

# Exploring Geology

## Chapter 16

### Rivers and Streams



# Yukon Delta

Bering Sea

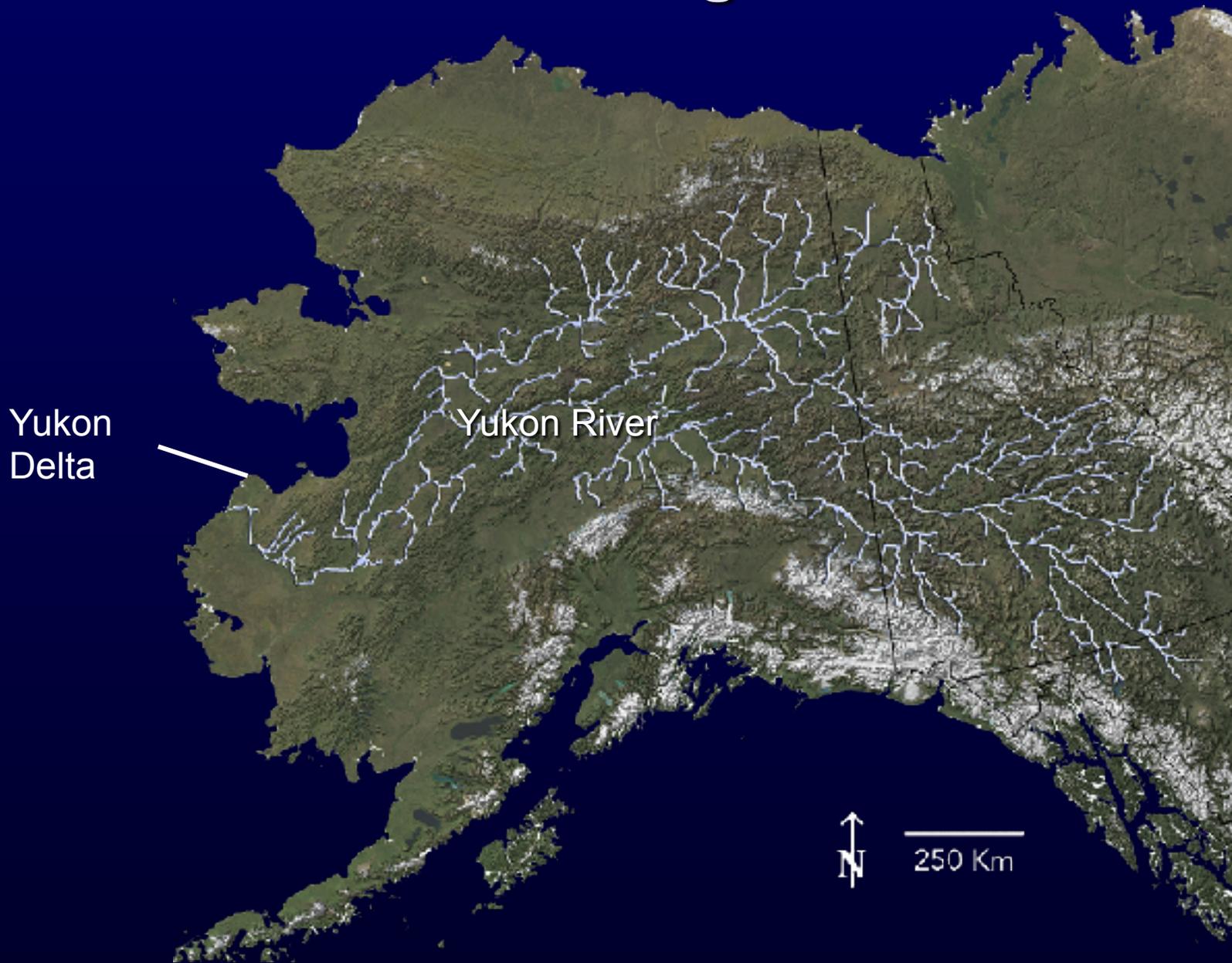
*Observe features on this satellite image that may be related to rivers*

5 Km  
N →

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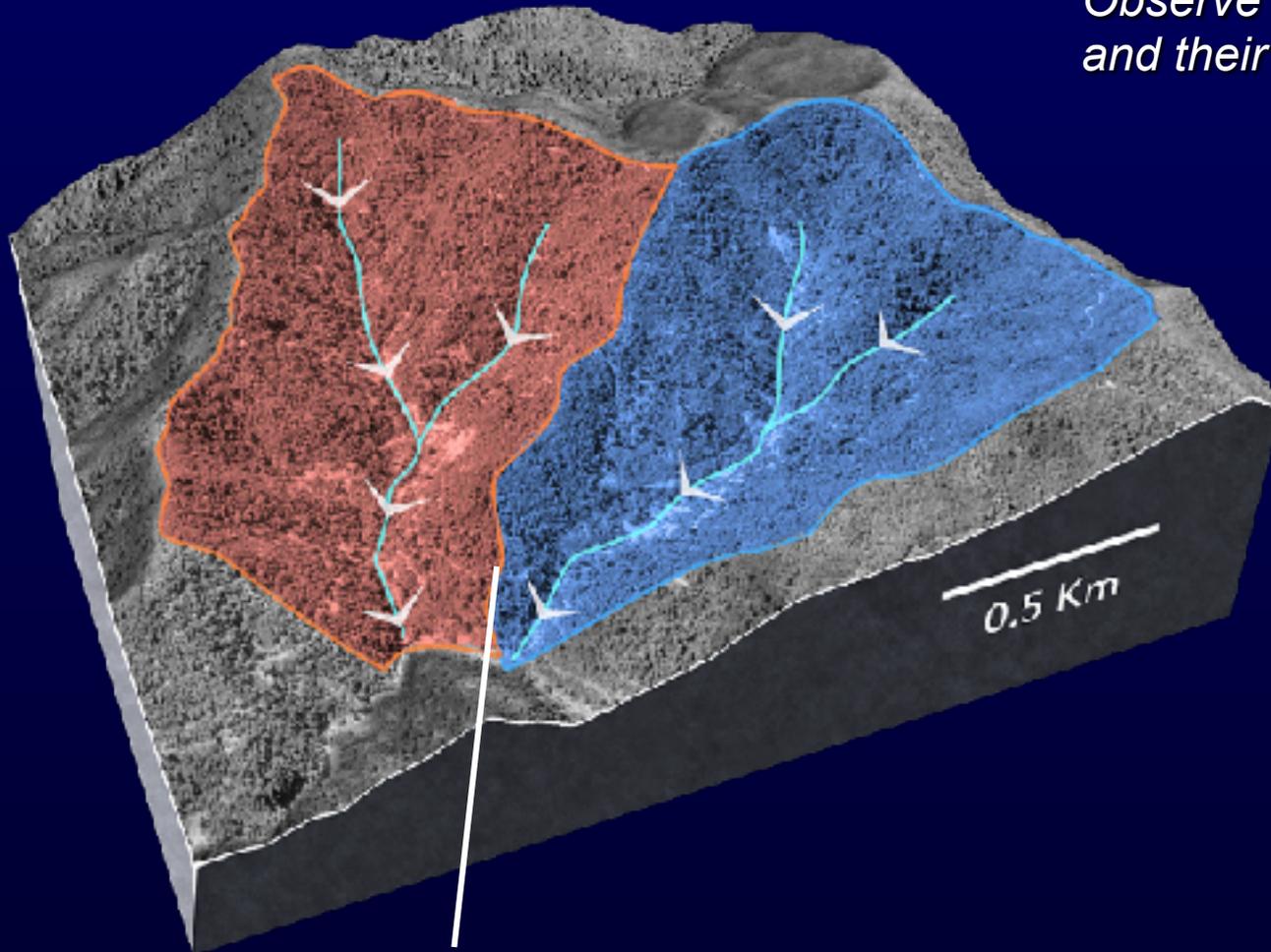


# Yukon Drainage Area



# Drainage Basins

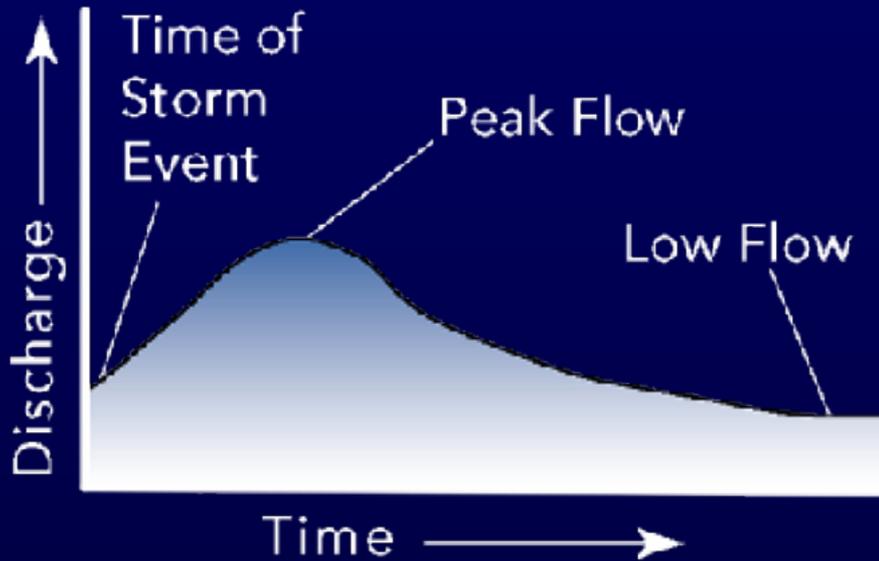
*Observe the red and blue areas and their boundary*



Red area drained by one stream, and blue area by another: each is a *drainage basin*

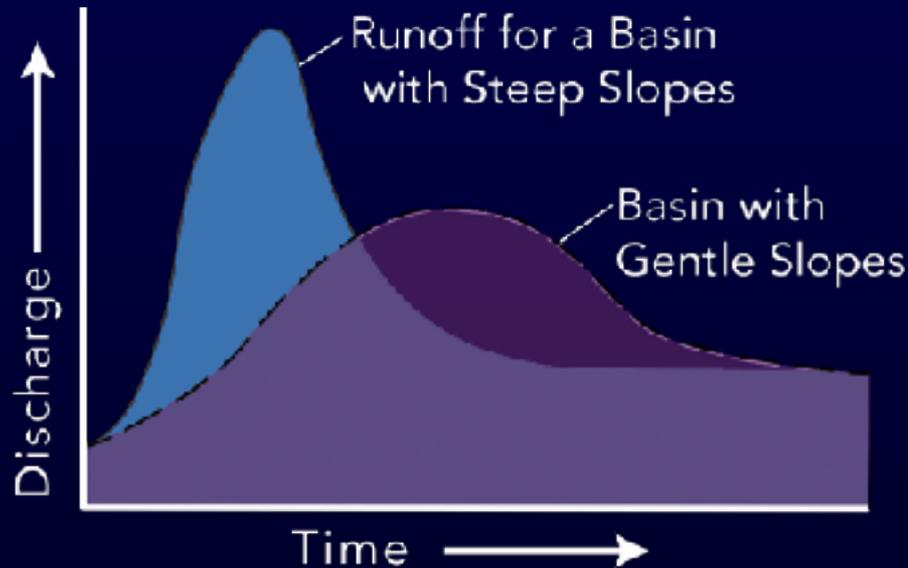
Boundary between basins is a drainage divide

