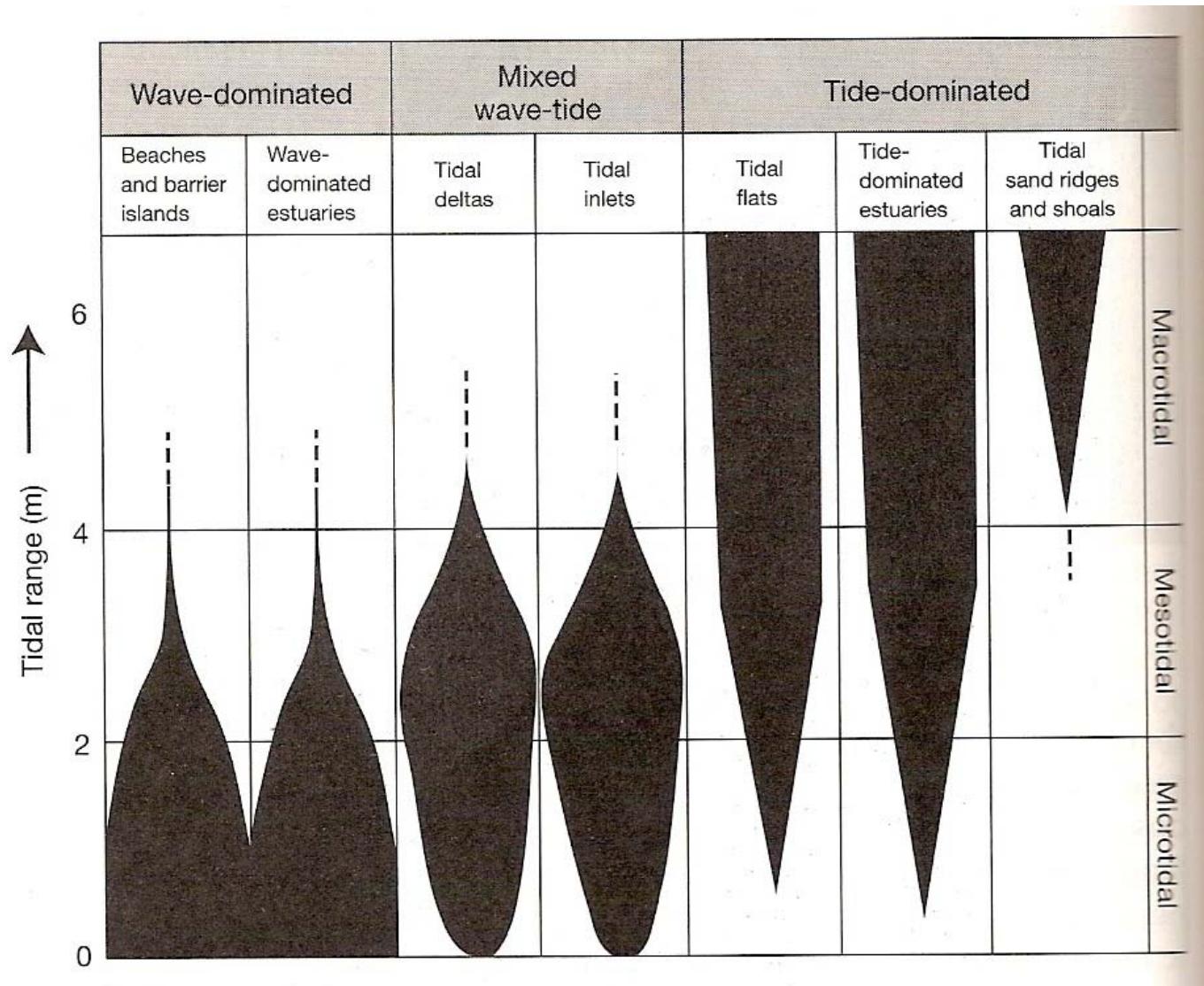


Coastal environments

Beach, barrier-island systems and
more...

Wave-dominated coasts



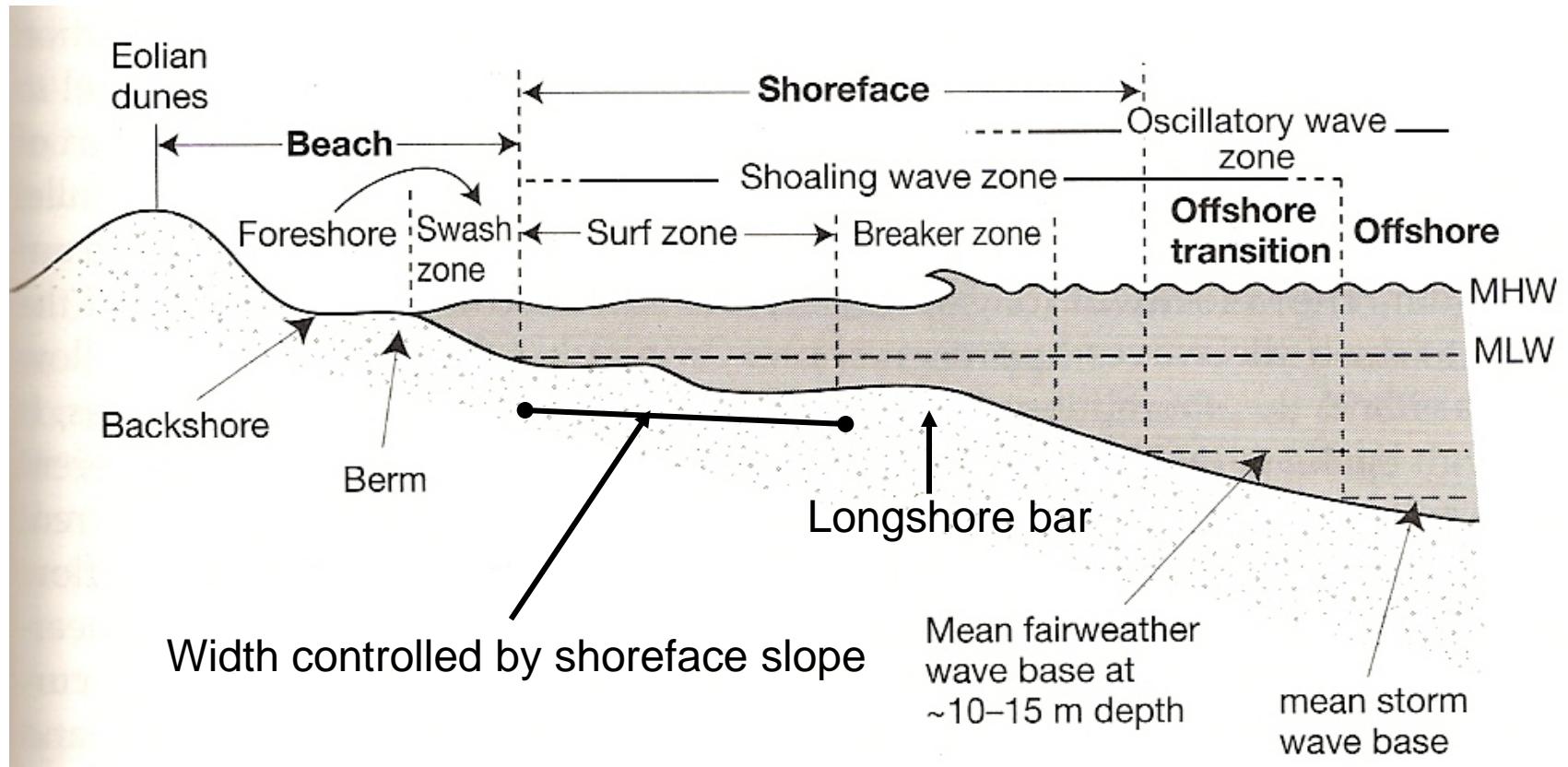
Introduction

- Beaches
 - Narrow accumulations of sand aligned parallel to the shoreline and attached to land
- Highly dynamic systems (almost constant flux)
Generated predominantly by marine processes
+ minor eolian sand transport

Why study beaches?

- Economic potential
 - Tourism and recreation
 - As a source of gold, platinum, diamonds...
 - Reservoirs for petroleum and natural gas
 - Host rocks for uranium
- Erosion buffer
- Paleoenvironmental indicator
 - e.g. sea level change

