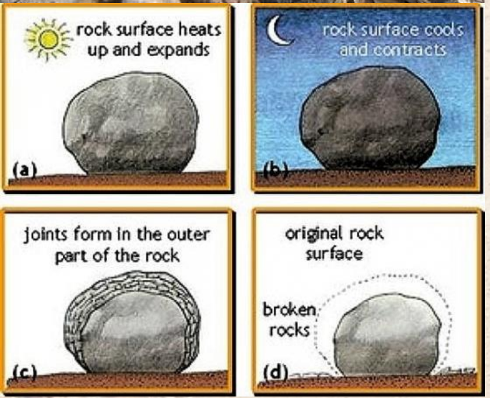
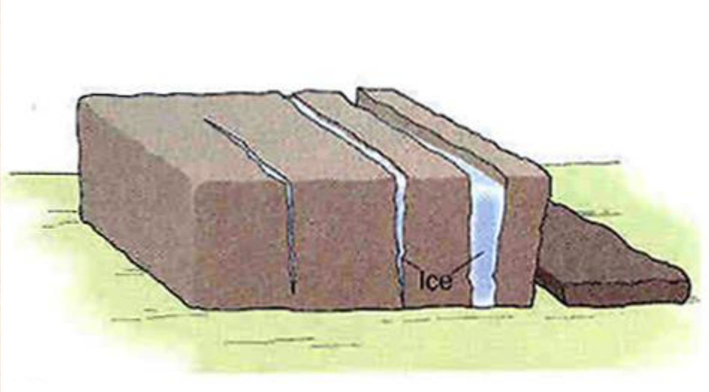
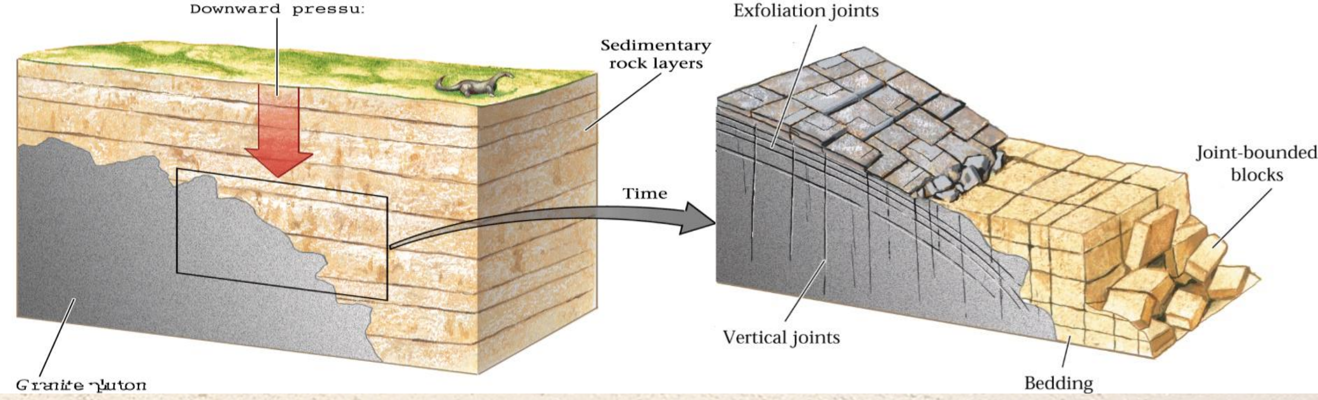
Landscape Evolution

Transport and Deposition

Weathering | *Mechanical weathering*







Weathering | *Chemical Weathering*







Weathering

e.g. Granite: formed deep underground, now uplands

When weathered:

- Feldspars undergo hydrolysis to kaolinite or dickite, releasing K^+, Na^+, Ca^{2+} cations
- Biotite hydrolises to clay, and oxidises to iron oxides
- Quartz and muscovite remain as residuals

