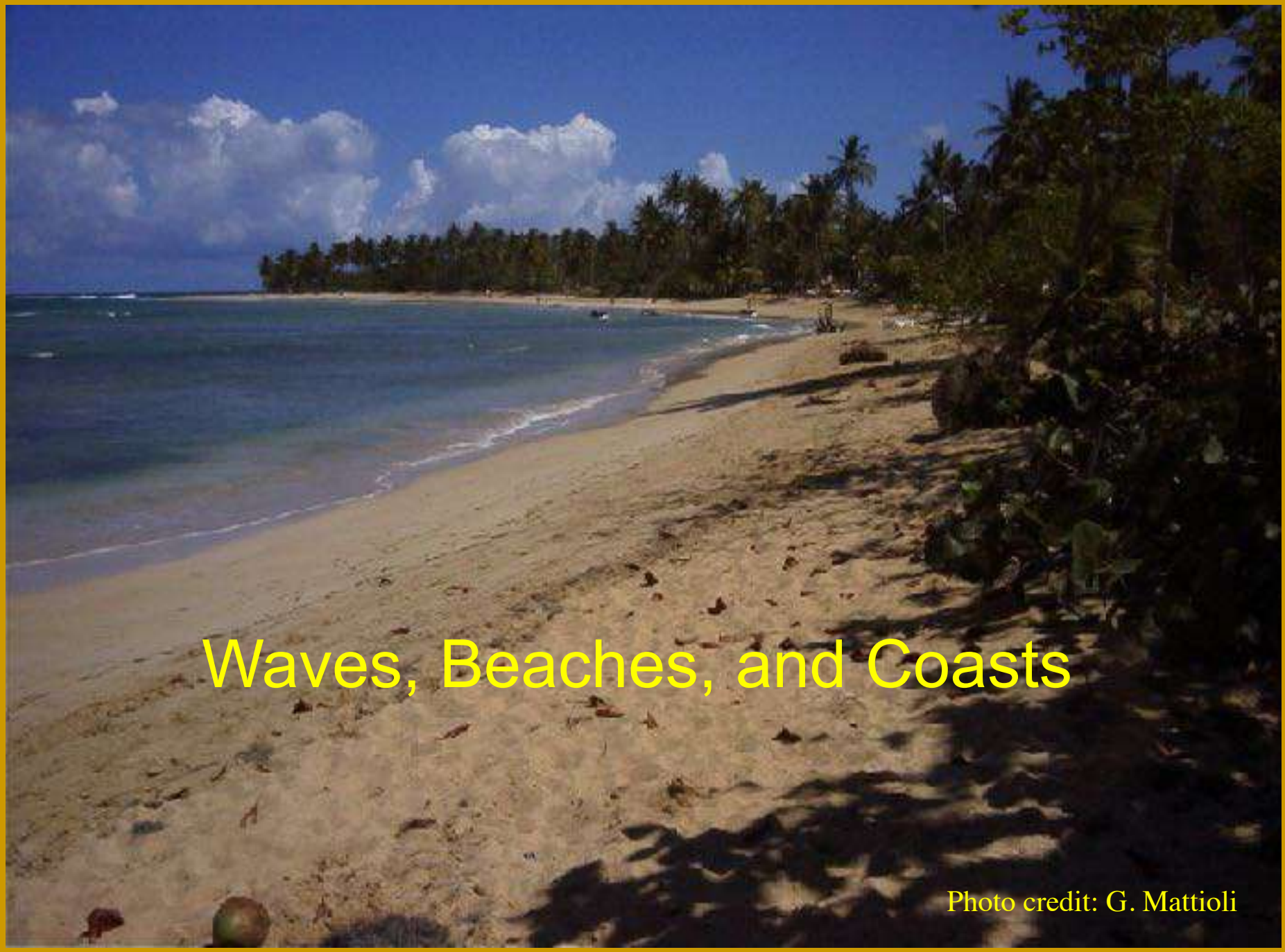
Modul 19
Shoreline System


Waves, Beaches, and Coasts
Photo credit: G. Mattioli

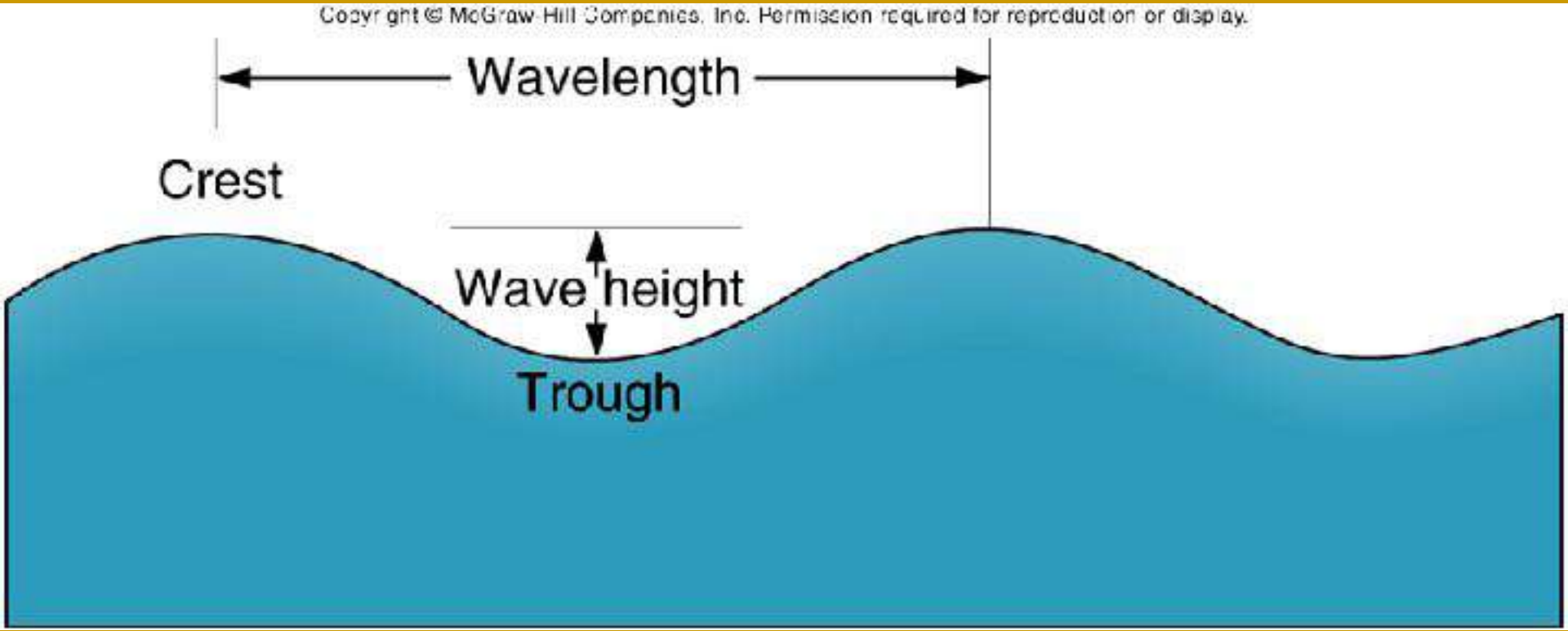
Water Waves

- Surf

Nearshore Circulation

- Wave Refraction
- Longshore Currents
- Rip Currents

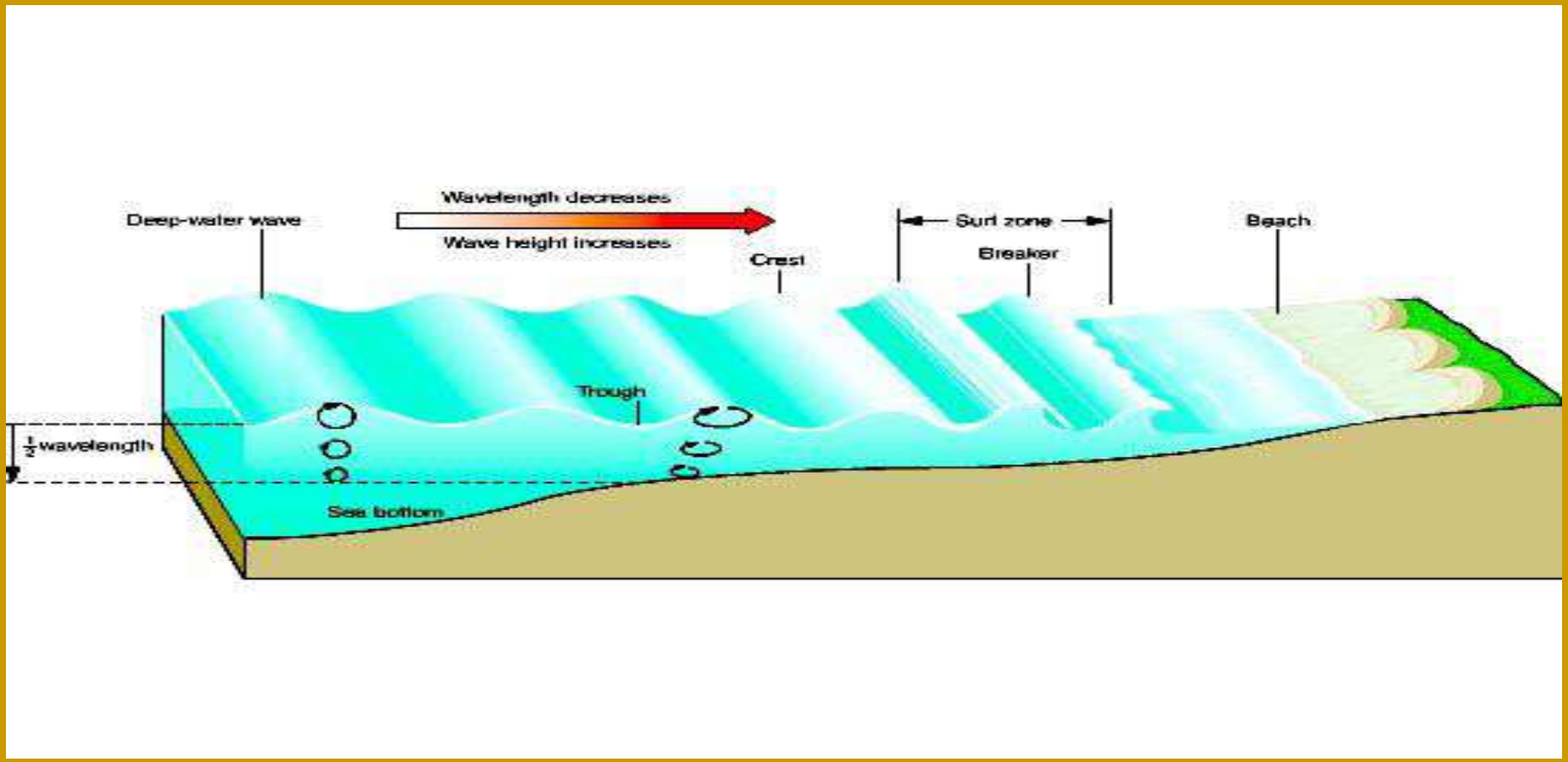
Wave Characteristics



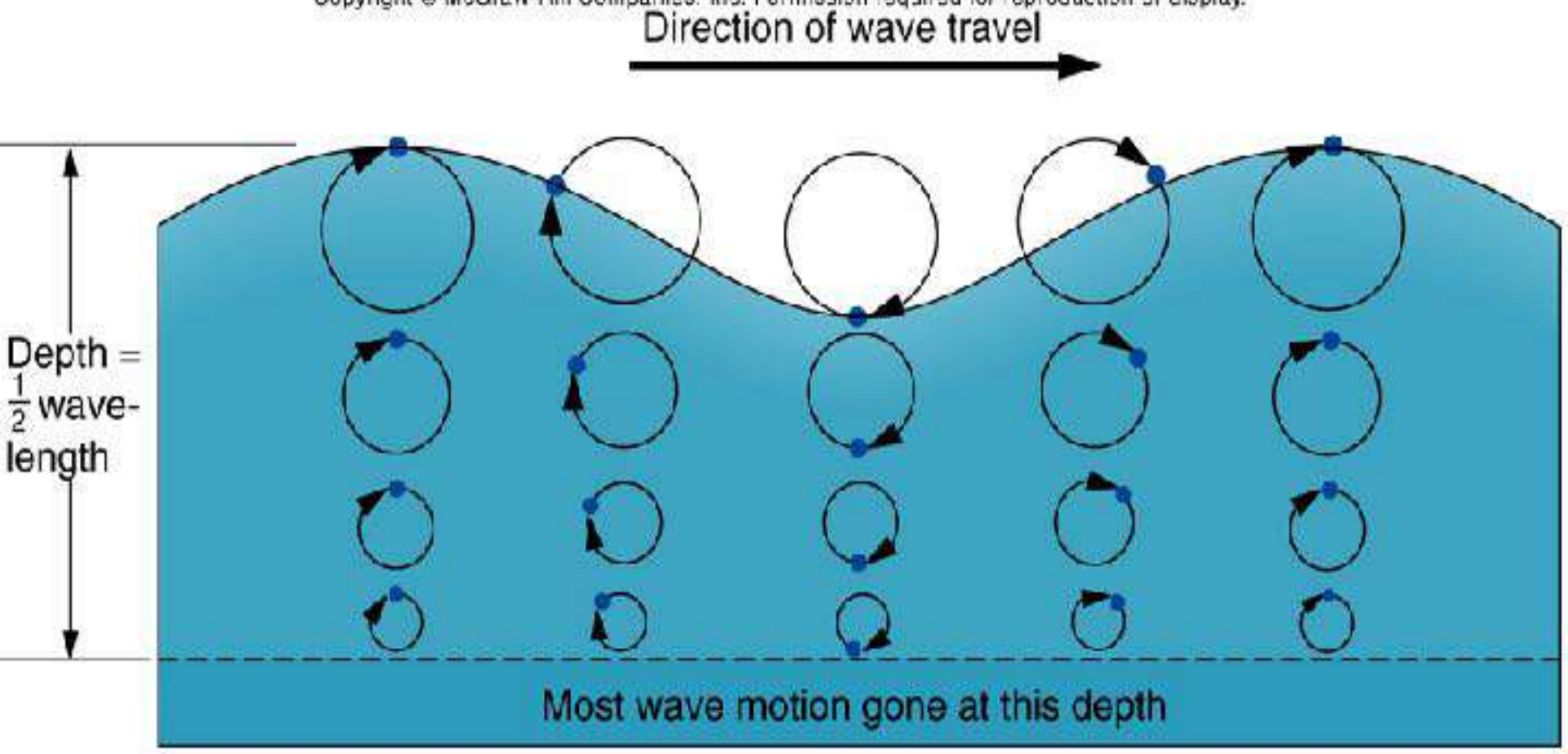
Wave Features

- **Wave height:** Vertical distance between the crest and trough of the wave.
  - Wave crest: Highest point on the wave.
  - Wave trough: Lowest point on the wave.
  - Ocean waves range 0.3 to 5 m; can be as high as 15 m.
- **Wavelength:** Horizontal distance between two wave crests or troughs.
  - Ocean waves range from 40 to 400 m.
- **Wave period:** Time for one wavelength to pass. This is inversely related to frequency P = 1/*f.*
  - Ocean wave velocities range from 25 to 90 km/hr.