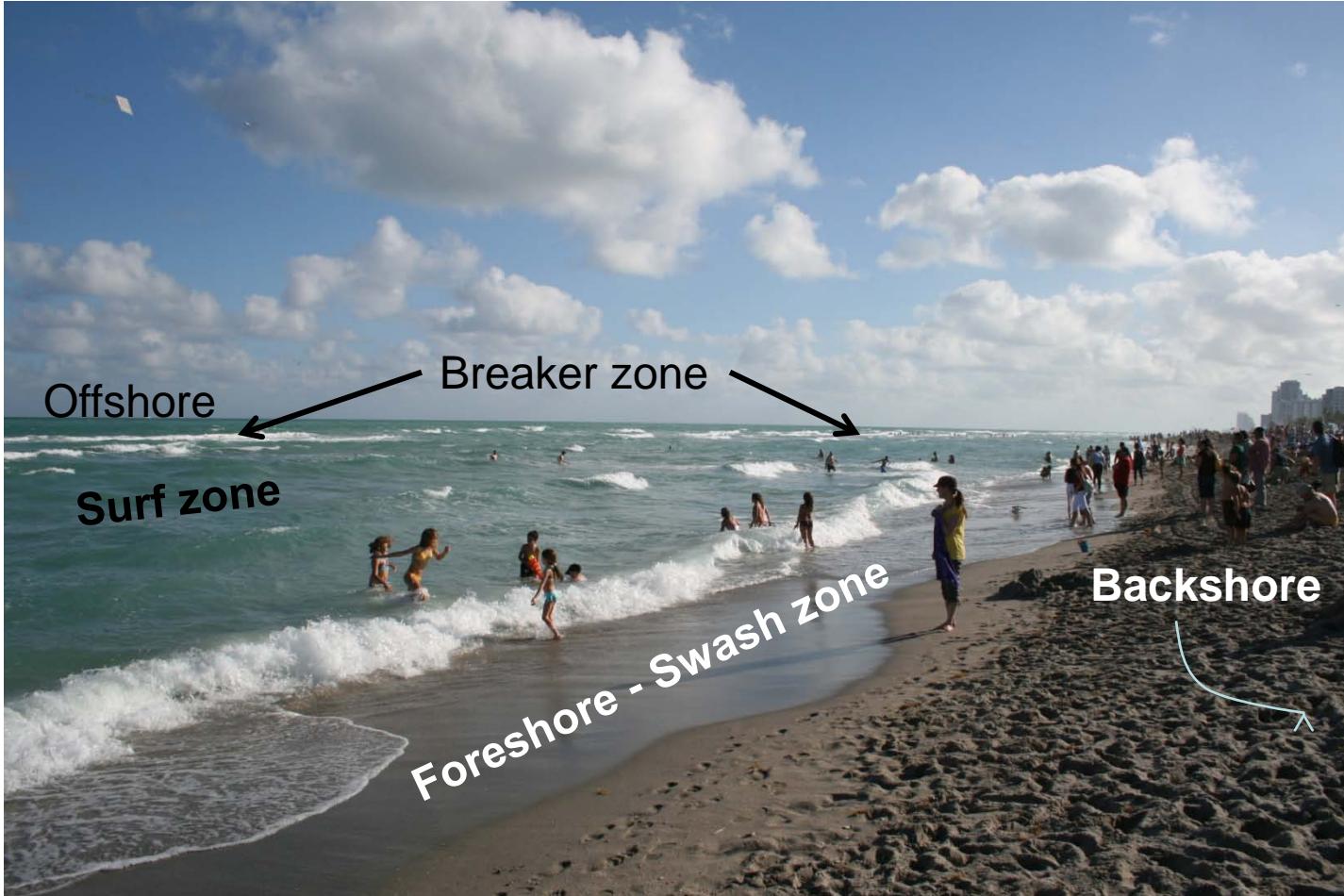
The beach environment



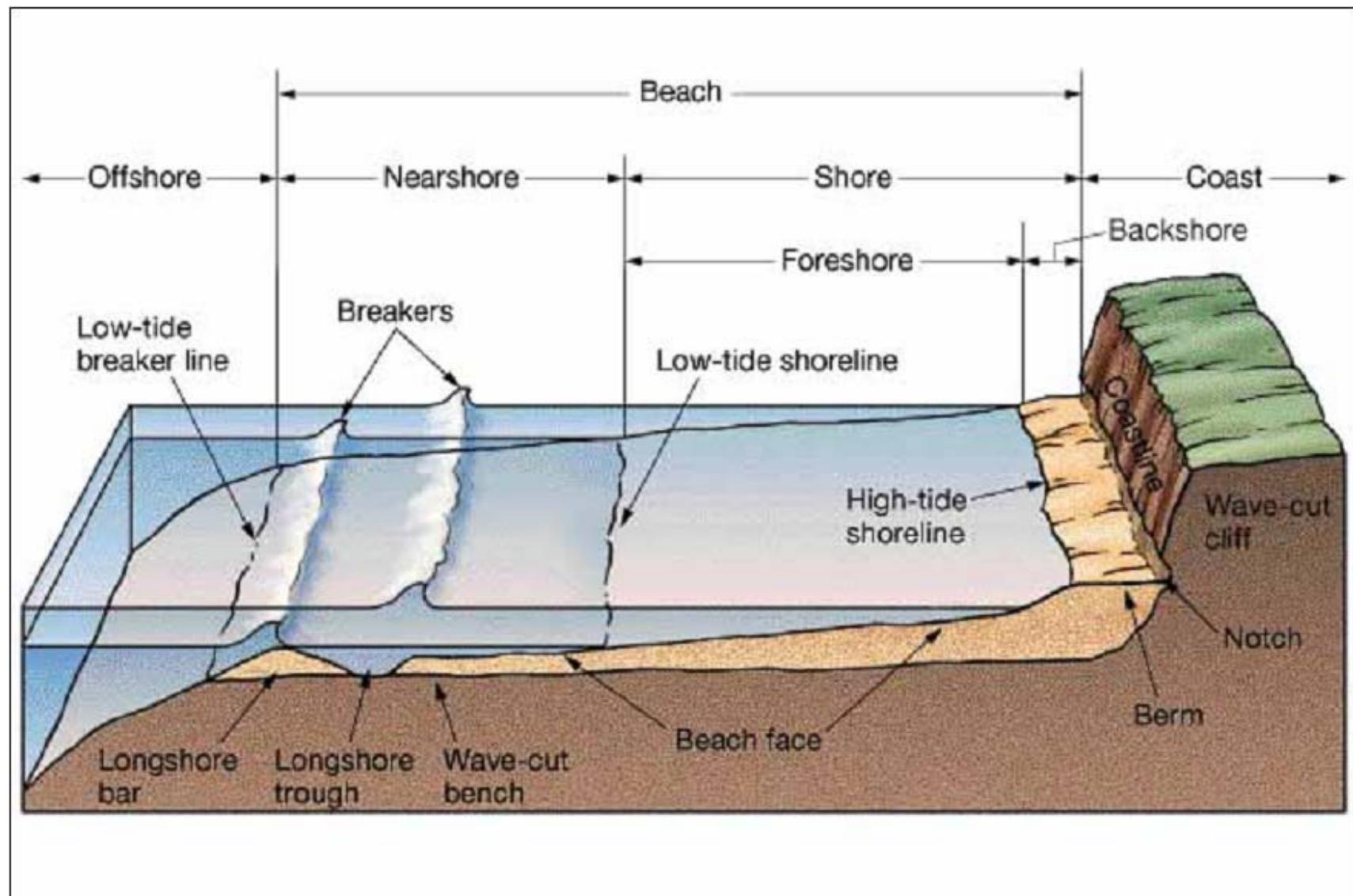
- Upwash is perpendicular to wave crest
- Backwash is perpendicular to the beach face

Seasonal cycles and storm activity

The beach environment



Beach – Rocky coast



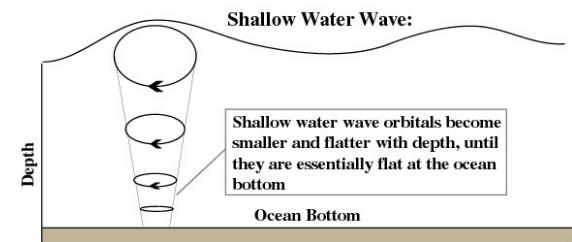
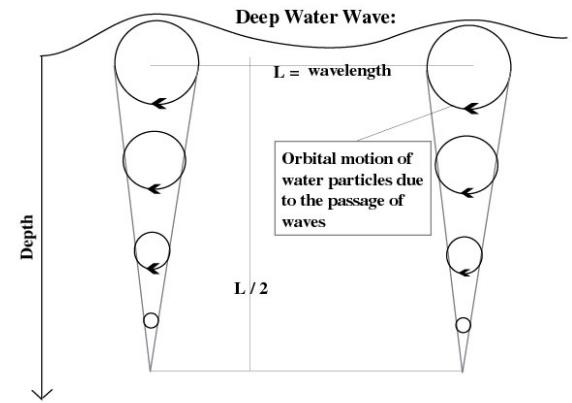
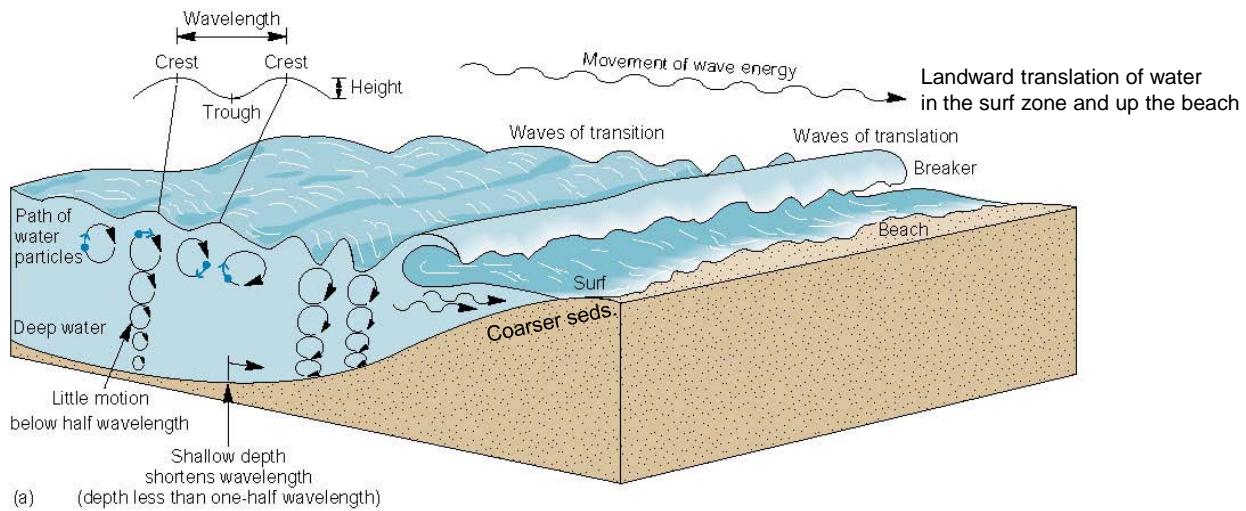
Iceland 2013