Granite: Mourne Mountains, Co. Down, Ireland

Residual minerals

e.g. grains of quartz: sand

New minerals

e.g. clays

Solutes

e.g. sea salt

Transport - agents

- **Gravity**

Erosion and Transport | *Transport Agents*

Transport - agents

- Gravity
- **Water**

Transport - agents

- Gravity
- Water
- **Ice**

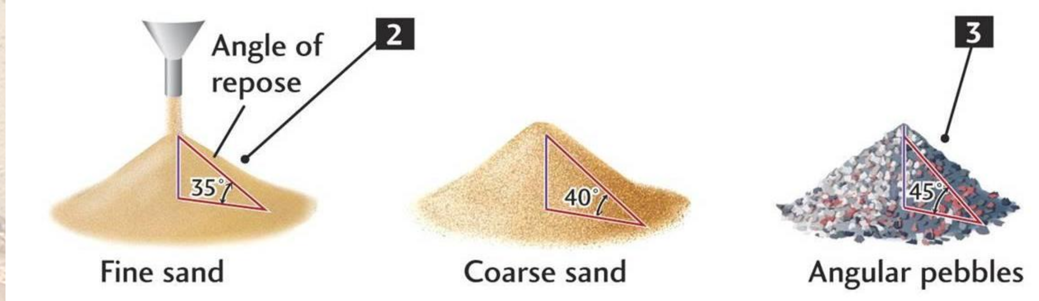
Transport - agents

- Gravity
- Water
- Ice
- **Air**

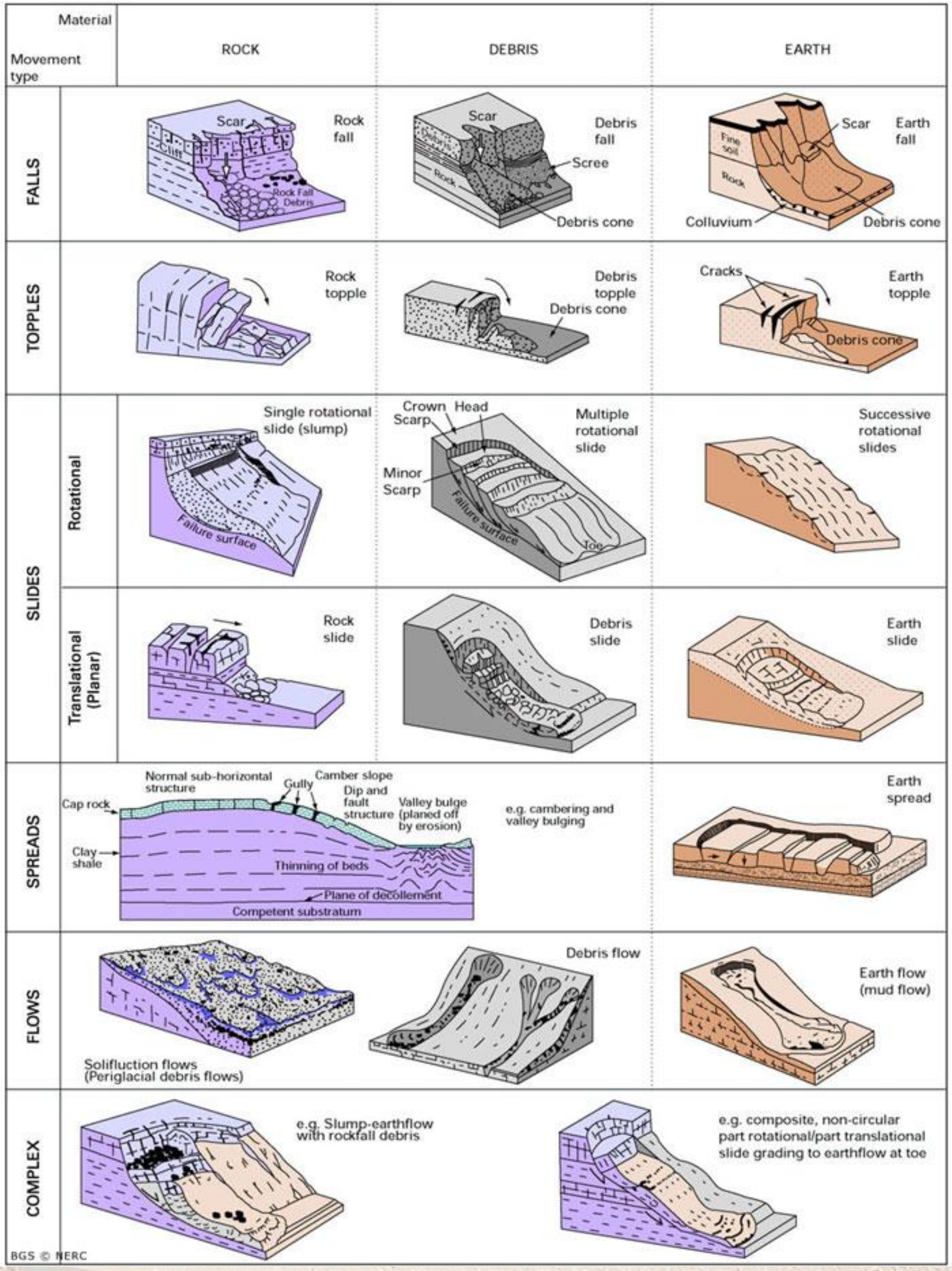
Erosion and Transport | *Gravity*

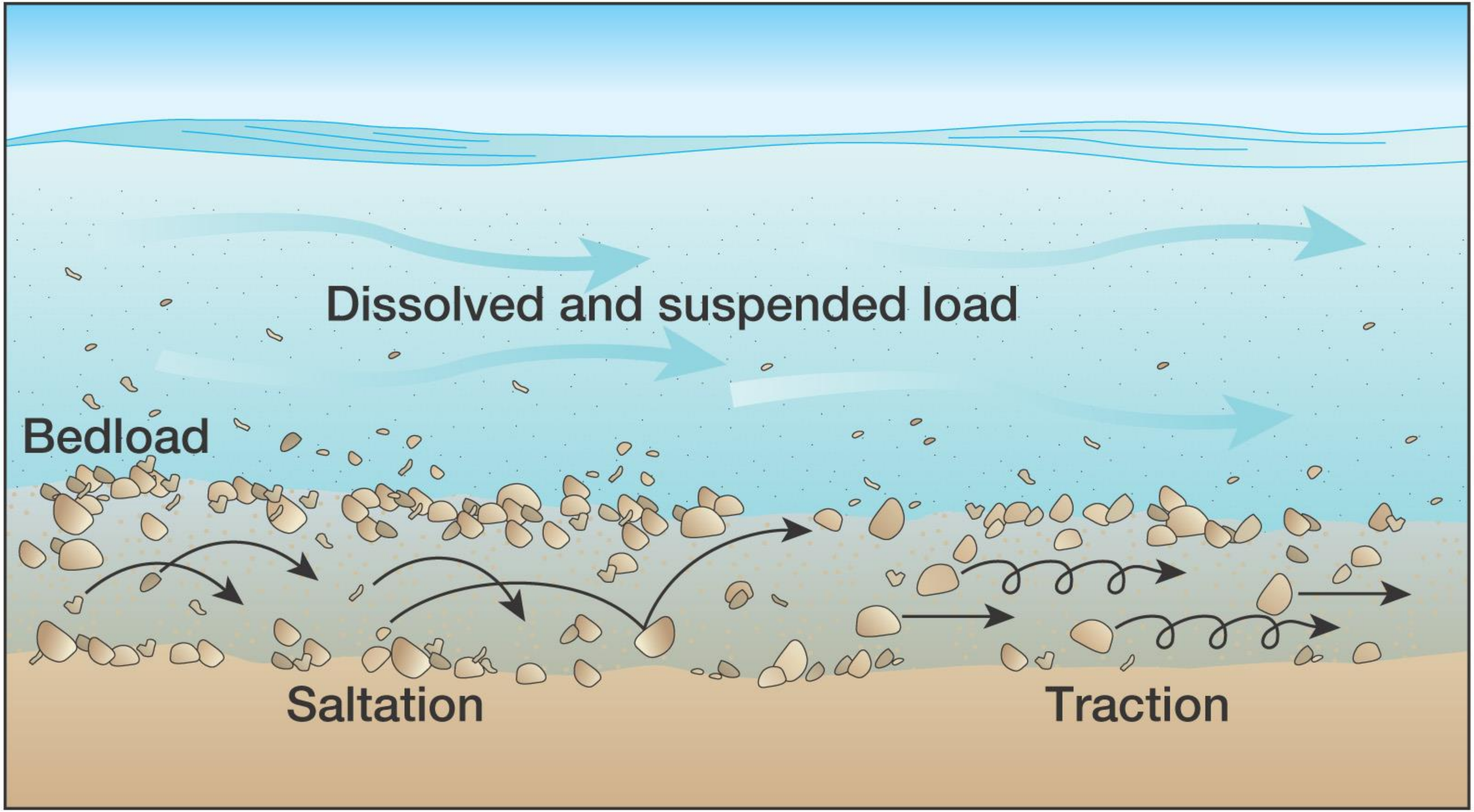
Types of gravity mass movement

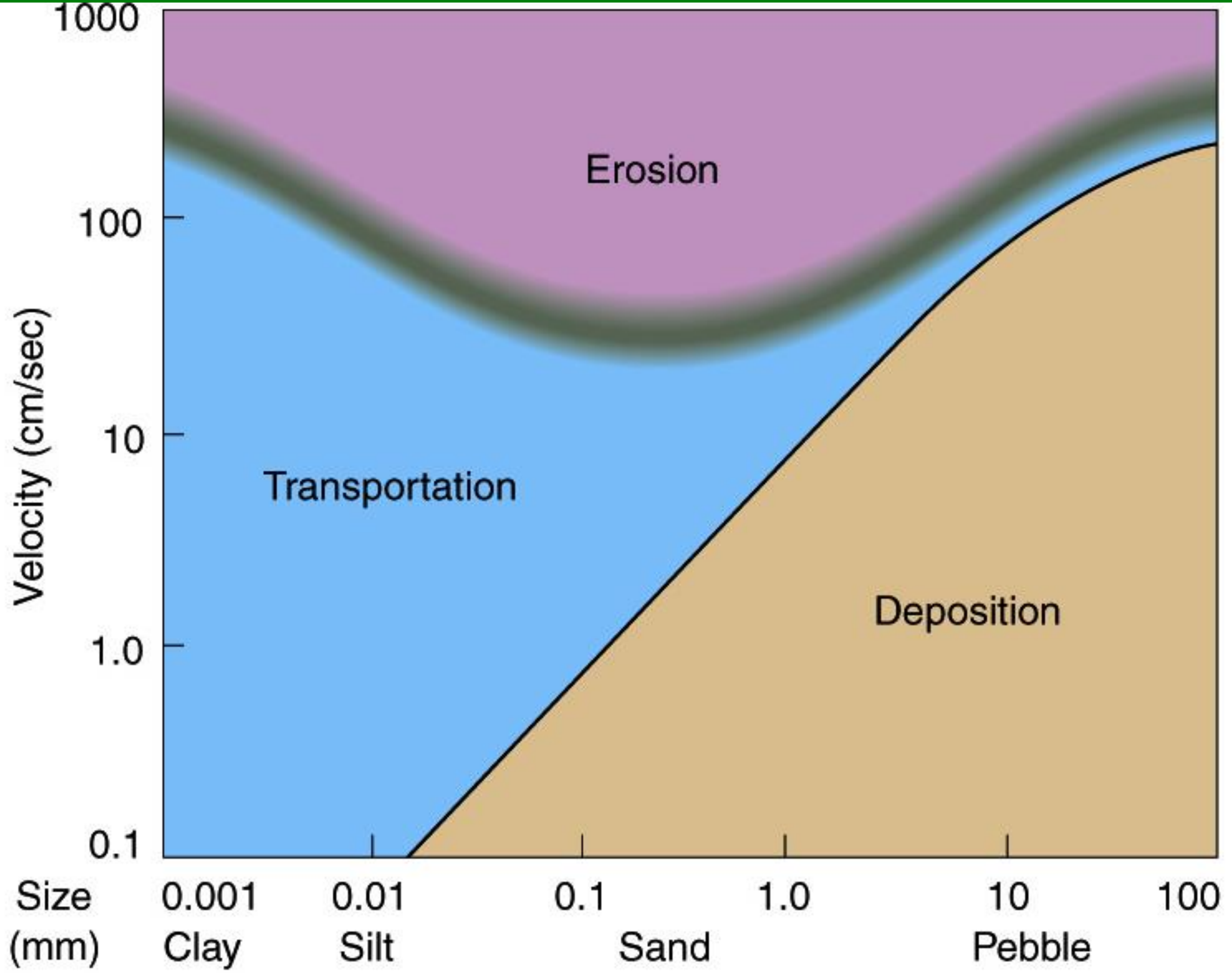
- What is being transported – rock, grains, soil?
- How much gravity – what's the slope profile?

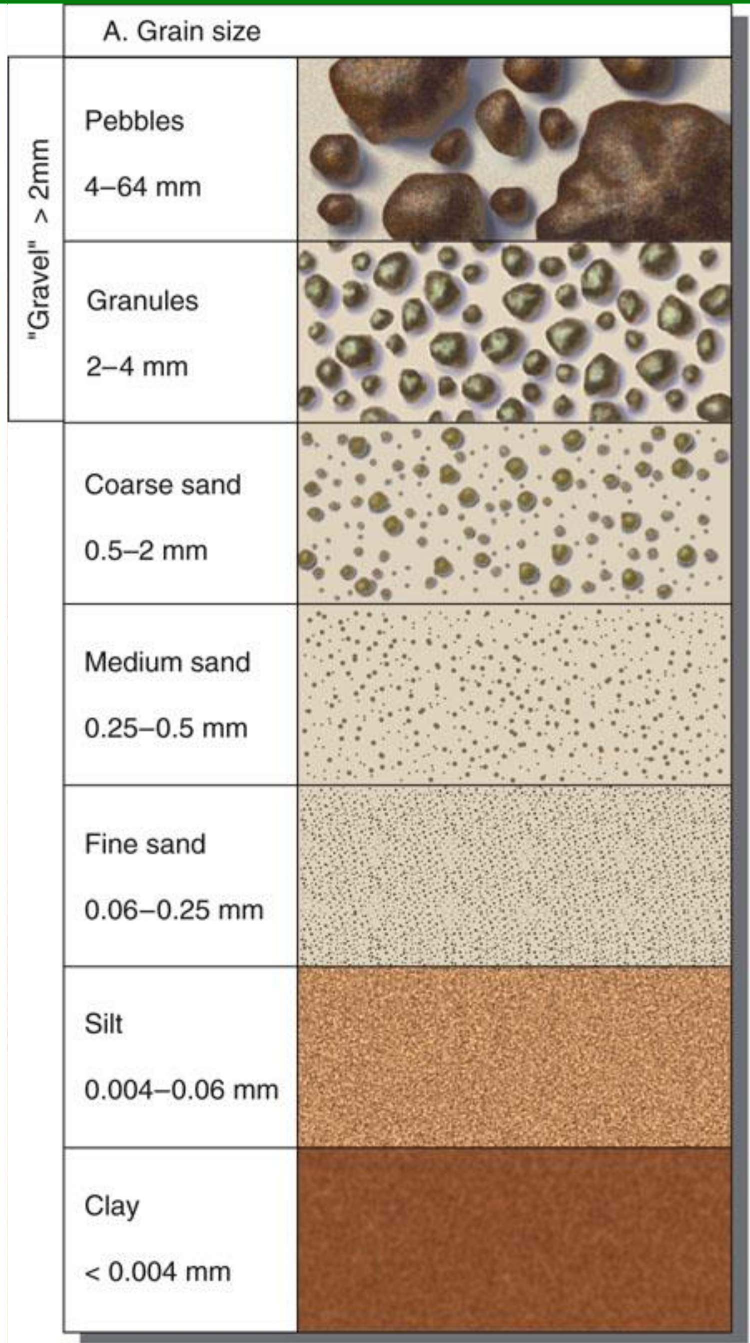


- Is there lubrication by air or water?




Dissolved and suspended load
Bedload
Saltation
Traction


1000
100
10
1.0
0.1
Velocity (cm/sec)
Erosion
Transportation
Deposition
Size (mm)
0.001
0.01
0.1
1.0
10
100
Clay
Silt
Sand
Pebble

