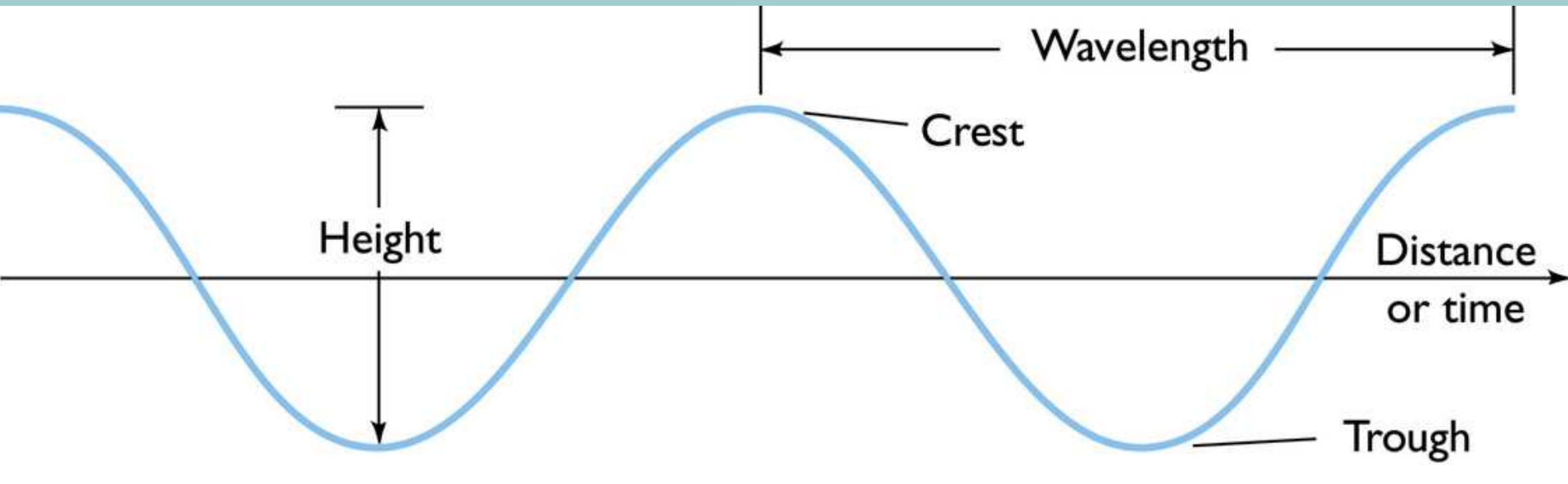
Waves and Tides

Parts of a wave:

height (H)

wavelength (L, or λ)

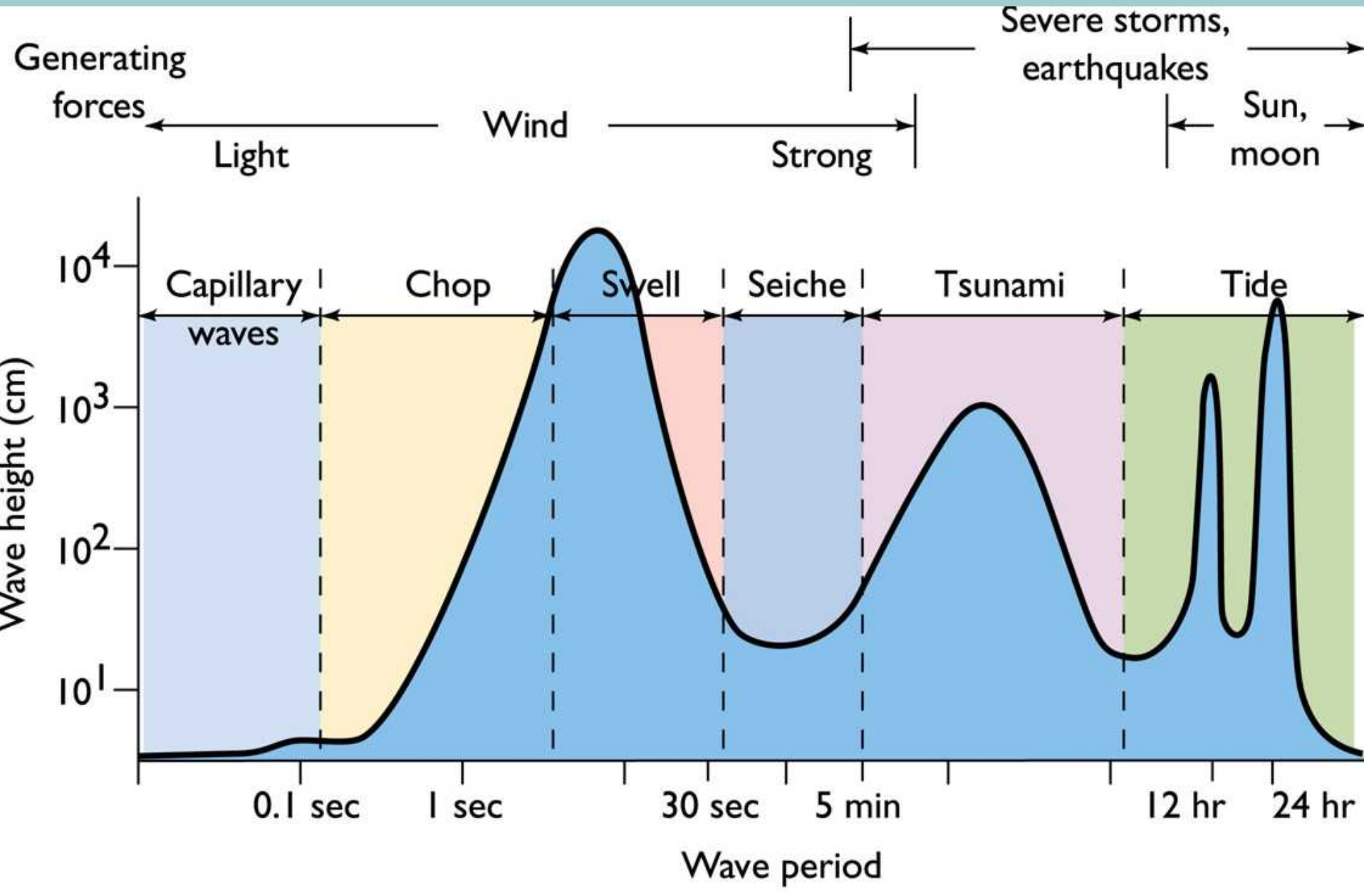


amplitude (H/2)

