Name: _____ [1 pt]

COASTAL DEPOSITIONAL ENVIRONMENTS

A LABORATORY AND HOMEWORK ACTIVITY

PURPOSE

Part 1: Explore wave transformation and wave-driven sediment transport.
Part 2. Classify coastal deltas based on morphology.
Part 3. Synthesize learning objectives to predict factors controlling real morphology.

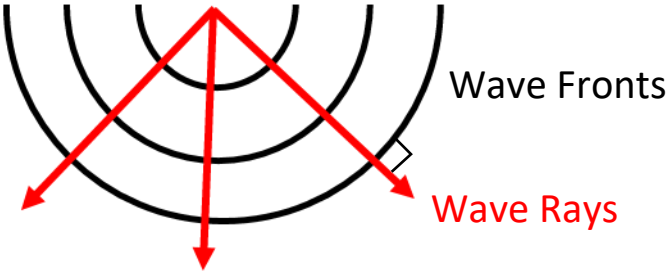
EXPECTATION

Part 1 and Part 2 should be completed in lab today. Part 3 should be started in lab and finished outside of class if not completed today.

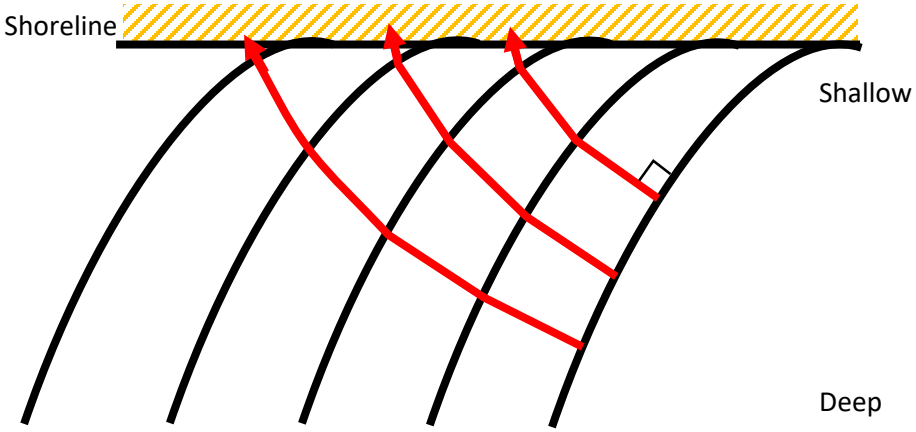
Part 1: Wave Transformations and Wave-Driven Sediment Transport

Step 1. We will discuss wave fronts, wave rays, wave refraction, and wave diffraction together as a class.

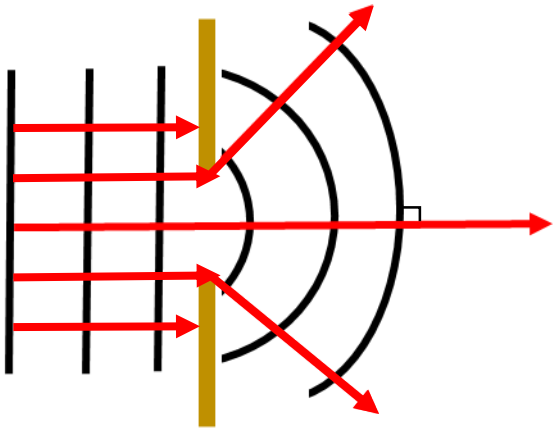
We can predict wave-driven sediment transport in wave-dominated environments by first tracing wave fronts and inferring wave rays, which are drawn perpendicular to the wave fronts. Where there is ample sediment availability, zones of wave ray convergence indicates an increase in energy applied to each unit length of seabed, and erosion can occur. Where wave rays are more divergent, energy is decreasing, and deposition is likely to occur.



Wave Refraction: We know that waves slow down when they "feel" the bottom in shallow water. Therefore, if a portion of a wave front is in shallower water than the rest of the wave front, that portion will slow down and bend the wave front.