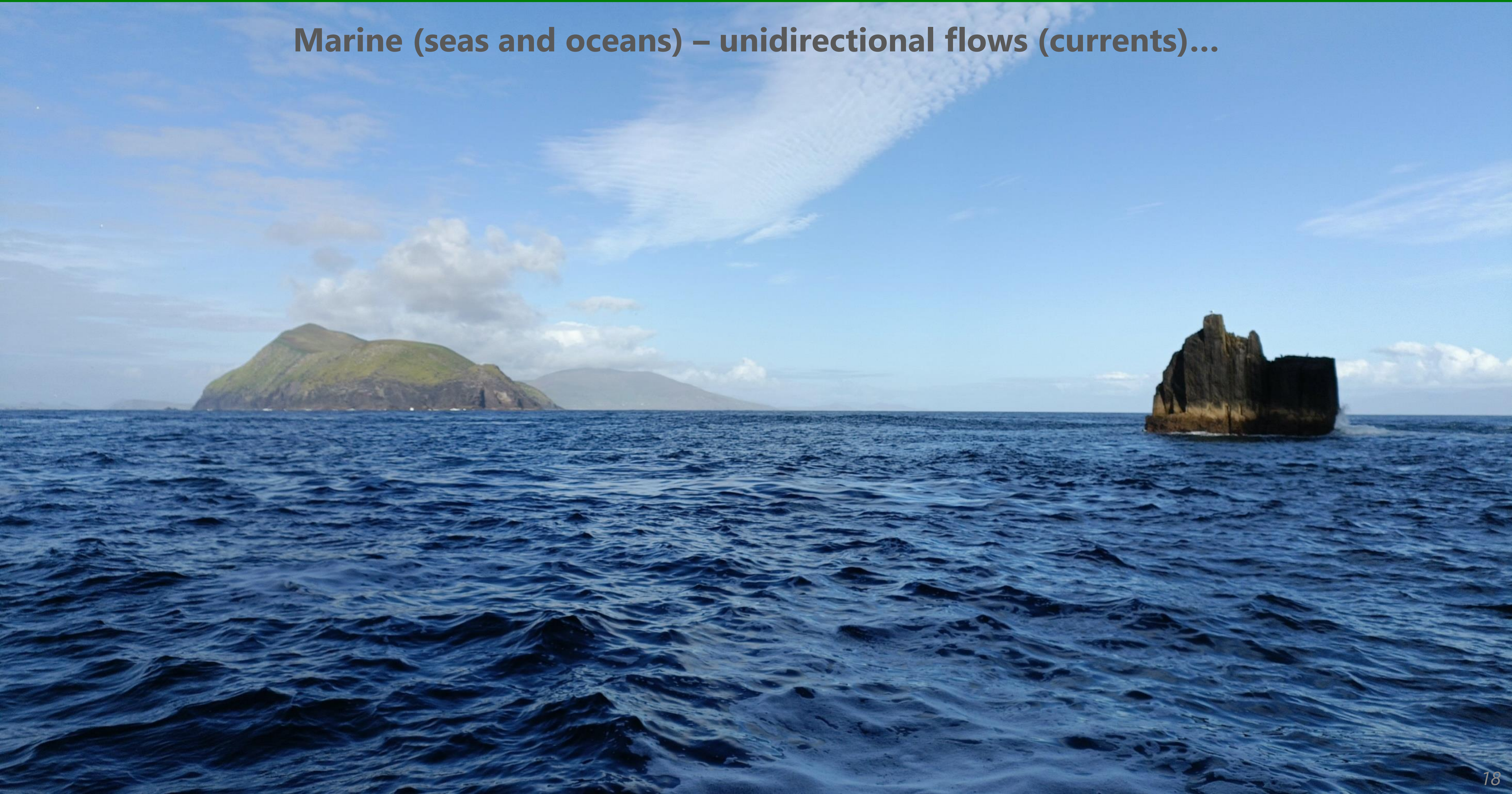

A. Grain size
"Gravel" > 2mm
Pebbles
4–64 mm
Granules
2–4 mm
Coarse sand
0.5–2 mm
Medium sand
0.25–0.5 mm
Fine sand
0.06–0.25 mm
Silt
0.004–0.06 mm
Clay
< 0.004 mm

Fluvial (rivers) – unidirectional turbulent flow

Bedload and suspended load movement, high degree of bed change, braided fluvial system, high degree of sediment modification – size, roundness, sorting and textural maturity

Fluvial (rivers) – unidirectional turbulent flow

Bedload and suspended load movement, erosional bed, meandering fluvial system, high degree of sediment modification – size, roundness, sorting and textural maturity

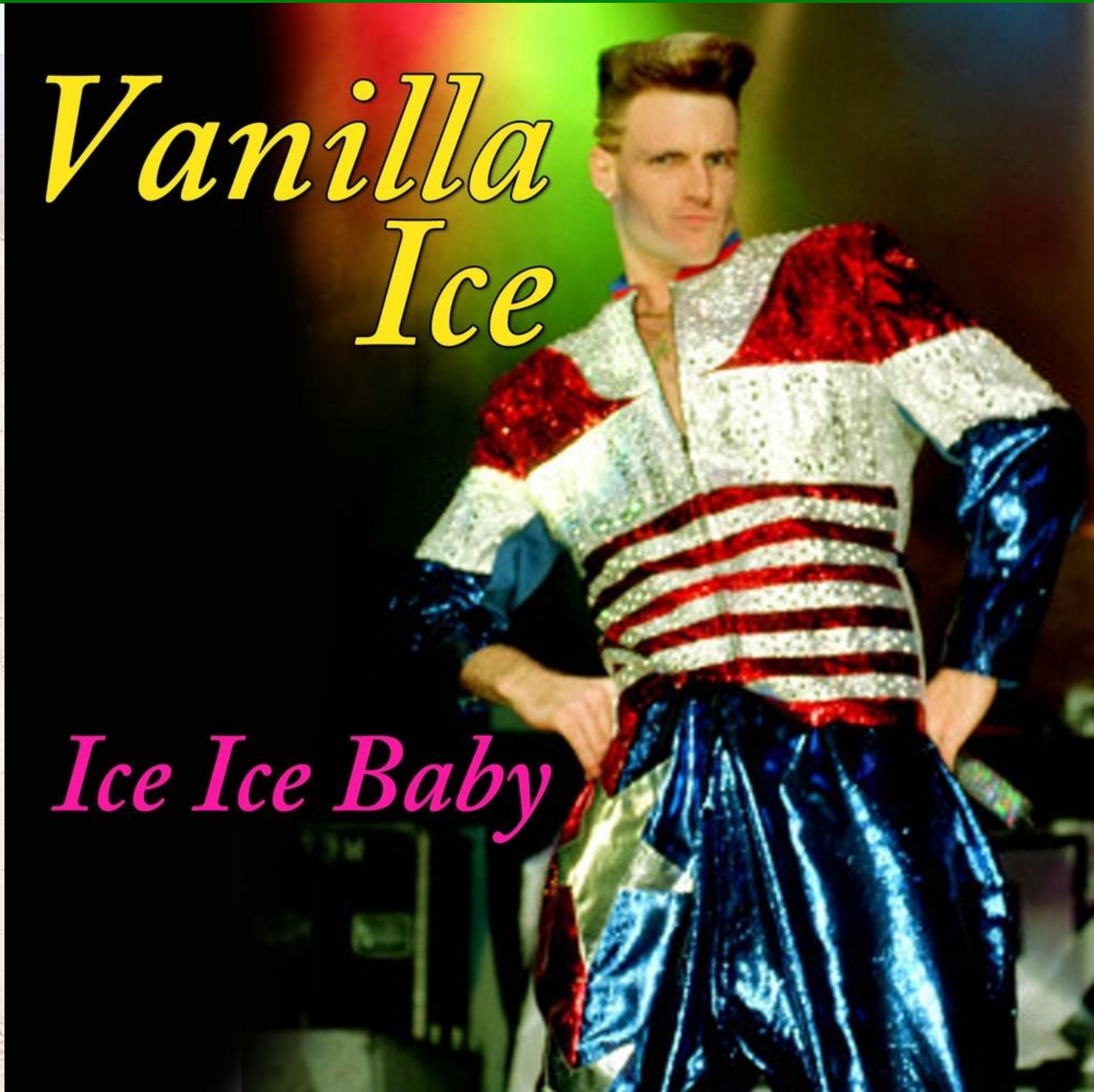


Marine (seas and oceans) – unidirectional flows (currents)…

Erosion and Transport | *Water*

Marine (seas and oceans) – unidirectional flows (currents)…

…and bidirectional flows (waves, tides)


