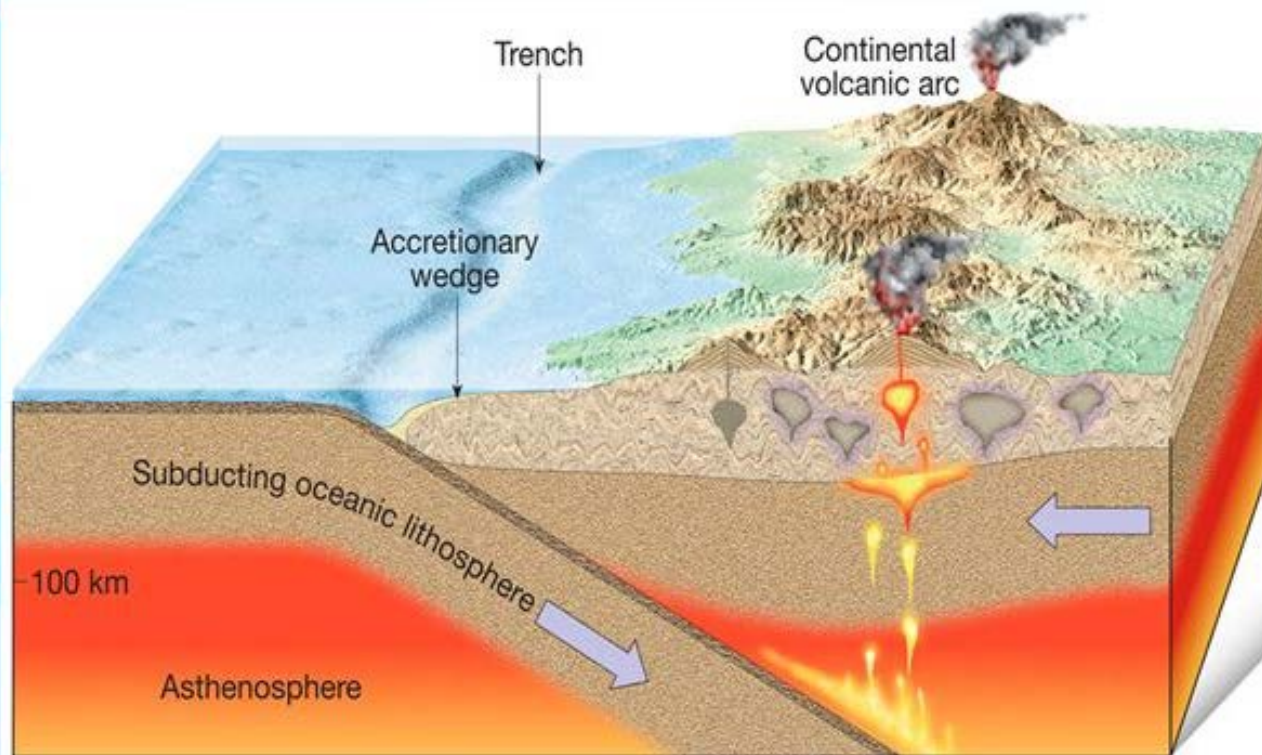


Coastal Geomorphology

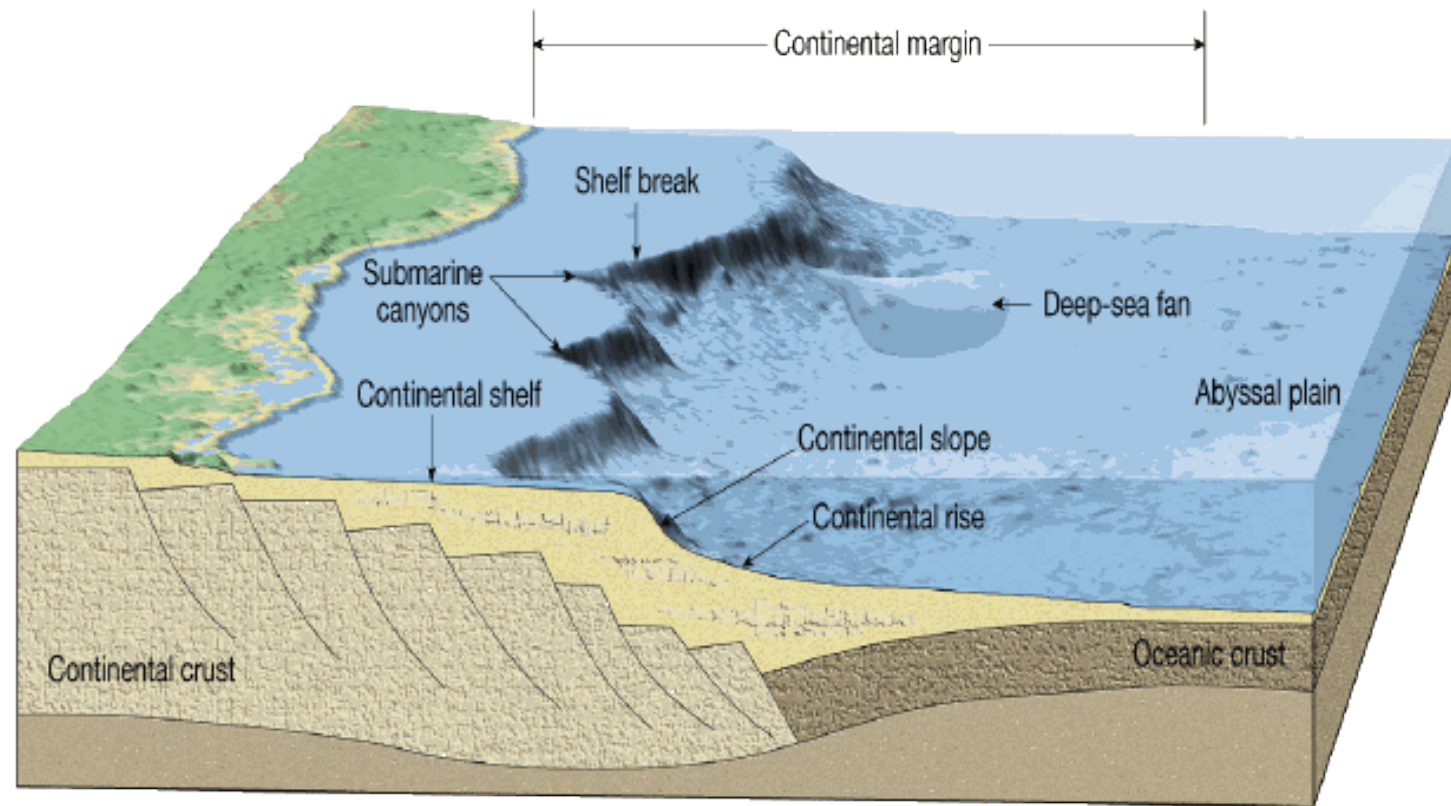
An active continental margin



Copyright © 2006 Pearson Prentice Hall, Inc.