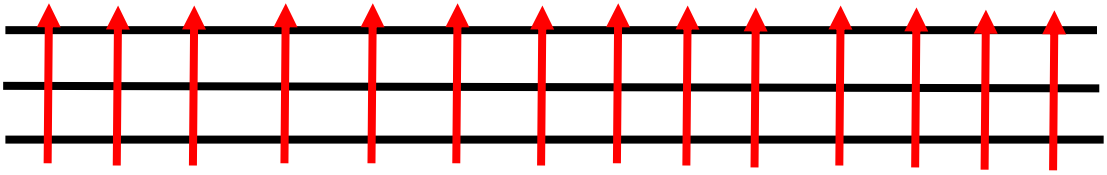
Wave Diffraction: This occurs when wave front encounters an obstacle or narrow opening. Diffraction is the process by which the waves propagate into the lee zone behind the structure by energy transmittance laterally along the wave crests. Wave fronts will bend around the obstacle and fill in available space beyond the obstacle or opening.



Step 2. Gather in groups of 3 people with the <u>same number</u> on the top of their paper. Work together on your problem number. (i.e. group #3 work on Question 3).

CHECK WITH AN INSTRUCTOR OR TA BEFORE MOVING TO STEP 3!

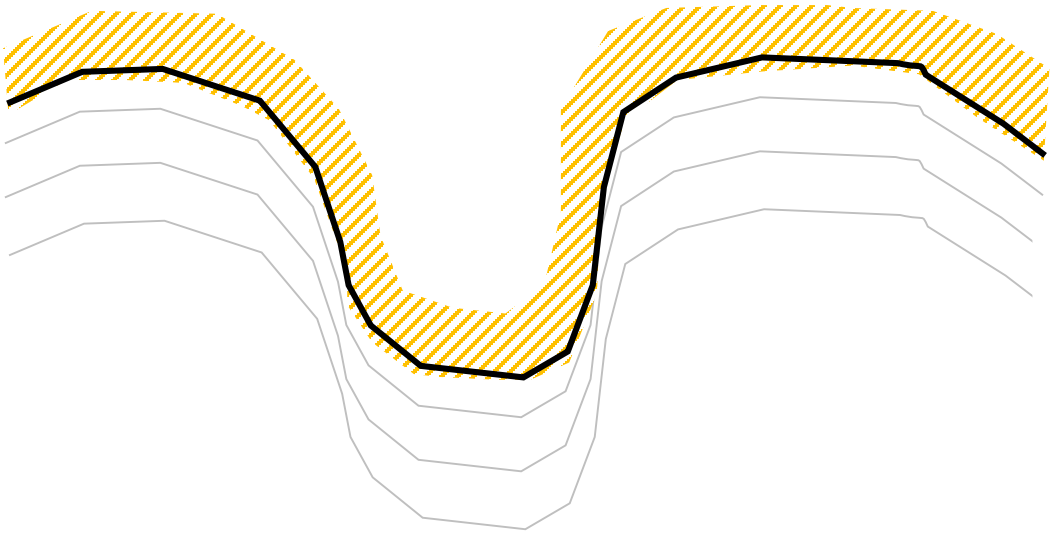
1. [10 pts.] Finish drawing in the wave fronts and wave rays close to shore, using the concepts of wave refraction and diffraction.

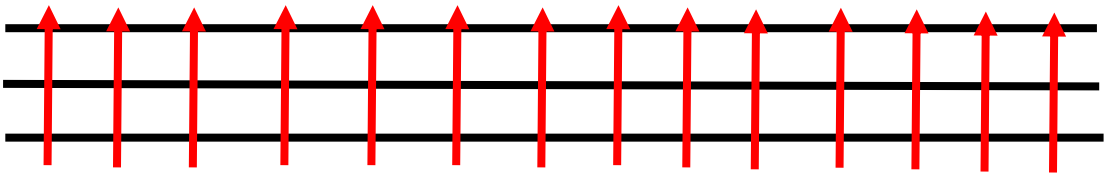


[4 pts.] Where along the shoreline will sediment deposition occur (stipple on the above map)?

[4 pts.] Draw what the shape of the shoreline may look like after an extended amount of time for sediment deposition to occur.

2. [10 pts.] Finish drawing in the wave fronts and wave rays close to shore. Bathymetry contours are in grey.