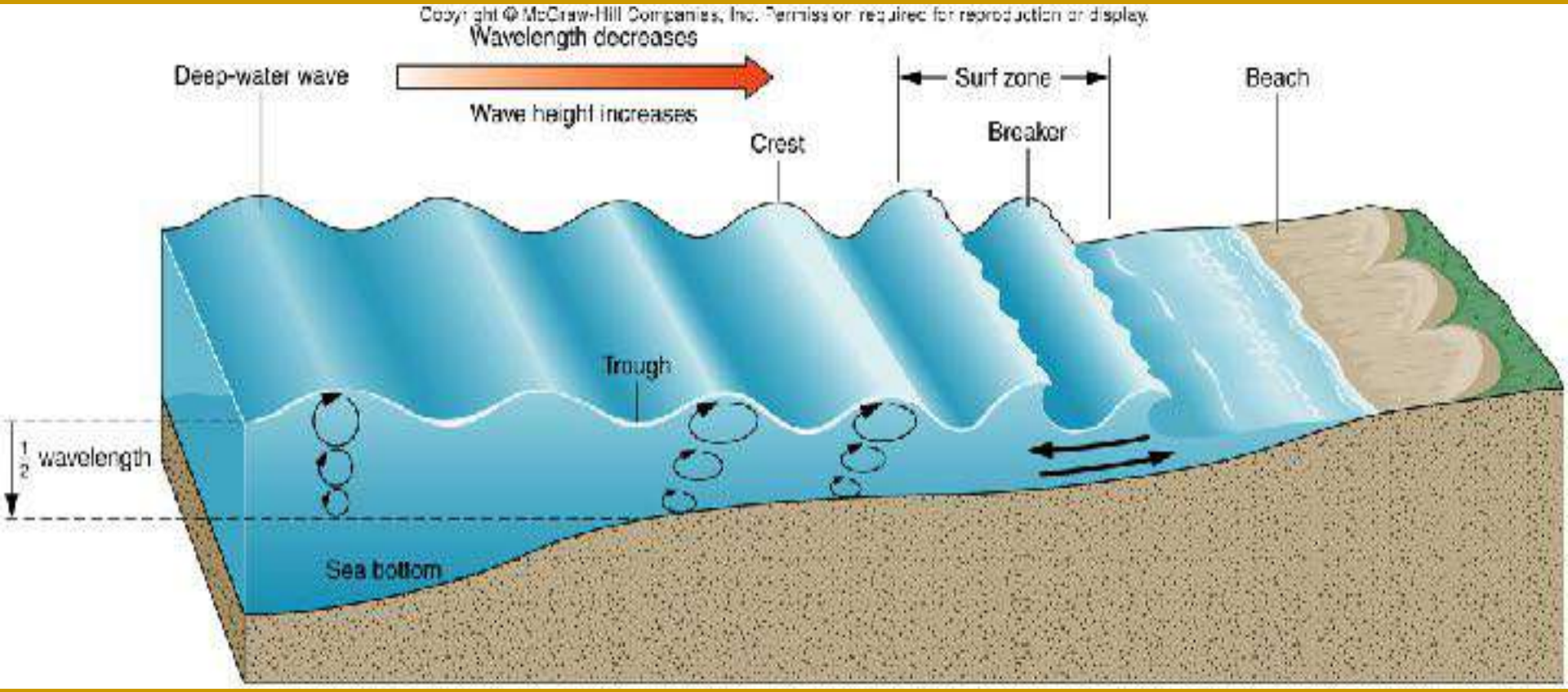
Orbital Motion Animation



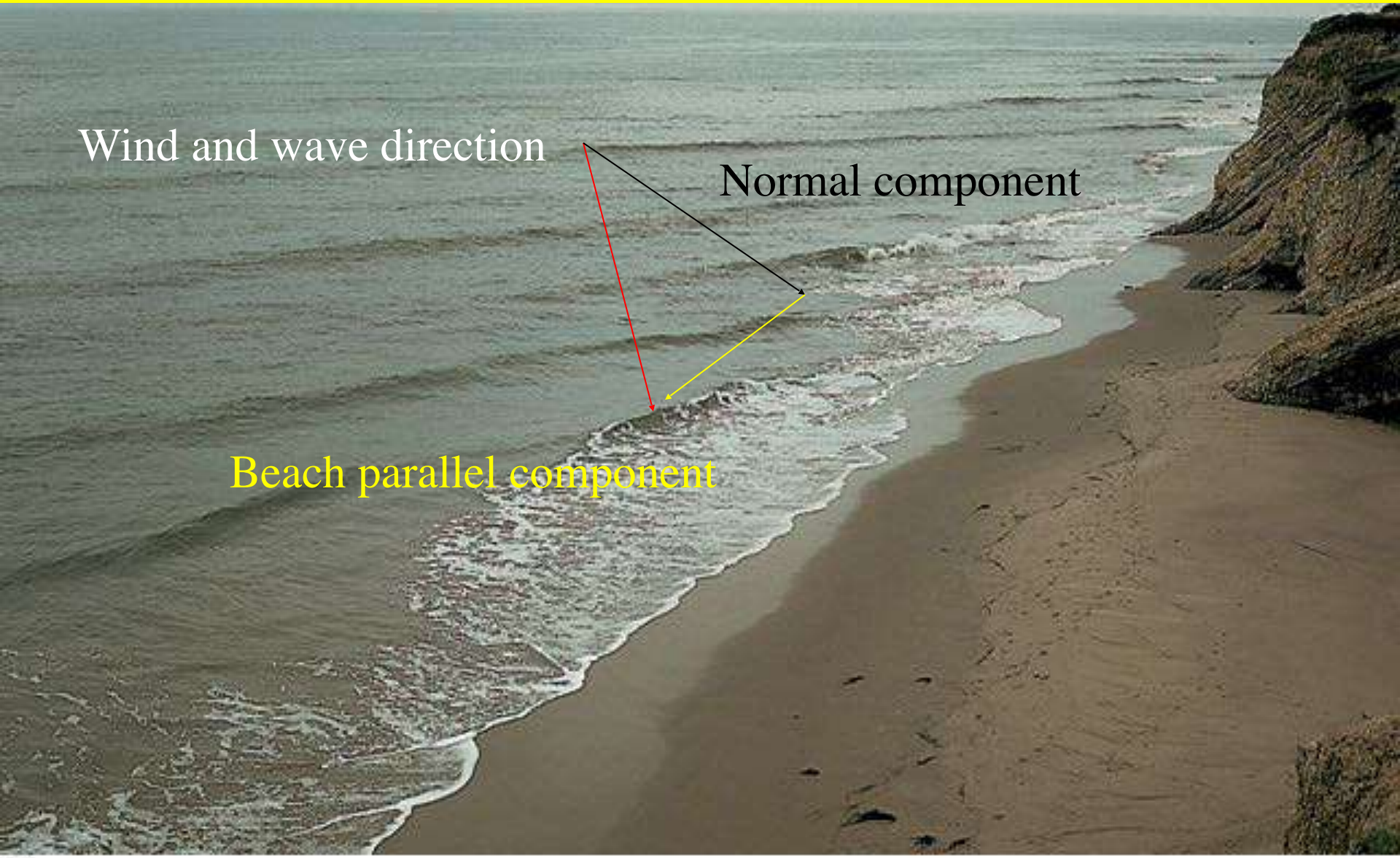
Wave Particle Motion



Wave Interaction with Sea Floor



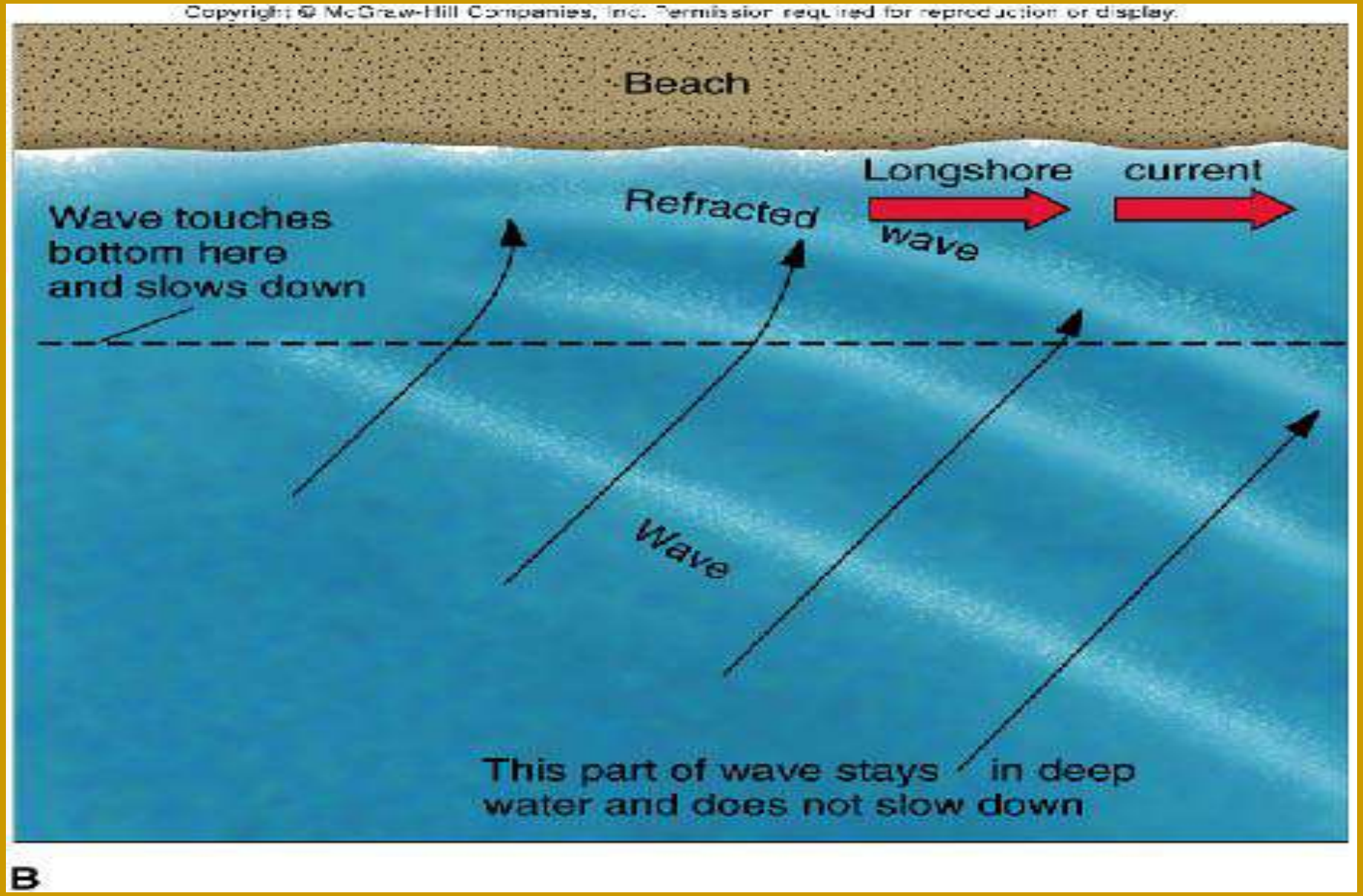
Oblique Waves



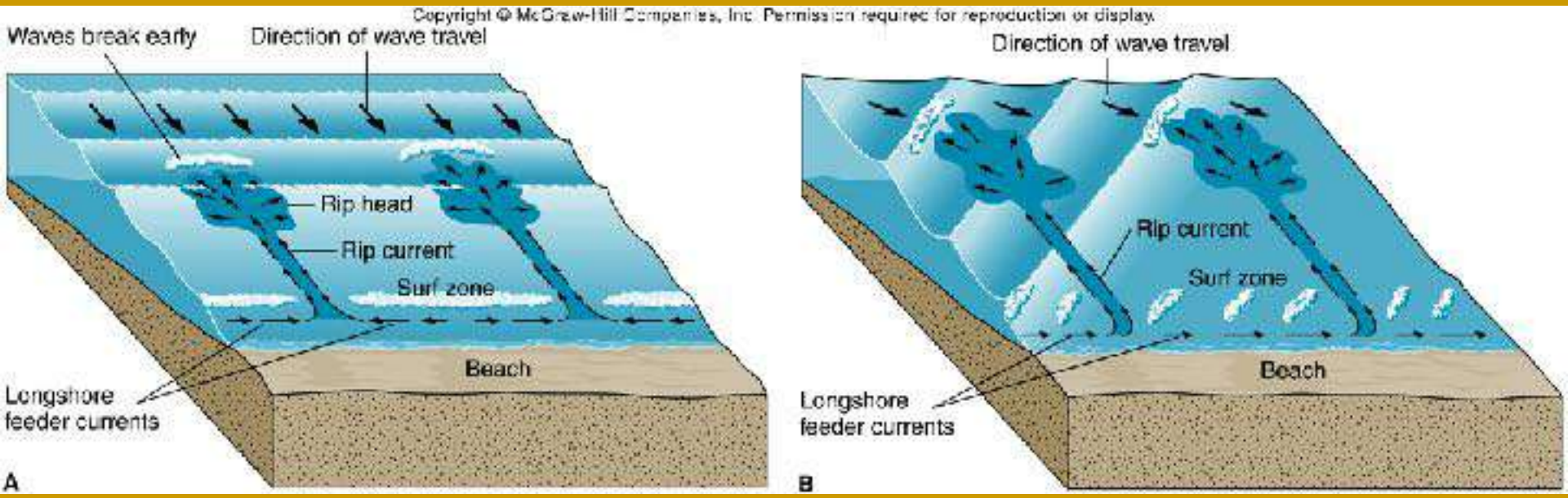
A

Photo by David McGeary