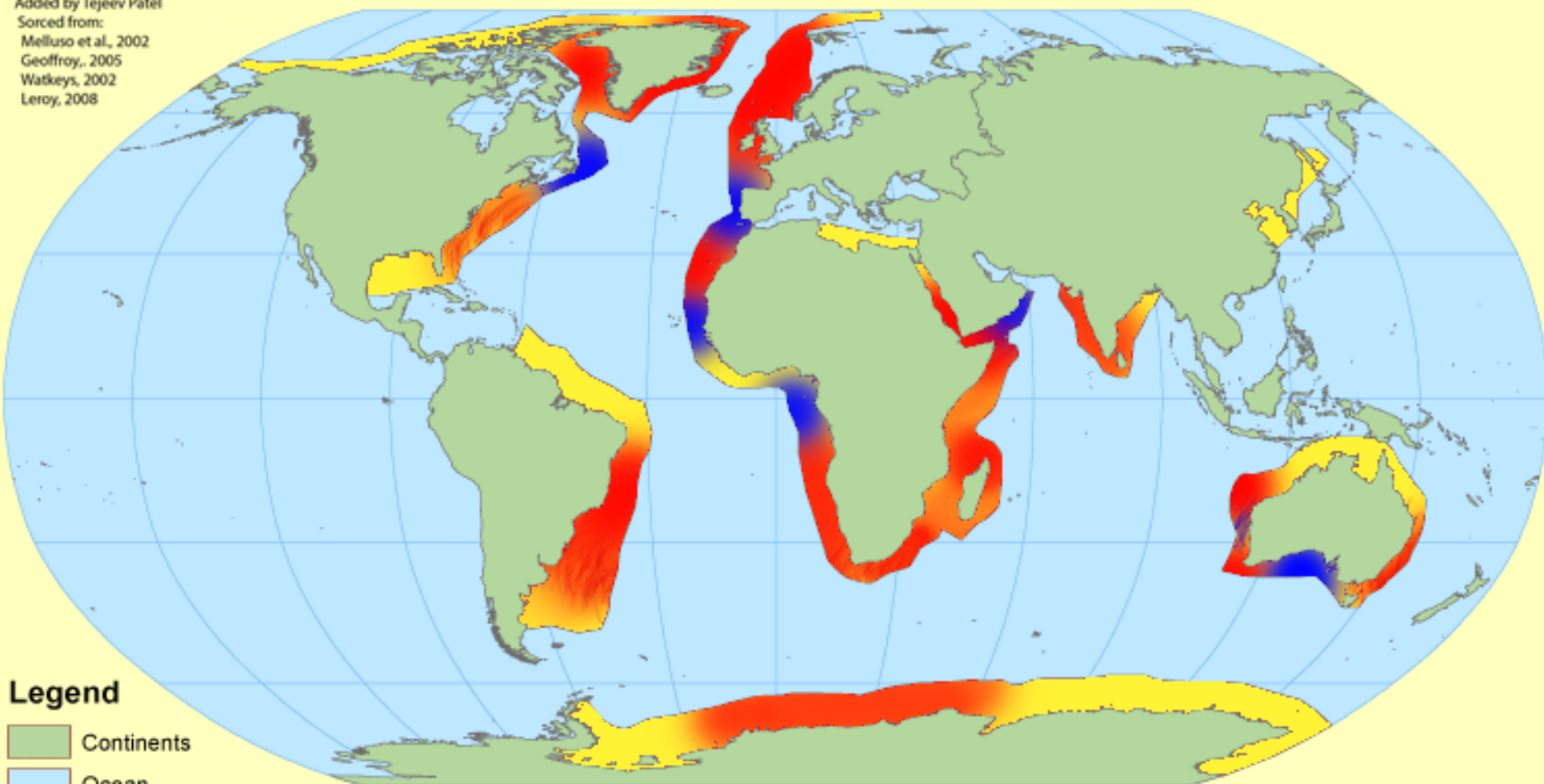


A passive continental margin



GCS_WGS_1984
 Datum: D_WGS_1984
 Projection: Robinson
 Prepared by Darin Pinto
 11/30/2007
 Volcanic and Non-volcanic Margins
 Added by Tejeev Patel
 Sourced from:
 Melluso et al., 2002
 Geoffroy, 2005
 Watkeys, 2002
 Leroy, 2008

Global Distribution of Passive Margins



Legend

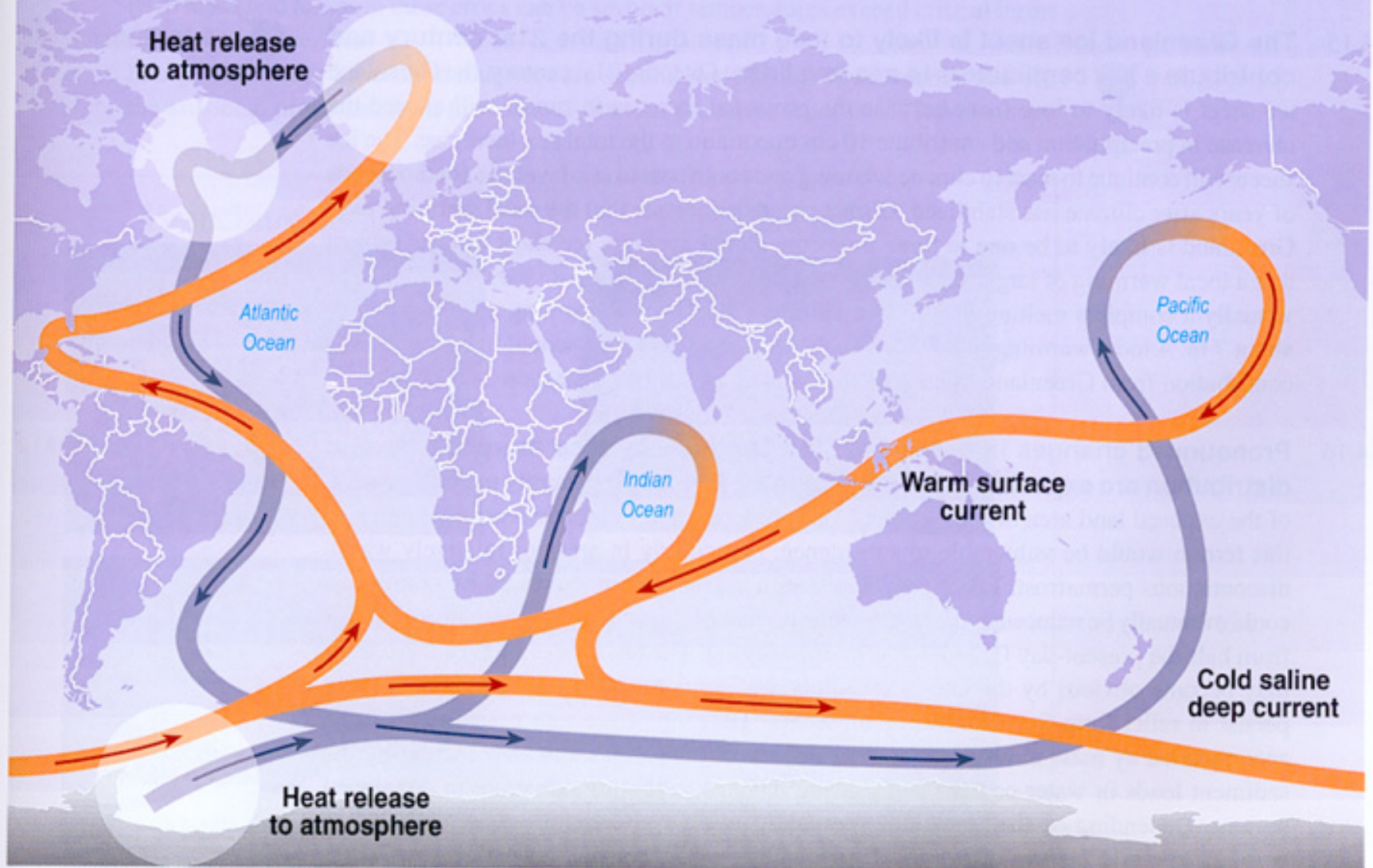
- Continents
- Ocean
- Passive Margin
- Volcanic Passive Margin
- Non-Volcanic Passive Margin
- Uncertain Non-Volcanic Passive Margin
- Uncertain Volcanic Passive Margin

0 2,000,000 4,000,000 8,000,000 Meters

A passive margin is the transition between oceanic and continental crust which is not an active plate margin. It is constructed by sedimentation above an ancient rift. Continental rifting creates new ocean basins. Eventually the continental rift forms a mid oceanic ridge. The transition between the continental and oceanic crust that is created by the rift is known as a passive margin.



Great ocean conveyor belt



Wind

1. Velocity
2. Duration
3. Distance over which the wind blows (the Fetch)

Velocity and Duration Vs. Fetch

High velocity + over a long period of time +
over long distance of open water = some
pretty big waves