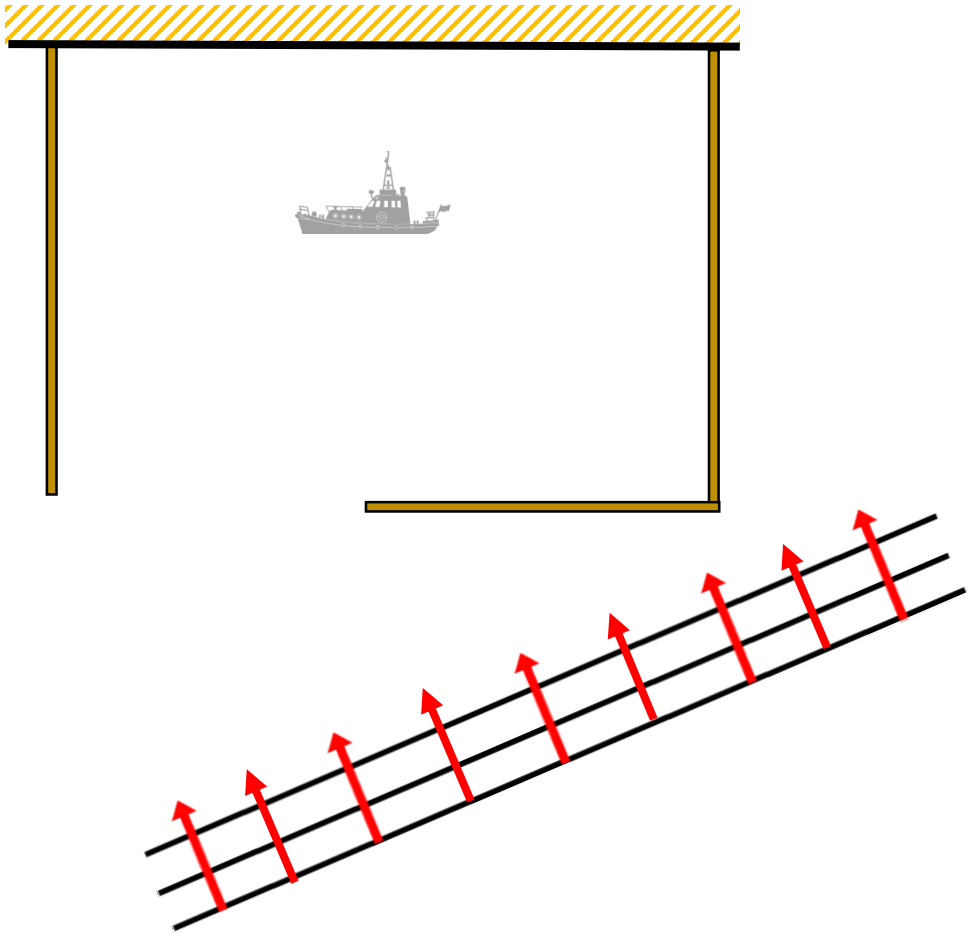




[4 pts.] Where along the shoreline will sediment deposition occur (stipple on diagram above)? Where along the shoreline will sediment erosion occur (xxxx on diagram above)?

[4 pts.] Draw what the shape of the shoreline may look like after an extended amount of time for sediment deposition to occur.

3. [10 pts.] Finish drawing in the wave fronts and wave rays as they move into the marina. Assume that water depth is constant.



[4 pts.] If you owned a boat in this marina, you would want to protect it from waves. Place a star on the image above where you would dock your boat.

[4 pts.] If you owned this marina, you would be concerned about sediment infilling. Circle the portion of the marina where you would likely have to dredge the most. Write a sentence or two about why.