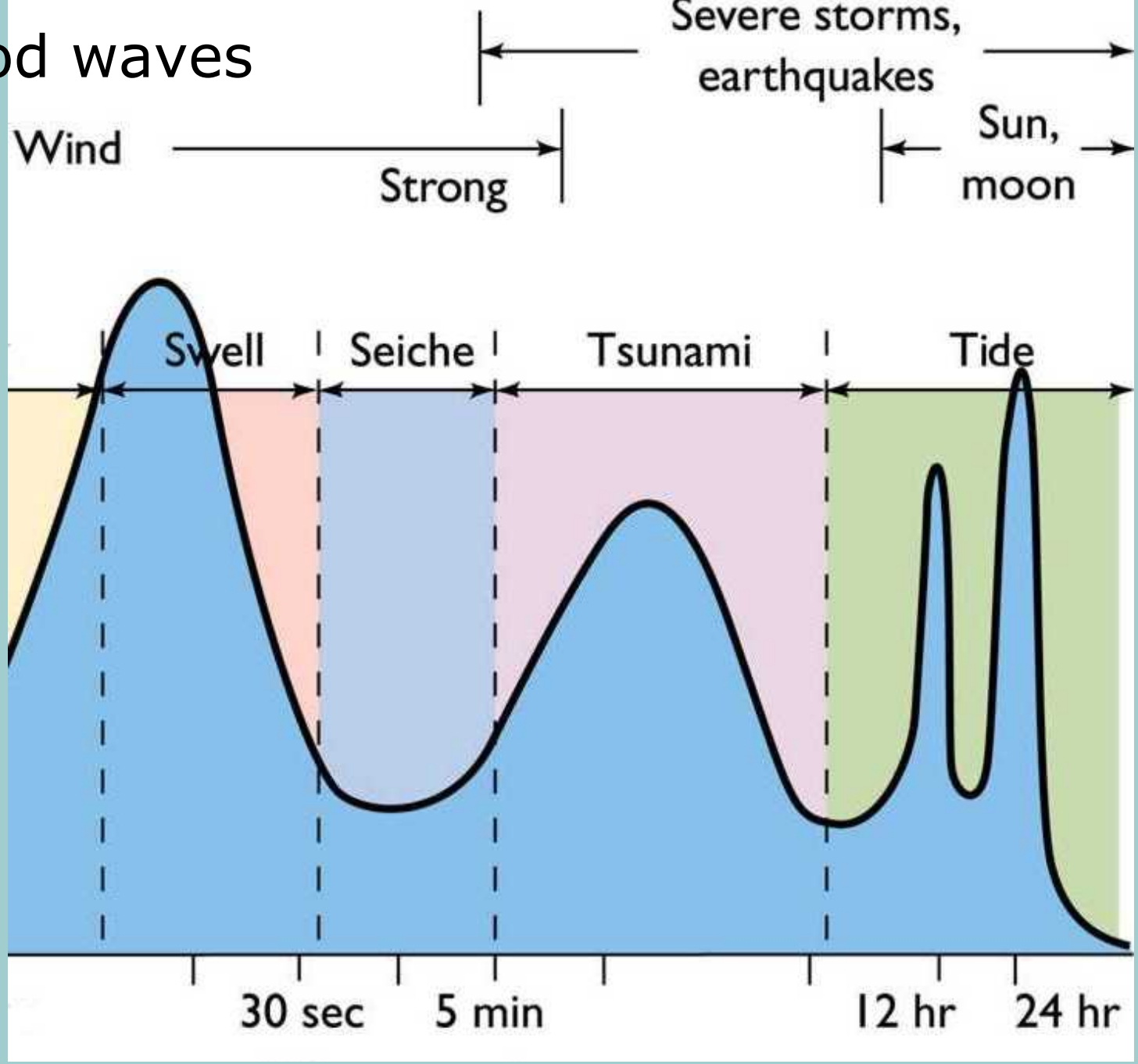
crest

trough

Distribution of wave heights



Long-period waves



Waves are energy

The energy moves through the water as a wave form

The water particles move in circles (orbits) as the wave passes

REALLY important point related to tsunamis:

The longer the wavelength, the faster the wave

$C = 1.25 * \sqrt{(\text{wavelength})}$

Wave speeds

Deep-water wind waves

Maximum values:

Period	20 seconds
Wavelength	600 meters
Speed	110 kilometers per hour (70 mph)

*Seismic sea waves (**shallow**-water waves)*

Maximum values:

Period	20 minutes (60x wind waves)
Wavelength	200 kilometers (120 miles)
Speed	760 kilometers per hour (470 mph)

