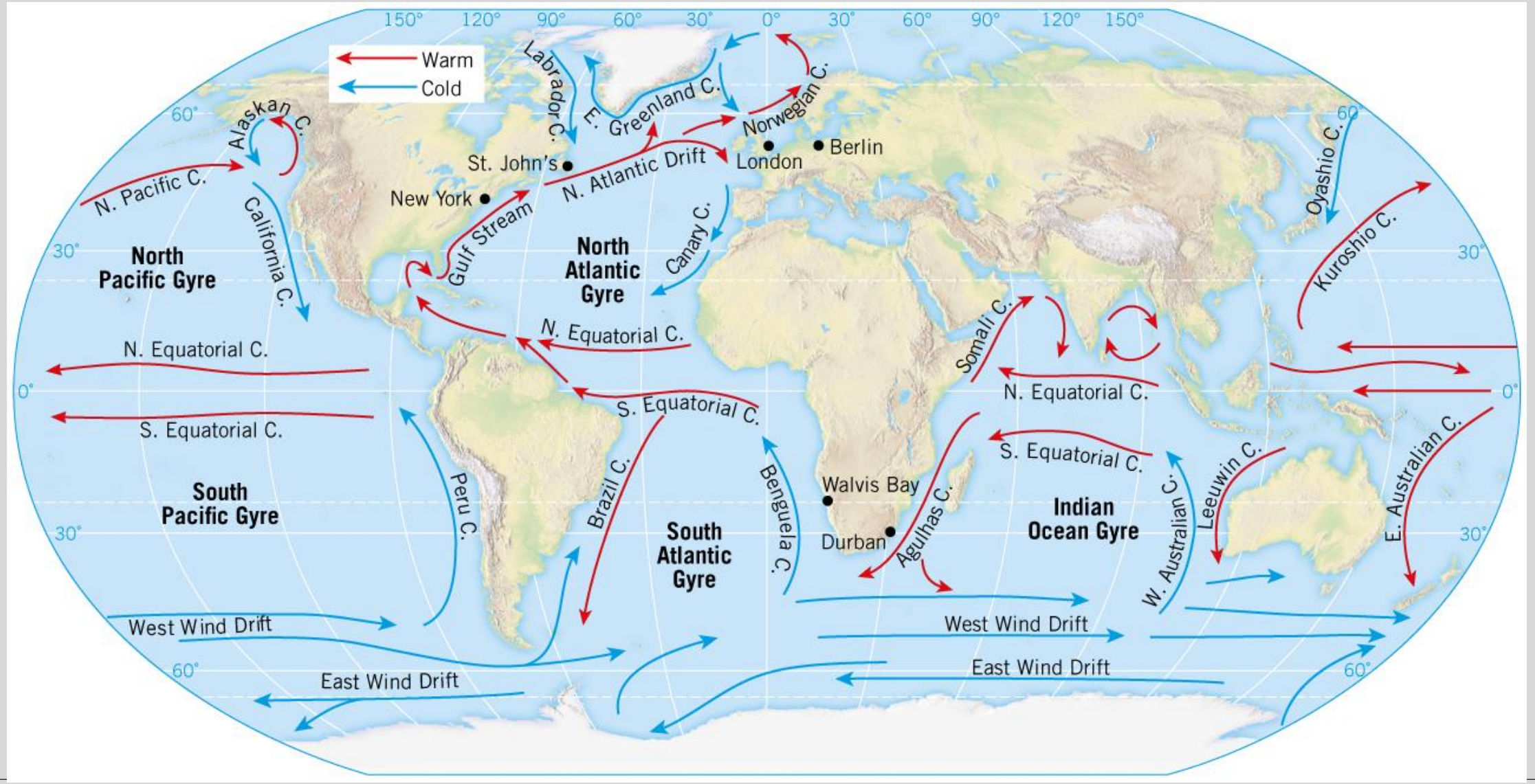
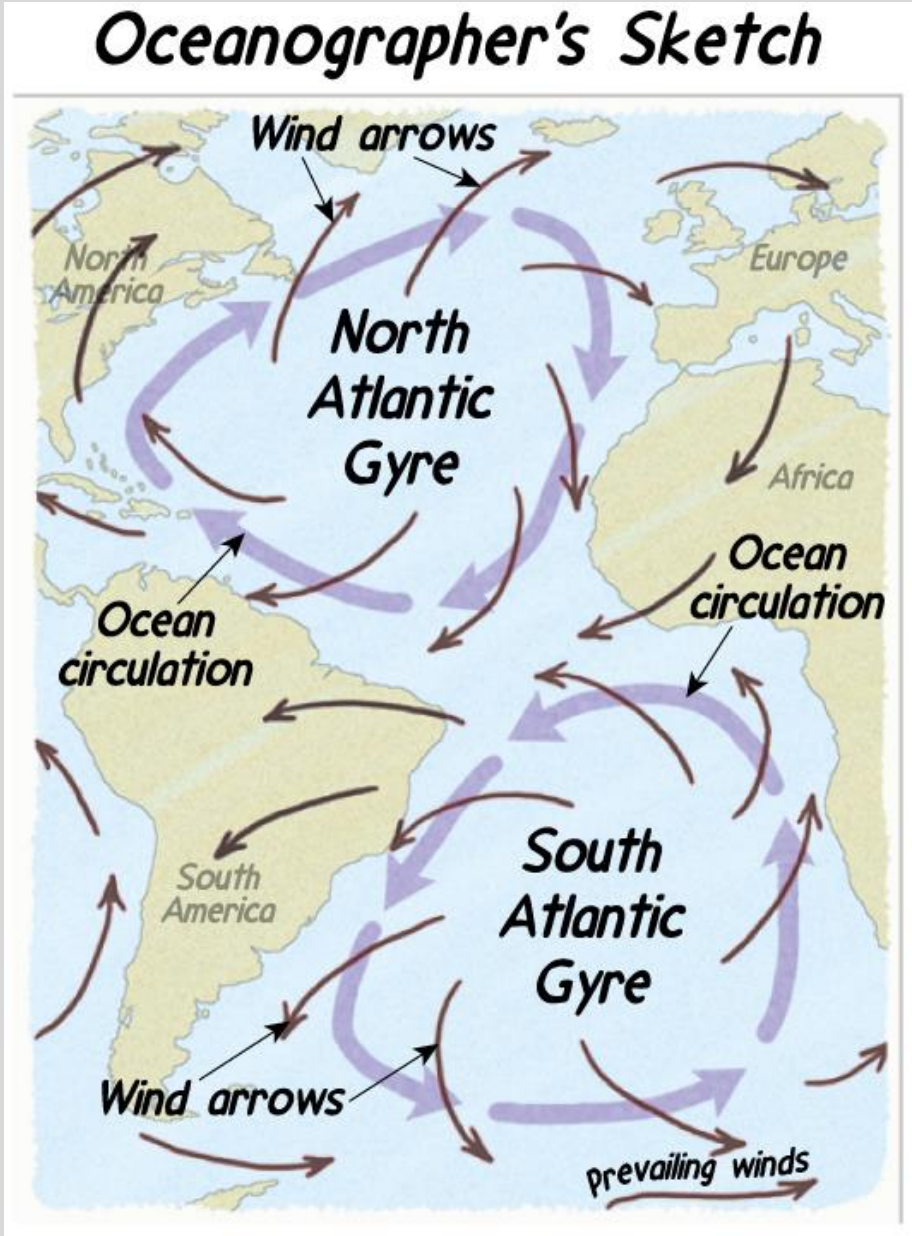
Dynamic Ocean