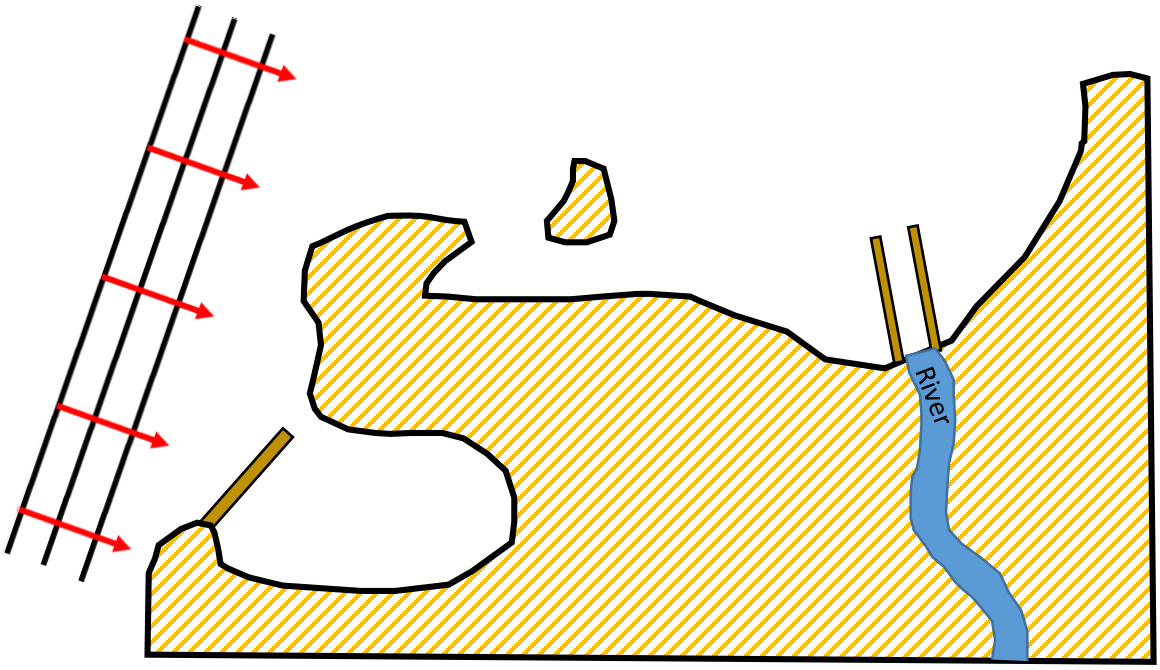
Step 3. Gather in groups of 3 people that have a <u>different number</u> on the top of their paper. Take turns explaining what you just learned from your question to the rest of the group. Then, work together on Question 4.

4. [18 pts.] You plan to build a beachfront house and want a stable location.

   a) Draw an X where you would NOT build your house because of erosion (pick at least 2-3 locations).

   b) Draw a Δ where you would decide to build on a stable or accreting coastline.

   c) Stipple all locations where you would expect sediment to deposit and create new beach.



Part 2: Coastal Origins- Deltas

Deltas: "When the sediment discharge from a river is so large that former estuaries become completely filled, and wave and tidal current action are unable to disperse sediment that reaches the river mouth, then it is deposited seawards of the mouth in the form of a delta. In this context, a delta is a coastal accumulation of river-borne sediment extending both above and below sea-level close to a river mouth." (WTSP Chapter 7)