Longshore Current

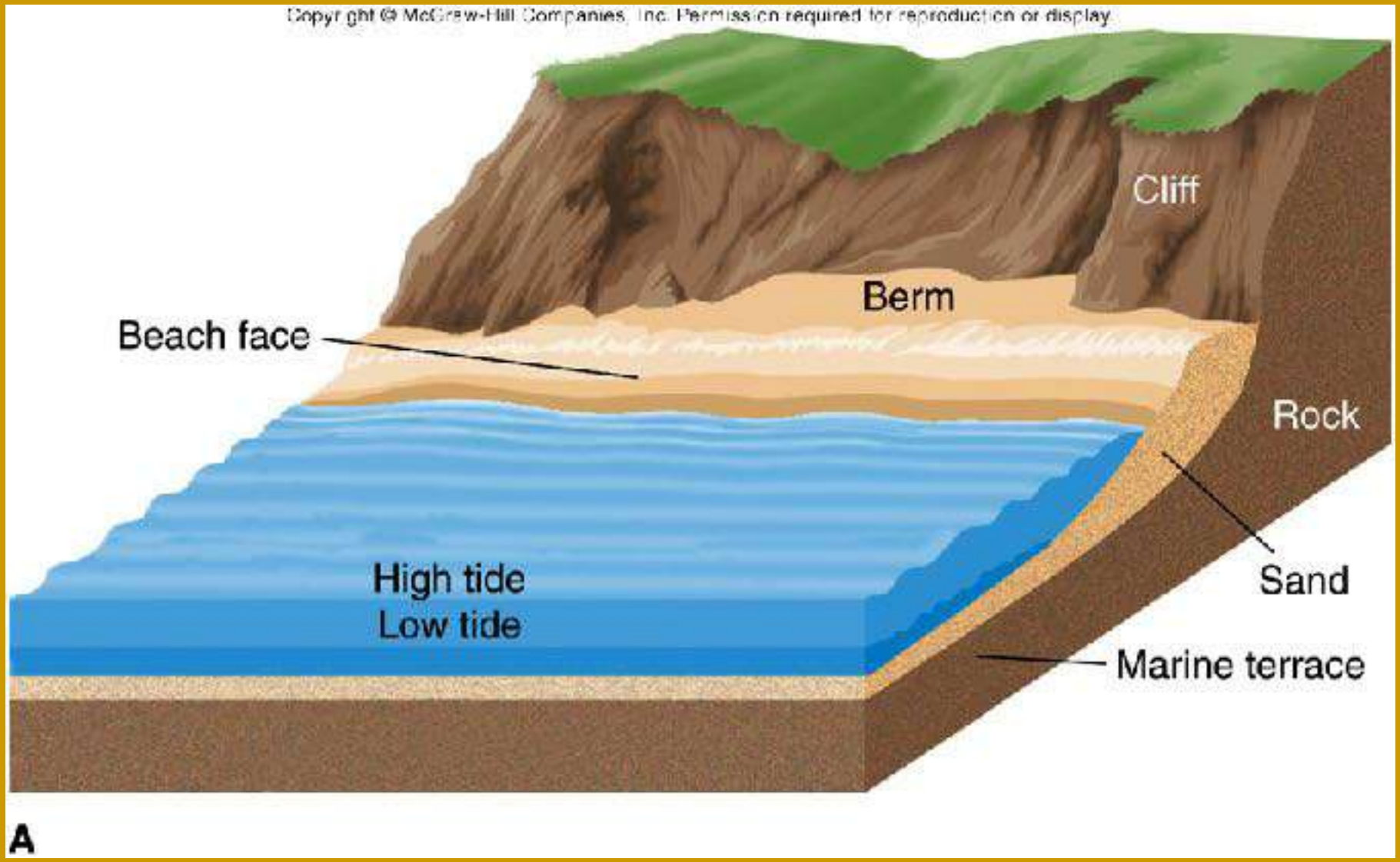


Rip Currents

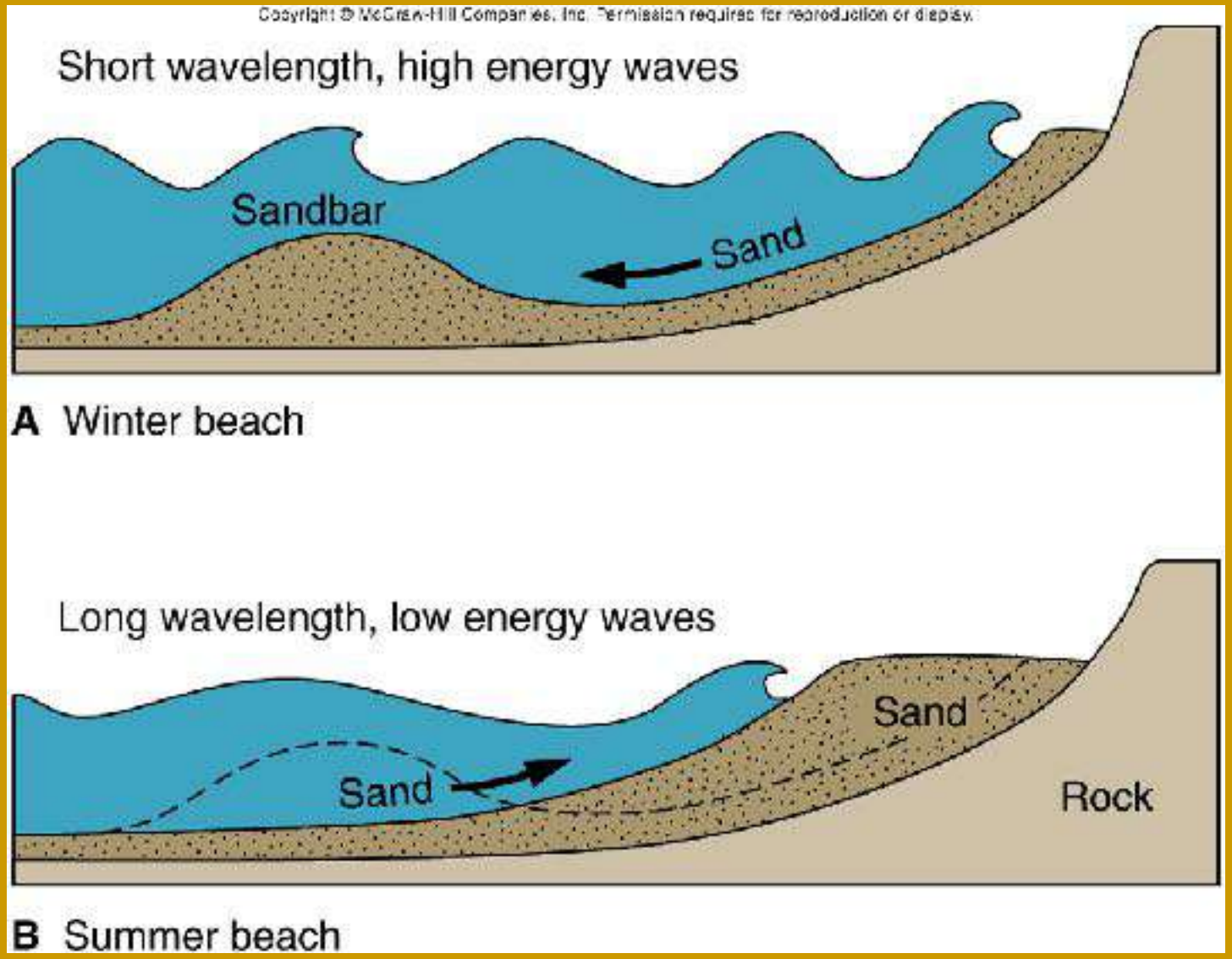


Rip currents: water that flows straight out to sea from the surf zone. Travel at the surface and die out at depth. Carry fine grained particles out of surf zone to deeper water.