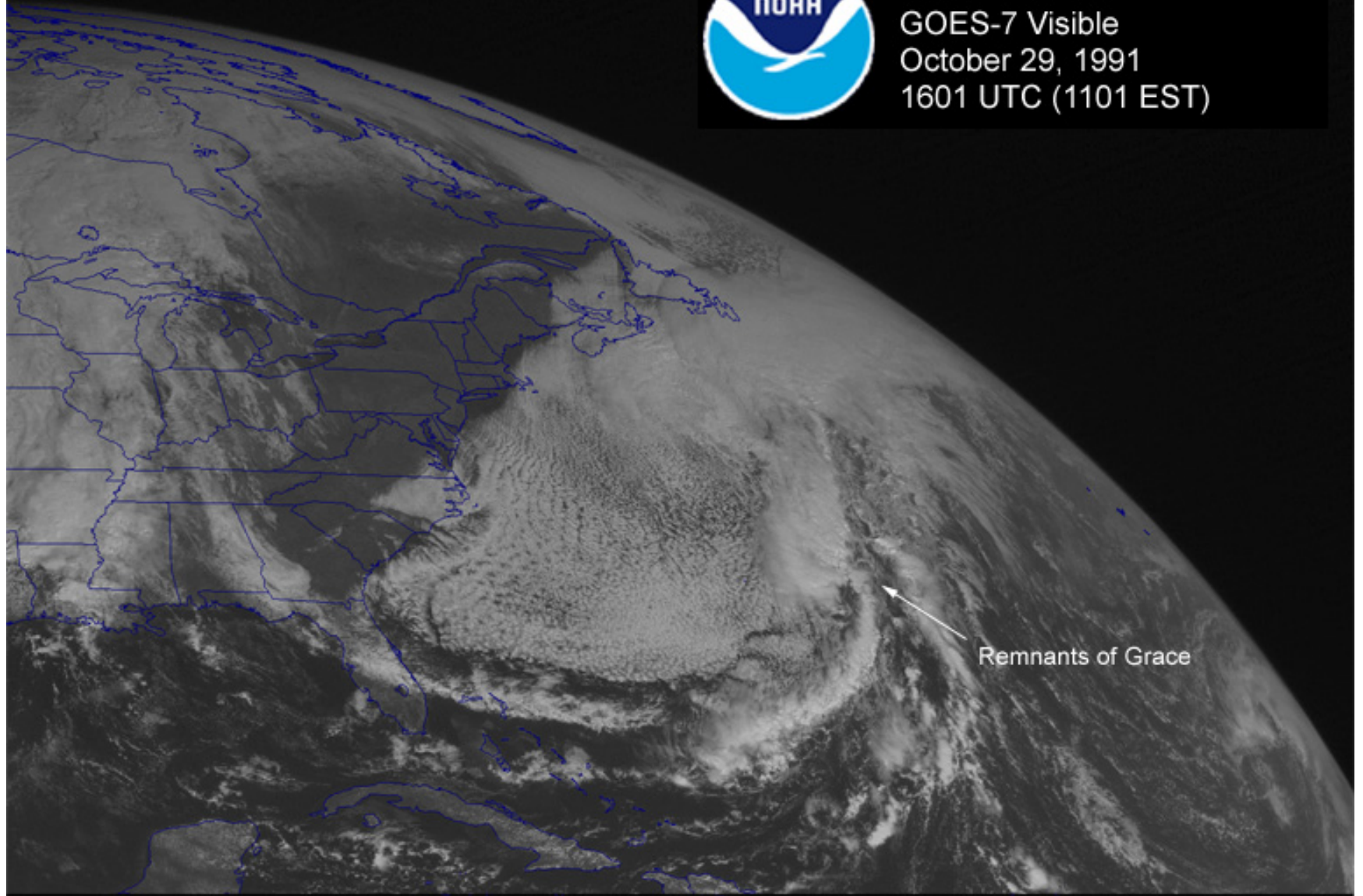


Perfect Storm Event

GOES-7 Visible

October 29, 1991

1601 UTC (1101 EST)

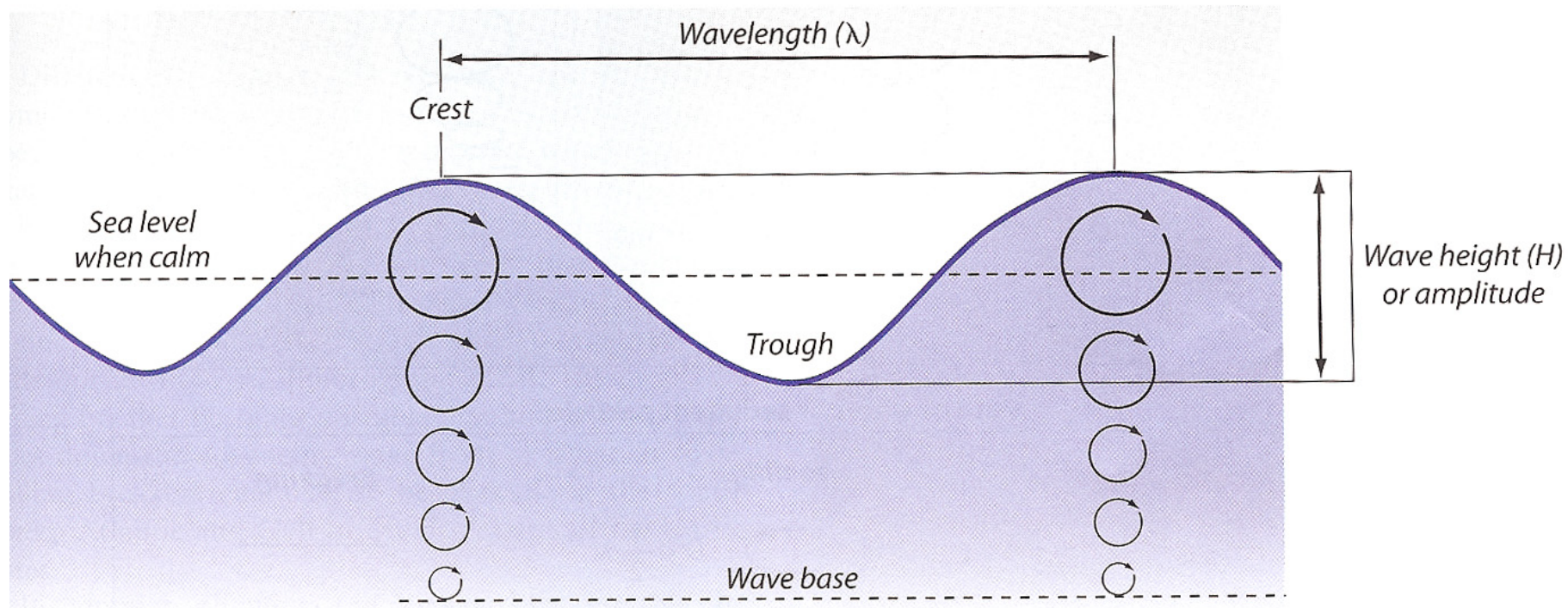


Remnants of Grace



Wave anatomy

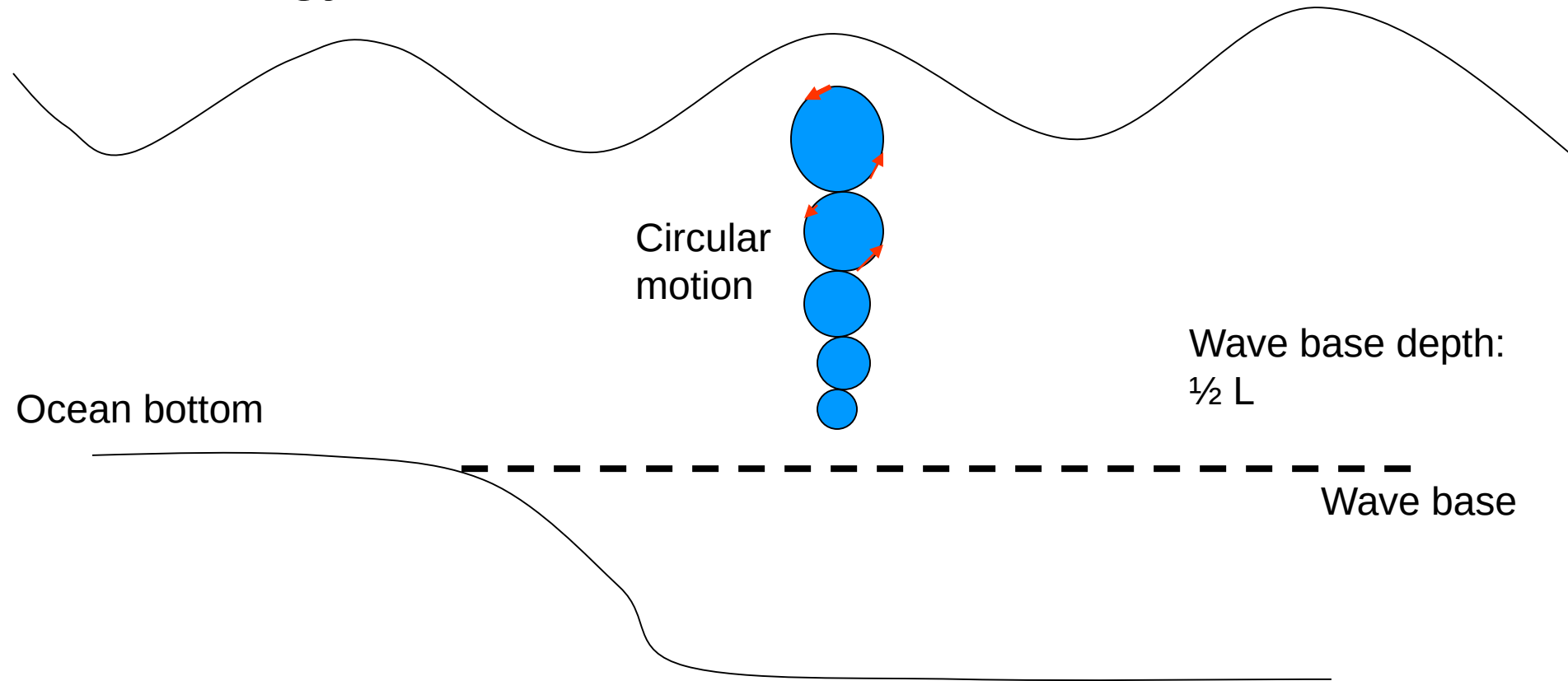
- Wavelength (L), the horizontal distance between wave crests or troughs;
- Wave height (H), the vertical distance between wave crest and wave trough;
- Wave period (T) The time taken for two successive wave crests to pass the same point
 - Celerity = wave speed = $T = (L/T)$



The **wave height (H)**, or amplitude is the elevation difference between the **trough** (low point) and **crest** (high point) of a wave. The **wavelength (λ)** is the distance between the two successive wave crests, and the wave **period** is the time it takes for the wave crest to move through the wavelength. As waves move across the surface of the sea, individual water molecules follow a roughly circular orbit that results in little net motion, advancing with the wave crest and retreating with the wave trough. **Wave base**, below which wave passage has no influence on the sea bed, is generally one-half the wavelength.