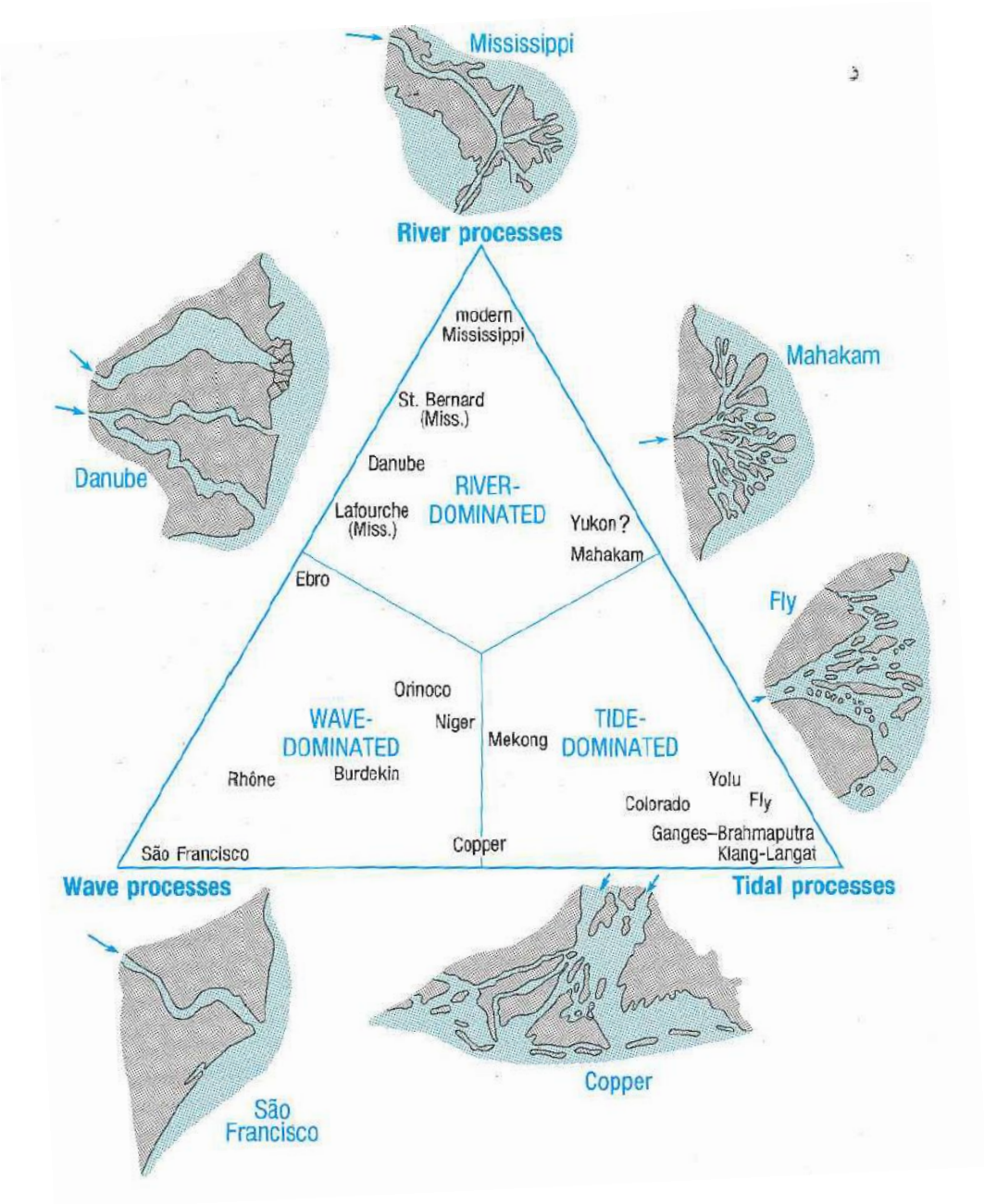


Figure 7.12 in WTSP. The classification of various delta systems based on the relative intensities of river, wave and tidal processes.

5. [12 pts.] Using the figure above, hypothesize what processes dominate each of these locations. Using what you can surmise about the environment from their geographic locations, plot them on the diagram above.