Wave as an oscillation

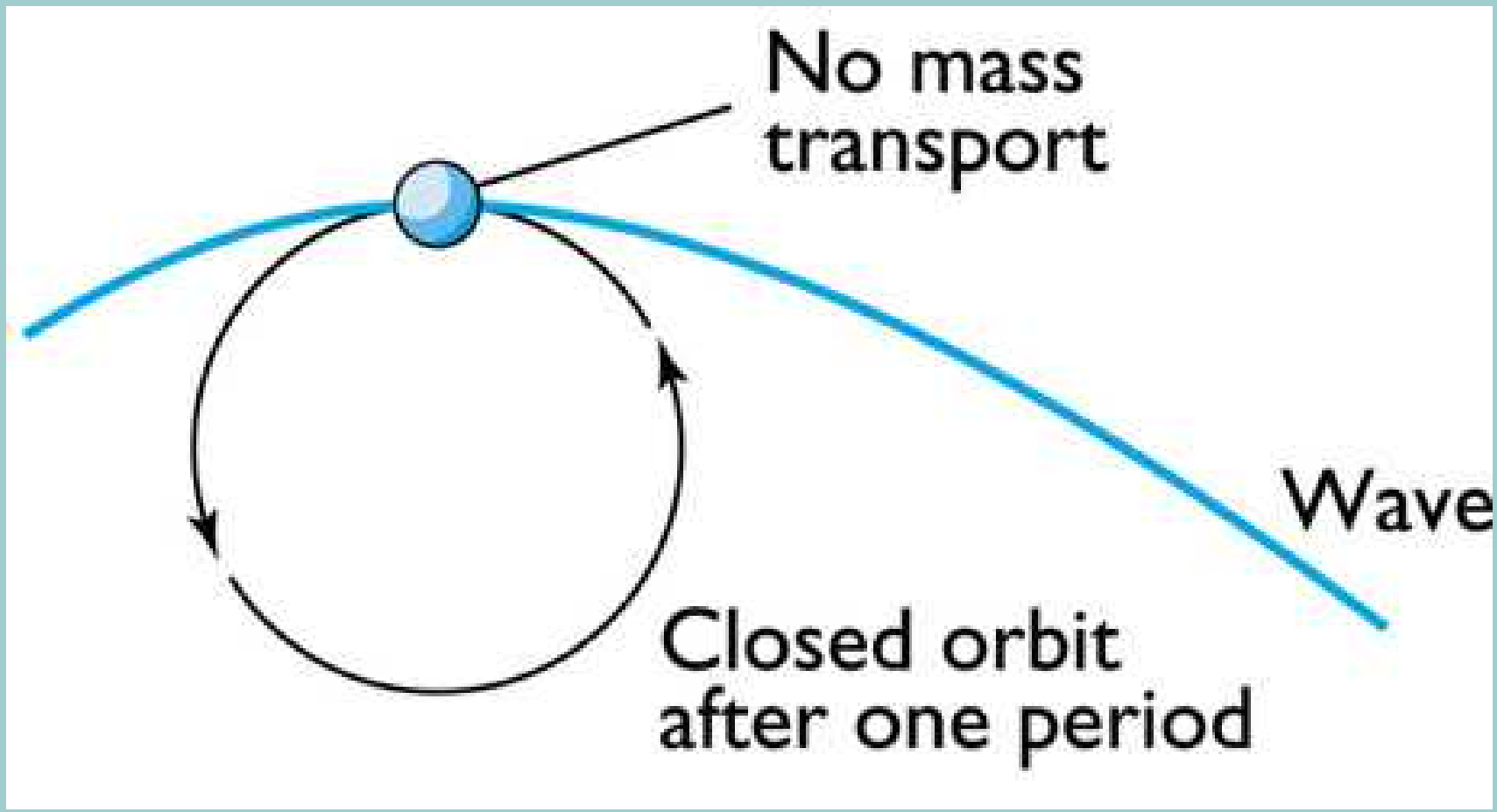
Wave as an oscillation

Waves are energy

The energy moves through the water as a wave form

The water particles move in circles (orbits) as the wave passes

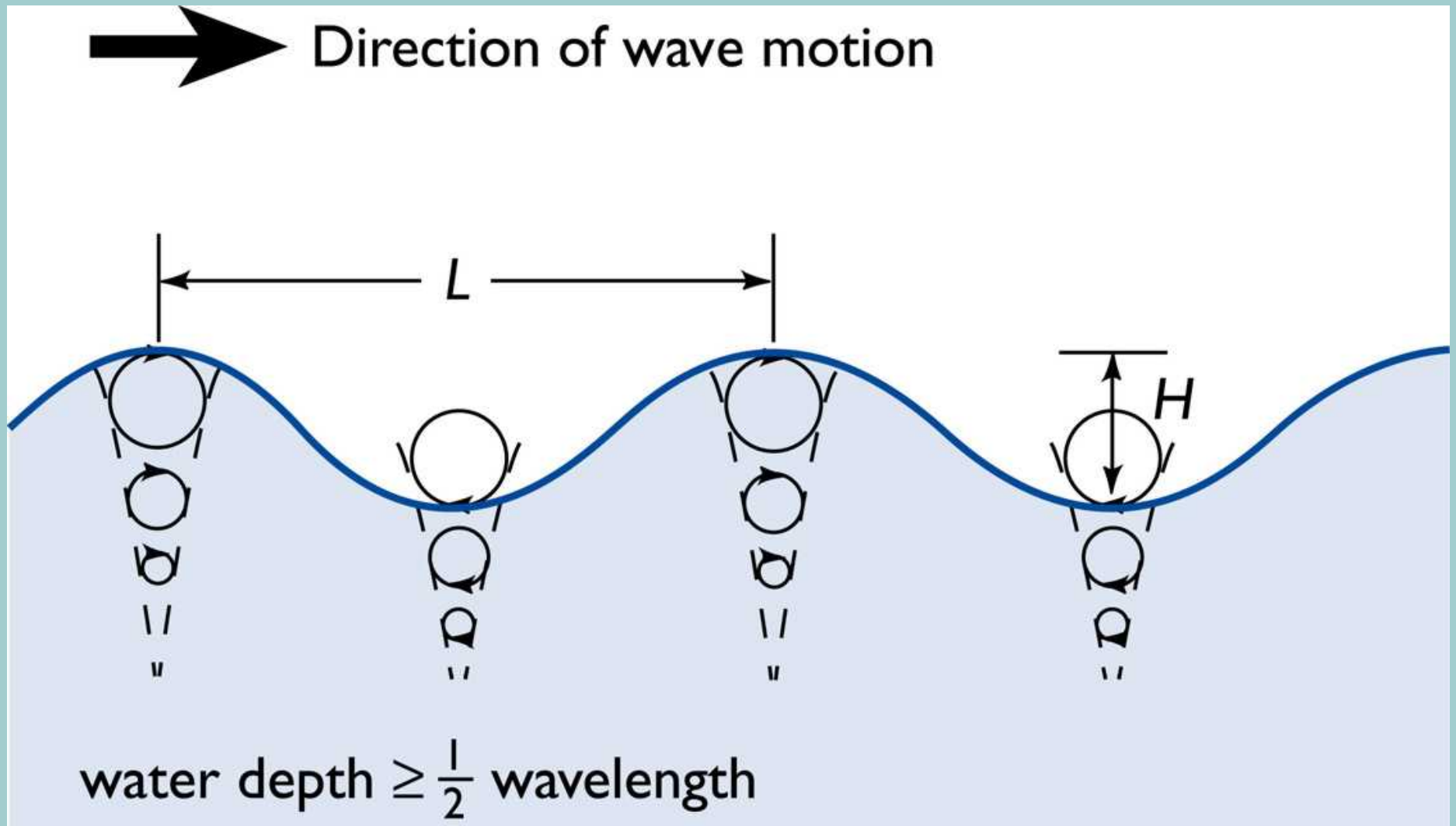
Wave orbits


Direction of wave motion
No mass transport
Wave
Closed orbit after one period

Deep-water wave

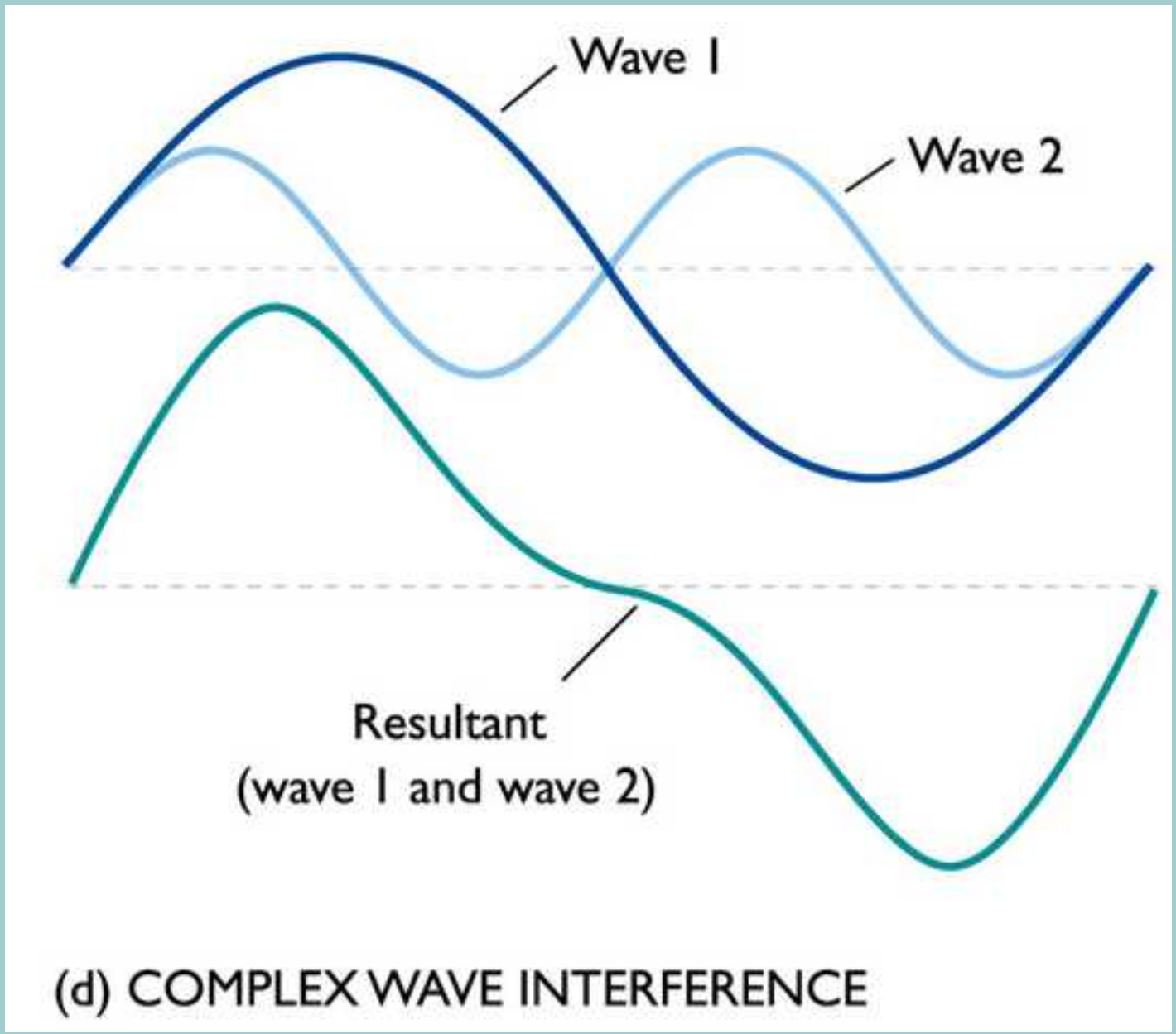
The wave does not “touch bottom”
Water depth > L/2

