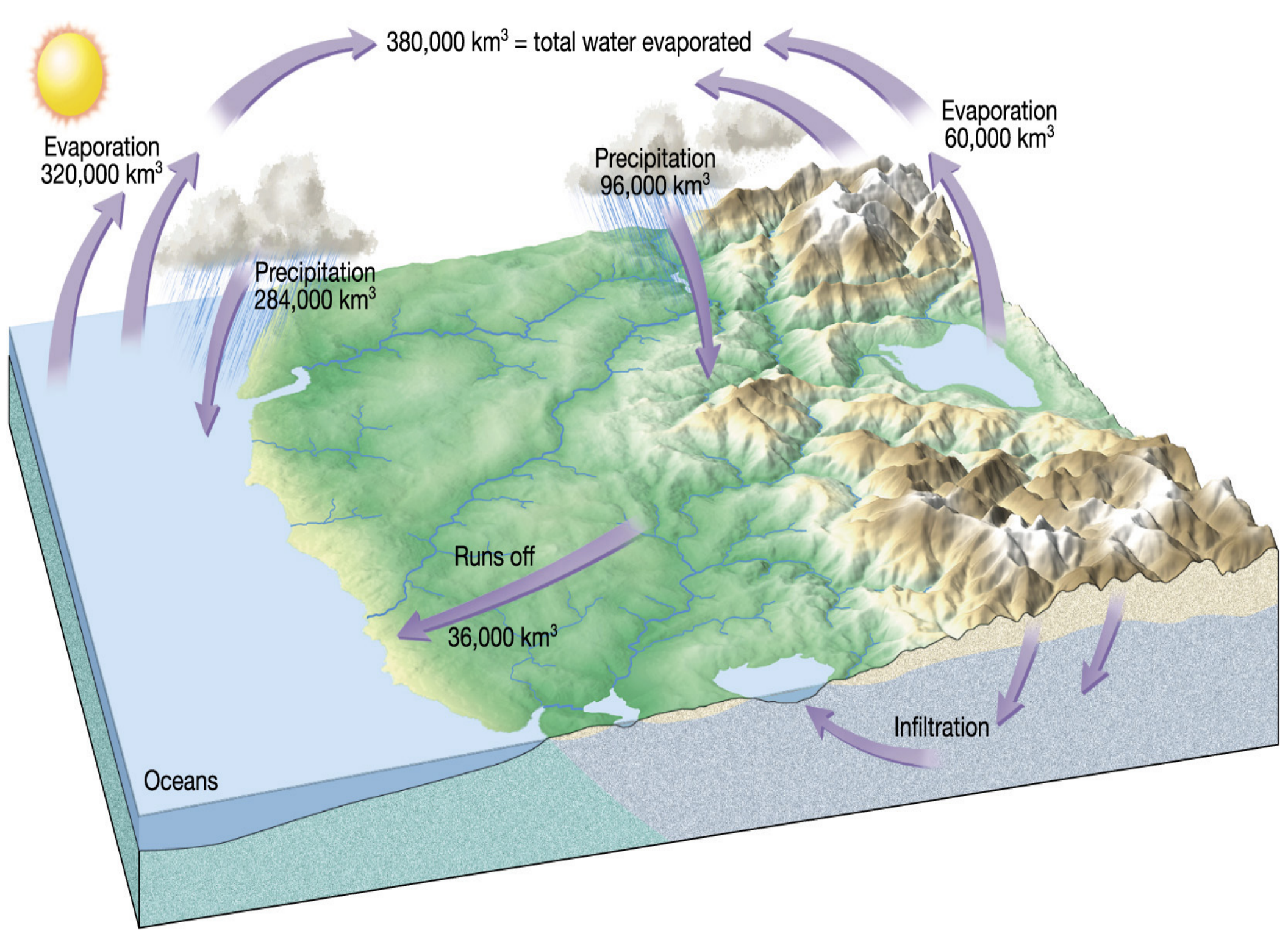
STREAM SYSTEMS and FLOODS

The Hydrologic Cycle

- Precipitation
- Evaporation
- Infiltration
- Runoff
- Transpiration


380,000 km3 = total water evaporated
Evaporation
320,000 km3
Precipitation
284,000 km3
Precipitation
96,000 km3
Evaporation
60,000 km3
Runs off
36,000 km3
Infiltration
Oceans

The Hydrologic Cycle

- Oceans not filling up
- Evaporation = precipitation
- System is balanced
- Runoff is the streams

RUNNING WATER

- Comes from precipitation
- Transports sediment
- Erode channels

DRAINAGE BASIN

- Area that drains into a stream
- Separated by drainage divides
- Tributaries contribute water to trunk stream


Divide
Missouri River
Mississippi River
Drainage Basin
Mississippi River
Ohio River
Divide
Divide

- http://blog.oregonlive.com/breakingnews/2008/02/large_willamette.gif

THE WORK OF STREAMS

- Erosion
- Transportation
- Deposition

EROSION

- Lifting loose particles
- Abrasion
- Dissolution

CONTROLS OF EROSION

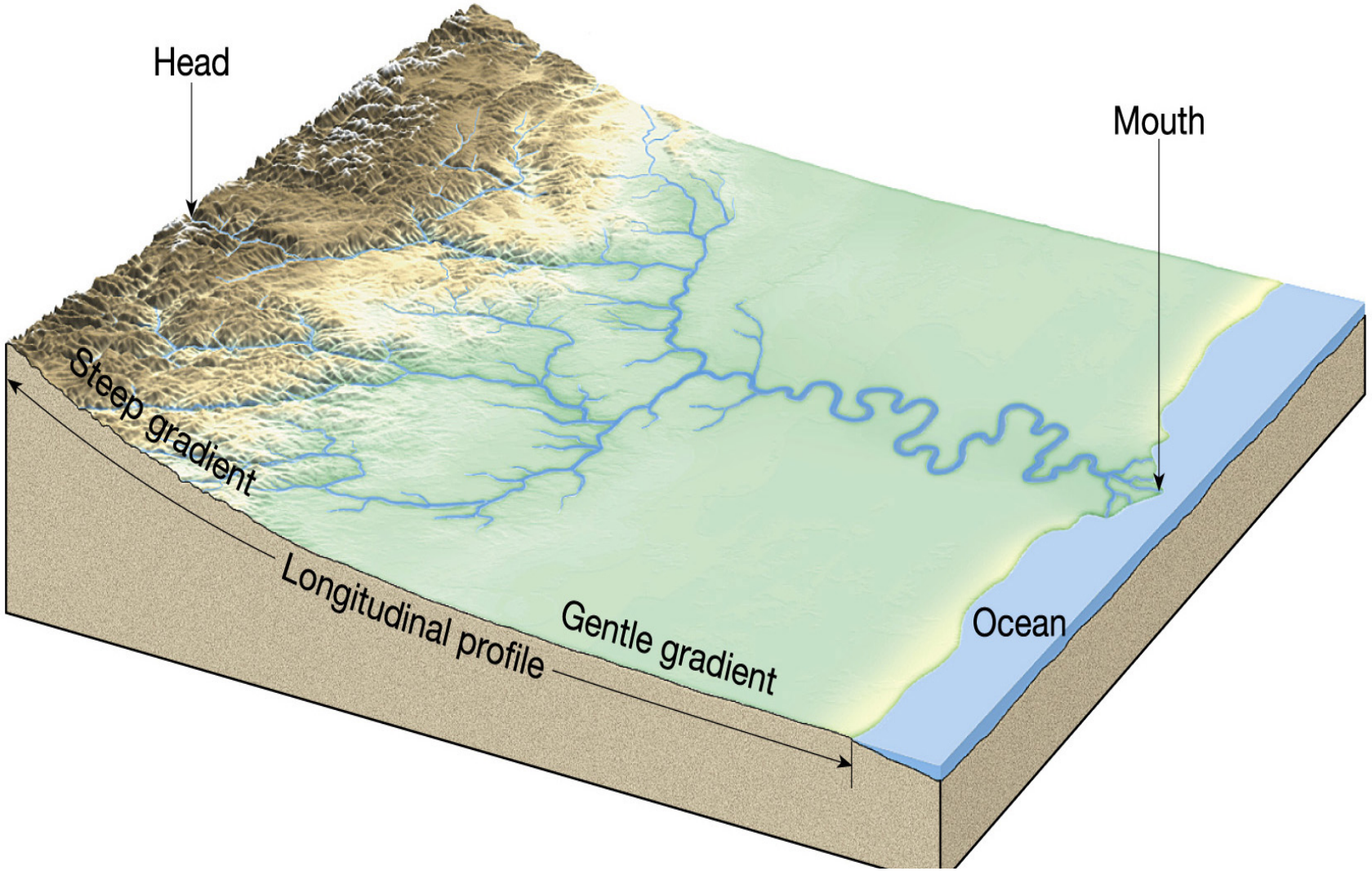
- Depends on velocity
  - Gradient
  - Channel characteristics
  - Discharge

GRADIENT

- Slope of channel
- Vertical drop / channel length

Stream Gradient

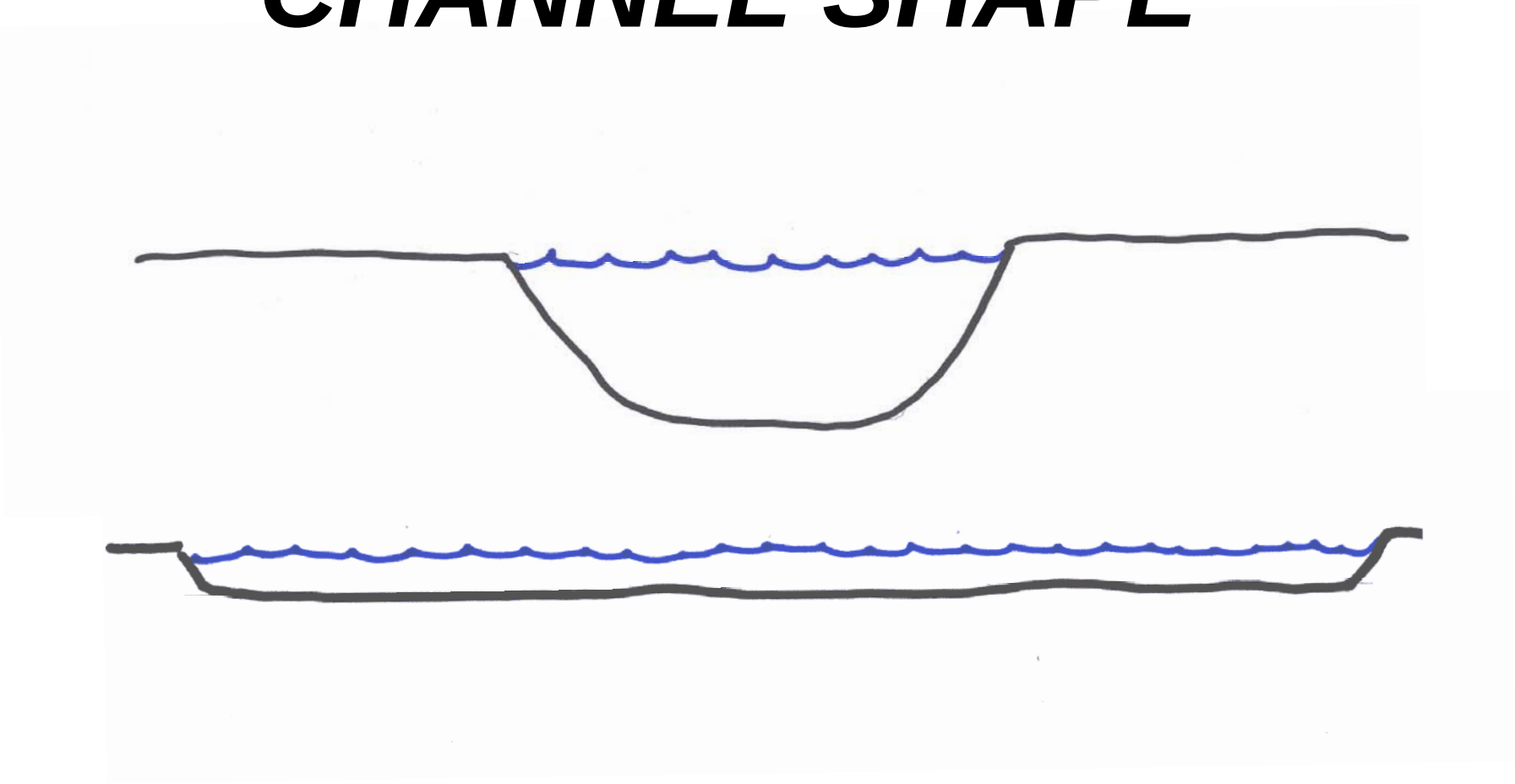
- Slope of channel along length of stream
- Changes from head to mouth of stream



