Rivers and Beaches (ESS/Ocean 230)

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Geomorphology

Professor, Dept of Earth & Space Sciences

Ph.D., University of California, Berkeley

Dave Montgomery studies the evolution of topography and the influence of geomorphological processes on ecological systems and human societies. His work includes studies of the evolution and near-extirpation of salmon, fluvial and hillslope processes in mountain drainage basins, the evolution of mountain ranges (Cascades, Andes, and Himalaya), and the analysis of digital topography of Earth and Mars.

Marine Geology and Geophysics

Professor, School of Oceanography and
Dept of Earth & Space Sciences

Ph.D., University of Washington

Chuck's research interests include the modern and ancient formation of sedimentary strata in continental-margin environments, and the effects of physical and biological oceanic processes on sedimentary characteristics. Ongoing research includes coastal areas of New Guinea-Australia, the Mediterranean, and US west coast. Other recent studies have been completed at the mouths of the Amazon River, Asian rivers, and off Antarctic and Alaskan glaciers.

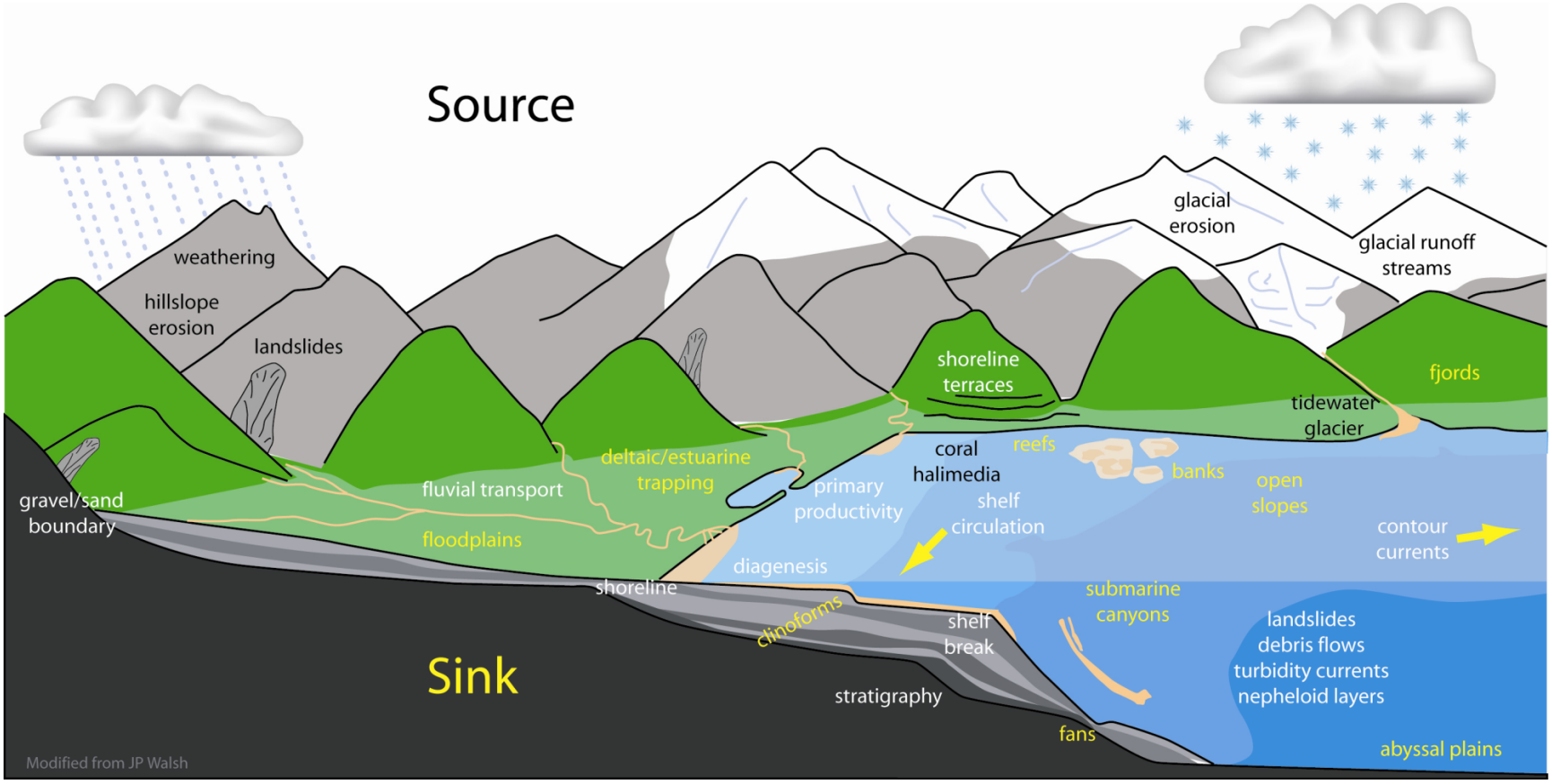
Topics to be covered

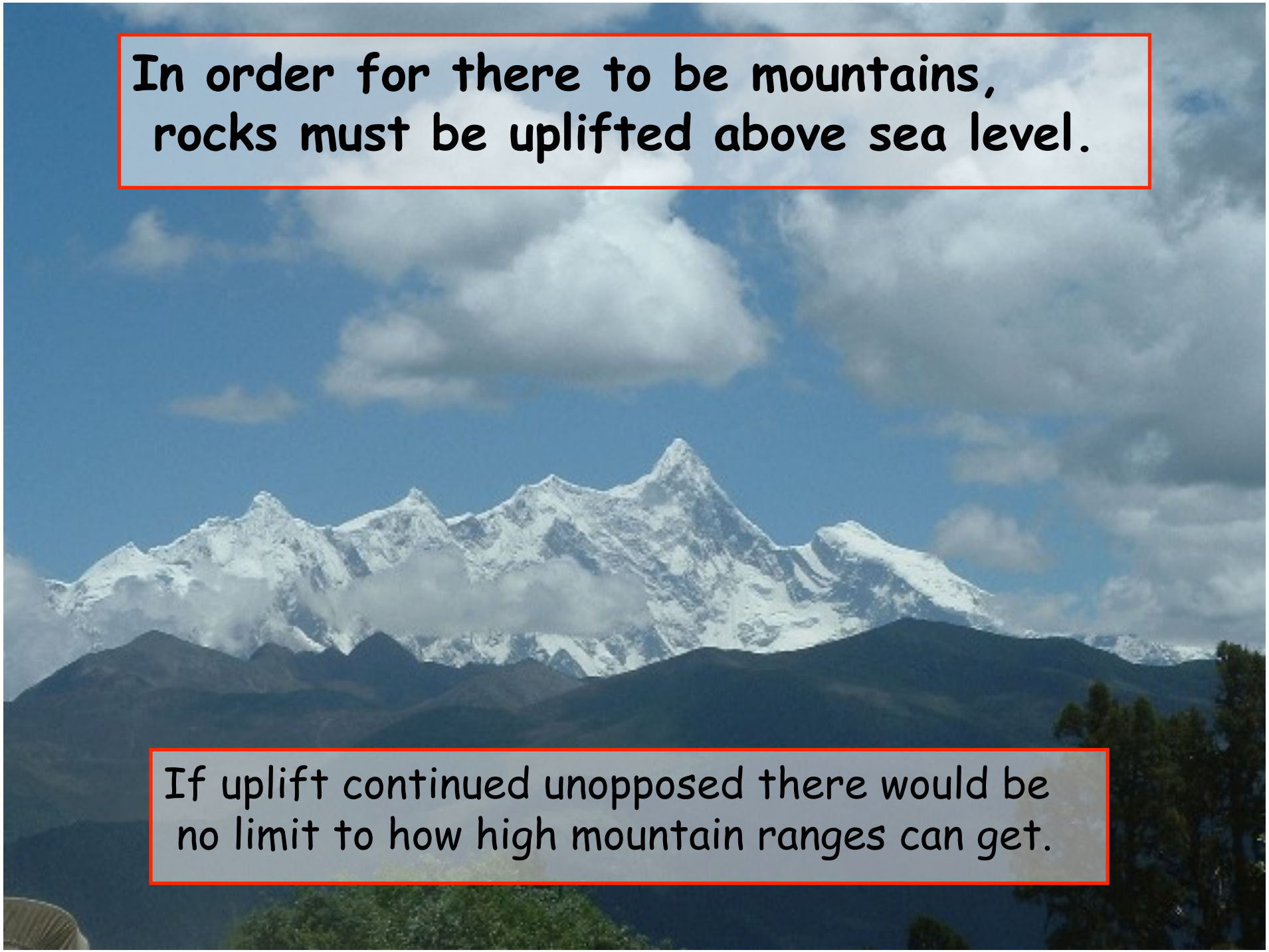
Earth Surface Processes

Mountains ⇒ Rivers ⇒ Beaches ⇒ Ocean

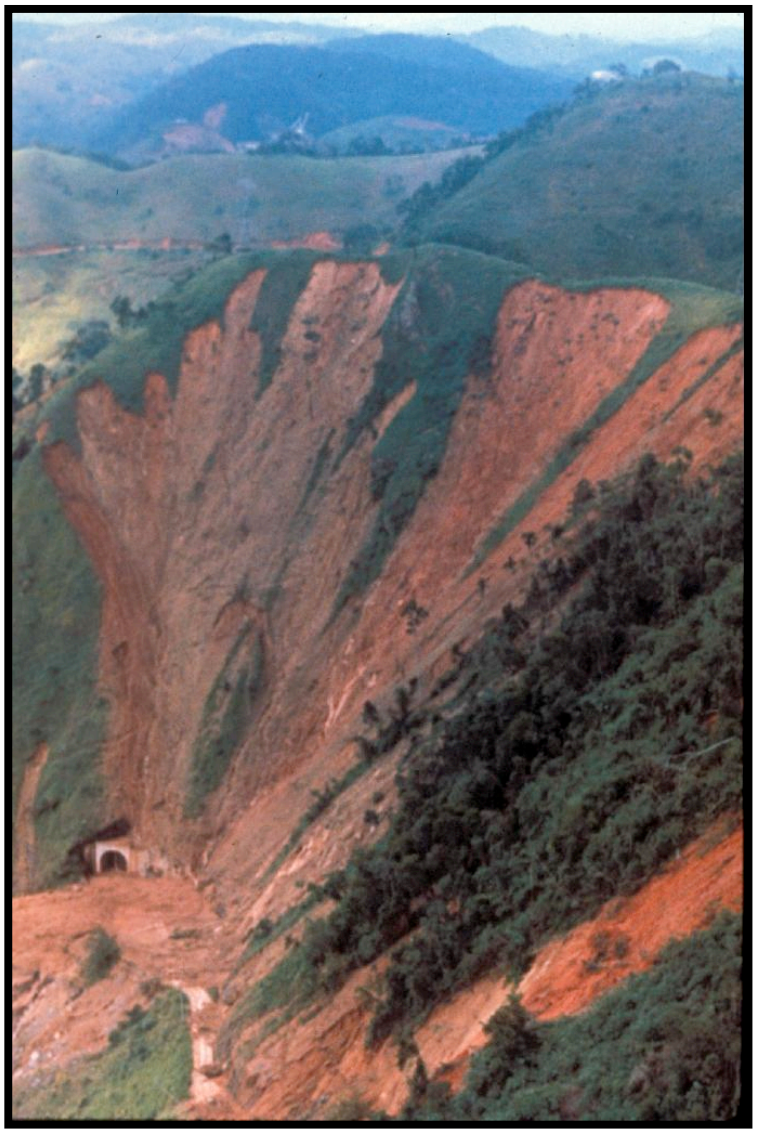
Holistic view, including: 1) Solid Earth
2) Atmosphere

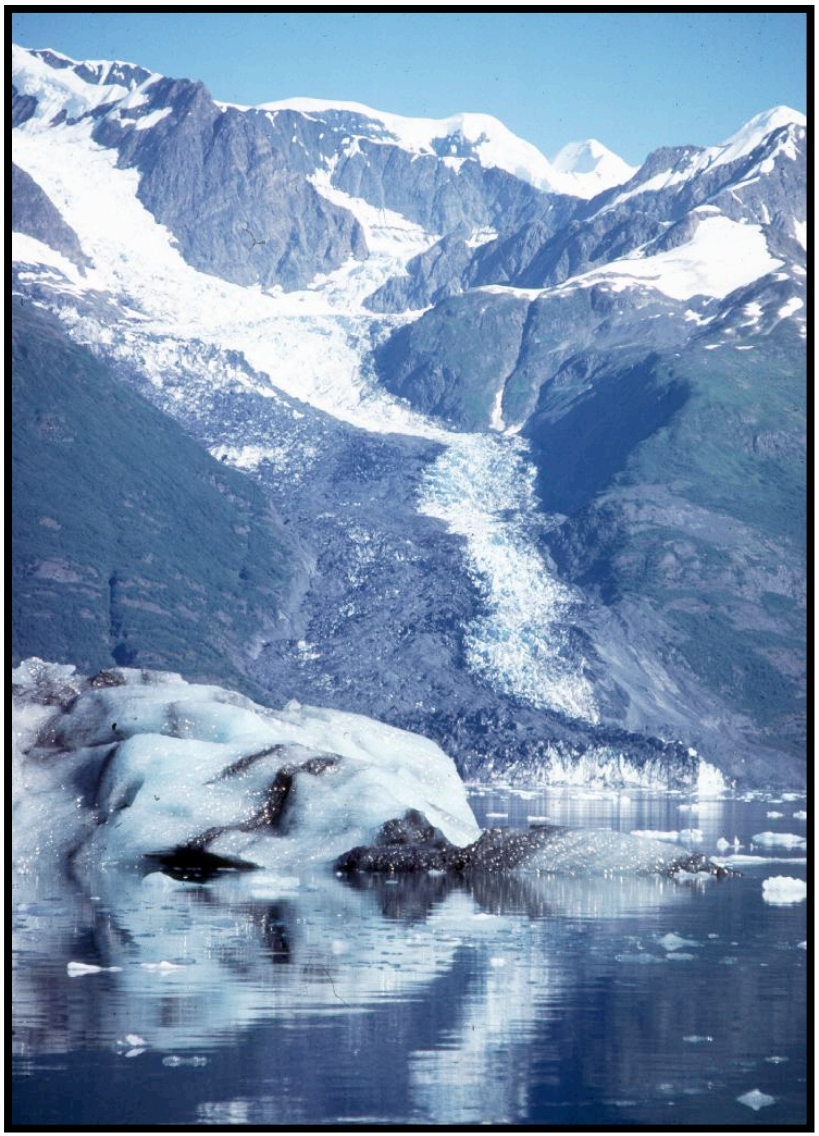
Linkages of all these will be an emphasis of the course.


Source
weathering
hillslope erosion
landslides
glacial erosion
glacial runoff streams
shoreline terraces
fjords
tidewater glacier
deltaic/estuarine trapping
fluvial transport
floodplains
gravel/sand boundary
primary productivity
coral halimedia
reefs
banks
open slopes
shelf circulation
contour currents
diagenesis
shoreline
chinoforms
shelf break
submarine canyons
landslides
debris flows
turbidity currents
nepheloid layers
Sink
stratigraphy
fans
abyssal plains
Modified from JP Walsh


In order for there to be mountains,
rocks must be uplifted above sea level.
If uplift continued unopposed there would be
no limit to how high mountain ranges can get.