# Volume of Flow Versus Time



Plot of discharge versus time is a *hydrograph*

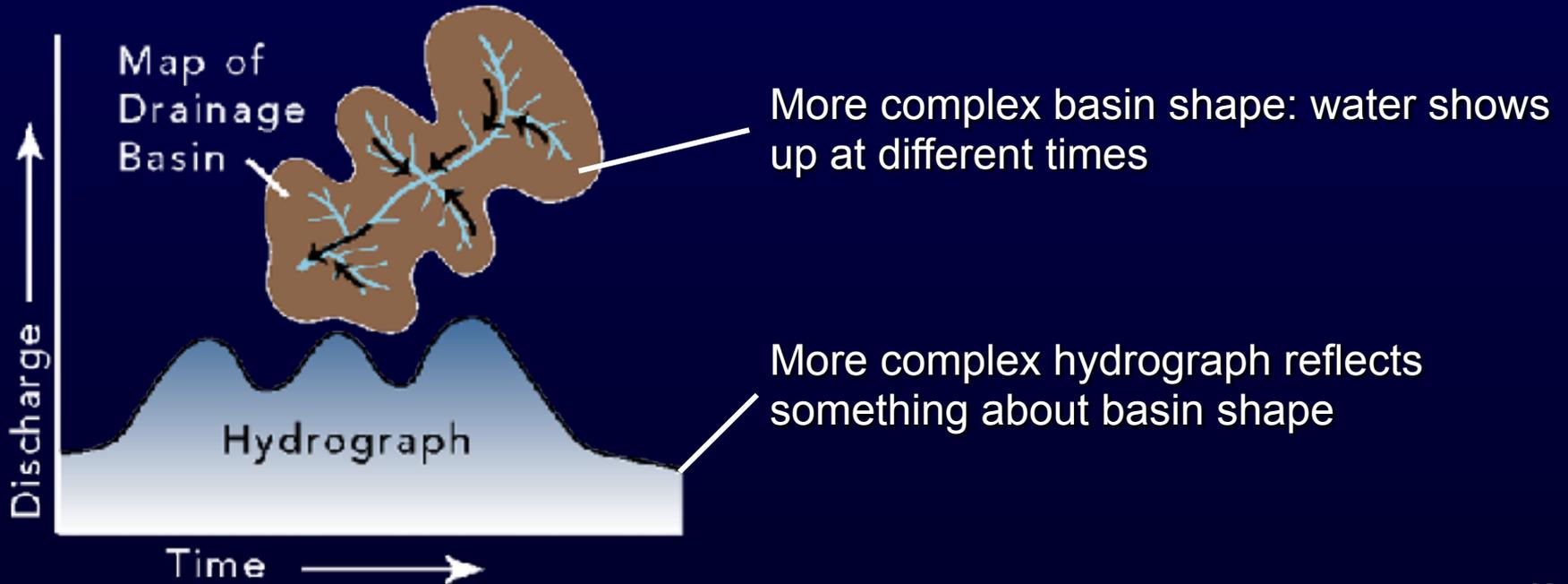
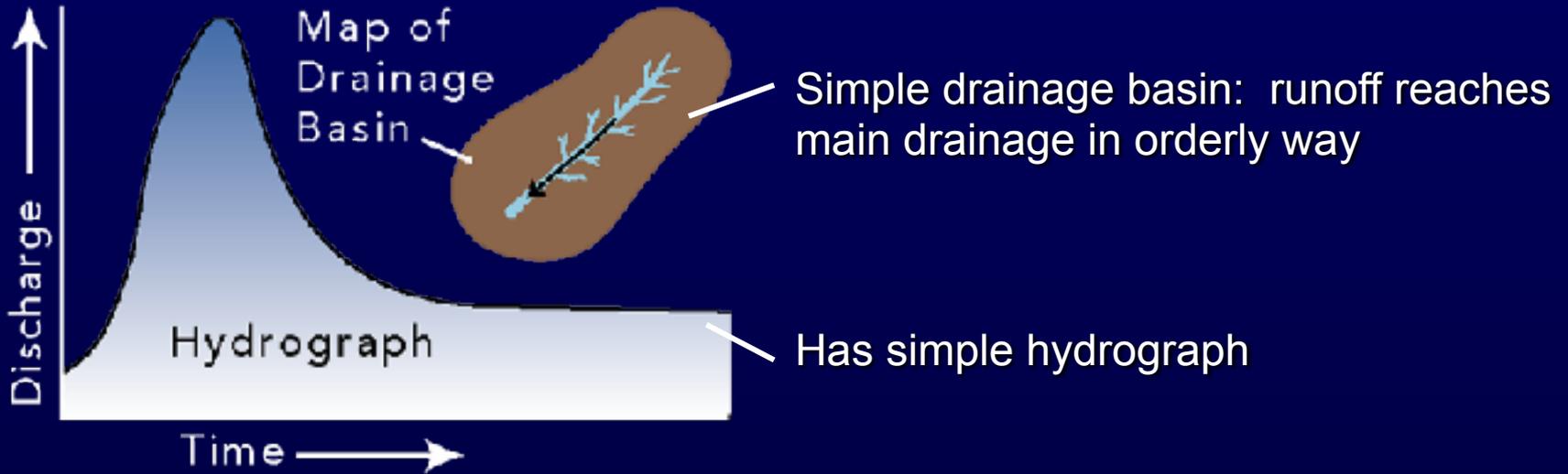
This hydrograph shows discharge (flow) increasing during a flood, then decreasing as flood ends



Runoff from steep drainage basin is fast and most water arrives downstream at once

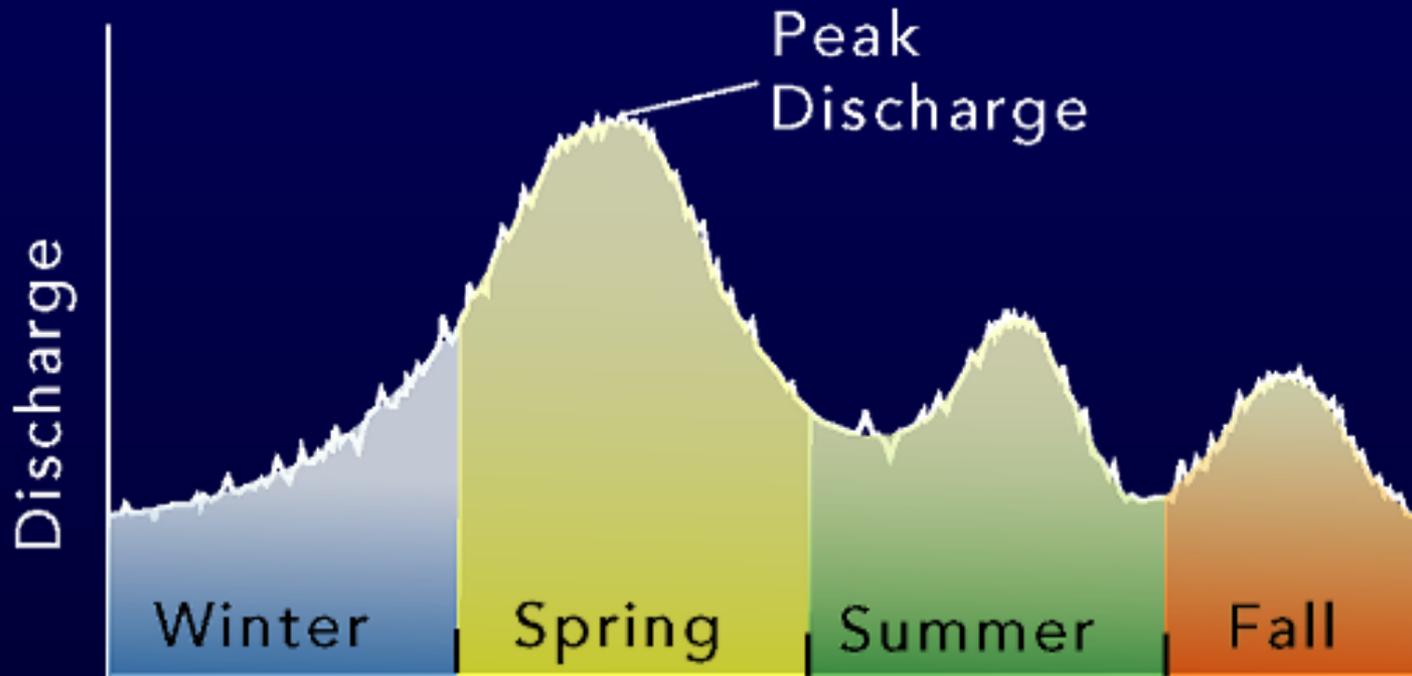
Runoff from basin with gentle slopes is spread out over time; less peak flow

# Discharge Versus Basin Shape



# How Do Rivers Vary Over Time?

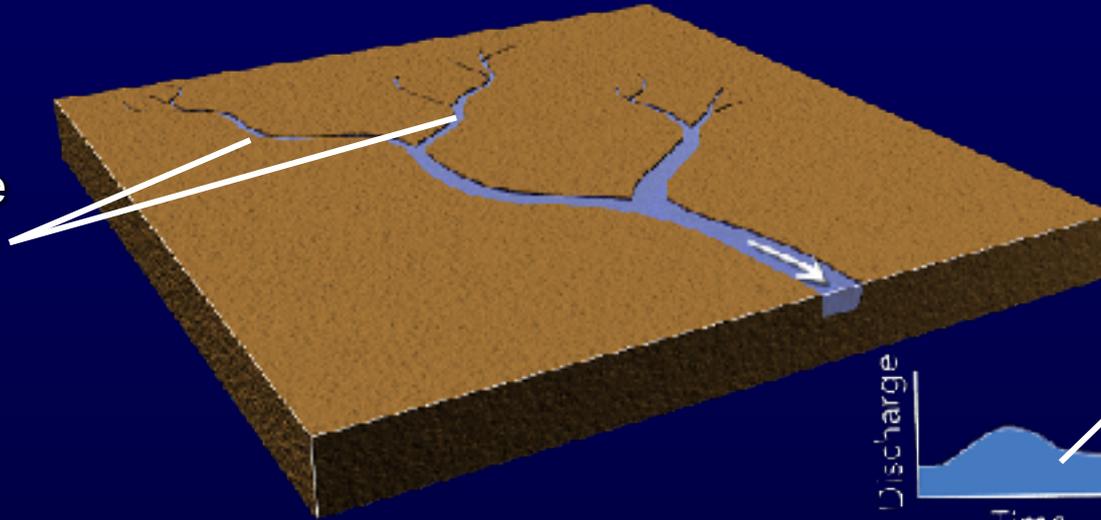
Rivers vary in discharge during the year due to snowmelt, wet/dry seasons, etc.