CHANNEL CHARACTERISTICS

- Shape
- Size
- Roughness
- Gradient

CHANNEL SHAPE



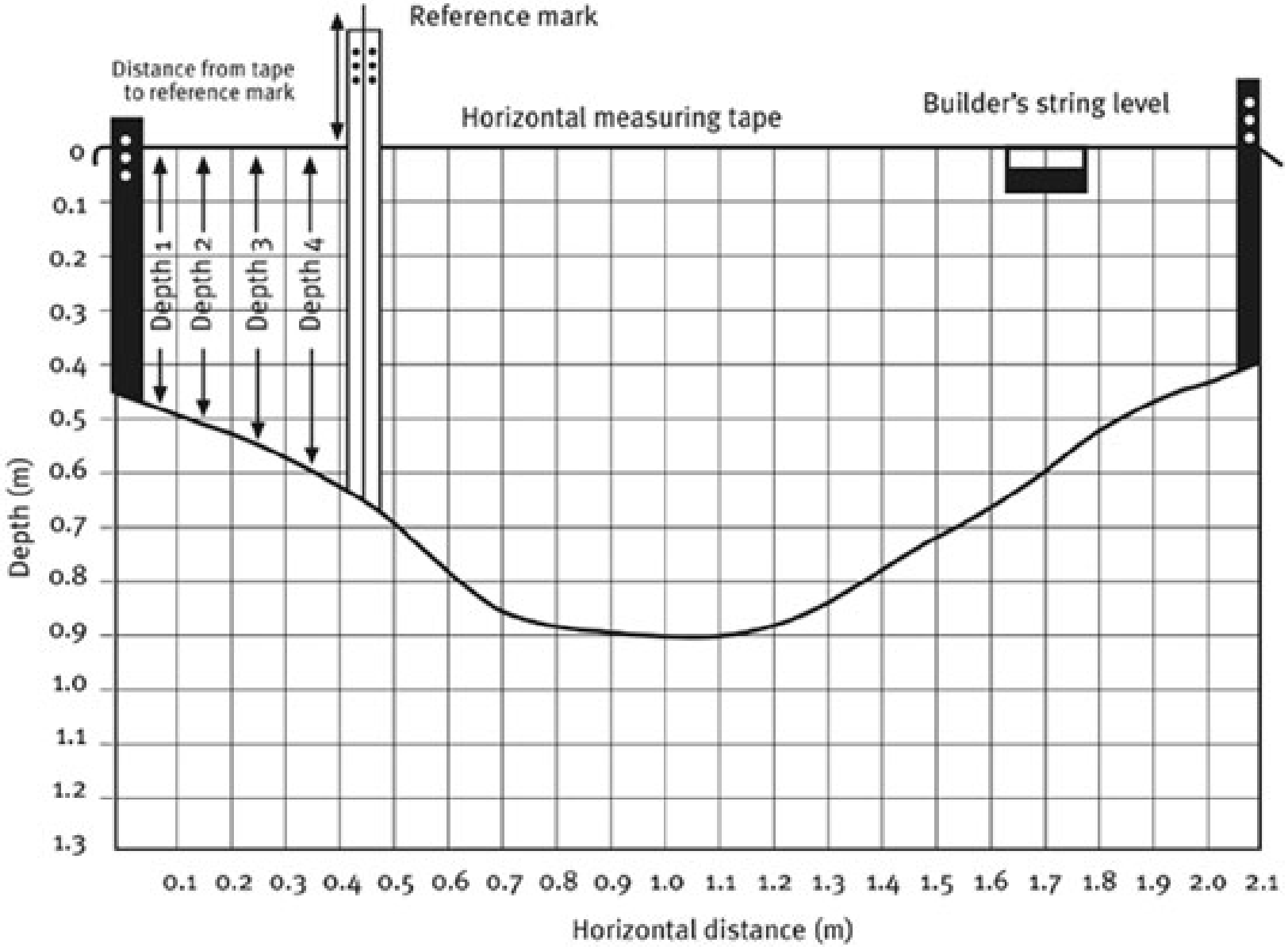
- Same cross sectional area
- Channel perimeter about doubled

DISCHARGE

- Volume of water flowing past a point in a certain amount of time
- Increases downstream
- Cross sectional area x velocity
- Gaging station

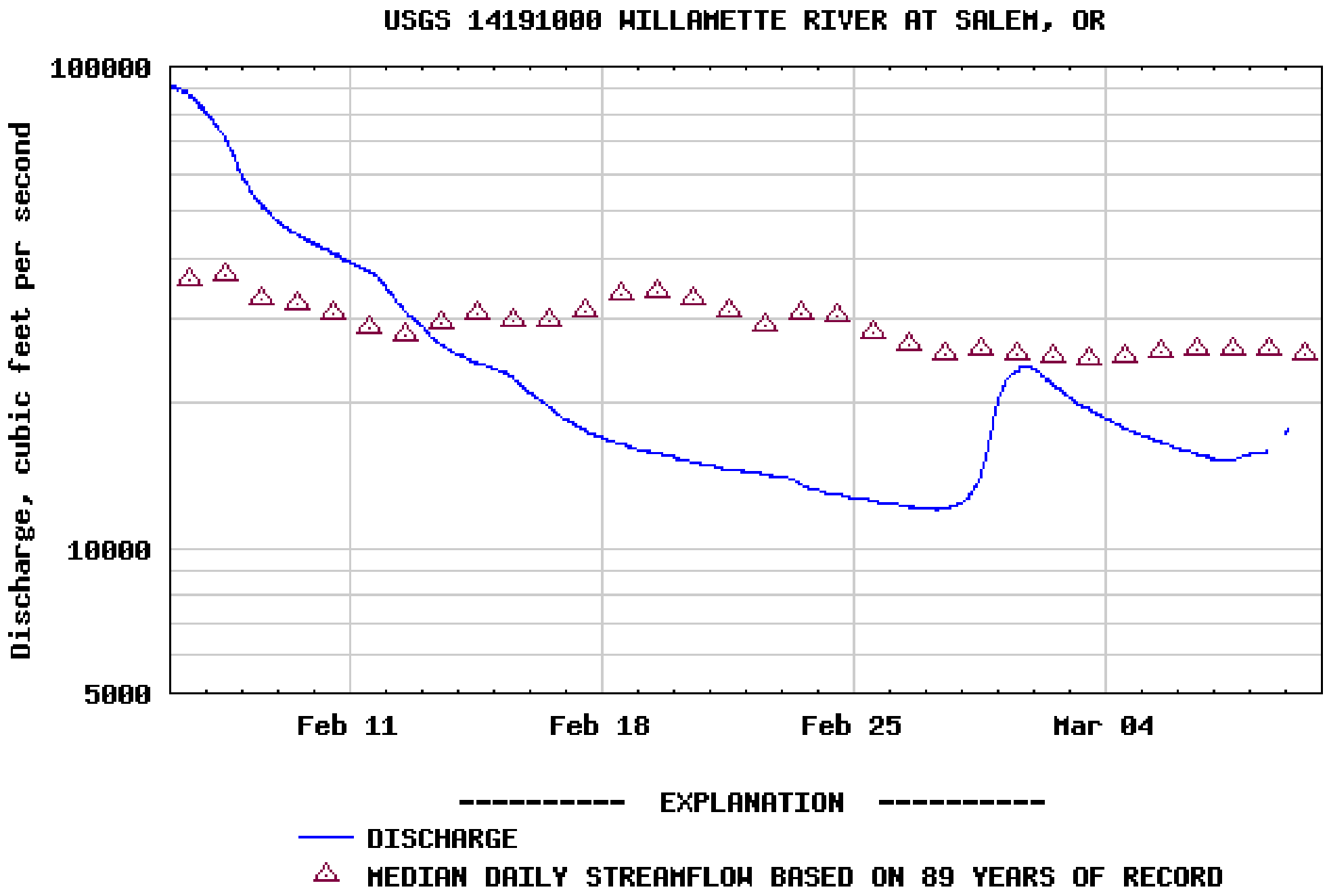
GAGING STATION

DISCHARGE CALCULATION



- http://www.waterwatch.org.au/library/module-4/flow.html#10

Willamette Discharge Winter 2006



- http://waterdata.usgs.gov/or/nwis/uv?format=gif&period=31&site_no=14191000

FLOODS

- River rises above normal bank retainment
- Described as ‘Flood Stage’
- Measured in feet above bank full discharge
- Floods occur periodically—due to weather variations
  - Rainfall
  - Snowmelt
  - Uncommon events like landslide or lava dams

- http://www.bpa.gov/Power/pl/columbia/4-gal-2.htm

- http://www.ci.oswego.or.us/engineer/images/Copyof96-flood-03_000.jpg

- http://zebu.uoregon.edu/flood3.html

RECURRENCE INTERVAL

- 100 year flood—1% chance of occurrence in a given year
- 20 year flood—5% chance
- 500 year flood—0.02% chance

Types of Floods

- Riverine floods
  - Slow events from protracted rainfall
  - Fast events from sudden rainfall
- Coastal floods
  - Storm surge
  - High tide
  - rainfall
- Catastrophic floods

Flood effects

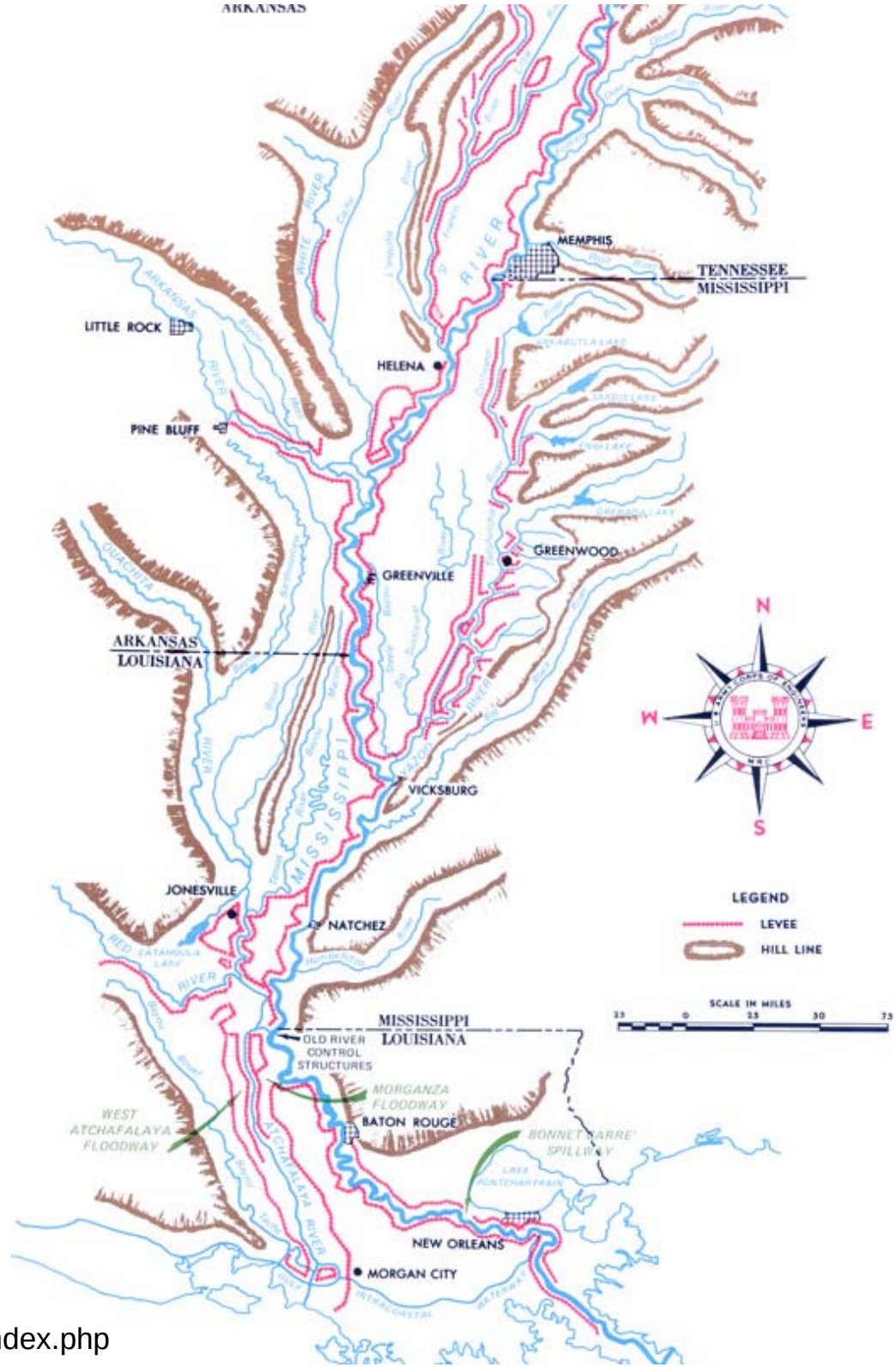
- Infrastructure damage
- Disease
- Crop and food supply
- Natural vegetation