Deep-water wave



(a) DEEP-WATER WAVE

Complex wave interference



Wave speed: Celerity

C = L / T (equivalent to R = D / T)

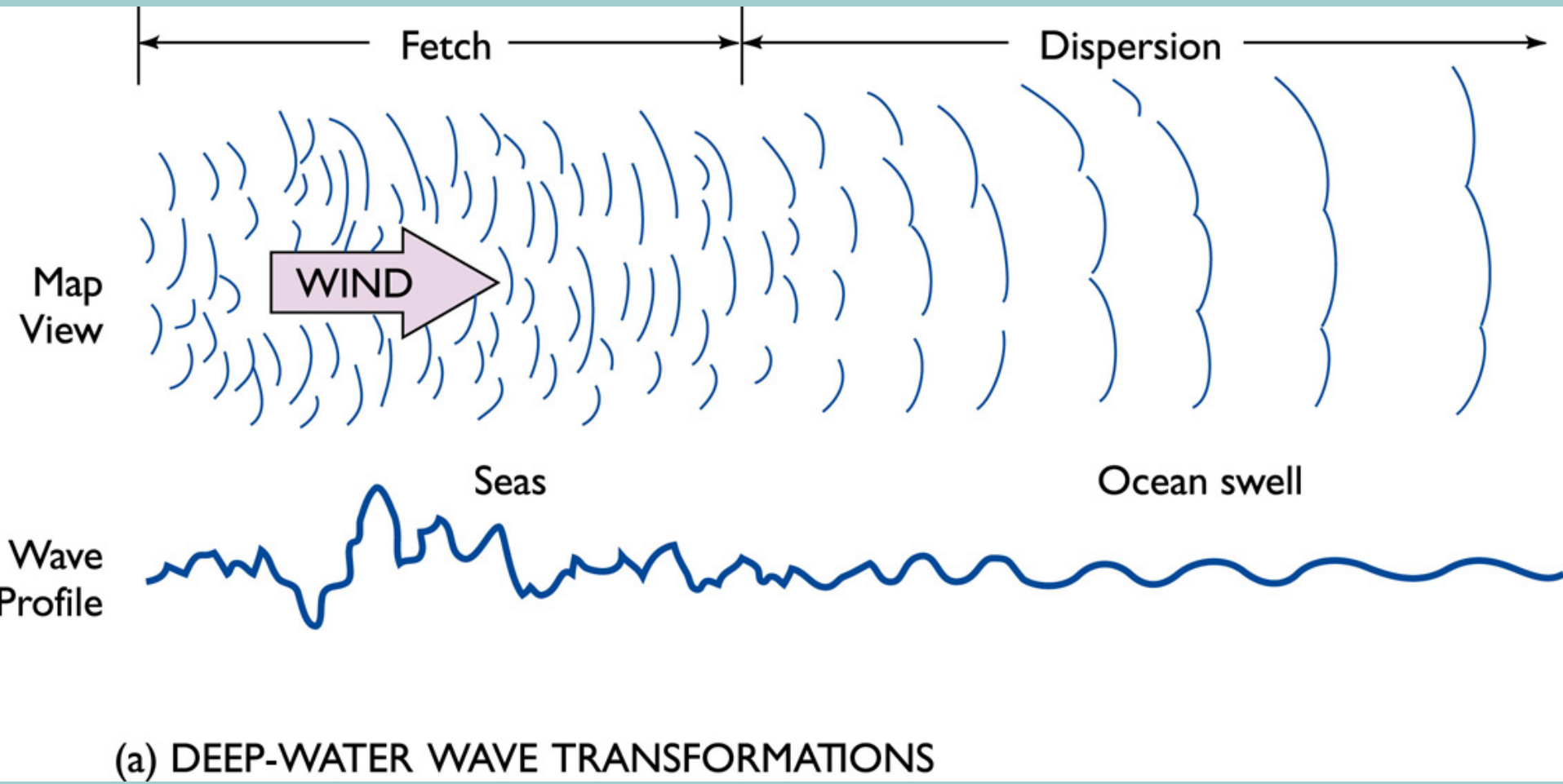
For surface waves in water, the longer the wavelength, the faster the celerity

Wave dispersion, away from a storm center

Where have you seen that 'C' before?