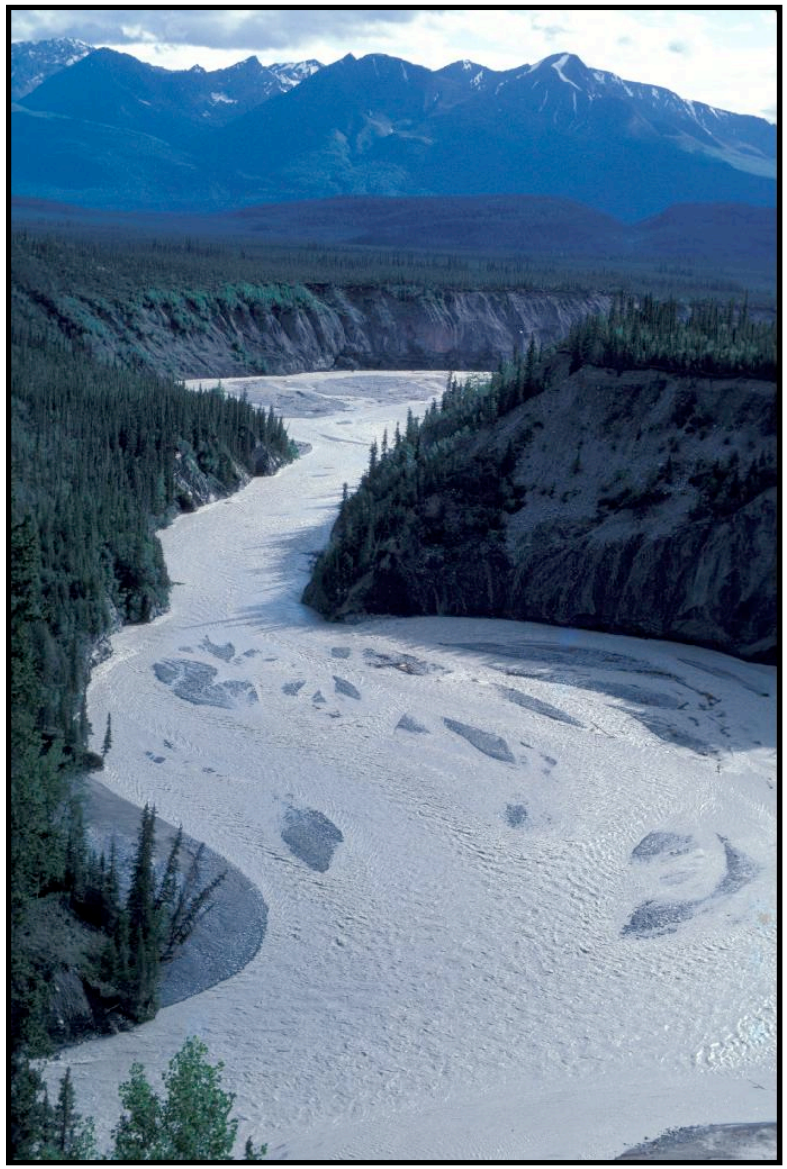
Erosion counter-balances rock uplift

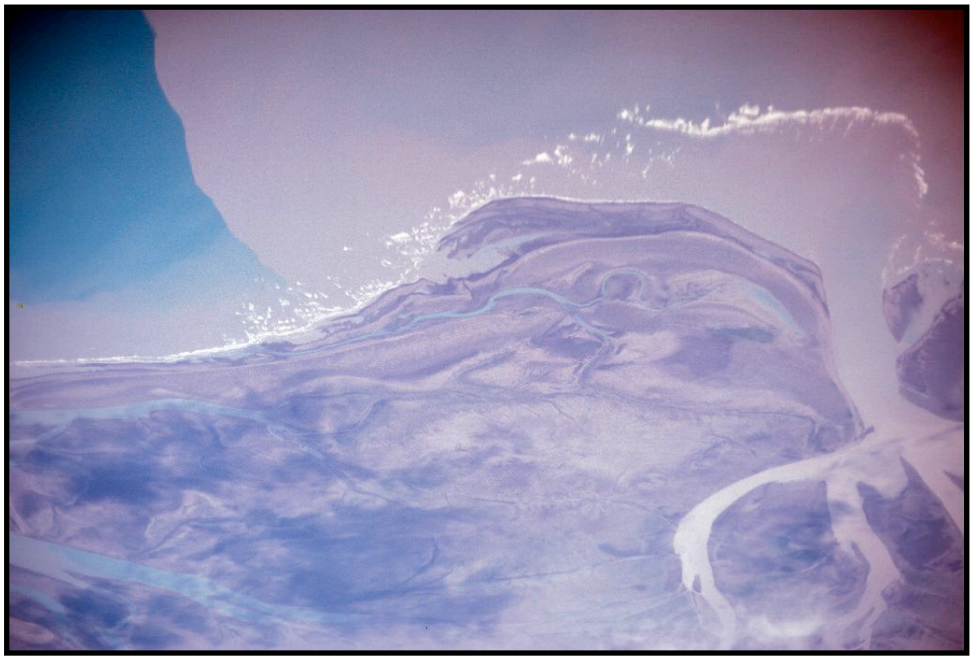




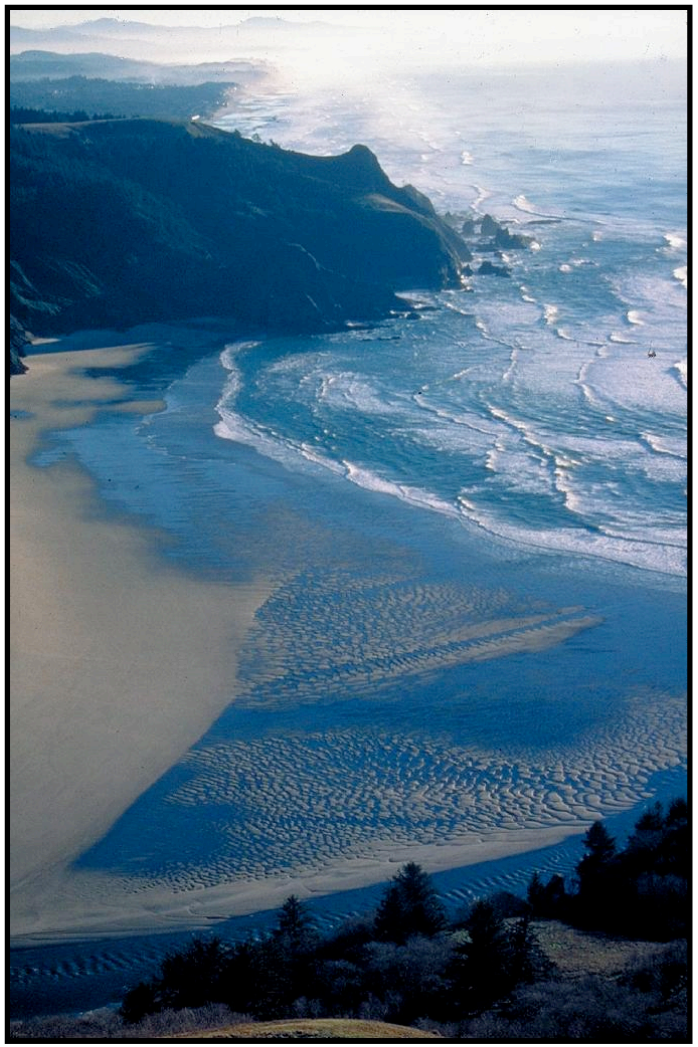
Mountain streams receive material from hillslopes and transport it to rivers

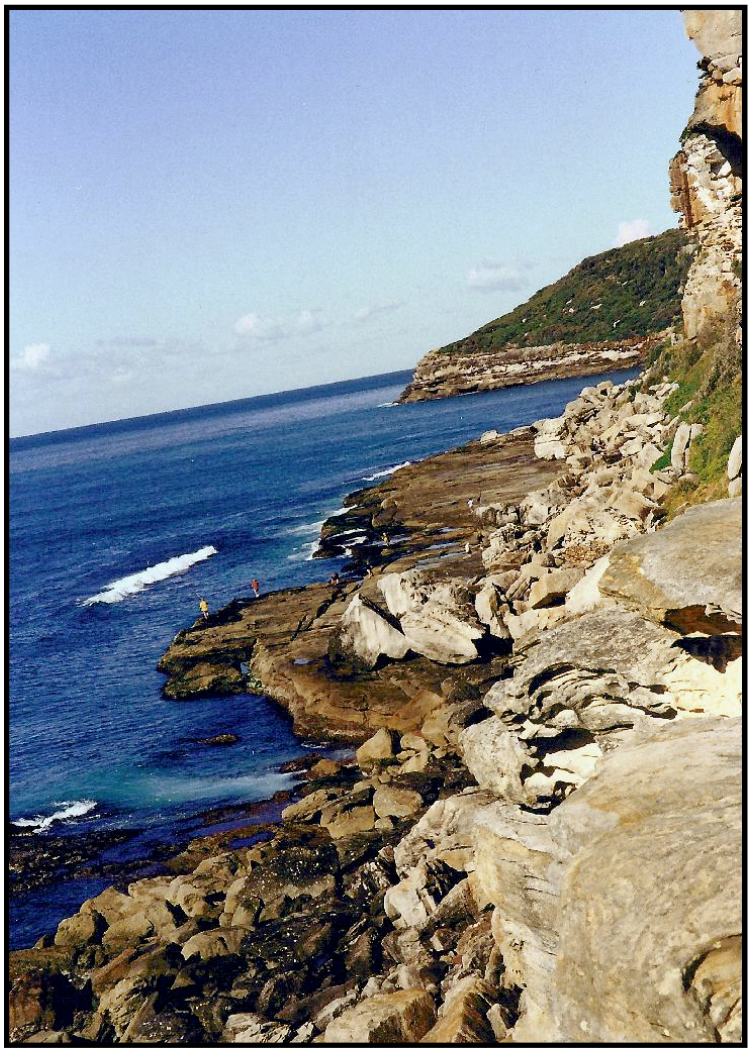
Rivers transport material to the coast





Nearshore processes redistribute sediment along beaches and coastlines





Types of beaches reflect differences in sediment sources and transport

Earth Surface = where we live

Recent Dramatic examples:

Centralia
rainfall ⇒ landslides ⇒ flooding

New Orleans/Galveston
hurricane ⇒ wind ⇒storm surge

Indonesia
earthquake ⇒ submarine landslide ⇒ tsunami

emphasis on understanding fundamental processes, but shock and awe will come with some examples

Rivers and beaches are part of sediment transfer systems.

- What forms them?
- What are the processes that maintain them?
- Why are there different types of rivers and beaches?
- What controls their distribution across Earth's surface?

We'll use 1 equation in this class

$$I - O = \Delta S$$

Input minus output equals change in storage.