Flood Control

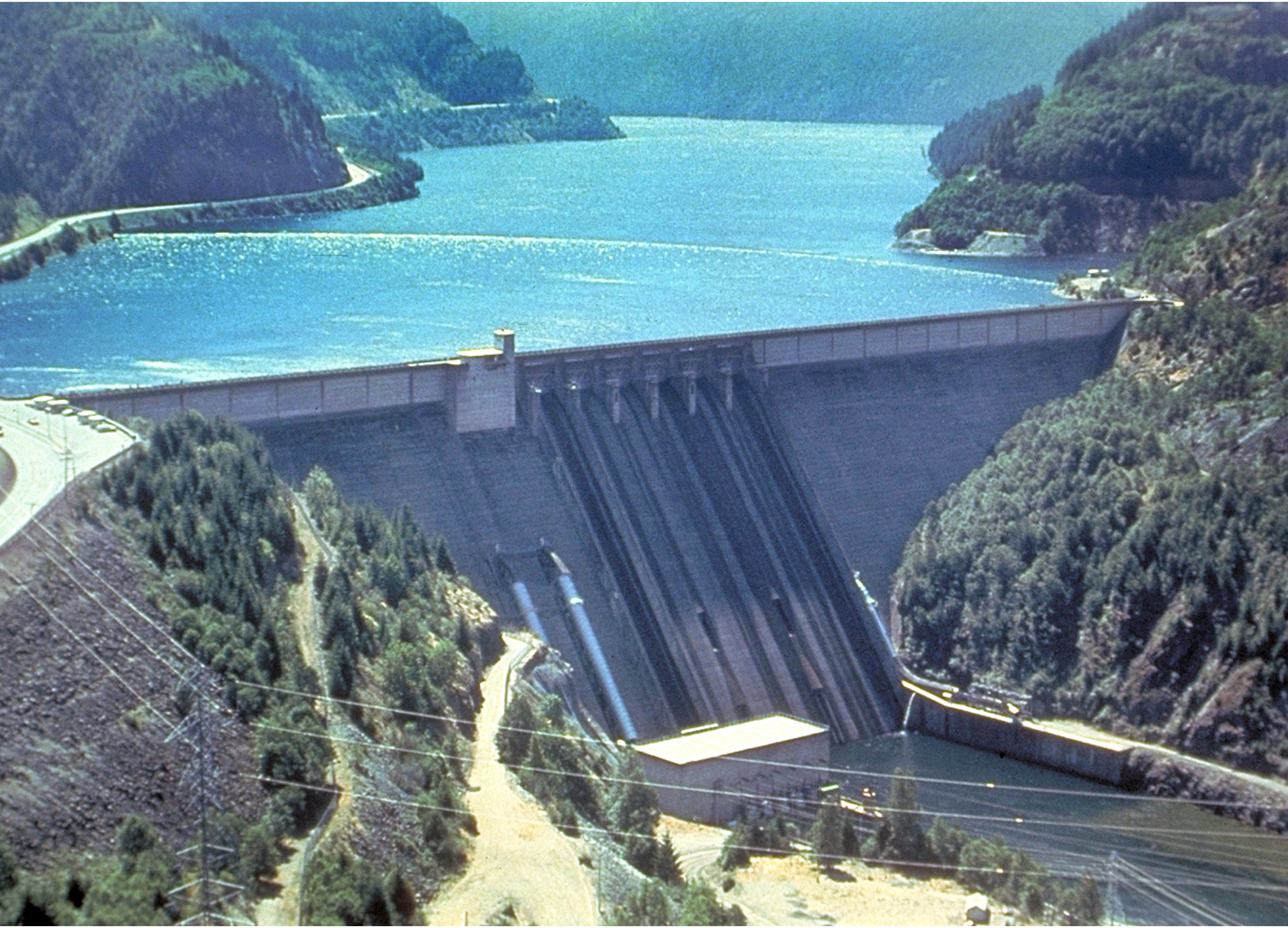
- Containment
- Water management
- Flood-plain building restrictions

Levees

- Pink is levees
- Brown is hill lines



- http://www.mvd.usace.army.mil/mrc/mrt/index.php



- http://www.bpa.gov/corporate/bpanews/library/images/dams/descriptions/detroit.cfm

- http://en.tourduvalat.org/nos_programmes/observatoires_biodiversite_et_politiques_publiques/observatoire_des_zones_humides_mediterraneennes

- http://www.australianecosystems.com.au/projects-edgewater-estate.htm

SUMMARY OF CHANGES FROM HEAD TO MOUTH OF STREAM

- Channel gradient
- Channel size
- Discharge
- Velocity of flow—controlled by
  - Gradient
  - Channel shape
  - Discharge

THE WORK OF STREAMS

- Erosion
- Transportation
- Deposition

TRANSPORTATION

Three modes of moving material

- In solution = **Dissolved load**
- **Suspended load**
- Sliding, rolling, bouncing = **Bed load**

DISSOLVED LOAD

- **From groundwater, runoff and channel**
- **Supplies ocean with minerals in solution**

SUSPENDED LOAD

- **Most of material transported**
- **Sand, silt, clay**
- **Larger particles in flood**

BED LOAD

- **Too large to keep suspended**
- **Grinds channel and downcuts**

TRANSPORTATION

- Competence
- Capacity

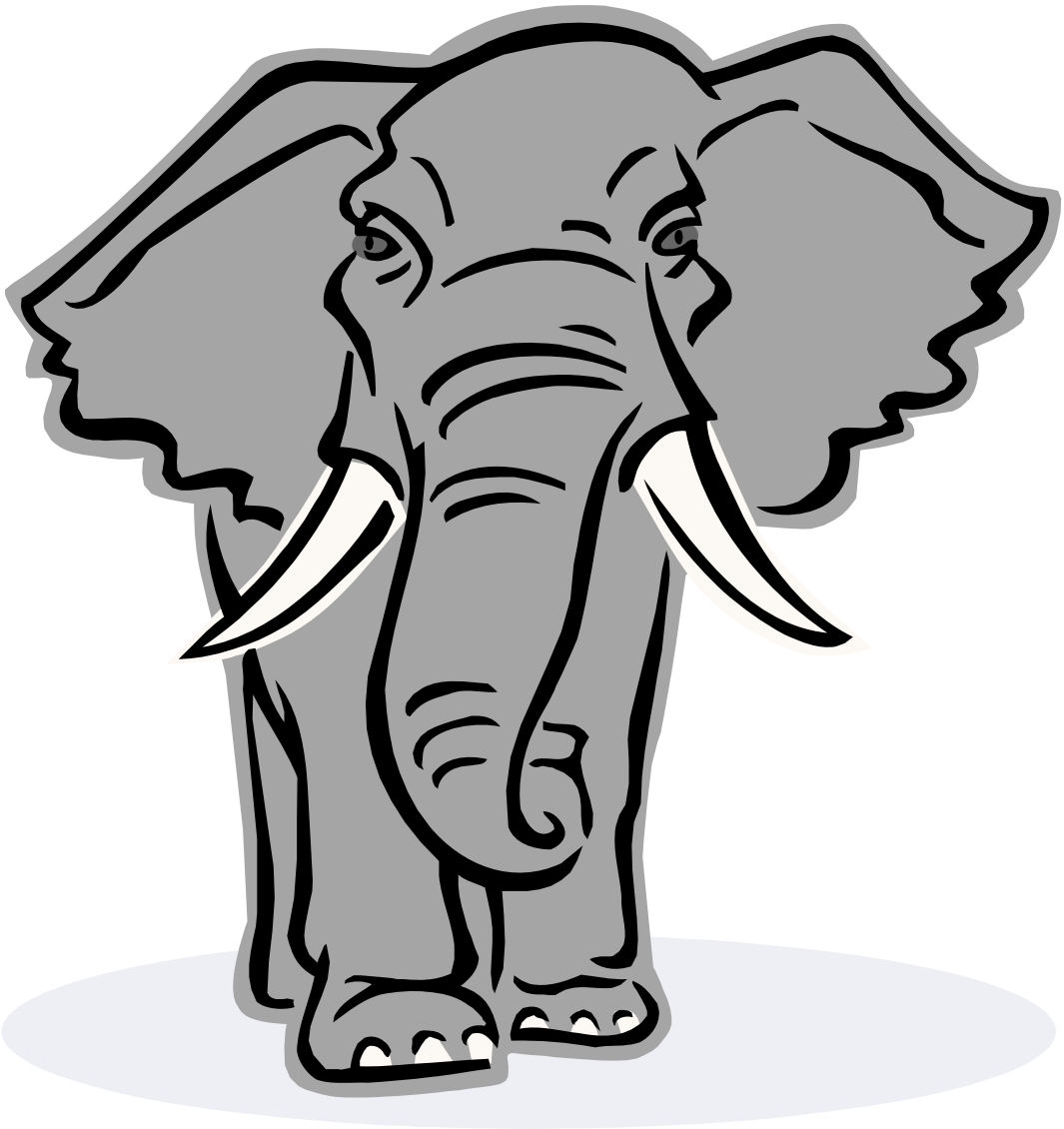
COMPETENCE

- Size of particles
- Depends on velocity
- Velocity is proportional to the square of competence

CAPACITY

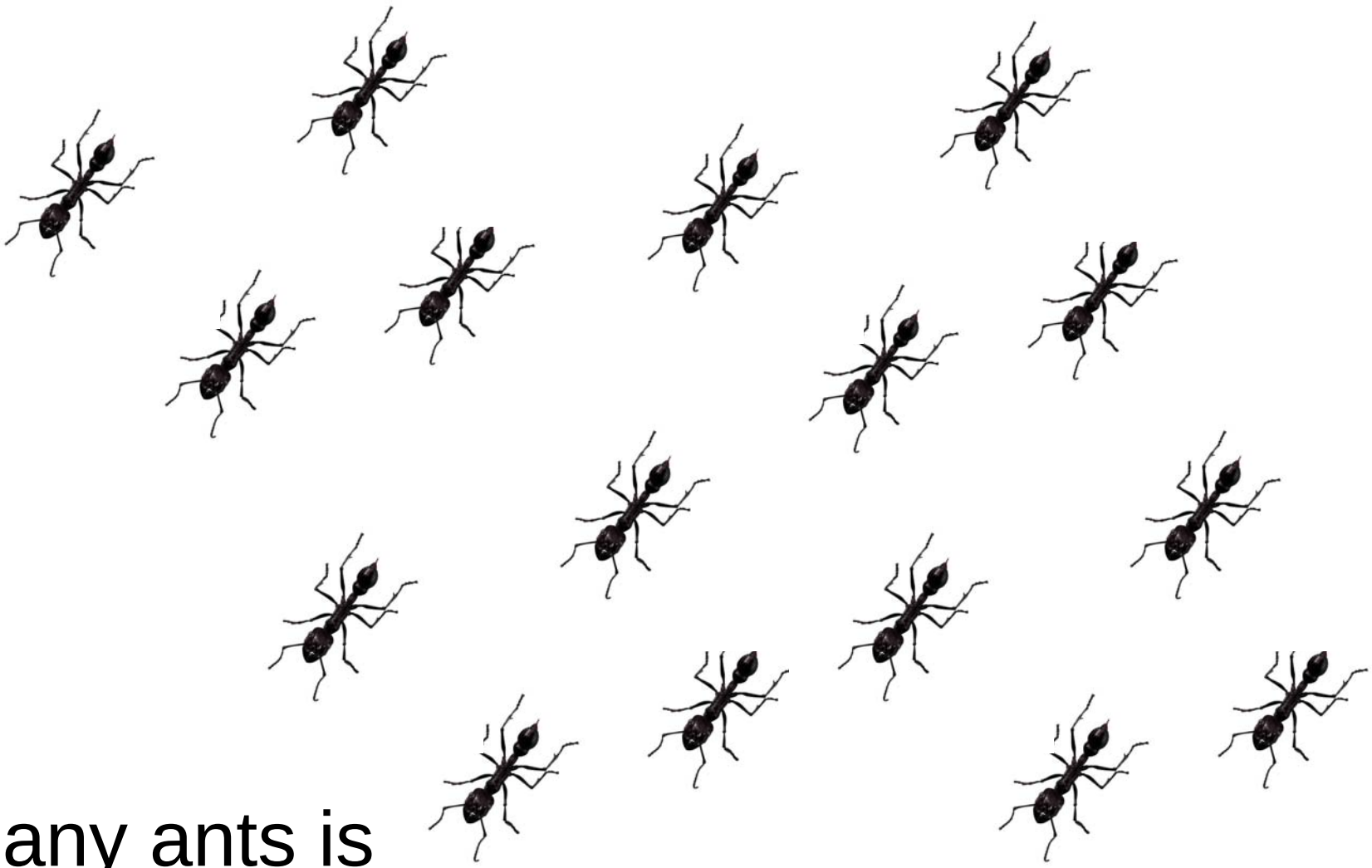
- Amount of material
- Depends on discharge

Competence vs. Capacity



- Elephant has greater competence
- Can carry heavier loads

Competence vs. Capacity



- Many ants is greater capacity

The Work of Streams

- Greatest competence with greatest velocity
- Greatest capacity with greatest discharge
- Maximum during floods