Vanilla Ice
Ice Ice Baby

Ice in glaciers is solid but plastic – it flows

Supraglacial transport

Passive transport of material which falls on top of the glacier

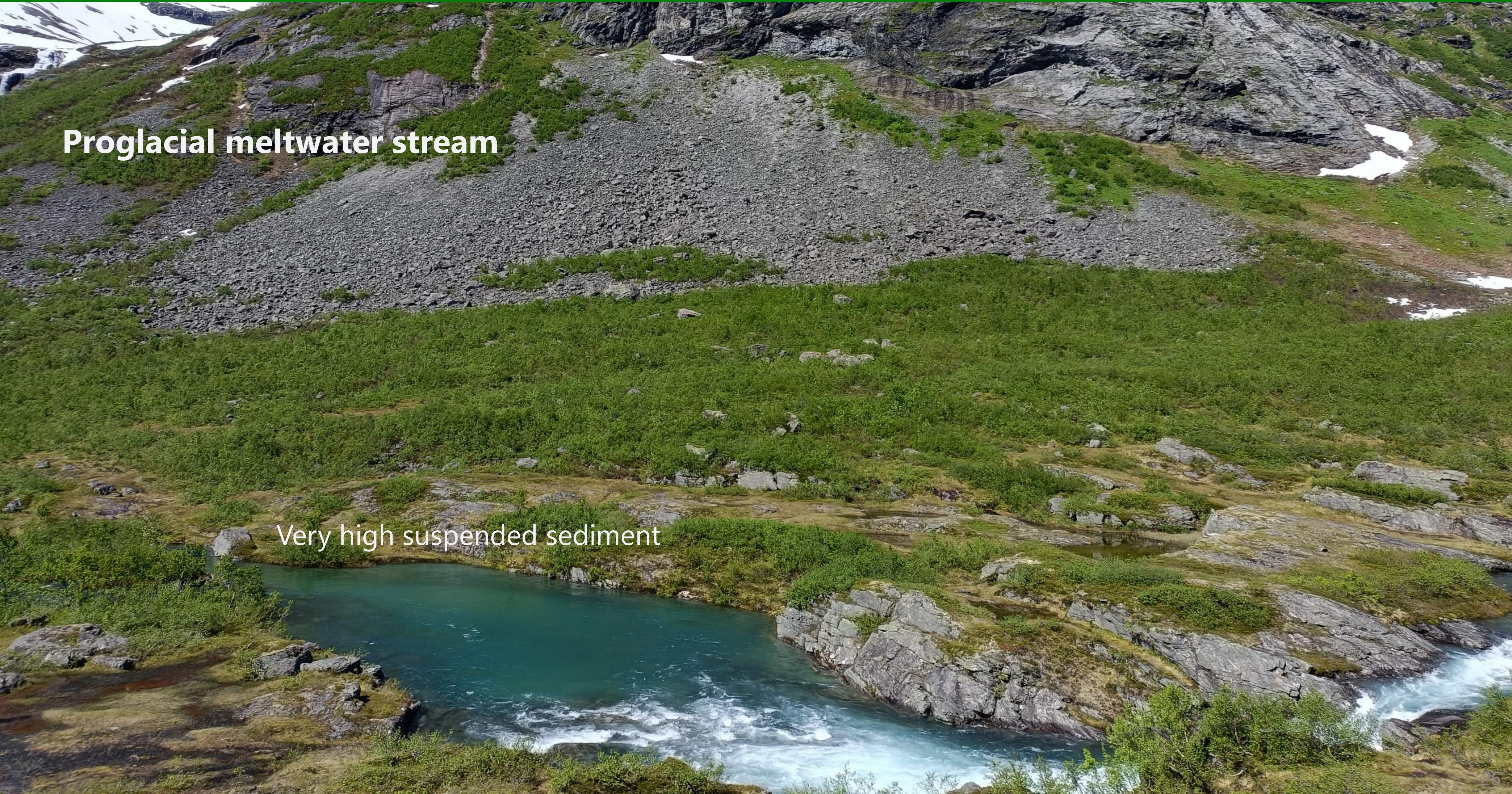
Englacial transport

Material frozen within the ice

Subglacial transport

Massive pressures at the base of the glacier

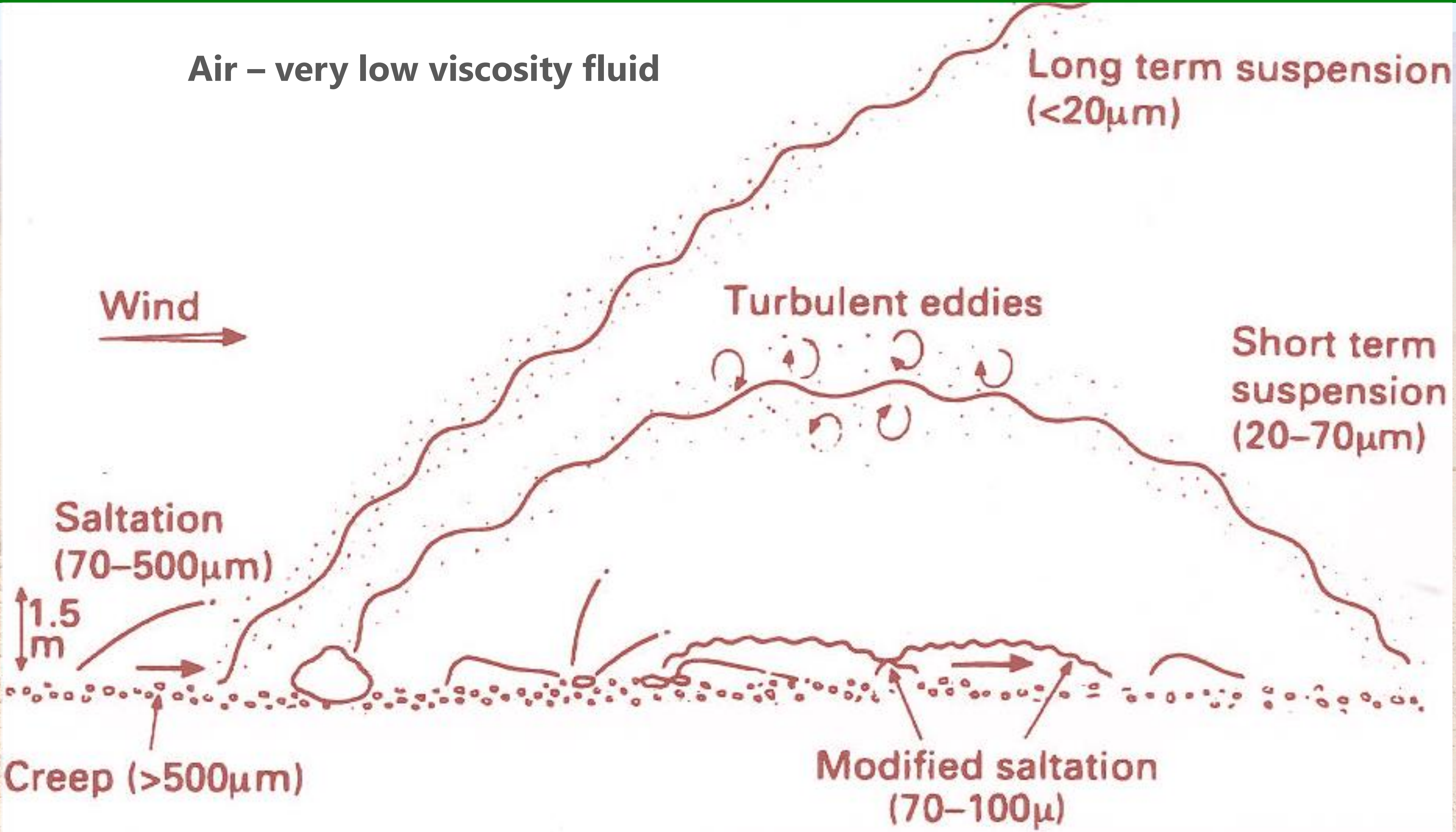
Meltwater transport – supraglacial and subglacial


Proglacial meltwater stream
Very high suspended sediment

Traction and saltation across a beach

Traction and saltation across a beach

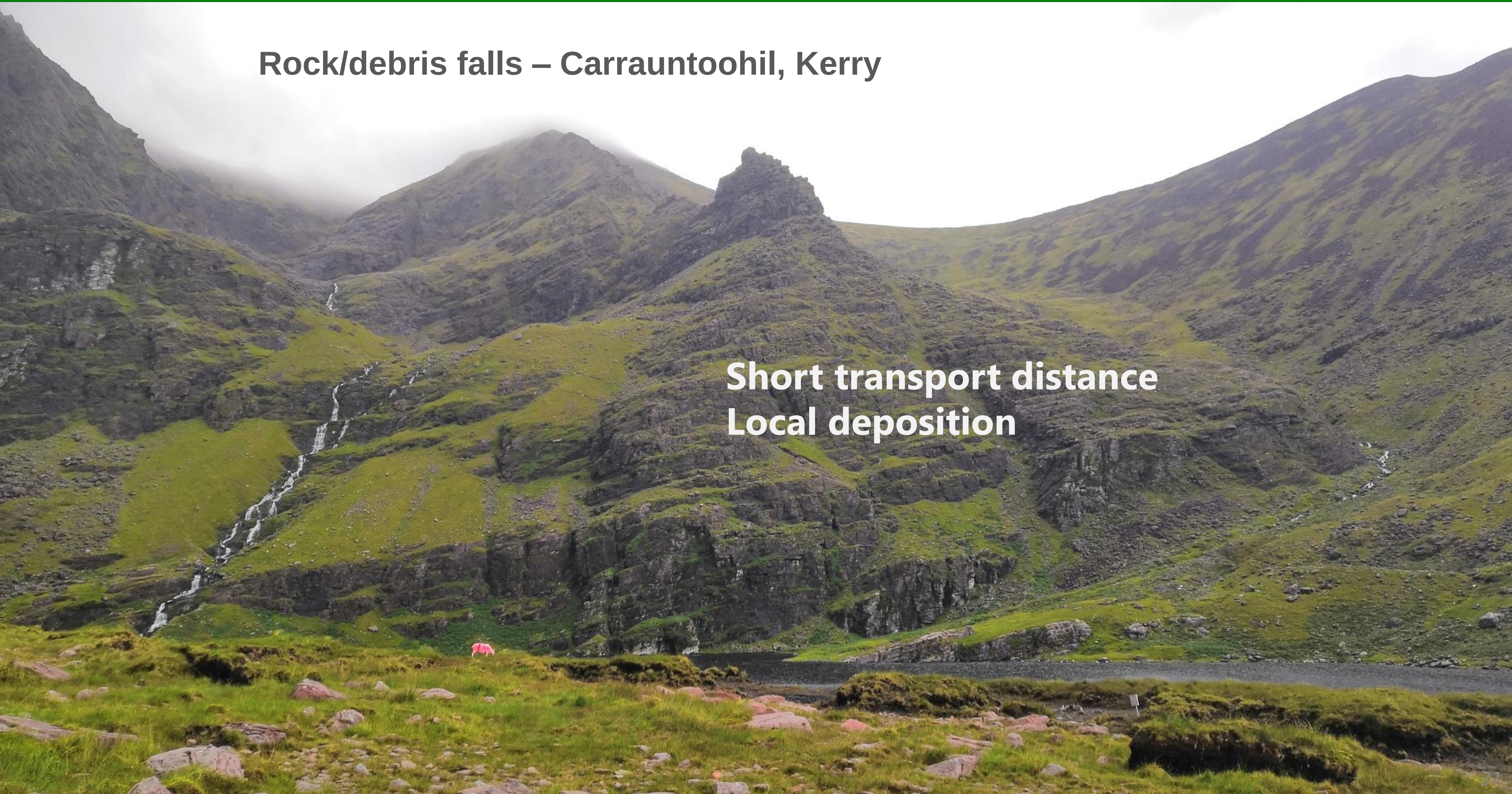
Air – very low viscosity fluid



Point source but wide dispersal pattern of very fine material (area sources also – e.g. Sahara)

Short and long-term suspension – volcanic ash (Etna)

Transport and Deposition | *Gravity*



Rock/debris falls – Carrauntoohil, Kerry

Short transport distance
Local deposition

Creep/slide – Mam Tor, Derbyshire, England

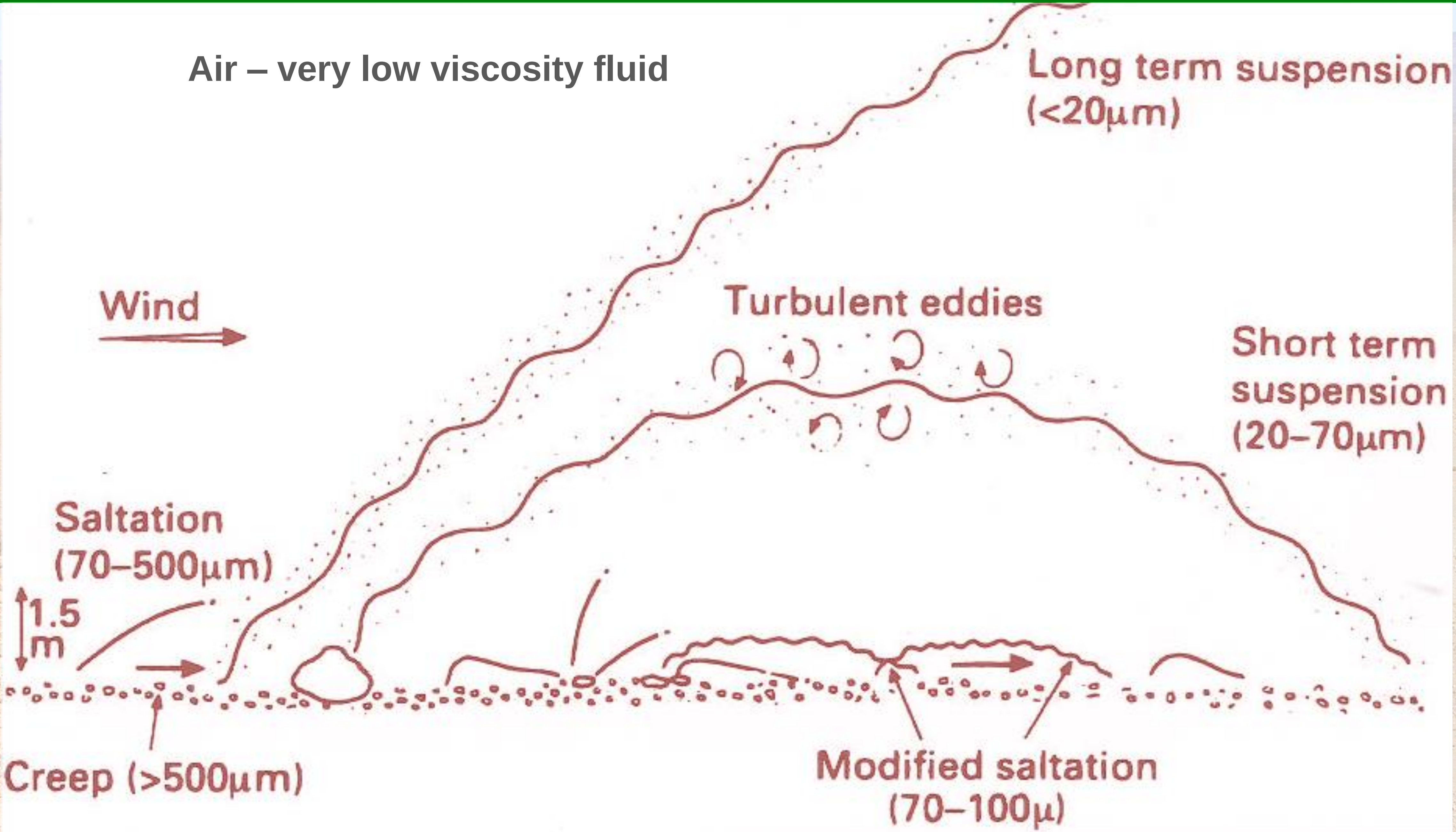
Erosion and Transport | *Gravity*


Creep/slide – Mam Tor, Derbyshire, England
Except for access
Short transport distance
Local deposition