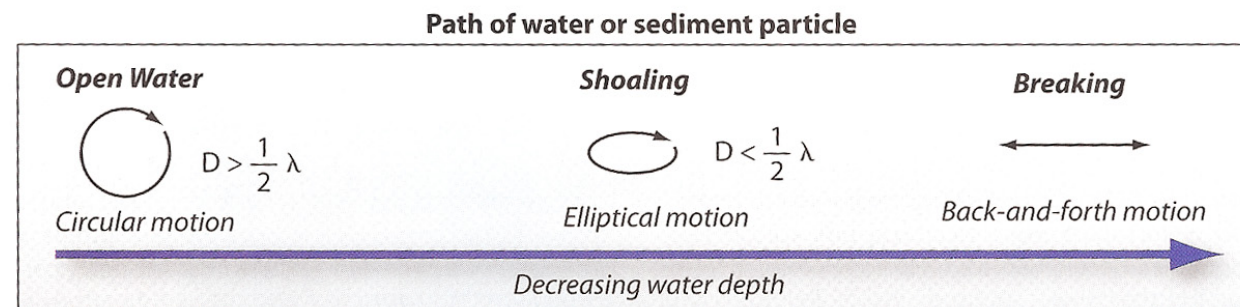
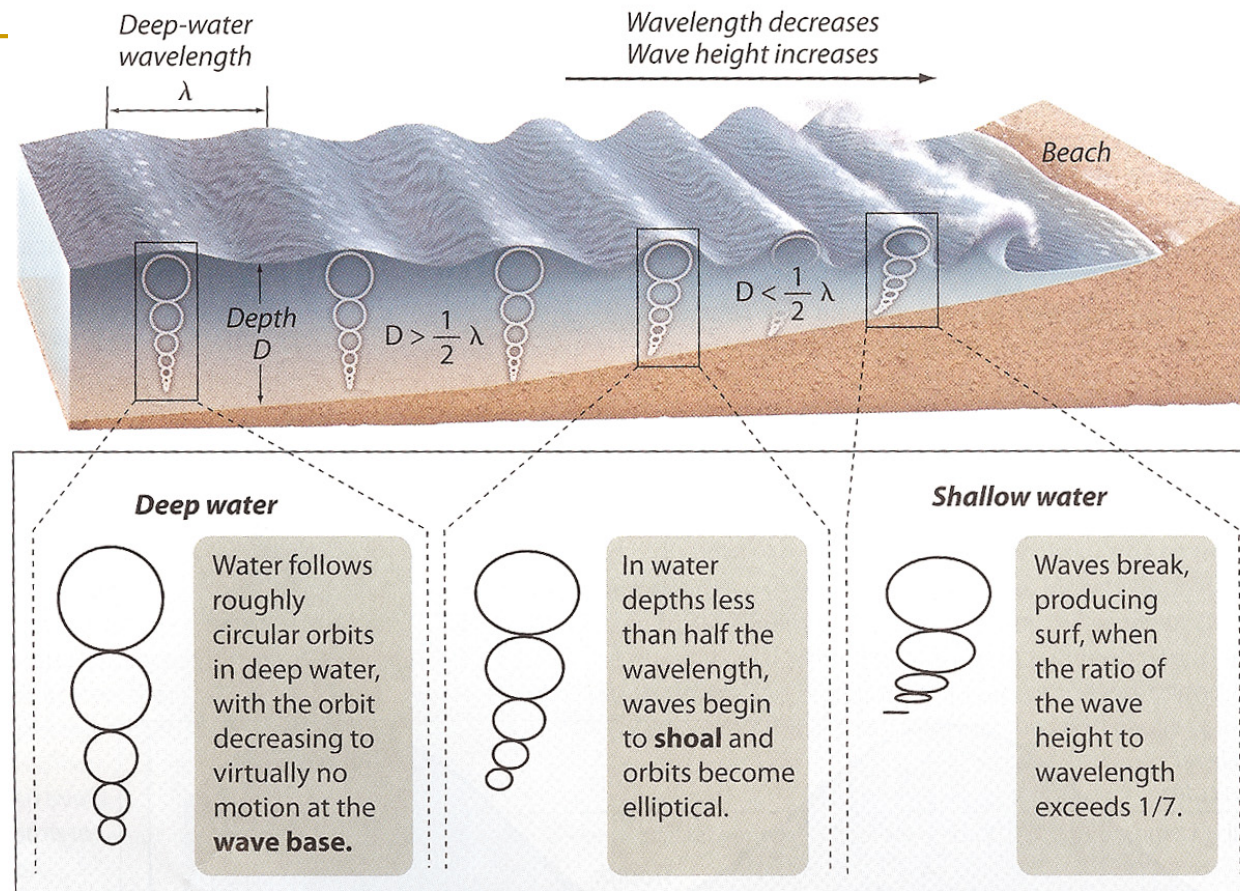
Oscillatory movement

- Little water, transport, most of the wave energy lies in vertical transfer.



Wave period (T)

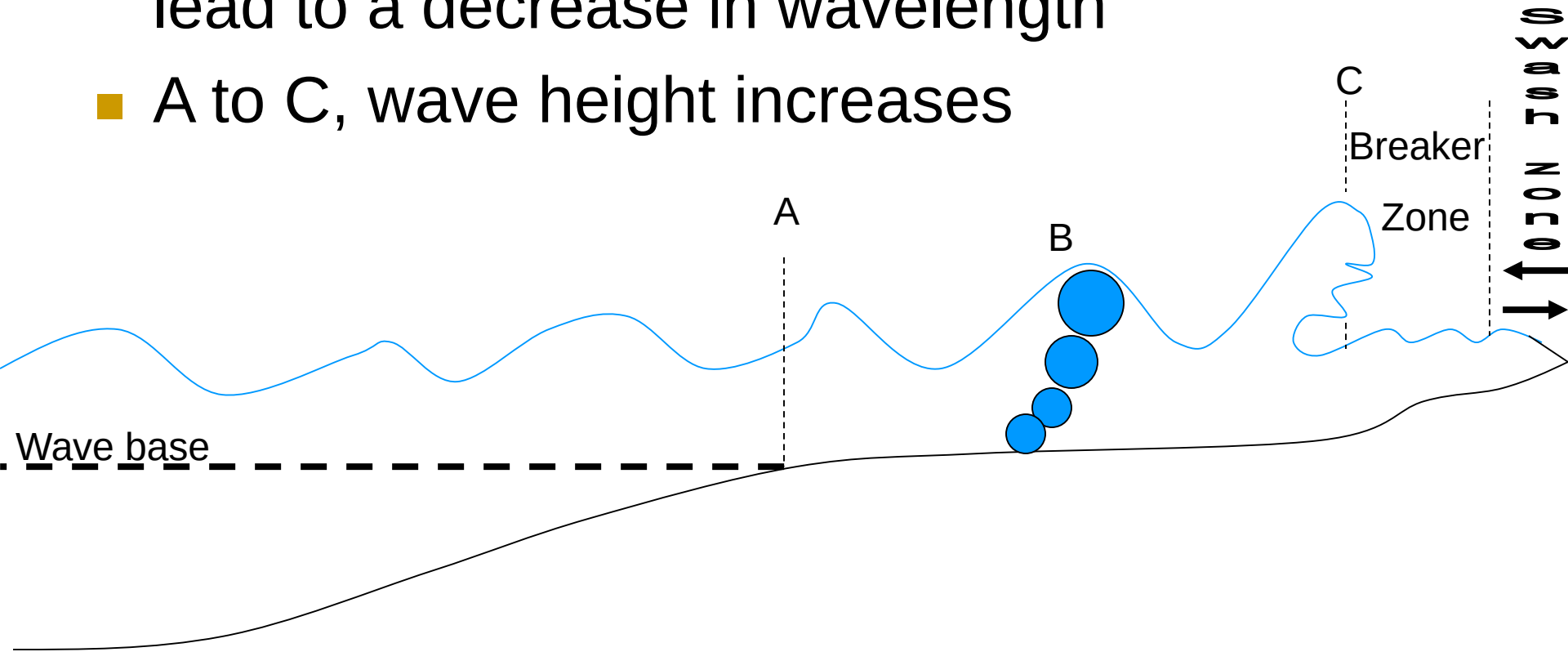
- Chop; $T = 1$ to 10 seconds, $L \sim 1$ -10 m
- Swell; $T = 10$ to 30 seconds, $L \sim 10$ to 100 m, (generated by distant storms)



In deep water, waves cause little sediment transport because the water depth, D , exceeds the wave base and is above the ocean floor. In shallower water, the wave base intersects the bed. As waves break in shallow water, bed friction becomes important and wave-induced sediment transport becomes asymmetrical.