The Work of Streams

- Erosion
- Transportation
- Deposition

Bedrock Channel

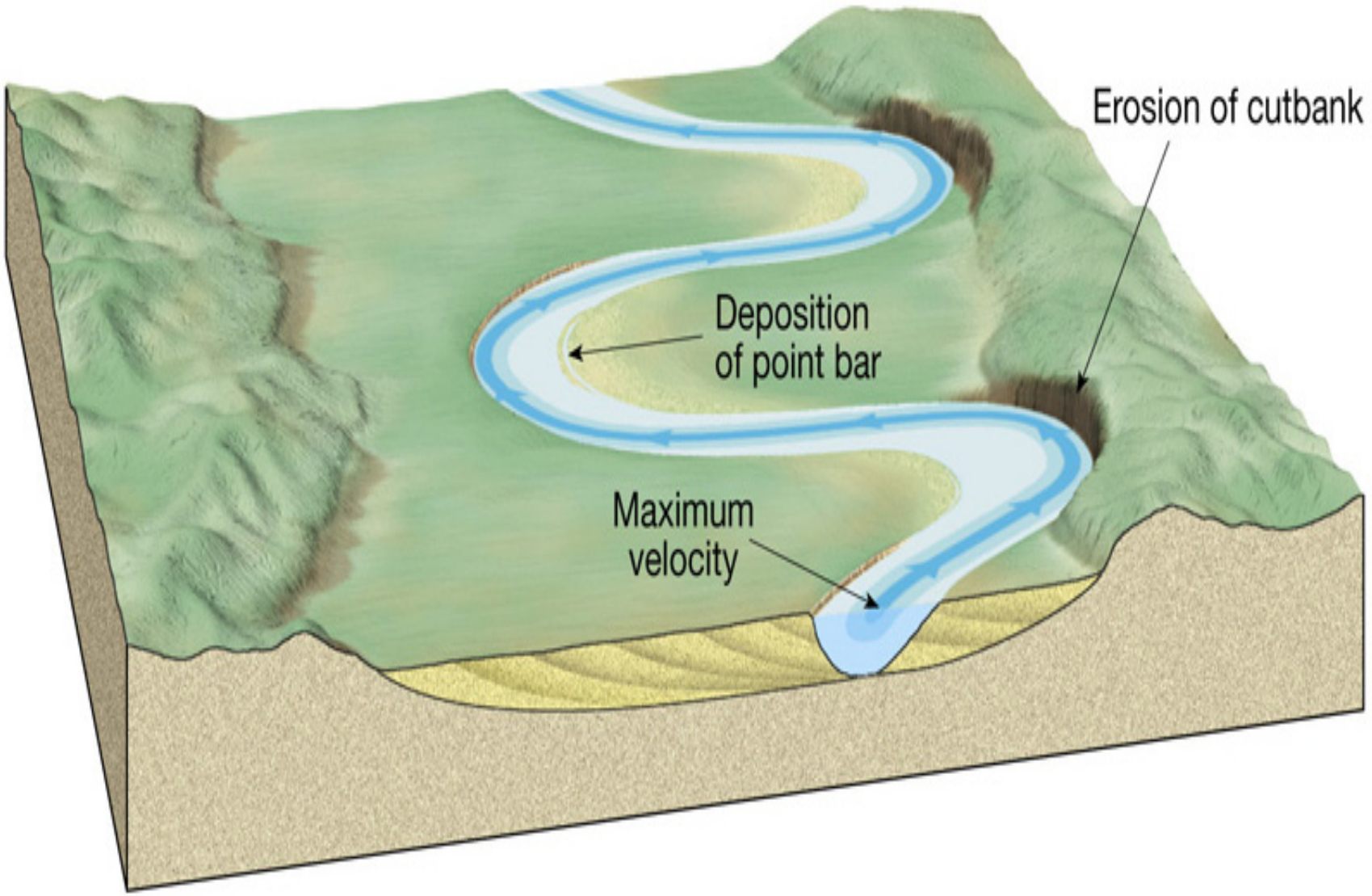
- High gradient
- Many rapids and waterfalls

