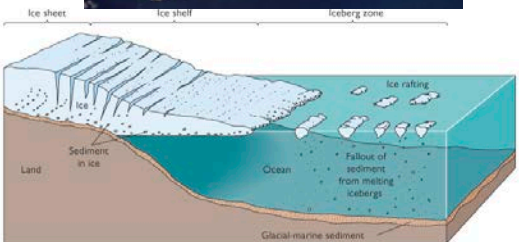




Terrigenous (cont'd)

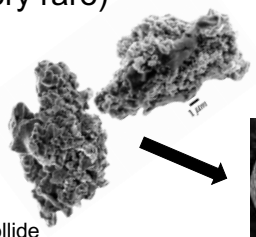
- Sediments derived from erosion of continental or island rocks
- Transport mechanisms include rivers, wind, turbidity currents, glaciers

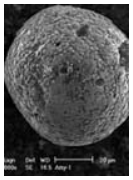
- Terrigenous sediments:
  - Volcanogenic sediments
    Windblown ash from volcanoes, wave-eroded volcanic rocks
  - Glacial marine sediments
    Ice rafted debris



Cosmogenous

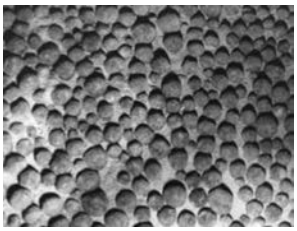
- Inorganic sediments that originate from accumulation of materials from outer space (very rare)
  - Cosmic spherules
    - Small, globular masses
    - Interplanetary dust
    - Removed from deep sea sediment by strong magnets
  - Impact deposits
    - Form when large asteroids or comets collide with Earth
    - These impacts blast meteorite material great distances





Hydrogenous

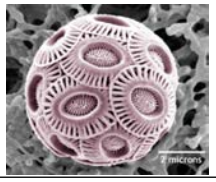
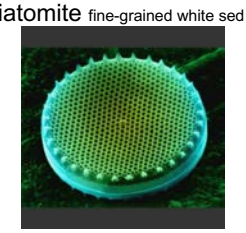
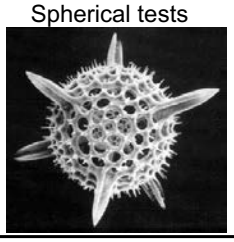
- Minerals that precipitate from seawater by chemical reactions
- Only a small portion of marine sediments
- Hydrothermal sediments are produced by leaching at MOR
- Manganese nodules are found in abyssal seafloor composed of mainly MnO_2 and Fe_2O_3
- Continental analog; evaporites in dried lakes



Biogenous

- Mostly skeletal material produced by marine organisms such as plankton
- When organisms die, their remains sink to the ocean floor and eventually lithify (become rock)
- Oozes are sediments made up of >30% biogenous material.
  - Calcareous oozes: contain skeletal materials of $CaCO_3$
  - Siliceous oozes: contain skeletal materials of SiO_2*nH_2O
  - Phosphates: skeletal material of bones and teeth of vertebrates

Biogenous (cont'd)

	Phytoplankton (algae)	Zooplankton (animal)
Calcareous ooze **$CaCO_3$** Calcite- most common biogenic form of $CaCO_3$ Aragonite- least common biogenic form of $CaCO_3$	Coccolithophores Chalk- fine-grained white sed rock 	Foraminifera Chambered tests 
Siliceous ooze **$SiO_{2*}nH_20$** Opal- the biogenic form of silica	Diatoms Diatomite fine-grained white sed rock 	Radiolarians Spherical tests 

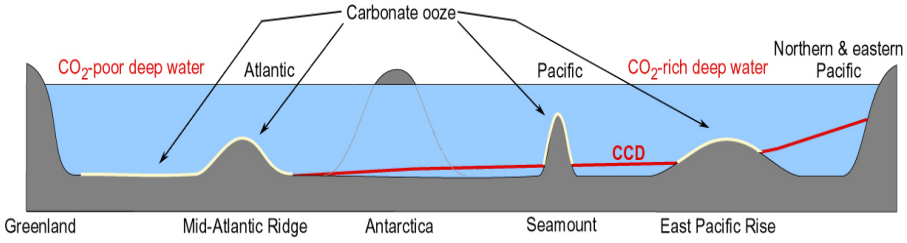
Carbonate Compensation Depth (CCD)

- Solubility of $CaCO_3$ varies in seawater
- The CCD is the depth at which rate of dissolution of $CaCO_3$ is equal to its rate of accumulation
- Depth of CCD is controlled by temperature, pressure, local chemistry, and biological productivity.