Also known as conservation of mass

(Δ means change in something)

Time and Place

Lectures:	M,W & F	1:30 - 2:20	75 Johnson Hall
Labs (5 credit):	W	2:30 - 3:20	111 Johnson Hall

Lab Fee: $50

3 or 5 credits (Natural World)

Website:
http://gis.ess.washington.edu/grg/courses09_10/ess230/index.html

Exams and Grading

9 Nov (M)	Mid-Term Exam, during class
14 Dec (M)	Final Exam 2:30 – 4:20 (PM)

Grading:

	3 credits	5 credits
midterm =	40%	35%
field trip/labs =	20%	30%
final =	40%	35%

No make-up field trips, No extra credit

Field Trips

A1	10 Oct (Sat)	Nisqually River watershed
A2	17 Oct (Sat)	Nisqually River watershed
B	21 Oct (Wed)	Puget Sound cruise
C	21-22 Nov (Sat & Sun)	Olympic Peninsula Beaches

For 3 credits; fieldtrip A is required. You are welcome to participate in additional field trips, if space is available.

For 5 credits; all field trips required.

Email Andy to reserve your space on trip A

larseni@u.washington.edu

Labs/Field Trip Write Ups

A field trip write up is due after each field trip, as indicated on the course syllabus.

Field Trip A

Trip from Mt. Rainier downstream to Nisqually River delta

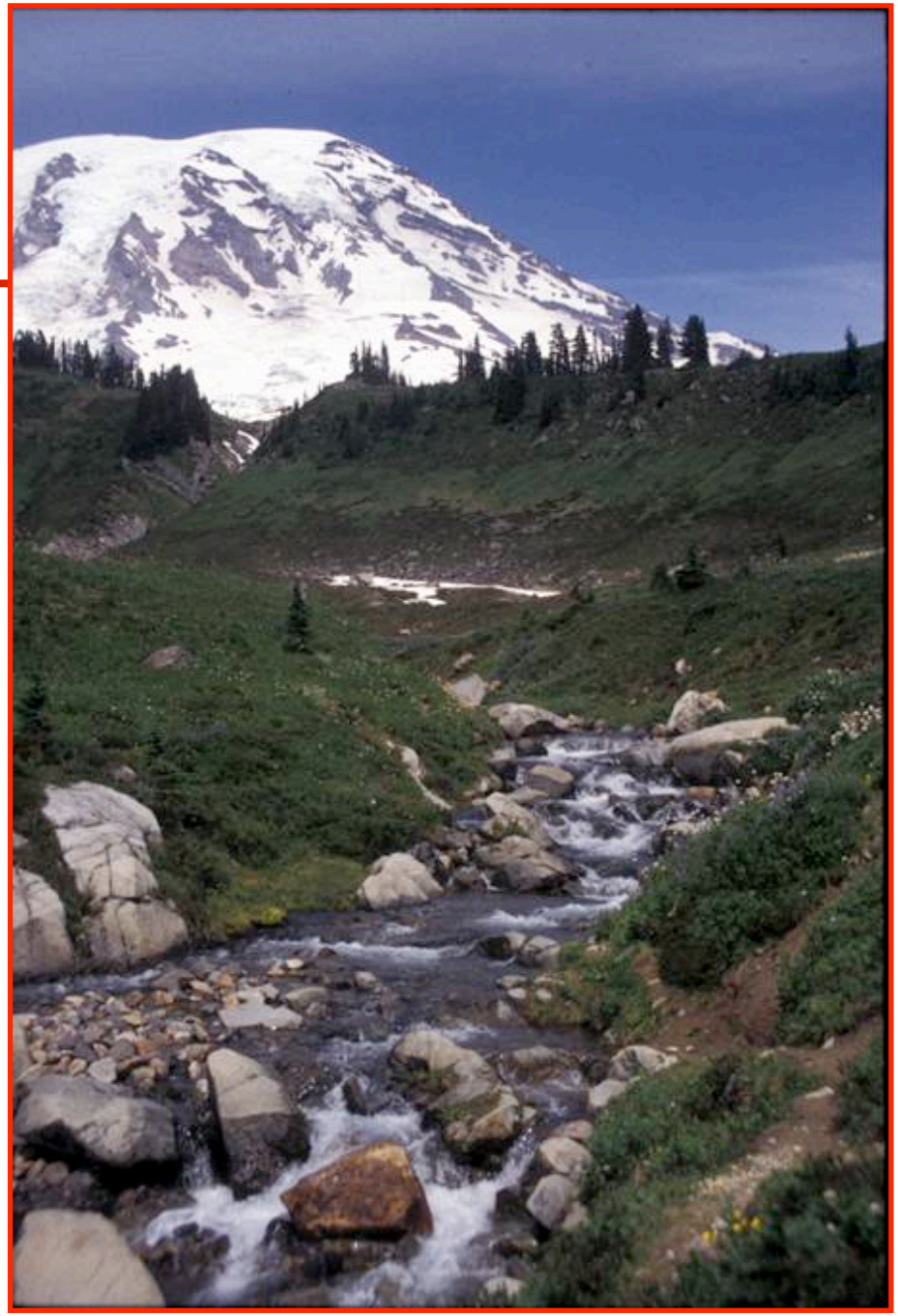
Either

Saturday October 10

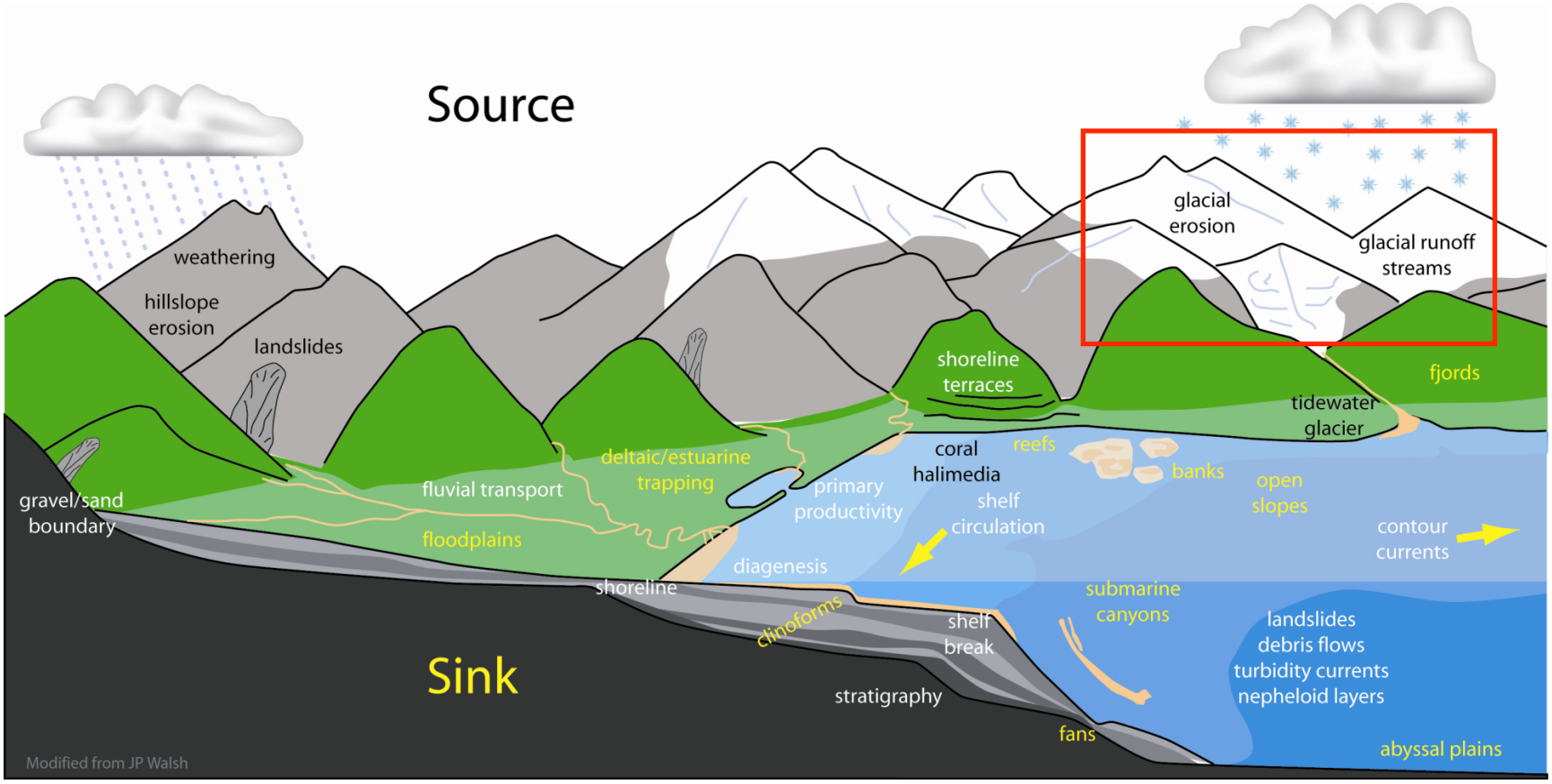
or

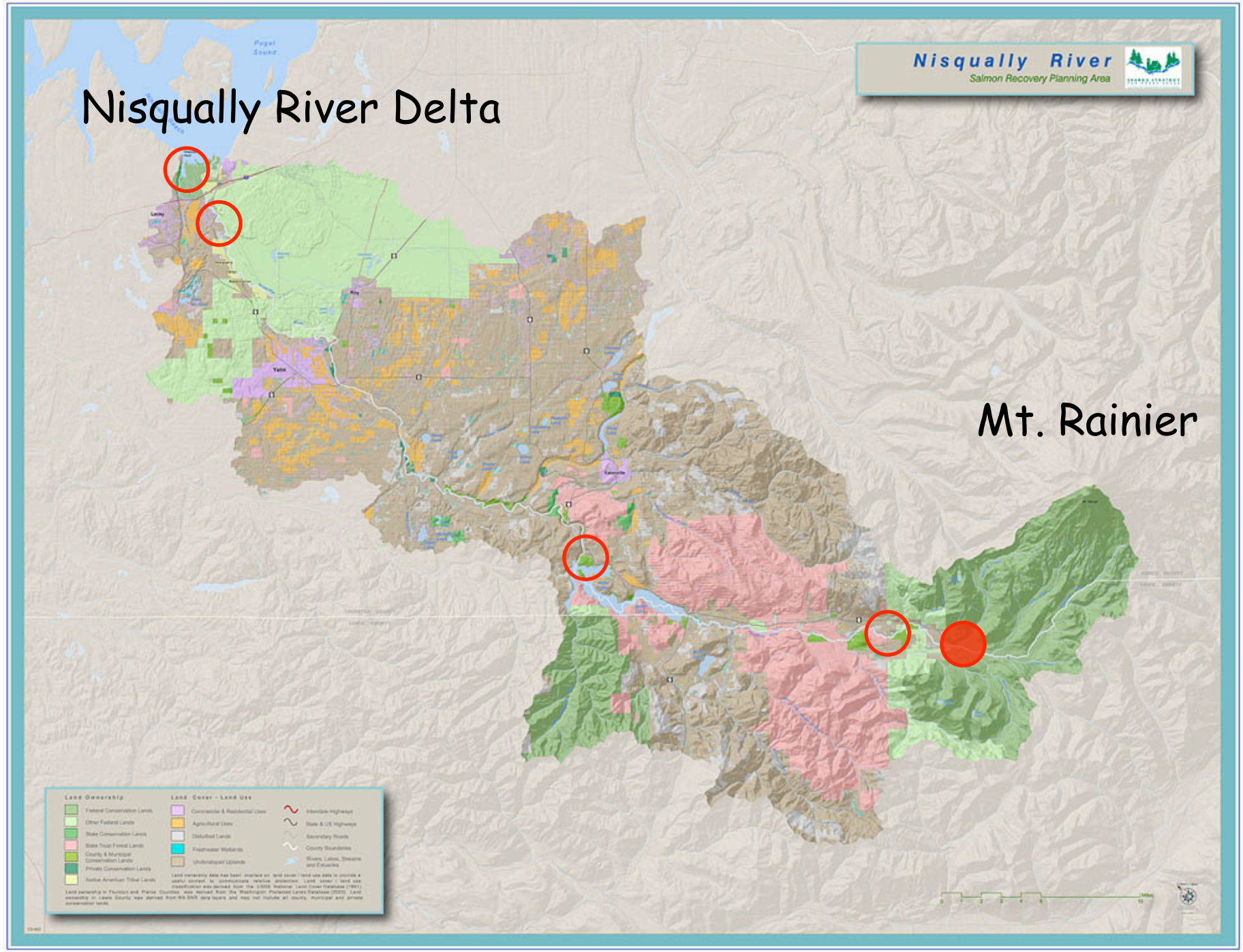