- http://www.paul.chesterfield.btinternet.co.uk/pages/landscapes12.htm

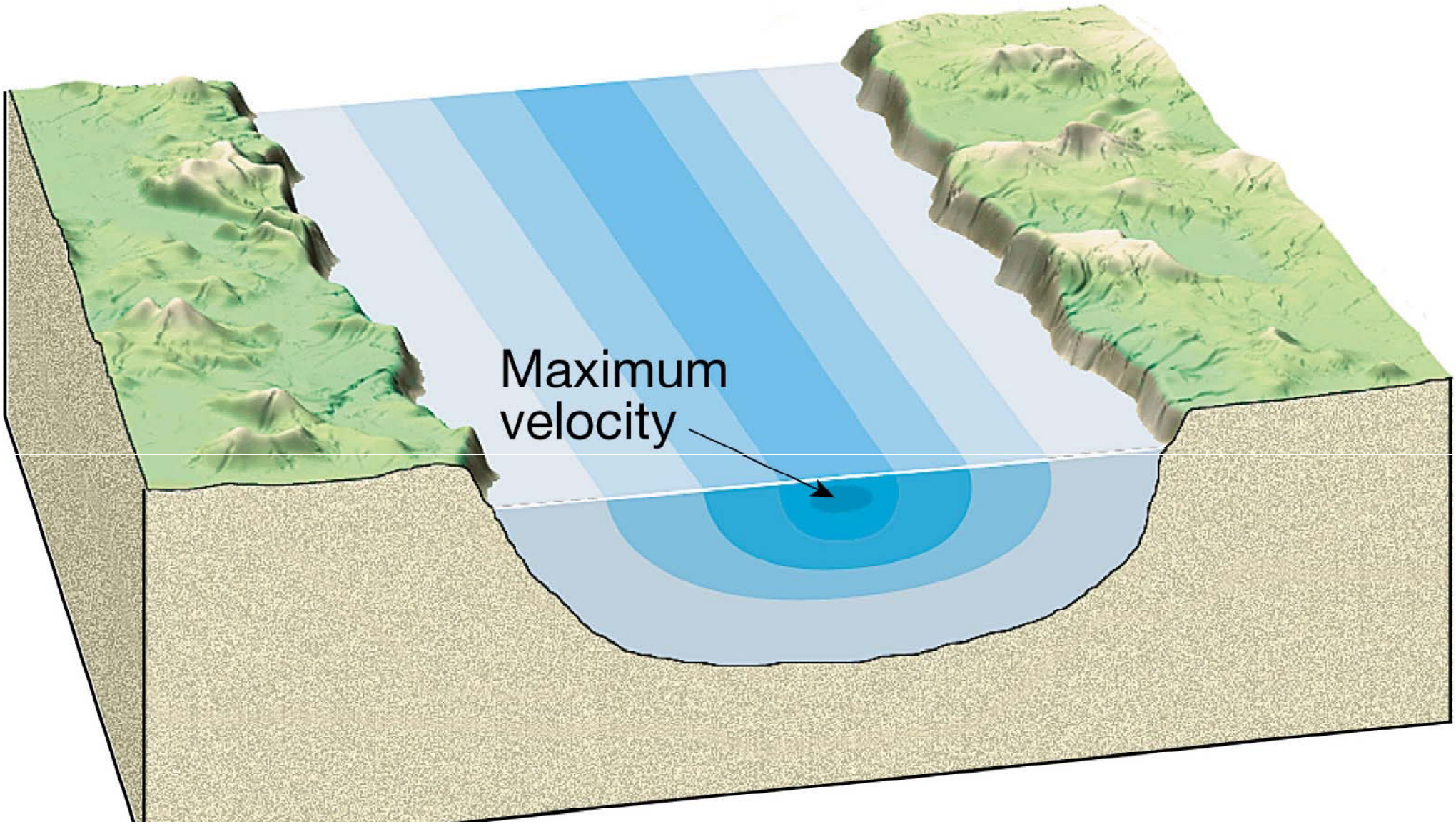
DEPOSITION

- Slowing of velocity
- Largest particles deposited first
- ALLUVIUM

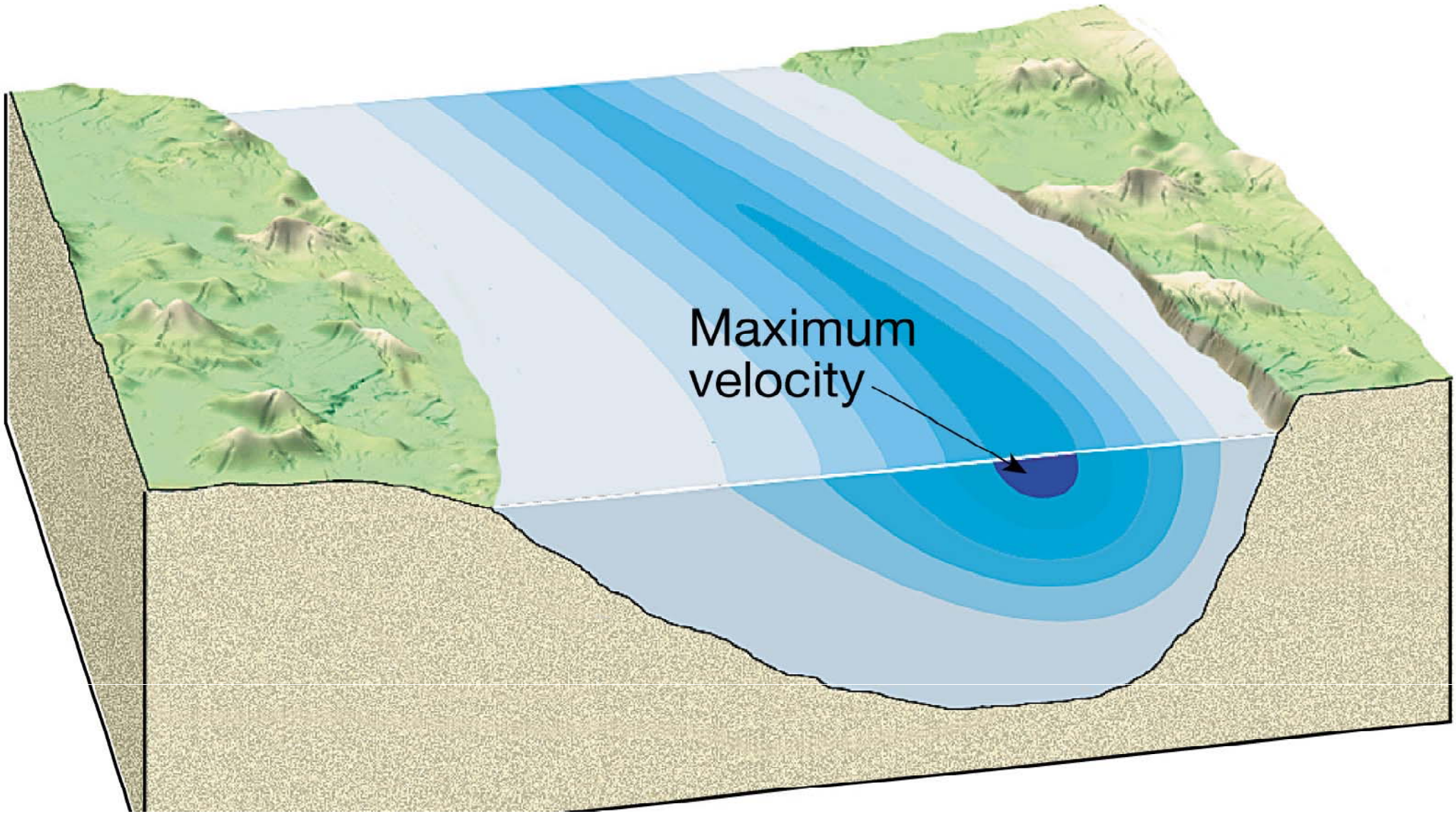
Alluvial Channel



High Velocity in Center

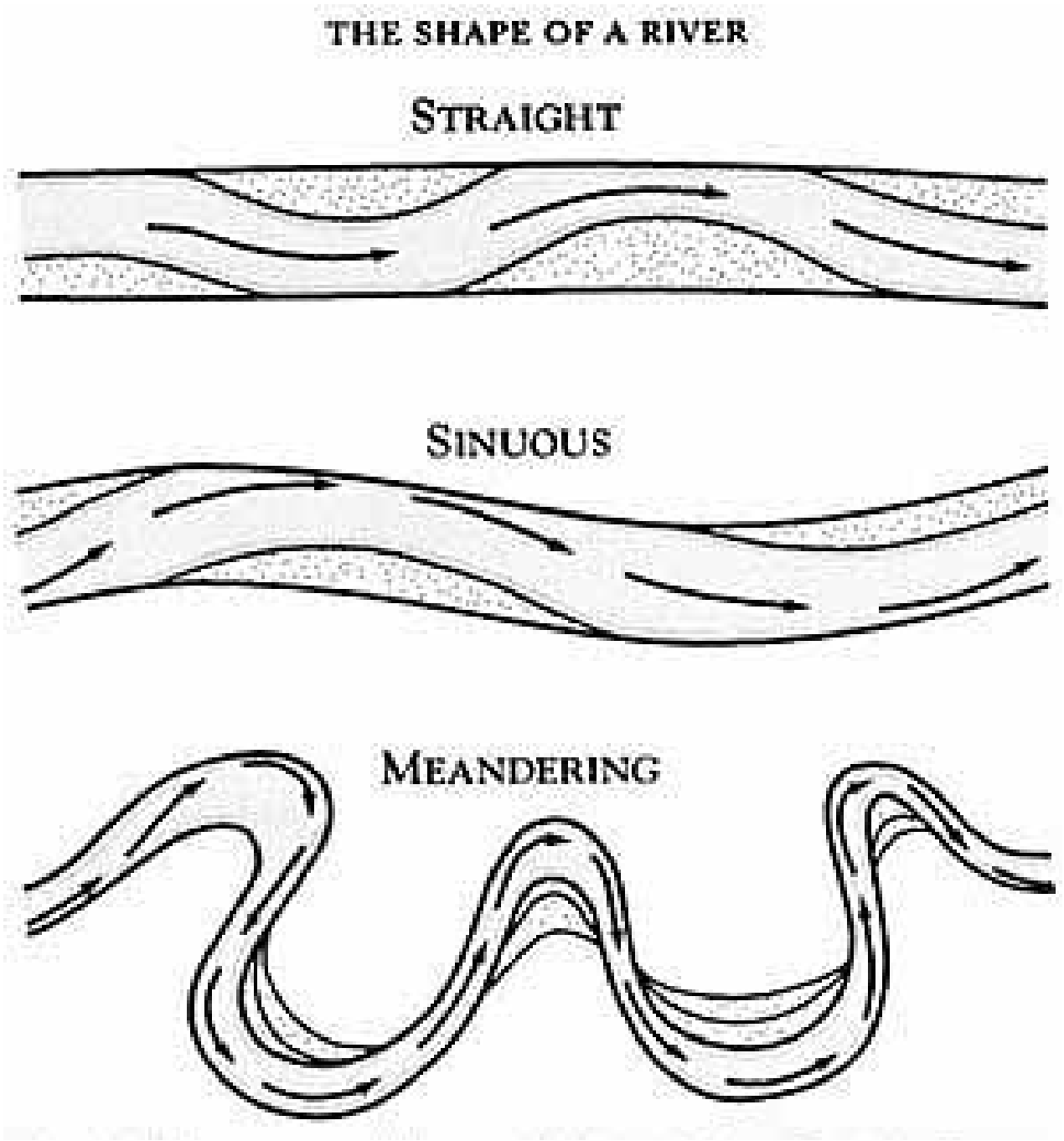


Velocity displaced around meander curve



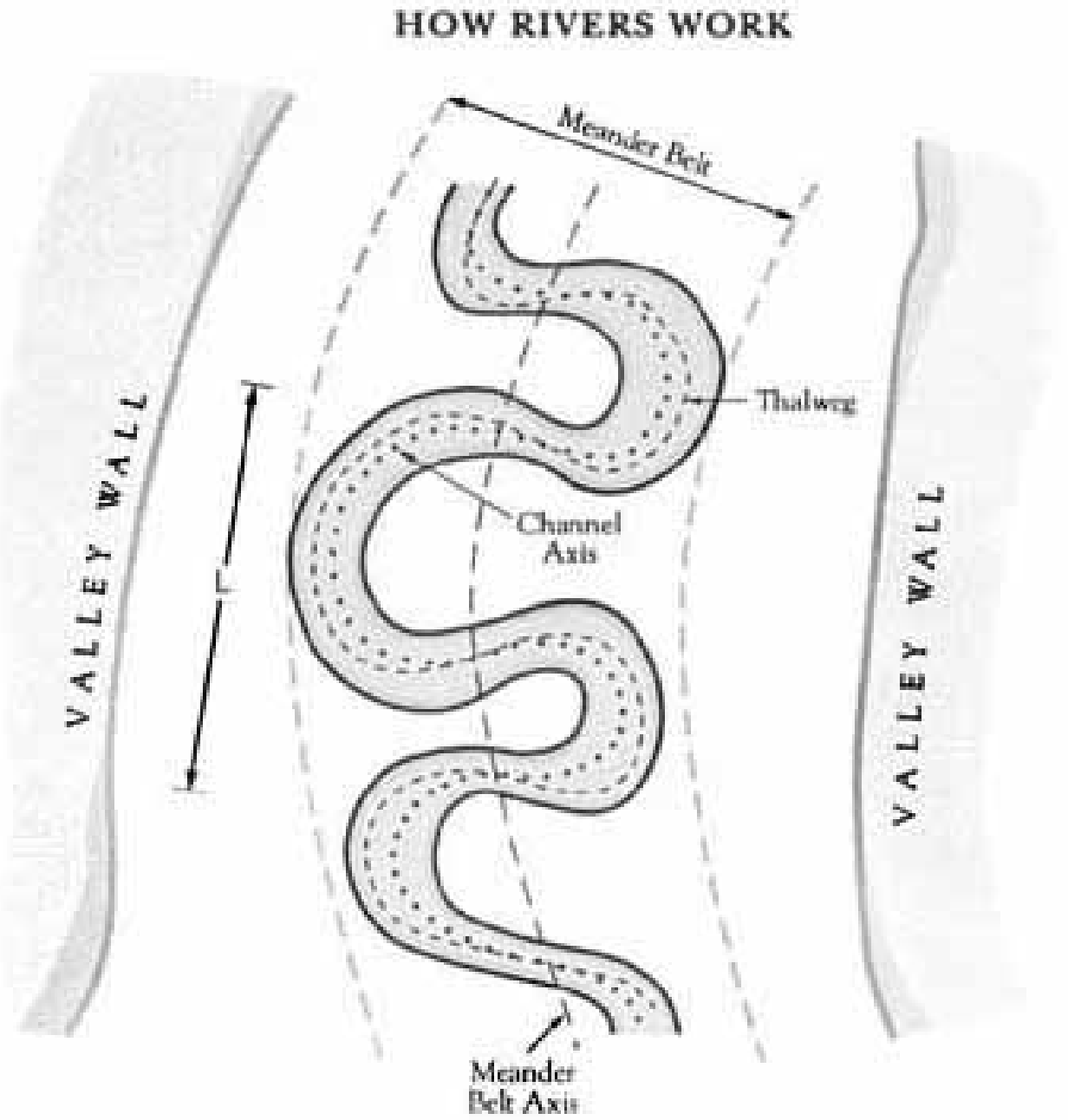
Channel Pattern

Natural progression to more meandering channel character



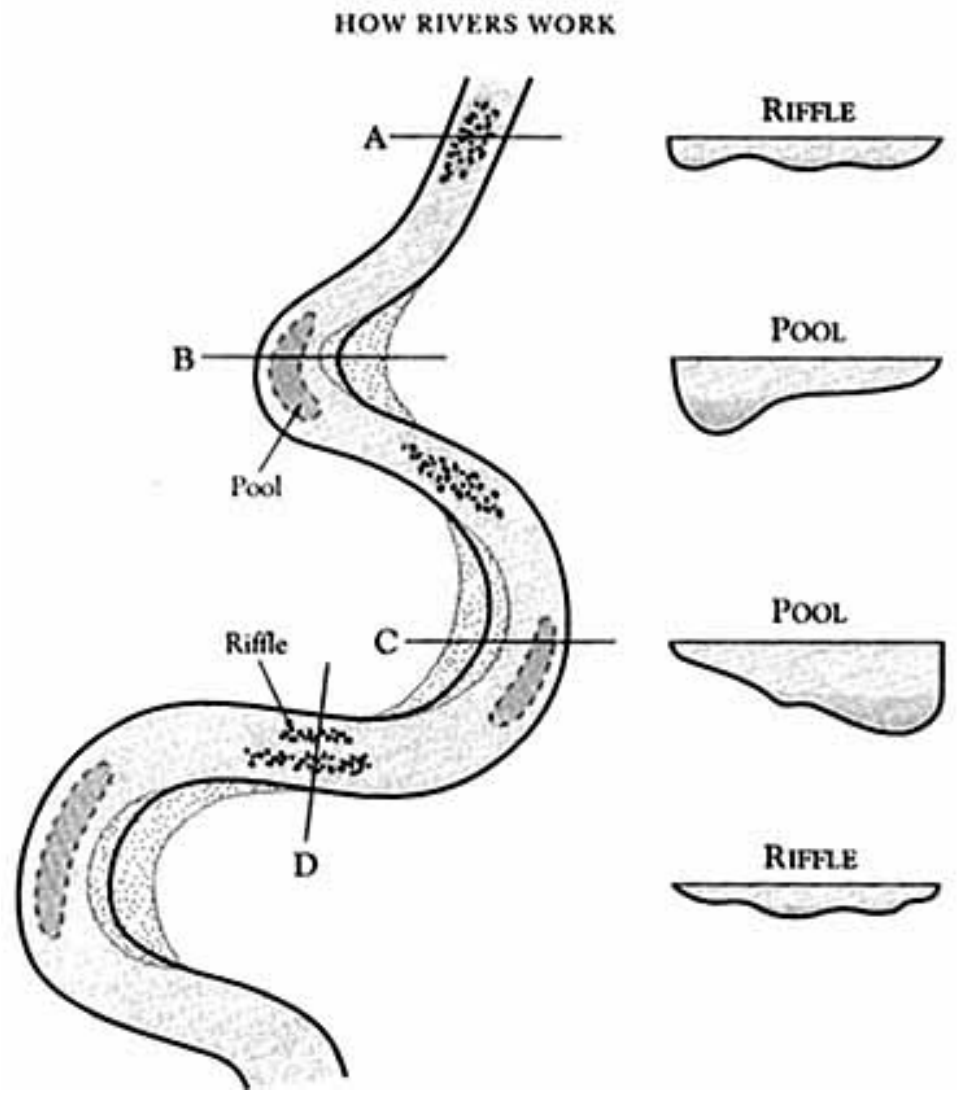
- http://www.ucpress.edu/books/pages/6664/6664.ch04.html

Develop-ment of meanders



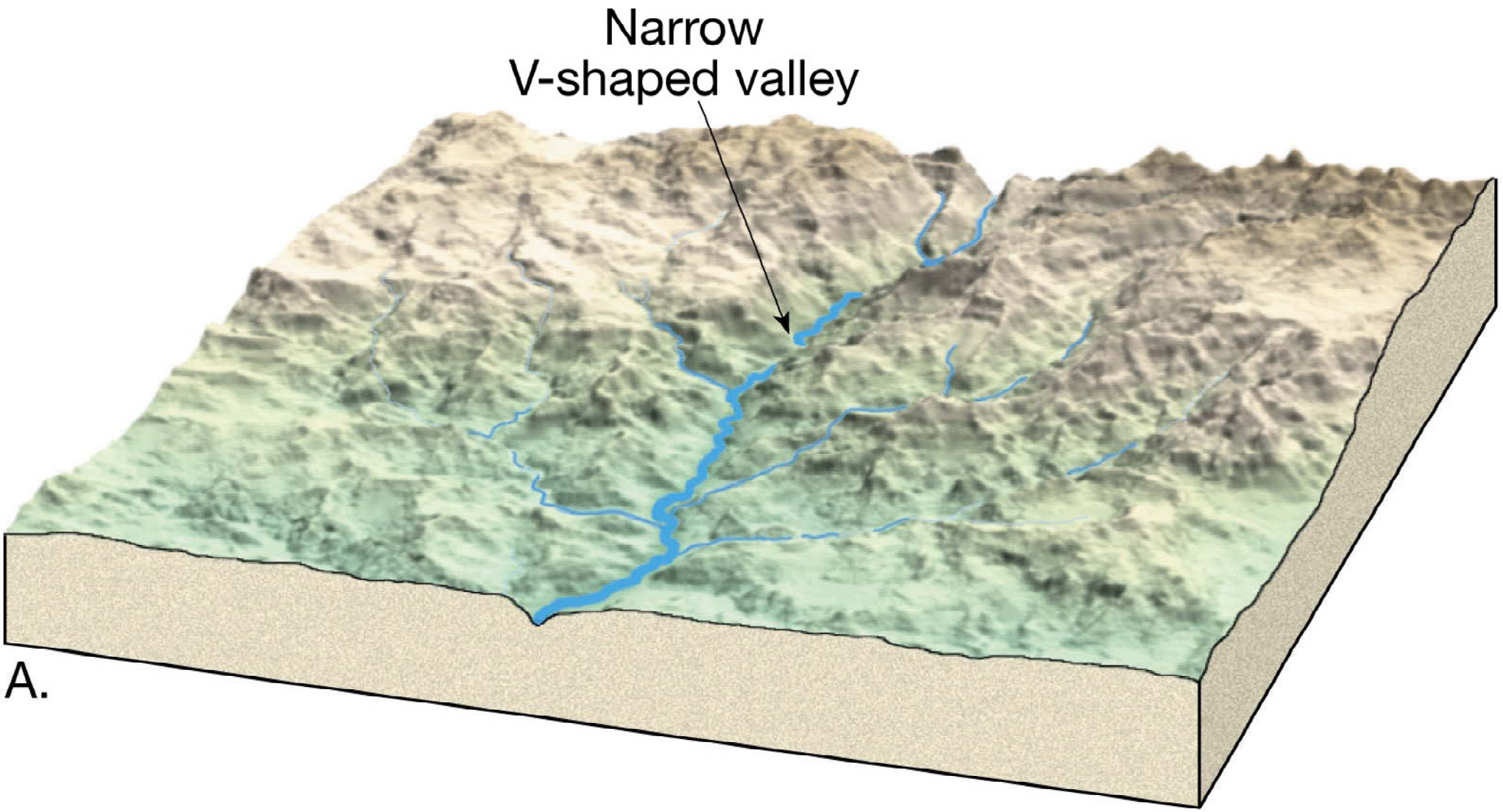
- http://www.ucpress.edu/books/pages/6664/6664.ch04.html