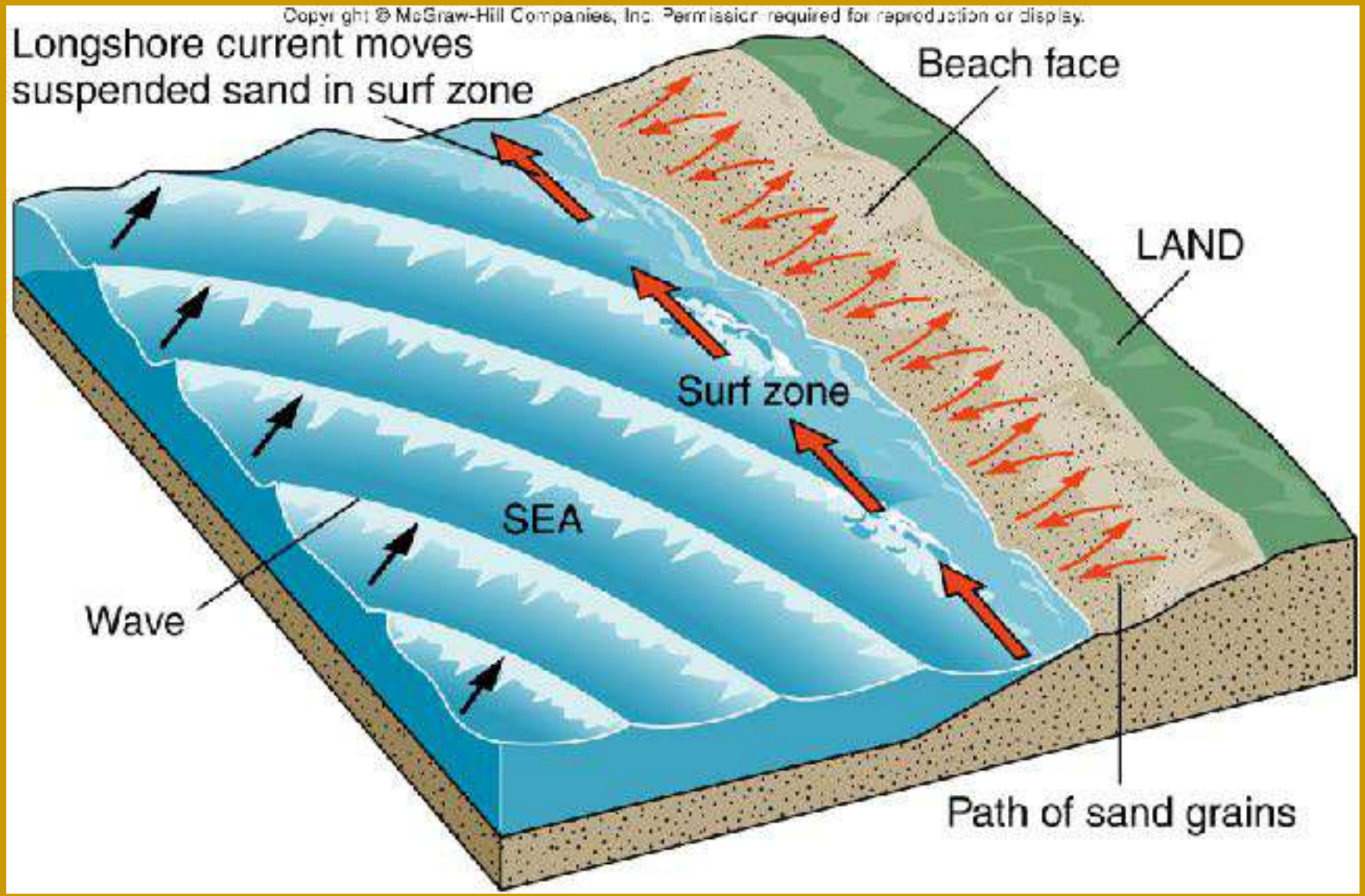
Beach Terminology



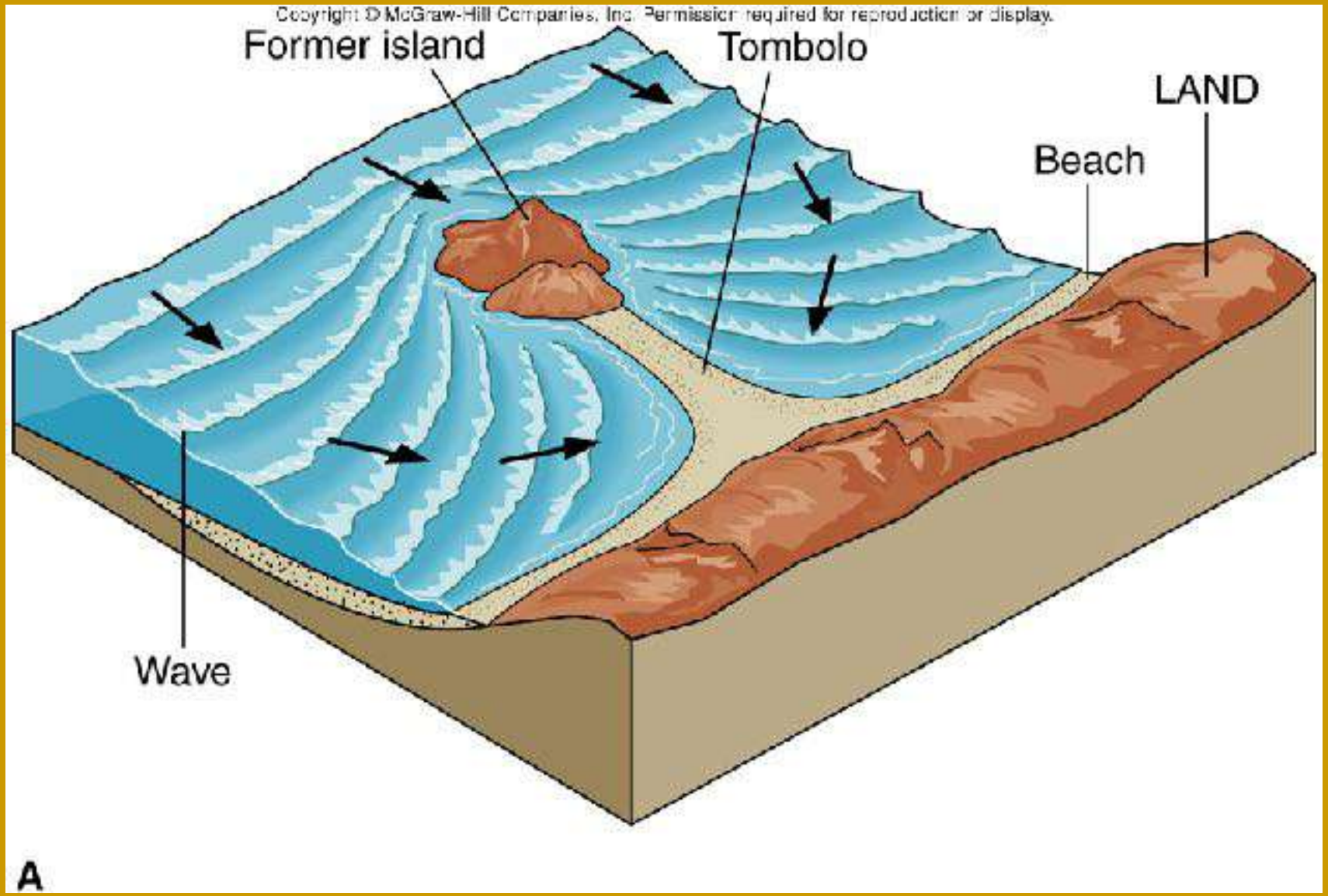
Seasons and Beach Development



Longshore Sand Movement



Tombolo Development



Tombolo - Santa Cruz, CA

B

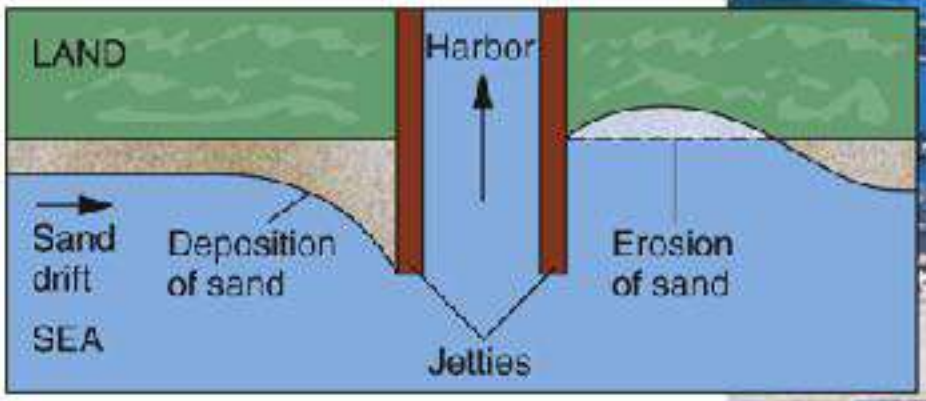
Photo by David McGeary

Beaches

Longshore Drift of Sediment

- Human Interference with Sand Drift
  - Jetties
  - Breakwaters
  - Groins
- Sources of Sand on Beaches
  - Deposition from rivers
  - Erosion of local rocks in cliffs and headlands
  - Transport from offshore regions
  - Bioclastics

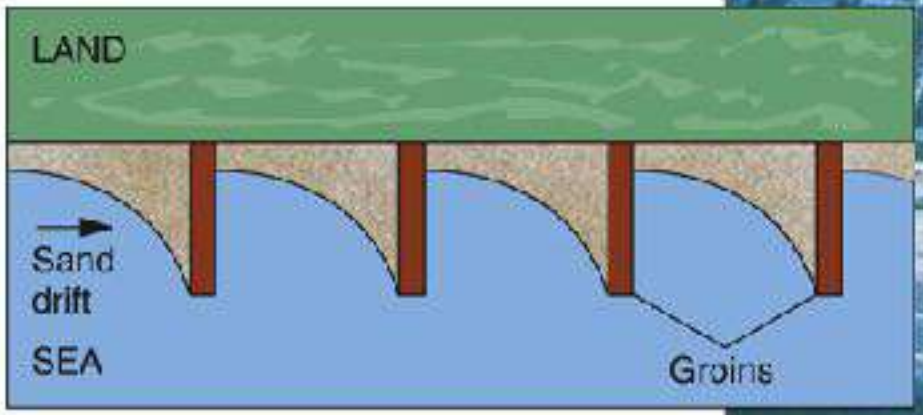
Sand Erosion and Deposition: Jetties



A

Photo by S. Jeffress Williams

Sand Erosion and Deposition: Groins



B

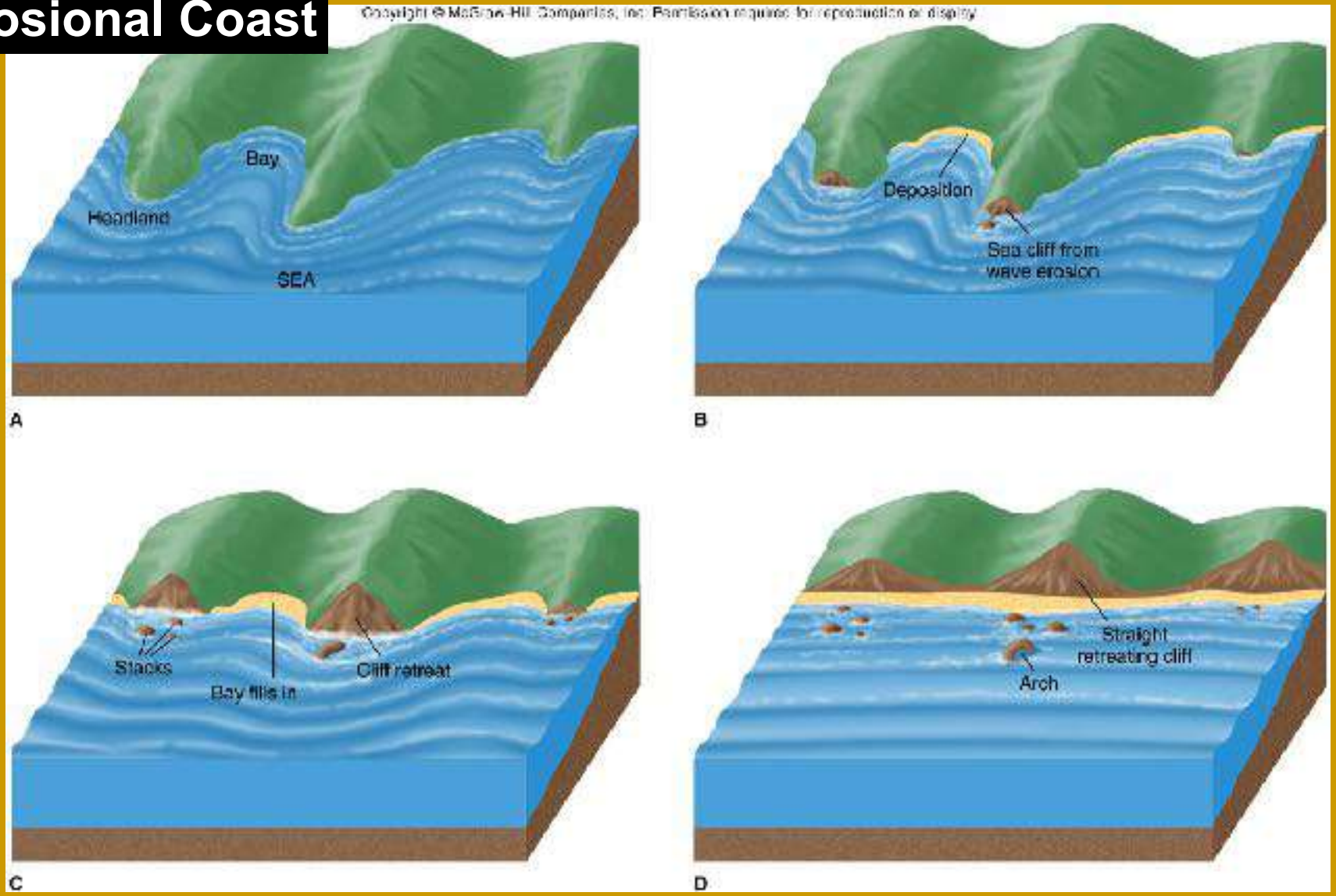
Photo by S. Jeffress Williams

Coasts and Coastal Features

- Erosional Coasts
- Depositional Coasts
- Drowned Coasts
- Uplifted Coasts
- Coasts Shaped by Organisms