Saturday October 17

All day



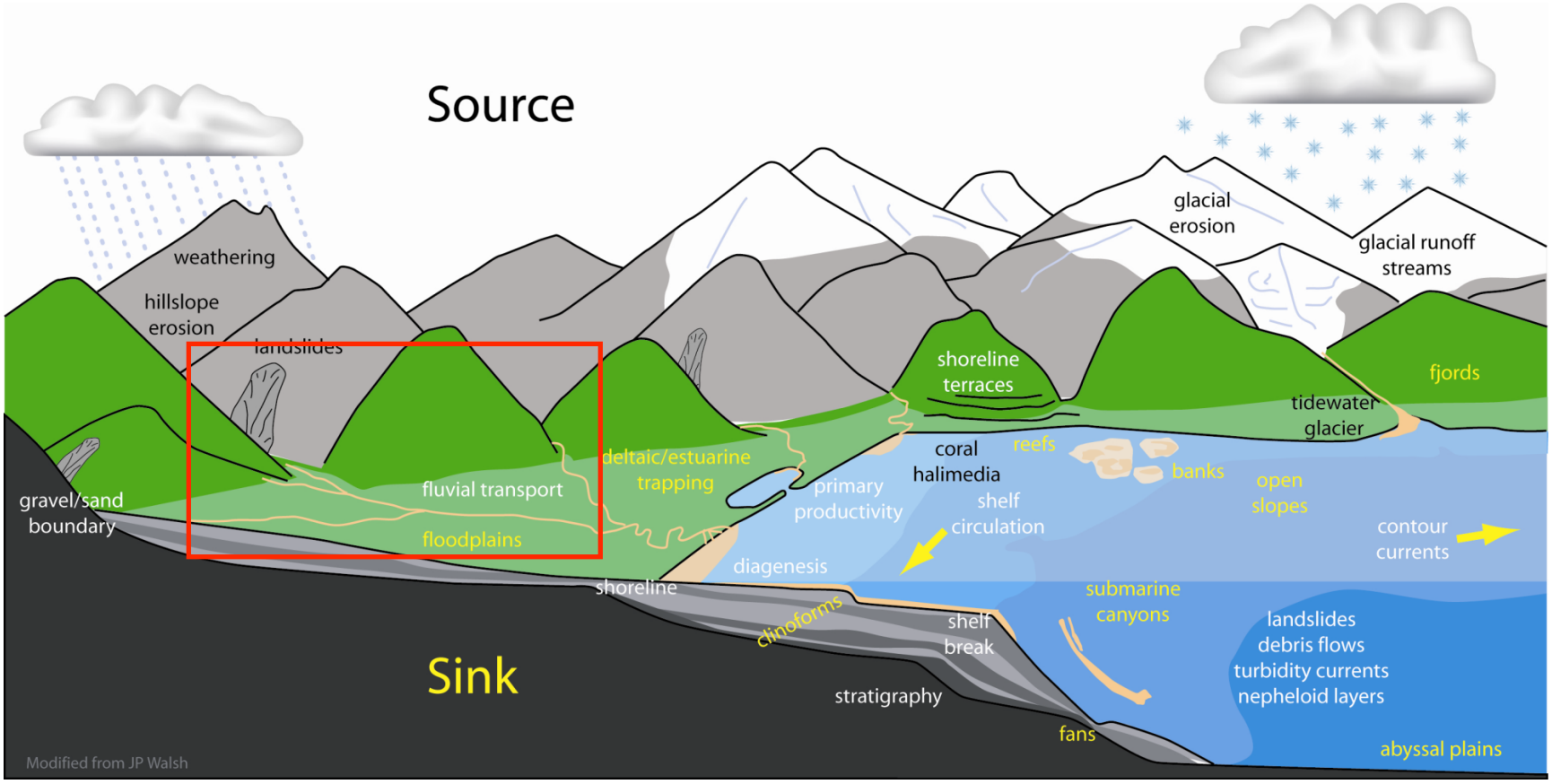
Start at glaciated flank of Mt. Rainier



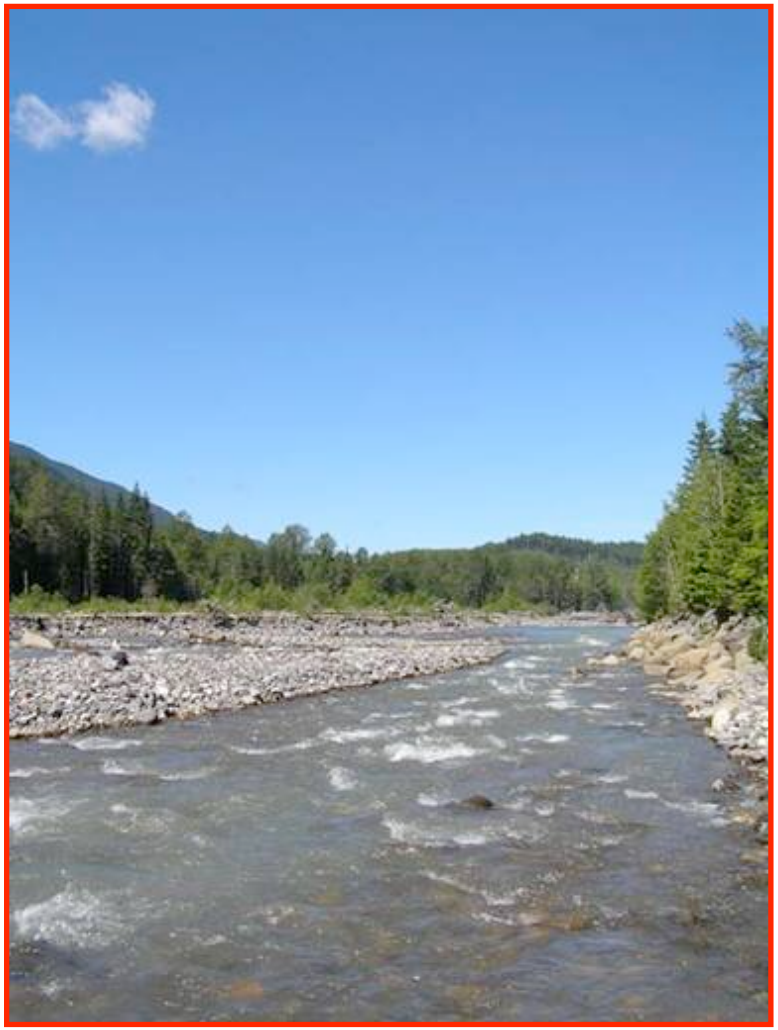

Nisqually River
Salmon Recovery Planning Area
Nisqually River Delta
Mt. Rainier

Field Trip A

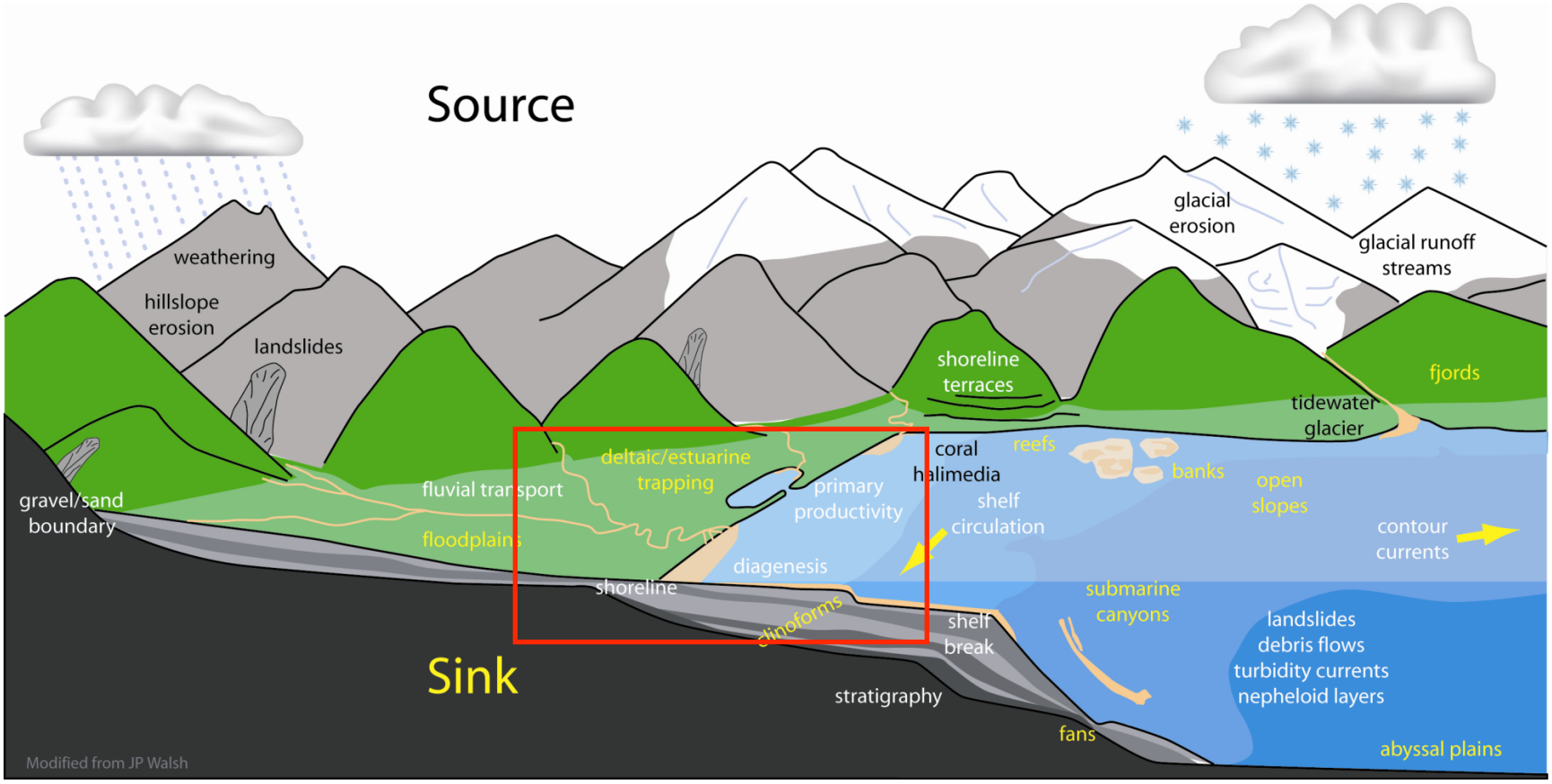
Follow river system down through mountain streams and into large rivers



Field Trip A



End at delta system where Nisqually River empties into Puget Sound



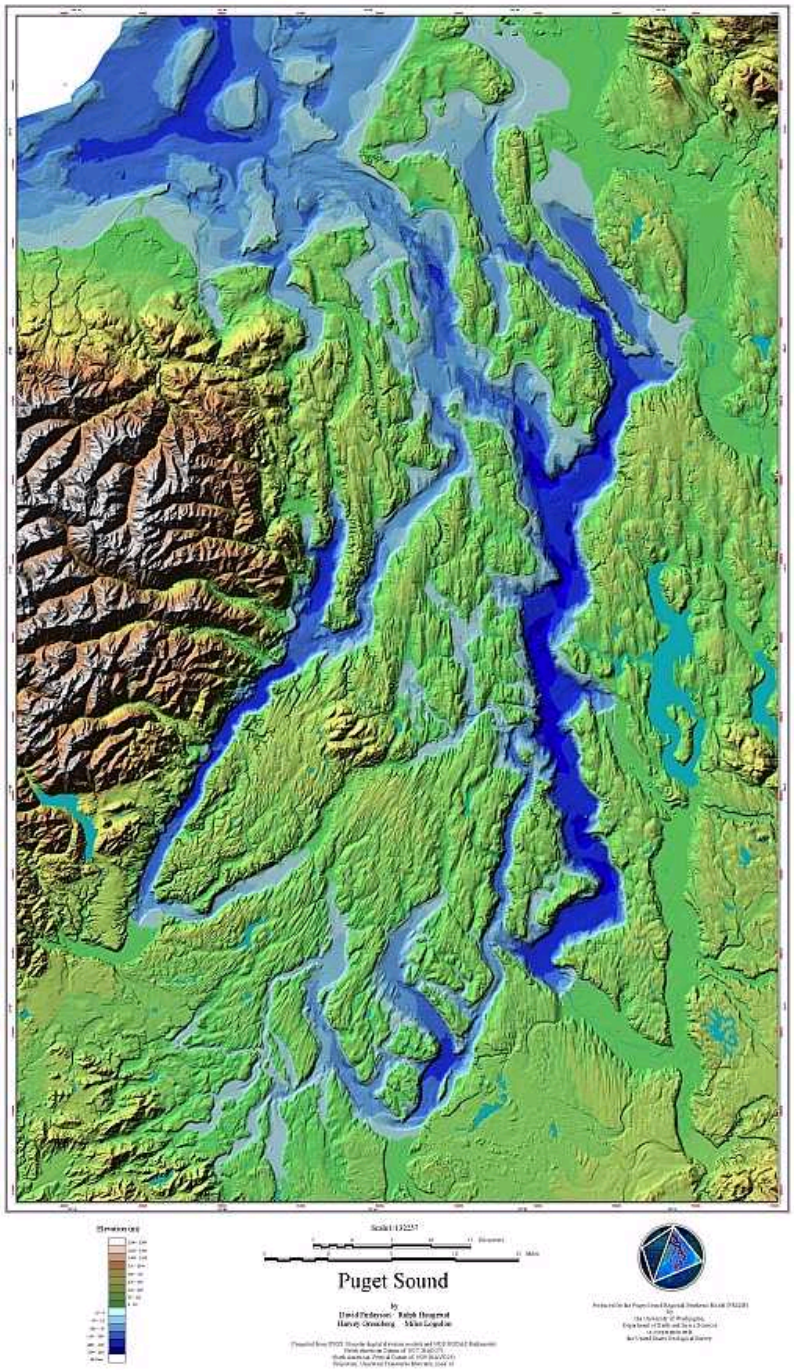
Field Trip A

Field Trip B

Working cruise on Puget Sound with Research Vessel Thompson, UW's oceanographic research vessel