Development of Meanders

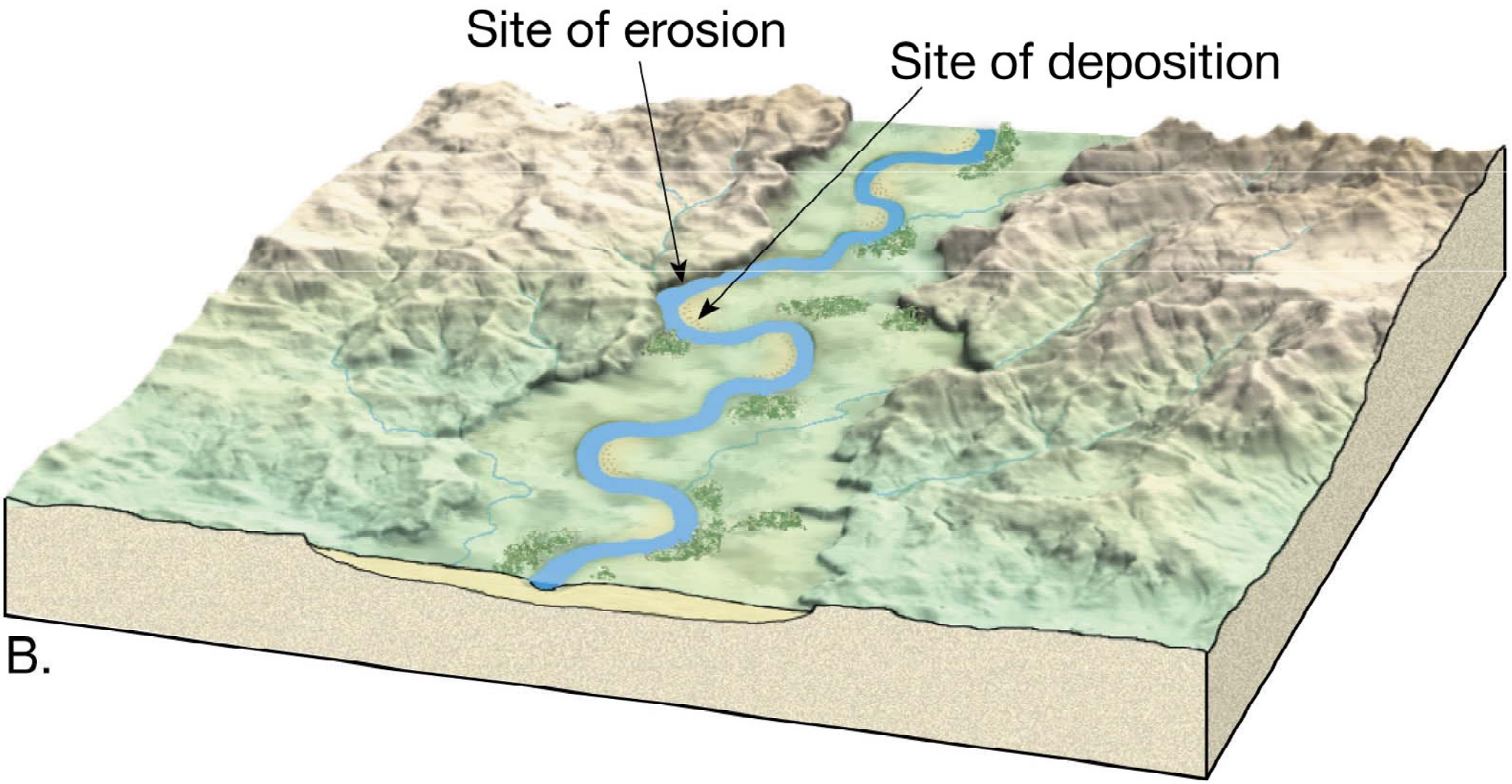


- http://www.ucpress.edu/books/pages/6664/6664.ch04.html

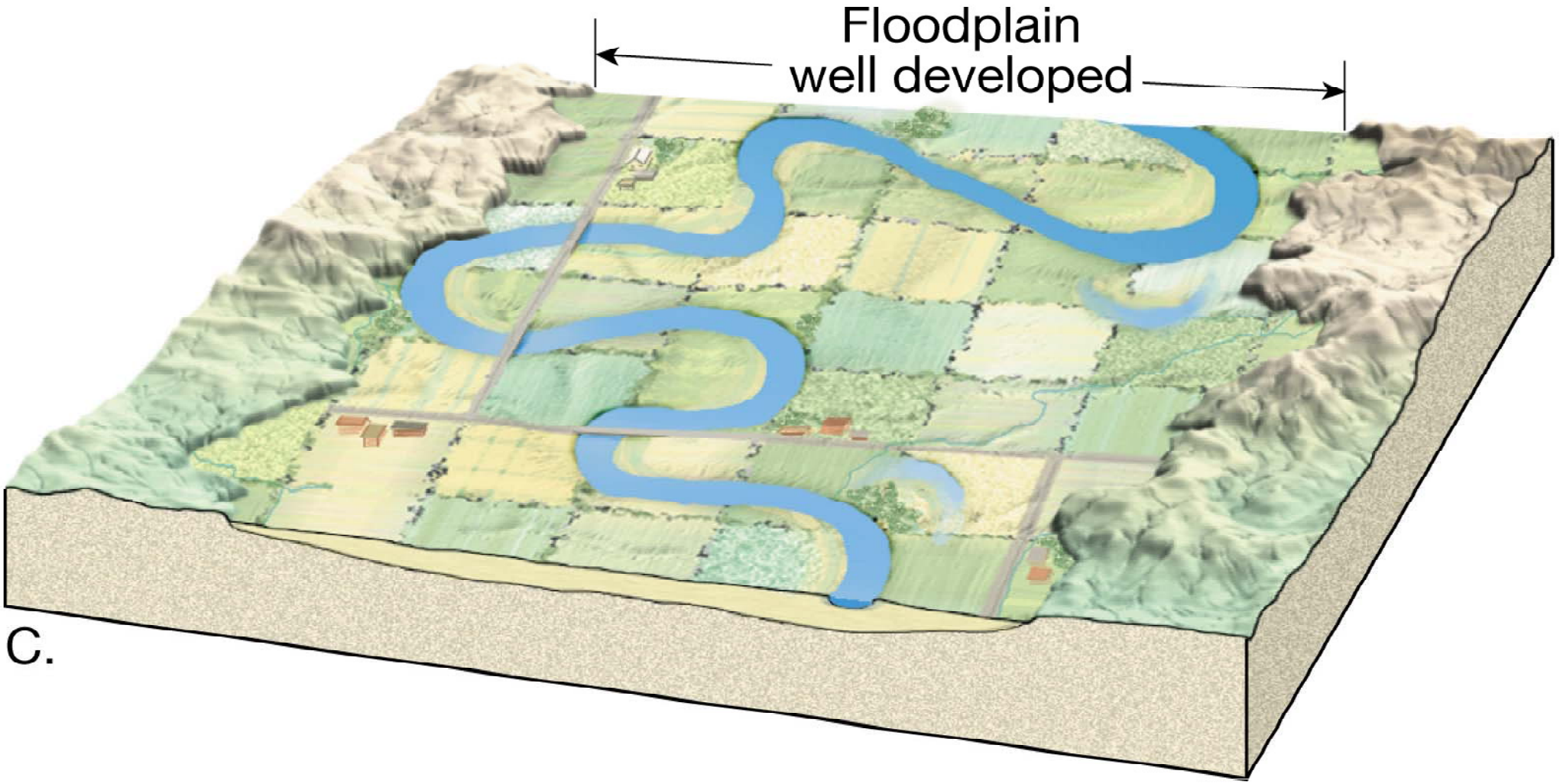
Channel development

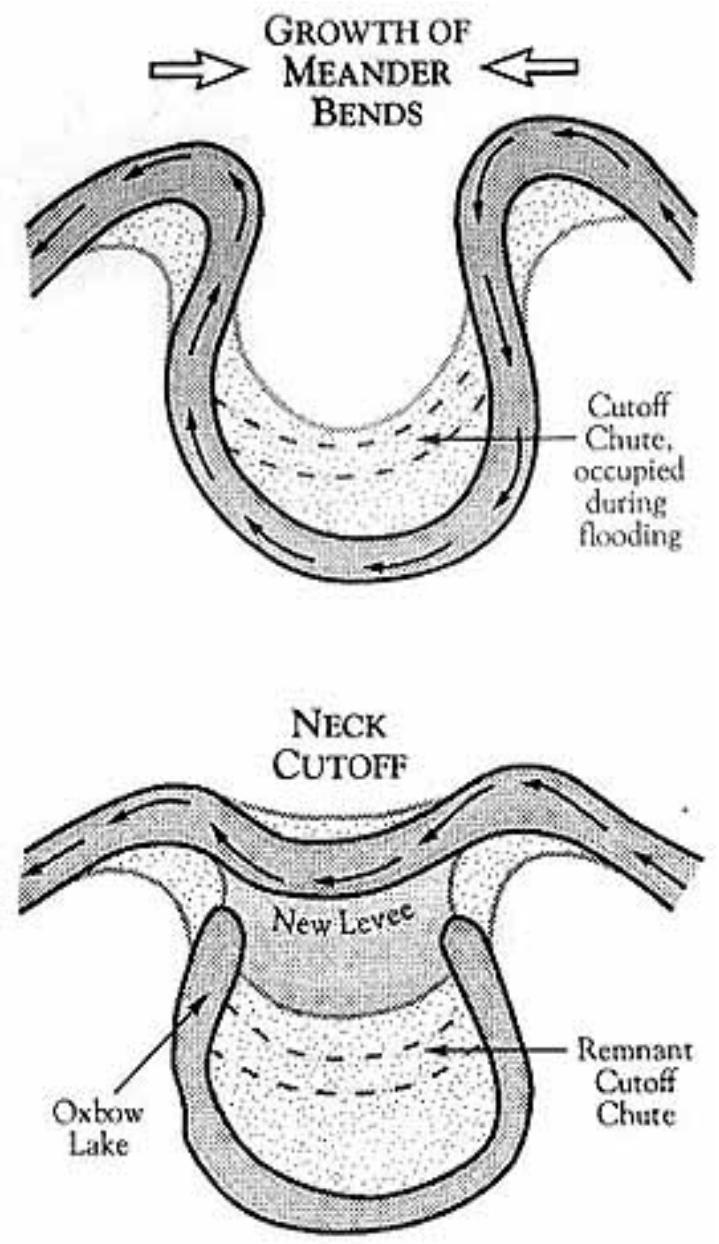


Channel development



Channel development

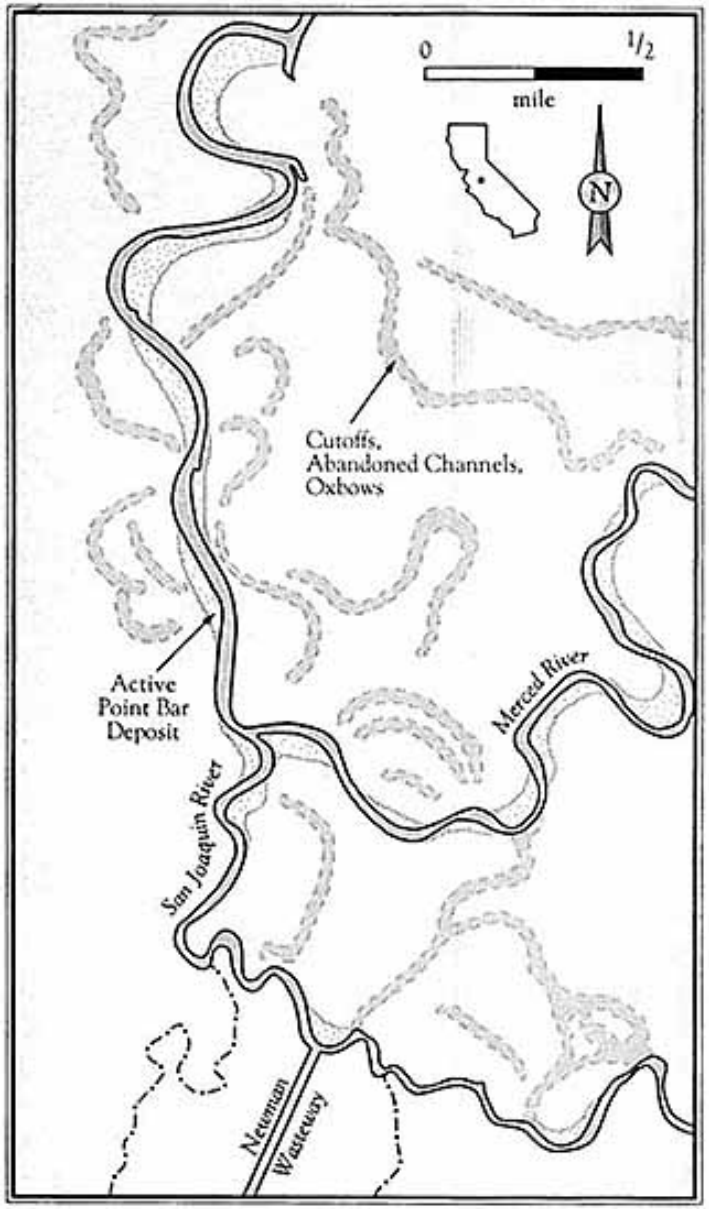




Formation of Oxbow Lake

- http://www.ucpress.edu/books/pages/6664/6664.ch04.html

Well Established Meandering Stream

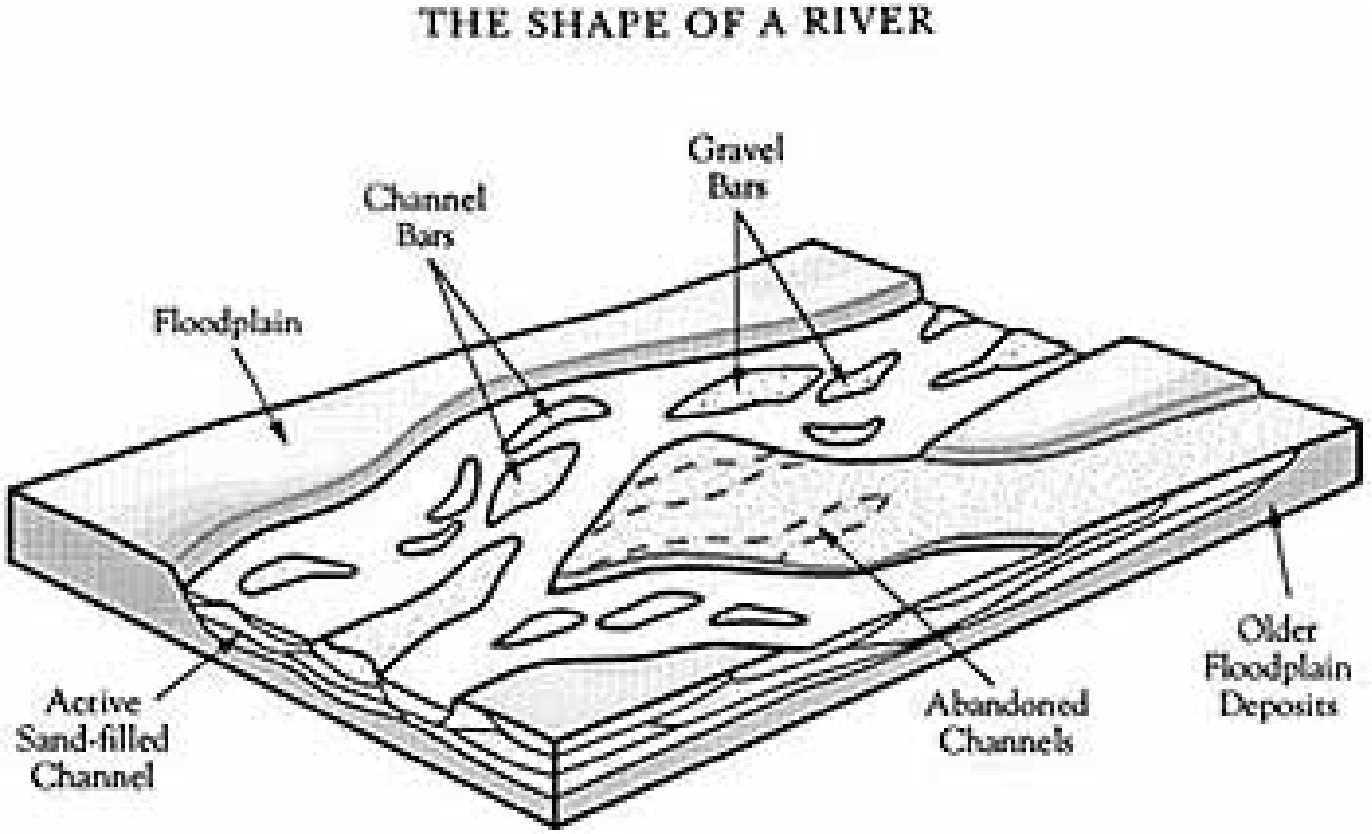


- http://www.ucpress.edu/books/pages/6664/6664.ch04.html

Channel Pattern

- High Gradient
- Highly variable discharge
- High, coarse sediment load
- Braided channel develops

Braided Channel



- http://www.ucpress.edu/books/pages/6664/6664.ch04.html

Glacial Stream

- Dart River
- South Island, New Zealand

- http://www.bartholmai.com/NZ2/WebPages%20NZ2-Pages/Image51.html

