

2/13/08

Class #12 OCEAN SEDIMENTS (cont'd)

Cosmogenous

Biogenous

Hydrogenous

SUMMARY

SEDIMENT TYPES (BY SOURCE):

Lithogenous ("rock-derived")

Biogenous ("life-derived")

Hydrogenous ("water-derived")

Cosmogenous ("cosmic-derived")

COSMOGENOUS SEDIMENTS

Micro-meteorites: silicates, metals, mixtures

Widespread, but found in very small quantities (noticeable in red clay)

BIOGENOUS SEDIMENTS -- produced directly by living organisms

1) Reefs in warm, shallow areas: large fragments formed and deposited

- clams, corals

- Very thick accumulations in some places

2) Everywhere: Microscopic particles produced by tiny living organisms

- Shells or skeletons of microplankton

- Biogenous "oozes" (>30% biogenous material) ...very fine particles, gooey mud

Calcareous ooze

CaCO_3 = calcium carbonate

Siliceous ooze

SiO_2 = silica (+ water, H_2O)

Types of sediment-producing microplankton:

Mineral made	Algae	Protozoans
CaCO_3	Coccolithophore	Foraminifera
$\text{SiO}_2 \cdot n\text{H}_2\text{O}$	Diatoms	Radiolarians

Where do biogenous oozes dominate the sediment collecting on the ocean floor?

1. The shells/skeletons are **produced in surface waters** (top 100 m):

Controlled by nutrient availability -- High N, P, and Fe causes high productivity

Siliceous oozes common below very nutrient-rich upwelling zones

2. Destruction of CaCO_3 particles in some places where the ocean floor is very deep, because the sinking particles dissolve below a certain depth known as the "Carbonate Compensation Depth" (CCD)

Atlantic: ~ 4,000 m

Pacific: ~ 500 - 1,500 m

Note: $\text{SiO}_2 \cdot n\text{H}_2\text{O}$ particles dissolve too, but more slowly; depth is not an issue

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Siliceous ooze possible in deepest areas
But...Must accumulate quickly (otherwise it dissolves away)- high productivity areas

3. Biogenous oozes overwhelmed by terrigenous sediment in cont. margins

HYDROGENOUS SEDIMENTS created by:

- Direct precipitation of solids from sea water OR
- Precipitation of solids because of sediment - sea water reactions

1. Evaporites

Dissolved ions in sea water

Evaporation in isolated basins

E.g., Mediterranean 6 M.Y. ago

Precipitation of "salts"

NaCl (halite)

CaSO₄• 2H₂O (gypsum)

Others

2. Sediment - sea water reactions

a) Manganese nodules and crusts

Mn + Fe oxides (+ Cu, Co, Ni)

In deep ocean and along mid-ocean ridges.

Origin: -- chemical reaction between oxygen in water and dissolved Mn +Fe

Mn + Fe come mostly from sediments and hydrothermal vents

b) Phosphate minerals

P released when organic matter degrades- Minerals precipitated

On Cont. shelves

c) Carbonate minerals

CaCO₃ precipitated directly- abiotic

Form round pellets- Oolites

d) Metal sulfides from black smoker vents

SUMMARY -- Distribution of sediment on the sea floor (modern sediments)

Terrigenous: continental margins and adjacent abyssal plains.

Calcareous oozes: wide-spread in areas of the deep sea where depth is less than the CCD

Siliceous oozes: polar and equatorial bands where nutrients are supplied to surface waters by vertical upwelling.

Manganese nodules: deep basins, especially the Pacific.

Red Clay: deep ocean regions where biogenic particles do not collect