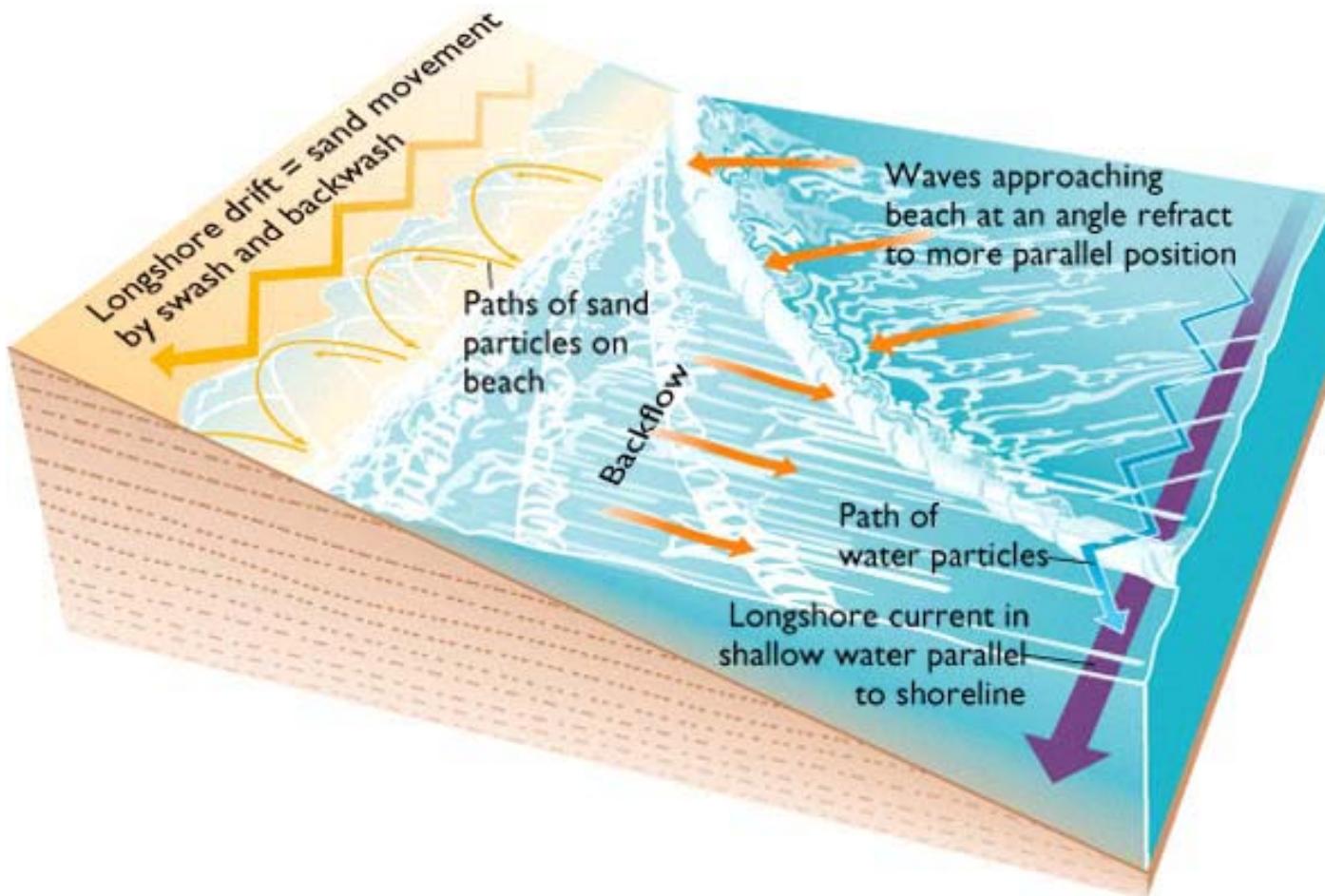
Iceland 2013



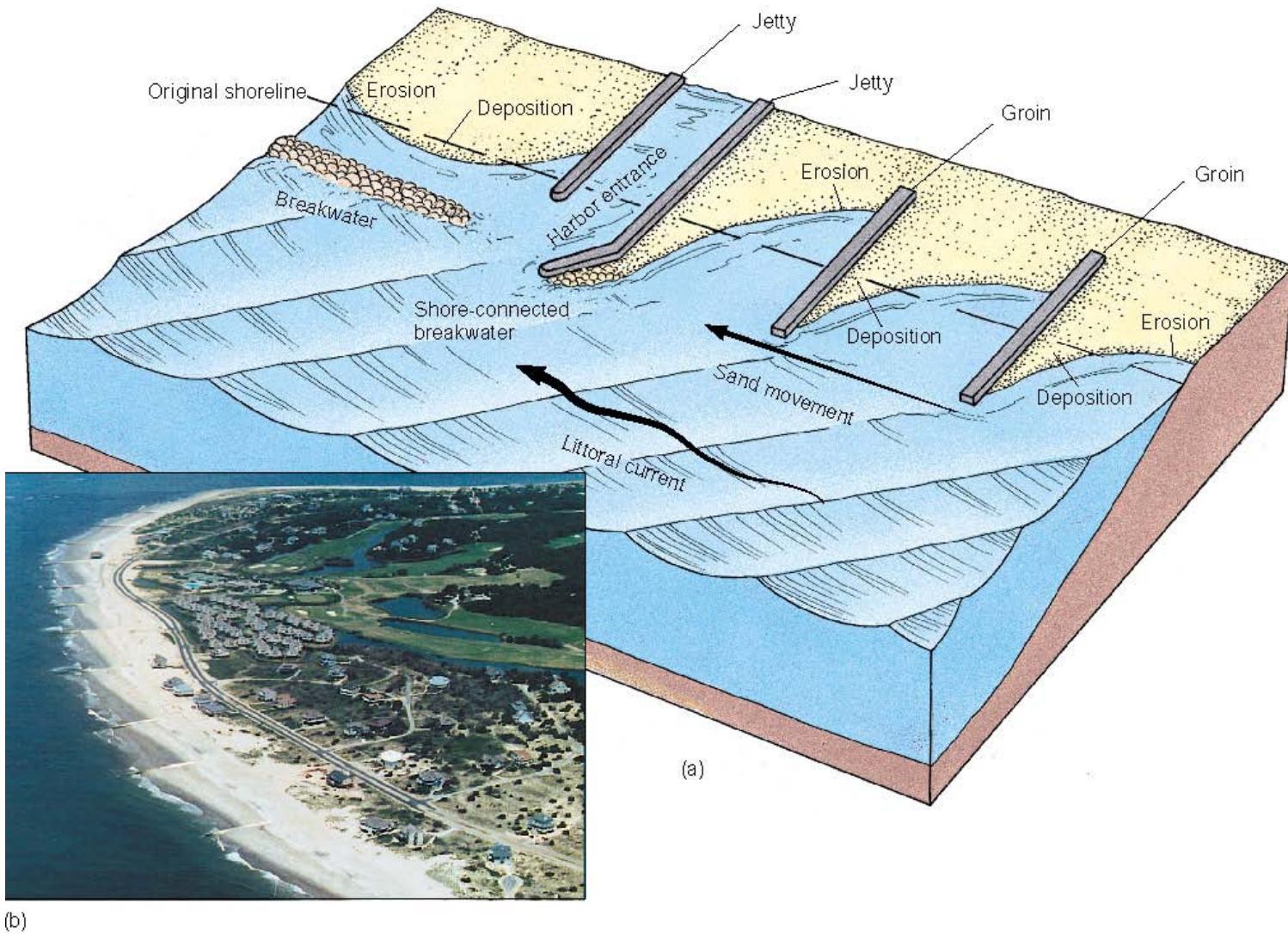
Waves...



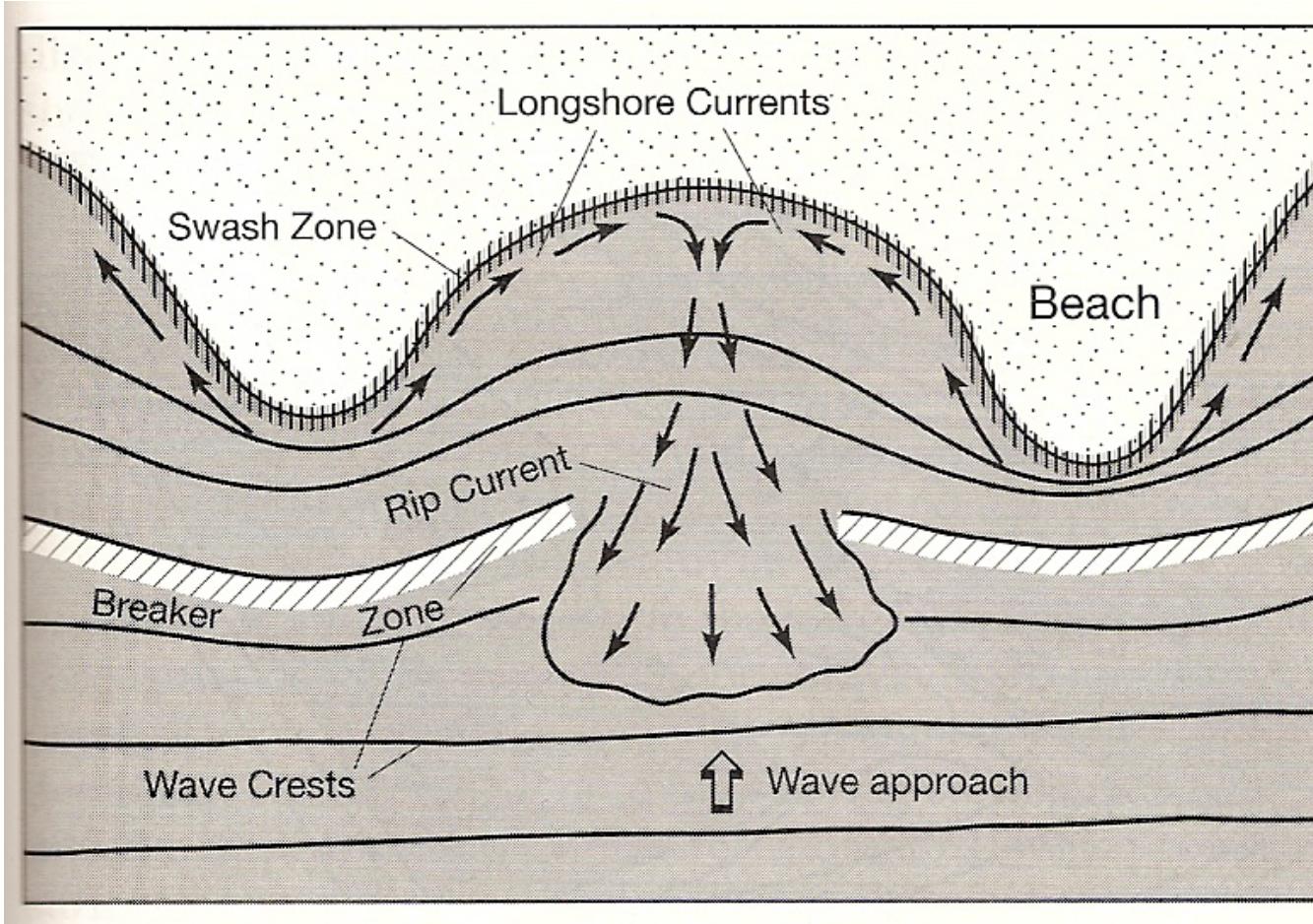
Longshore drift



Coastal infrastructures...

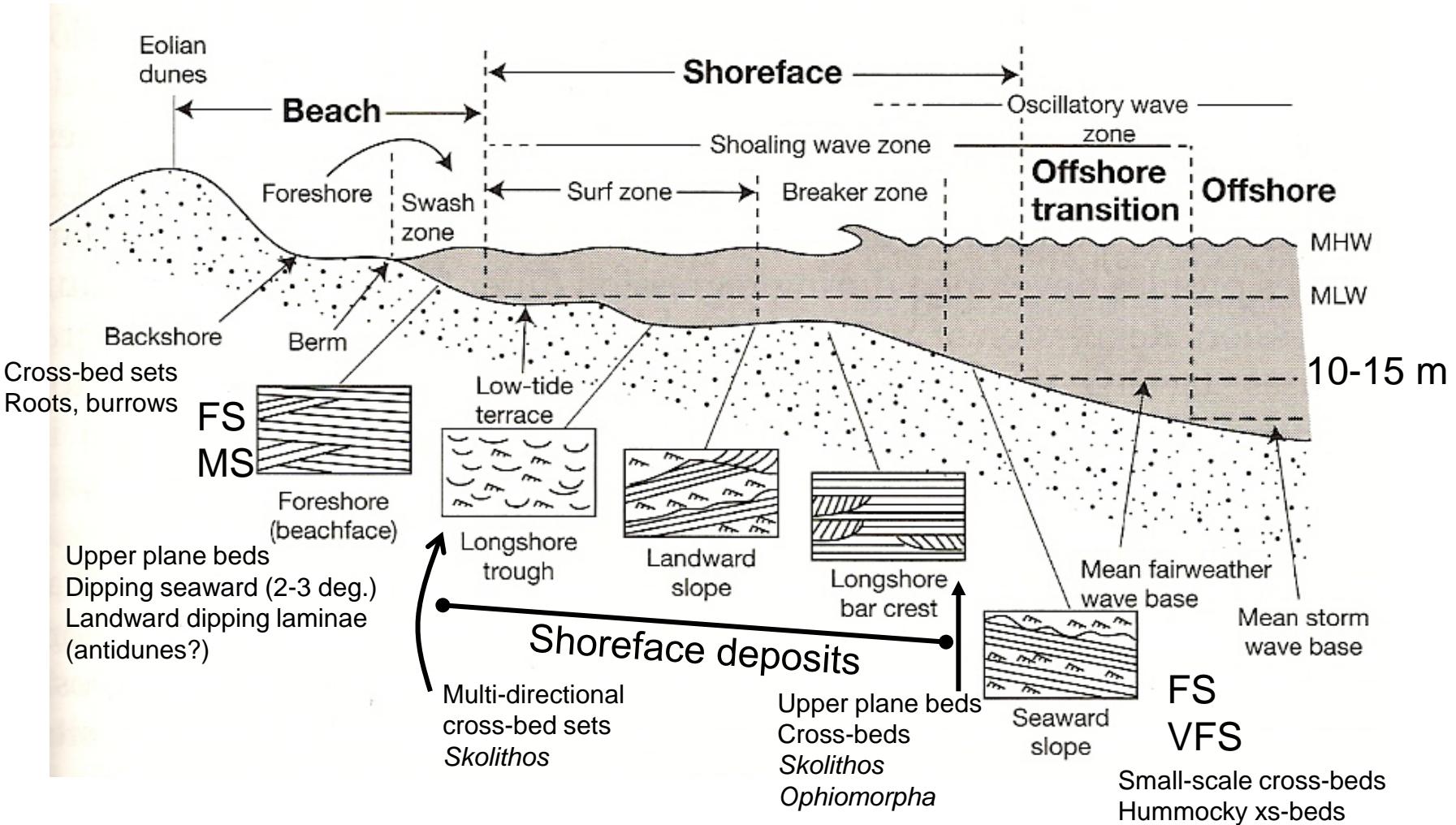


Wave-induced currents



The velocity of longshore currents is related to wave height and angle relative to the shoreline

Beach deposits



Upper plane bed stratification



Modern beach deposit. Note that the 3D nature of the cut demonstrates the horizontal and planar aspect of this structure

Coarser facies example

Beach deposit, Iceland



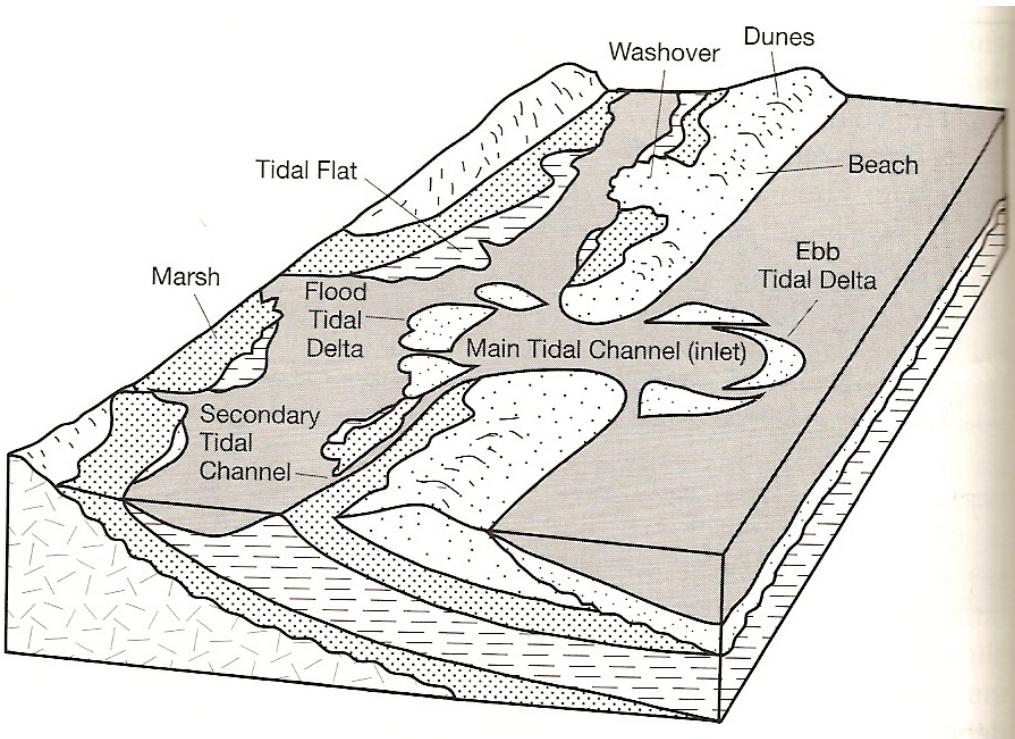
Sh: in this case, coarse black sand and horizontally/plane-bedded and low angle cross-lamination