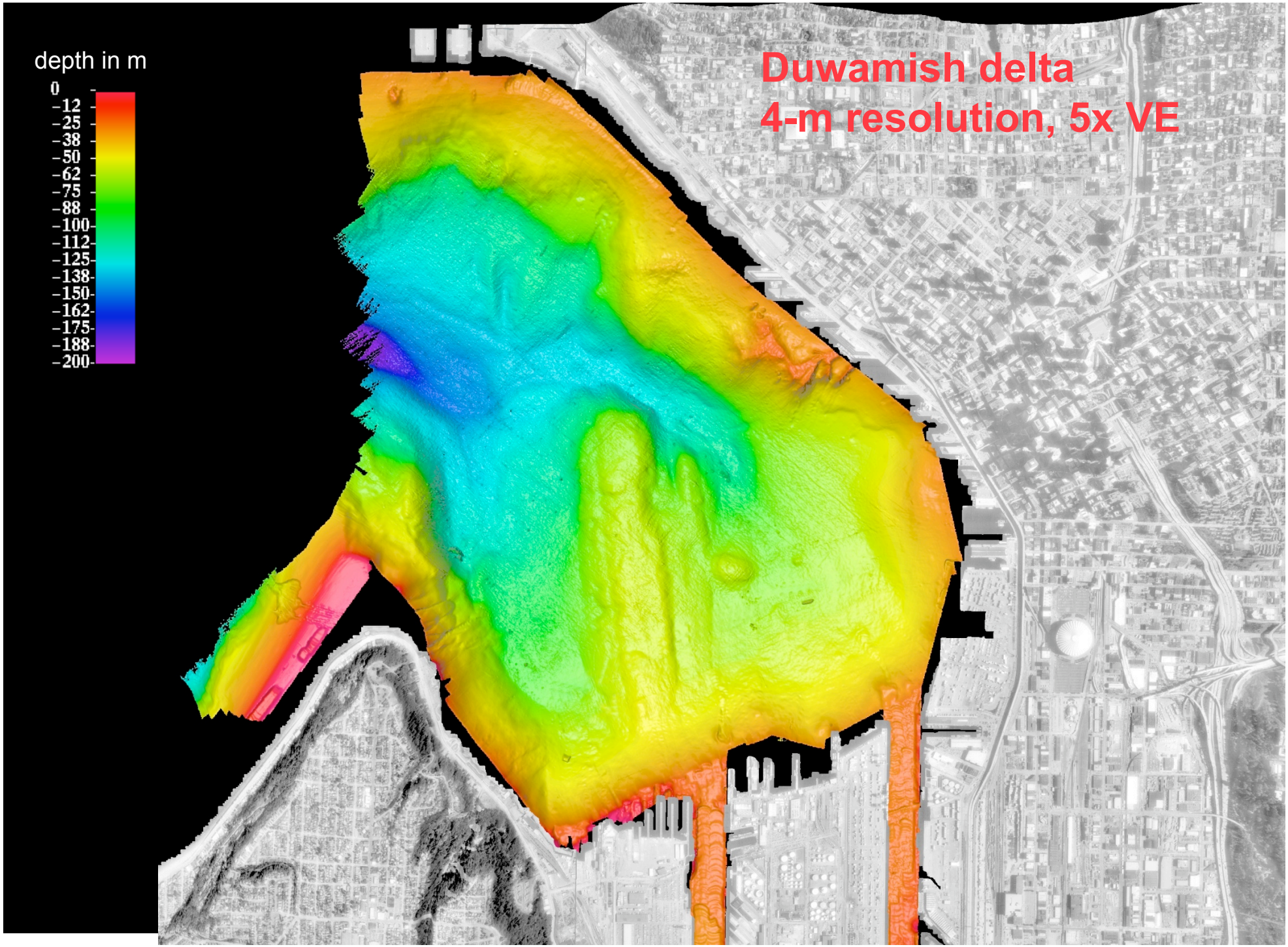
Wednesday
21 October

All day
(no class or lab)



Cruise on Puget Sound in Elliot Bay

Sample bottom sediments, measure water salinity and temperature, and map bathymetry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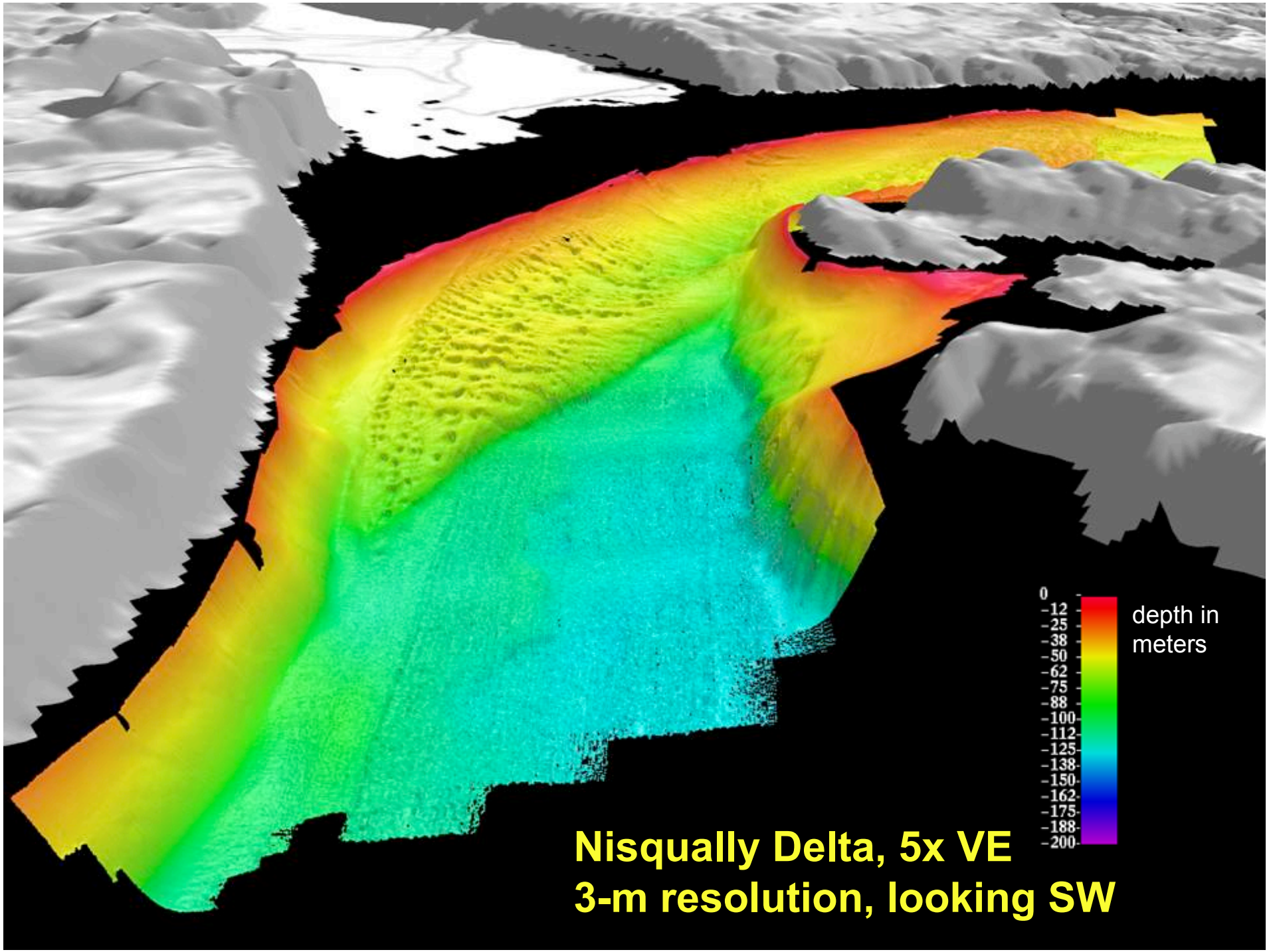
-200
Duwamish delta
4-m resolution, 5x VE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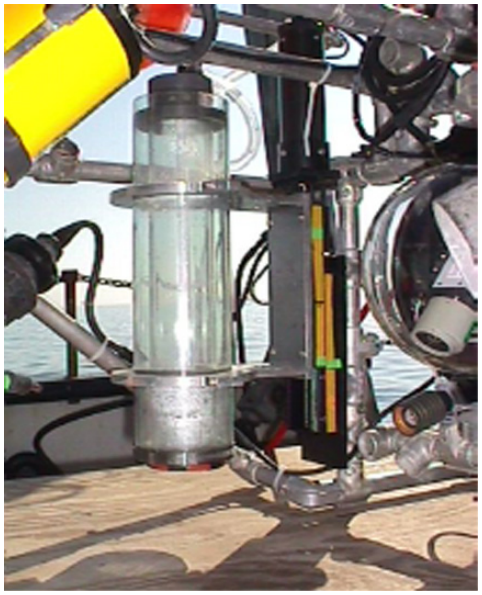
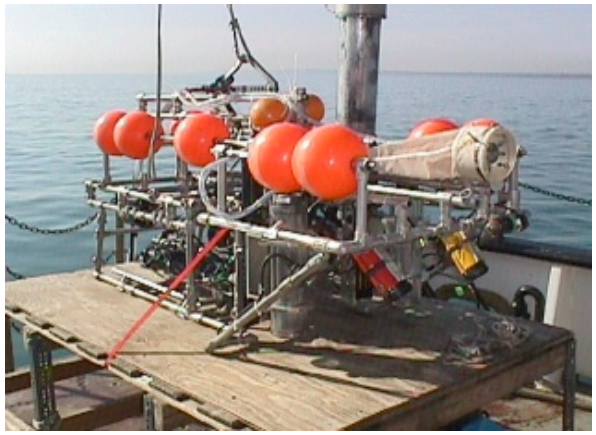
-175
-188
-200
depth in meters
Nisqually Delta, 5x VE
3-m resolution, looking SW





Field Trip C

Beaches of the Olympic Peninsula

21-22 November

Saturday and Sunday; Overnight camping in the field on Saturday night.