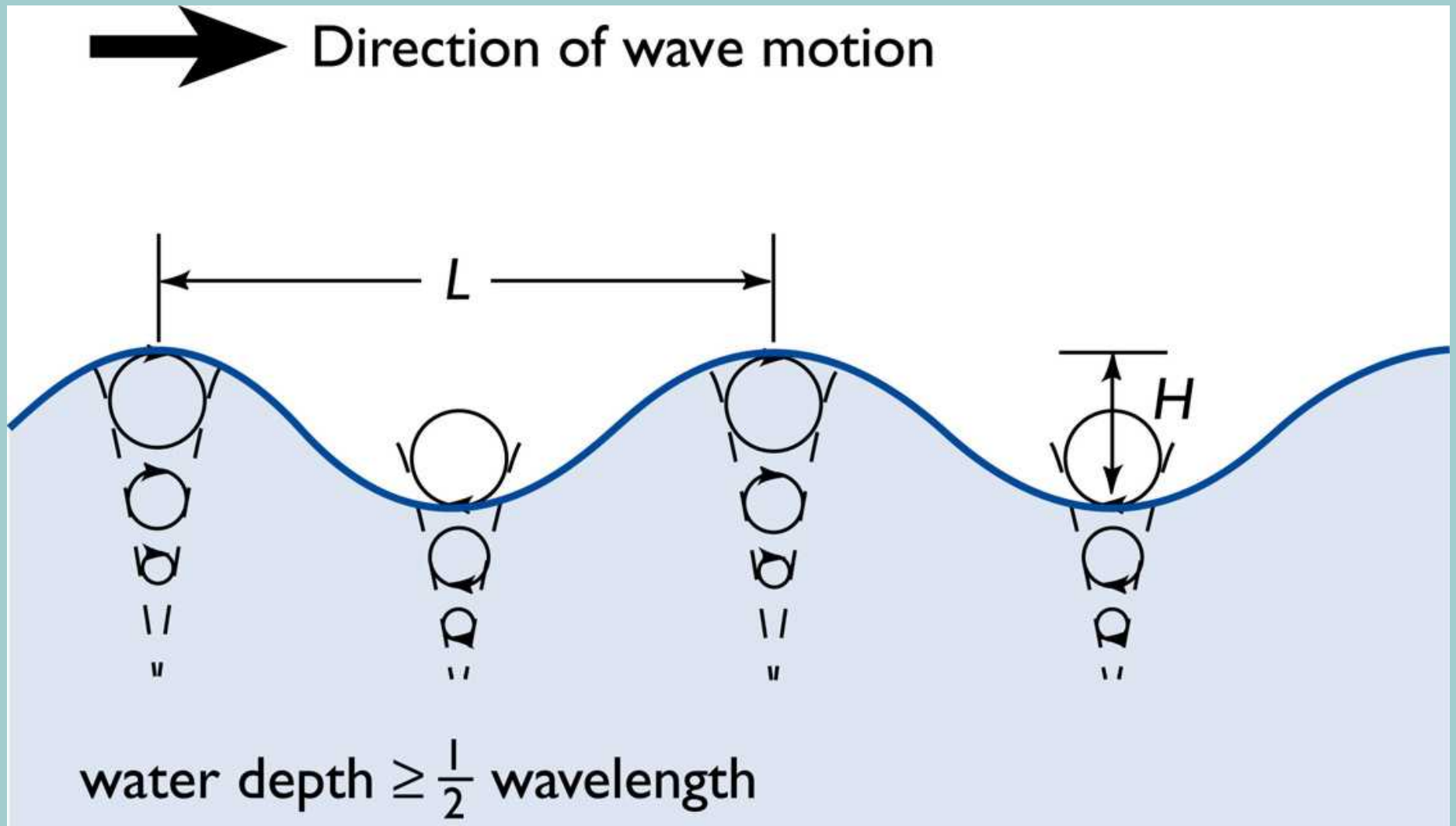
Wave dispersion away from a storm

Long wavelength waves move out ahead



(a) DEEP-WATER WAVE TRANSFORMATIONS

Deep-water wave



(a) DEEP-WATER WAVE

Waves in shallow water

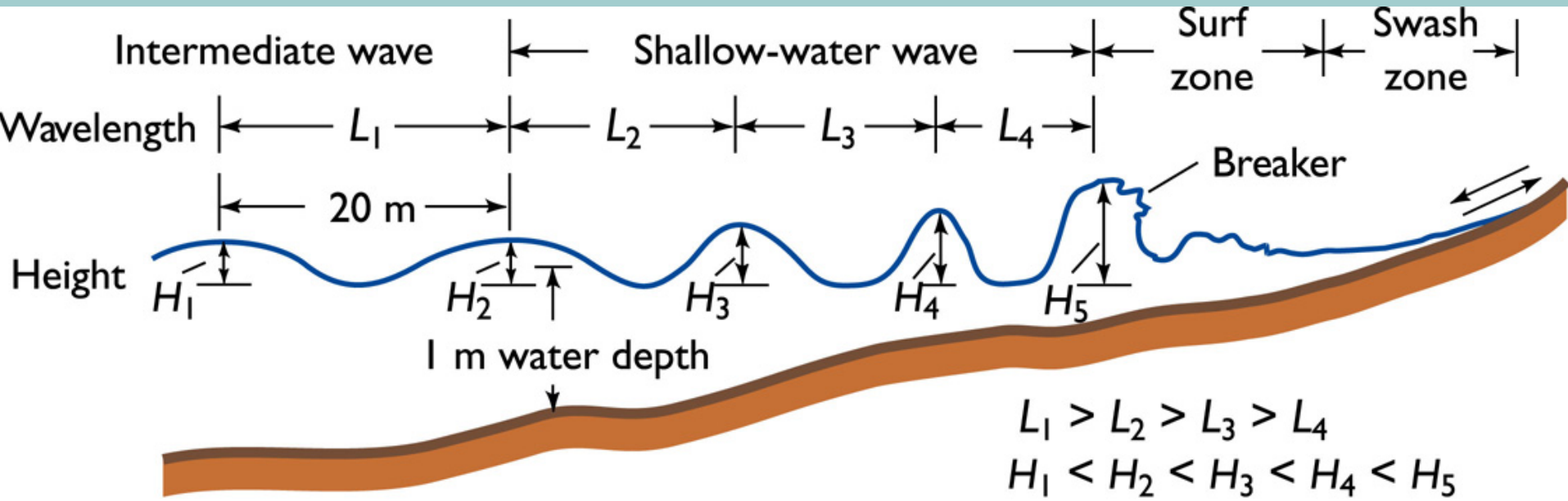
Energy is lost from the wave because of friction with the bottom