Barrier-island systems

Barrier islands

Beaches separated from land by shallow lagoon, estuary, or marsh
Commonly dissected by tidal channels or inlets

- Upward building and eventual emergence of the longshore bar
- Spit segmentation
- Mainland ridge engulfment
- Lateral shifting of coastal sands during transgression



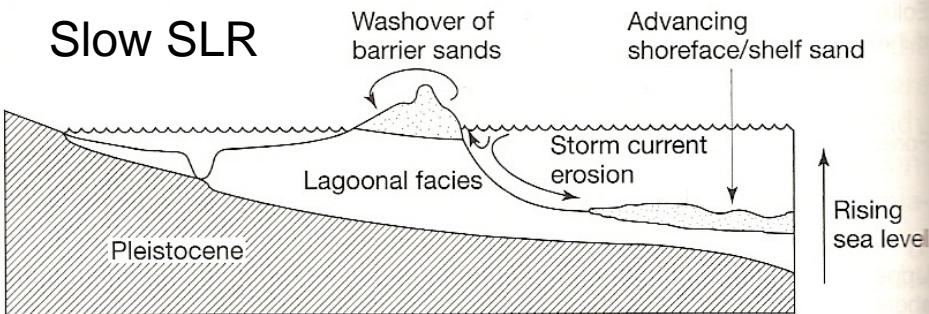
A wide-angle photograph of a coastal landscape. In the foreground, a dark, sandy beach slopes down to the right. The ocean is a vibrant turquoise color, with white-capped waves crashing onto the shore. In the middle ground, a large, rugged rock formation juts out from the water. The sky is a clear, pale blue with a few wispy clouds on the horizon.

Iceland 2013

Sea-level change

A Transgression by shoreface retreat

Slow SLR



Rapid SLR

B Transgression by in-place drowning

New barrier

Shoreface sediments

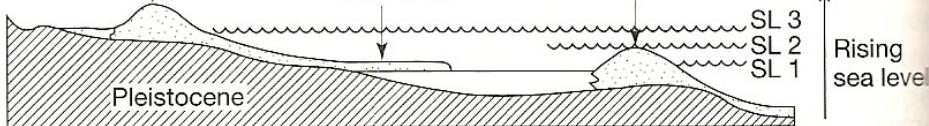
Drowned barrier

SL 3

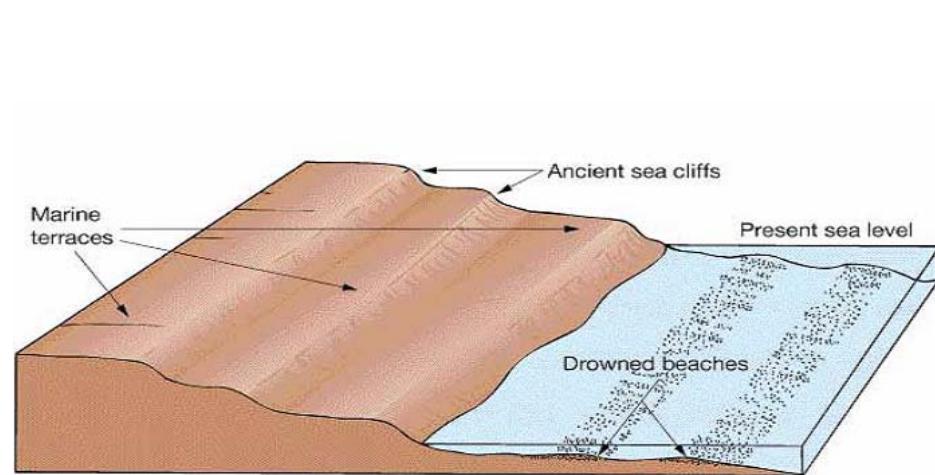
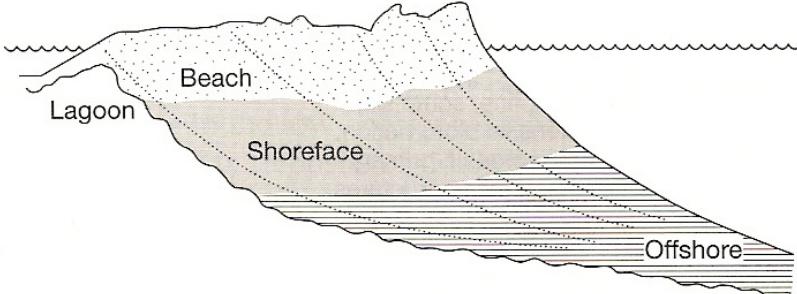
SL 2