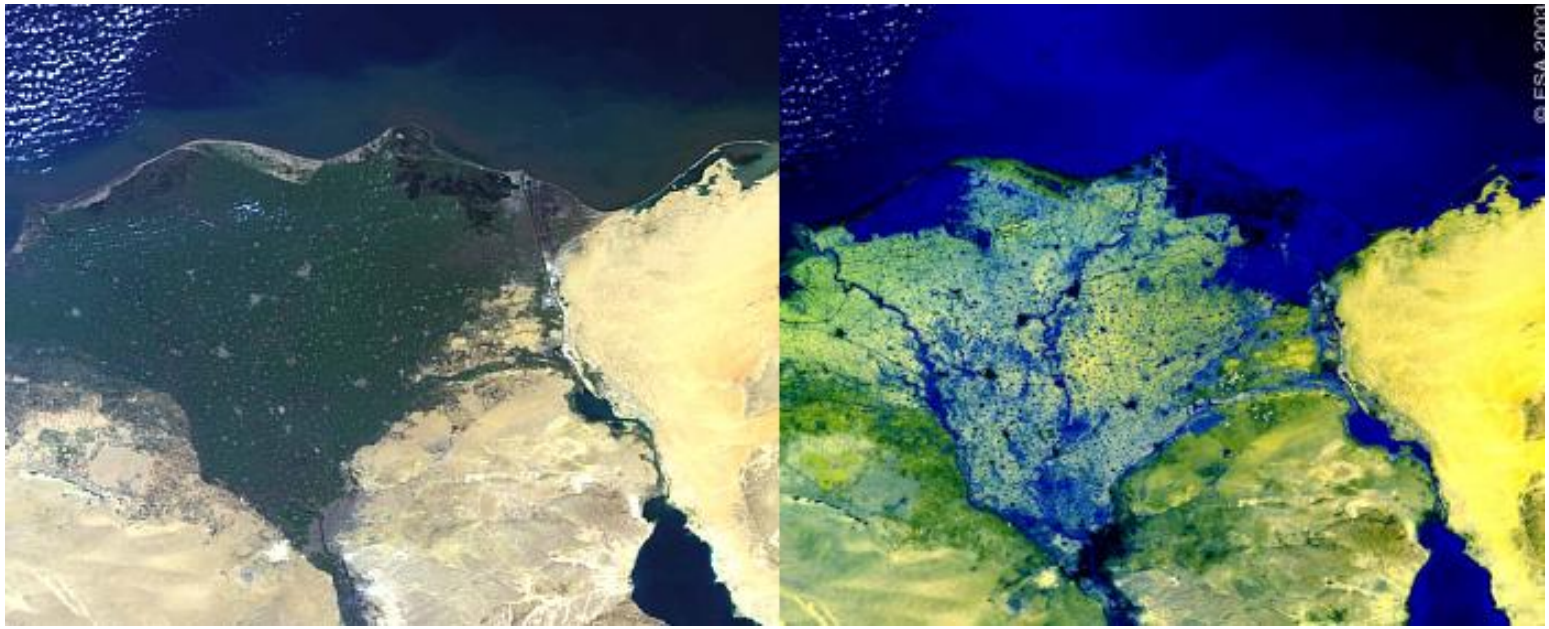
Alsek River, Alaska (photo taken by Jeff Mount)

The Alsek River is a braided river in this area. Note the multiple channels separated by longitudinal bars within a broader channel. The banks are heavily vegitated, whereas floods limit the establishment of plants on within the active river bed.

- http://www-geology.ucdavis.edu/~gel109/SedStructures/Lg/AKRiverChannel.jpg

Deposition by Streams

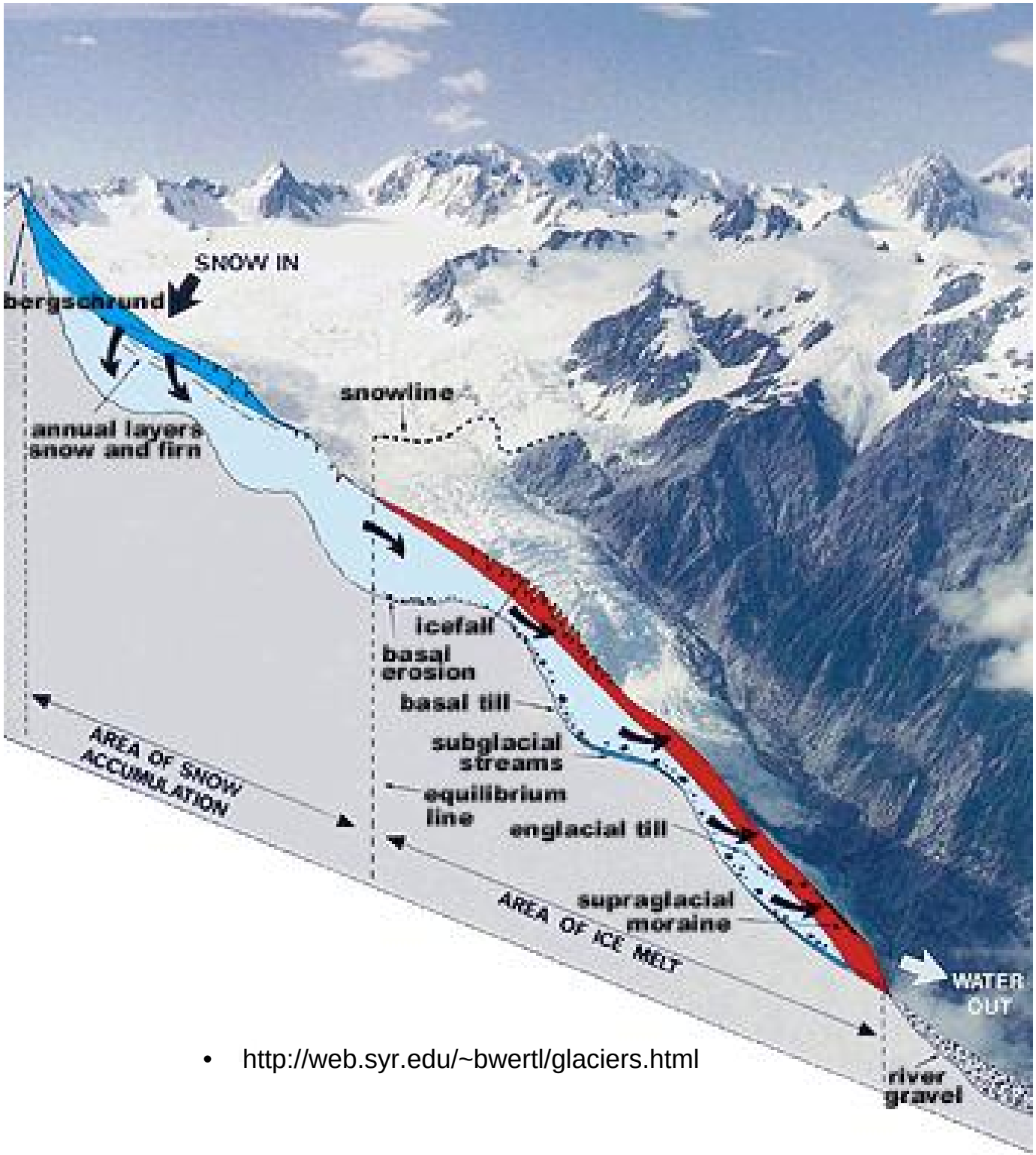
- Delta
  - Where stream enters standing body of water
  - Velocity slows, drops its suspended load
  - Lengthens the stream
  - Distributaries



- http://earth.esa.int/images/article_archive/nile.html

Glaciers

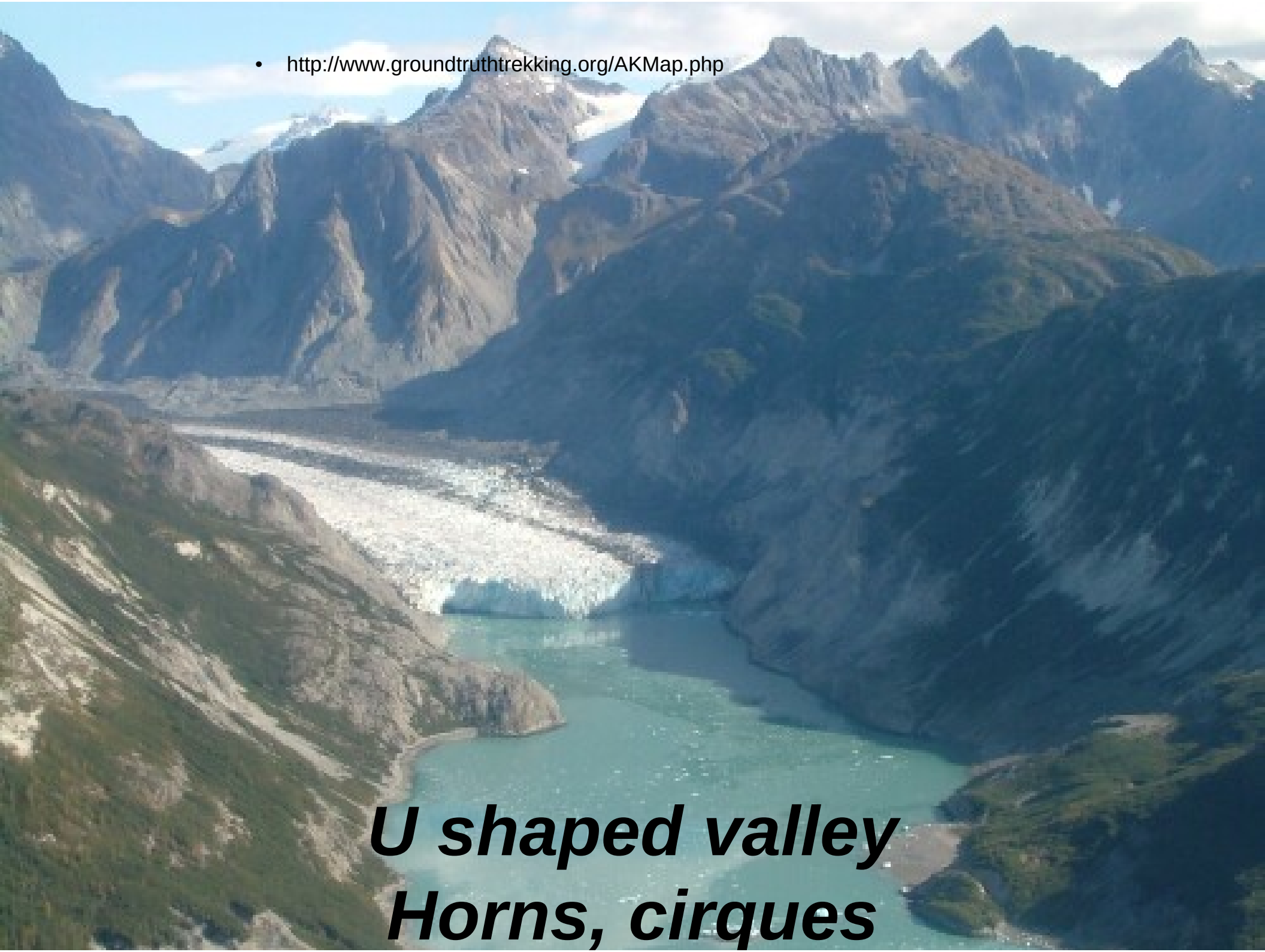
- Rivers of ice
- Moving downslope or out from accumulation center
- Distinctive erosional and depositional landforms