Energy used to move sediment particles

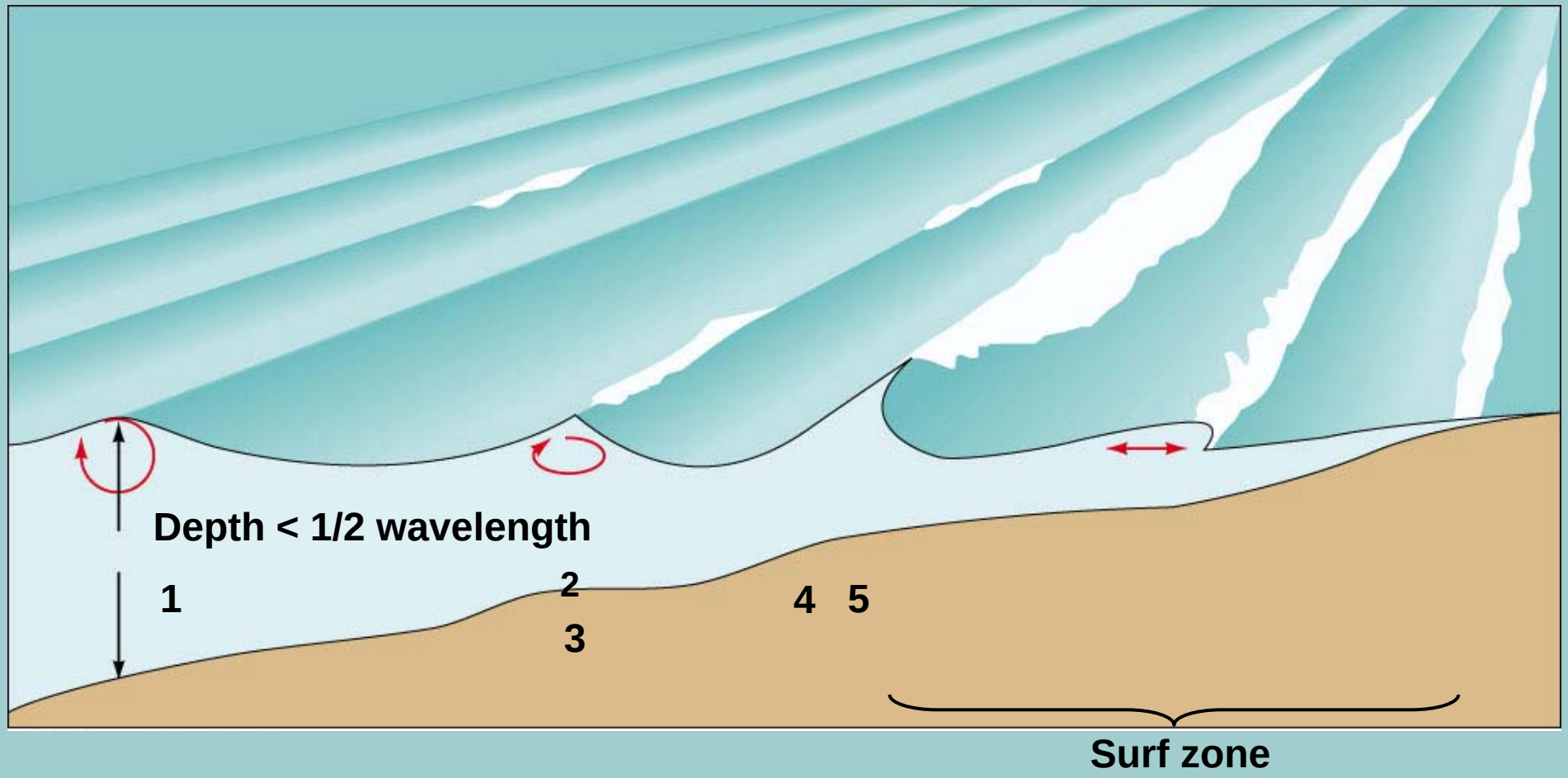
As a wave moves into shallow water:

- speed decreases
- wavelength decreases
- height increases

Waves in shallow water



(b) SHALLOW-WATER WAVES IN PROFILE

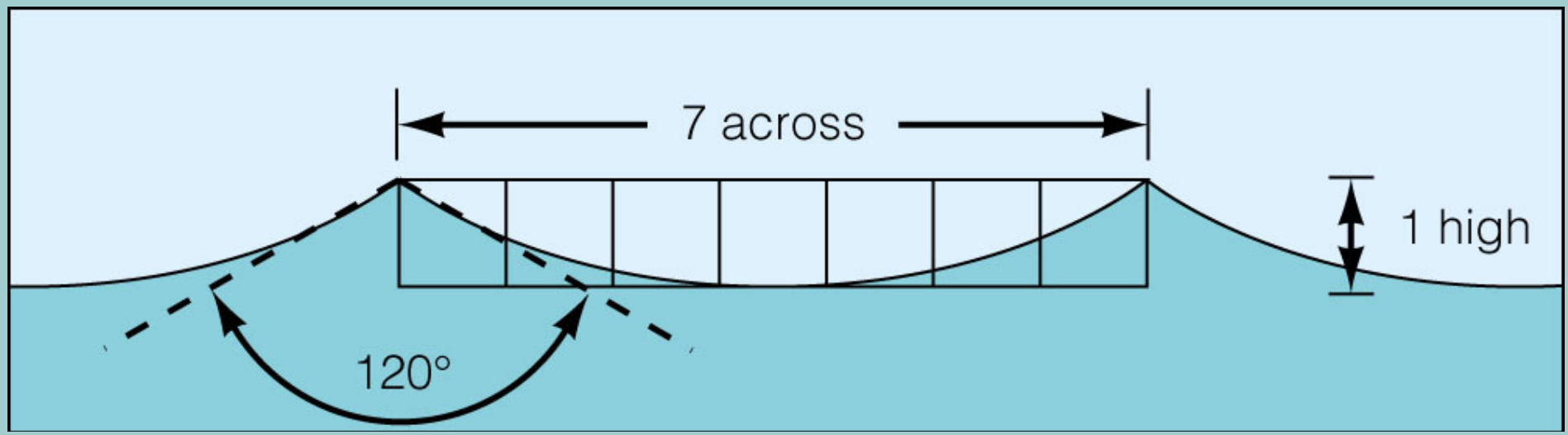

Depth < 1/2 wavelength
1
2
3
4
5
Surf zone

Critical wave steepness

H / L = 1 / 7

For a wave with L = 7 m,
if H > 1 m, it will break

Whitecaps and breakers



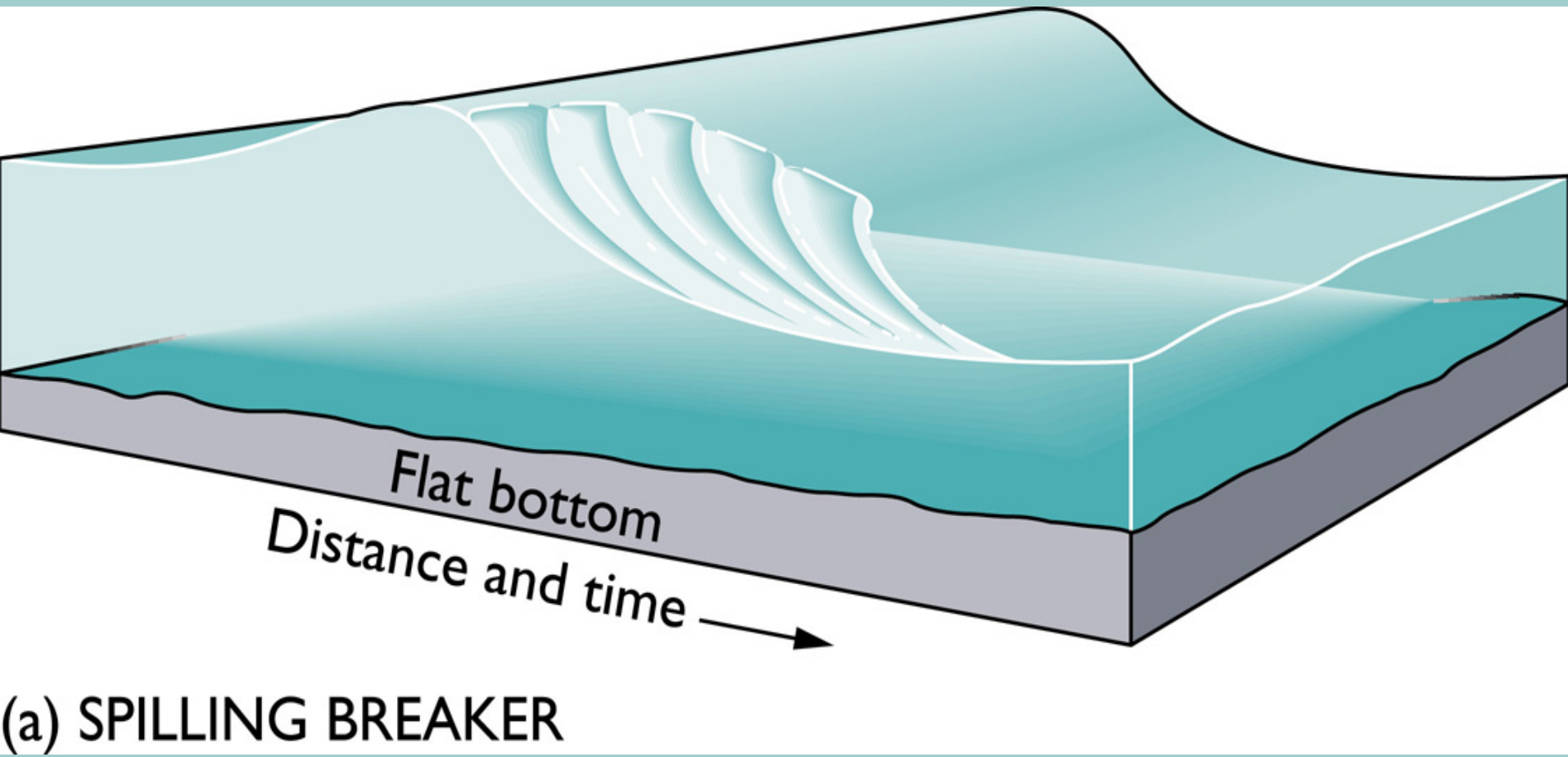
Breaking waves

The type of breaking wave depends on the slope of the beach

low slope – spilling
steep slope – plunging
very steep – surging
(extreme case, seawall)

Spilling breaker – low slope

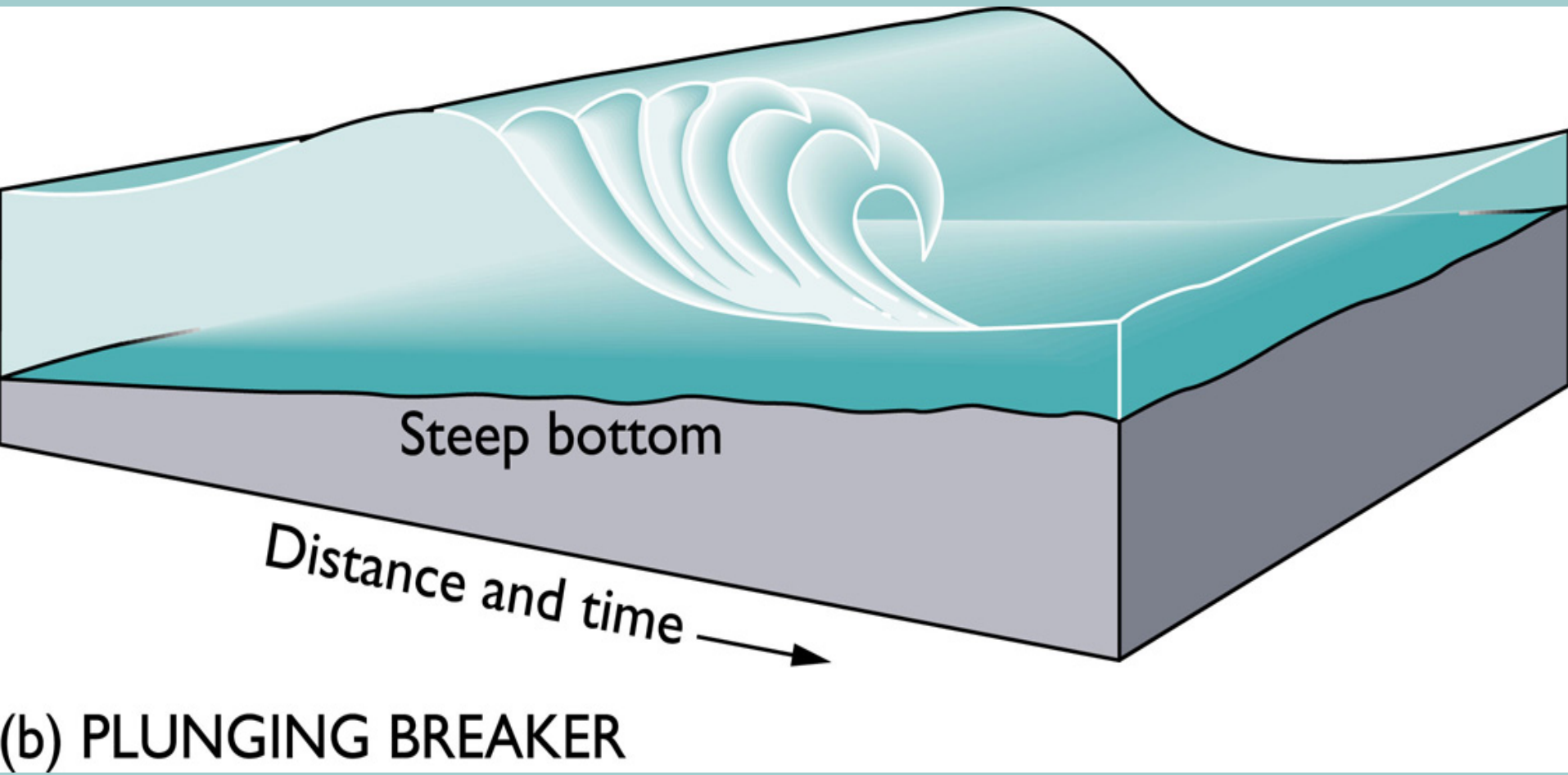
Slow loss of energy by contact with bottom