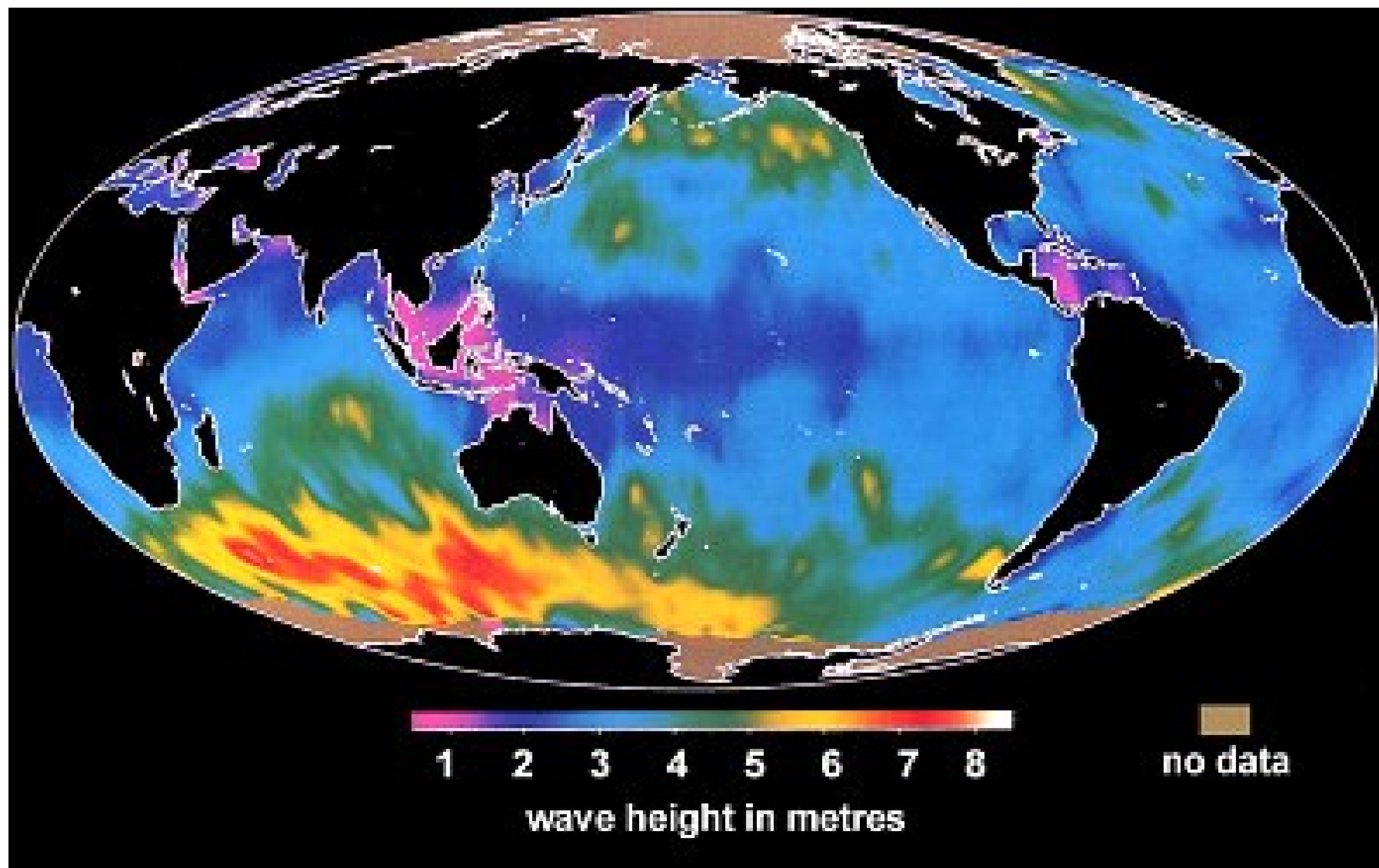
Waves approaching a shore

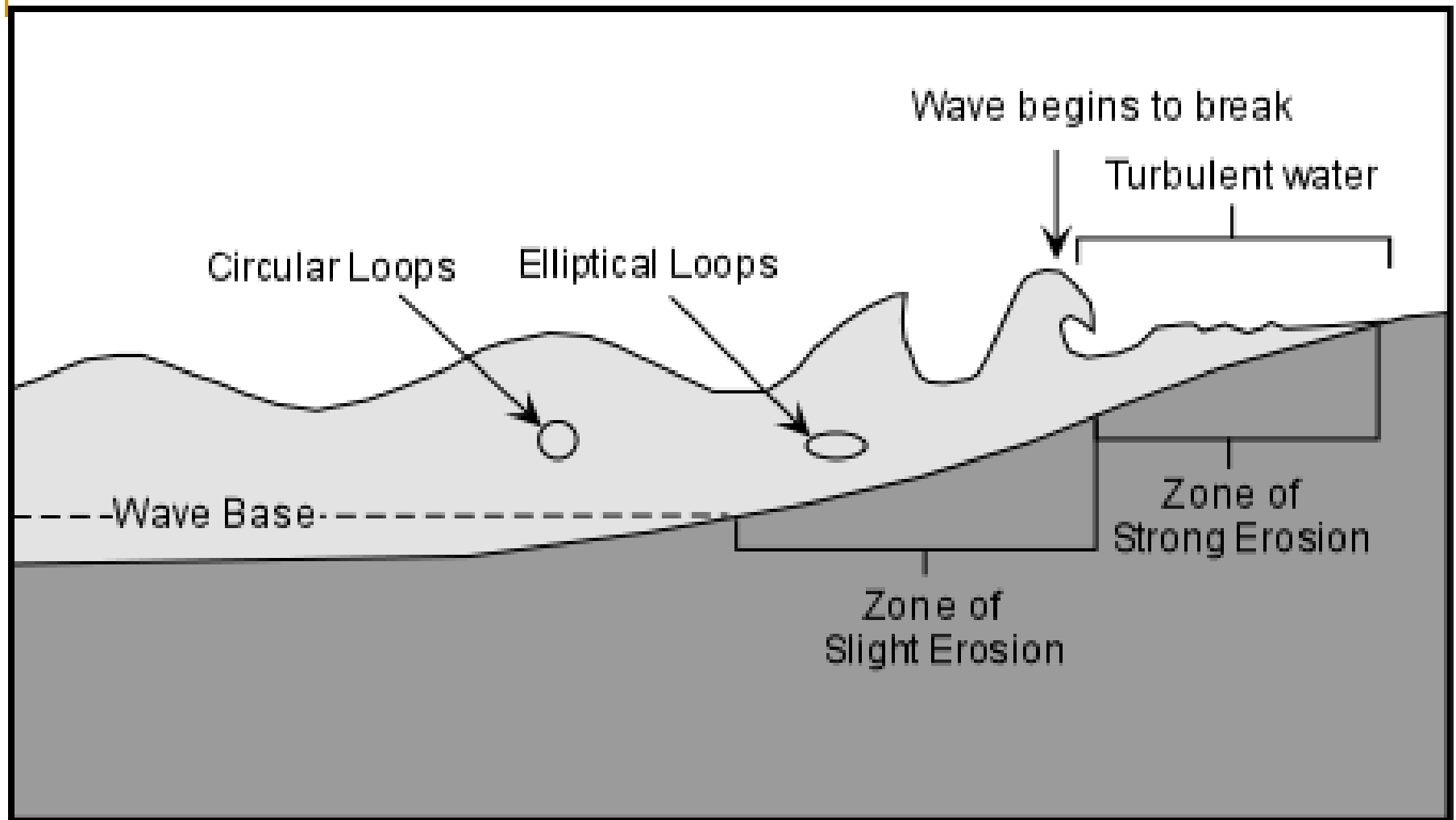
- A to B, wave speed decreases due to drag, lead to a decrease in wavelength
- A to C, wave height increases



Wave concepts

- In deep water, longer waves travel more rapidly than shorter waves and will gradually leave short waves behind. (Wave dispersion)
 - Leads to the swell formations as waves of diverse length differentiate from one another resulting in regularly spaced wave periods.
 - When varying sets of wave periods meet near the coastline the wave 'trains' often produce wave higher than either one, (Surf beat)
-