Shoreline Straightening

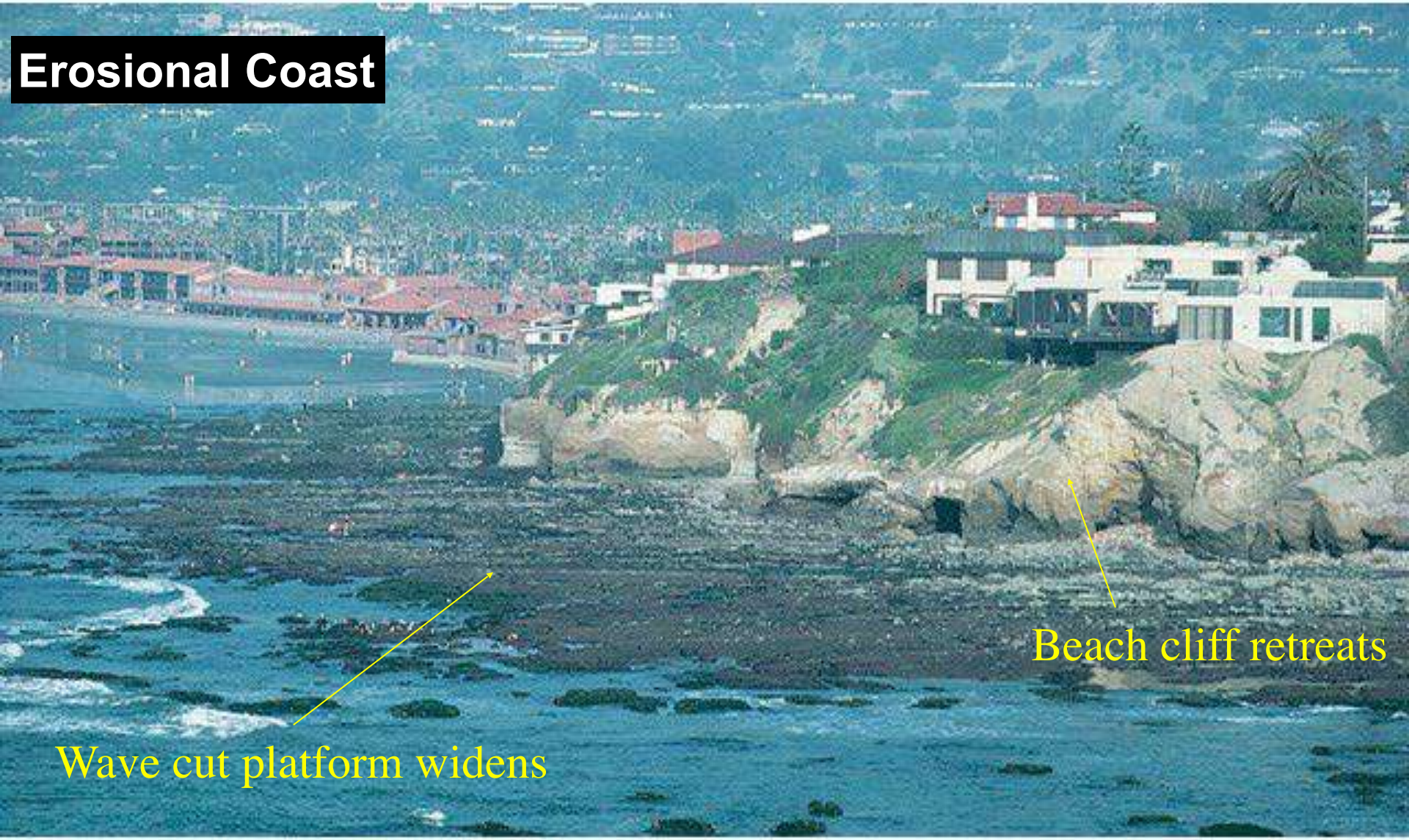
Erosional Coast



Wave Cut Cliff Retreat

Photo by David McGeary

Wave Cut Platform - Low Tide

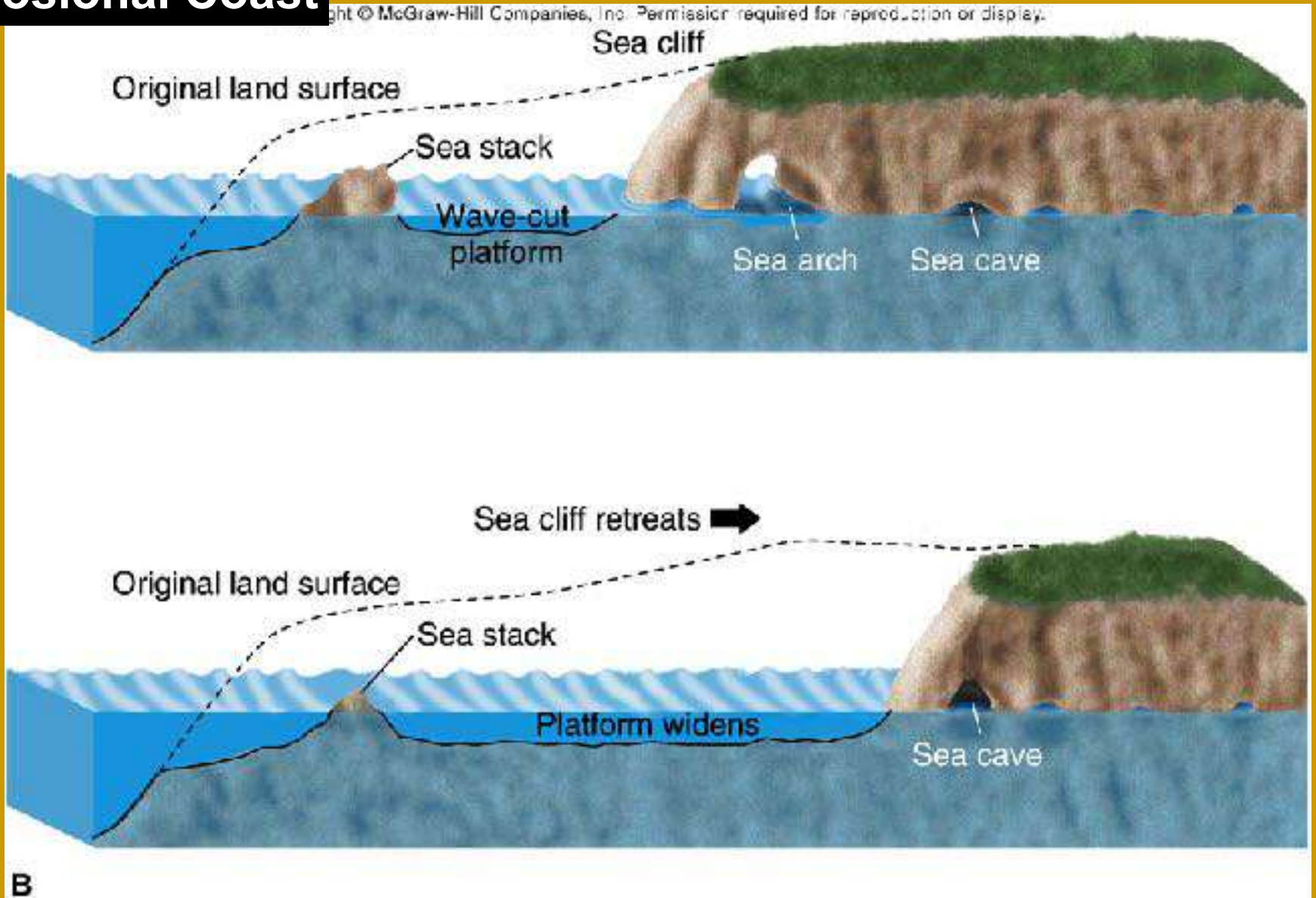


A

Photo by David McGeary

Cliff Retreat & Wave Cut Platform Growth

Erosional Coast



Stacks and Arches

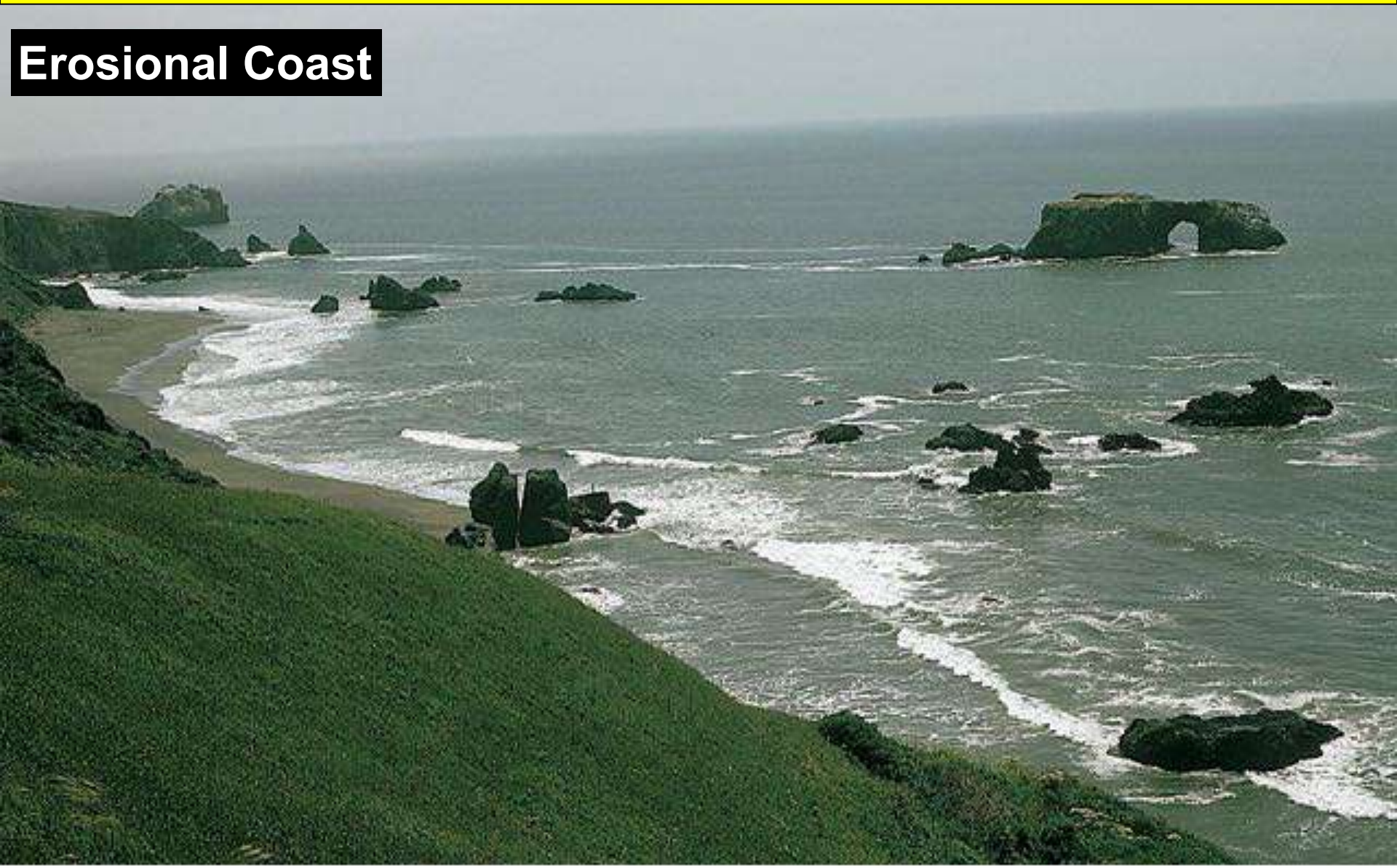
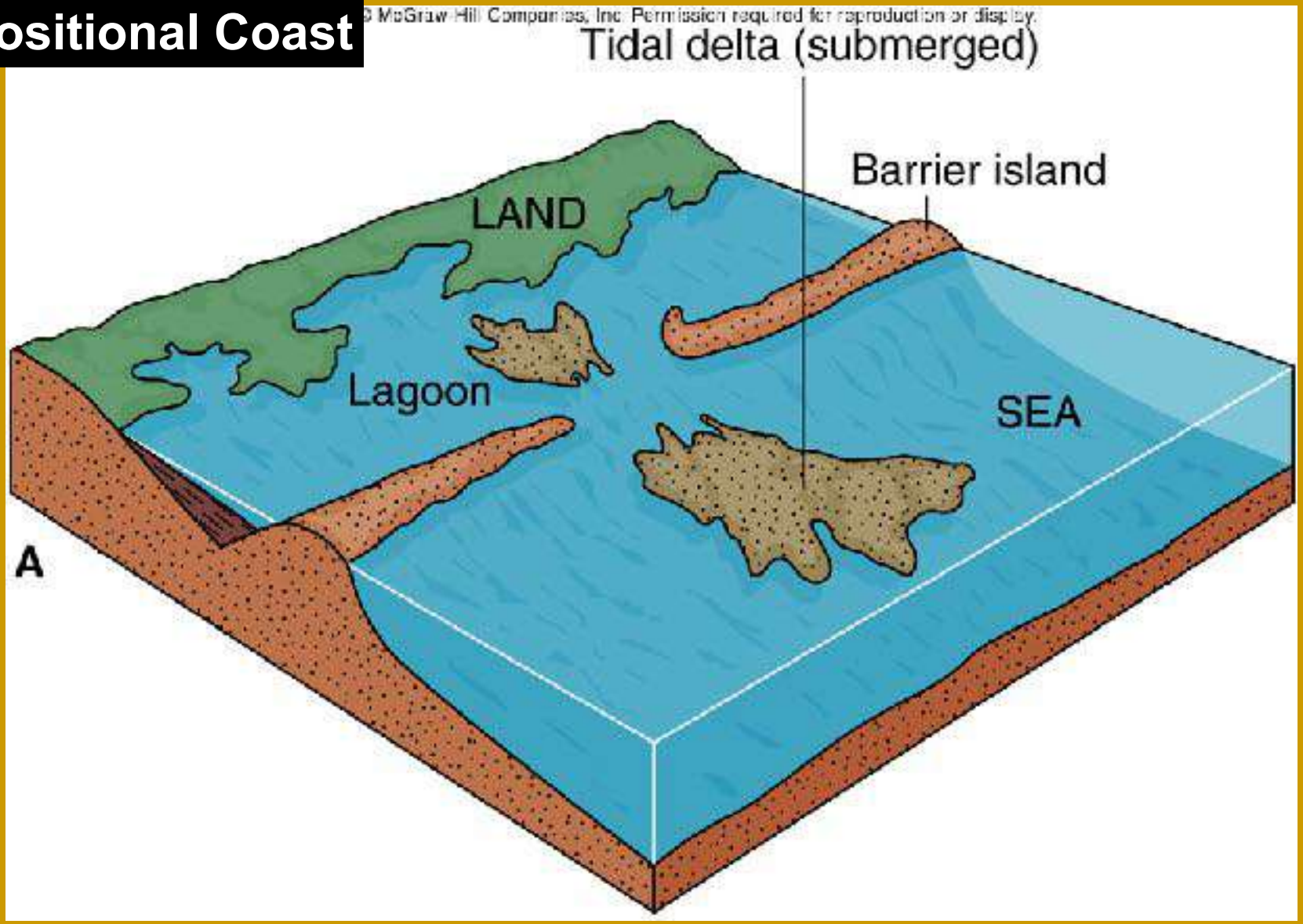