*Suggest some factors that might explain this pattern above (many possible answers)*

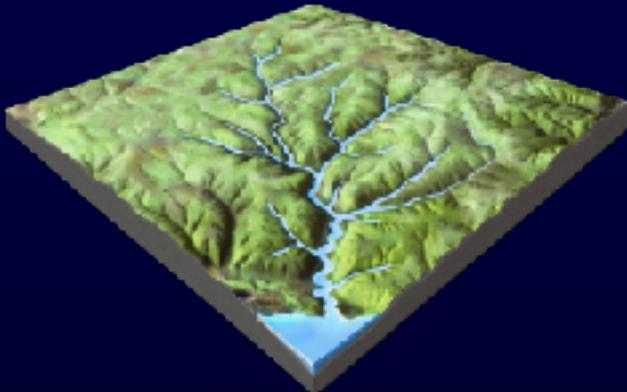
# Tributaries and Drainage Networks

Smaller subsidiary channels are *tributaries*

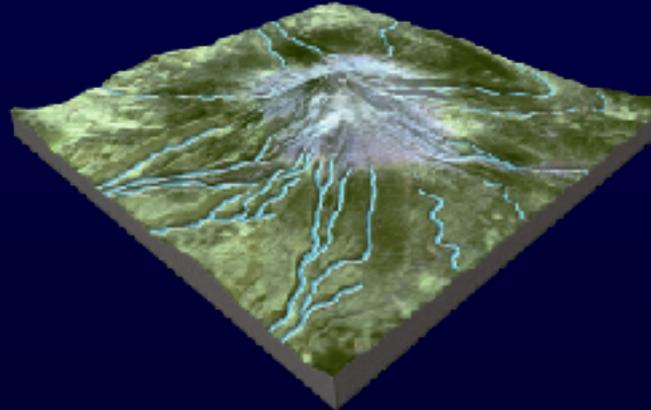


Tributaries spread out discharge over time

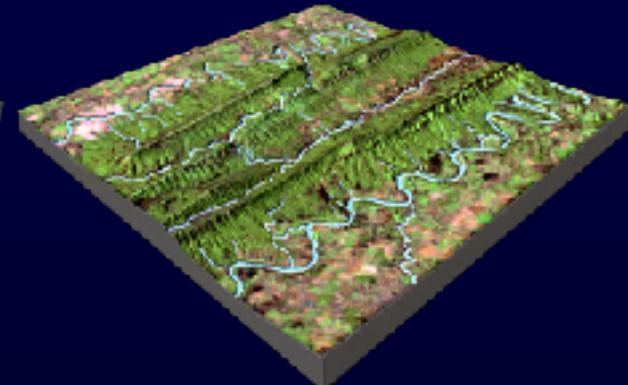
## Types of Drainage Patterns



Dendritic



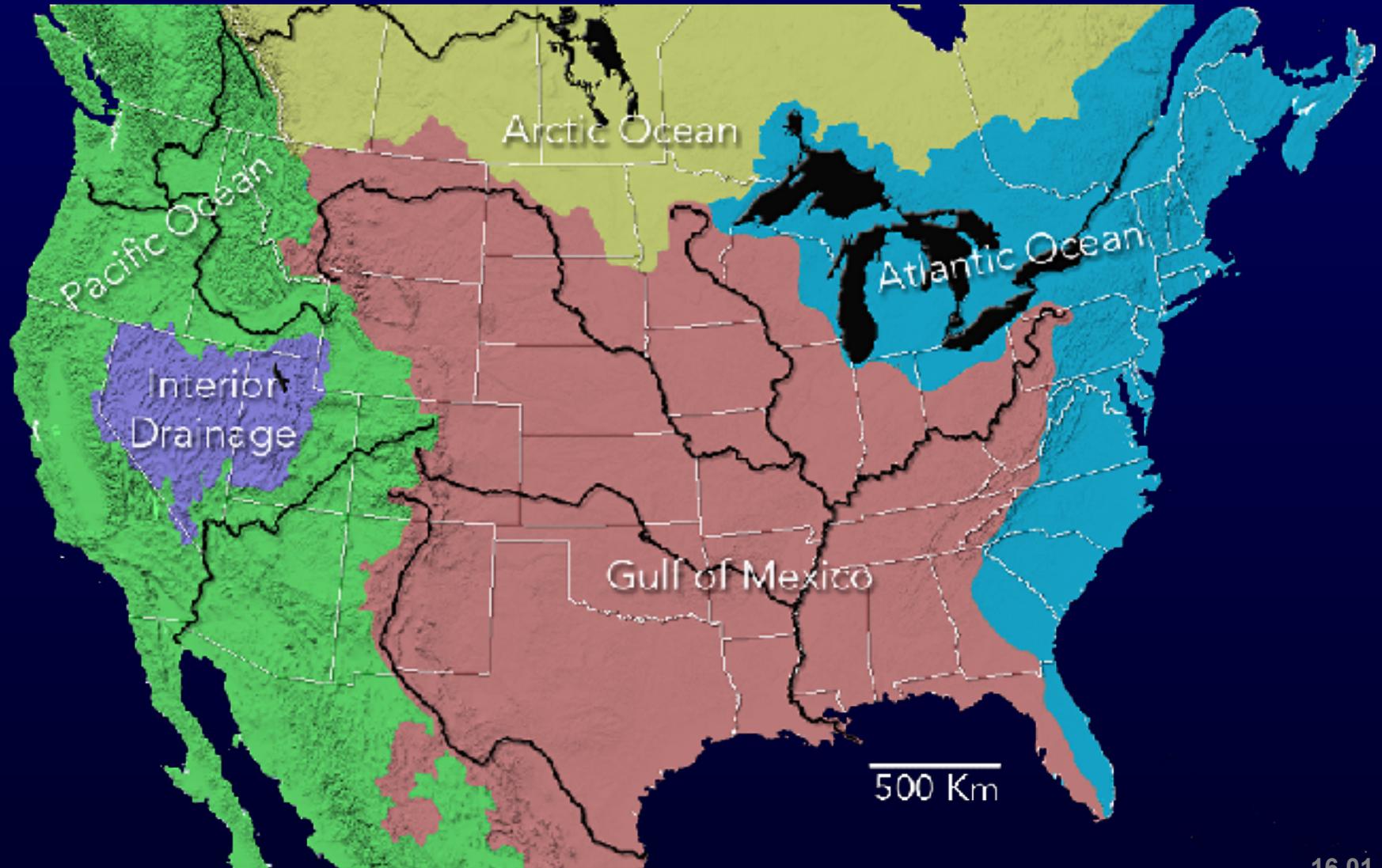
Radial



Structurally controlled

# North American Drainage Basins

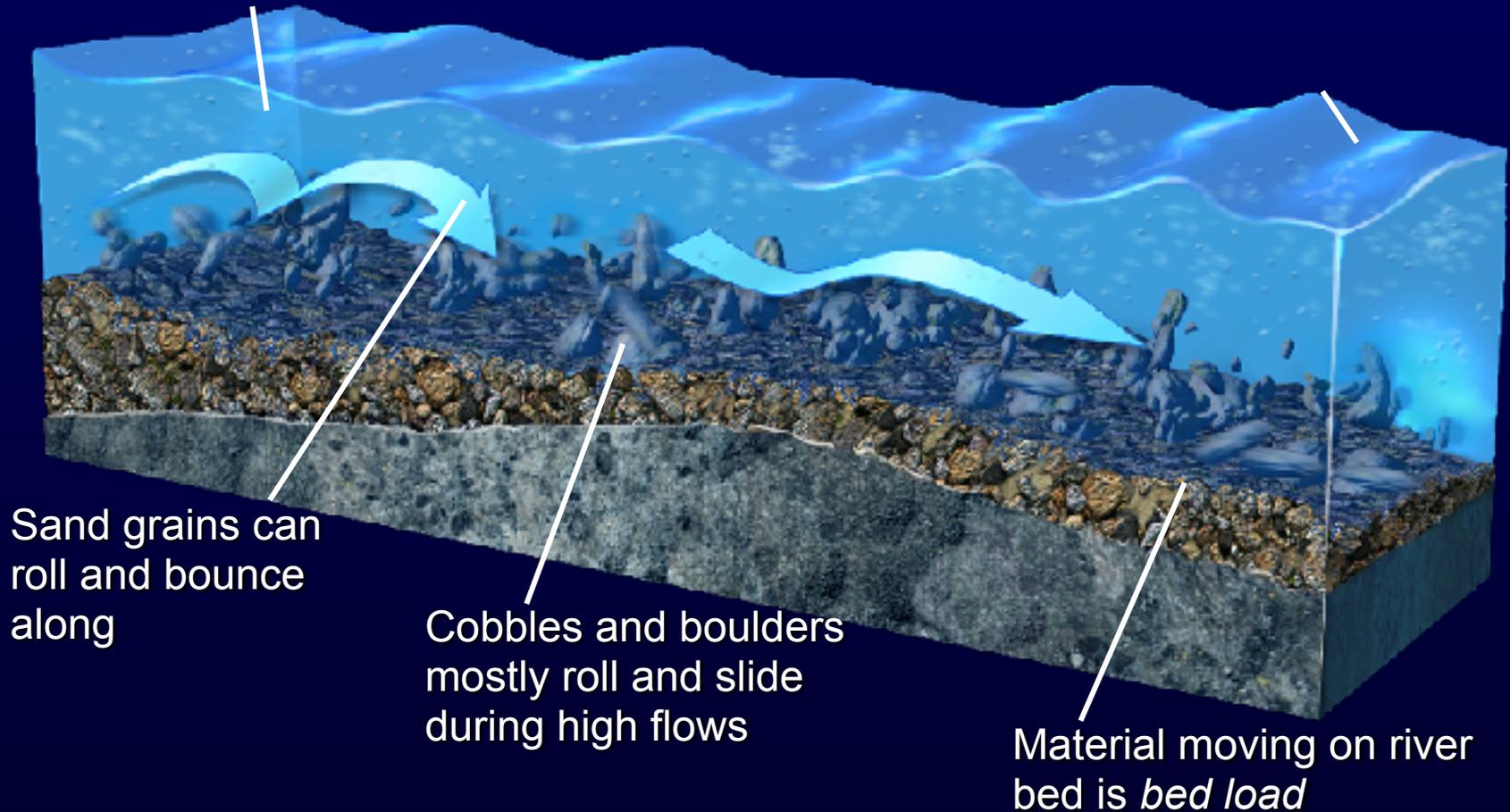
*Observe these drainage basins and  
find where runoff in your area ends  
up*