- http://web.syr.edu/~bwertl/glaciers.html

Alpine Glacier

- http://www.homeralaskacharters.com/glacier_tours.htm

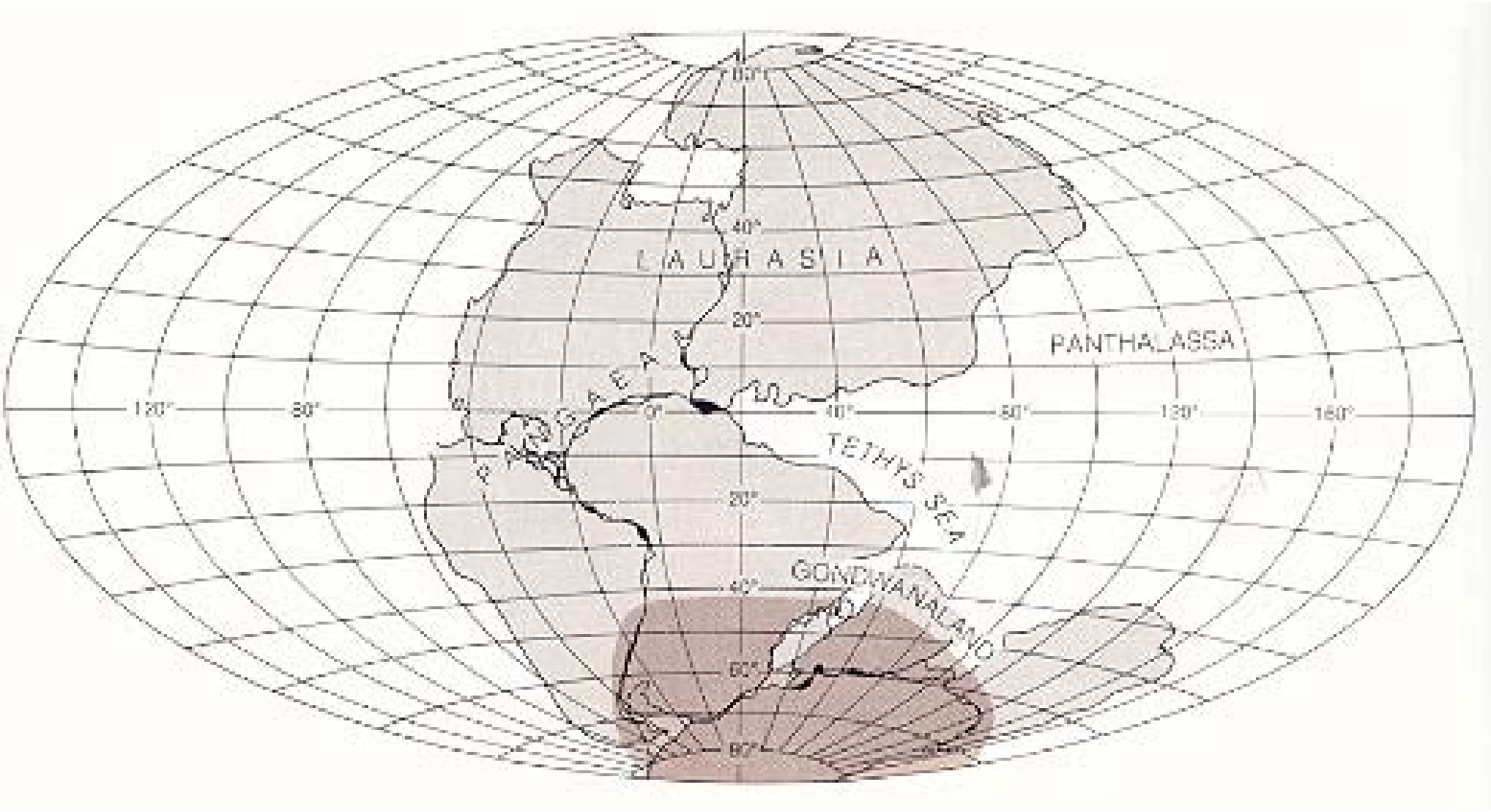


- http://www.groundtruthtrekking.org/AKMap.php

U shaped valley
Horns, cirques

- http://formontana.net/striations.html

Striations



- http://www.seismo.ethz.ch/kradolfer/Angewandte_Erdbebenseismologie/earth/pangaea.htm

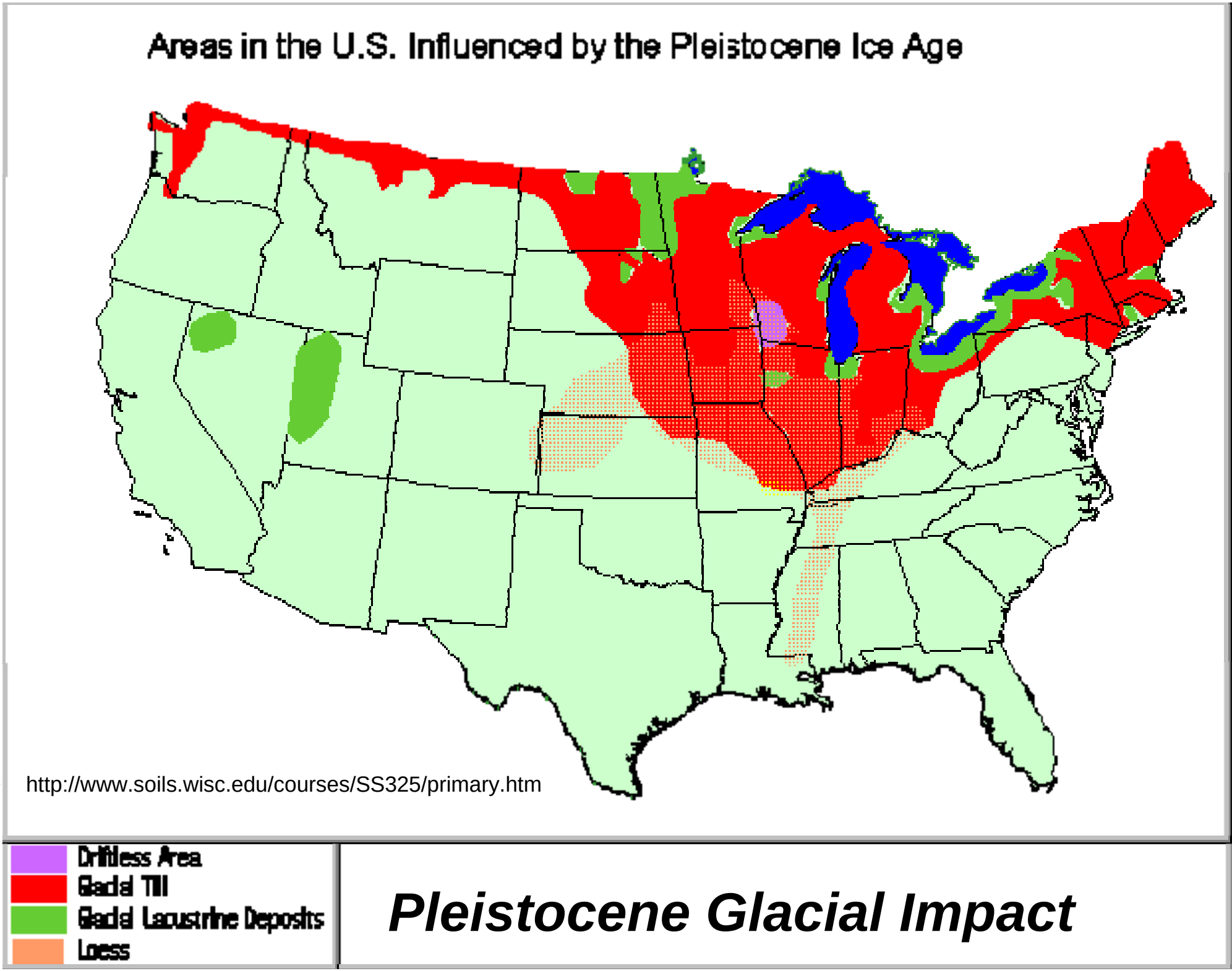
Continental Ice Sheet

- Greenland

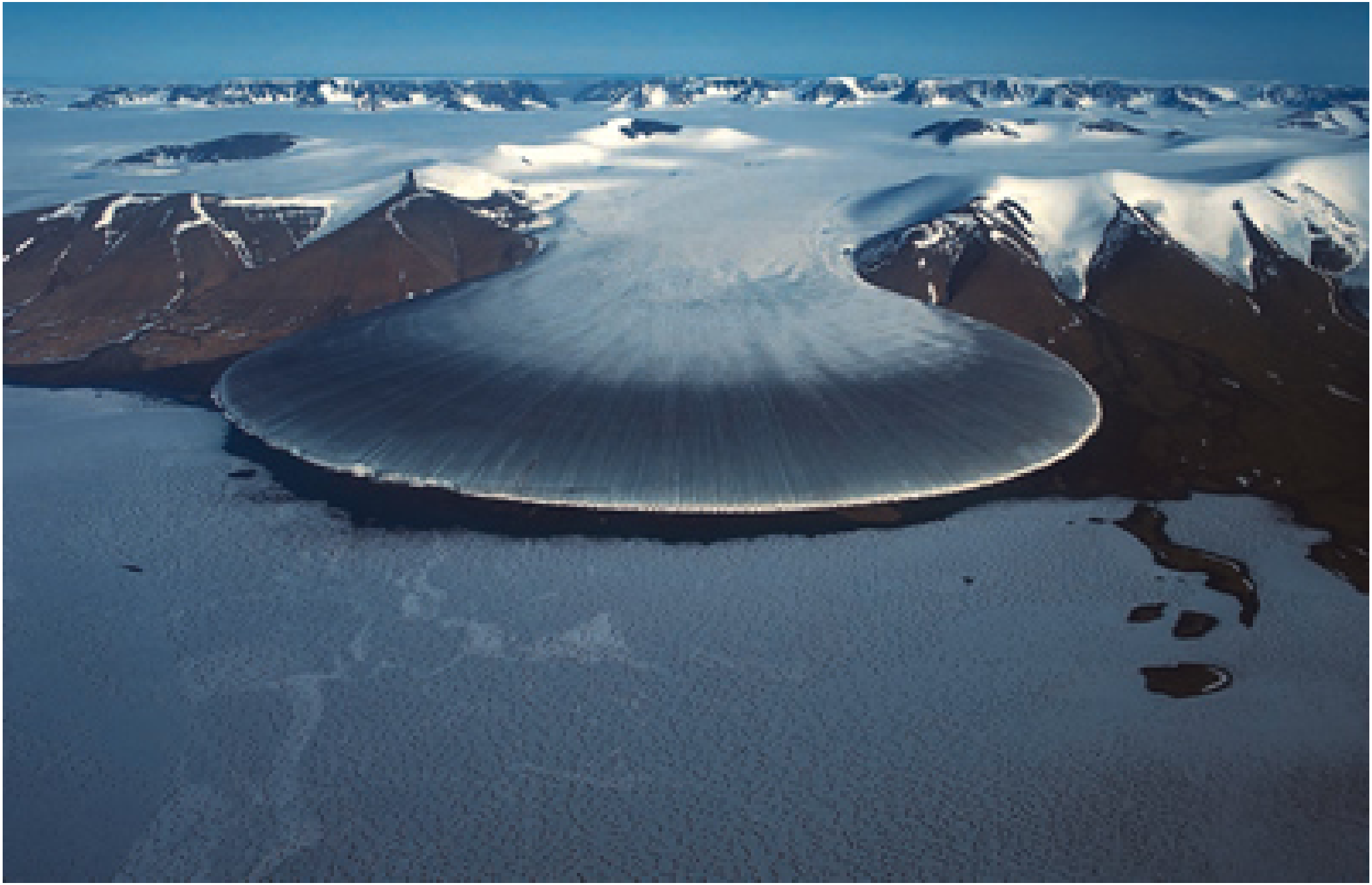
  - http://www.homepage.montana.edu/~geol445/hyperglac/morphology1/

Antarctica

- http://www.homepage.montana.edu/~geol445/hyperglac/morphology1/



- http://www.soils.wisc.edu/courses/SS325/primary.htm



- http://www.awi.de/en/news/press_releases/detail/item/scientists_expect_increased_melting_of_mountain_glaciers/