Photo by David McGeary

Depositional Coasts - Barrier Island

Depositional Coast



Barrier Island Development

Depositional Coast

Photo by Florida Division of Tourism

Albemarle and Pamlico Sounds, NC

Depositional Coast

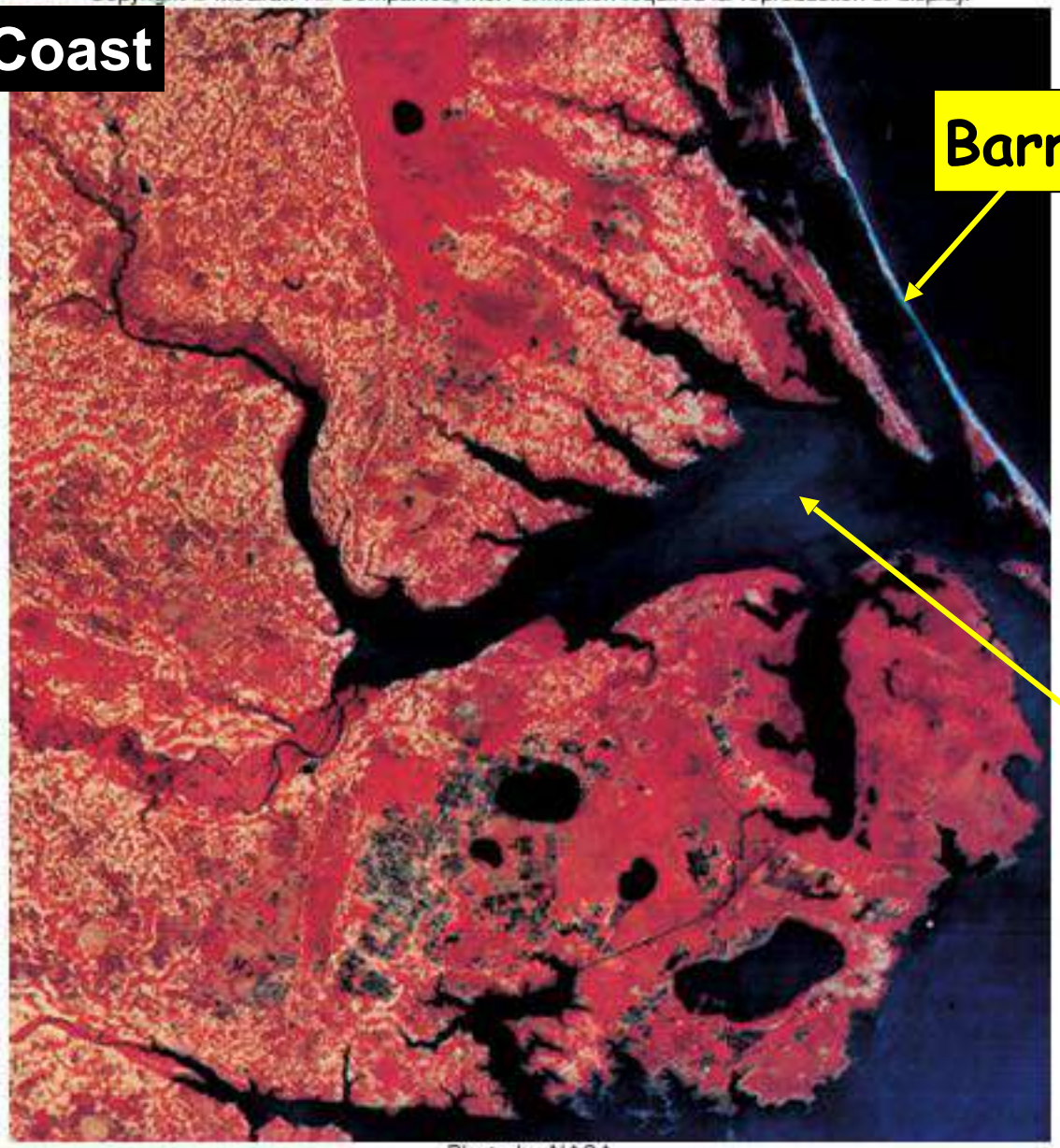


Photo by NASA

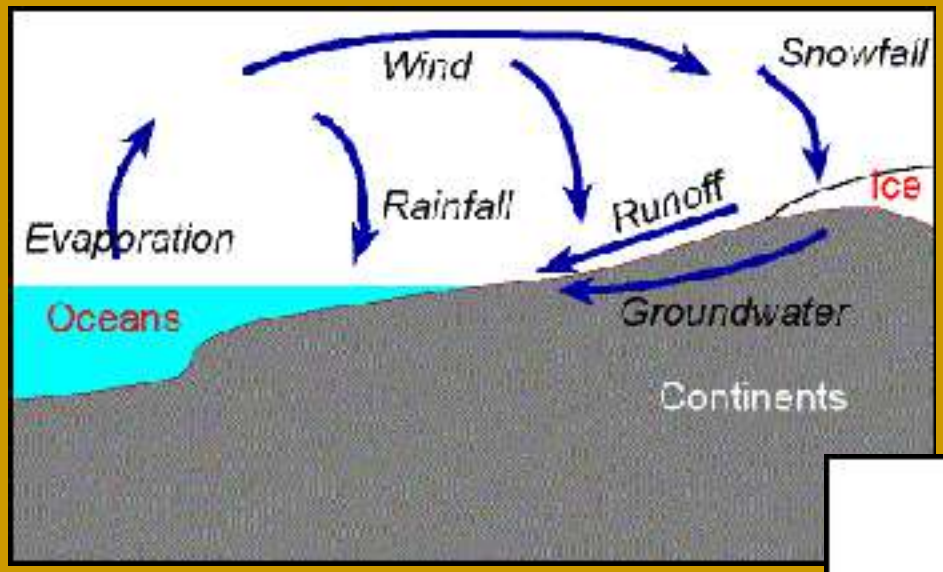
Infrared Image: vegetation shown in red

Uplifted Marine Terrace, CA

Uplifted Coast

Photo by David McGeary

Hydrological Cycle and Glaciation



Glacial Periods:
- Low standing seas
- Ice accumulation on continents

Interglacial Periods:
- High standing seas
- Little or no ice accumulation on continents

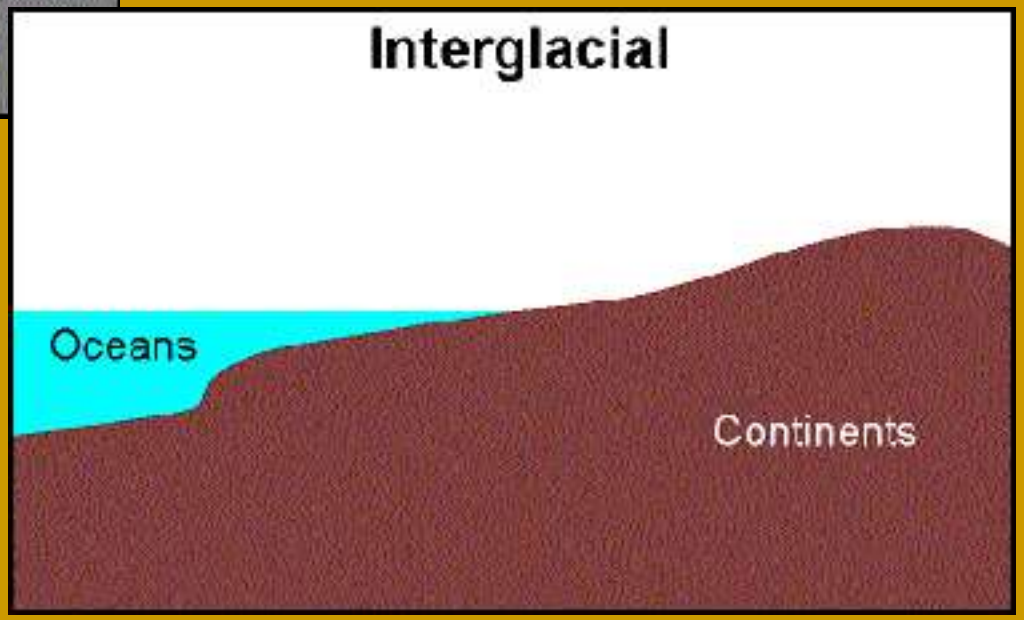


Image source: http://www.homepage.montana.edu/~geol445/hyperglac/eustasy1/

Relative Sea Level Changes in NAM

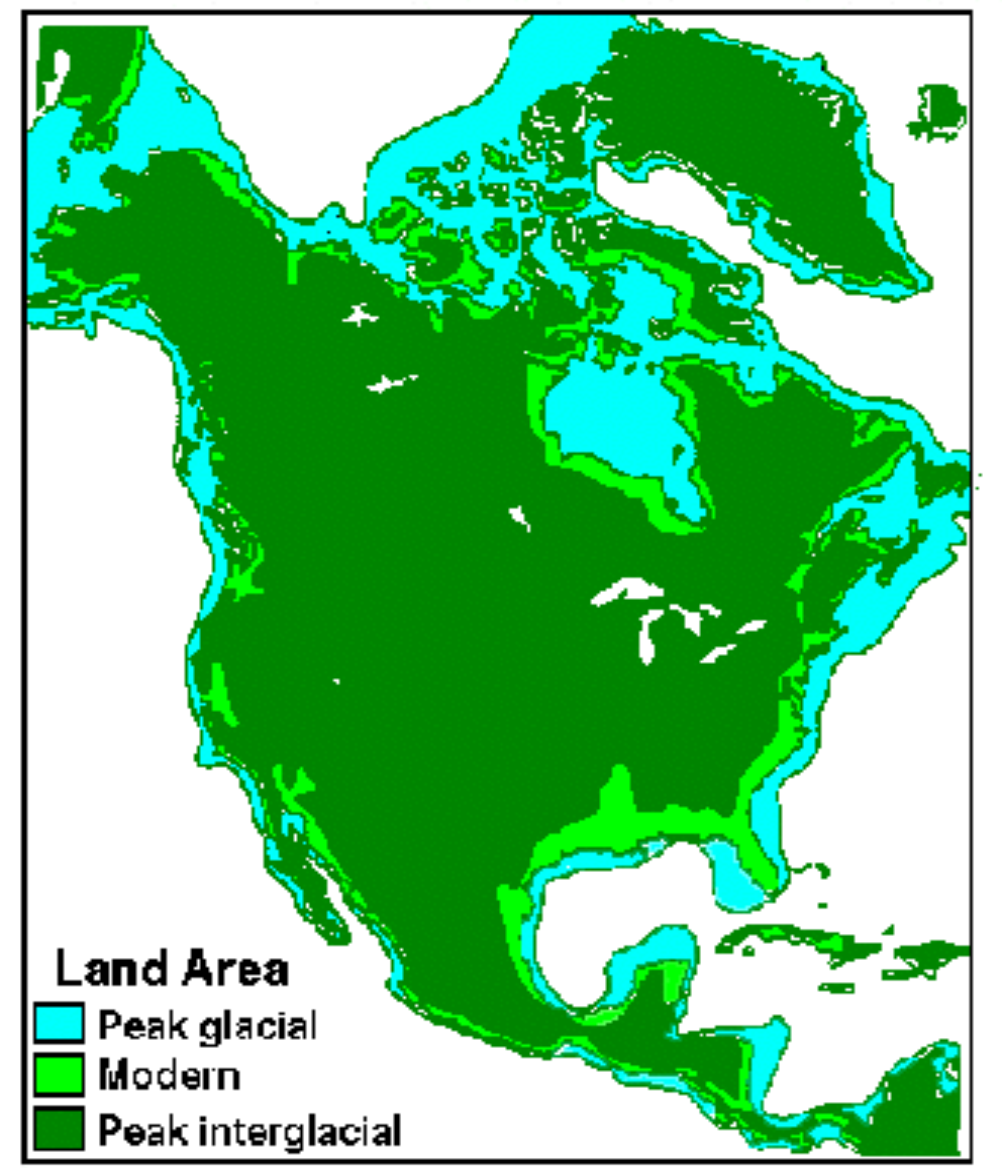
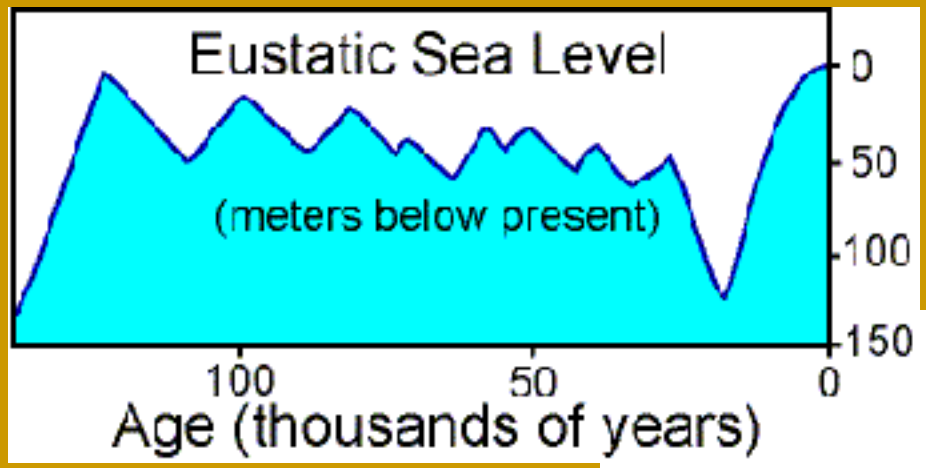


