

Ocean 201 week 5 Lecture 3: Shelf Sediments (M.J. Mottl)

Text from slides

Classification by **Size**

Boulder, cobble, pebble, granule, sand, silt clay

Classification by **Mode of Formation**

- **Detrital** sediments
 - Transported and deposited as particles
 - Derived from weathering of pre-existing rocks (igneous, metamorphic or sedimentary)
- **Chemical** sediments
 - Precipitated from solution

Terrigenous Sediment Cycle

- Land (terra) born (-genous)
- Land source **identifiable**
- Participates in sediment cycle...
 - Erosion
 - Transport
 - Deposition
 - Recycling in deep earth

Sedimentary Rocks

Sediments lithified by cementation and/or recrystallization

Detrital or Chemical

Detrital Sedimentary Rocks

- Classified by size:
 - Conglomerate: boulders, cobbles and pebbles (>2mm rocks)
 - Sandstone: sand (1/16- 2 mm)
 - Siltstone: silt (1/256-1/16 mm)
 - Shale: clay (<1/256 mm), often organic-rich

Chemical Sedimentary Rocks

- Limestone: calcite = CaCO_3
- Dolomite: $\text{CaMg}(\text{CO}_3)_2$
- Evaporites: evaporation of seawater:
 CaCO_3 , $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, NaCl, KCl, borates

Erosion, Transport, and Deposition of Sediment: Hjulstrom's Curve

- Faster currents are necessary to transport larger particles.
- Mid-sized particles (sand) are eroded more readily than either finer or coarser particles (cohesion vs gravity).

Passive Margins (Eastern USA)

- continental crust
- Triassic rift valley sediments in faulted blocks
- Overlain by Jurassic marine sediments/salt.
- Overlain by thick (shelf, slope, rise) sediments (Cretaceous and Cenozoic) that buried ancient reef.
- Whole coastal plain still subsiding and accumulating.

Origin of salt beds by evaporation when the ocean basin was young

Deposition of Sediment Types in Shallow Seas during High Sea Level Stands

- Gulf of Mexico (now relatively deep)
- Sediment from Rockies carried by Mississippi.
- Ovelies salt (~180 Ma).
- Weight of sediment causes domes of salt to rise, spread out and dissolve.
- Collapsed salt domes create “pockmarks”.

Sea Level Changes: I

- Deduced from sediment packets on continental margin using seismic methods.
- Use of one or two ships
- Earlier used dynamite, now use airguns.
- **reflection** (layering) vs **refraction** (speed of sound in layers)

Sea Level Changes: II

- **Transgression**: Progressive flooding of land, high sea level stand
- **Regression**: Progressive draining of land, low sea level stand

Sequence Stratigraphy

- Assign time of deposition to sediment layers.
- Objective is to establish time scales for ocean sediments
- Sediment layers can be “correlated” through “litho-” “bio-” “chrono-” or “magneto-” stratigraphy

Sea Level Change

- **Local causes**
 - Water in motion
 - Storm surges, wind driven, currents along shoreline
 - Tectonic uplift or subsidence
- **Global causes**
 - Change in ice volume
 - Change in mean seafloor spreading rate (fast = younger seafloor, sea level rises, slow = older seafloor, sea level falls
 - Change in mean ocean T (water expands on warming)

Sea Level Summary

- Sea level is rising!

- Sea level fell from ~30Ka to ~20 Ka due to ice buildup.
- Sea level has been (generally) rising for the past 20 Ka. (evidence from drowned reefs).
- Global sea level has risen about 20 cm over past century, largely due to melting of glacial ice.
- There is a local effect of Hawaiian geology on sea level rise.

Sea Level in Hawaii

- Two causes:
 - Local: Hawaiian Arch
 - Eustatic: overall sea level rise

Effect of Sea Level on Coasts: I

Effects of Sea Level on Low Areas

- Rise of only a few 10's of cm can be critical.
- Pacific Atolls (Marshall, Micronesia, Tuamotu, etc.)
- Indian Ocean (Maldives... shown here!)
- Also important for low continental areas (Florida, New Orleans, London, Venice)

Effect of Sea Level on Coasts: II

Low sea level at ~20 ka increased dry land (from reef banks and continental shelf) as much as 200 km seaward.

Future sea level will rise up to 70 m if polar ice caps melt, flooding the reef platform and continental shelf of the SE USA . . .