Strait of Juan de Fuca
Pacific Ocean
Neah Bay
112
Seiku
Clallam Bay
113
112
Port Angeles
Sequim
Port Townsend
5
Lake Ozette
Elwha
101
Port Hadlock
Everett
Ralto Beach
Sol Duc Hot Springs
Hurricane Ridge
Forks
Port Ludlow
La Push
104
Kingston
OLYMPIC
Quilcene
Hoh Rain Forest
3
Edmonds
101
NATIONAL
Brinnon
Poulsbo
Kalaloch
PARK
Seattle
Winslow
Queets
101
Lake Quinault
Lake Cushman
Neilton
Hoodsport
5
Moclips
Shelton
Pacific Beach
Copalis Beach
101
Kamiche
Tacoma
McCleary
108
Ocean City
8
8
101
109
Ocean Shores
Hoquiam
12
Elma
Olympia
Aberdeen
105
Westport
5
Grayland
101
12

Field Trip Tips

Bring clothes for bad weather (rain, cold, wind) -- even if it doesn't seem like you'll need them!

Get UW supplemental field trip insurance: it's only $0.85 per day!

(*www.washington.edu/admin/risk/documents/Domestic_Trip_Coverage.pdf*)

Field Trip Commitments

You must email Isaac by this Friday with your preferred date for field trip A.

larseni@u.washington.edu

Space will be filled on a first-come basis

If you are 3-credit and would like to go on more than one trip -- clearly indicate this.

Constraints:

limited space for 3-credit people on Thompson cruise (field trip B).

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Source to Sink

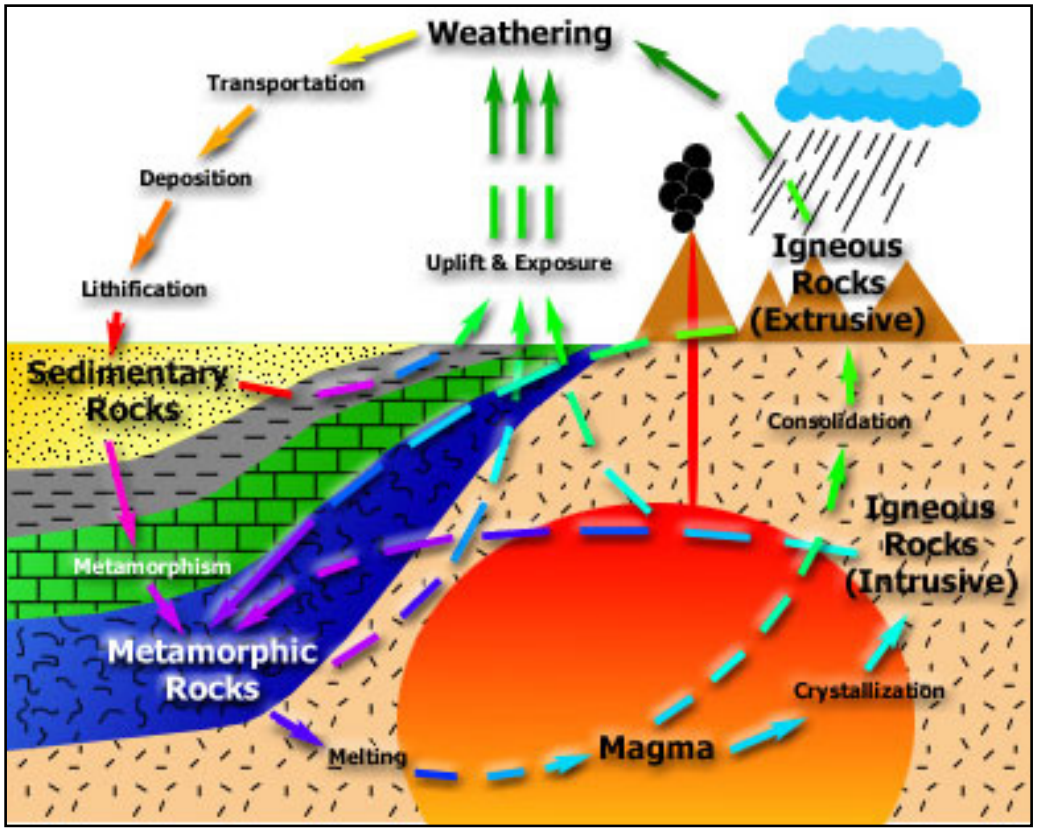
A different way of seeing landscapes…

The Big Picture = The Rock Cycle

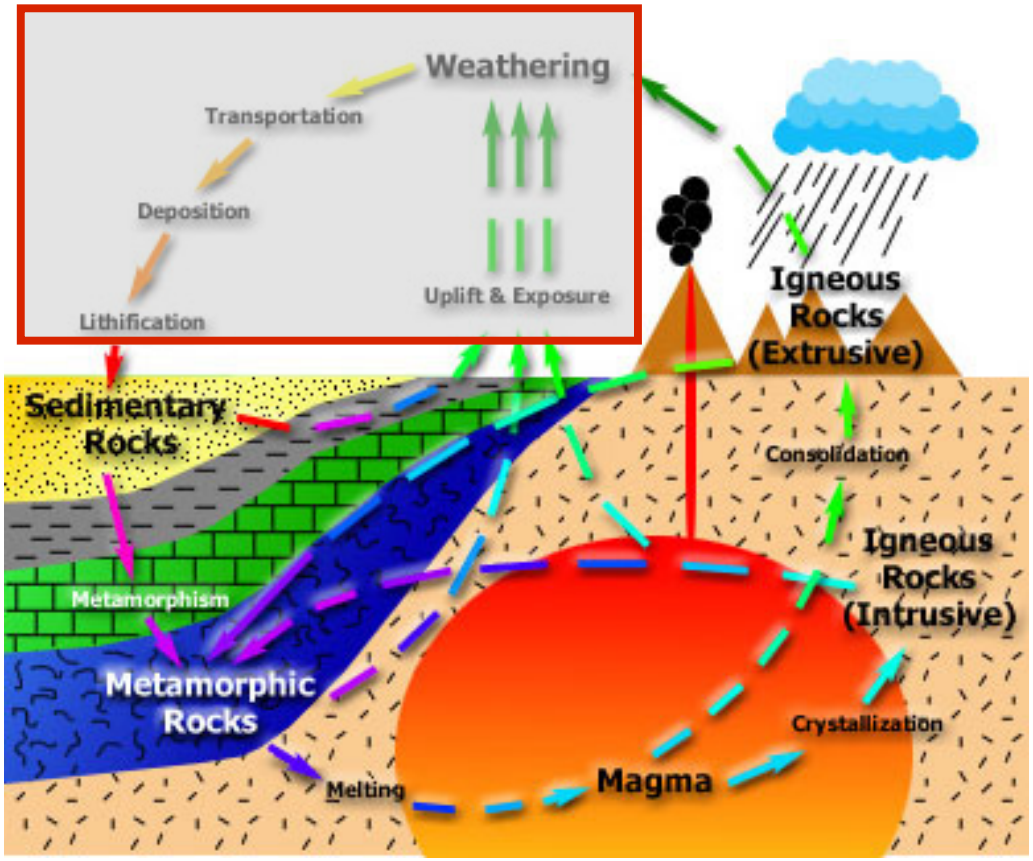
The Rock Cycle

Material eroded from mountains enters streams and rivers and is delivered to coastal environments, from where it is moved to deeper sedimentary basins that get shoved back into mountains through processes of rock uplift.

The Rock Cycle



Erosion in the Rock Cycle



What we see as rivers and beaches are rest stops for sediment moving through the eroding half of the rock cycle.

Framework for this Class

Rock uplift → Mountains

Mountains → Mountain Streams

Mountain Streams → Rivers

Rivers → Estuaries

Estuaries → Beaches

Beaches → Off-shore depositional basins

Off-shore depositional basins → Rock uplift.