# How is Material Transported and Deposited?

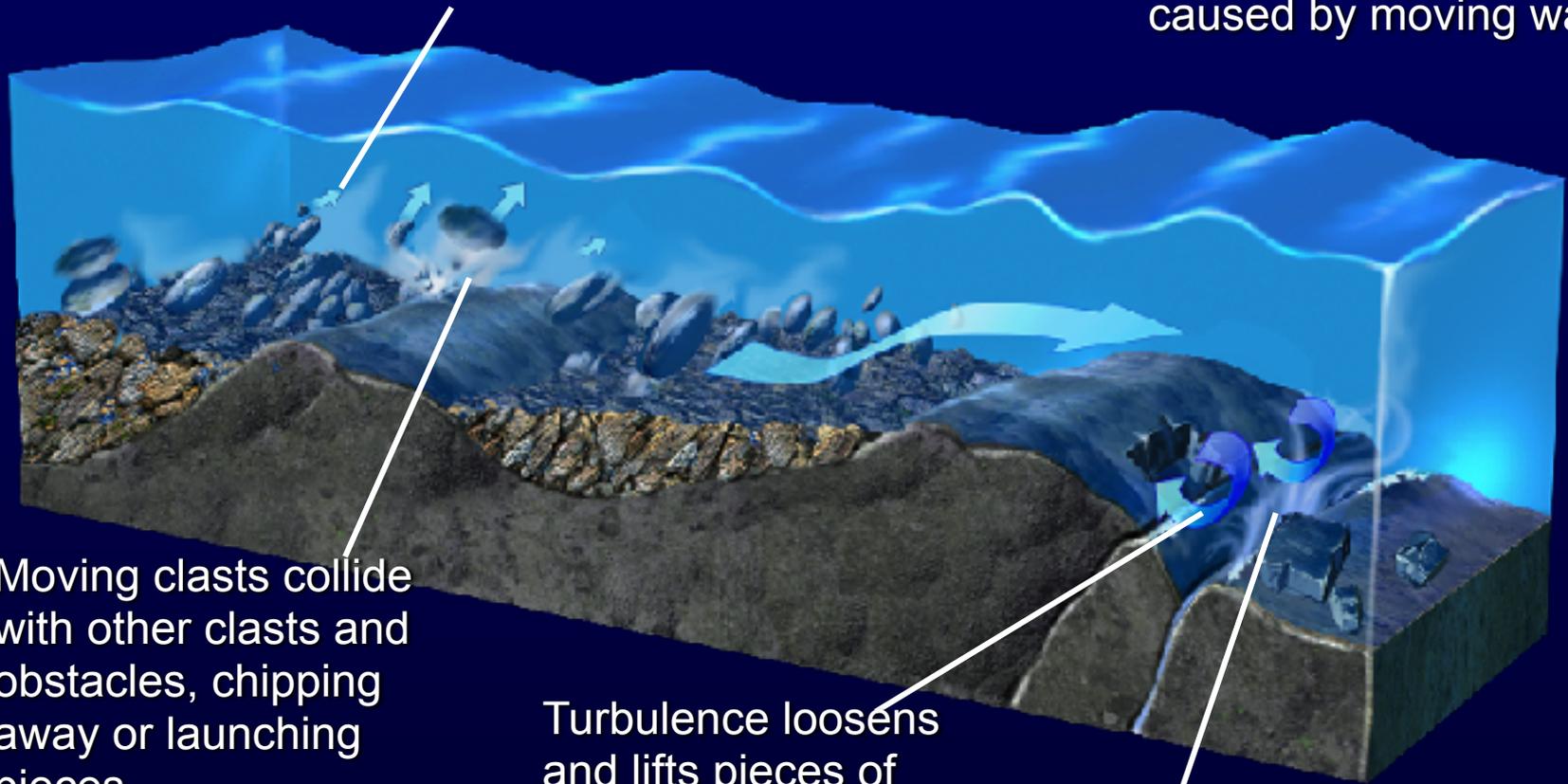
Fine particles can be carried in suspension (floating) in water

Soluble ions are *dissolved* in and carried by moving water



# What Processes Erode Material?

Clasts can be picked up by turbulence and low pressure caused by moving water

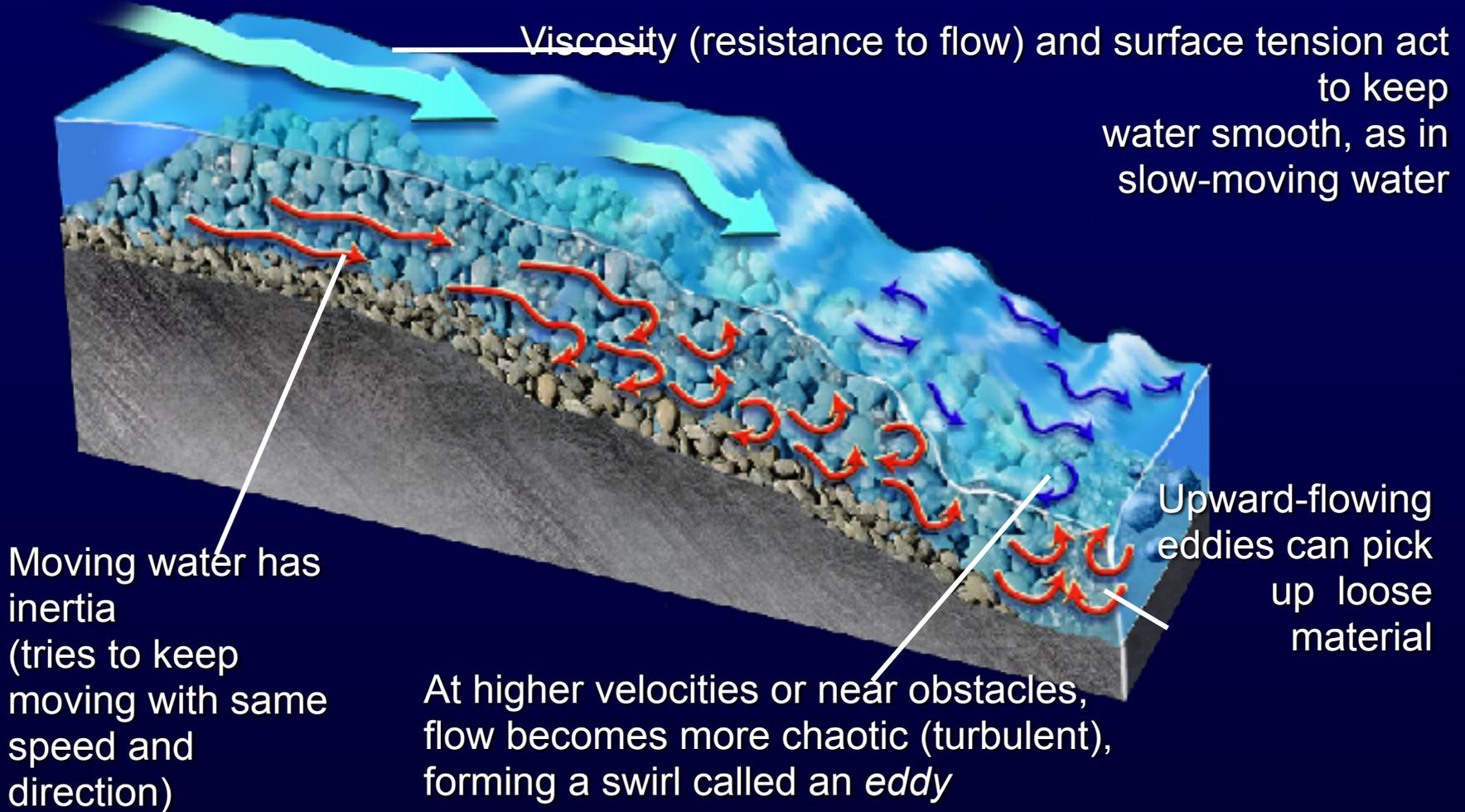


Moving clasts collide with other clasts and obstacles, chipping away or launching pieces

Turbulence loosens and lifts pieces of streambed

Soluble material is dissolved and removed

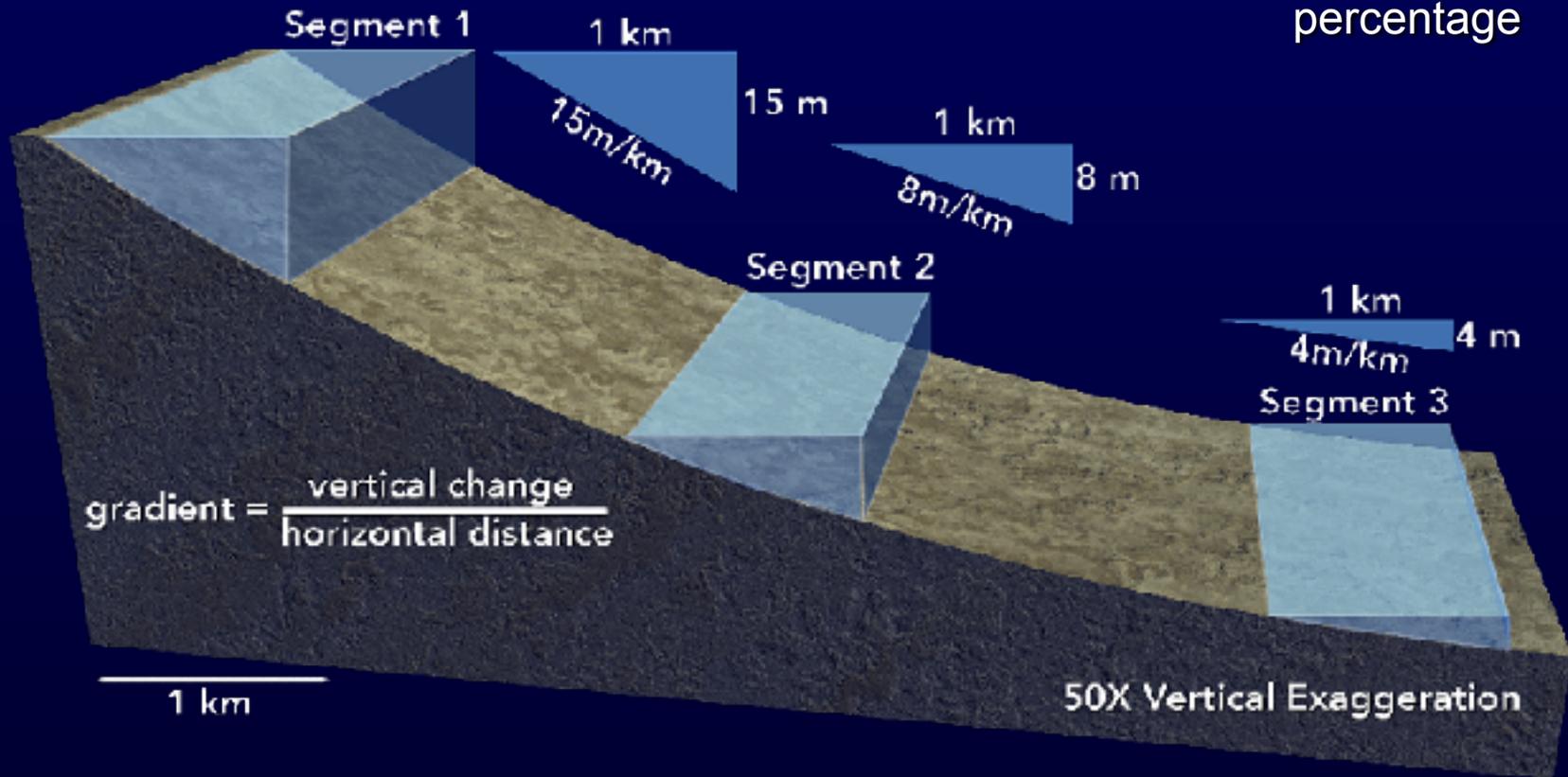
# Turbulence



Observe how river gradient changes downstream

Gradient = change in elevation for a horizontal distance  
(small blue triangles)