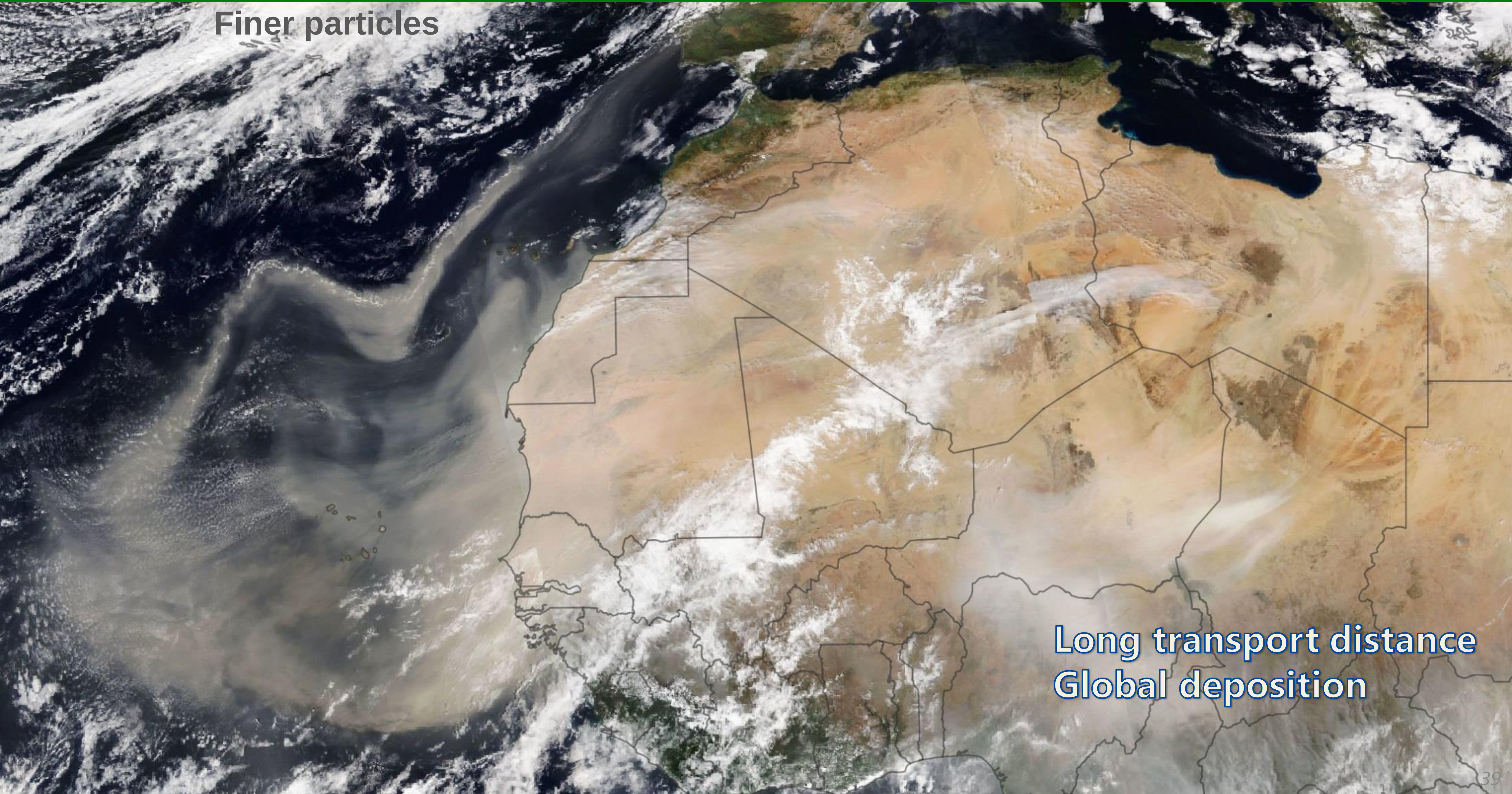

Glaciers can flow across entire continents
Long transport distance
Exotic deposition