Image source: http://www.homepage.montana.edu/~geol445/hyperglac/eustasy1/

Marine Terraces and Sea Level



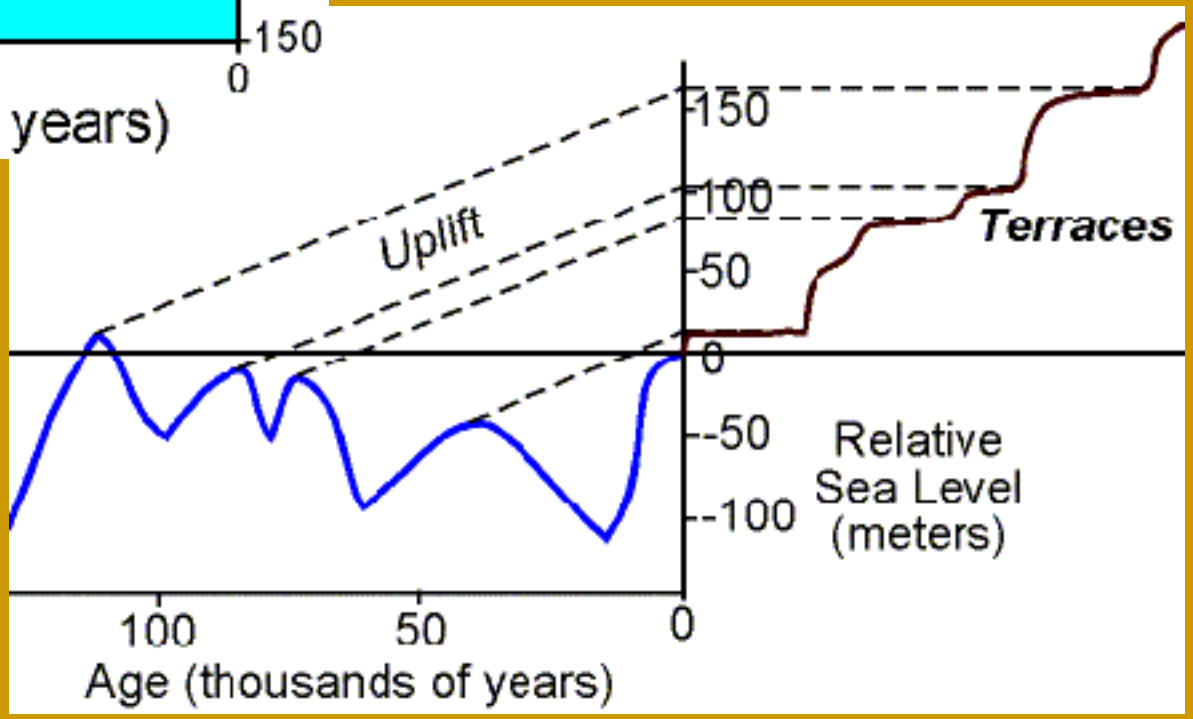
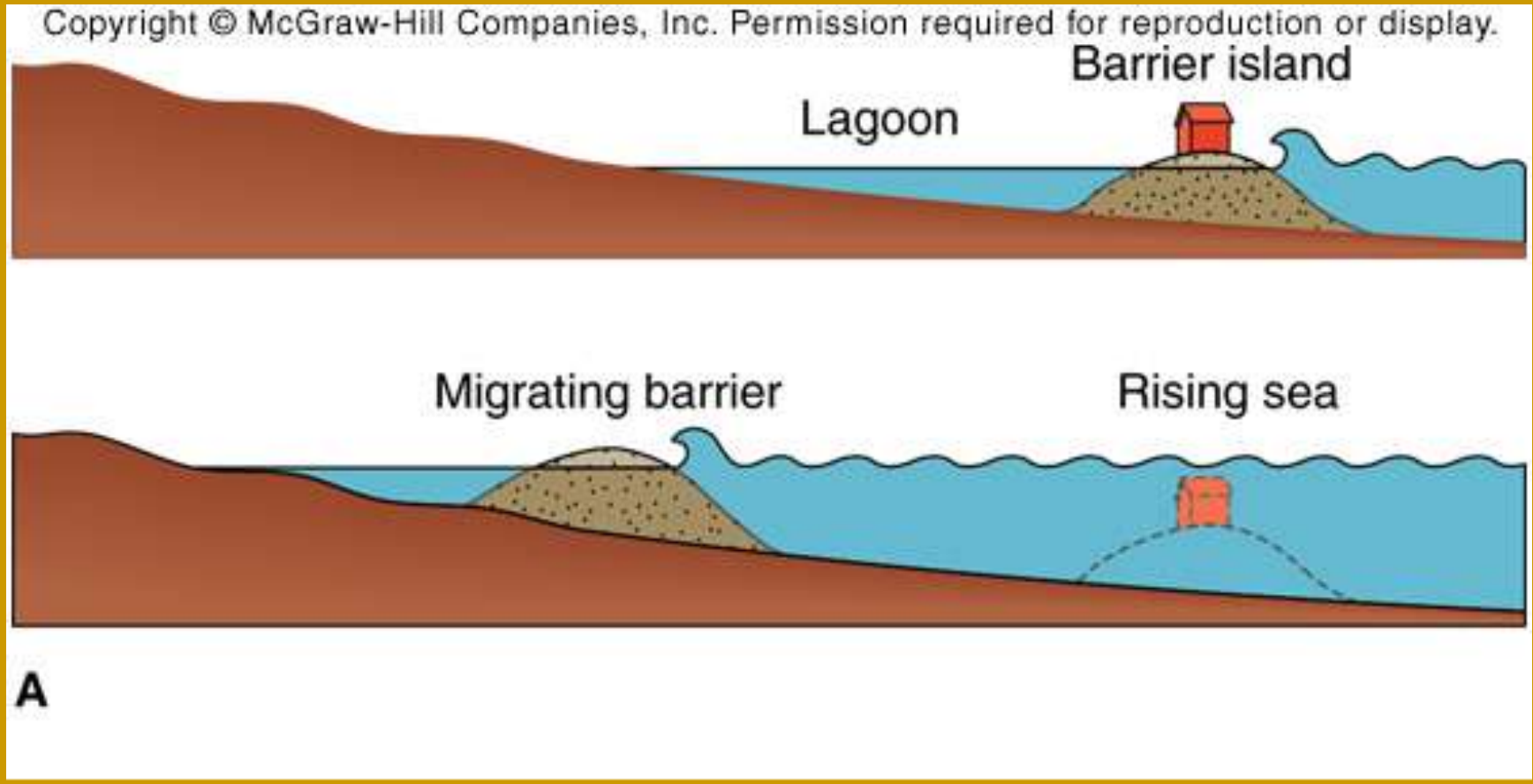


Image source: http://www.homepage.montana.edu/~geol445/hyperglac/eustasy1/

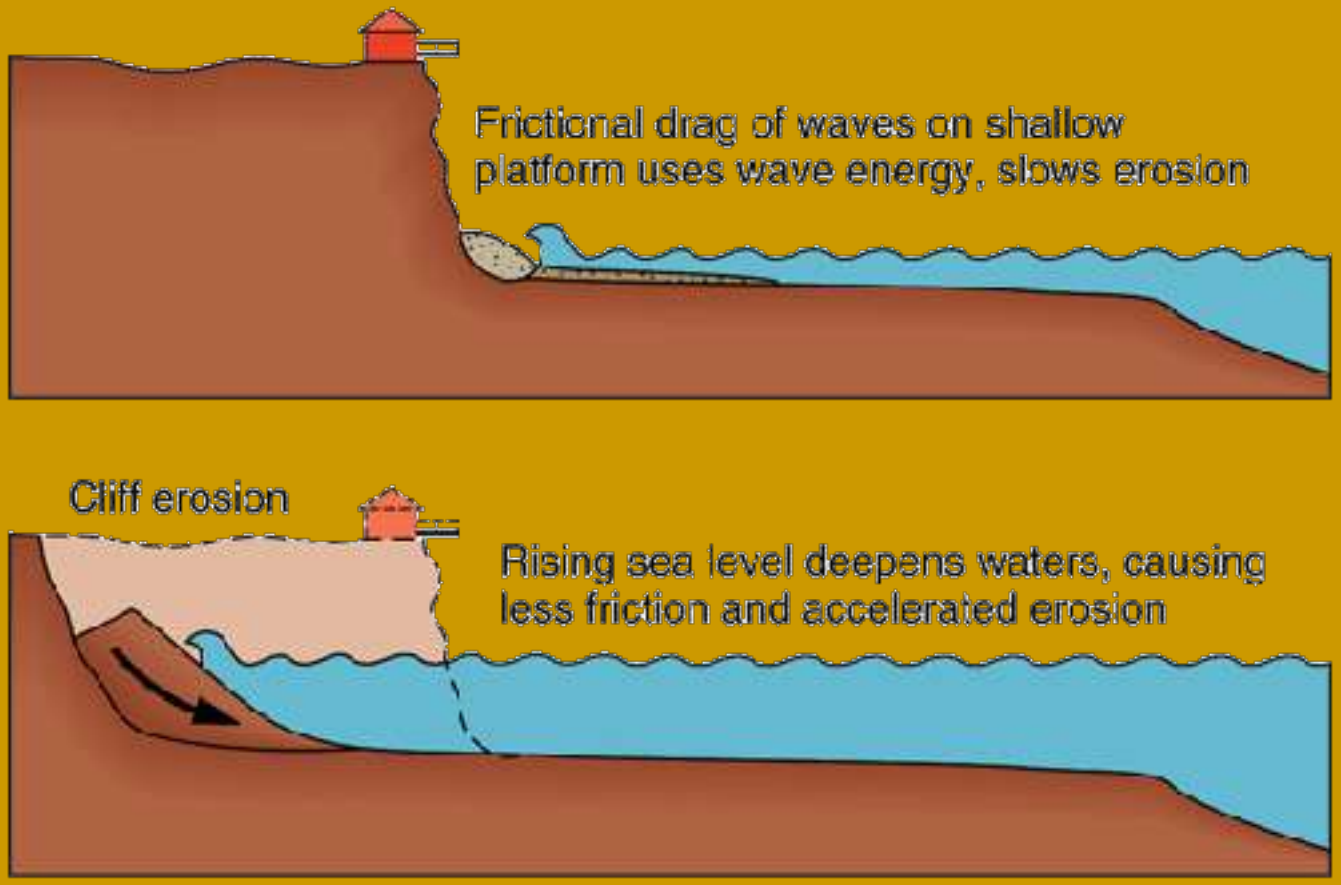
Summary of Sea Level Changes

- Sea level has risen 130 m in last 15 ka due to melting of Pleistocene glaciers.
- Initially rate was **rapid**, ~1.3 m/100 year, but in last 3000 years it **slowed** to about 0.04 m/100 year.
- Since 1930, sea level rise has again **increased** and now is ~0.24 m/100 year or 2.4 mm/yr along Atlantic and Gulf coasts.
- Suggested causes include **Global Warming** due to **Greenhouse** gas emissions and increased glacial melting in response.