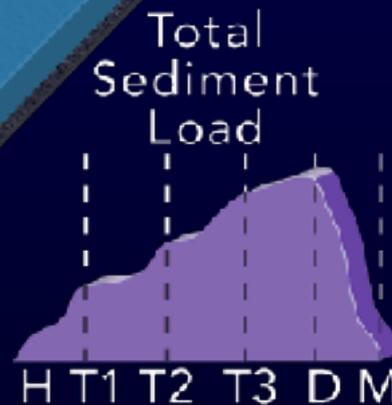
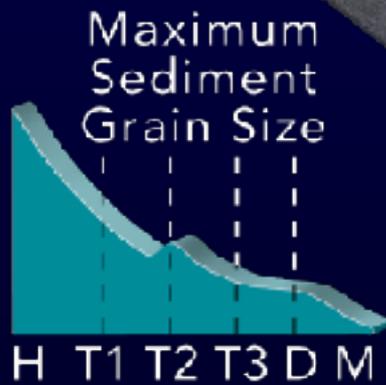
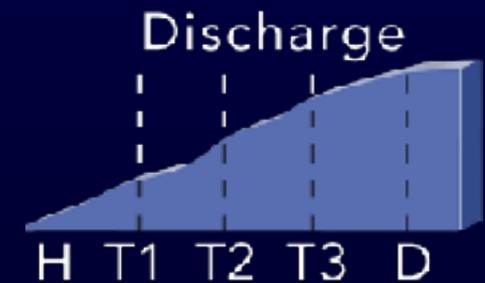
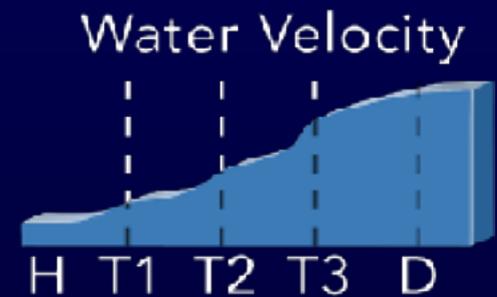
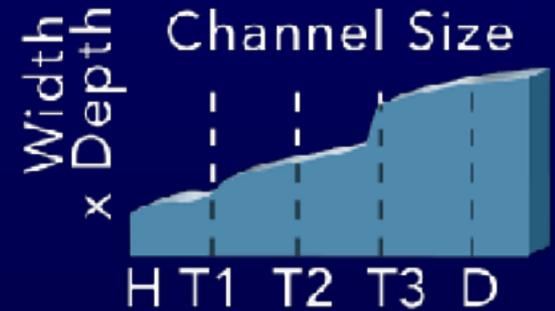
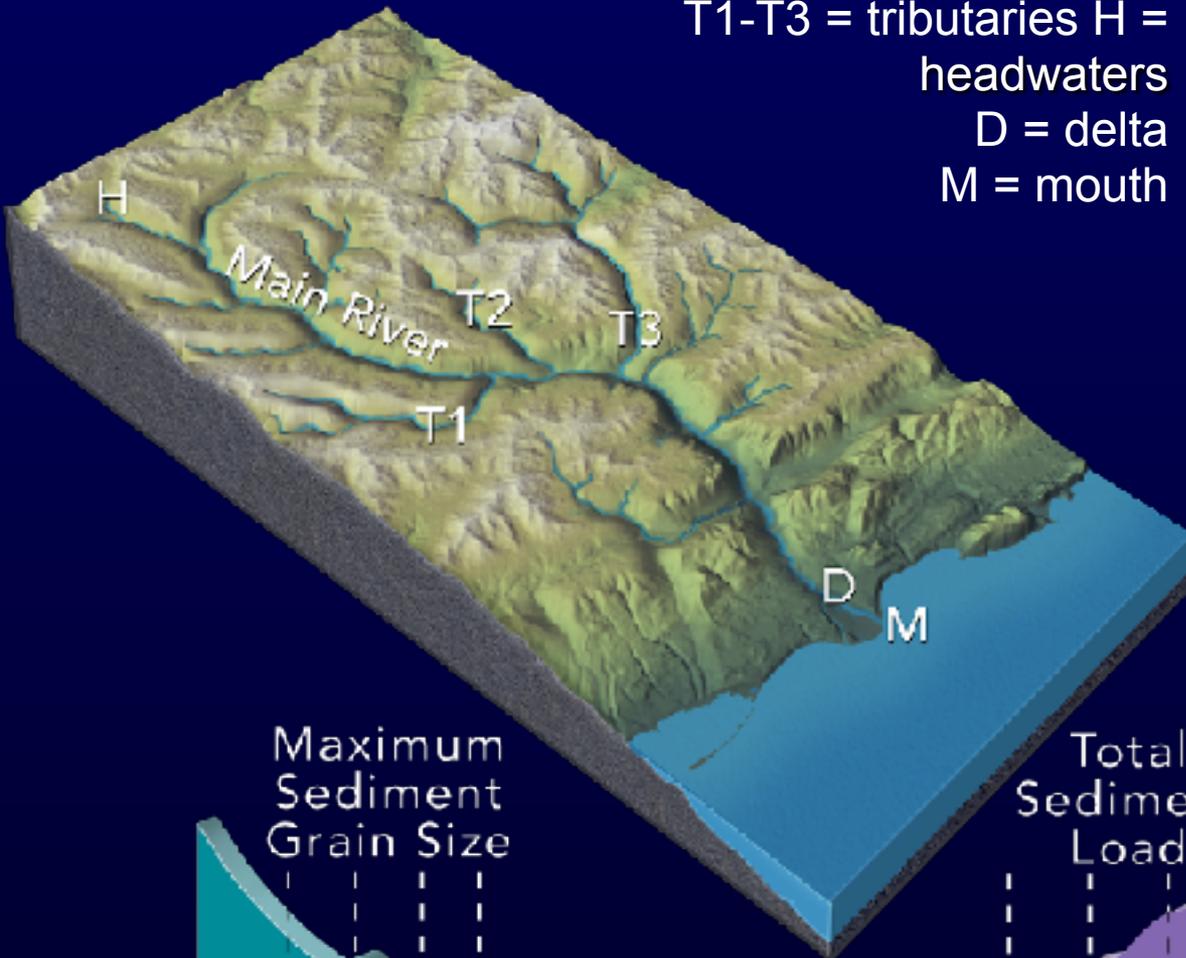
Expressed as m/  
km or ft/mile,  
degrees, or  
percentage



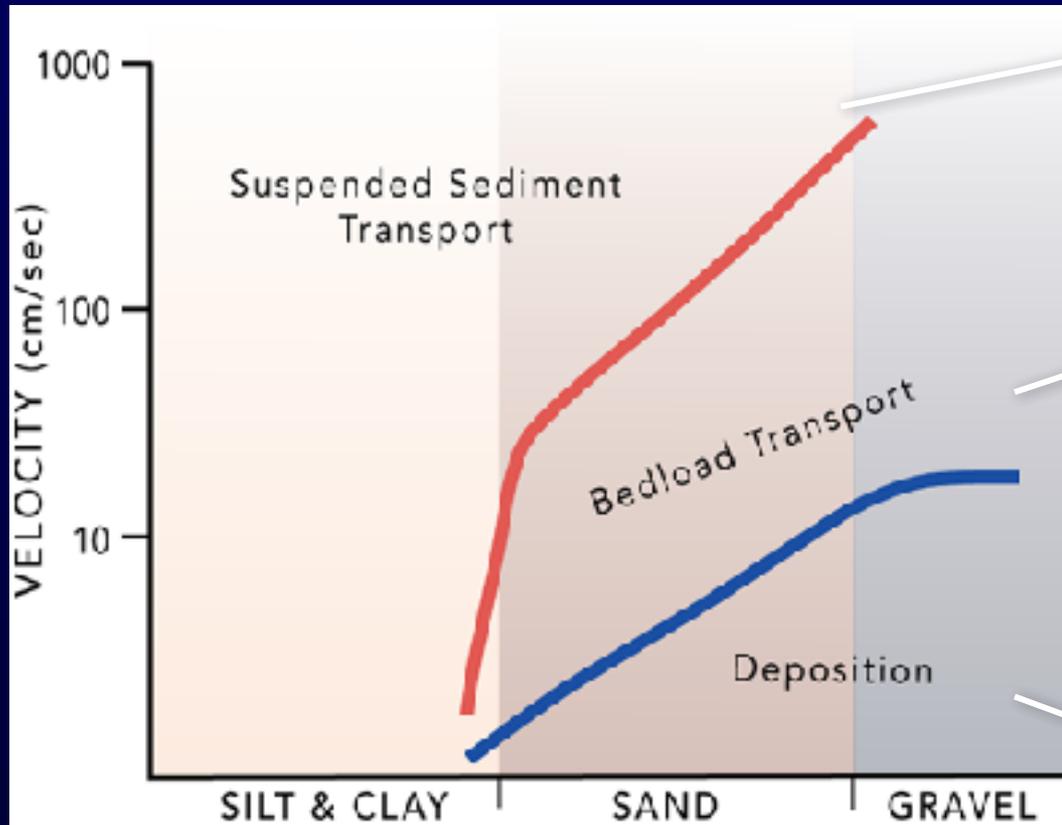
Steeper gradient: river drops more for a given distance