   Po River Delta: _____

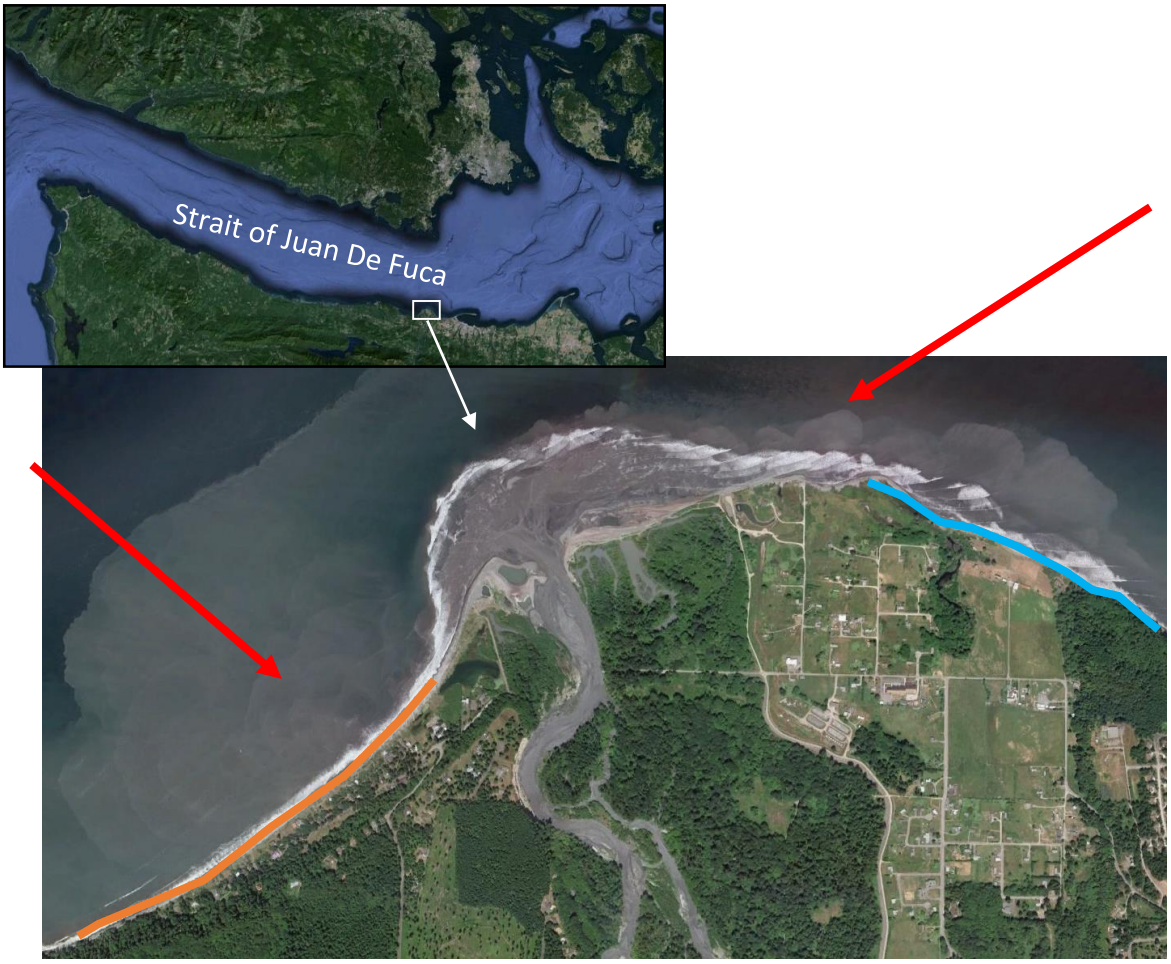
   Nile River Delta: _____

   Selenga River Delta: _____

Possible Answers:
Tidal Processes
River Processes
Wave Processes

   Look at the Amazon River mouth in GoogleEarth, does a delta exist? Why or why not?

6. Now let's take a closer look at sediment dispersal at the Elwha River Delta.



a. [3 pts.] What processes likely dominate the Elwha Delta based on the delta's morphology?

b. Waves propagate from two dominant directions towards the Elwha Delta, shown by the red arrows.
Waves generated in the Pacific Ocean come from the West/Northwest.
Waves generated in Puget Sound come from the East/Northeast.

[3 pts.] For the ocean-generated swell, how are the waves angled relative to the shore highlighted in blue?

[3 pts.] Will an alongshore current due to wave-shoreline interaction develop here?

[3 pts.] In what direction will sediment be transported here due to the waves?

c. [3 pts.] How are the ocean-generated swell waves angled relative to the shore highlighted in orange?

[3 pts.] Will an alongshore current due to wave-shoreline interaction develop here?

[3 pts.] In what direction will sediment be transported here due to the waves?

Part 3: Learning Synthesis

7. [30 pts.] Using what you have learned in this lab, list 3 things you can surmise from the shoreline morphology at the following locations.

   For example, you could say that waves are relatively strong in this environment based on the delta morphology.

   Possible Topics to Address:
   Wave Transformation
   Wave-Driven Sediment Transport
   Delta Classification / Dominant Processes

   a. Latitude: 48.64 Longitude: -2.82

   b. Latitude: 31.47 Longitude: 30.36

   c. Latitude: 48.3 Longitude: -122.4

REFERENCES - This lab was created by Robin McLachlan of University of Washington in 2016.