SL 1

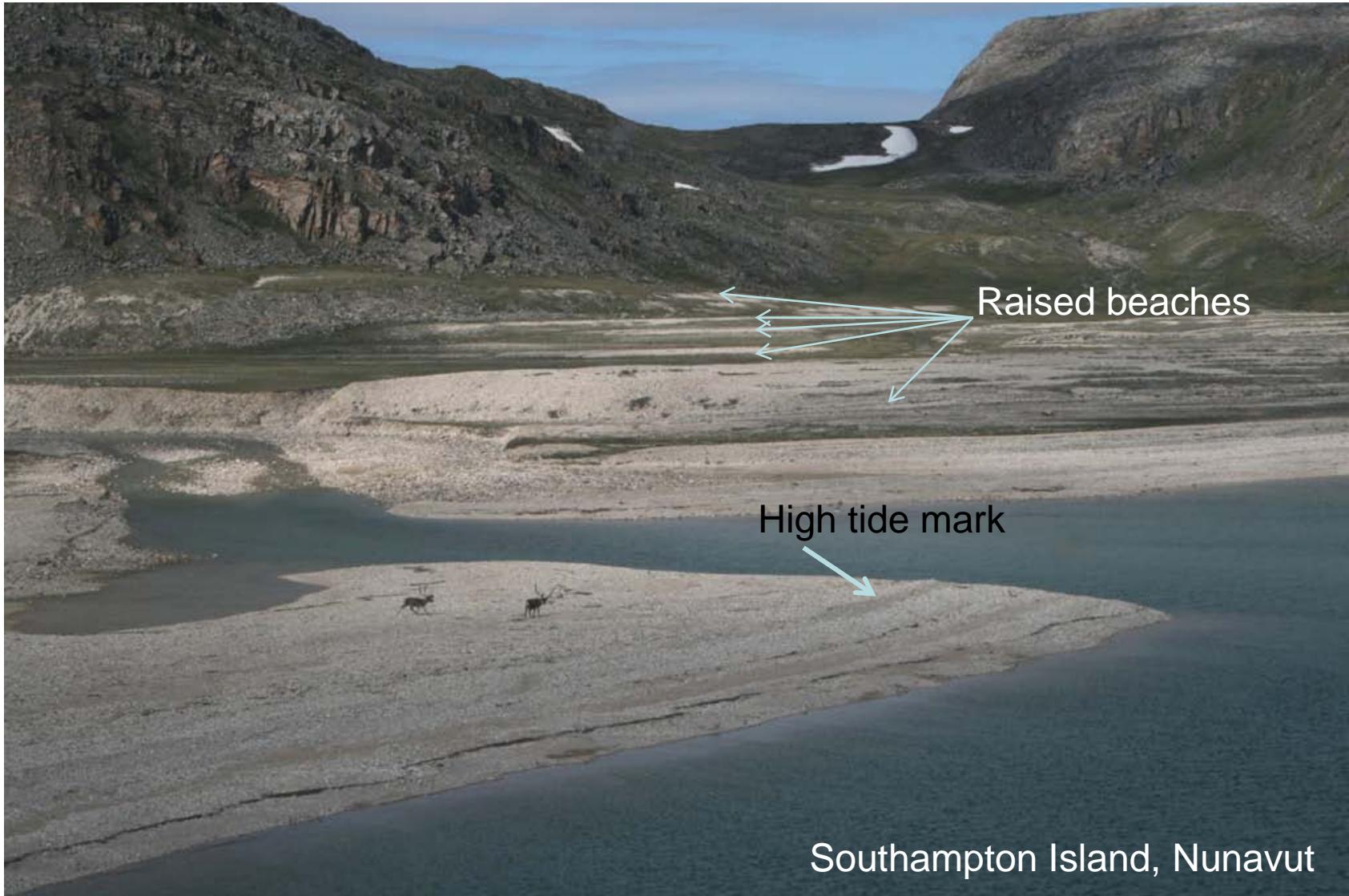
Rising sea level



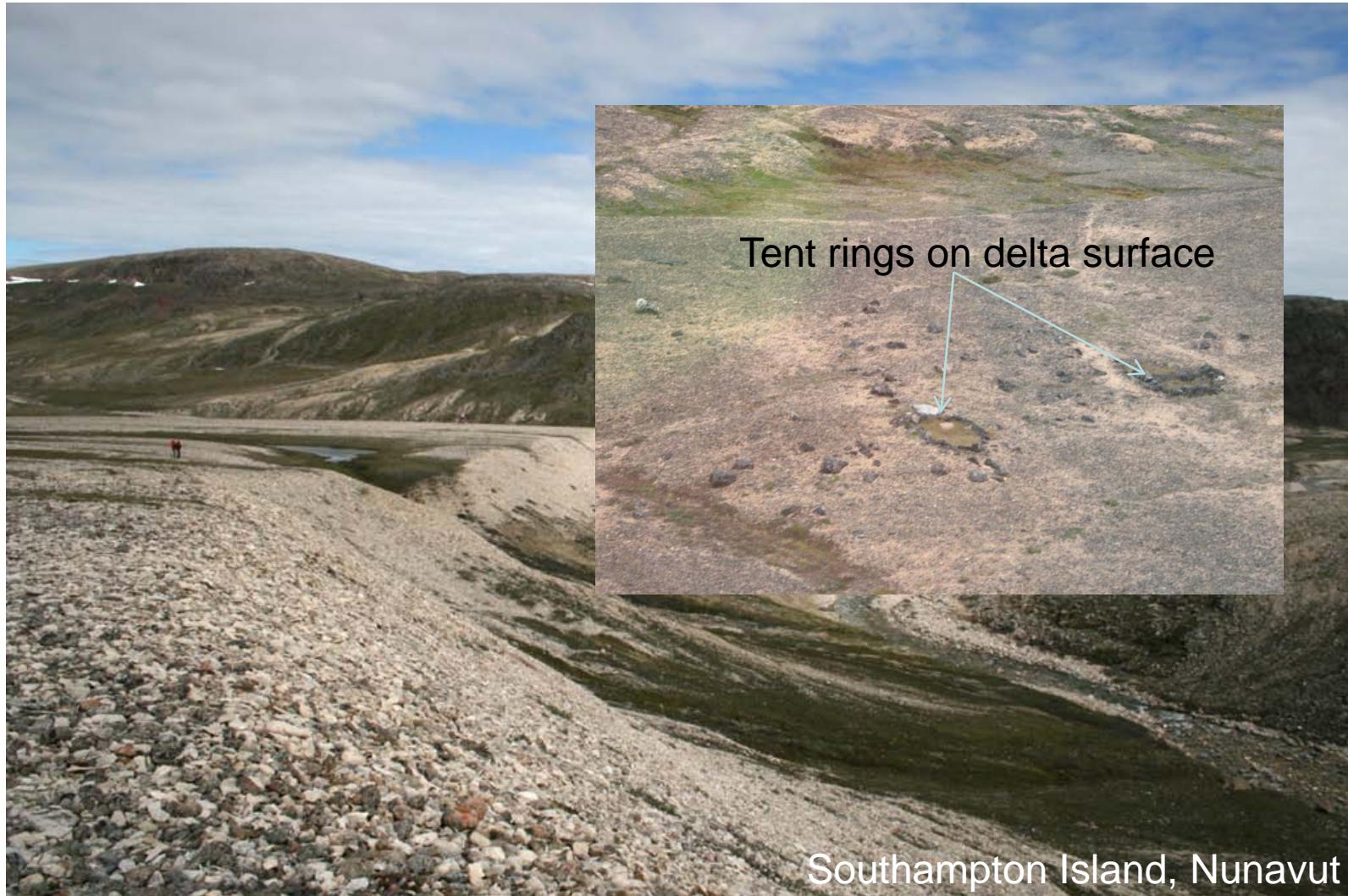
C Regression



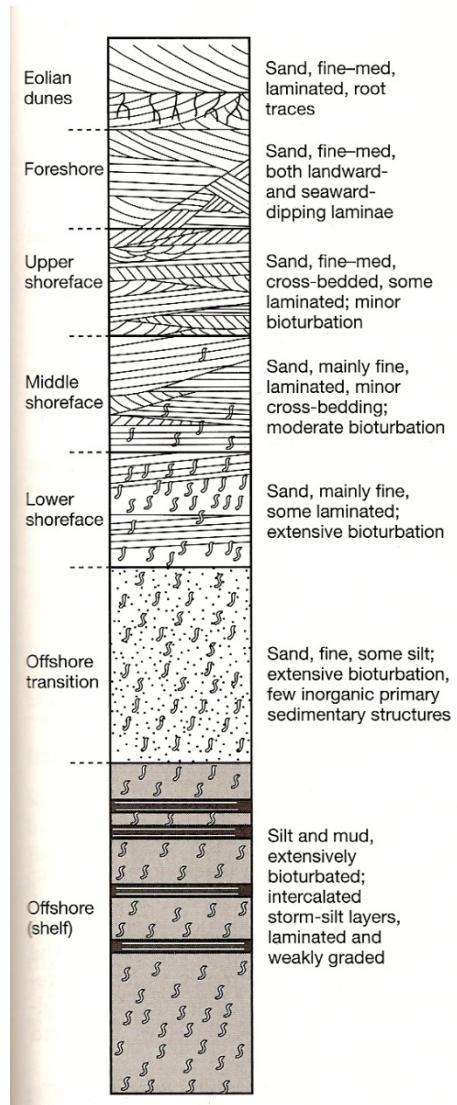
Raised beaches – relative SLR



Raised delta



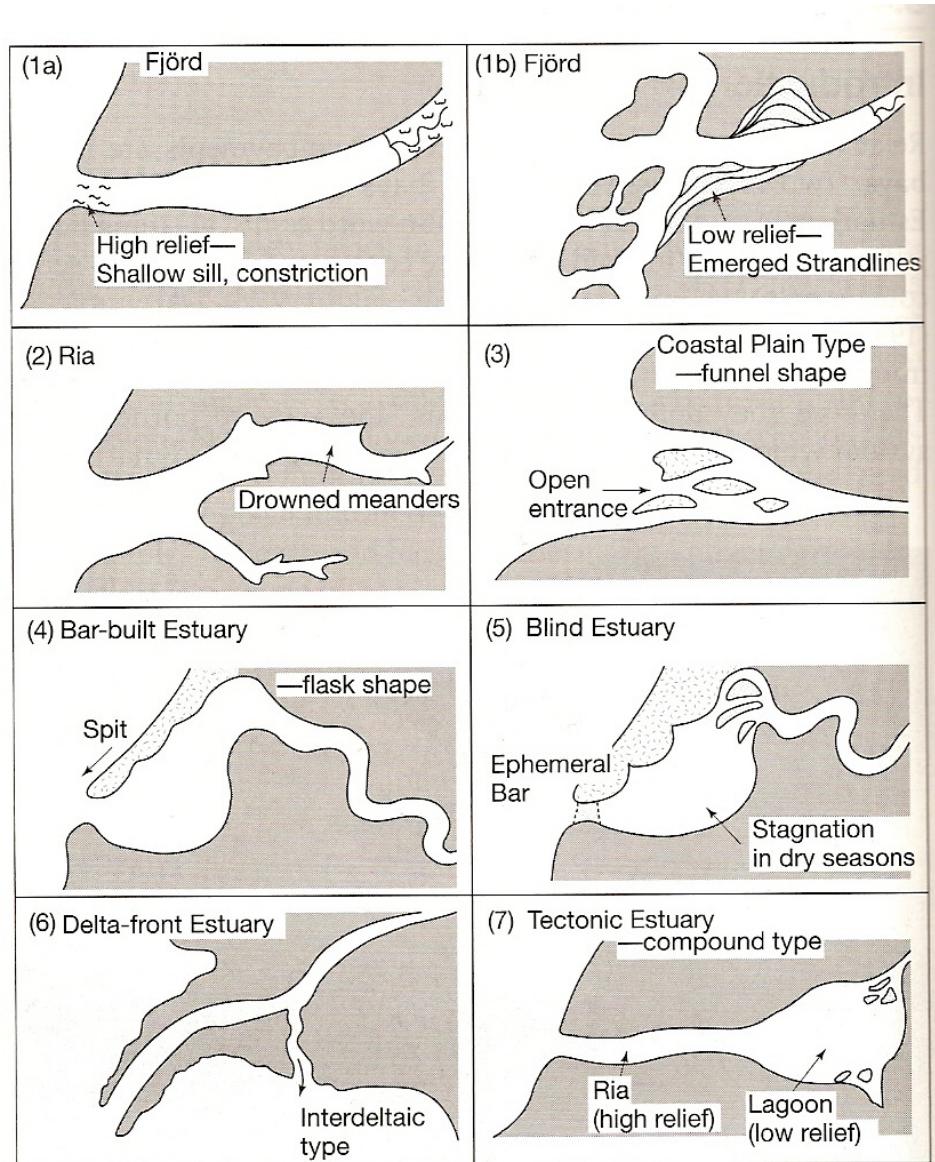
Shoreline shift through time



Estuarine systems

- Seaward portion of a drowned valley system
 - Influenced by fluvial, tidal and wave processes
 - Form under transgressive (SLR) conditions
 - May evolve into deltas

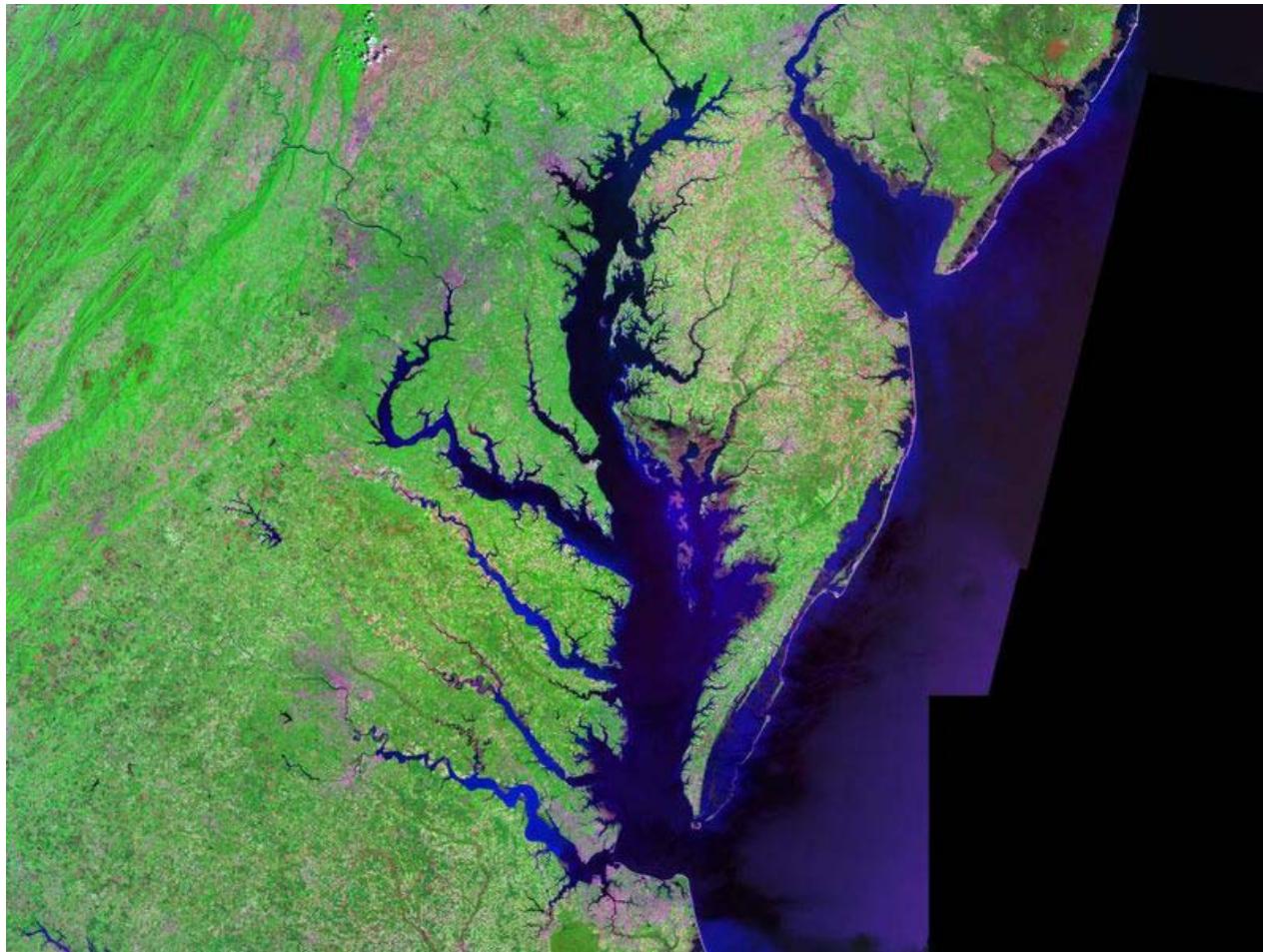
Principal types of estuaries



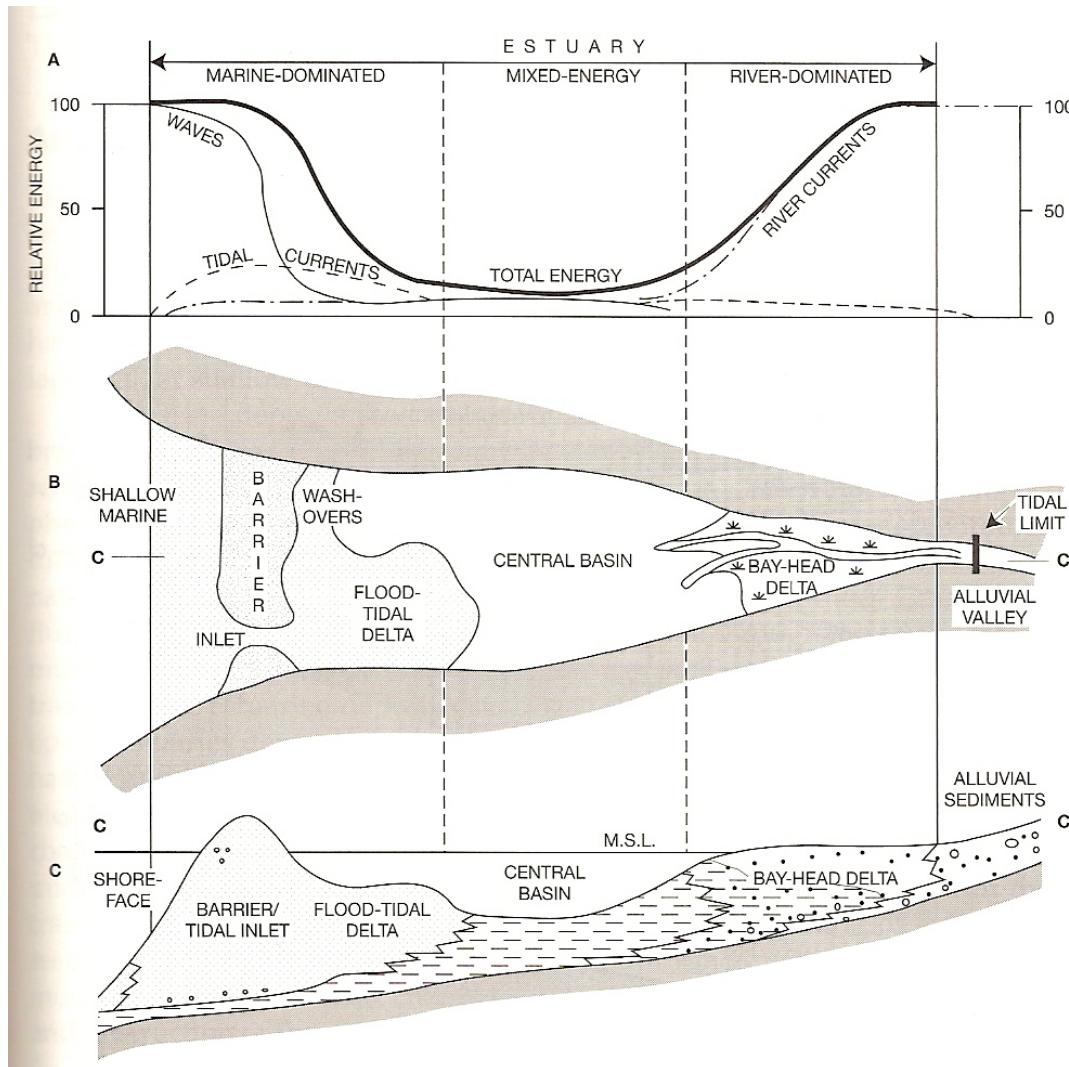
Example of a fjord...