OCEAN CURRENTS

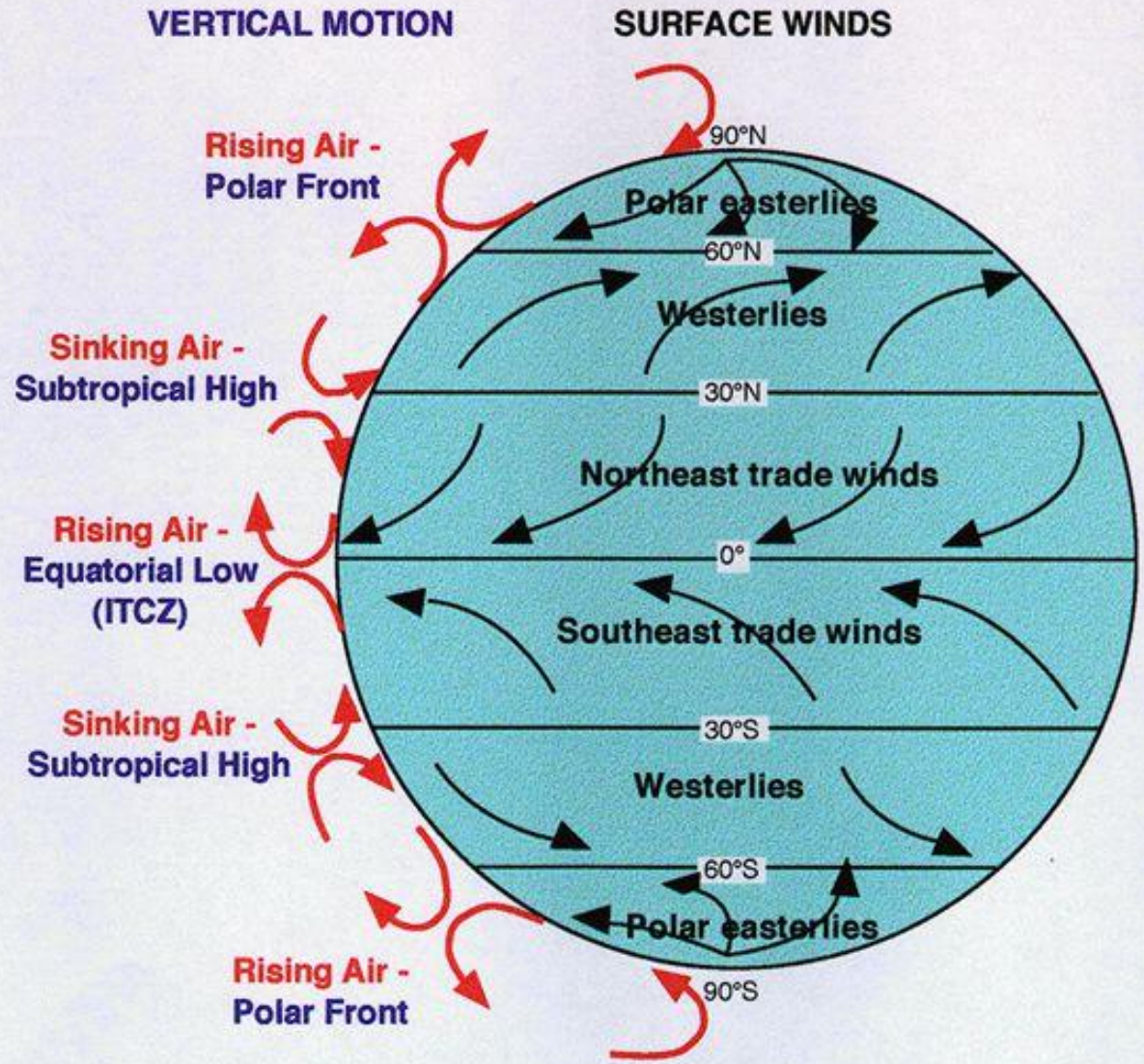
Surface Circulation



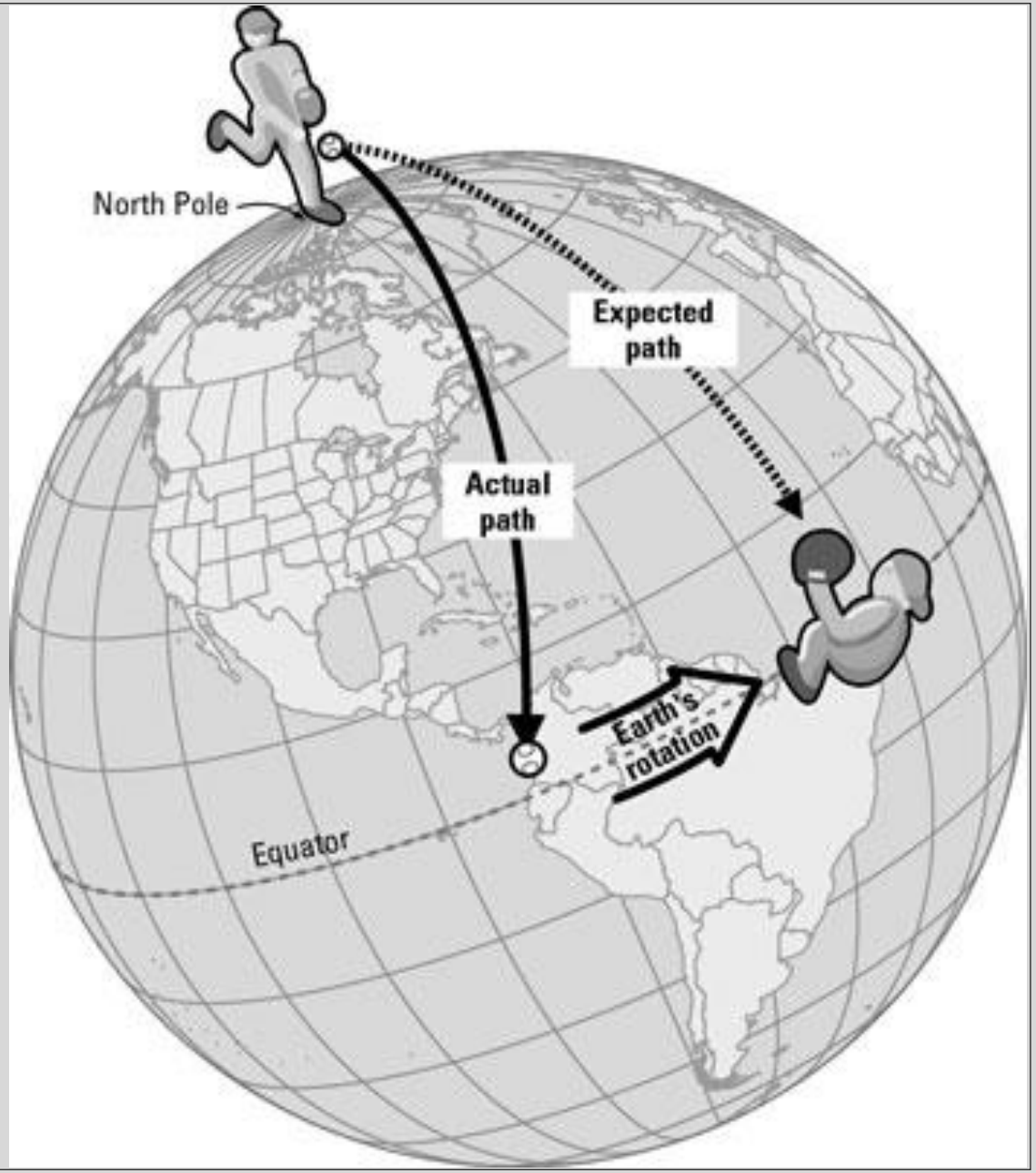
Oceanographer's Sketch



Generalized Sketch of Global Atmospheric Circulation



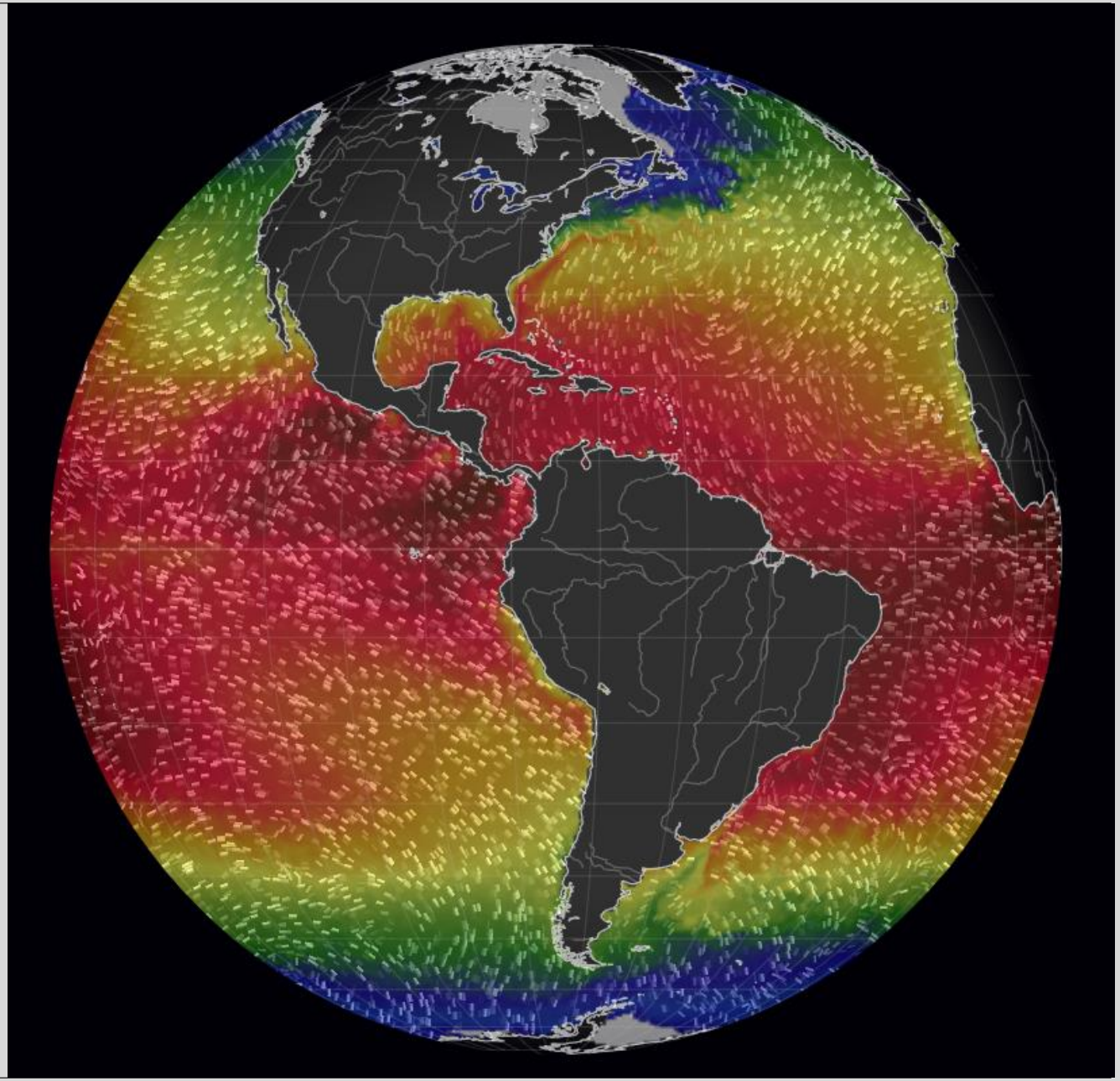
Coriolis Effect



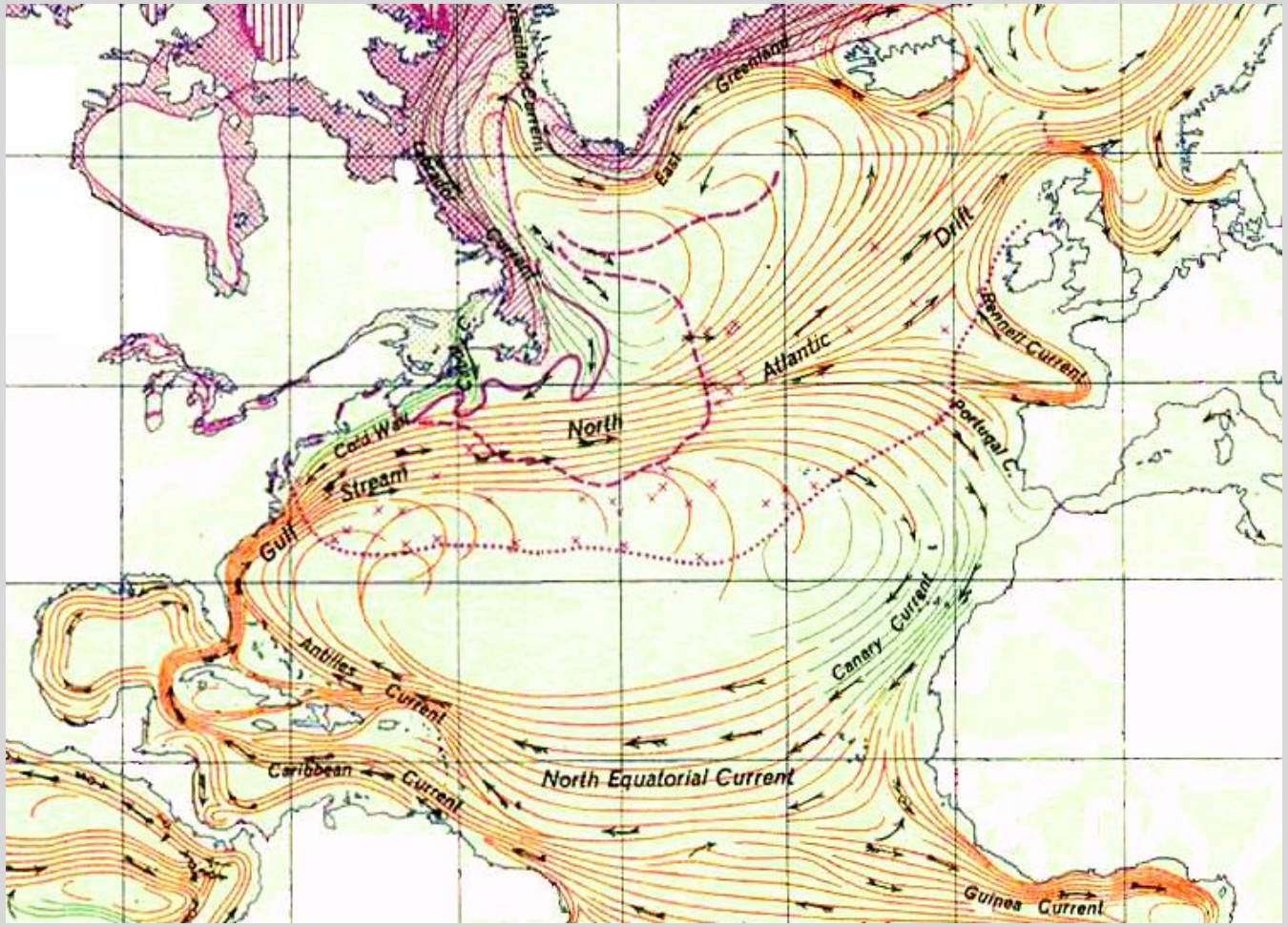
Coriolis Effect

https://www.youtube.com/watch?v=dt_XJp77-mk&t=94s

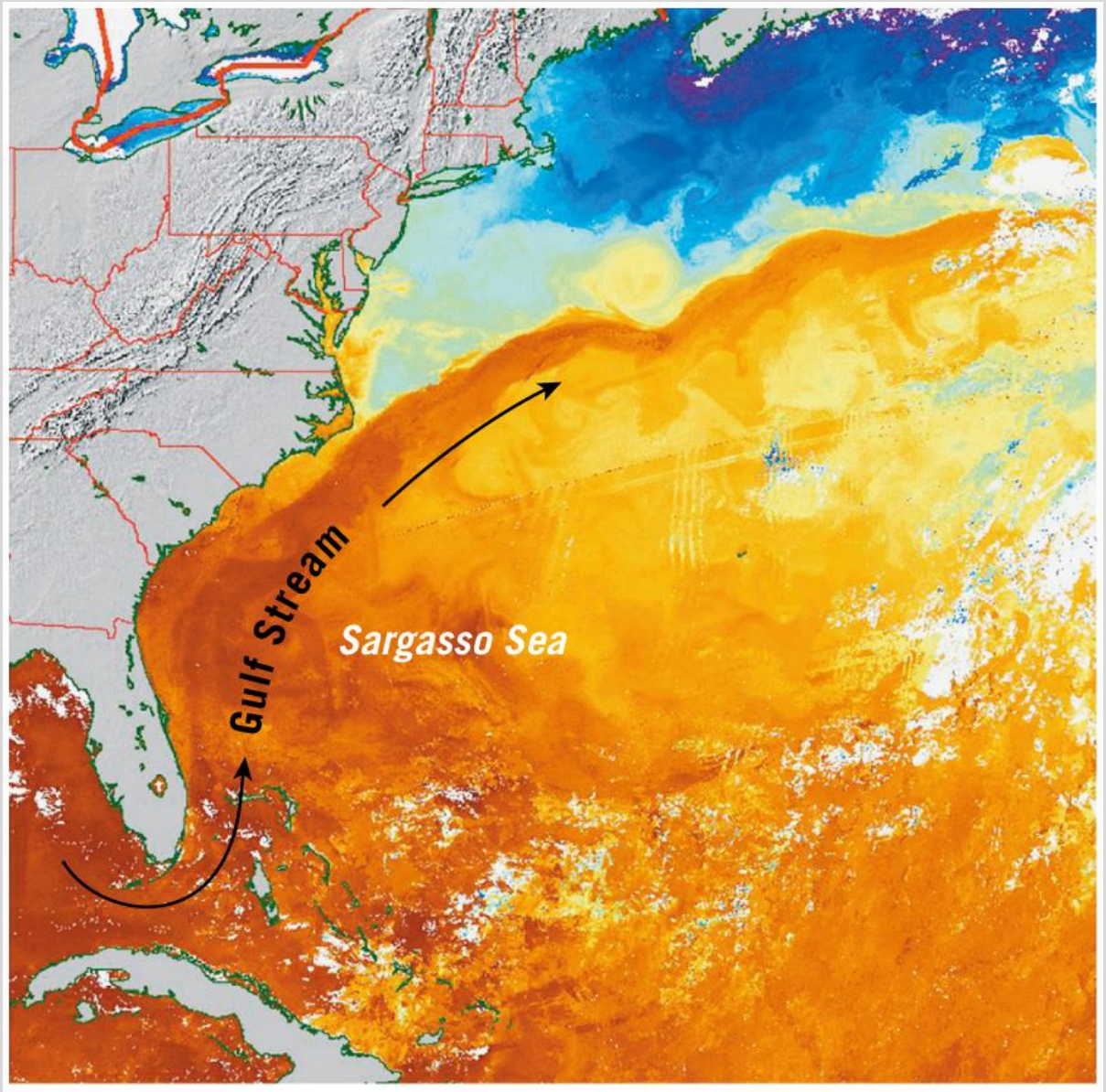
Visualize Earth

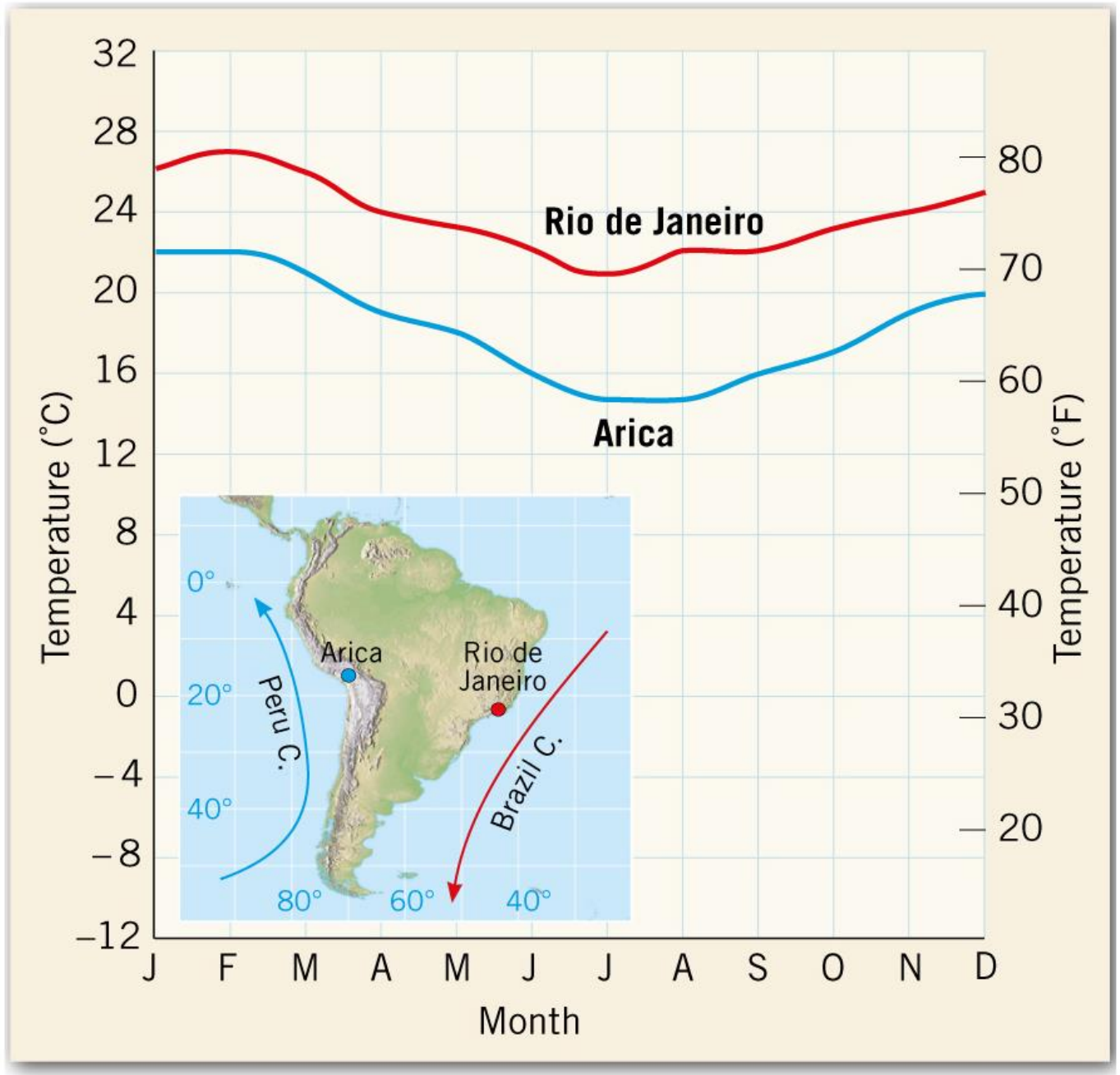


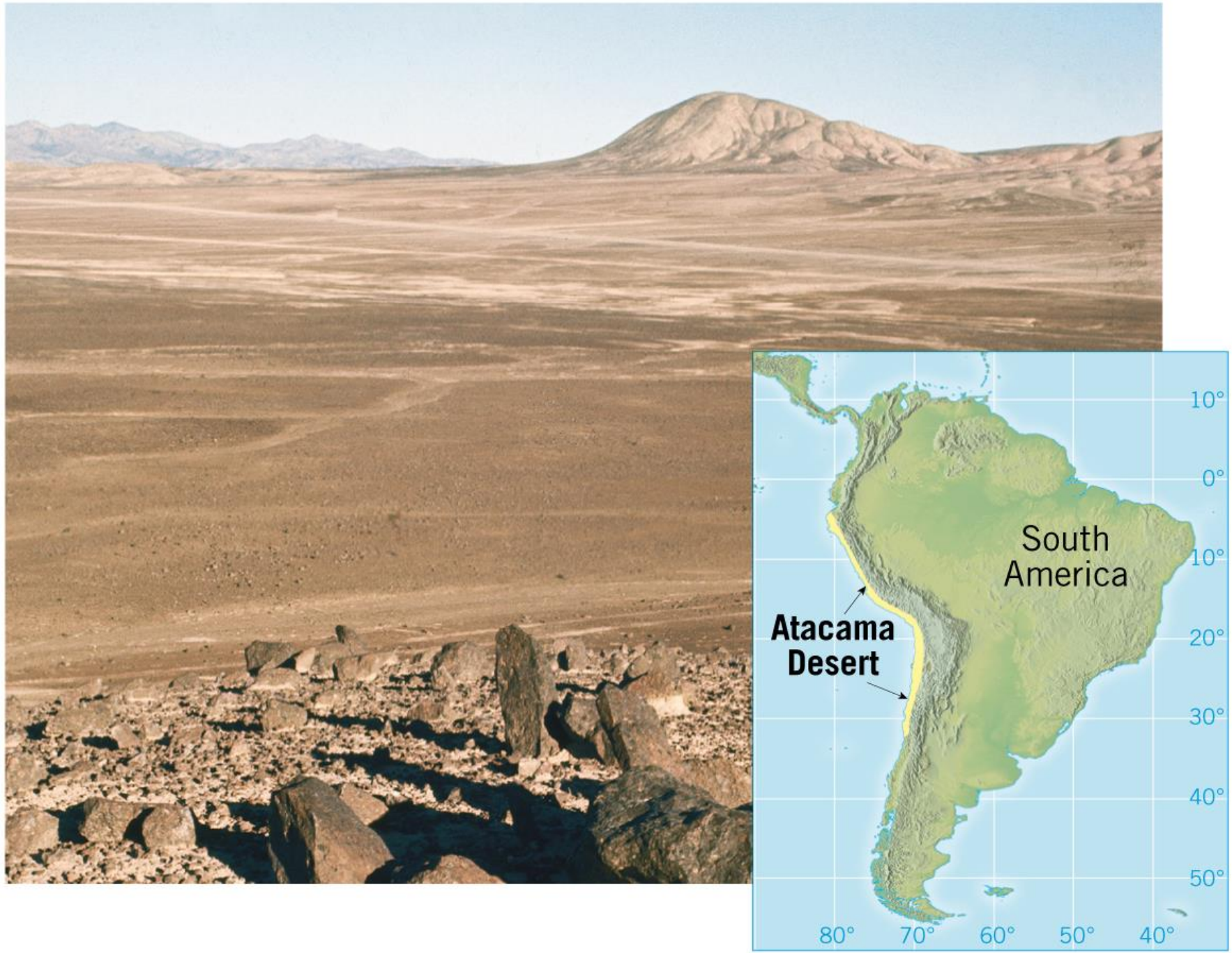
The only sea in the world without a coast.