Effects of Rising Sea Level - I

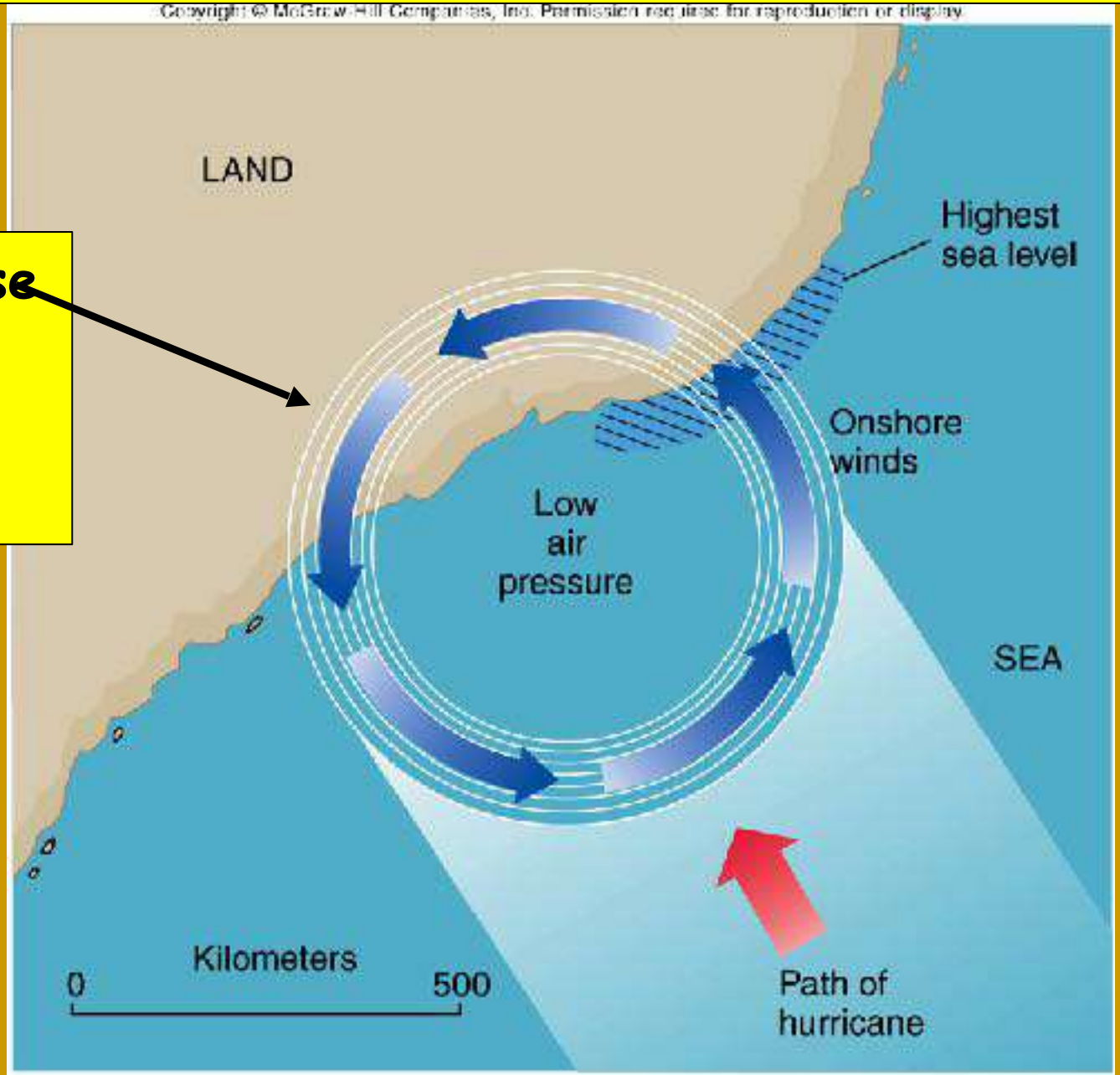


Effects of Rising Sea Level - II

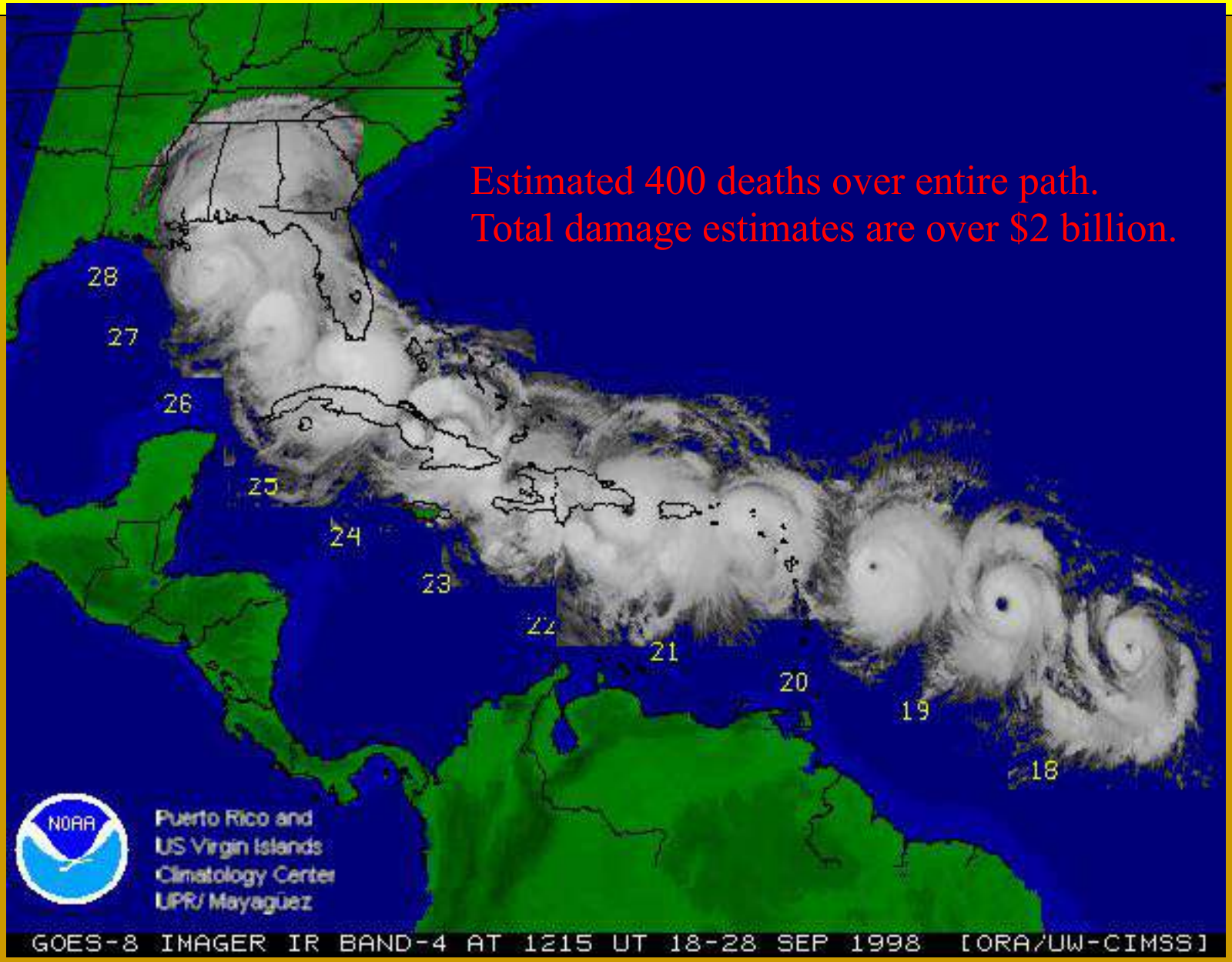


Hurricane Storm Surge

Anti-clockwise rotation in the northen hemisphere



Hurricane Georges - 1998



Georges Landfall - US Gulf Coast

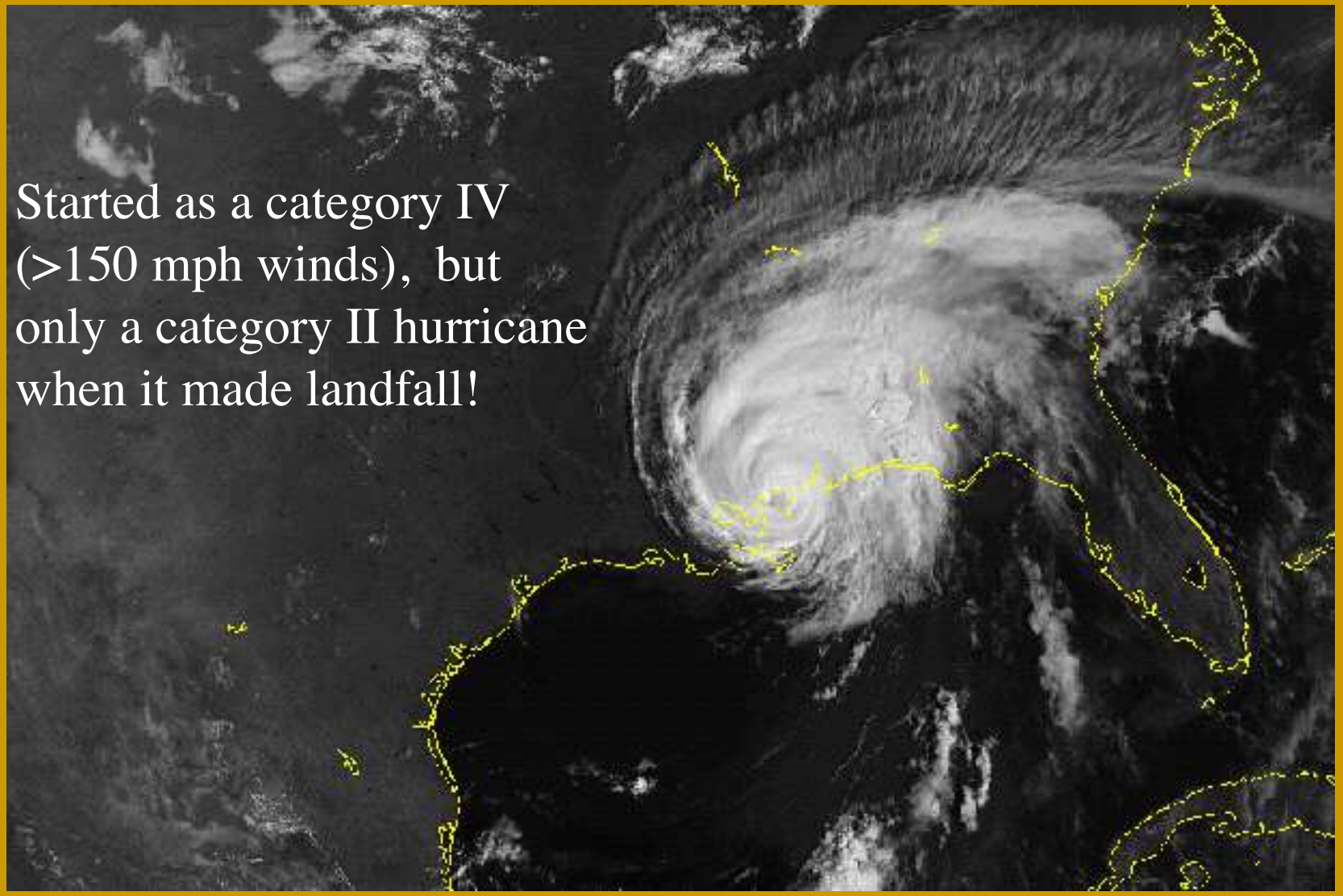


Image source: http://dmsp.ngdc.noaa.gov/html/hurricanes/atlantic98.htm

Mobile Alabama - Georges Storm Surge

AP Photo/Mobile Register, G.M.

Image source: http://www.sam.usace.army.mil/pa/October98/9810hurrig.htm

Some Historical Texas Storm Surges

YEAR	SURGE	LOCATION	COMMENTS
1837	6.5 FT	GALVESTON	
1854	8.2 FT	GALVESTON	
1877	10.5 FT	INDIANOLA	
1886	9.0 FT	SABINE	
1886	12.4 FT	SABINE	
1900	15.5 FT	GALVESTON	
1901	4.5 FT	GALVESTON	
1909	9.0 FT	VELASCO	
1913	12.7 FT	GALVESTON	
1919	8.8 FT	GALVESTON	
1919	16.0 FT	CORPUS CHRISTI	
1933	5.0 FT	PORT ARANSAS	
1941	10.8 FT	MATAGORDA	
1942	7.0 FT	HIGH ISLAND	
1942	14.7 FT	MATAGORDA	
1945	15.0 FT	PORT LAVACA	
1949	11.5 FT	HOUSTON SHIP CHANNEL	
1957	6.0 FT	GALVESTON	
1967	12.0 FT	PORT ISABEL	BEULAH
1970	9.2 FT	PORT ARANSAS	CELIA

Data from: http://www.wxresearch.org/family/surge.htm

THANK YOU