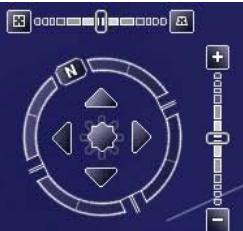


Chesapeake Bay



Wave-dominated estuary





Gulf of St. Lawrence

Fox Island

Miramichi River, NB

Northumberland County

Kent County

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Image © 2008 DigitalGlobe
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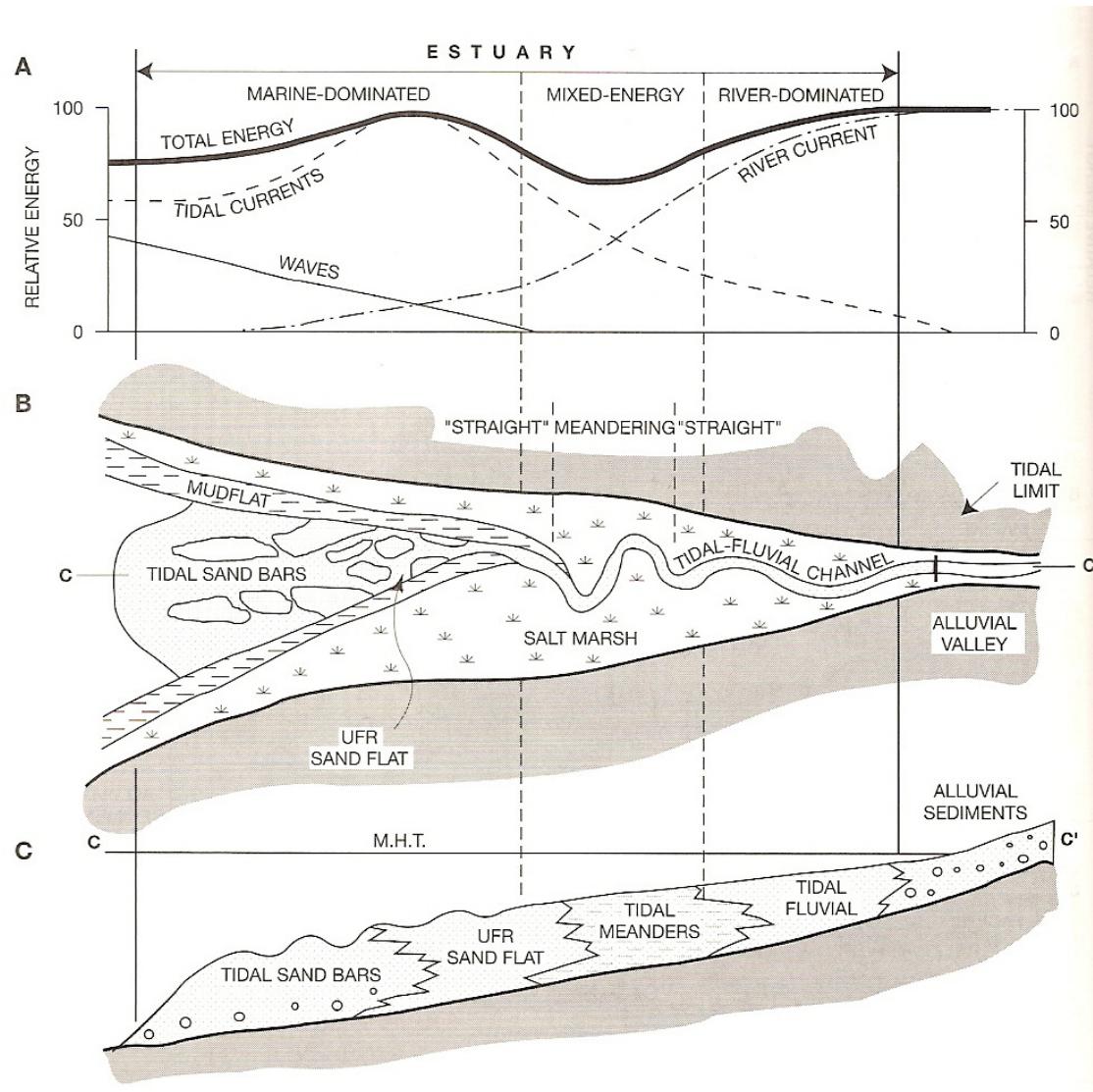
Streaming 100%

Pointer 46° 46' 49.17" N 65° 22' 35.30" W elev 84 m

© 2007 Google™

Eye alt 104.38 km

Tide-dominated estuaries





Île d'Oléron

Rochefort

Charente-Maritime

Saintes

Cognac

Royan

Gironde River, France

Médoc

Haute
Gironde

© 2008 Tele Atlas
Image NASA
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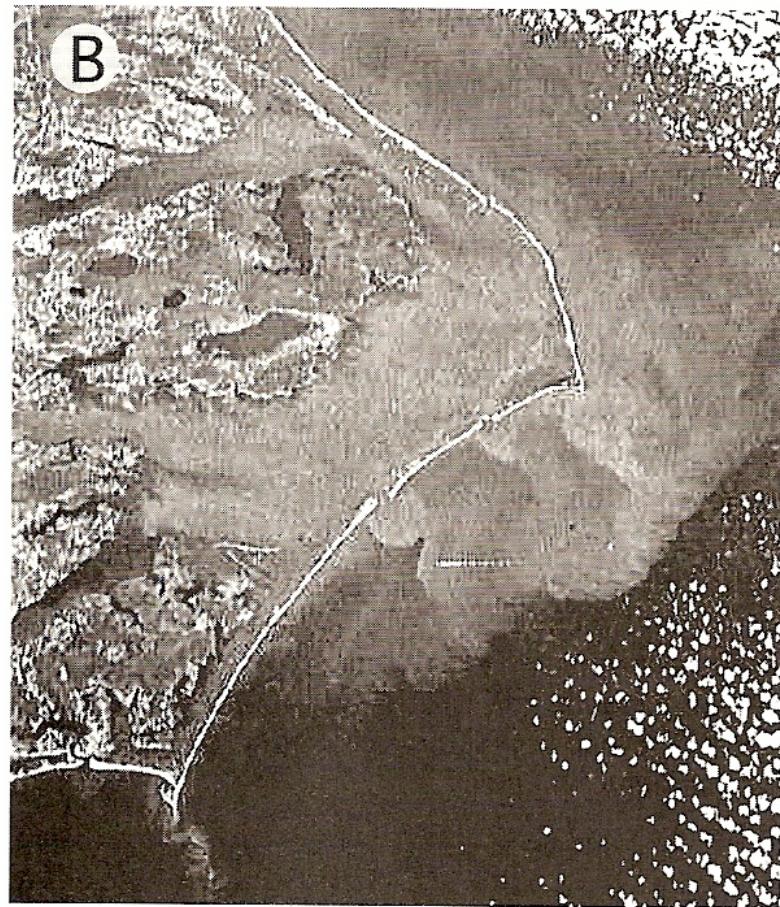
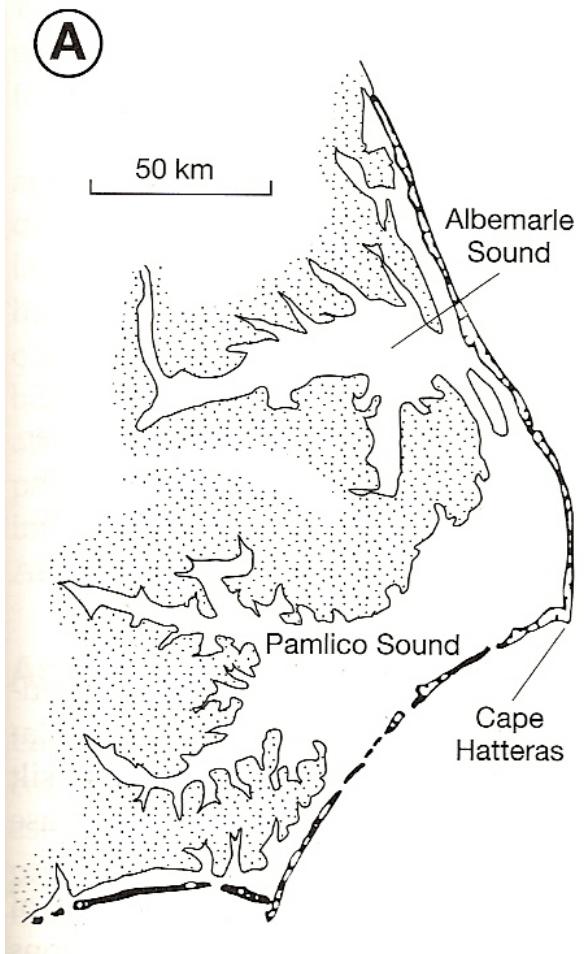
Ord River, Australia



Facies successions

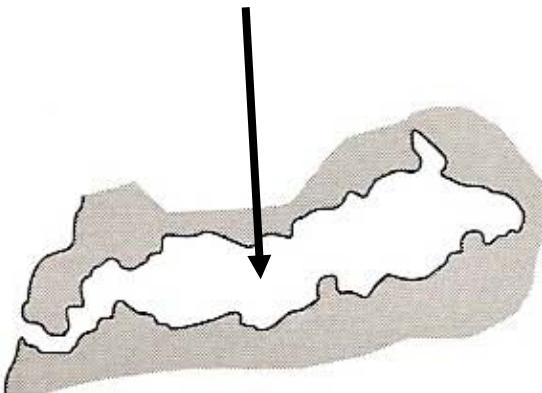
- Cross-bedded, bioturbated sand near the mouths and in fluvial-tidal channels
- Laminated, well-bioturbated muds occupy the nonchannel middle and upper parts of the estuary
- Many are subjected to transgression
 - Vertical stacking
 - Estuary mouth-sands
 - Middle-estuary muds
 - Or fluvial-tidal channel sands
- Regression causes filling and destruction of the estuary and seaward progradation
 - Estuary may evolve into a delta