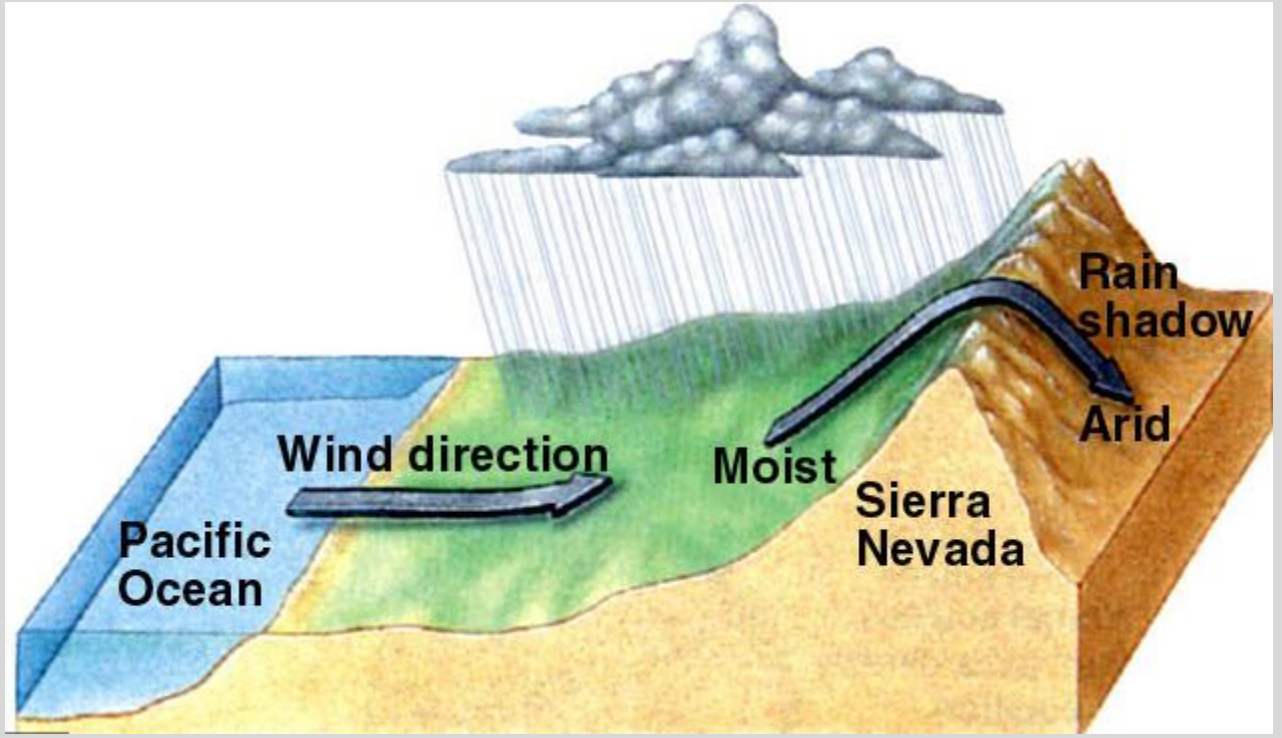
The Sargasso Sea is the name given to a large part of the North Atlantic Gyre, located in, well, the North Atlantic ocean. A gyre, in geography is any place that has a lot of currents (air or water) converging on that location, rotating around it. The large patch in the middle which has very few current lines in it is the gyre. Because of so many opposing currents at one place, ocean gyres are noted for their still waters, and also because the flotsam from a large area around them tends to get accumulated in the region. In this case, when the gyre was discovered, it happened to be large quantities of the seaweed, sargassum. Hence the name, Sargasso Sea.


Gulf Stream
Sargasso Sea

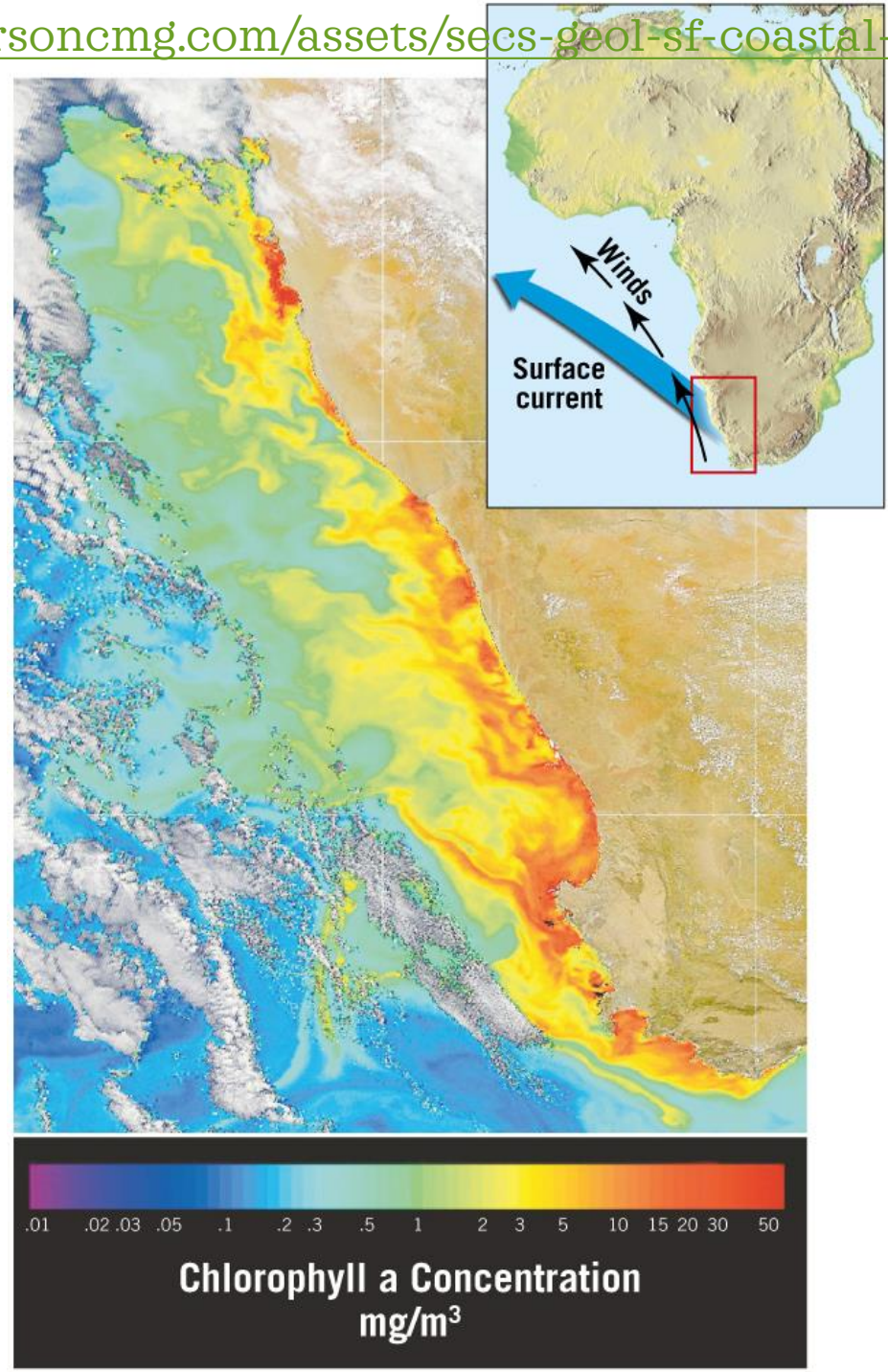

Rio de Janeiro
Arica
Temperature (°C)
Temperature (°F)
32
28
24
20
16
12
8
4
0
−4
−8
−12
80
70
60
50
40
30
20
J
F
M
A
M
J
J
A
S
O
N
D
Month
0°
20°
40°
80°
60°
40°
Arica
Rio de Janeiro
Peru C.
Brazil C.