Tsunamis

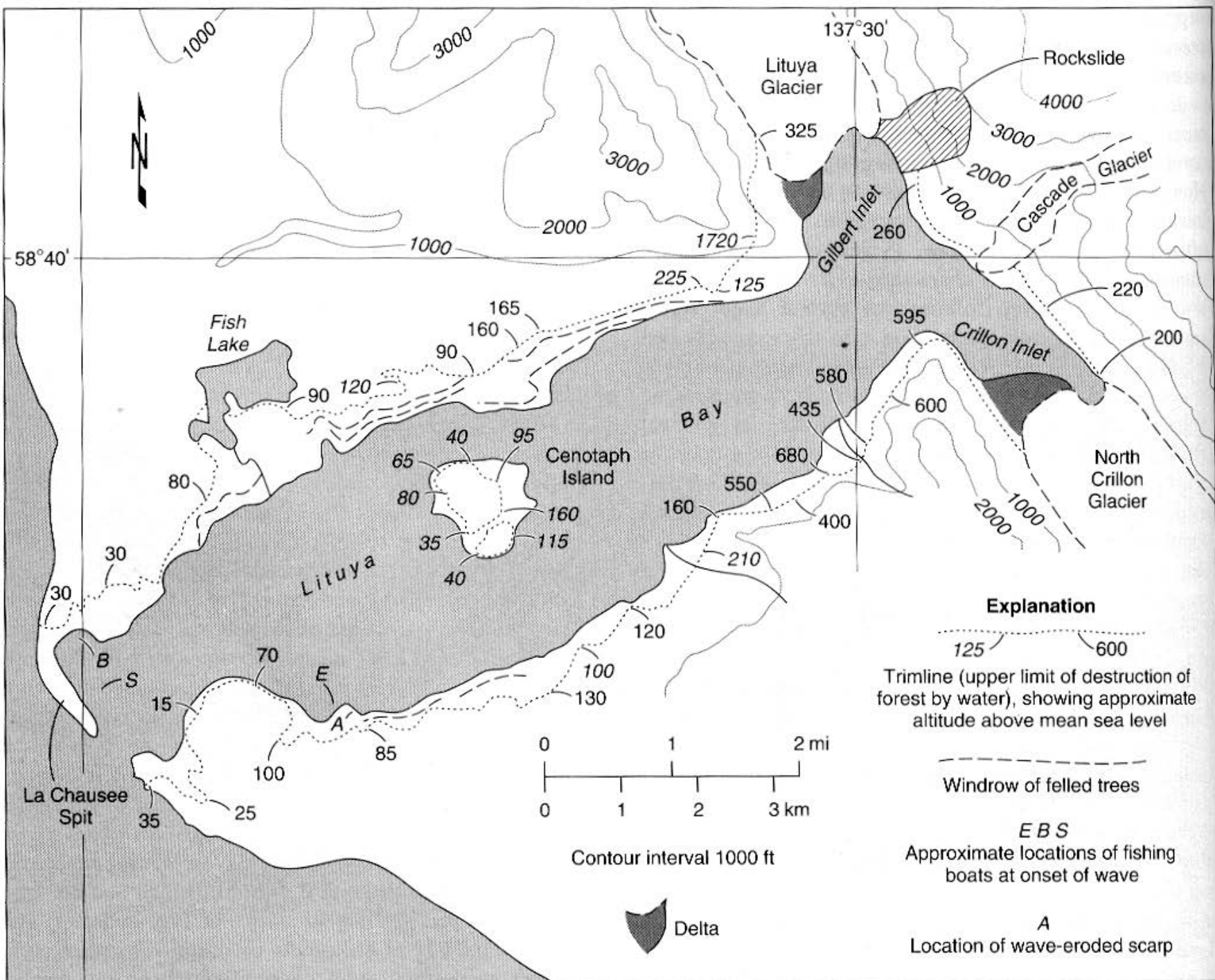
- Large waves formed by sudden tectonic displacement of the sea floor, submarine or subaerial landslides, and submarine volcanic eruptions.
 - Enormous wavelengths, 100 to 200 km, and extremely low wave heights approx. 1 meter
 - In the deep ocean the waves may go by unnoticed, but in shallow water the wave heights are capable of growing. (E.g. 525 meters or 1740 feet! Punch it? Or sit back and enjoy?)
-