Often dropping their sediment load in the sea

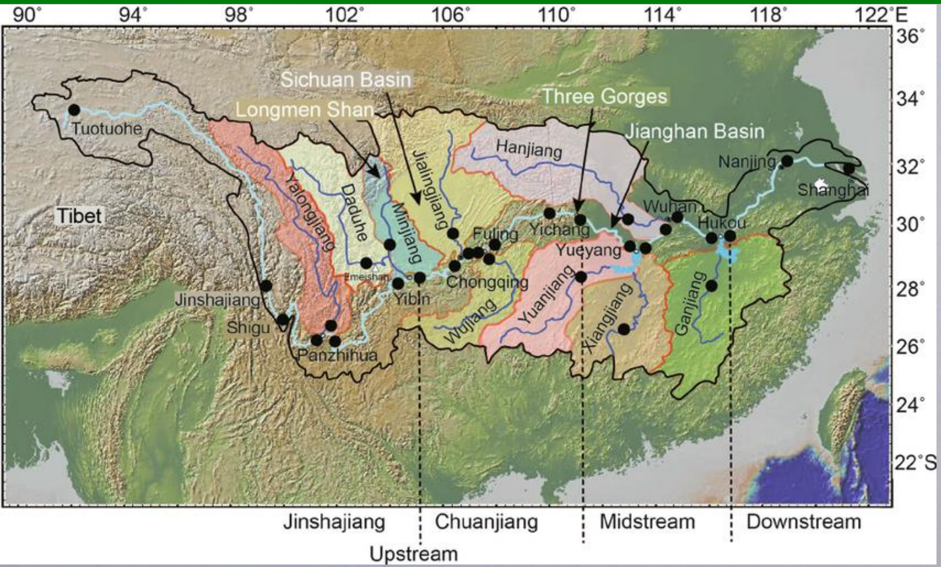
Air – very low viscosity fluid



Transport and Deposition | *Air*

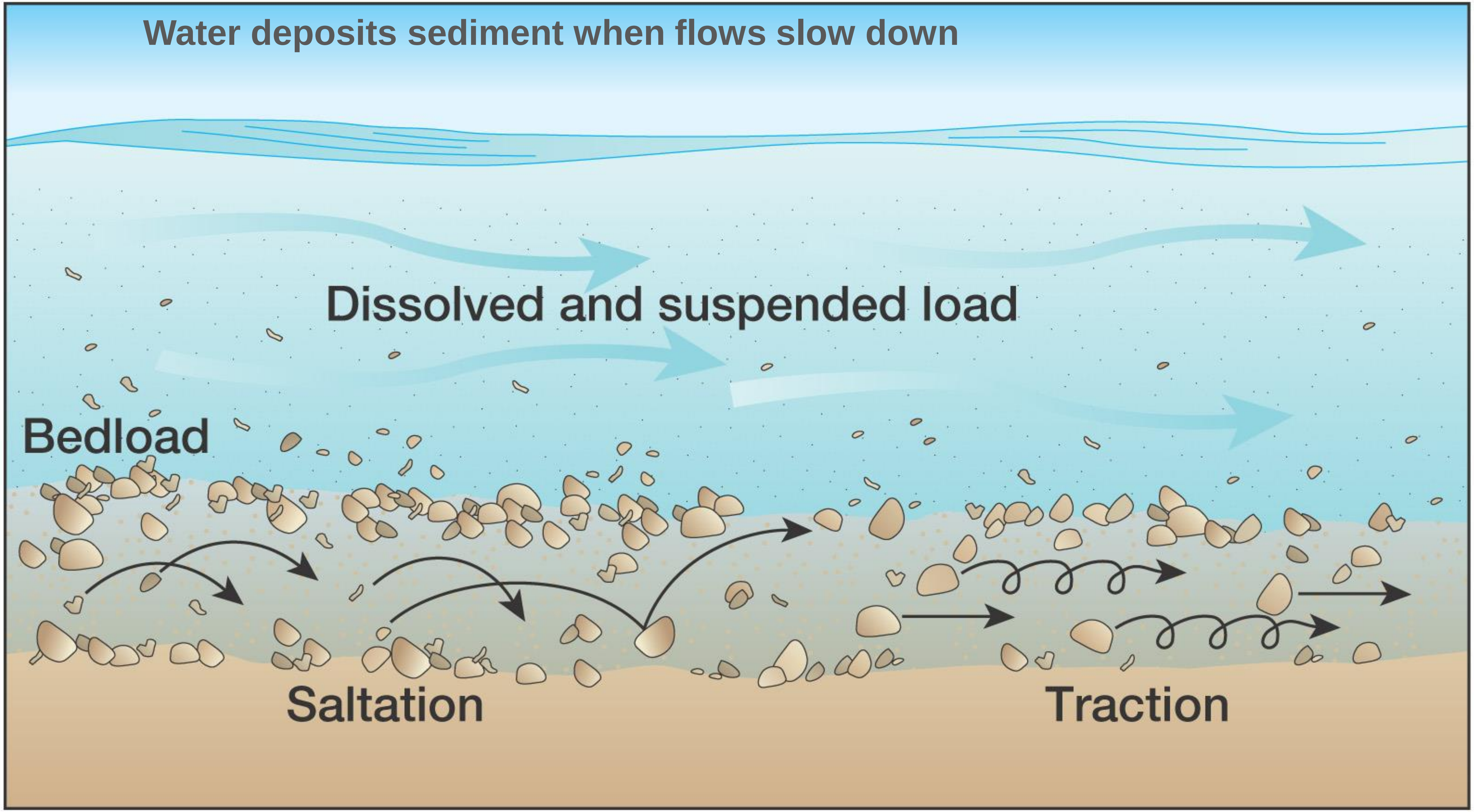

Finer particles
Long transport distance
Global deposition

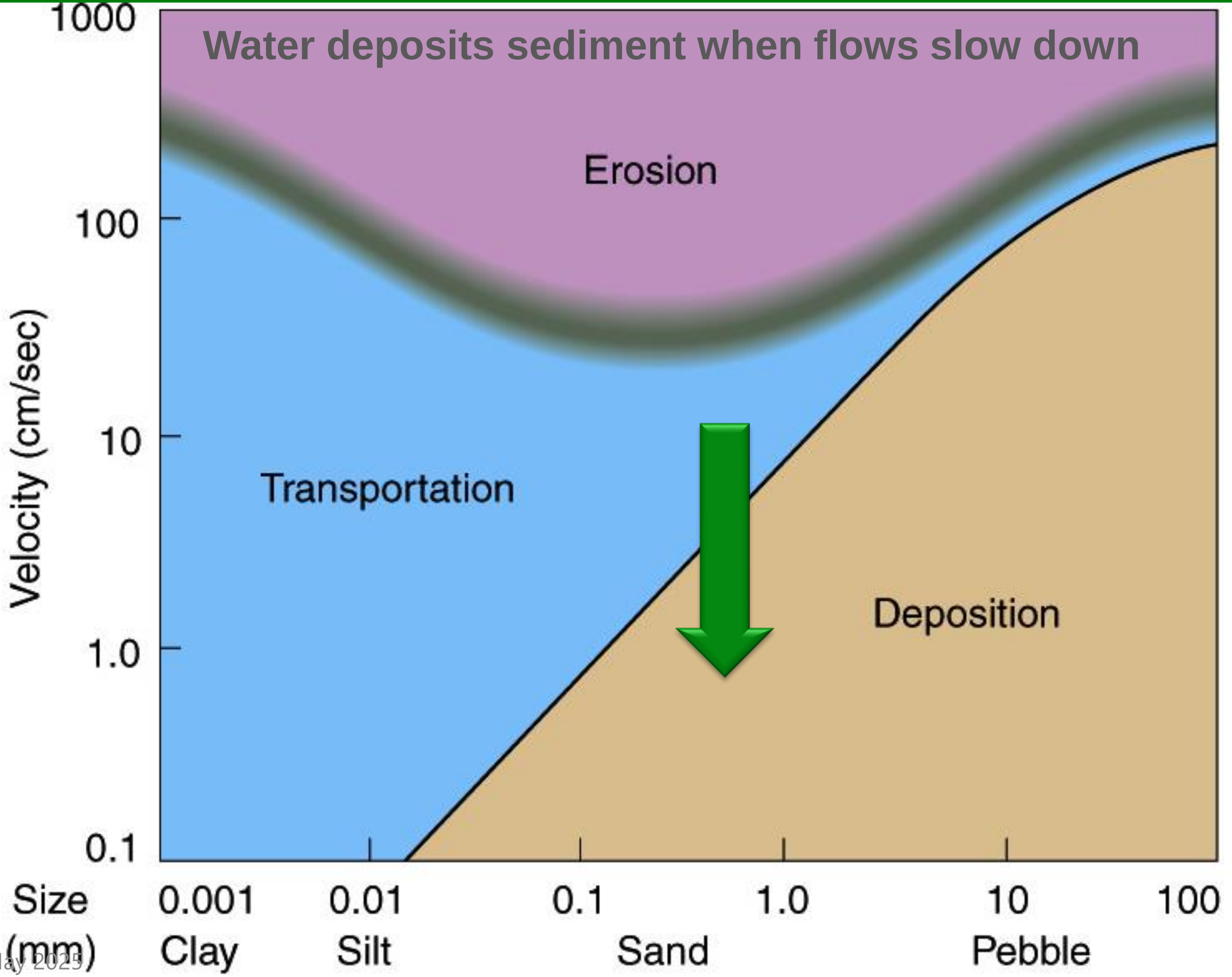
Transport and Deposition | *Water*



Landscape Evolution

Transport and Deposition (continued)


Water deposits sediment when flows slow down
Dissolved and suspended load
Bedload
Saltation
Traction


Water deposits sediment when flows slow down
Erosion
Transportation
Deposition
Velocity (cm/sec)
1000
100
10
1.0
0.1
Size (mm)
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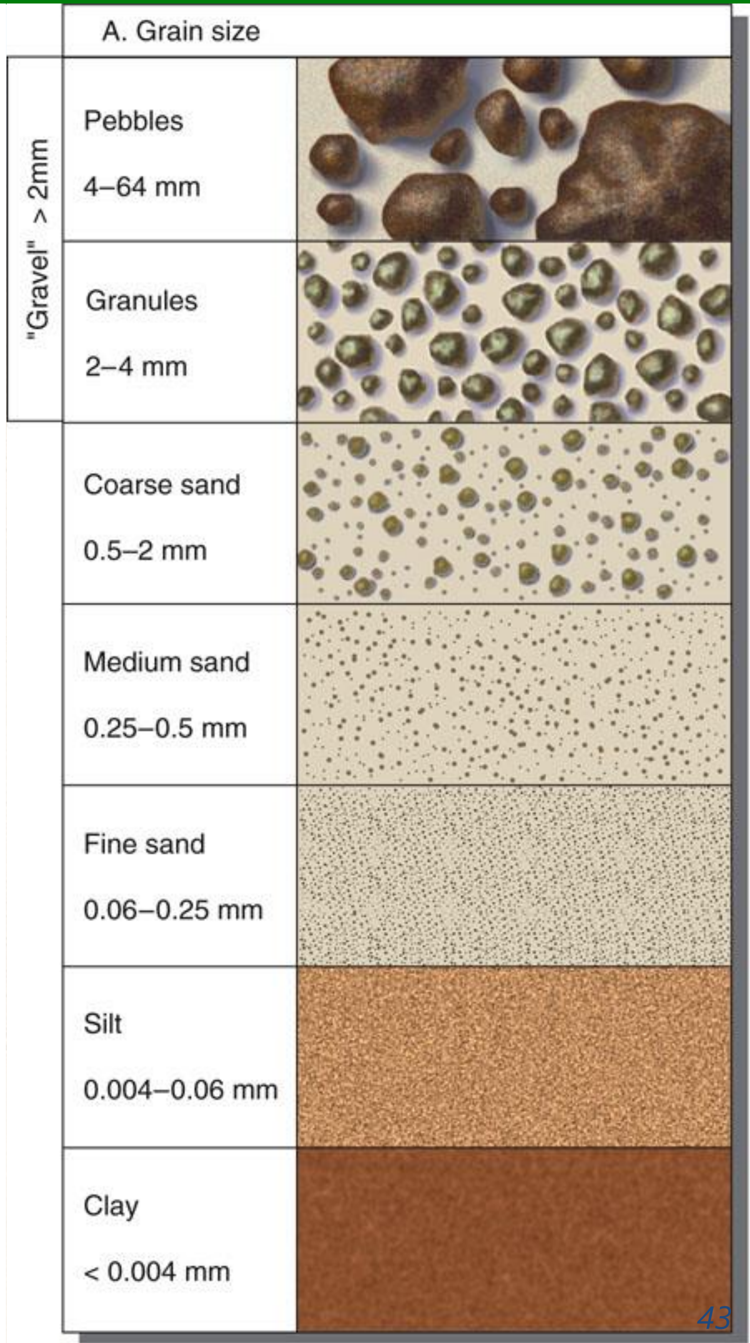
0.01
0.1
1.0
10
100
Clay
Silt
Sand
Pebble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0.06–0.25 mm
Silt
0.004–0.06 mm
Clay
< 0.004 mm

Why do flows slow down?

- Transient flows
- Channel morphology
- Flowing into larger body of water
- Existing geomorphology

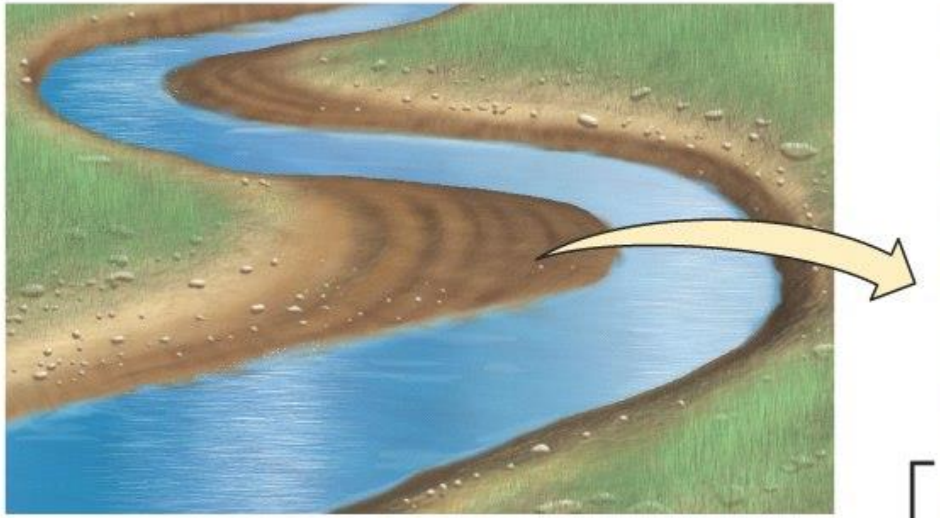
Why do flows slow down?

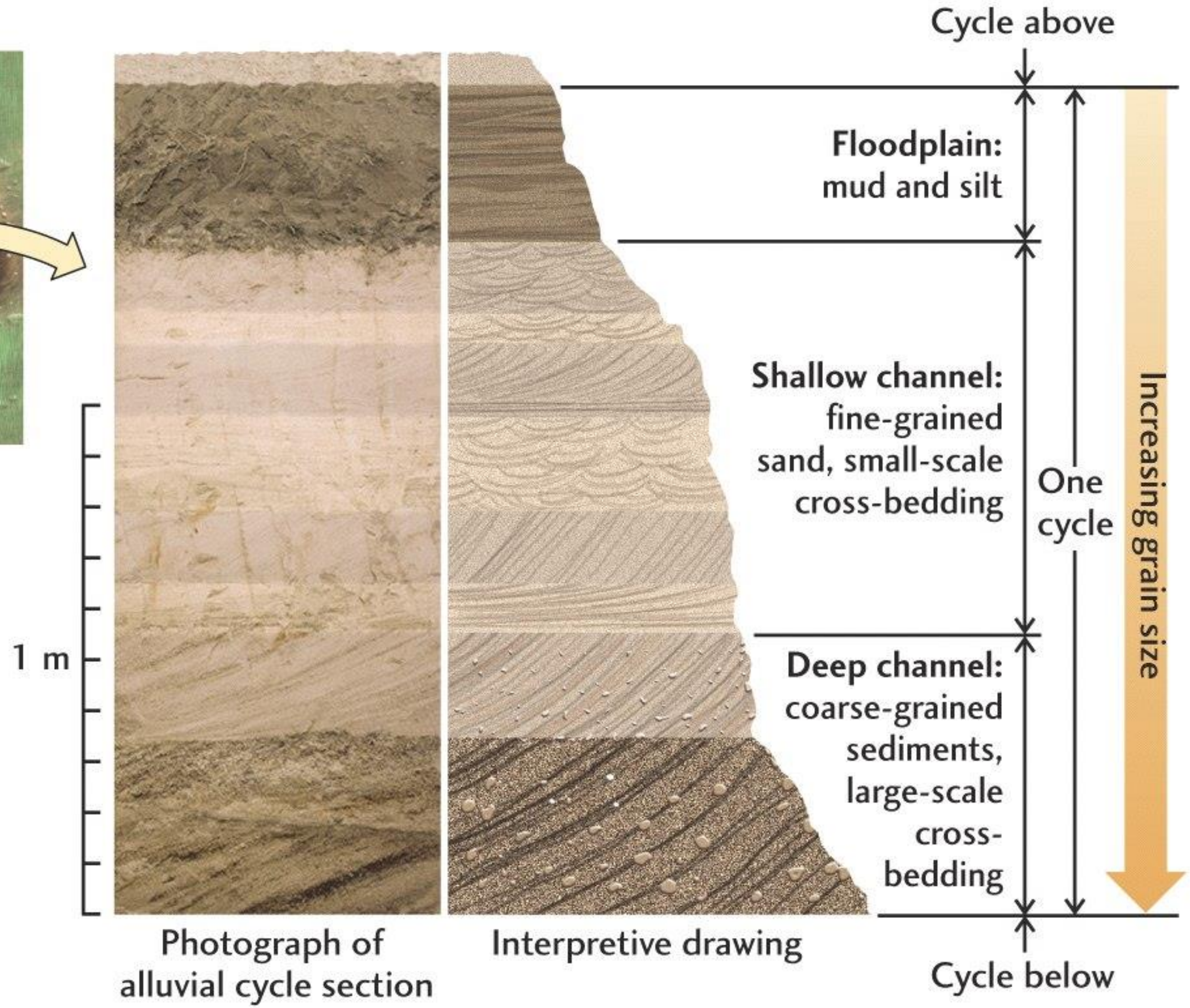
- Transient flows

Why do flows slow down?

- Transient flows

Deposit where they stop
Or where they flow into something





Why do flows slow down?

- Channel morphology

Why do flows slow down?