South America
Atacama Desert
10°
0°
10°
20°
30°
40°
50°
80°
70°
60°
50°
40°

Rain Shadow Desert

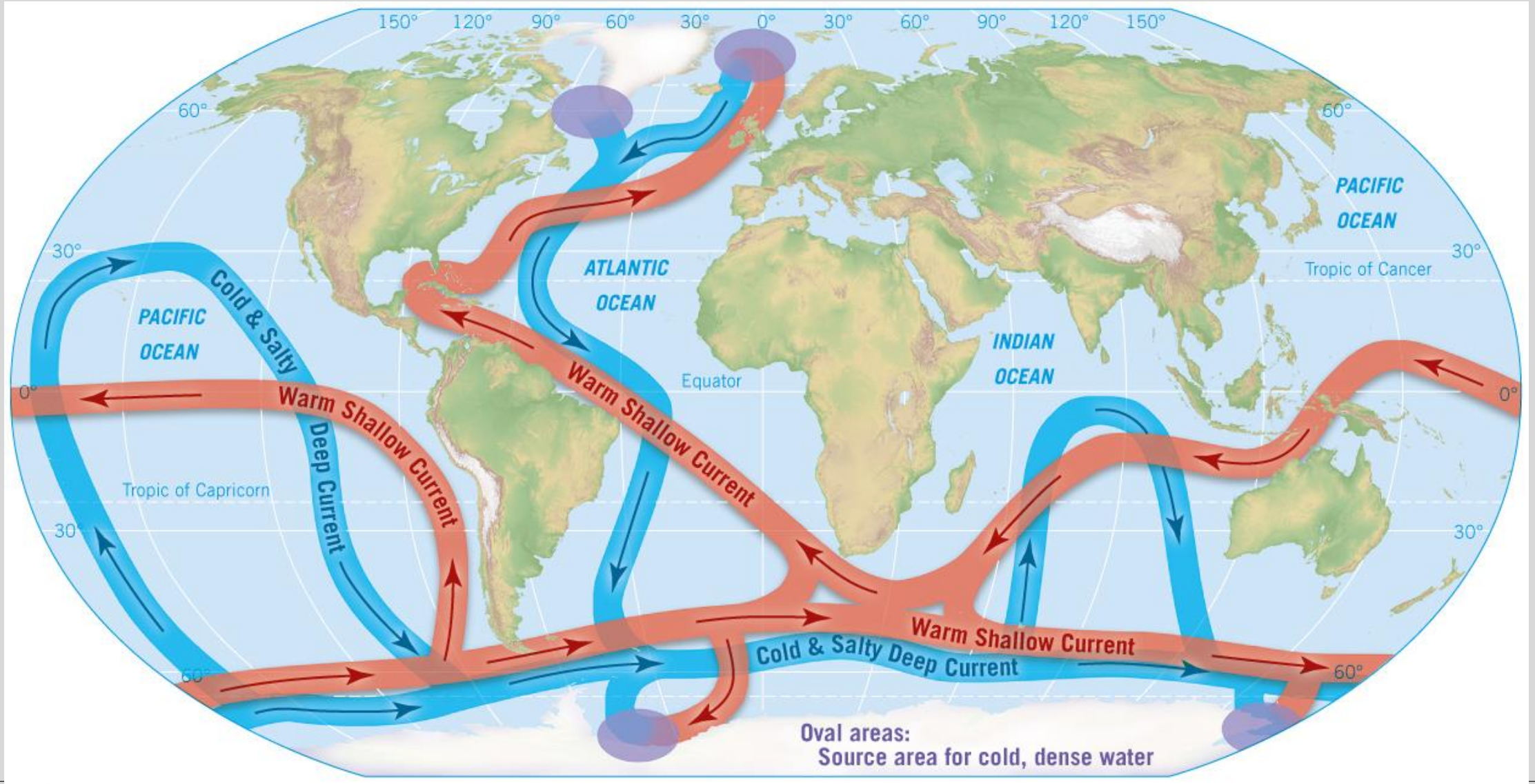


https://mediaplayer.pearsoncmg.com/assets/secs-geol-sf-coastal-upswelling



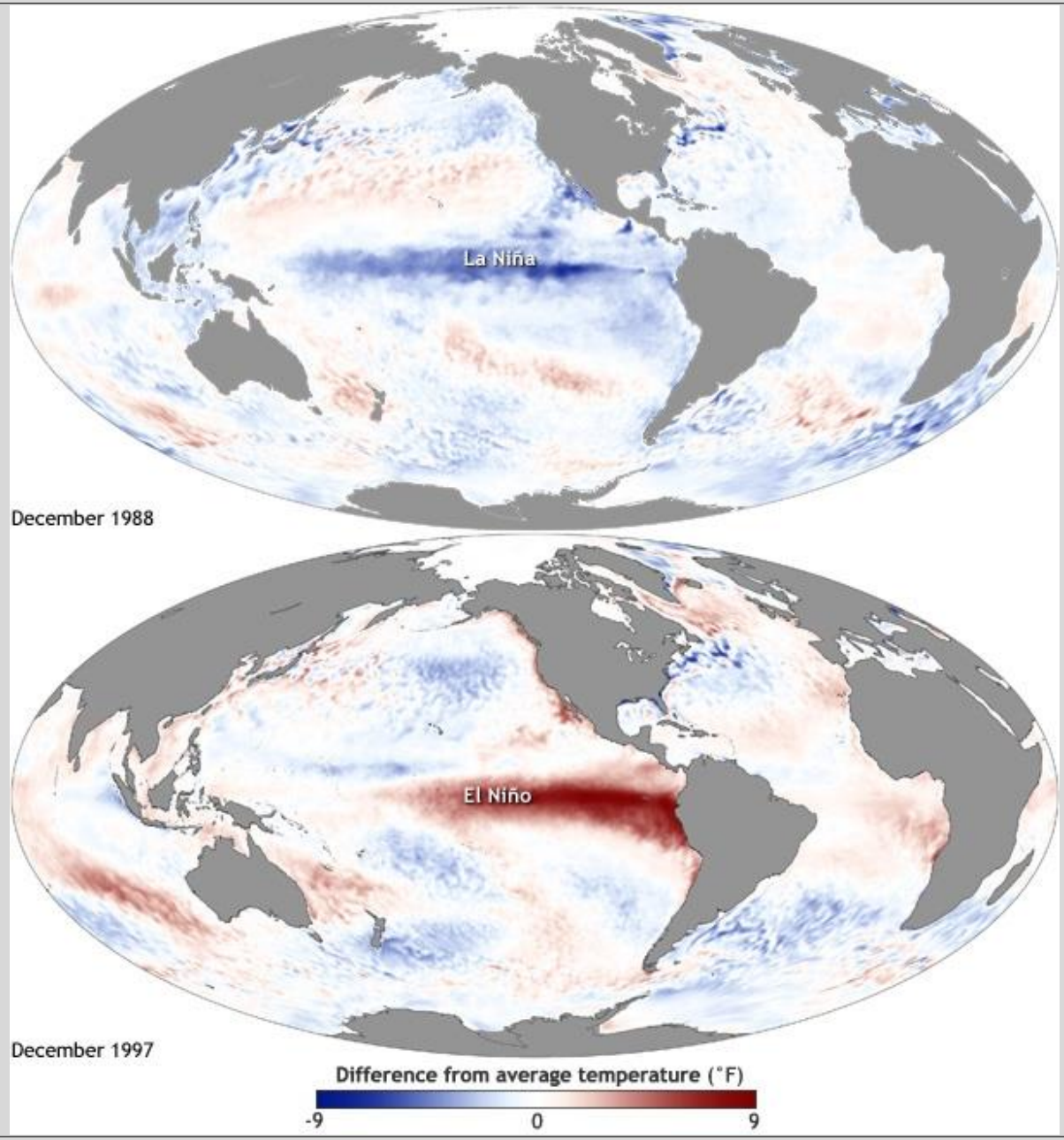

U. S. COAST GUARD

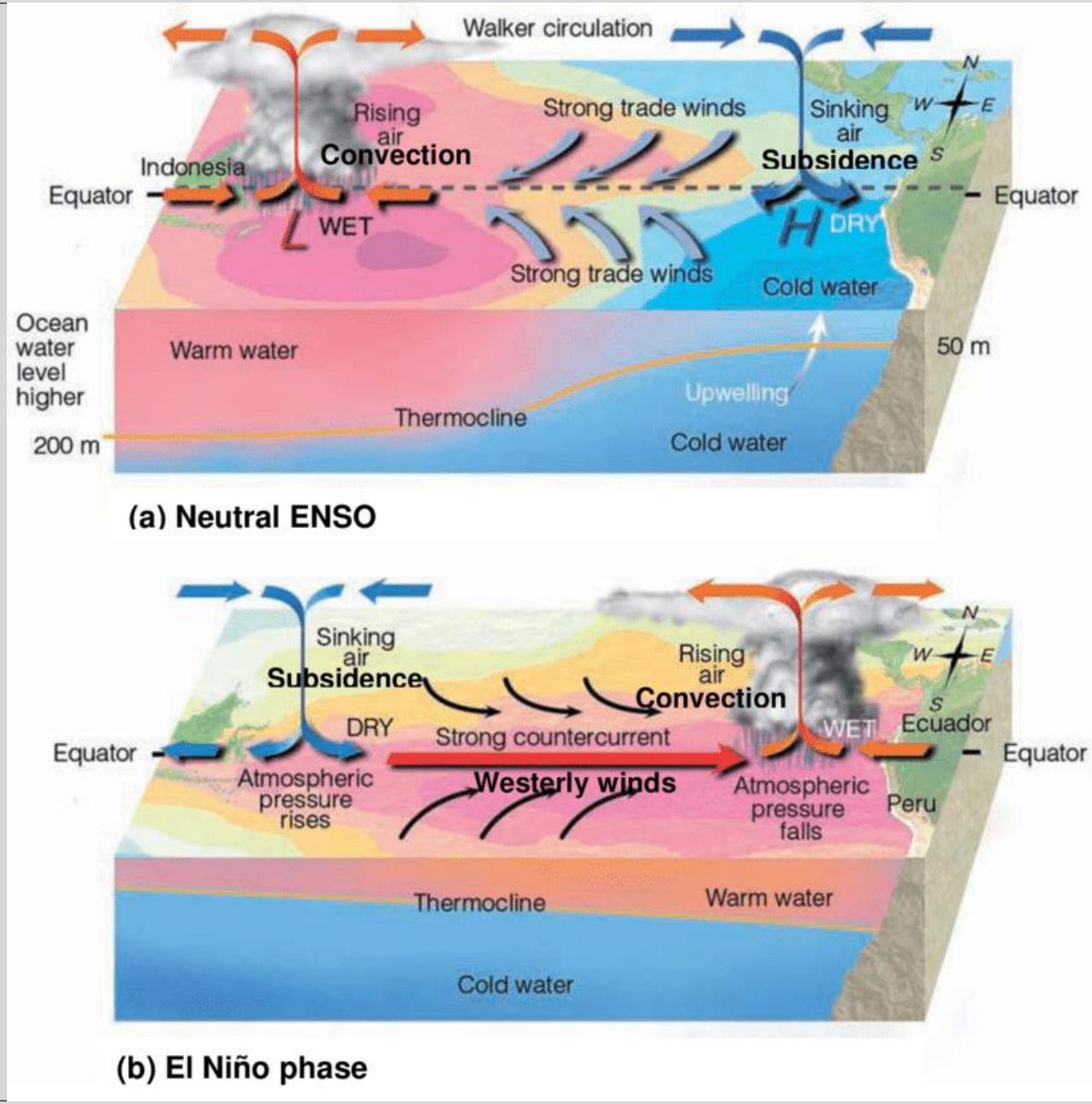
Deep Ocean Circulation



ENSO
El Niño / Southern Oscillation

Graphs of ENSO


La Niña
December 1988
El Niño
December 1997
Difference from average temperature (°F)
-9
0
9


Walker circulation
Rising air
Convection
Strong trade winds
Sinking air
Subsidence
N
W
E
S
Indonesia
Equator
WET
H
DRY
Equator
Strong trade winds
Cold water
Ocean water level higher
Warm water
50 m
Upwelling
Thermocline
200 m
Cold water
(a) Neutral ENSO
Sinking air
Subsidence
Rising air
Convection
N
W
E
S
DRY
Strong countercurrent
WET
Ecuador
Equator
Equator
Atmospheric pressure rises
Westerly winds
Atmospheric pressure falls
Peru
Thermocline
Warm water
Cold water
(b) El Niño phase

How does ENSO affect Illinois?

Summary of Impacts of El Niño

El Niño events vary in size, intensity, and duration. As a result, the impacts can vary from one event to the next. In addition, there may be other factors that influence Illinois weather during these events.

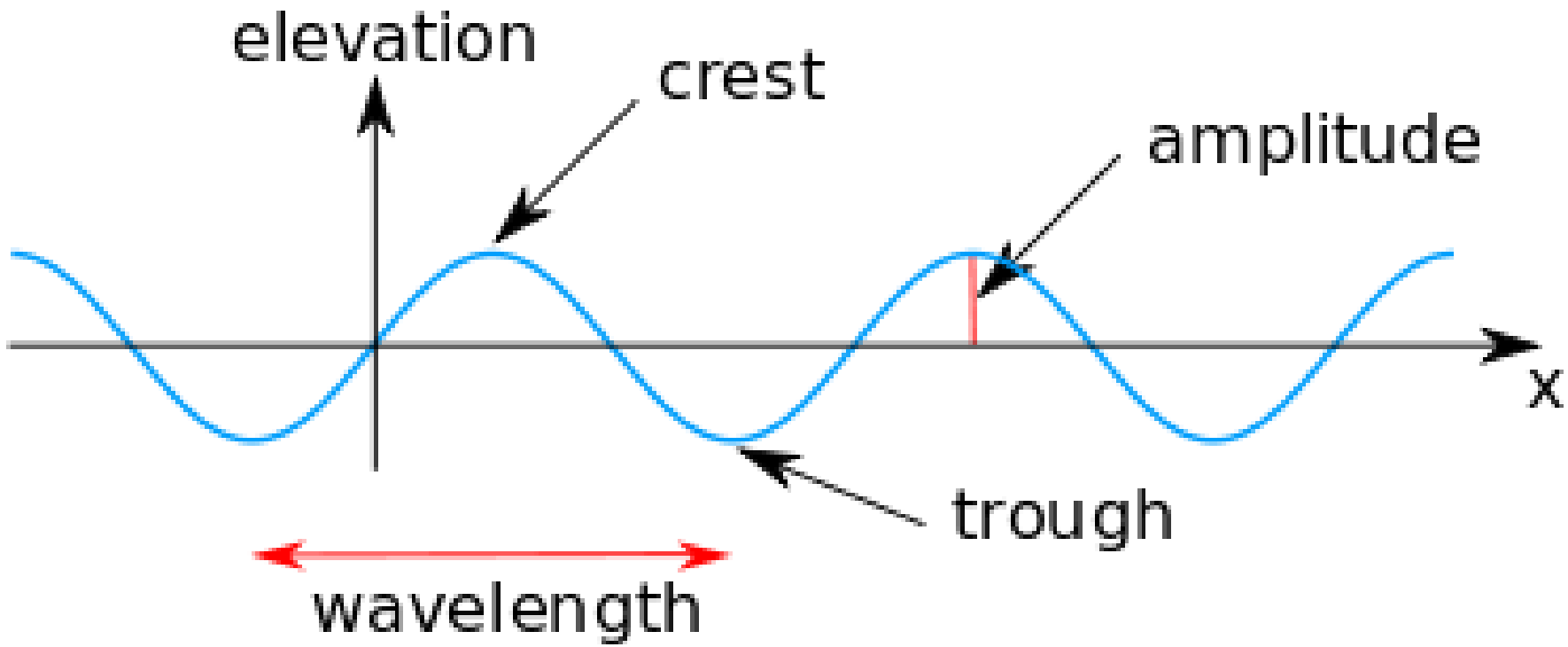
- Summers tend to be slightly cooler and wetter than average
- Falls tend to be wetter and cooler than average
- Winters tend to be warmer and drier
- Springs tend to be drier than average
- Snowfall tends to be below average

Summary of Impacts of La Niña

Generally, La Niña impacts are not as clear-cut because there are fewer strong ones in recent years (1970-71, 1973-74, 1975-76, 1988-89).

- Summers have a tendency to be warmer and drier in Illinois
- Falls have a tendency to be cooler in the north and wetter in the southeast
- Winters are typically warmer and wetter than average with more snow and winter storms
- Springs tend to be cooler across most of the state and drier in the west

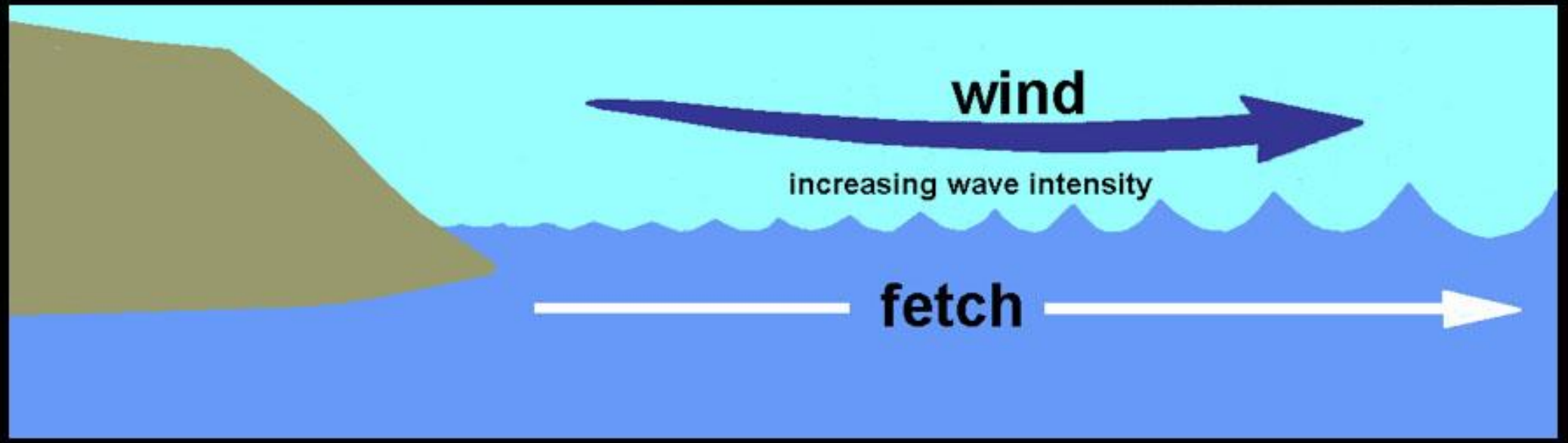
OCEAN WAVES

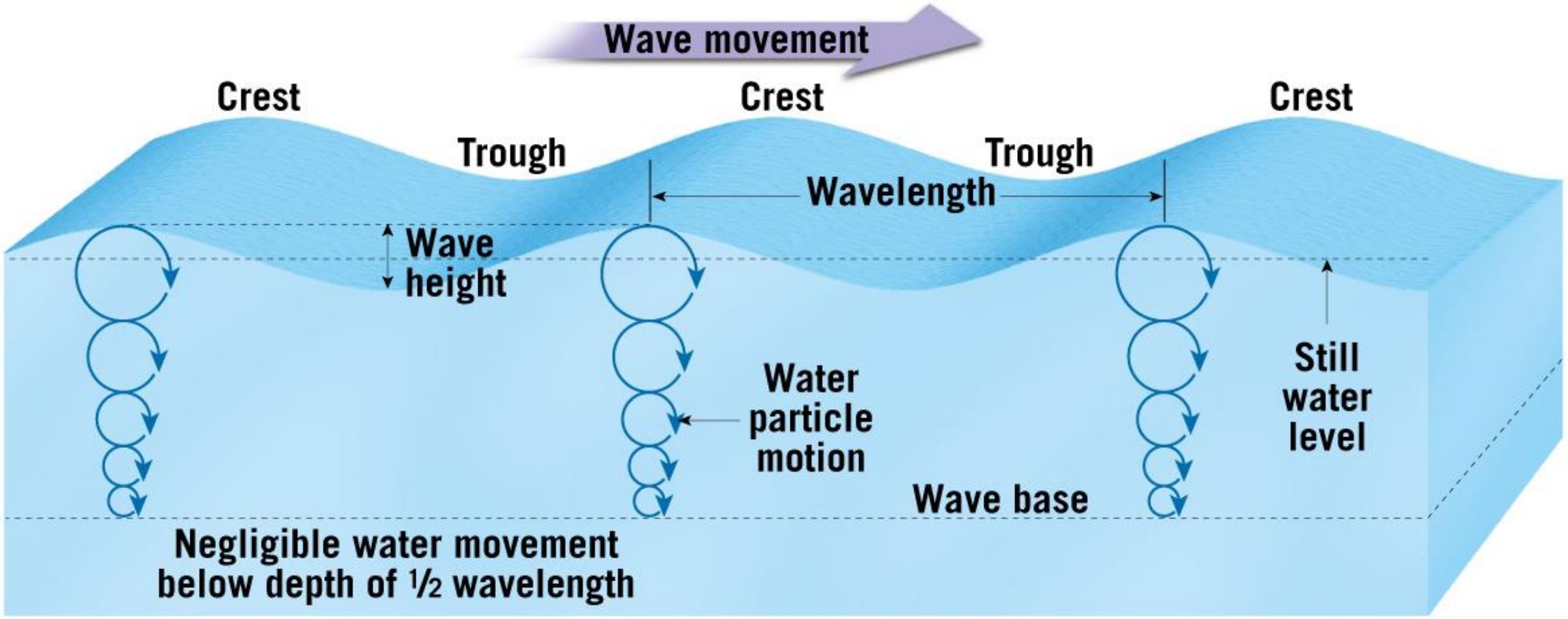

elevation
crest
amplitude
x
trough
wavelength

*Ocean waves are created by wind blowing over water.