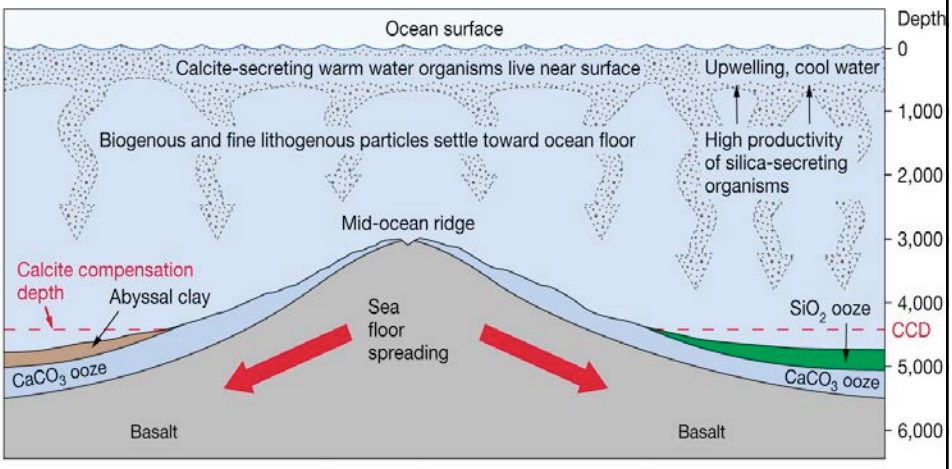
$CO_2 + H_2O \rightarrow H_2CO_3$ $H_2CO_3 + CaCO_3 \rightarrow Ca^{2+} + 2HCO_3^-$

* Concentration of CO_2 is higher in colder, deeper waters

* More CO_2, more carbonic acid, more $CaCO_3$ dissolution

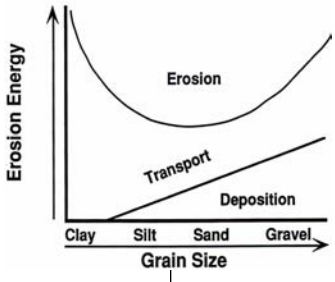


Carbonate Compensation Depth (CCD)



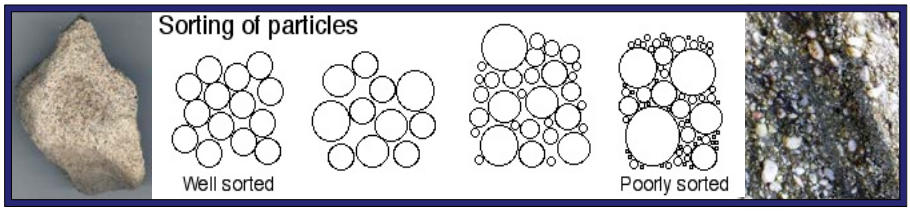
Descriptive Classification

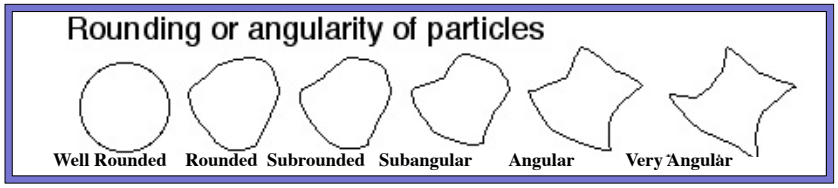
Diameter (mm)	Name	Grain size	Transport Energy
>256	Boulder	Coarse grained	High Energy
256-64	Cobble		
64-4	Pebble		
4-2	Granule		
2-0.062	Sand		
0.062-0.004	Silt		
< 0.004	Clay	Fine Grained	Low Energy

