A Historic Look at Sediment Delivery and Coastal Systems

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STAC - Designing Sustainable Coastal Habitats
April 16, 2013
Chesapeake Bay

- 200 miles long (320 km)
- 6 to 35 miles wide (10-56 km)
- Average depth of ~ 7 meters
- 20% less than 2 meters depth
- Huge watershed area relative to volume
- Microtidal – max range just over ½ meter
- 50% freshwater from Susquehanna River
- 90% freshwater from 5 major rivers
Pleistocene
Sea levels
(Oxygen Isotope)
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Relative Sea Level Curve for the Chesapeake Bay Area

From 10,000 to 7,000 years ago Rise from -60 m to -20 meters = 13 mm/yr
From 6,000 to present. Rise from -10 meters = 1.67 mm/yr
Baltimore Tide Gauge Record

Last 100 years sea level rise of 30 cm = 3 mm/year
Dominant Sediment Sources

Watershed – Fluvial
Shore Erosion
Oceanic Input
Internal Production

Complicating Factor
Internal Redistribution - Resuspension
Sources and pathways of sediments in the Bay

- Fluvial – watershed
- Shore erosion
- Oceanic input
- Internal production
- Resuspension
ETM Salinity and Suspended Sediments
Winter/Spring 1996
Tropical Storm Lee: Fall 2011

Map showing flood deposit thickness in centimeters for the area around Patapsco River, Poole's Island, Chester River, Choptank River, and Susquehanna River.
Estimated Susquehanna River Load to Reservoirs 1900-1999

Sediment Load (millions of tons)

Year

Sources and pathways of sediments in the Bay

- Fluvial – watershed
  - $4.27 \times 10^6$ metric tons/yr
- Shore erosion
- Oceanic input
- Internal production
- Resuspension
Sources and pathways of sediments in the Bay

- Fluvial – watershed
- Shore erosion
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What is Shore Erosion?

- Pleistocene Estuarine Sediments: ~ 35% Sand, 65% Silt & Clay
- Lag Deposit: 100% Sand
“Shore” Erosion – Fastland & Nearshore

Bank Sediments: ~44% Sand, 56% Silt & Clay

Lag Deposit: 100% Sand

Fastland Erosion (65%)

Nearshore Erosion (35%)

Mean Sea Level
Sources and pathways of sediments in the Bay

- Fluvial – watershed
- Shore erosion
  - $8.42 \times 10^6$ metric tons/yr
- Oceanic input
- Internal production
- Resuspension
Estimated sediment loads to Chesapeake Bay

Sediment source loads:
Shoreline fastland erosion only (Metric tons/year)

- Riverine at Fall Line (4.27E+06)
- Fastland Shoreline Erosion (3.60E+06)
- Below Fall Line (9.00E+05)
- Oceanic Input (1.14E+06)

Sediment source loads:
Shoreline fastland & nearshore erosion (Metric tons/year)

- Riverine at Fall Line (4.27E+06)
- Fastland & Nearshore Shoreline Erosion (8.42E+06)
- Below Fall Line (9.00E+05)
- Oceanic Input (1.14E+06)
**LEGEND**

**SEDIMENT SOURCES AND DEPOSITIONAL ENVIRONMENT**

- **River Input Sediment** (deltas) from Piedmont and Appalachians (thicknesses range from 3-10 m)
- **Coastal Erosion Sediment** from terraces, islands and steep bluffs of Coastal Plain outcrops (thicknesses range from 3 to 10 m)
- **Atlantic Sediment** from continental shelf and nearby coastal erosion (thicknesses range from 3 to 10 m, may exceed 15 m)
- **Thin Deposits** on Tertiary rock outcrops and buried Pleistocene channels; thick sediment stored in troughs along ancient thalweg (valley ways) of major rivers (as much as ~15m thick, locally may exceed 15 m)
Upper Estuary Characteristics

• Sands are deposited in “deltas” near fall line
• Turbidity maximum is effective trap for much of the finer grained sediment from the watershed
• Deposition rates in the deeper channels are much higher than on adjacent shallower platforms
• Finest particles are transported beyond the upper estuary, particularly during high flow periods
Mid and Lower Estuary Characteristics

- Fastland retreat and nearshore erosional platform development are major sediment sources.
- These sediments can be locally composed of coarser grained sands along with silts and clays.
- Finest particles transported from the upper estuary form relatively thin layers of accumulation in deeper waters.
- Bay mouth has been a significant long-term source of sediments (10,000 years).
- Deposition rates in the deeper channels are much higher than those on the shallower platforms.
- Platform deposition rates approximate the long-term rate of sea level rise (if not too fast).
From an Ecosystem Perspective
Not all Sediment Input is Detrimental

• Sand component
  – Remains near source
  – Forms Beaches
    • Limited habitat type in the Bay
    • Recreational value
    • Buffers shore against continued erosion
  – Necessary for healthy SAV
From an Ecosystem Perspective
Not all Sediment Input is Detrimental

• Silt/Clay (Mud) Component
  – Transported in suspension away from source
    • Close affinity with nutrients
    • Attenuates light, adversely affecting SAV
    • Interferes with filter feeding organisms
    • Contributes to burial of sessile benthic organisms (oysters)
      • Necessitates dredging shipping channels
  – Serves as sediment supply to tidal marshes, enhancing ability to keep pace with sea level rise