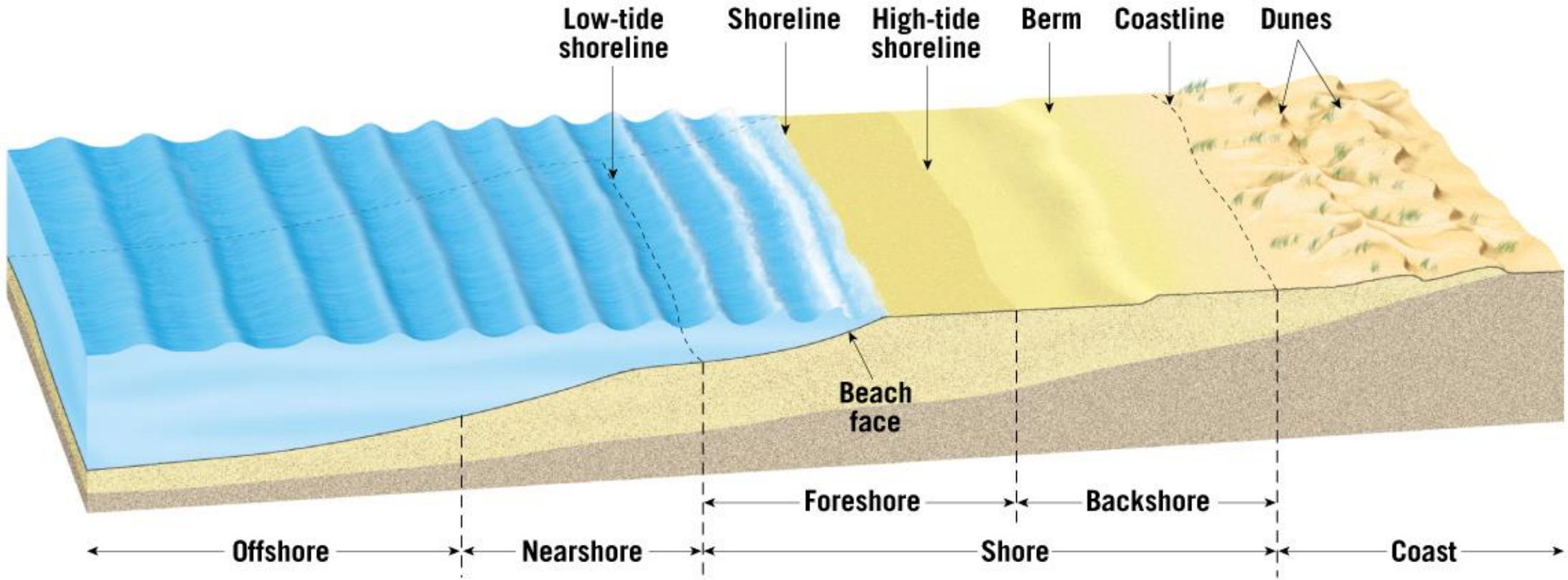
Ocean wave intensity reflects characteristics of:

* wind speed
* wind duration
* fetch (the distance the wind has traveled over open water).

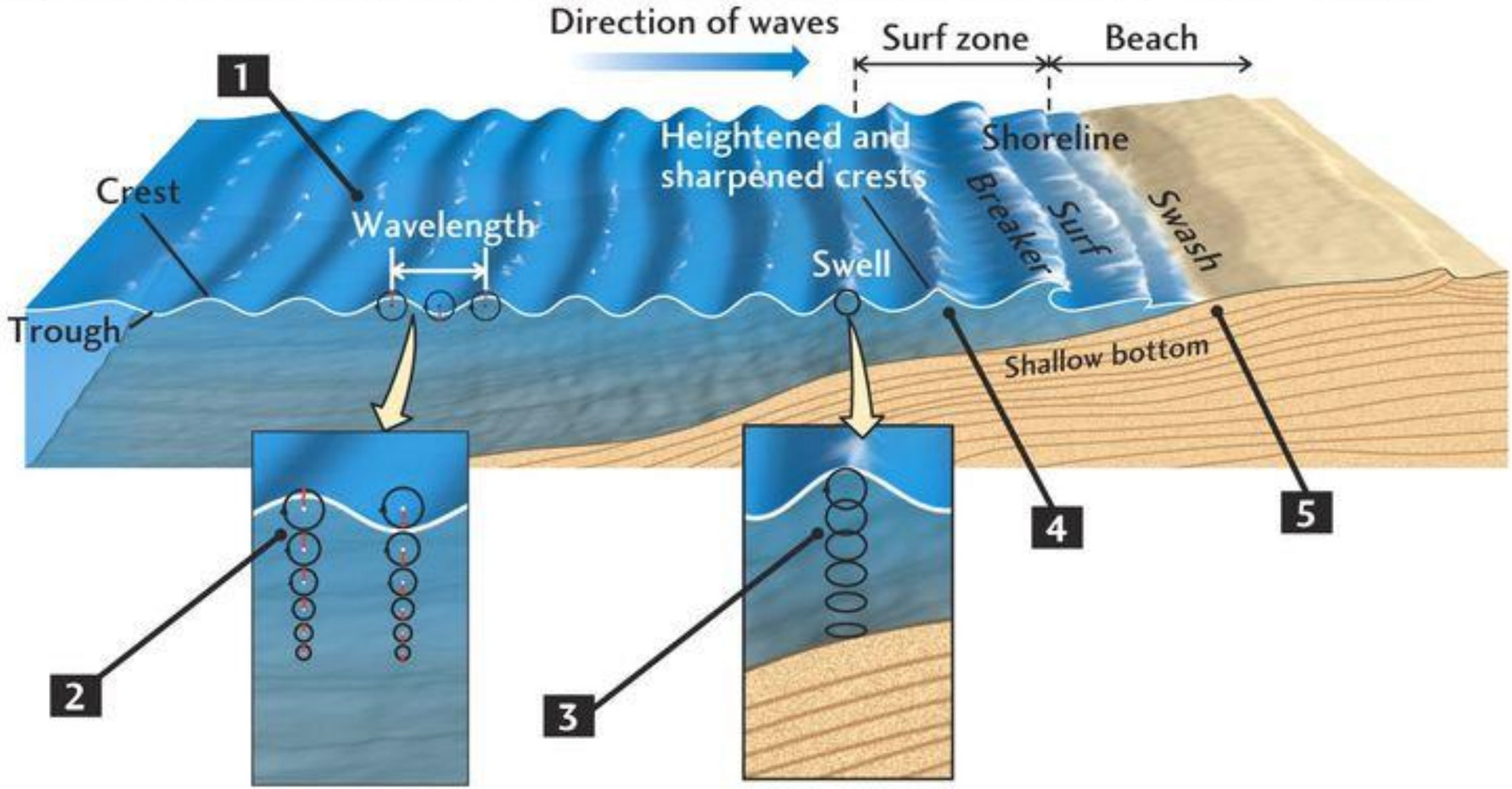


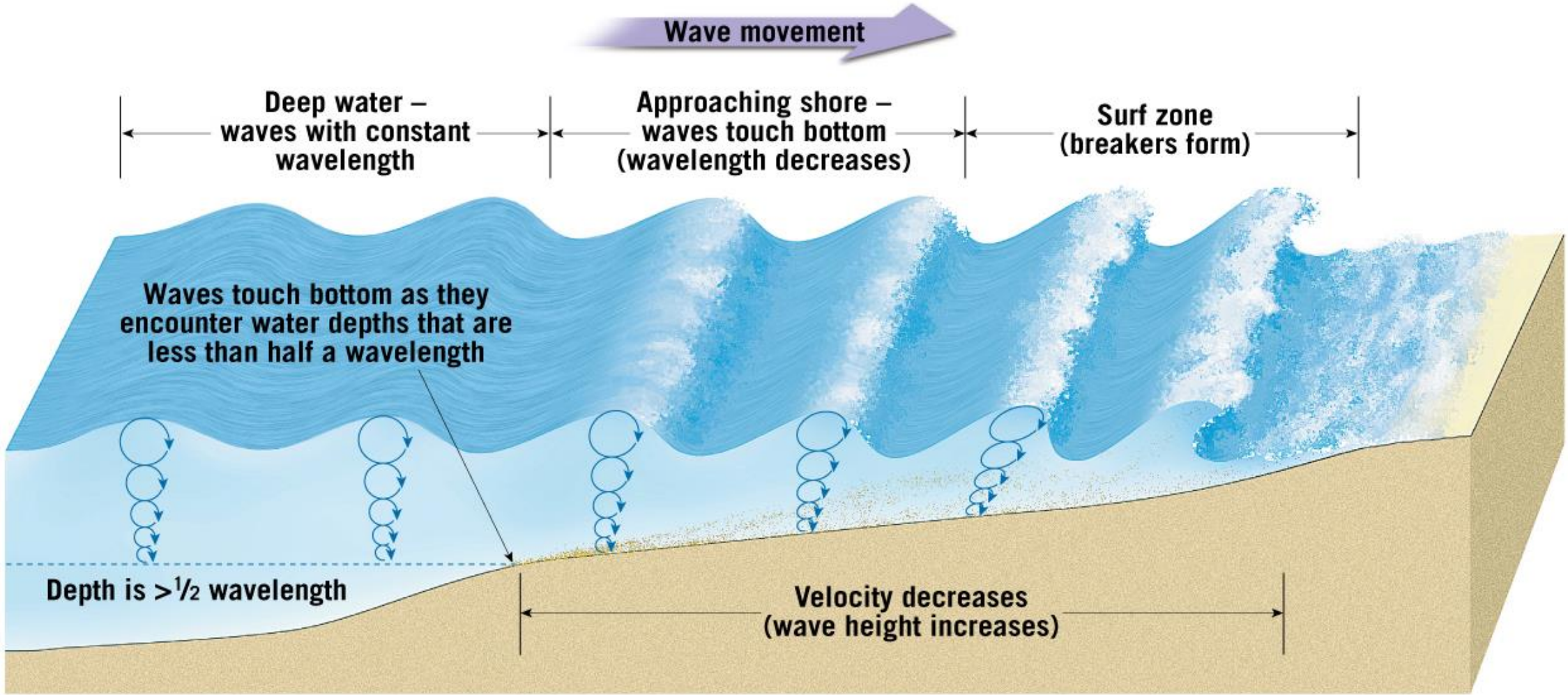


Waves are moving energy; the water mostly goes up and down.

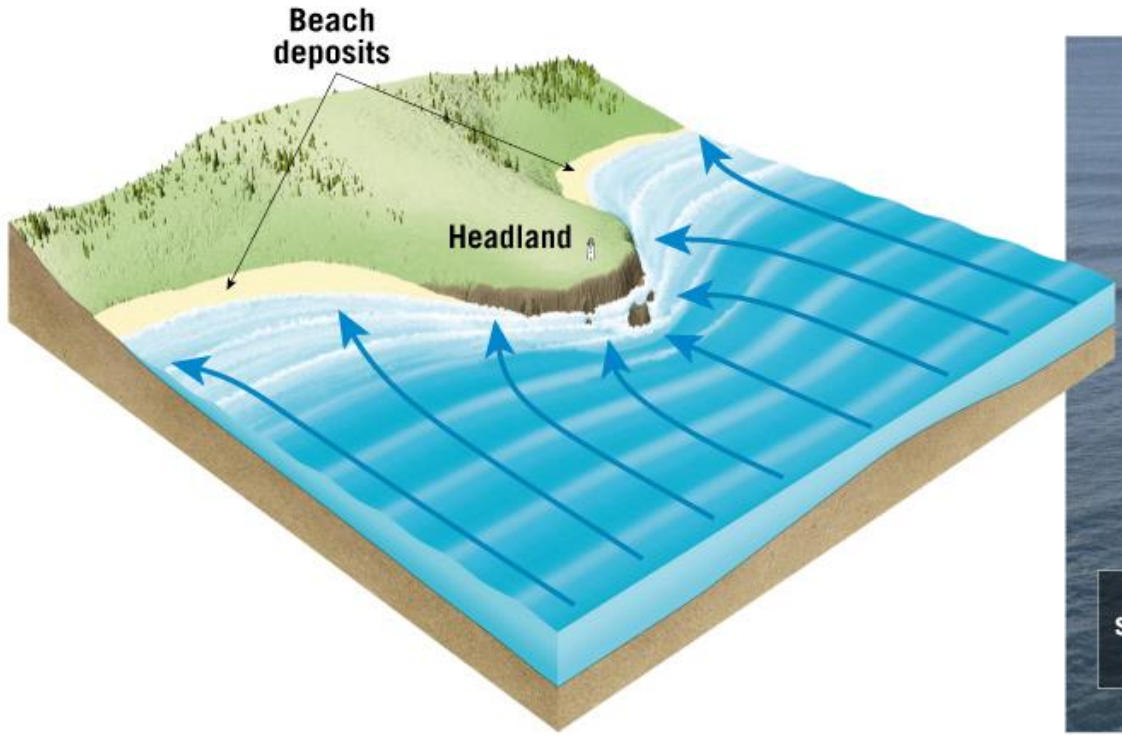

Low-tide shoreline
Shoreline
High-tide shoreline
Berm
Coastline
Dunes
Beach face
Foreshore
Backshore
Offshore
Nearshore
Shore
Coast

