4/2/08

GEOL 117 Class 29
WAVES ALONG COASTS

Wind-generated waves
- Shallow water waves (more)
- Changes as waves move onto shore
- Longshore transport

Tsunamis in coastal areas
Seiches

WIND-GENERATED WAVES along coastlines

(1) Changes in wave speed, etc. as they move from deep water into shallow water

- They "feel bottom" in shallow water (D < L/2)
- "Deep-Water" --> Transitional Waves → "Shallow Water" waves
- S decreases
- T remains constant
- Therefore, L decreases
- H increases (wave energy confined to smaller area)

When D < L/20, S & L controlled only by depth.

$S = \sqrt{gD}$ (g = 9.8 m/sec^2)

If wave height gets great enough, top of wave crashes forward as the bottom of the wave slows down → "breakers," "surf" when H/L > 1/7

TSUNAMIS in coastal areas

H = 1-2 m in open ocean, long L

BUT, as they move onshore:

1. L decreases (compresses waves)
2. H can increases to 20+ m, usually less than that
   a. Period is still very long, L still very long
   b. So waves are not steep breaking waves
   c. More like floods- water rushes inland, continues for several minutes, then rushes back out (laden with debris)
3. Energy focused by bottom topography and man-made barriers
   a. Same as other coastal waves- see below

Prediction of tsunamis -- earthquake events
- Large vertical displacement required
  - Some large quakes have strike-slip movement --> no tsunami
- We can predict wave migration from the earthquake location
- Plenty of time to warn people (hours)

Tsunamis can also be caused by underwater landslides or turbidity currents

WIND-GENERATED WAVES along coastlines- MORE

(2) Changes in wave direction -- refraction.

If waves approach at an oblique angle (not parallel)...

- Bending of wave "fronts" (crests)
- Bending of wave movement direction

Why does refraction occur?

a. Wave constantly loses speed as water gets shallower, AND

b. The part of wave that is in shallow water moves more slowly than the part in deep water

Result:

- Waves turn toward shallow water
- Waves crest become closer to parallel with shore

Refraction due to irregular shapes of coastlines causes:

a) **Focussing of wave energy onto headlands** or shallower parts of beaches

b) **Quieter conditions on recessed beaches**

c) **Erosion in headlands and deposition of sediment in recessed areas**

(3) Longshore transport

- Wave fronts and onshore "swash" – often oblique to beach front
- "Backswash" perpendicular to beach front

Result: longshore transport: Water and sediment move parallel to the beach front

Erosion occurs in areas of strong wave action (headlands)

Longshore transport tends to be away from headlands and toward quieter areas

Both sediment and water converge in recessed areas

- Sediment collects there (beaches)
- Water turns back seaward
    - Rip currents move water and some sediment offshore

Longshore transport intensity depends on wave energy…

- **Sediment transported from areas of greater wave energy**
- **Sediment dropped where wave energy is lesser**

SEICHES (harbors, bays, oceans)

"Standing" waves- they don't move

"Sloshing back and forth"- bathtub

Occur in harbors, bays

Natural resonance period (T) of a basin: Depends on depth and dimensions

If entering wave has same T, it "resonates" in basin

Water moves back and forth, up and down

Winds, tides, and waves can cause seiches