Lituya Bay Alaska

July 10,
1958

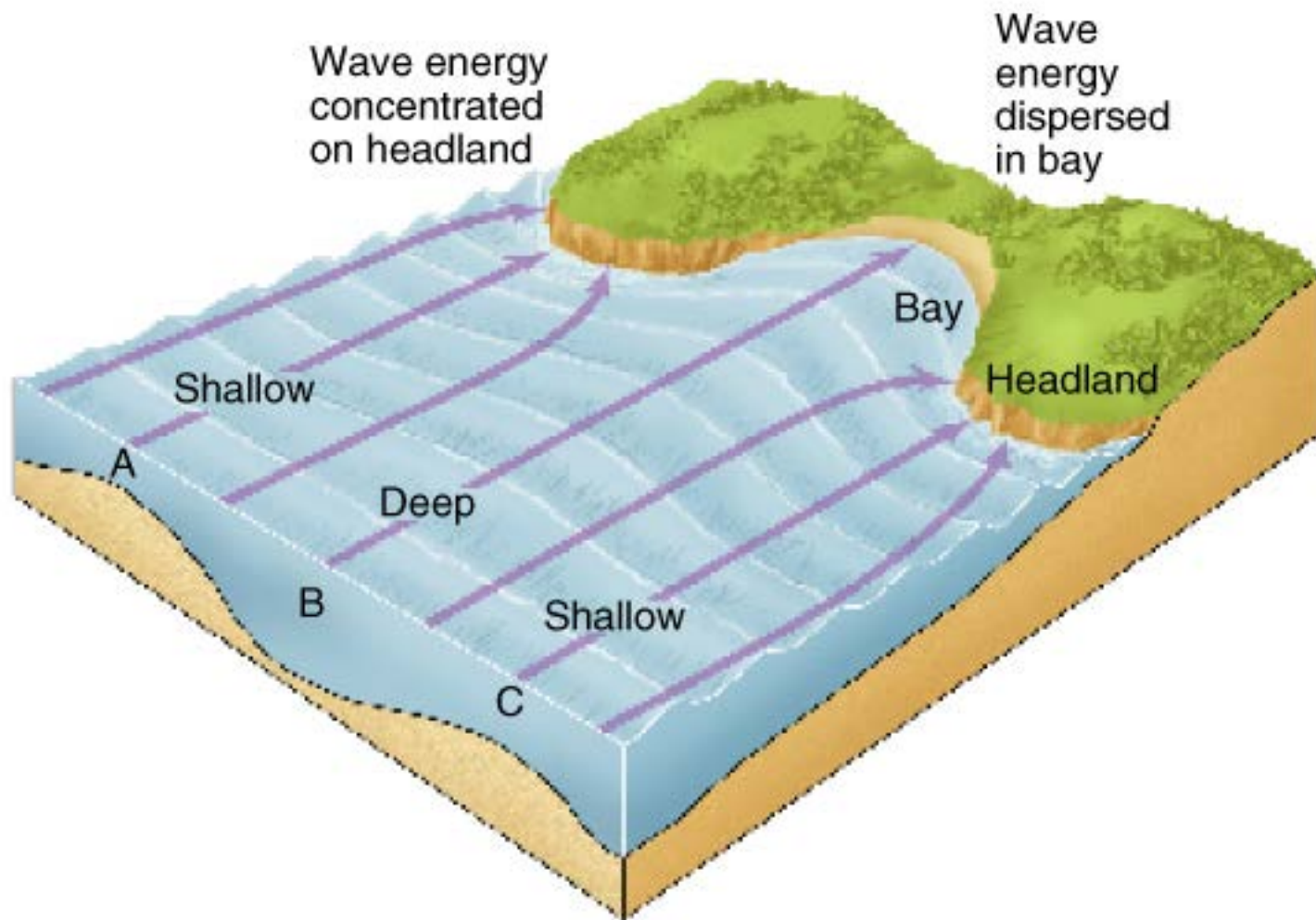
Photo by C.E. Heinzel





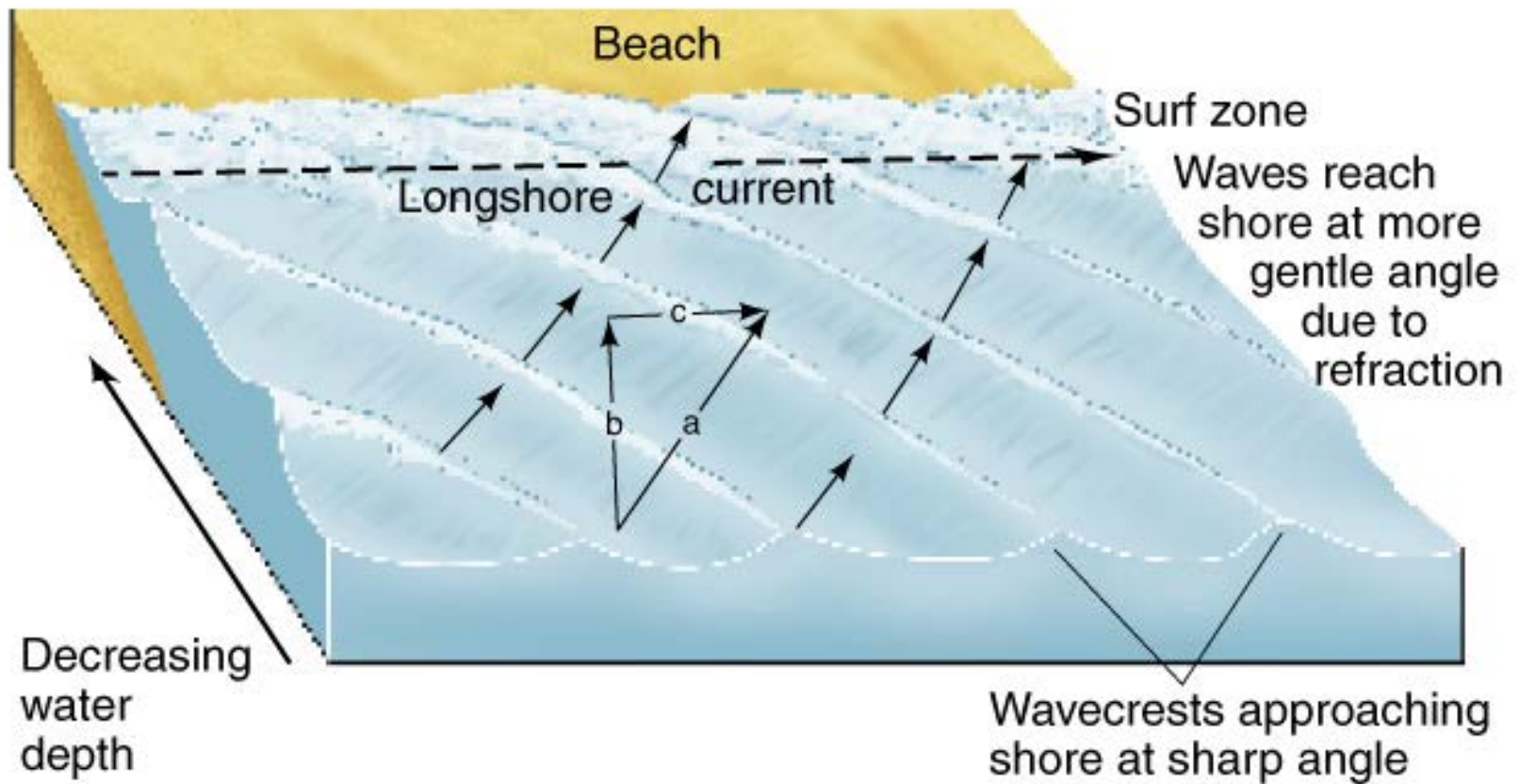
Activity along the shoreline

- Long shore current
 - Rip current
 - Beach drifting (dune formation)
 - Beach drifting + long shore current = Long shore transport
-



Longshore current

- Product of seaward waves that strike the shoreface obliquely.



Rip currents

- Are strong narrow currents at nearly right angles to the shoreline that move seaward through the surf.
 - Present a danger to swimming!
-

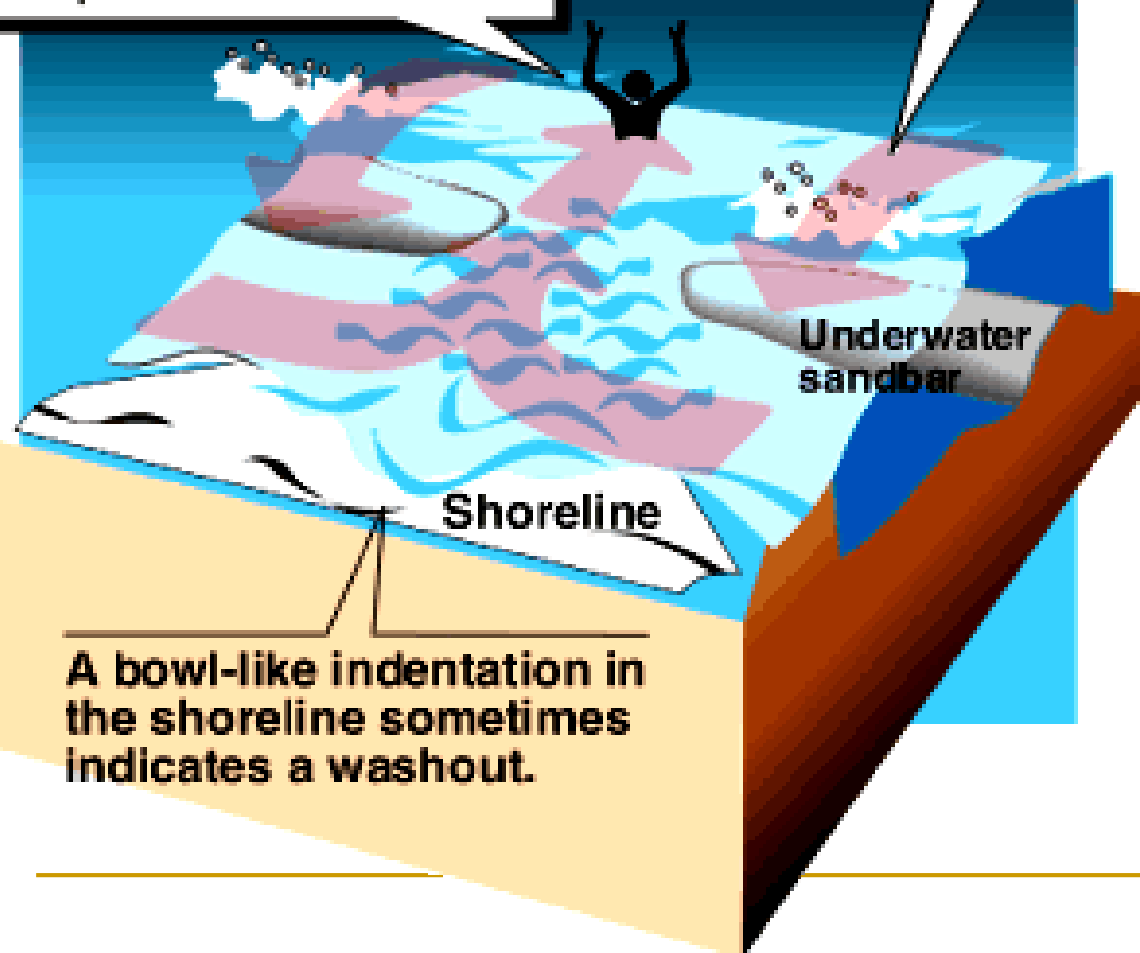




Escape

Don't try to swim toward shore against the current. It should take you out only 5 to 30 yards until it subsides. Then, swim parallel to shore to escape.

Water returning to the Gulf sometimes breaks a gap in the sandbar. The waves are usually choppy in this area.

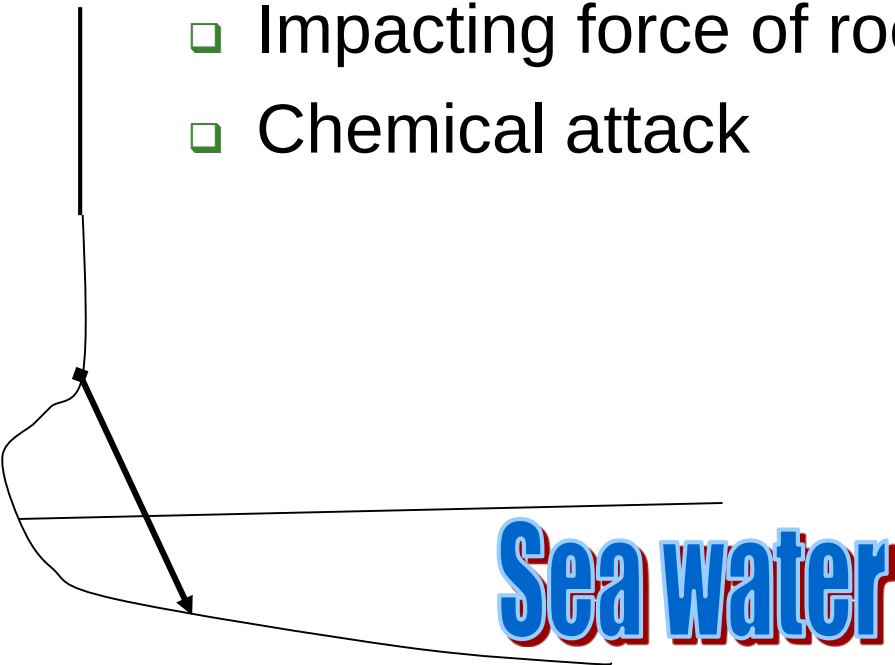


Coastal Erosion

- Sea cliffs

Sea cliffs

- Destructive forces, hydraulic forces (compressed air, water weight)
 - Impacting force of rock debris
 - Chemical attack



Sea cliff regression

- In New England: Cystalline rock 0m/yr
 - Cape Cod: Glacial drift 30cm/yr
 - New Jersey: Sand, gravel, clay 2m/yr
 - Louisiana: sand, clay, up to 38m/yr
-