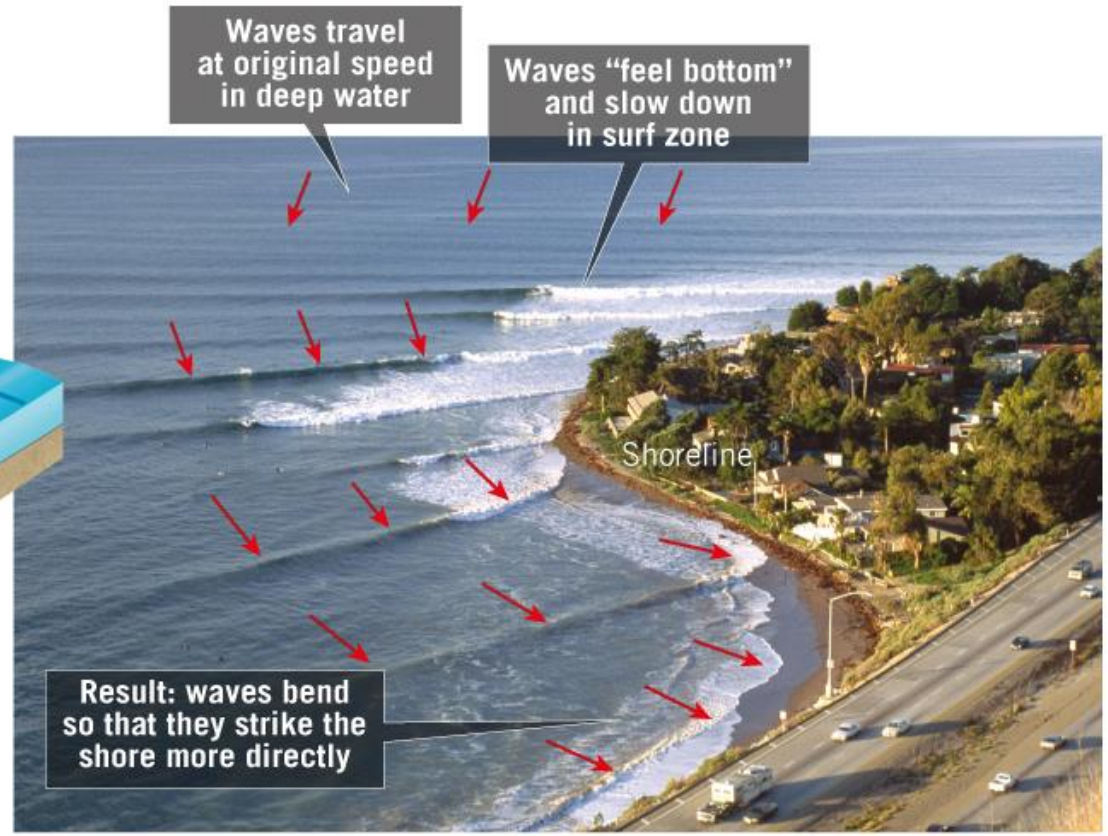
WAVE MOTION IS INFLUENCED BY WATER DEPTH AND SHAPE OF THE SHORELINE



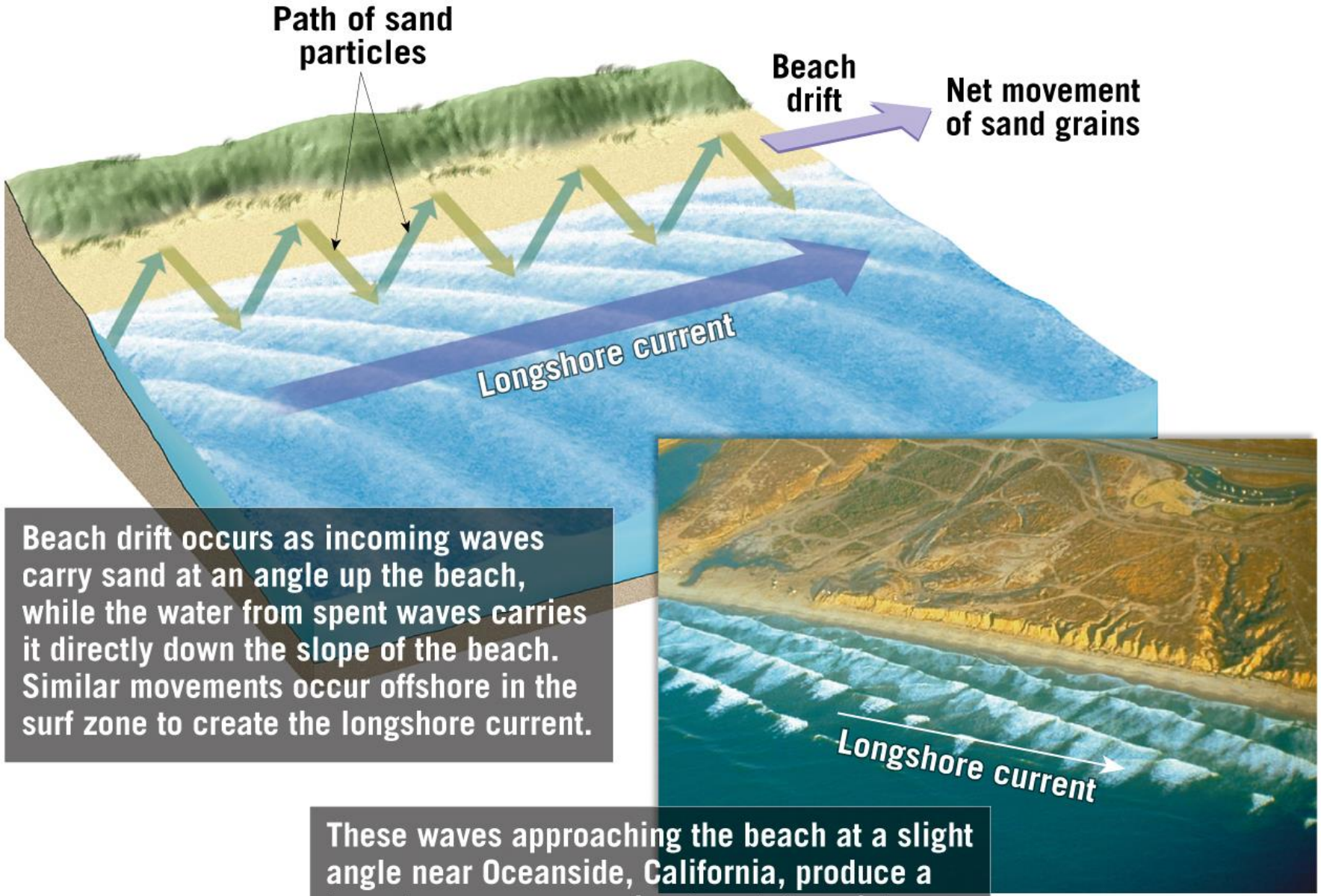

Wave movement
Deep water – waves with constant wavelength
Approaching shore – waves touch bottom (wavelength decreases)
Surf zone (breakers form)
Waves touch bottom as they encounter water depths that are less than half a wavelength
Depth is >½ wavelength
Velocity decreases (wave height increases)

As these waves approach nearly straight on, refraction causes the wave energy to be concentrated at headlands (resulting in erosion) and dispersed in bays (resulting in deposition).



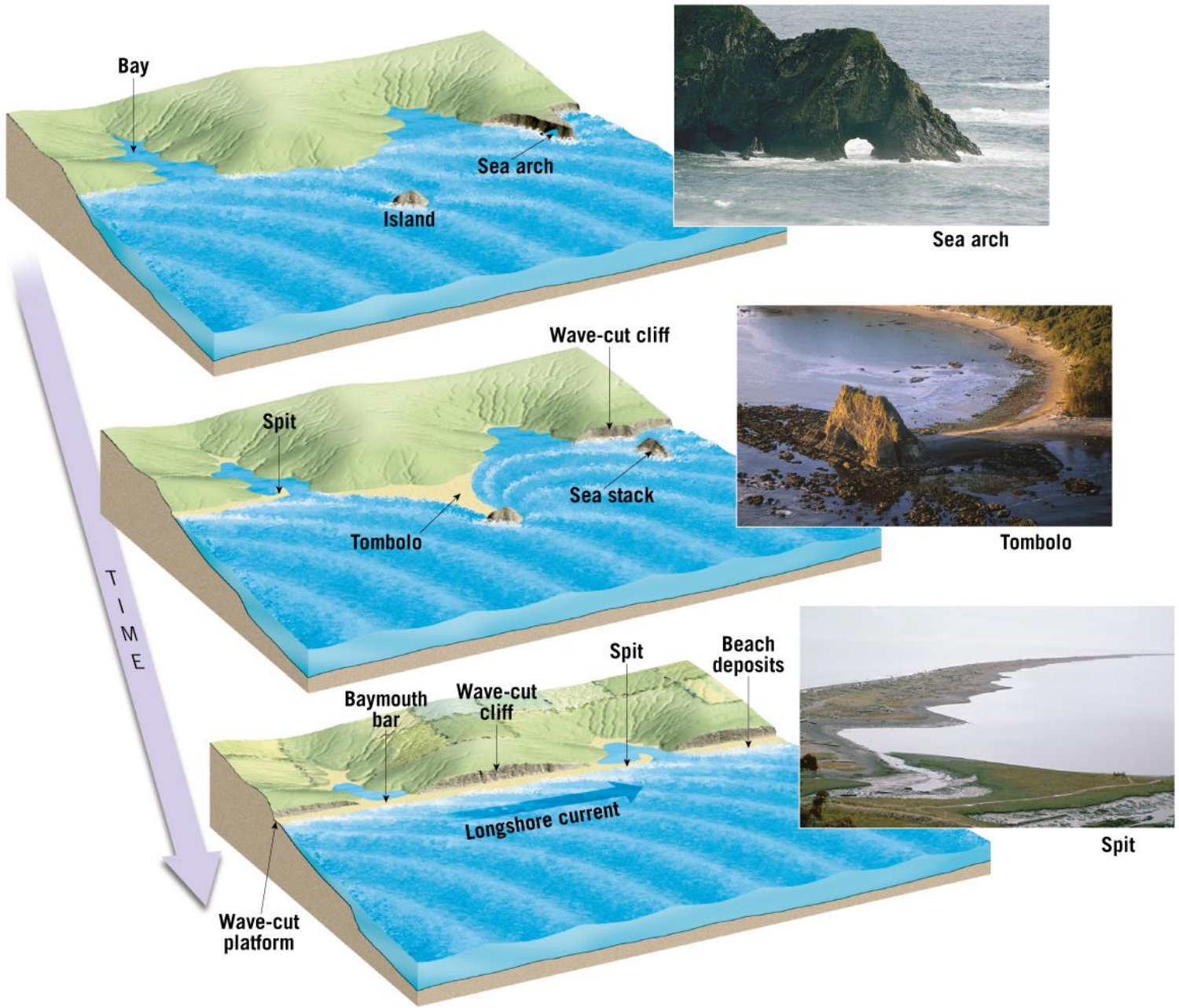


Wave refraction at Rincon Point, California



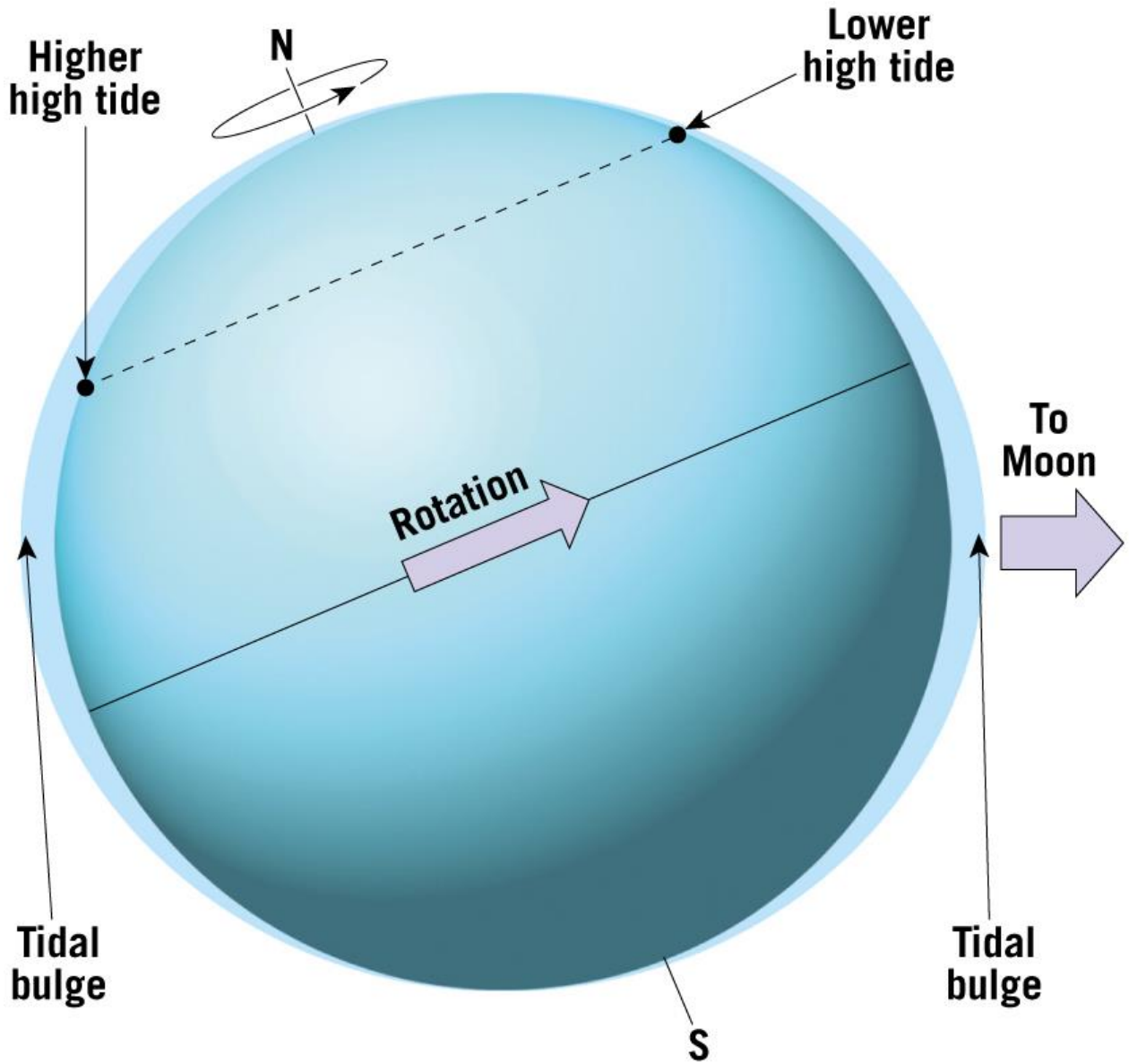
Beach drift occurs as incoming waves carry sand at an angle up the beach, while the water from spent waves carries it directly down the slope of the beach. Similar movements occur offshore in the surf zone to create the longshore current.

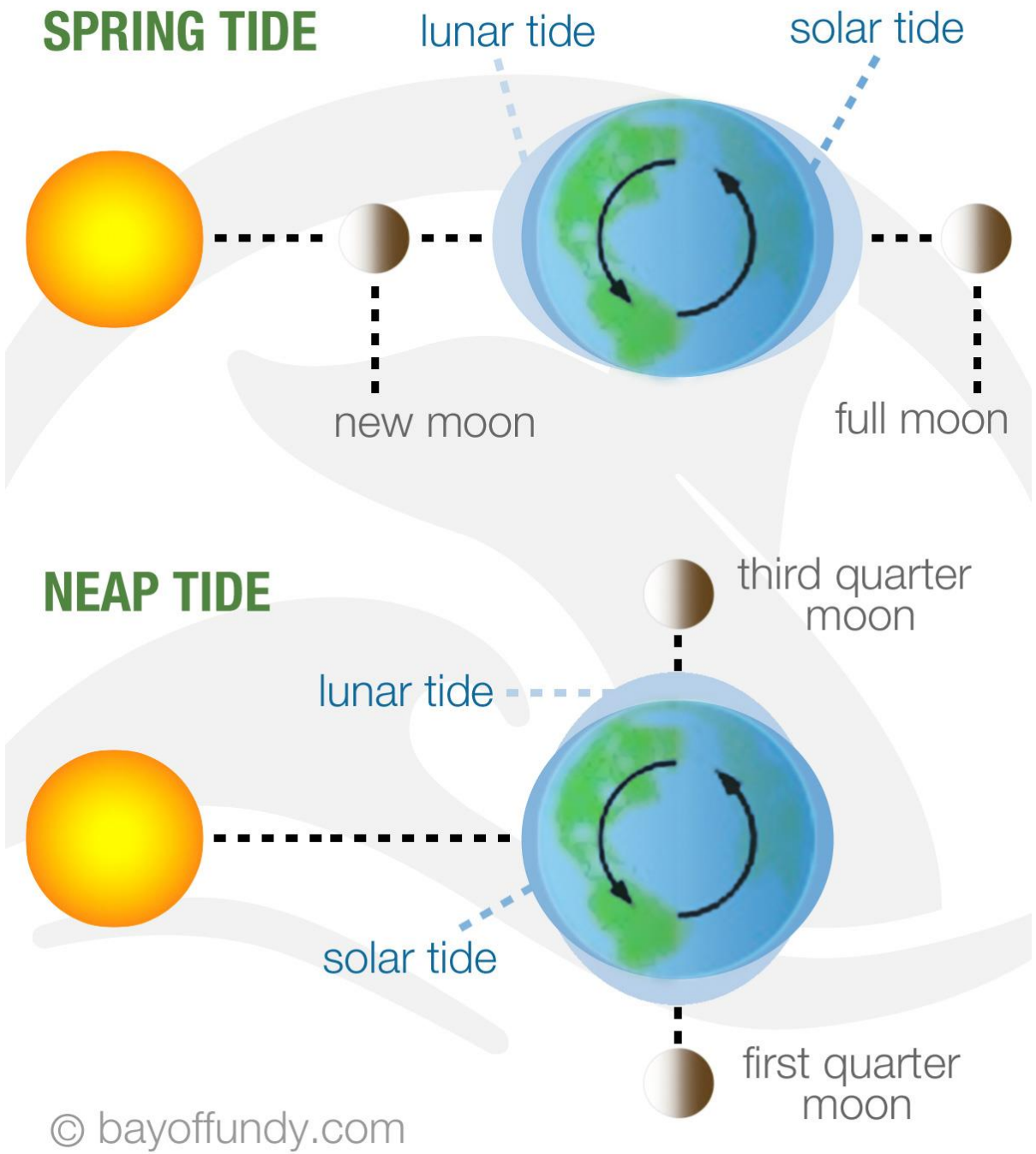
These waves approaching the beach at a slight angle near Oceanside, California, produce a longshore current moving from left to right.