# How Does a River Change Down Stream?

T1-T3 = tributaries  
H = headwaters  
D = delta  
M = mouth



# Sediment Size Versus Current Velocity



At high velocity, sand and smaller particles carried in suspension

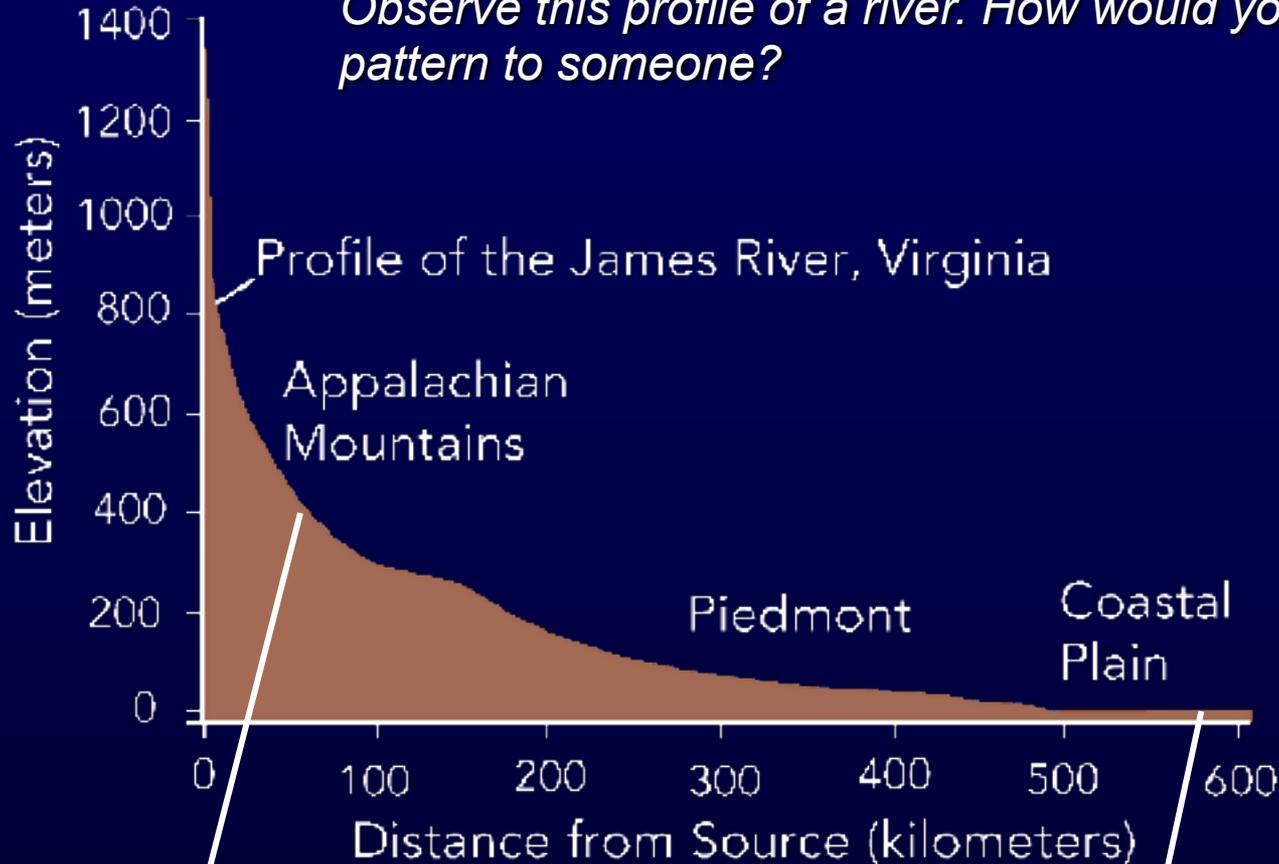
At moderate velocity, silt and clay remain suspended but sand moves as bed load (rolls, etc.)

At lowest velocity, sand dropped but silt and clay remain in suspension

*Observe and interpret this graph of stream velocity versus mode of transport for different sizes of sediment*

# How Do Rivers Change Downstream?

*Observe this profile of a river. How would you describe this pattern to someone?*



Rivers tend to be steep near their origin, such as in hills and mountains

Most rivers become less steep (more gentle) down stream (profile is concave upward)

# Base Level

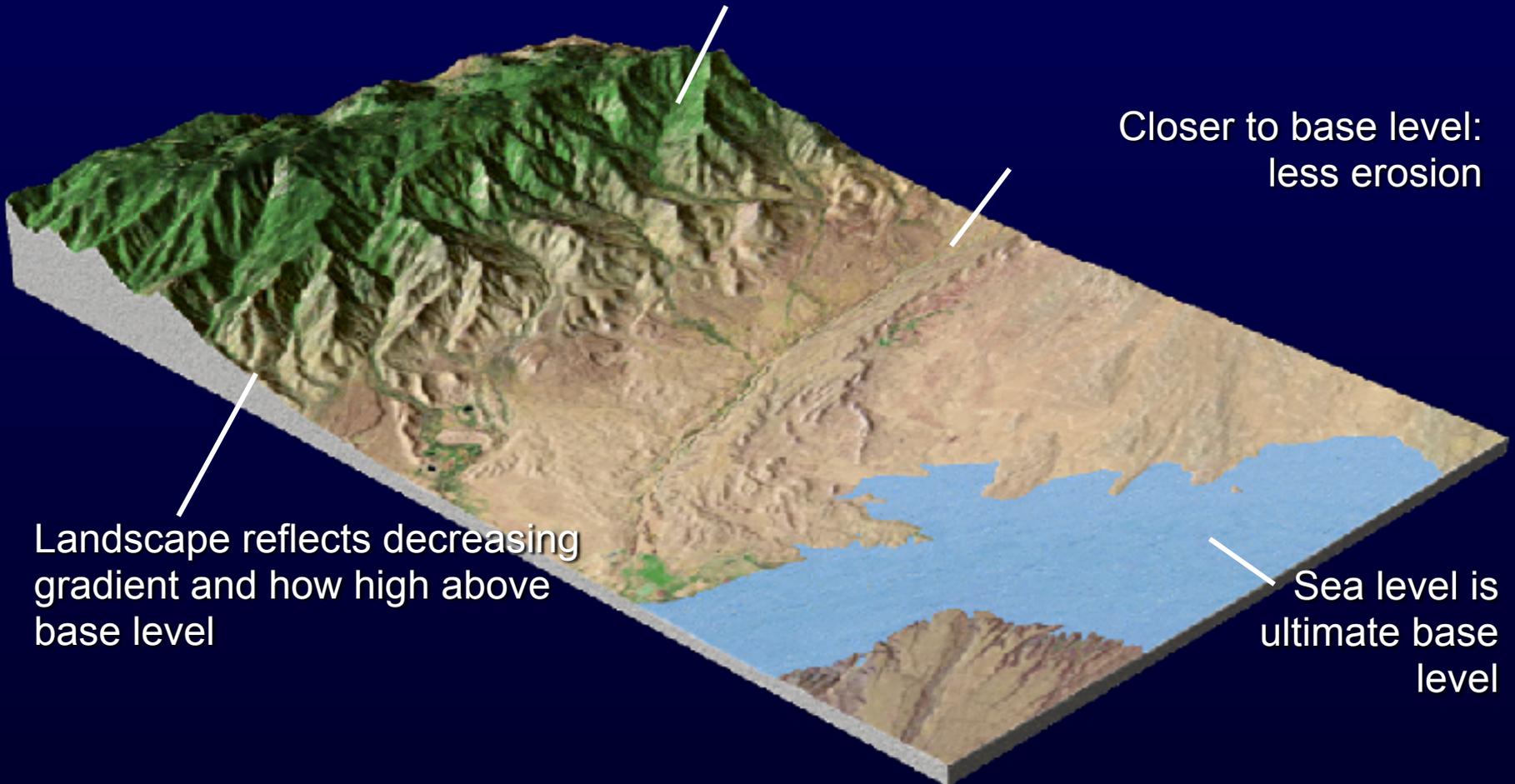
The lowest level to which a river can erode: *base level*