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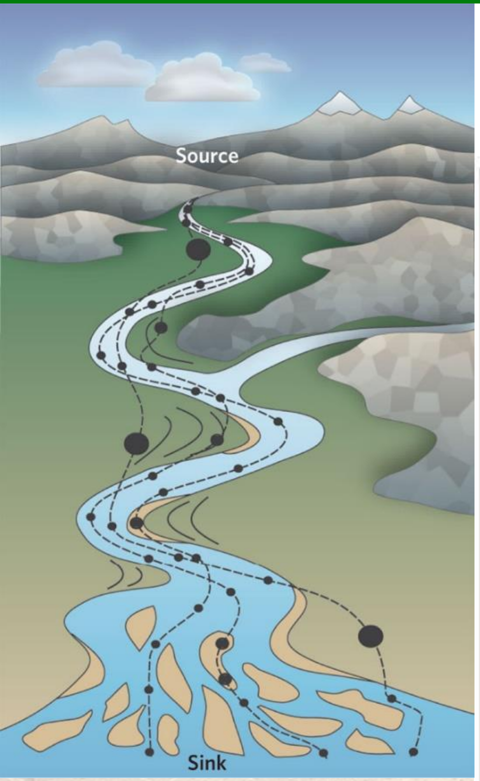
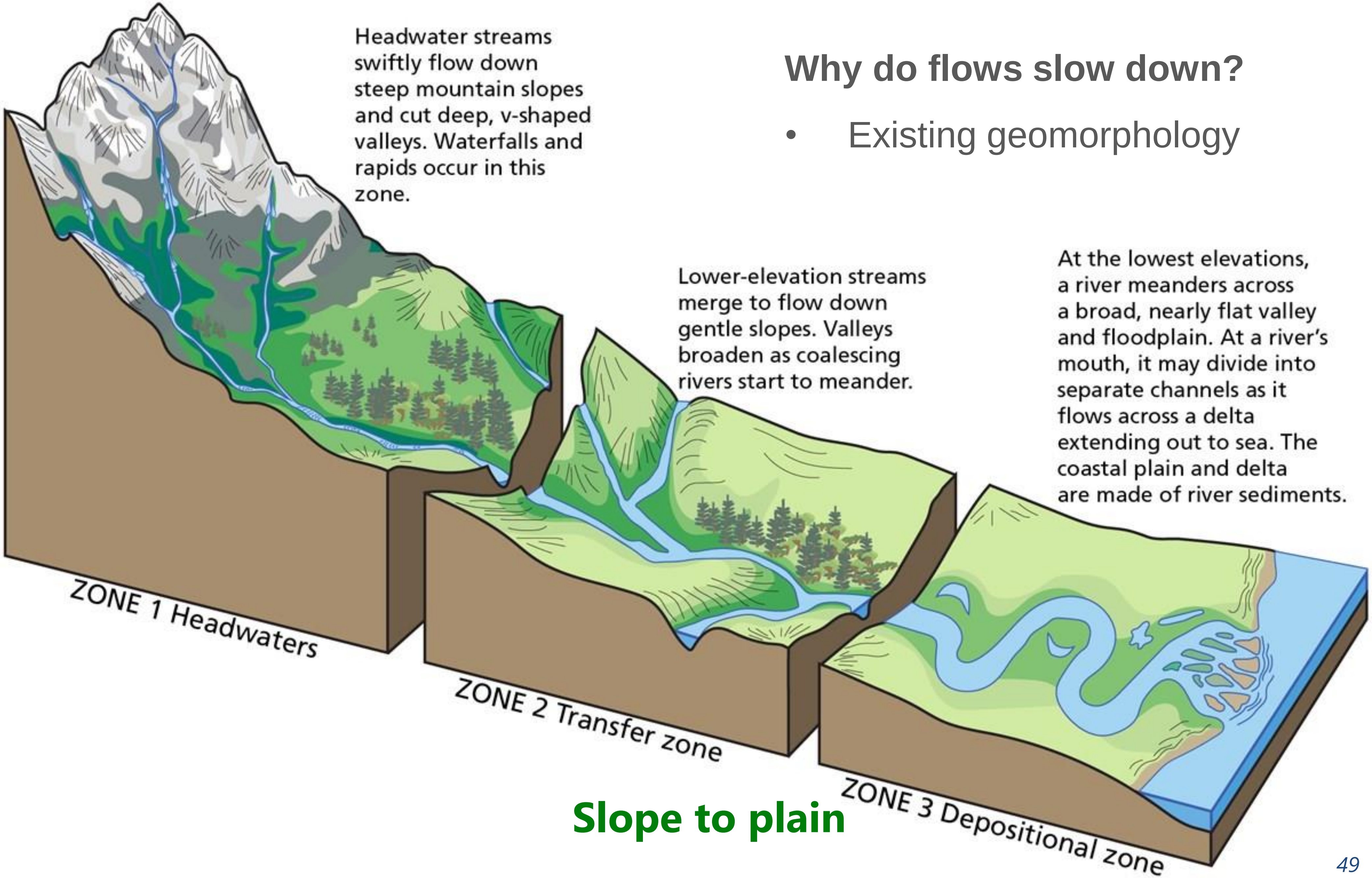




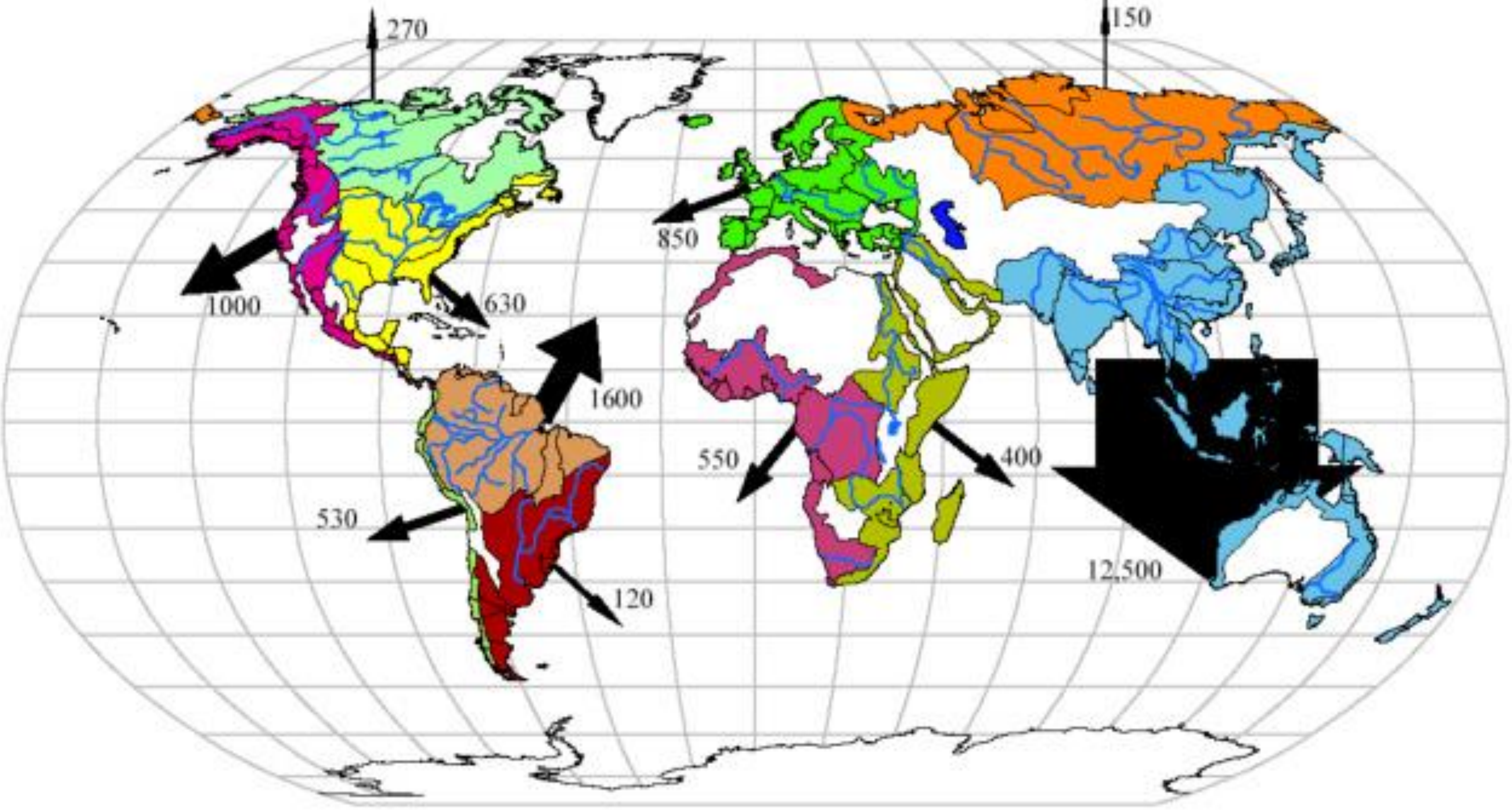
Why do flows slow down?

- Existing geomorphology

Slope to plain

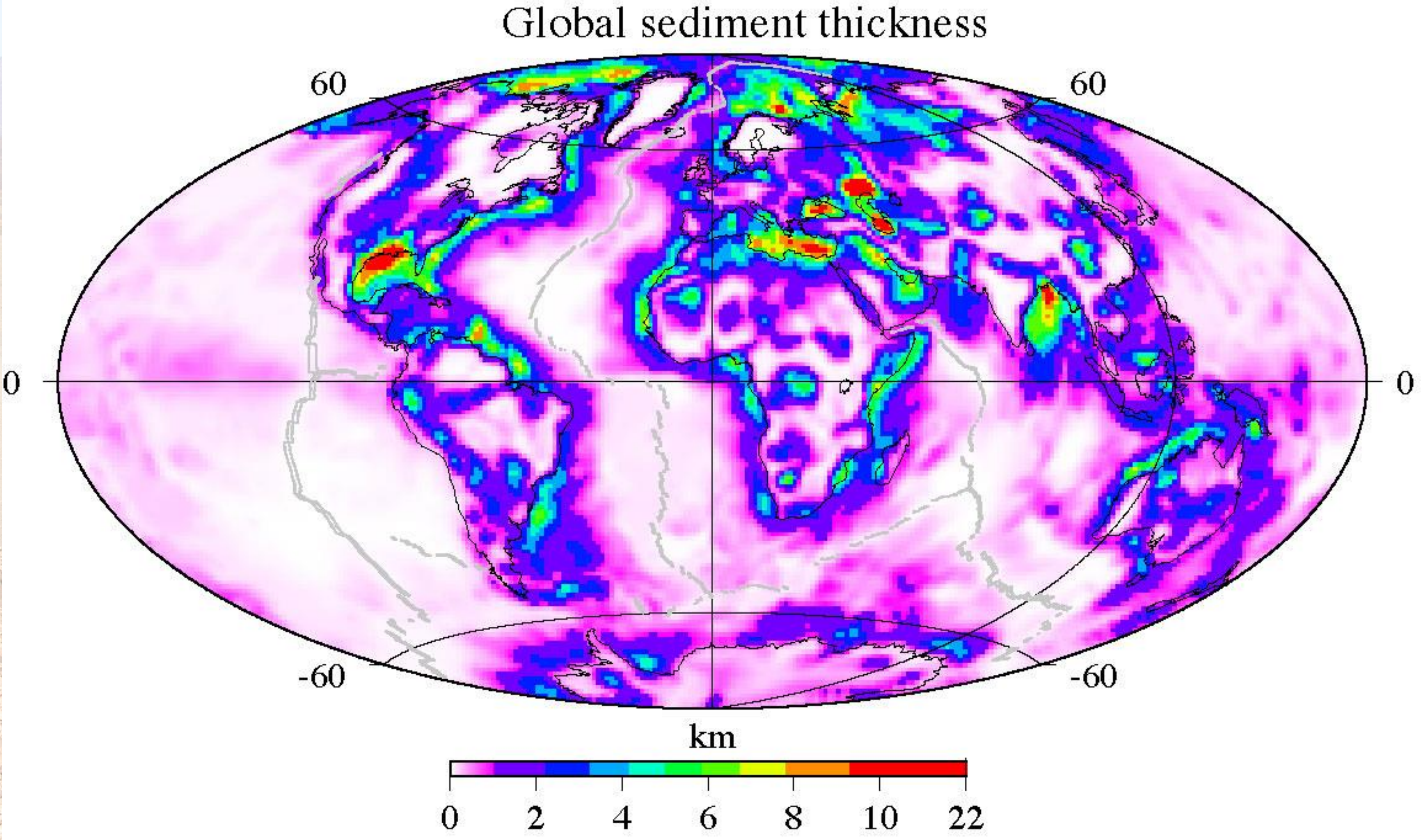
Why do flows slow down?