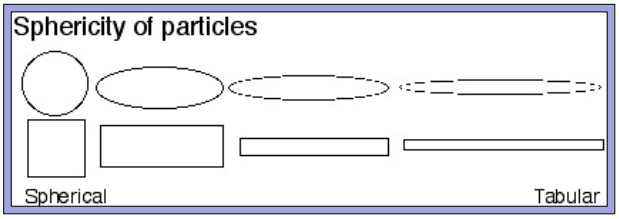


Gravel Sand Mud

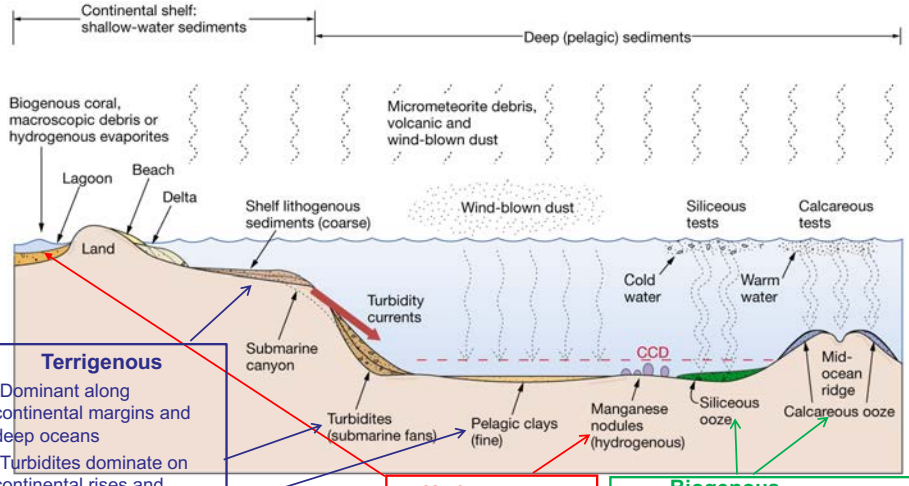
Descriptive Classification cont'd







Distribution of Marine Sediments

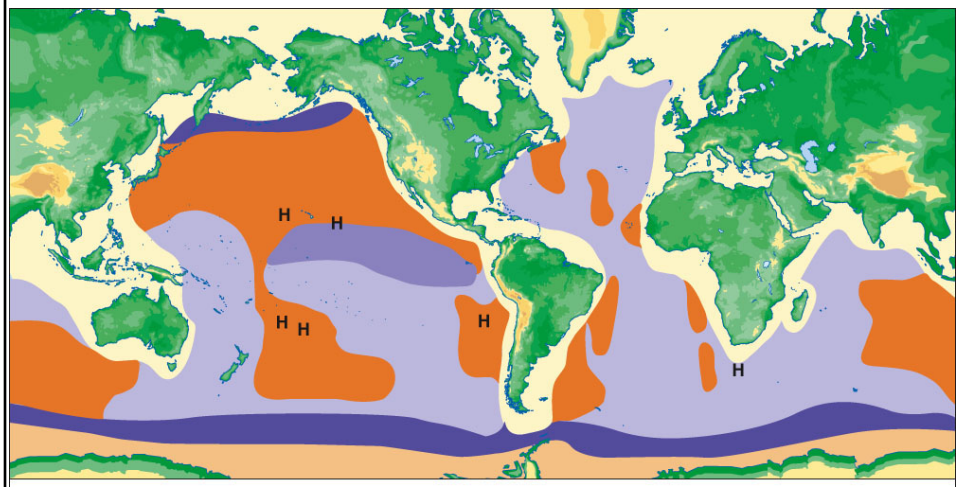


Terrigenous
- Dominant along continental margins and deep oceans
- Turbidites dominate on continental rises and abyssal plains
- Glacial sediments dominate at high latitudes
- Range from coarse to fine

Hydrogenous
- exist in diverse environments such as MOR and ocean basins

Biogenous
- Calcareous ooze- warm shallow regions above CCD
- Siliceous ooze- colder regions of high surface activity; below CCD

Distribution of marine sediments



Terrigenous deposits:
- Continental margin sediments
- Glacial-marine sediments
- Pelagic clays

Biogenous deposits:
- Calcareous oozes
- Siliceous radiolarian oozes
- Siliceous diatom oozes

H Hydrogenous deposits also present (manganese nodules)