(a) SPILLING BREAKER

Plunging breaker – steep slope

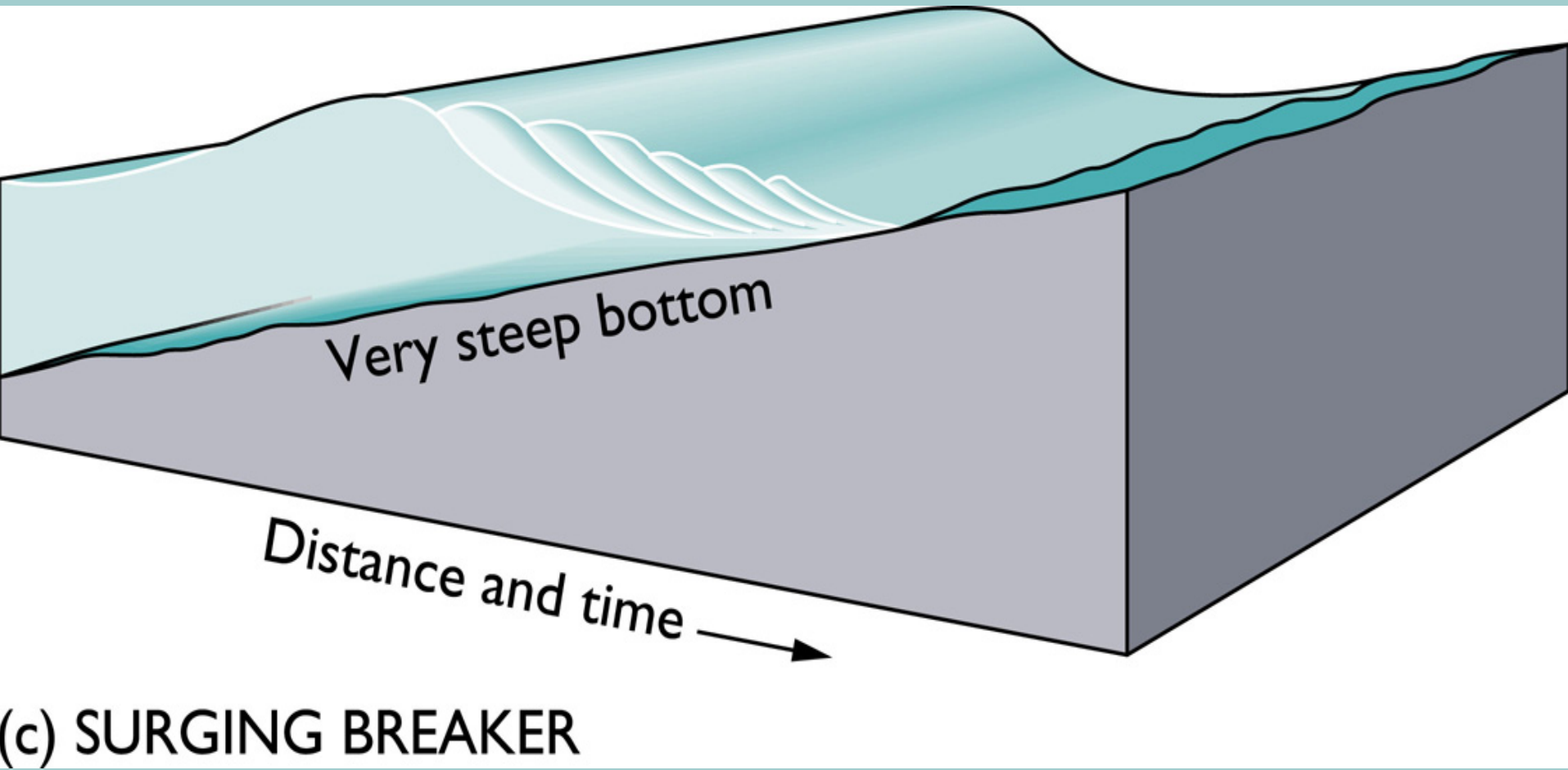
Rapid increase in bottom friction



(b) PLUNGING BREAKER

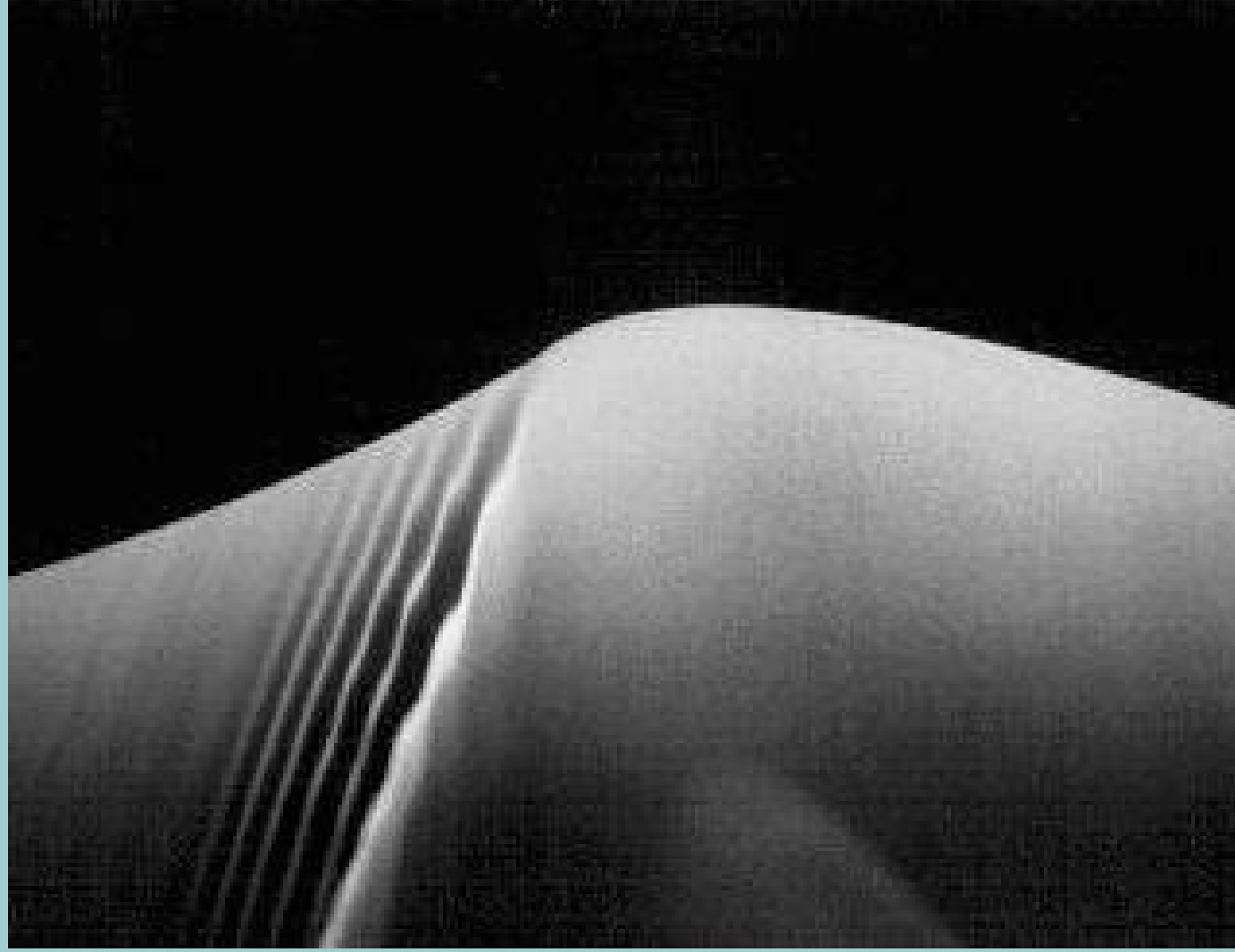
Surging breaker – very steep slope

Most of the wave energy is reflected



(c) SURGING BREAKER

Surging wave



A spilling wave

Max wave ridden:

18 meters (60 feet)