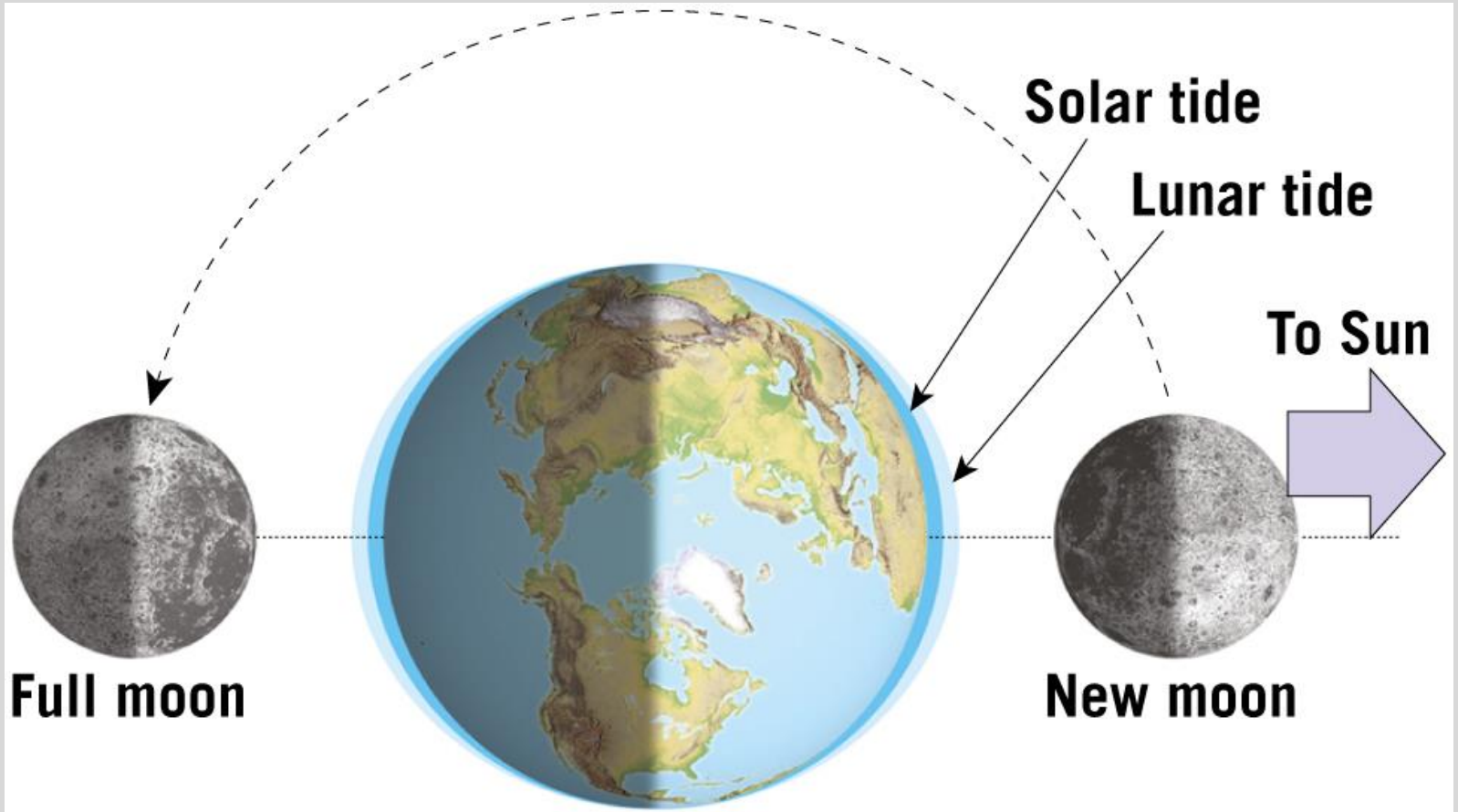

Bay
Sea arch
Island
Sea arch
Wave-cut cliff
Spit
Sea stack
Tombolo
Tombolo
TIME
Spit
Beach deposits
Baymouth bar
Wave-cut cliff
Longshore current
Spit
Wave-cut platform

TIDES

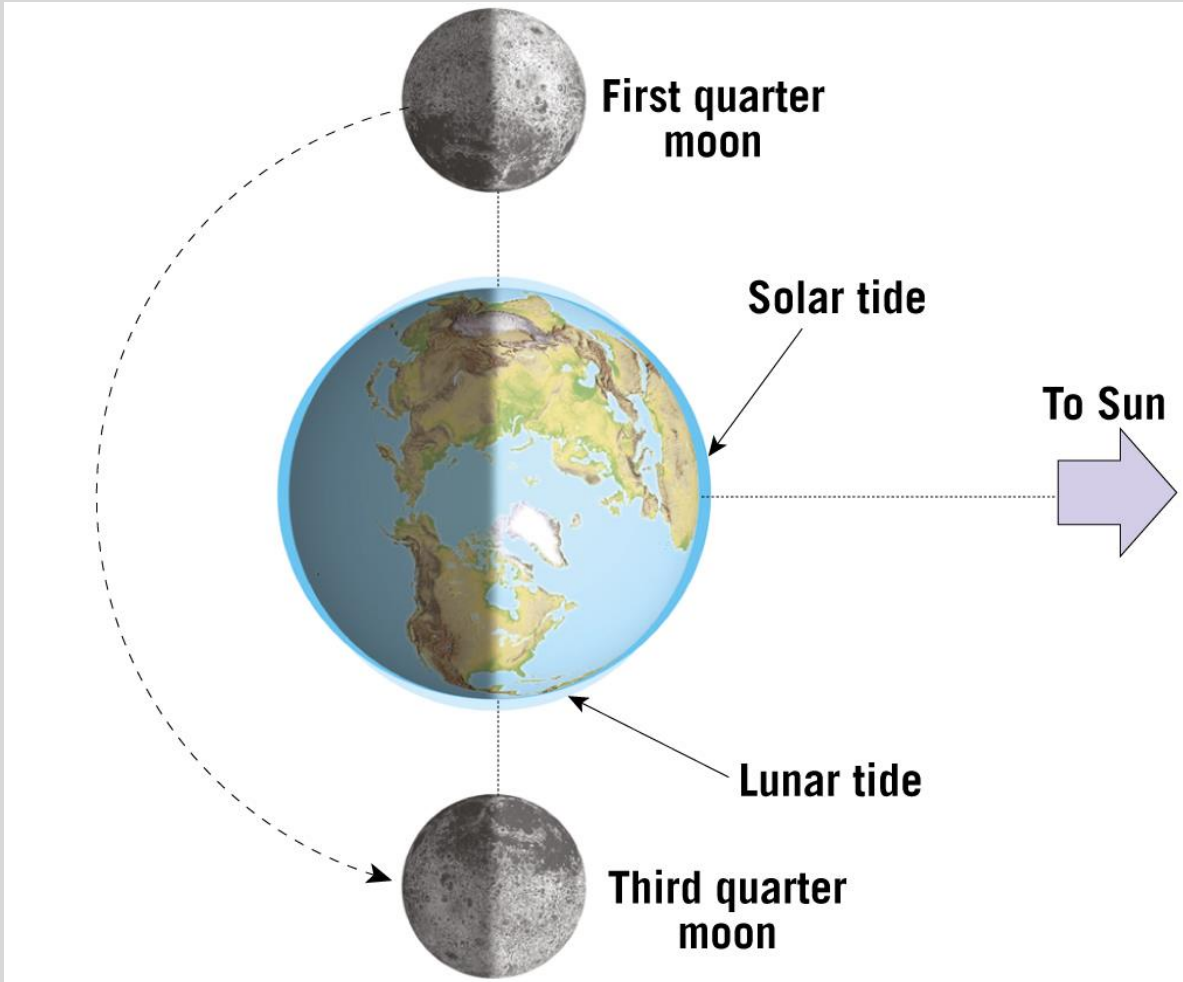
https://www.youtube.com/watch?v=KlWpFLfLFBI


Higher
high tide
N
Lower
high tide
Rotation
To
Moon
Tidal
bulge
Tidal
bulge
S


SPRING TIDE
lunar tide
solar tide
new moon
full moon
NEAP TIDE
third quarter moon
lunar tide
solar tide
first quarter moon
© bayoffundy.com



A. Spring Tide When the Moon is in the full or new position, the tidal bulges created by the Sun and Moon are aligned and there is a large tidal range.



B. Neap Tide When the Moon is in the first-or third-quarter position, the tidal bulges produced by the Moon are at right angles to the bulges created by the Sun and the tidal range is smaller.

More Data Than You Can Imagine

https://tidesandcurrents.noaa.gov


MERCEARIA
DO CAIS
DOMICILIO

COASTAL LANDFORMS

"Active" vs. "Passive" Continental Margins

Continental margins typically fall into two classes: "active" and "passive."

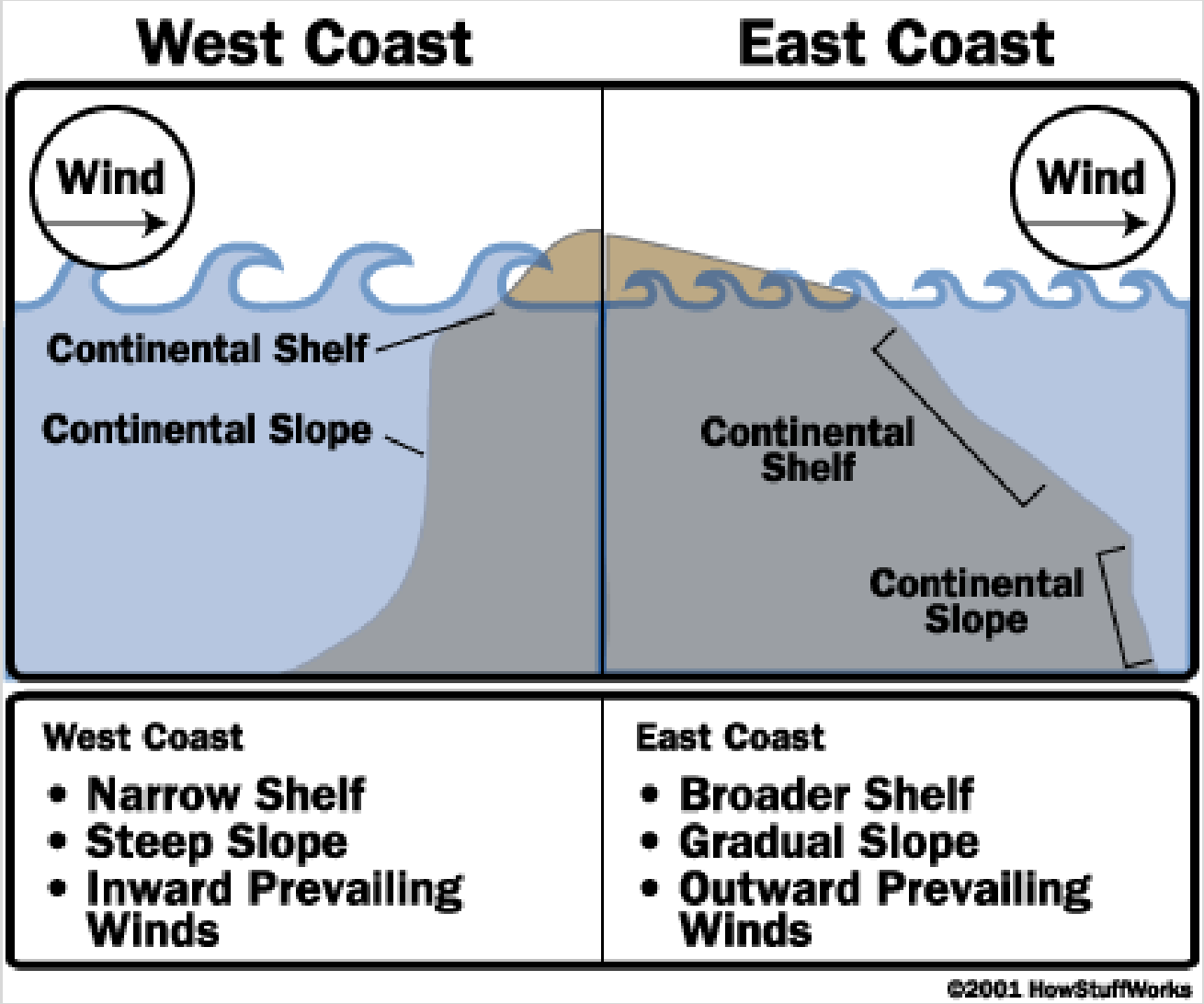
An **active continental margin** is a coastal region that is characterized by mountain-building activity including earthquakes, volcanic activity, and tectonic motion resulting from movement of tectonic plates. Characteristics of active continental margins include:

- Found on mostly convergent plate boundaries
- Continental slope descends abruptly into a deep-ocean trench (no continental rise)
- Located primarily around the Pacific Ocean

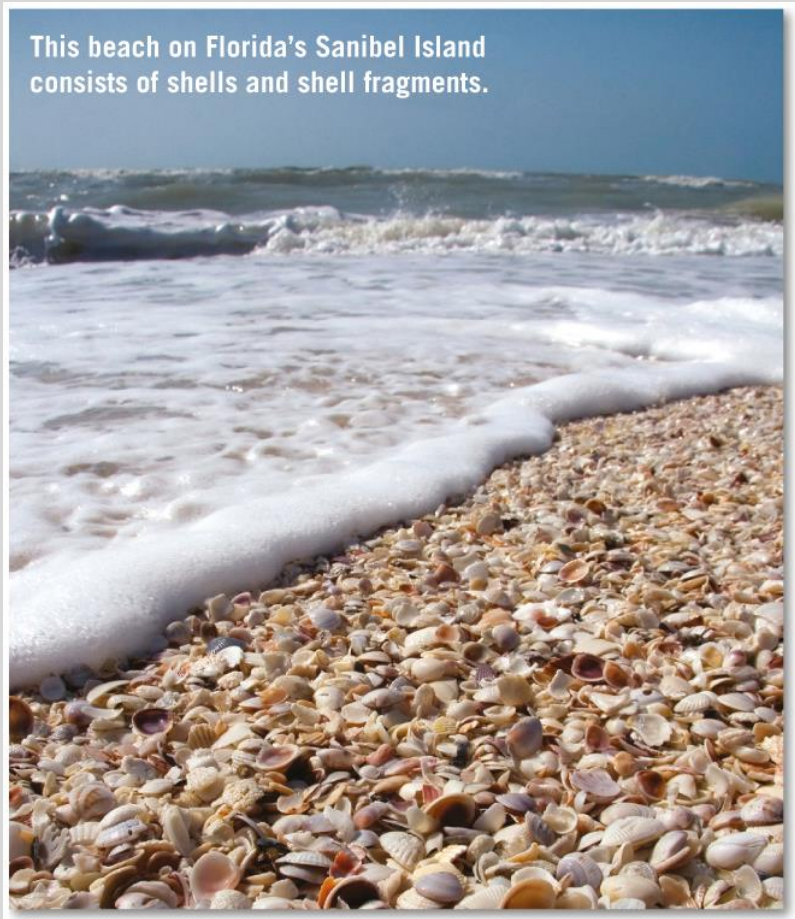
The West Coast of the United States is an active margin that is characterized by rugged coastlines with narrow beaches and steep sea cliffs.

Passive continental margins occur where the transition between oceanic and continental crust which is not an active plate boundary. Examples of passive margins are the Atlantic and Gulf coastal regions which represent setting where thick accumulations of sedimentary materials have buried ancient rifted continental boundaries formed by the opening of the Atlantic Ocean basin. The Atlantic Coast of the United States is characterized by wide beaches, barrier islands, broad coastal plains (see features discussed below).

https://www.youtube.com/watch?v=pSZuINb-9aQ

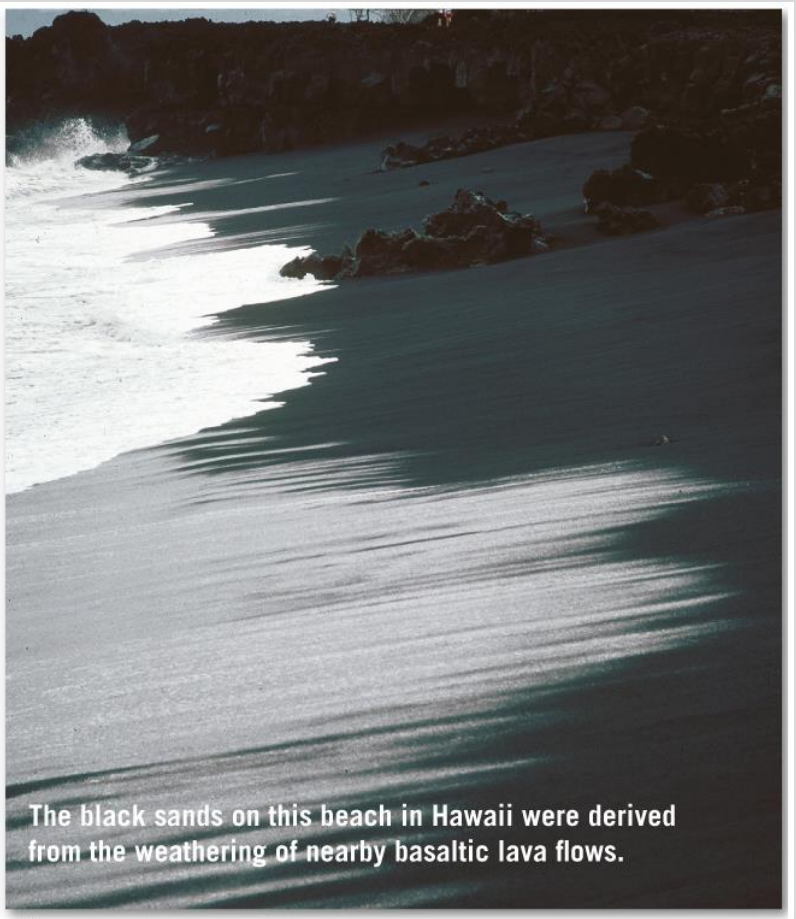

West Coast
East Coast
Wind
Wind
Continental Shelf
Continental Slope
Continental Shelf
Continental Slope
West Coast
• Narrow Shelf
• Steep Slope
• Inward Prevailing Winds
East Coast
• Broader Shelf
• Gradual Slope
• Outward Prevailing Winds
©2001 HowStuffWorks

Erosion



This beach on Florida's Sanibel Island consists of shells and shell fragments.