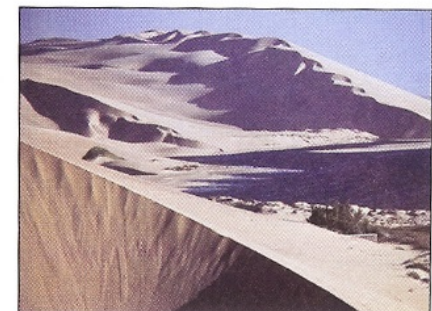
Coastal deposition

- Beaches
 - Littoral drifting
 - Spits and bars
 - Barrier bars and Islands
-

Sources

Sinks

River
input



Dunes

Tidewater
glaciers



Lagoons/
estuaries

Coastal
erosion



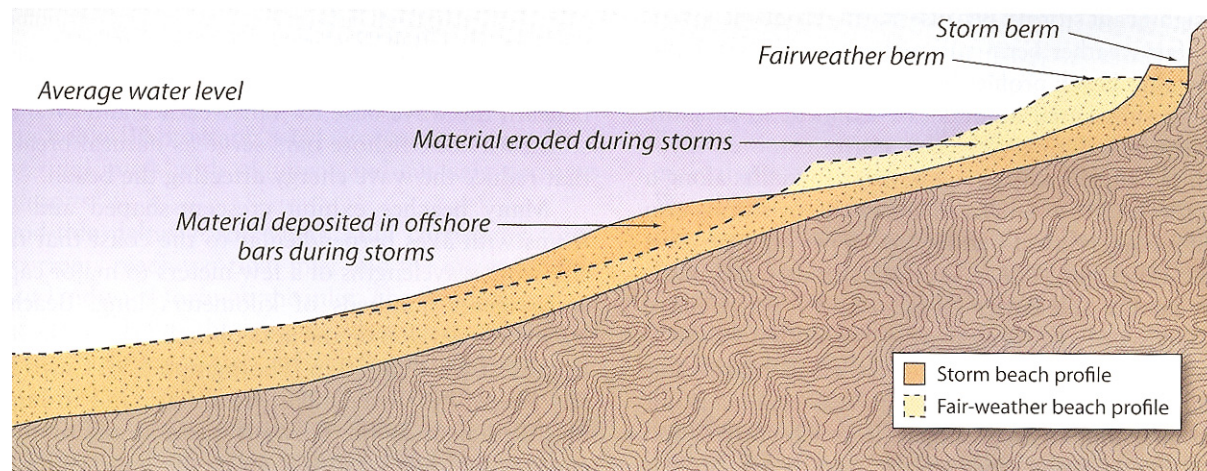
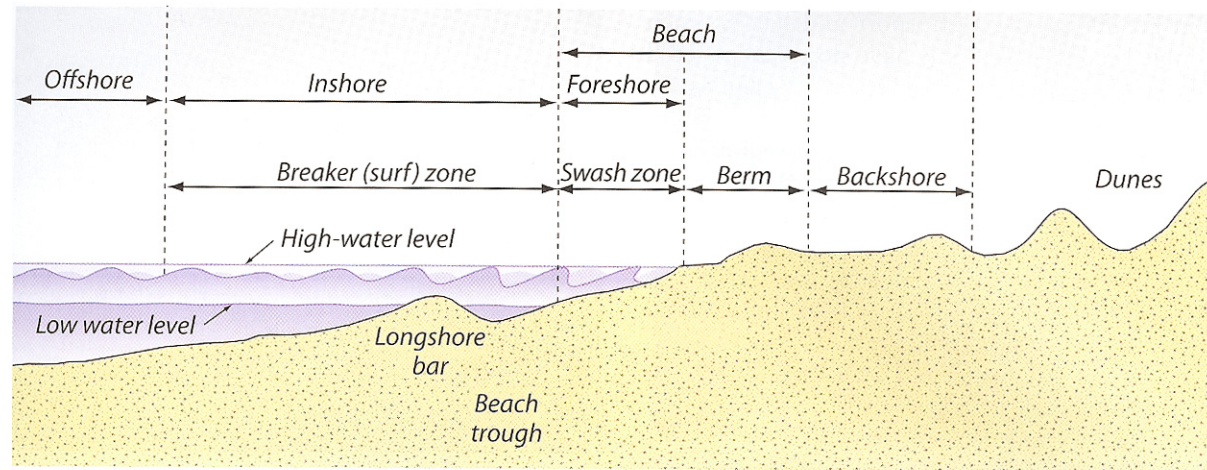
Offshore

Sources of sediment to coastal environments include rivers, tidewater glaciers, coastal erosion, and aeolian inputs. Sediment sinks in coastal environments include deposits of material in coastal dune fields, beaches, lagoons, and estuaries, and off-shore transport that delivers sediment to the coastal shelf and deeper-water environments. Coastal environments can be either a net sediment source or a sink depending on the configuration of the coast and the time scale of analysis. The relative importance of each type of source and sink varies in different tectonic and climatic settings.

Beaches

- Accumulations of sand, pebbles, or cobbles along a shoreline in the zone of breakers.

- ❑ Sediment availability
- ❑ Fluvial transport
- ❑ Sea cliff erosion



High-energy storms build storm **berms** above the mean high-water mark, while eroding fair-weather berms and steepening the beach profile. Material eroded during storms from the fair-weather berm is stored in offshore bars.

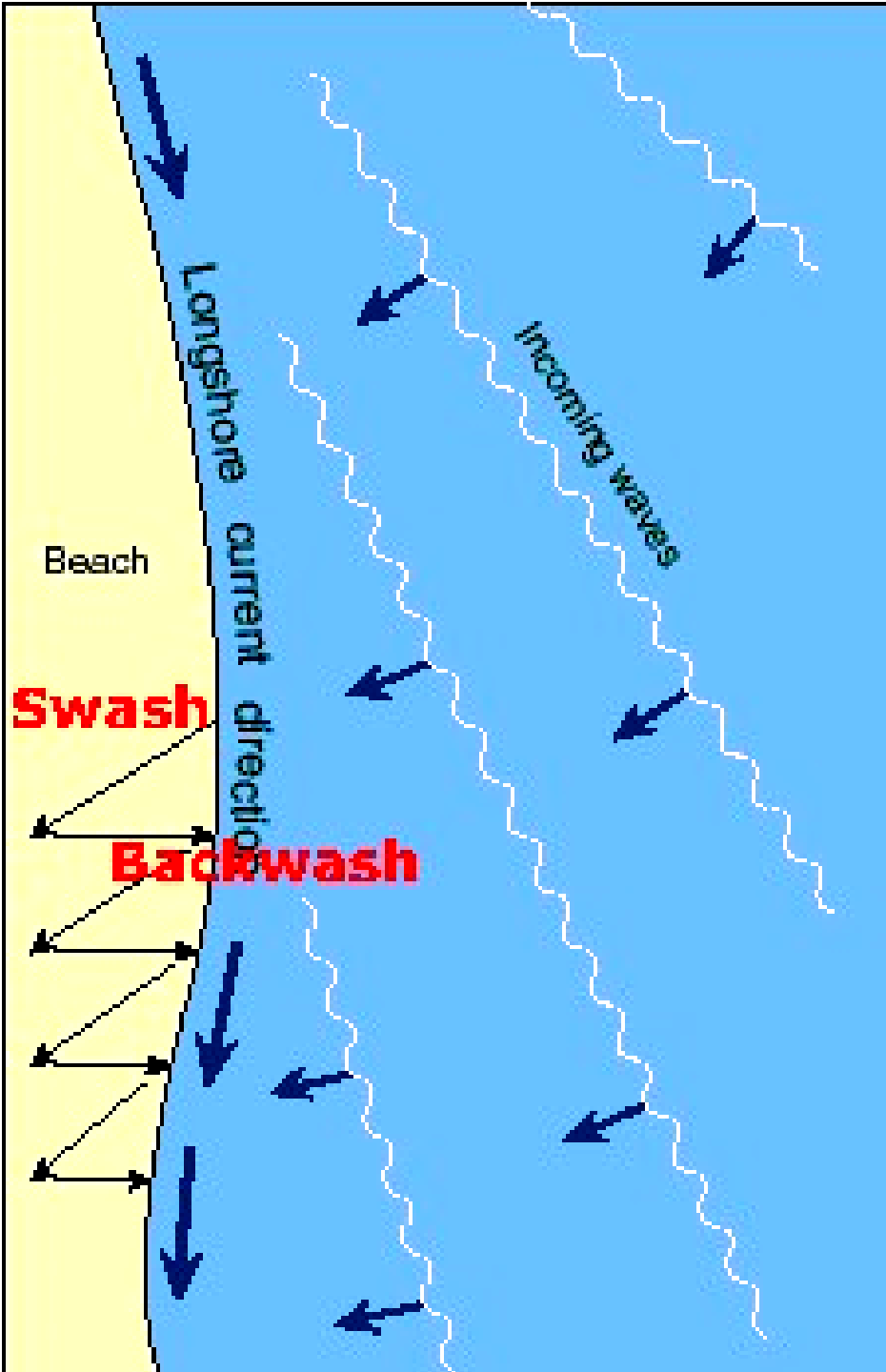
Lower wave energy typically builds a large gently sloping fair-weather berm by slowly transporting material from offshore bars back onto shore, resulting in a seasonal cycle of beach profile change.

Beach location

- Determined by;
 - Sediment supply
 - Wave activity
 - Continually evolving
 - Everyday processes
 - Storm events
-

Littoral Drifting

- Sediment is moved through
 - Swash transfer
 - Long-shore currents
 - It is estimated that 450,000 cubic yards of sediment is moved by littoral drift annually
-



Spits and Bars

- A ridge of sediment connected at one end to land and terminating in open water at the other end.



Barrier Bars and Islands

■ Bars

- Large, elongate bars, usually composed of sand, just off shore and parallel to the shoreline but not attached to the mainland.
 - 3 to 30 km off shore
 - Extend for 10 to 100 km

Barrier Islands

- The seaward side contains
 - Low-gradient beaches
 - Dunes
 - Continuously changing (storms)
 - The landward side contains
 - Lagoons
 - Salt marshes
 - Large, shallow, tidal mud flats
-