Lagoonal systems



Types of lagoons

Long residence time of water

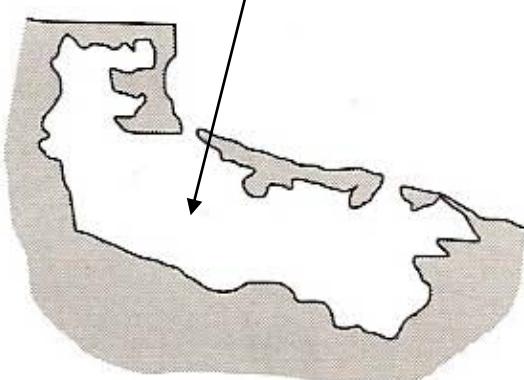


High-wave energy

A Choked

Water movement by wind forcing

Silty or muddy seds.
Carbonates, evaporites



B Restricted

Well-defined tidal circulation
But strongly influenced by winds

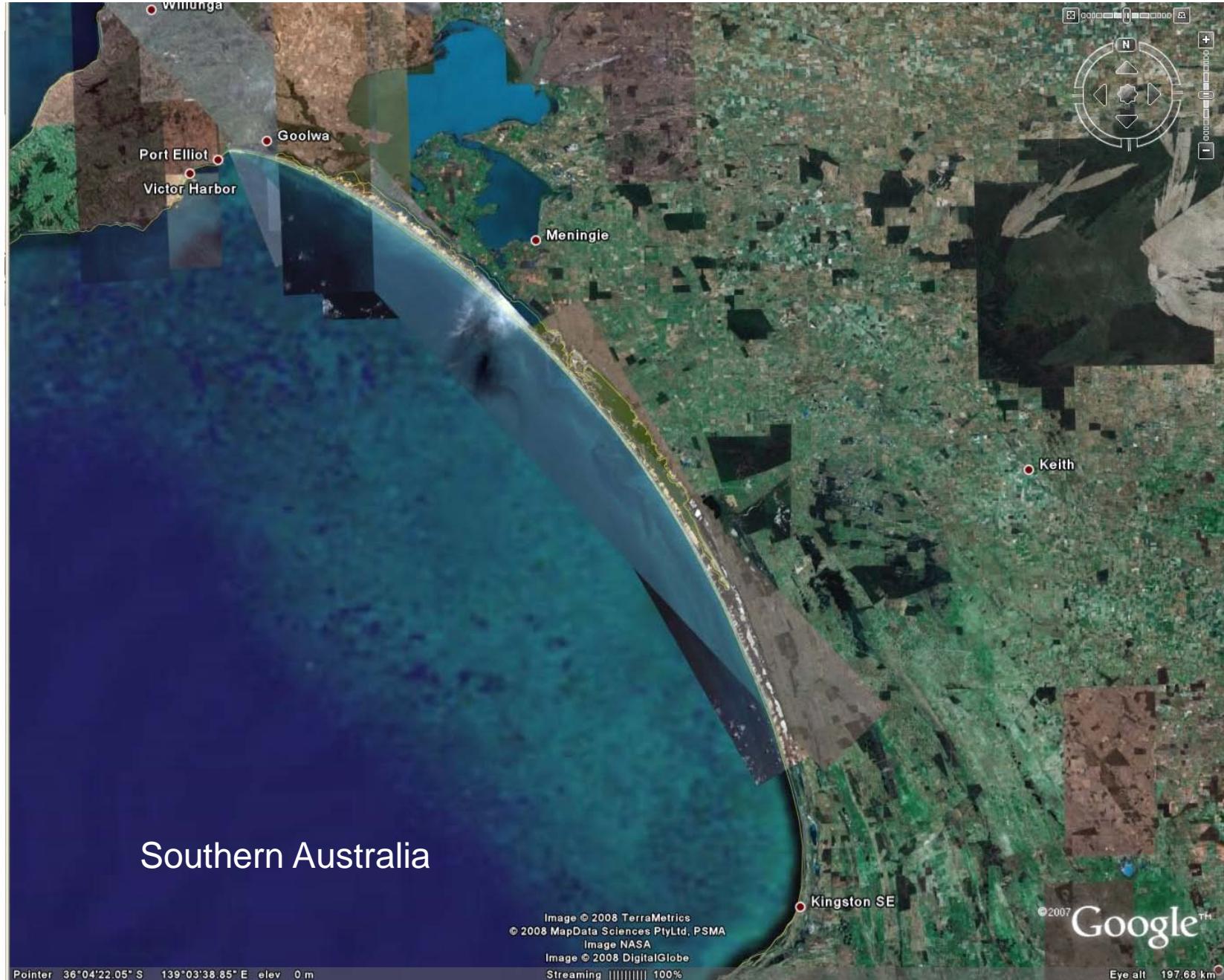
Efficient water exchange with the ocean



C Leaky

Important tidal currents

Dominance of low-energy conditions; little or no freshwater input



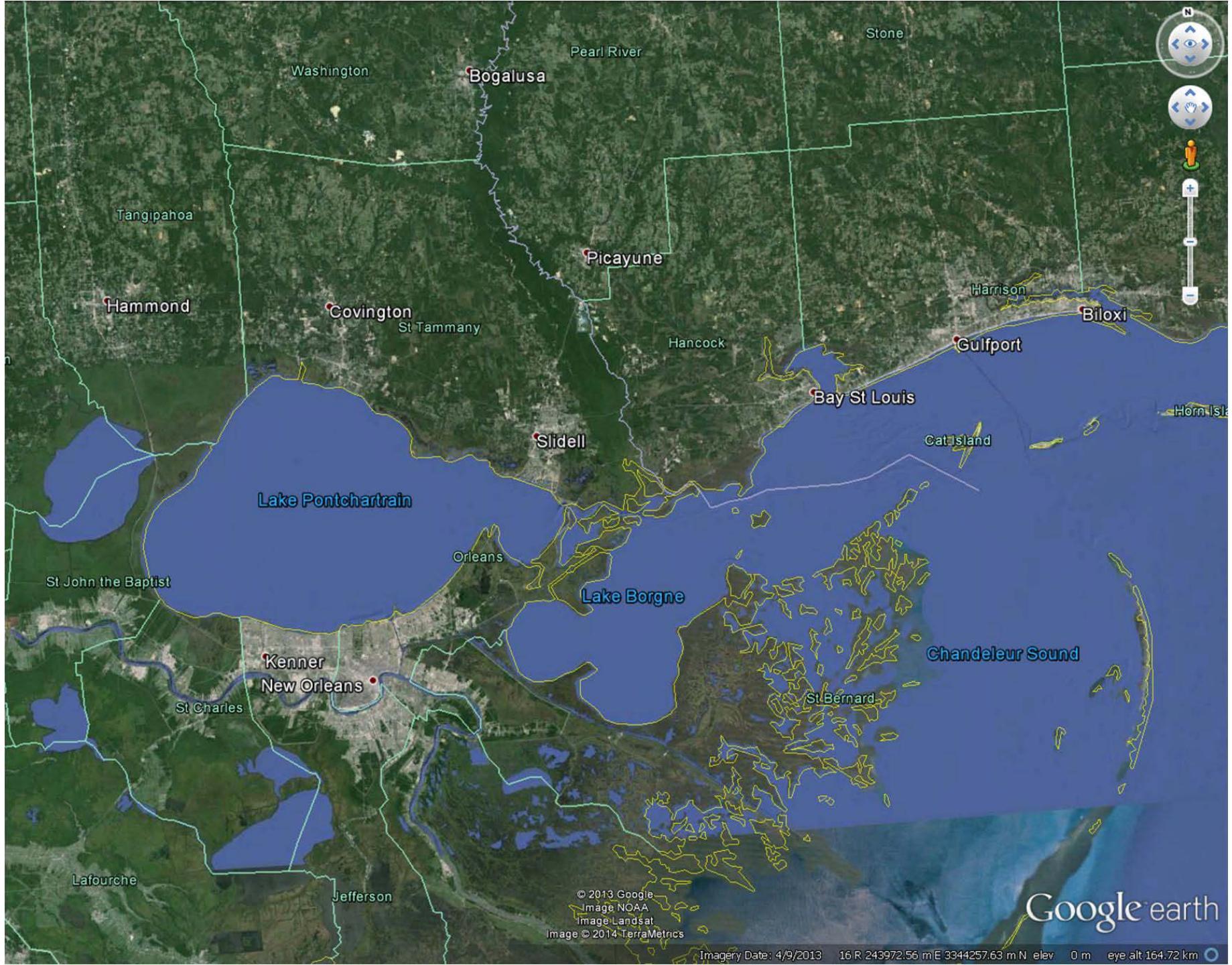
Southern Australia

Image © 2008 TerraMetrics
© 2008 MapData Sciences PtyLtd, PSMA
Image NASA
Image © 2008 DigitalGlobe
Streaming ||||||| 100%

© 2007 Google™

Pointer 36°04'22.05" S 139°03'38.85" E elev 0 m

Eye alt 197.68 km



© 2013 Google
Image NOAA
Image Landsat
Image © 2014 TerraMetrics

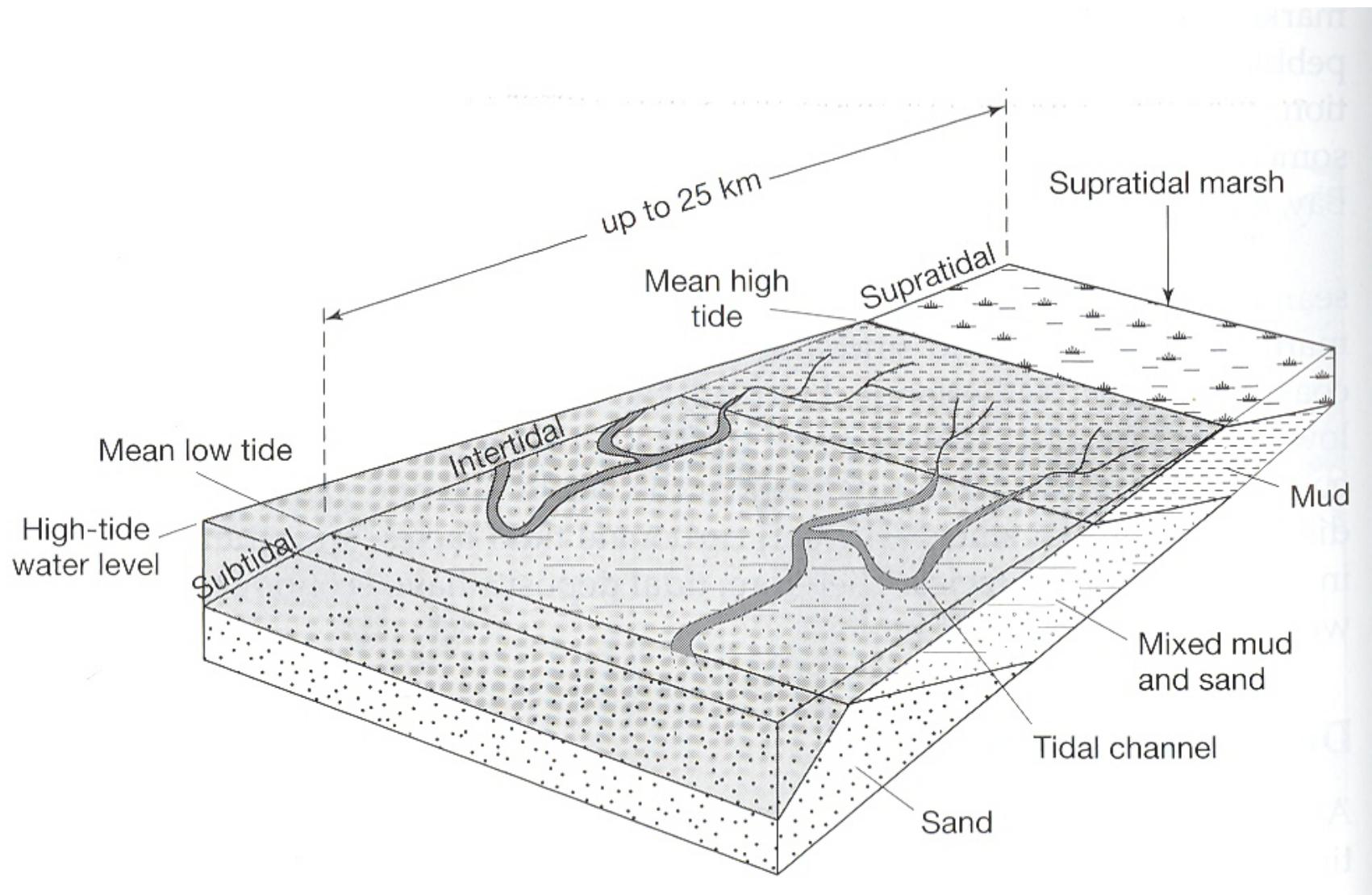
Imagery Date: 4/9/2013 16 R 243972.56 mE 3344257.63 mN elev 0 m eye alt 164.72 km

Google earth

Ancient lagoonal deposits

- Evidence for restricted circulation
 - Evaporites
 - Anoxic facies (black shales)
 - Lack of strong tidal influence
 - Low faunal diversity
 - Extensive bioturbation