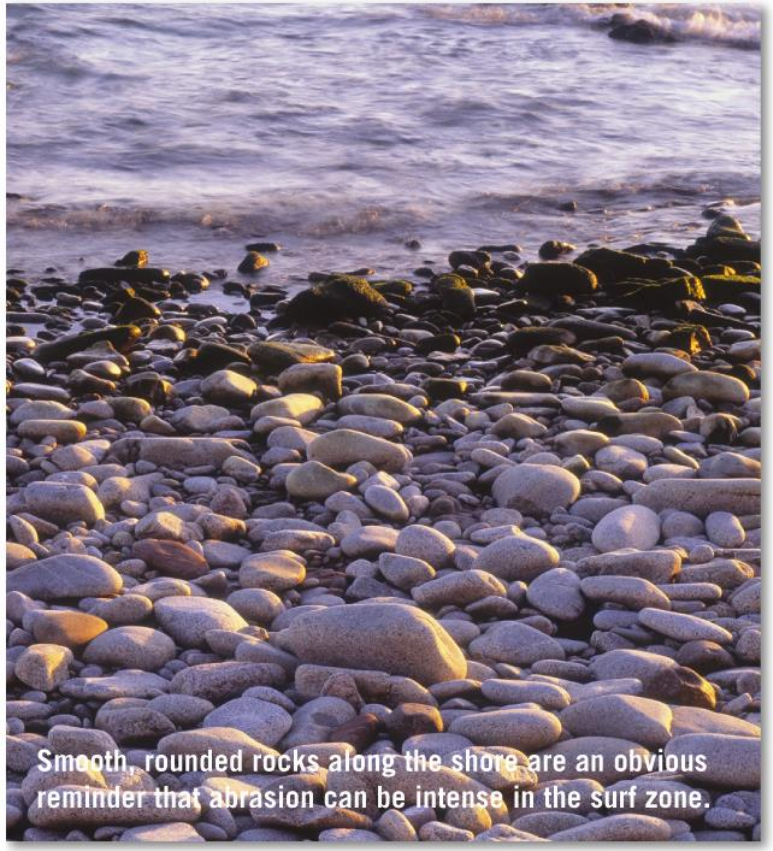
A.



The black sands on this beach in Hawaii were derived from the weathering of nearby basaltic lava flows.

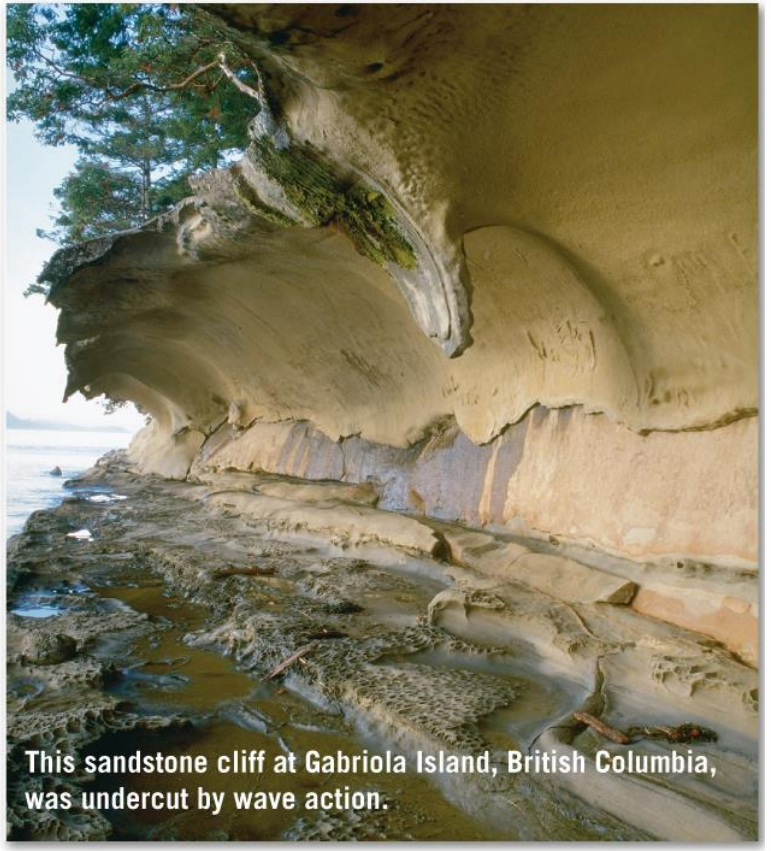
B.

A.



Smooth, rounded rocks along the shore are an obvious reminder that abrasion can be intense in the surf zone.

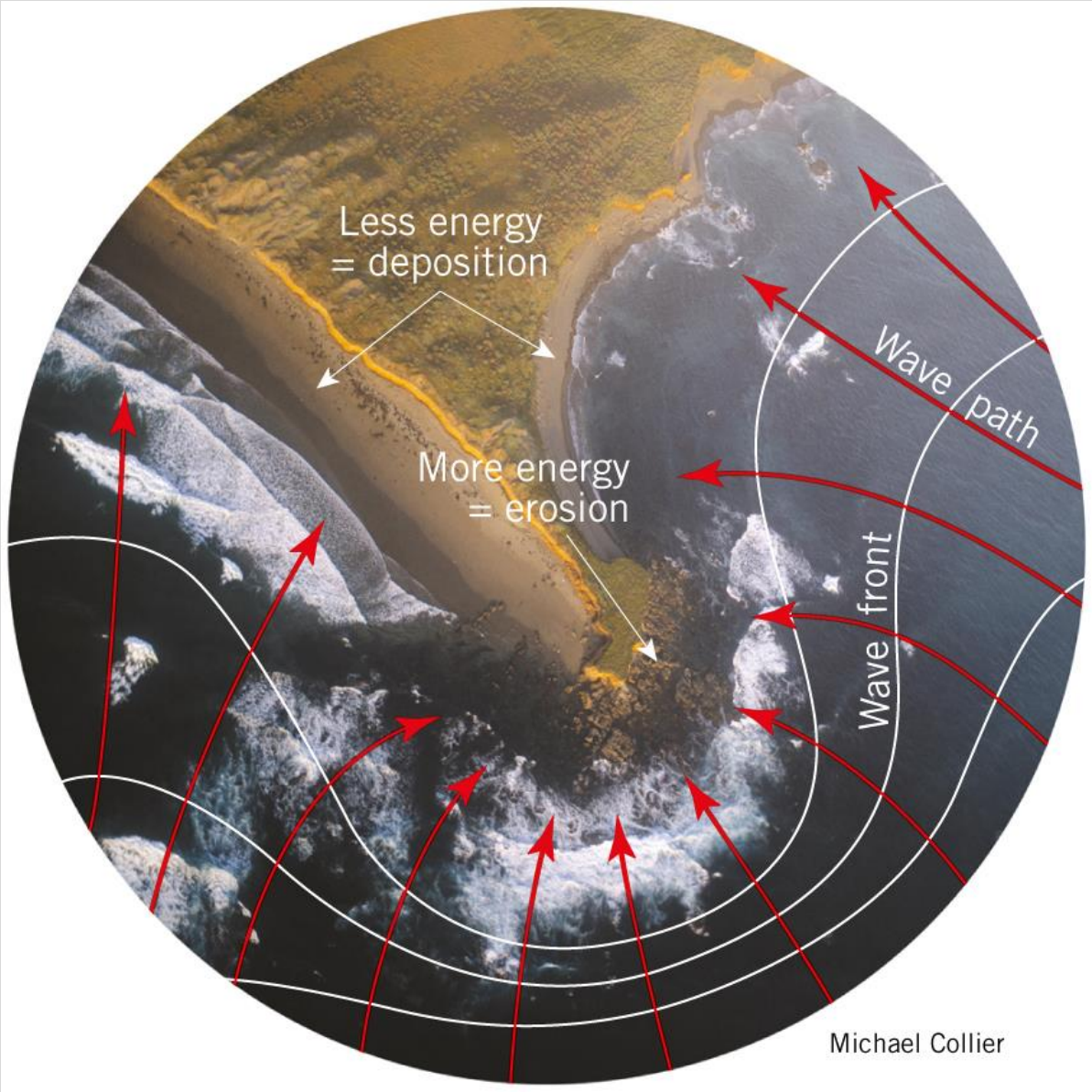
B.

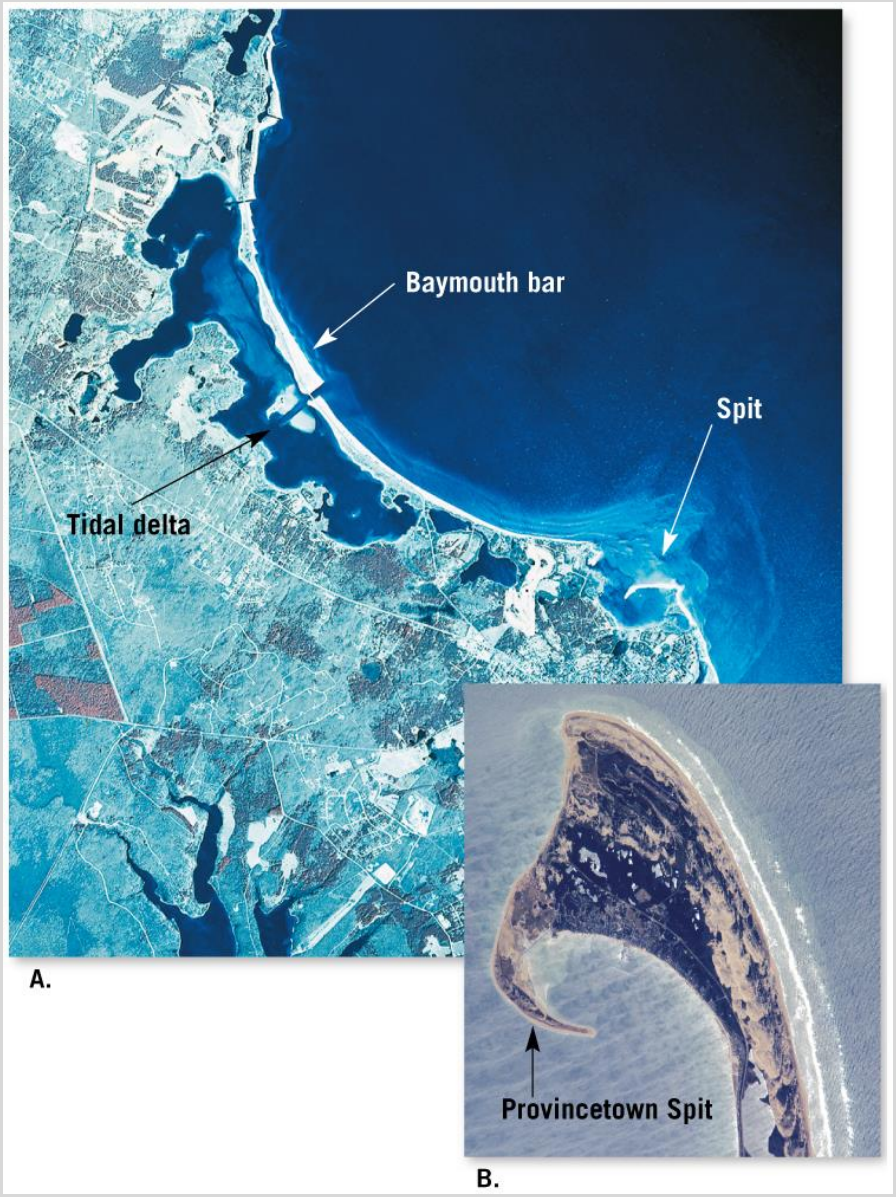


This sandstone cliff at Gabriola Island, British Columbia, was undercut by wave action.


Wave-cut
platform
Marine terrace


Sea stack
Sea arch


Less energy
= deposition
More energy
= erosion
Wave path
Wave front
Michael Collier


Baymouth bar
Spit
Tidal delta
A.
Provincetown Spit
B.


VIRGINIA
NORTH CAROLINA
Albemarle Sound
NC
Pamlico Sound
Hatteras Island
ATLANTIC OCEAN
Cape Lookout
Hatteras Island
Pamlico Sound
Road
Dunes
ATLANTIC OCEAN

GEOGRAPHICS 15.1

A Brief Tour of America's Coasts*

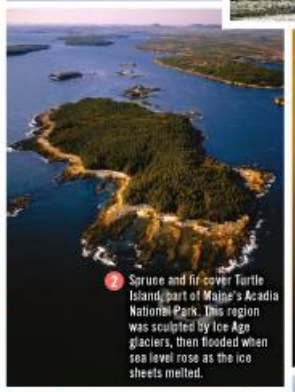
Coasts are among Earth's most dynamic landscapes. Waves, tides, and currents continuously shape this interface between land and sea. Coasts may also exhibit the effects of mountain building, sea level changes, rivers, glaciers, and people. Here is a very small glimpse at the diversity and beauty of America's costs.

1 A small portion of the Cape Cod coast shows the entrance to Nauset Bay. Depending on the whims of recent storms and the strength of coastal currents, the opening into the bay may only be a few hundred feet wide. Tidal currents have created an underwater sandbar just inside the harbor.

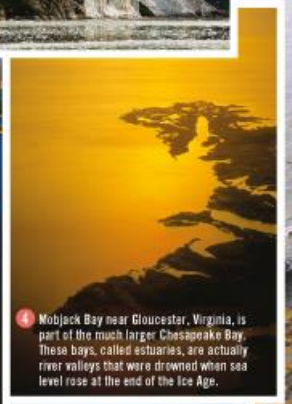
5 The delta of the Mississippi River is a major feature in the Gulf of Mexico. This low-lying coastal zone is a maze of low soggy islands that are barely above sea level with a myriad of natural distributries and artificial channels.

9 A small glacier flows down a steep mountain slope into the Cook Inlet southwest of Anchorage, Alaska. The total length of Alaska's irregular coastline is nearly 71,000 kilometers (44,000 miles).

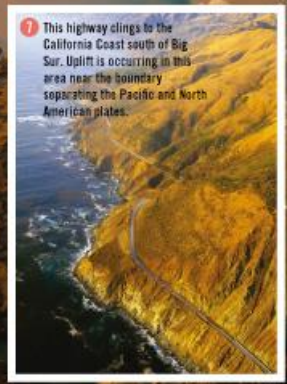
10 Sea ice hugs Alaska's north slope near Barrow. The Arctic shore is locked in ice for much of the year.



2 Spruce and fir cover Turtle Island, part of Maine's Acadia National Park. This region was sculpted by Ice Age glaciers, then flooded when sea level rose as the ice sheets melted.



4 Mobjack Bay near Gloucester, Virginia, is part of the much larger Chesapeake Bay. These bays, called estuaries, are actually river valleys that were drowned when sea level rose at the end of the Ice Age.



7 This highway clings to the California Coast south of Big Sur. Uplift is occurring in this area near the boundary separating the Pacific and North American plates.

3 North Carolina's Outer Banks. Oregon Inlet Bridge connecting Bodie Island (foreground) and Hatteras Island. These narrow wisps of sand are part of an extensive barrier island system. The beach and dunes on the left face the Atlantic Ocean. On the right are the quieter waters of Pamlico Sound.

11 Padre Island is a barrier island that protects the coast of southern Texas from storms. Winds off the Gulf of Mexico create dunes, which offer a temporary footing for vegetation that is occasionally stripped away by hurricanes.

6 Waves have aggressively attacked the coast north of La Push Harbor, Washington. In places, remnants of the cliff remain as sea stacks.

8 Cliffs and waterfalls along the north coast of Hawai'i's Big Island. This portion of the island receives abundant rainfall. There are still active volcanoes elsewhere on the island.

Question:
Use these images to identify at least two shoreline features described in section 20.4.

?

*Prepared with the assistance of Michael Collier. All photos by Michael Collier.