High above base level: much erosion

Closer to base level: less erosion

Landscape reflects decreasing gradient and how high above base level

Sea level is ultimate base level



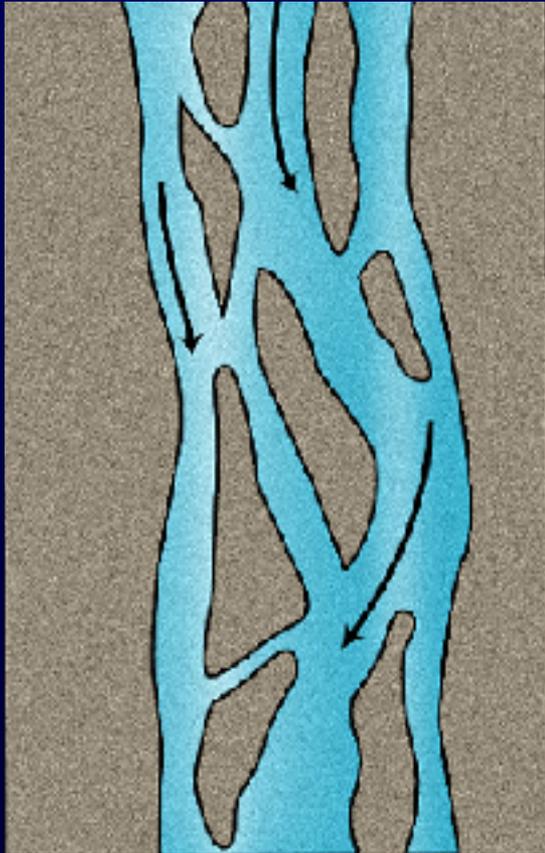
# Curves in Rivers and Streams

Observe these satellite images of rivers

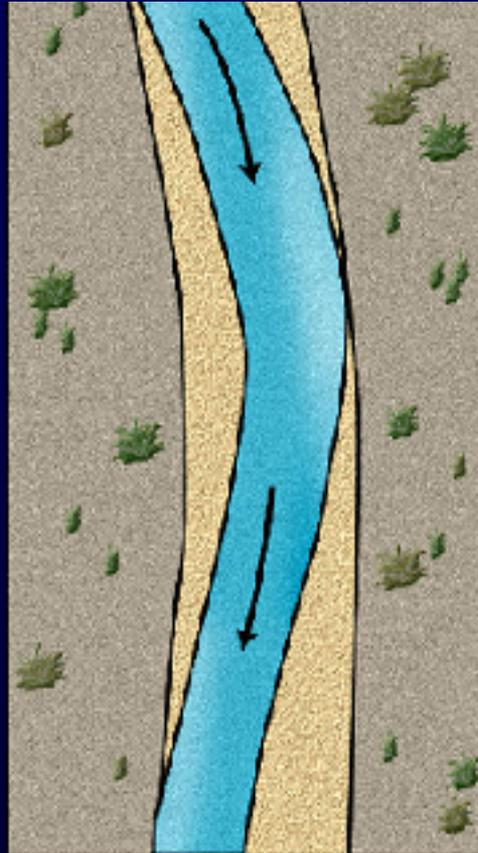


# Curves in Rivers and Streams

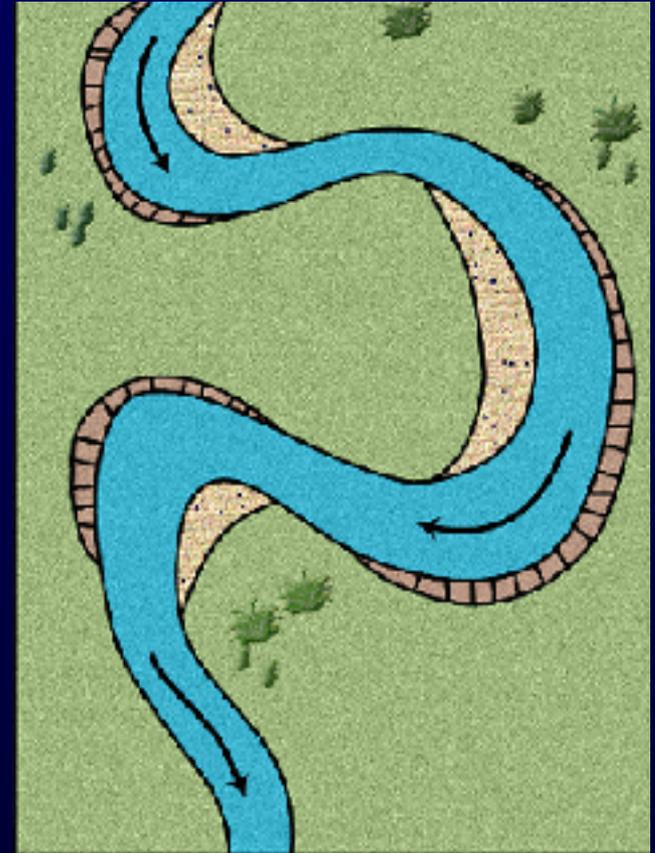
*Observe the channels in three rivers*



*Braided: network of interweaving channels*



*Low sinuosity: gently curved*

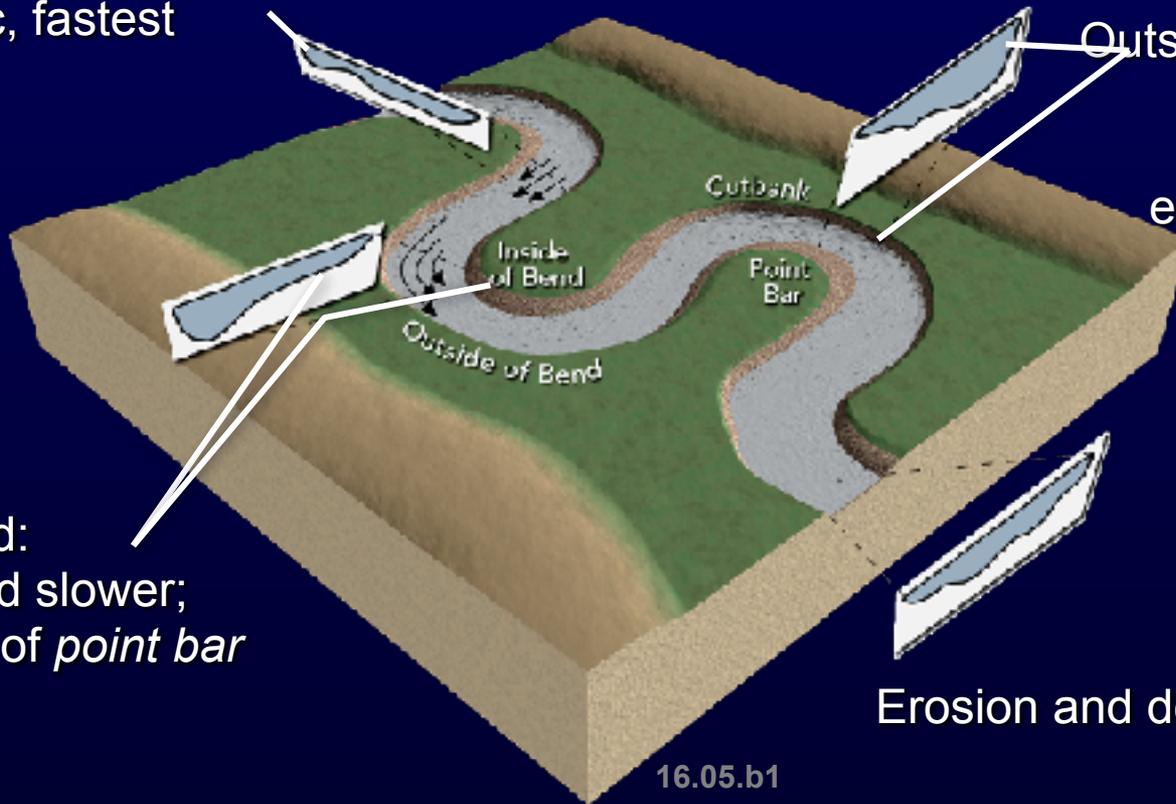


*Meandering: very curved; high sinuosity*

# What Processes Operate on Meanders?

*Small graphs show profiles across the river channel; observe the channel profiles for different parts of the river*

Straight channel:  
symmetric, fastest  
in center



Outside bend: deeper  
and  
faster;  
erosion of *cutbank*

Inside bend:  
shallow and slower;  
deposition of *point bar*

Erosion and deposition may be  
balanced

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# How Do Meanders Form and Move?