Tidal-flat systems

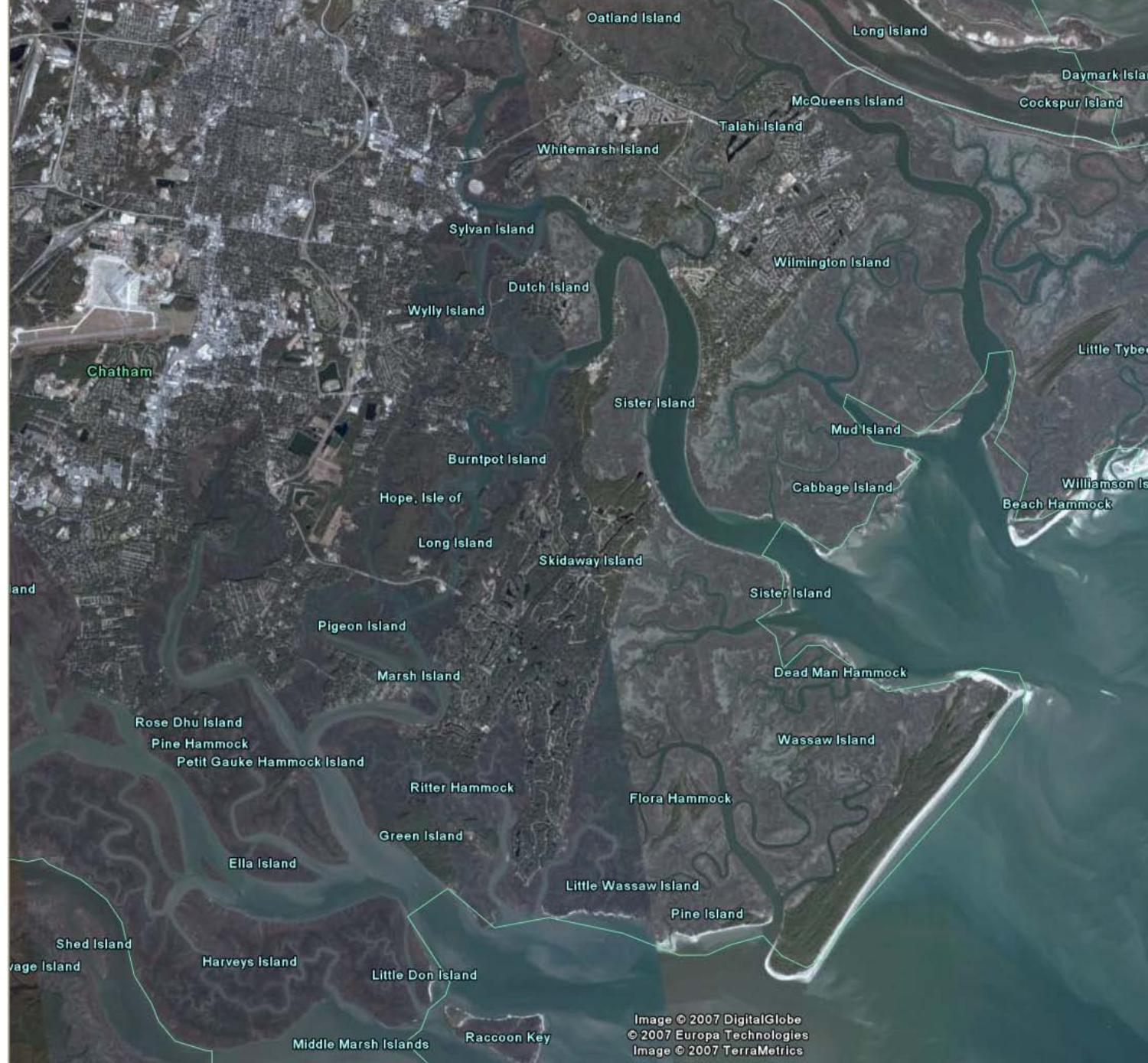




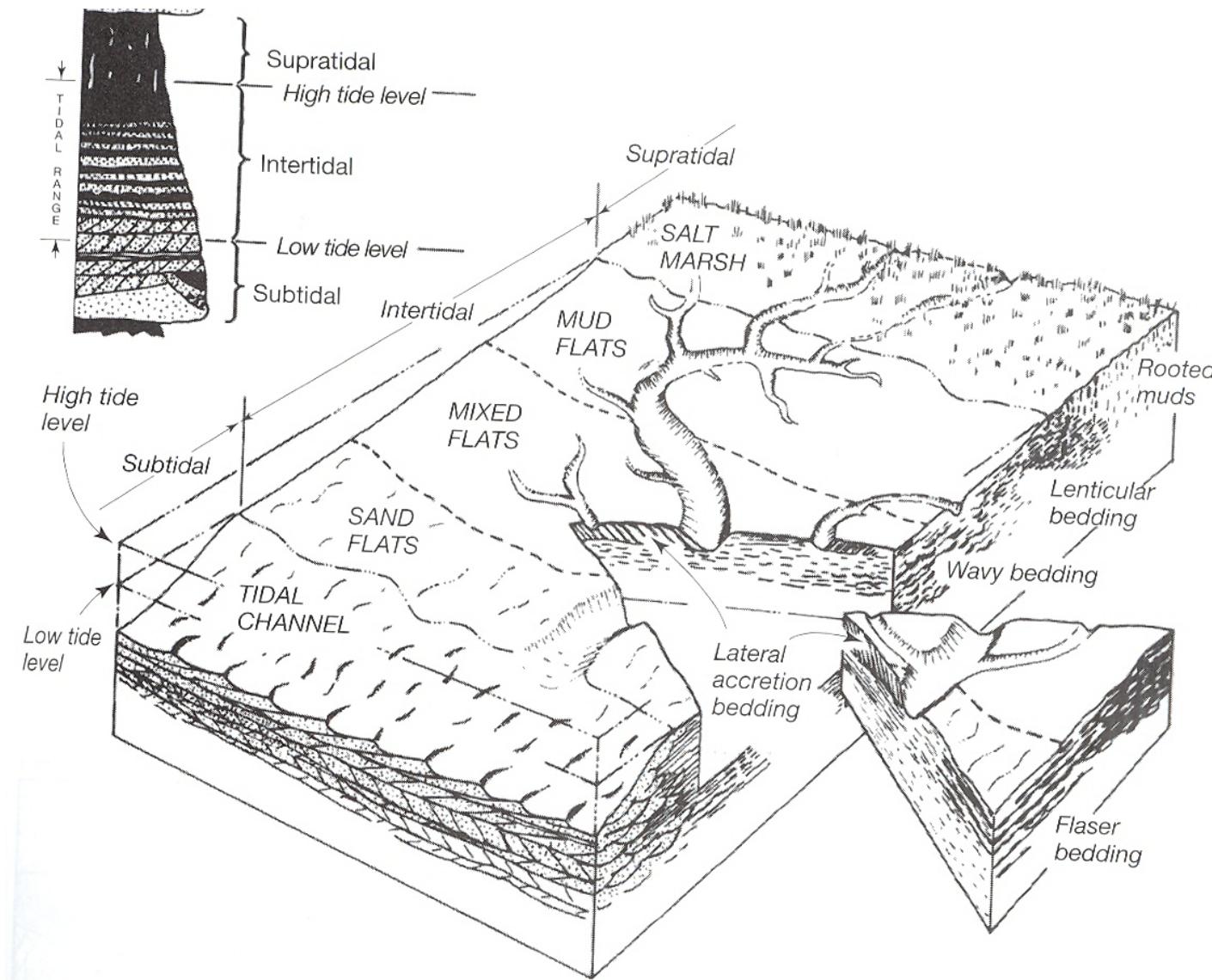
Georgia, USA

Image © 2007 DigitalGlobe
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Facies model

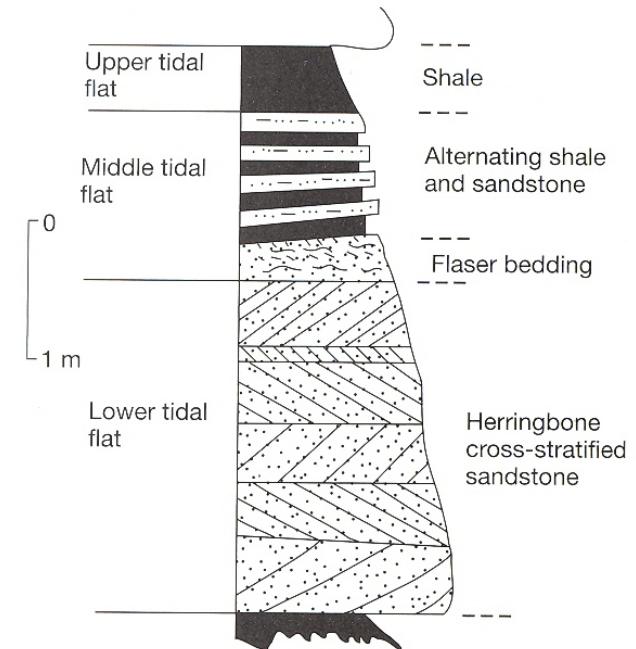


Bimodal directions of foreset dip

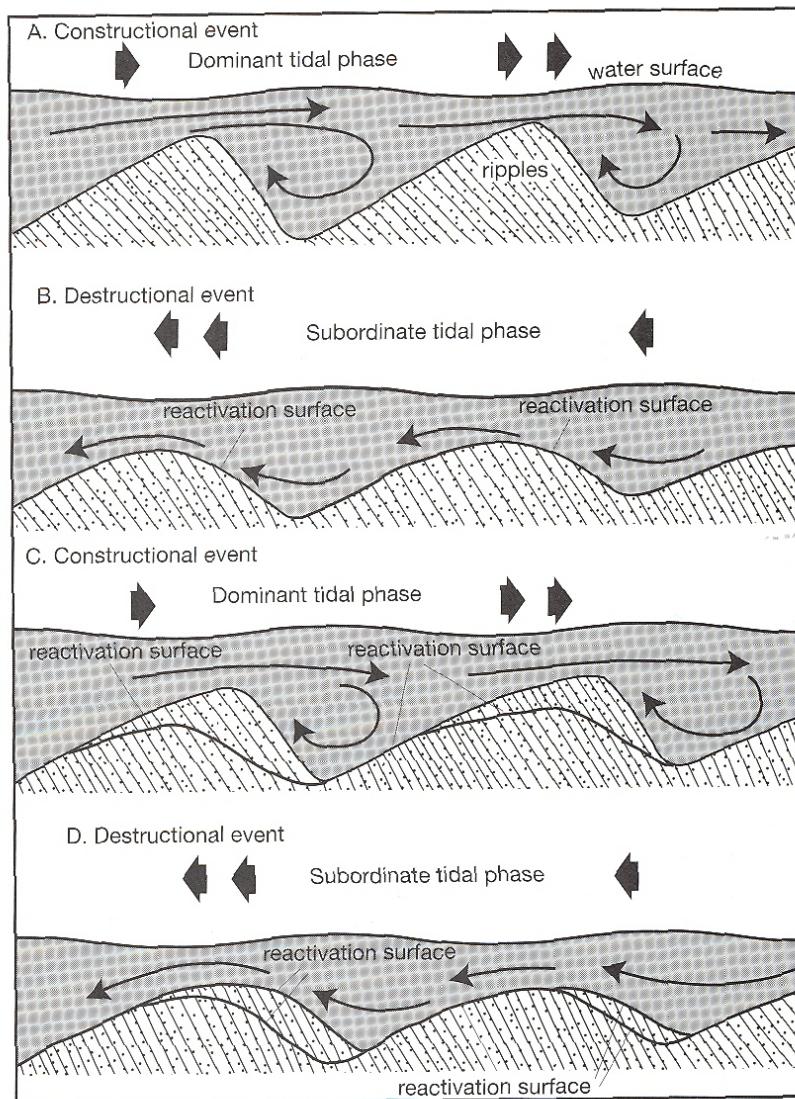


Curtis Frm., Jurassic, Utah

<http://www.depauw.edu/acad/geosciences/tcope/SedStruct.html>



Reactivation surfaces



Ancient tidal-flat sediments

- Herringbone cross-stratification
- Joint occurrence of large-scale (channel) and small-scale (sandflat and mudflat) structural units
- Abundant reactivation surfaces and flaser bedding
- High frequency of erosional contacts and abrupt facies change
- Mudcracked stromatolites, raindrop imprints, hail marks, and animal or bird tracks