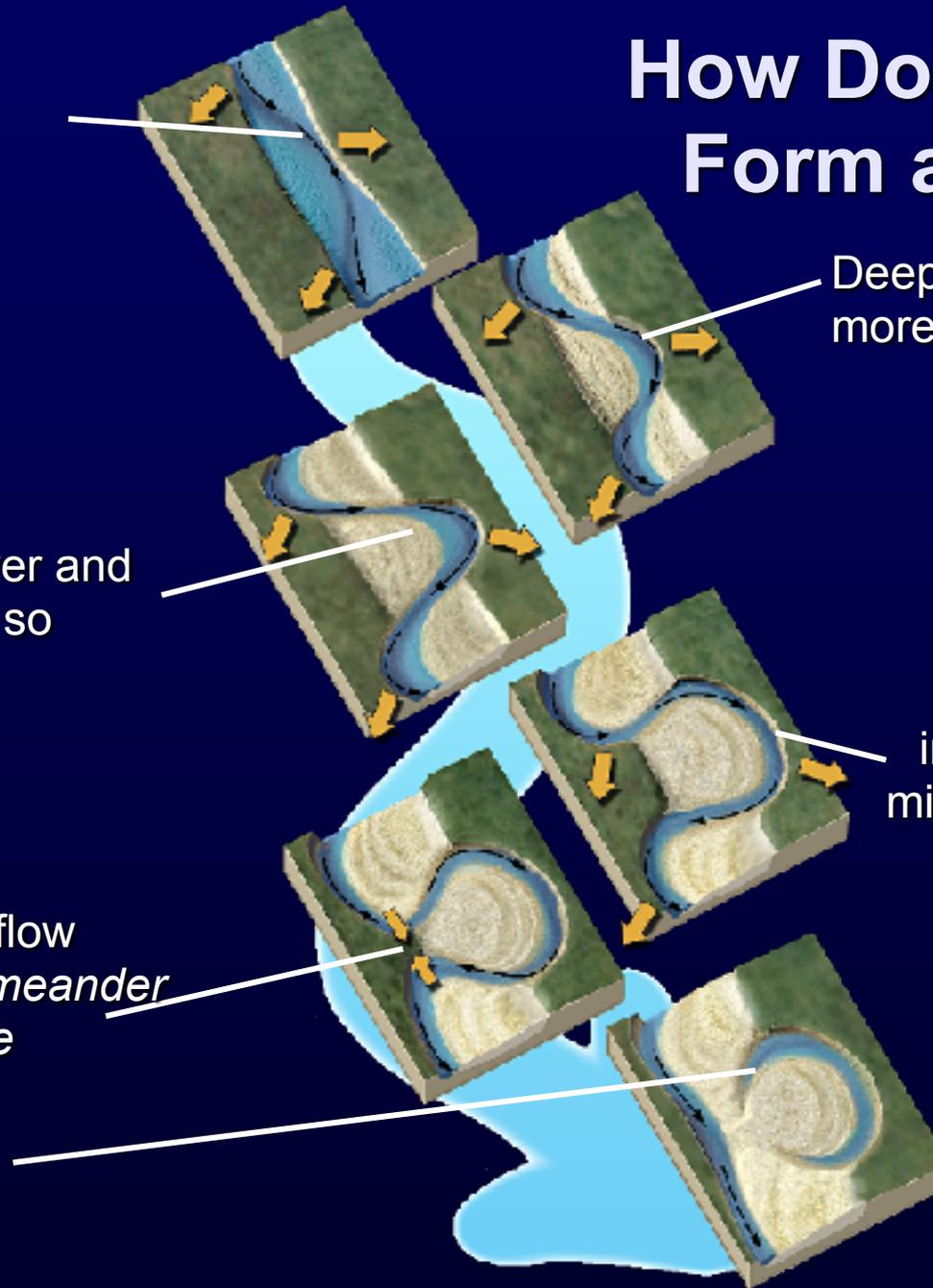
Faster side erodes and deepens

Deep side faster and more water, so erosion

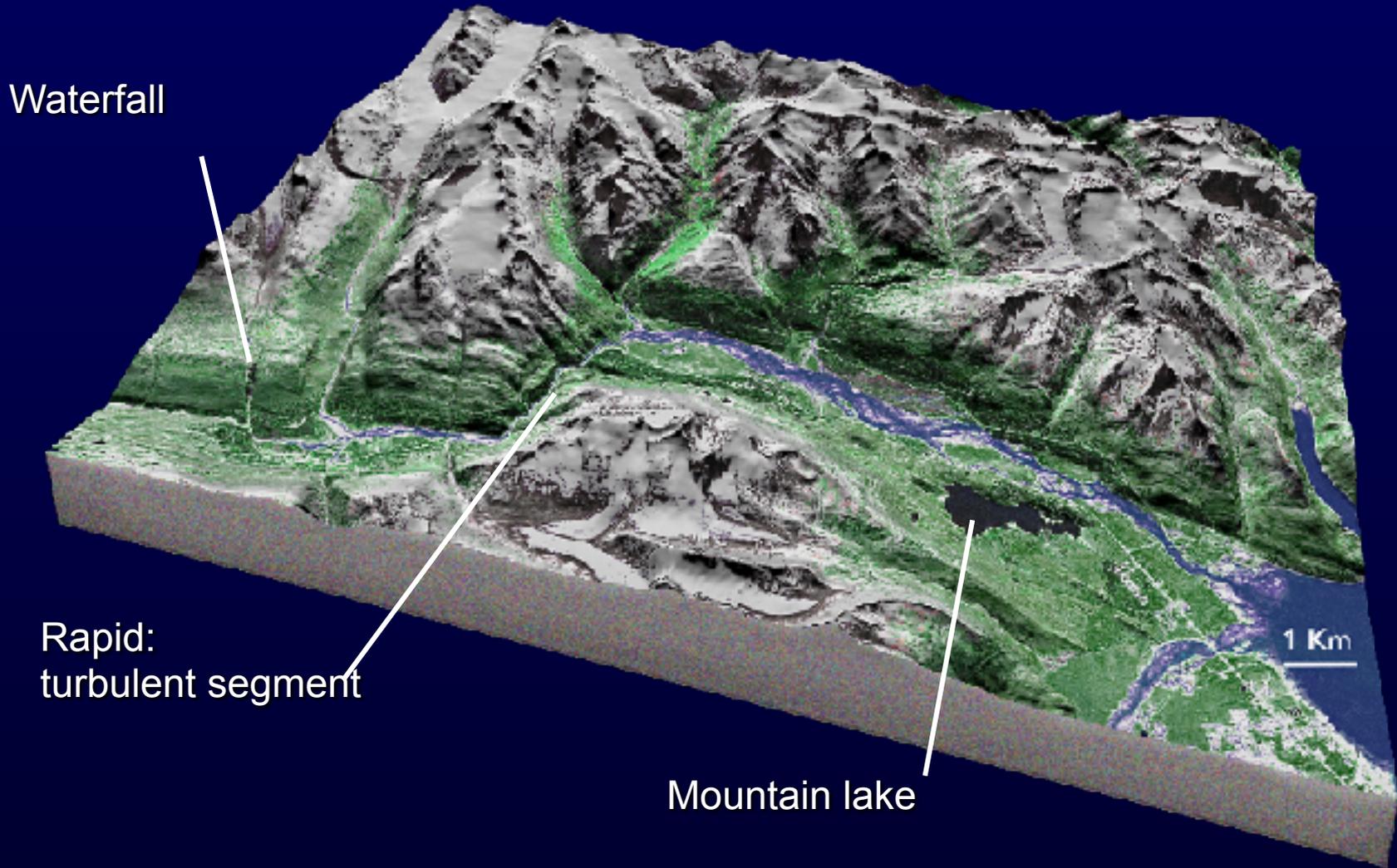
Inside slower and less water, so deposition

Erode outside bend, increasing curvature; migration outward and downstream

Erosion or overflow erosion: *cutoff meander* and *oxbow lake*



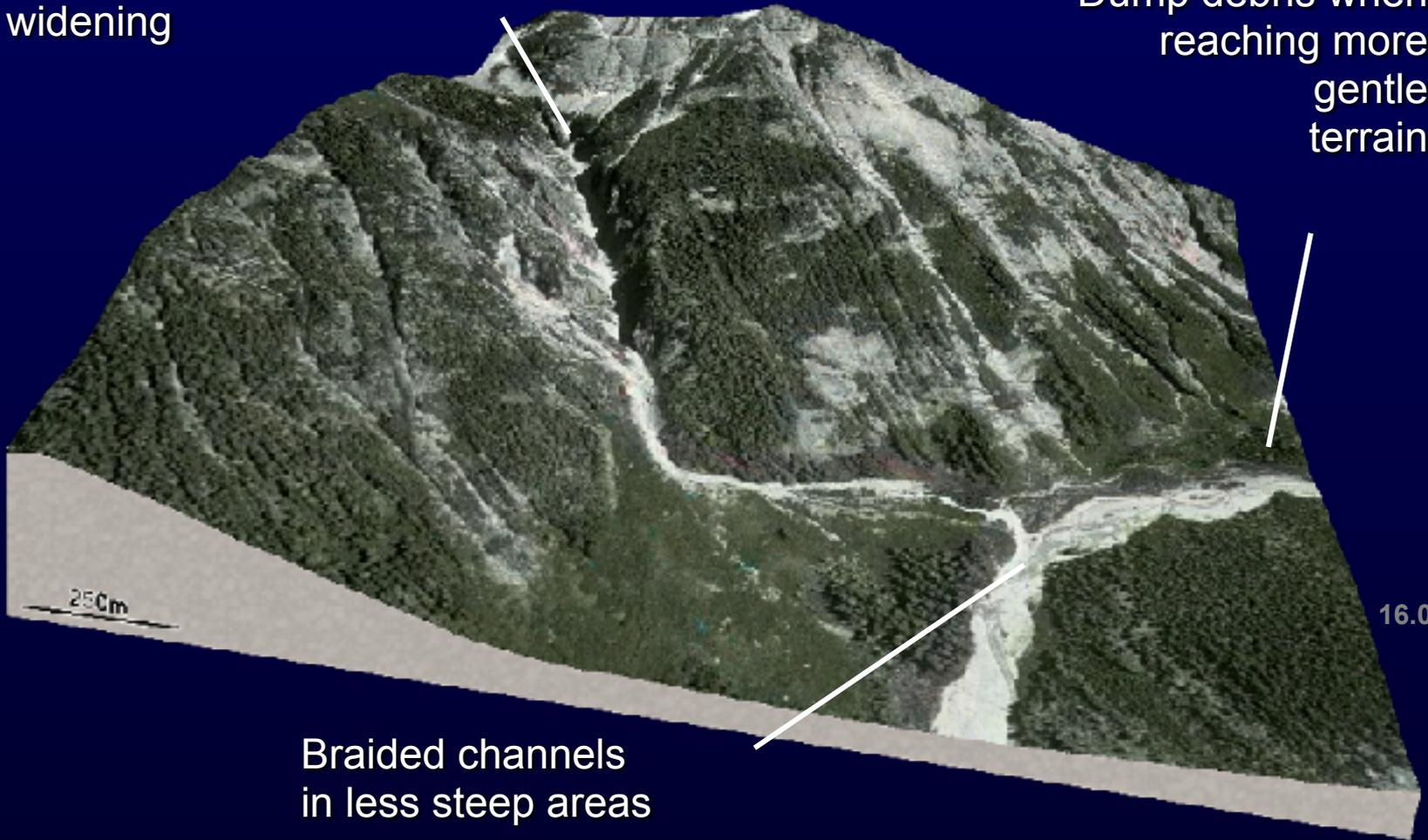
# Landforms in the Headwaters of Streams



# Landforms of Mountain Streams and Rivers

Incise into bedrock; narrow canyon if incision faster than widening

Dump debris when reaching more gentle terrain



Braided channels in less steep areas

*Observe this view of a braided river*

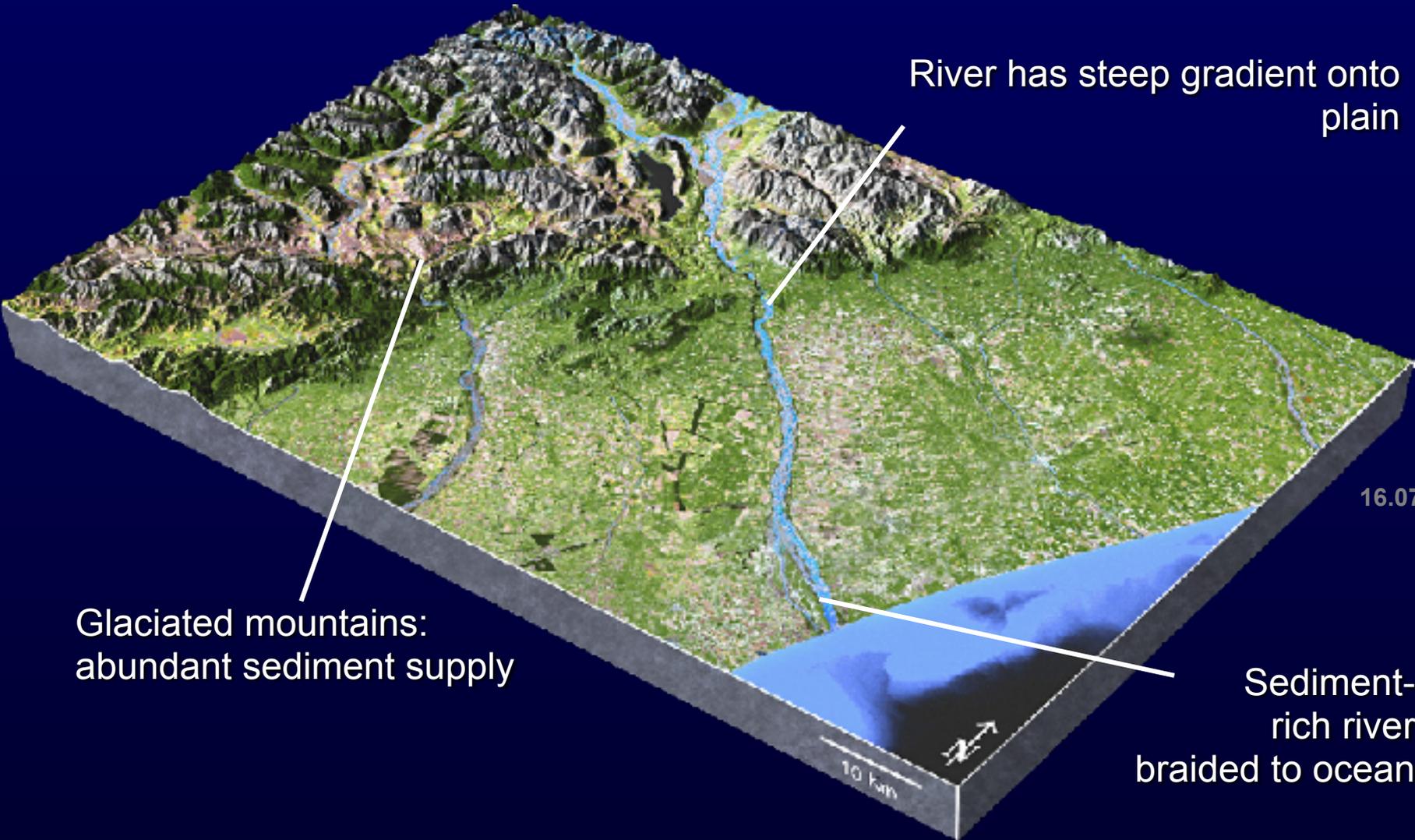
River has steep gradient onto plain

Glaciated mountains:  
abundant sediment supply

Sediment-  
rich river  
braided to ocean

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10 km



# Close-Up Views of Braided River



Braided channels: steep gradients, abundant supply of sediment, and variable flows



Part of fairly straight river