- Flowing into larger body of water

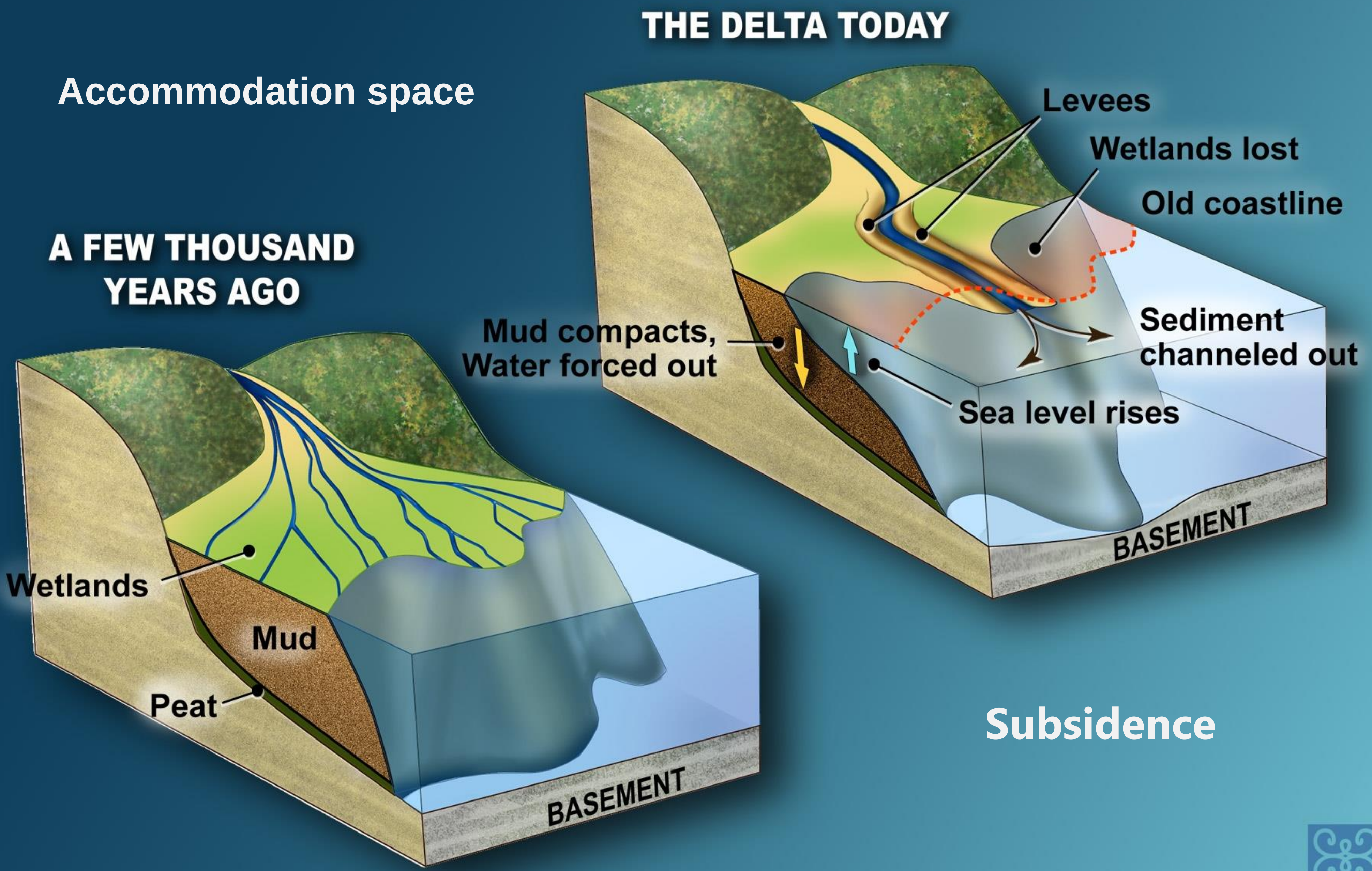


Total = 19,000 * 10^6 t/yr

(Milliman and Farnsworth, 2011)

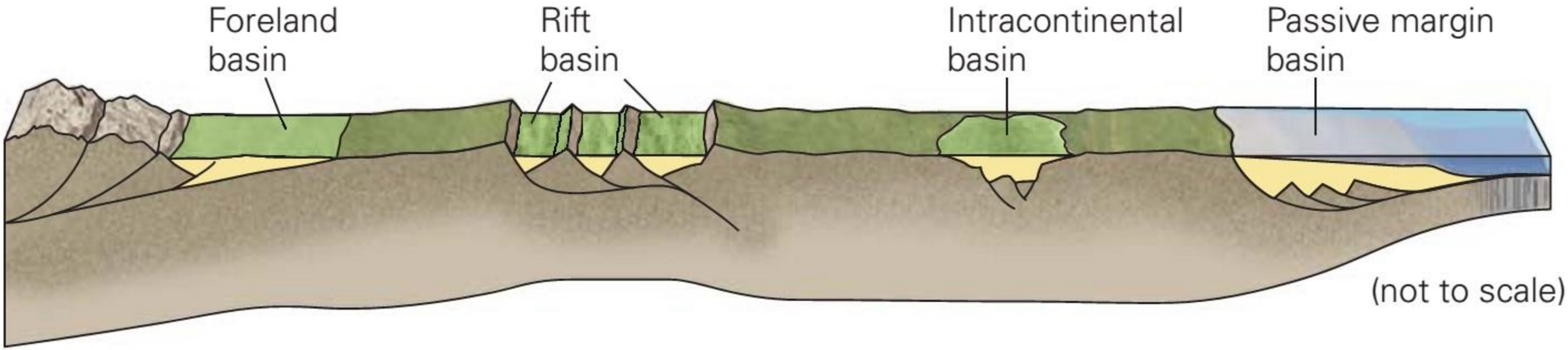

Global sediment thickness
60
60
0
0
-60
-60
km
0
2
4
6
8
10
22

Accommodation space



Subsidence

Accommodation space



Weight of the mountain belt pushes down the crust's surface.

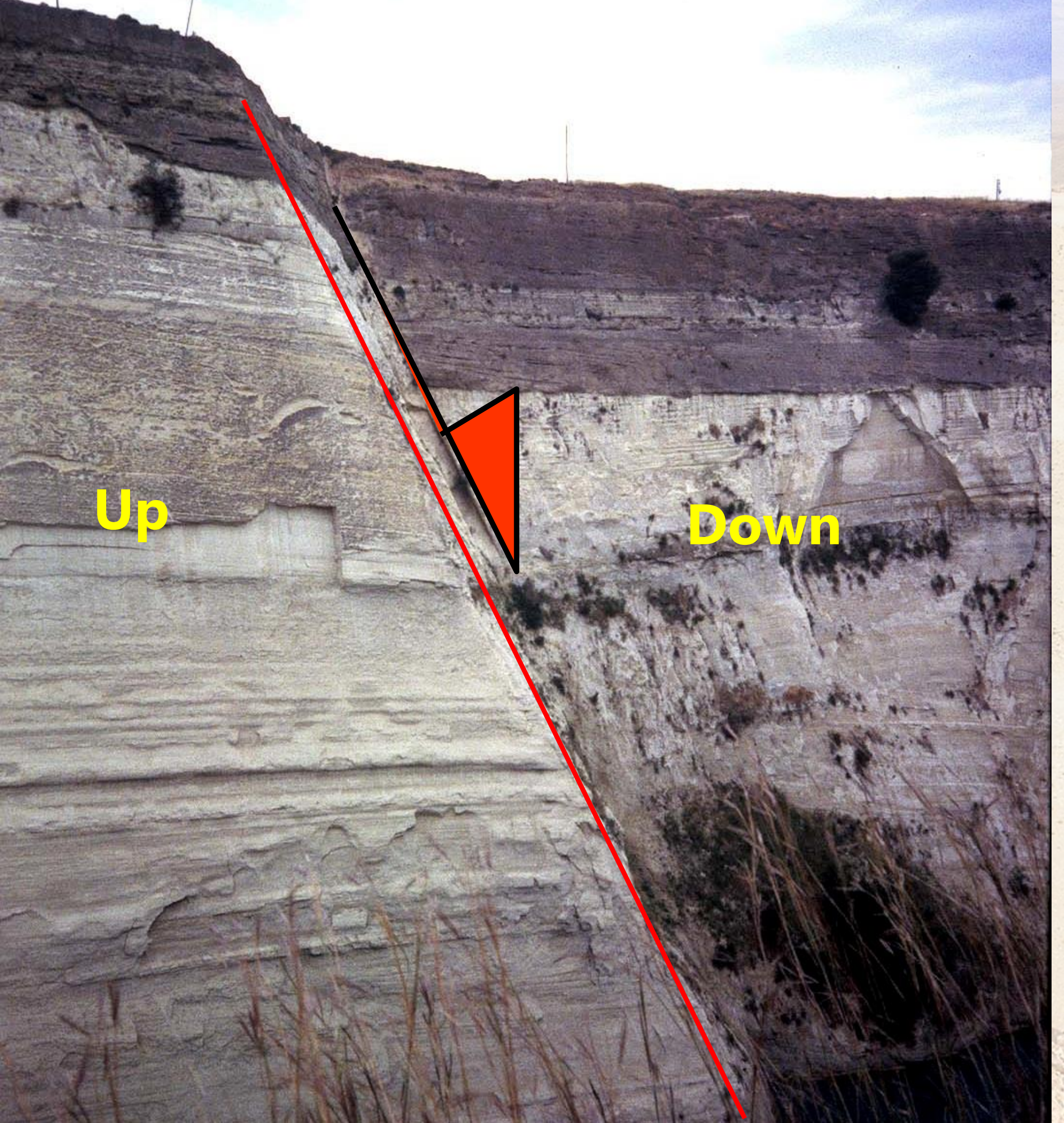
Downward slip on faults produces narrow troughs.

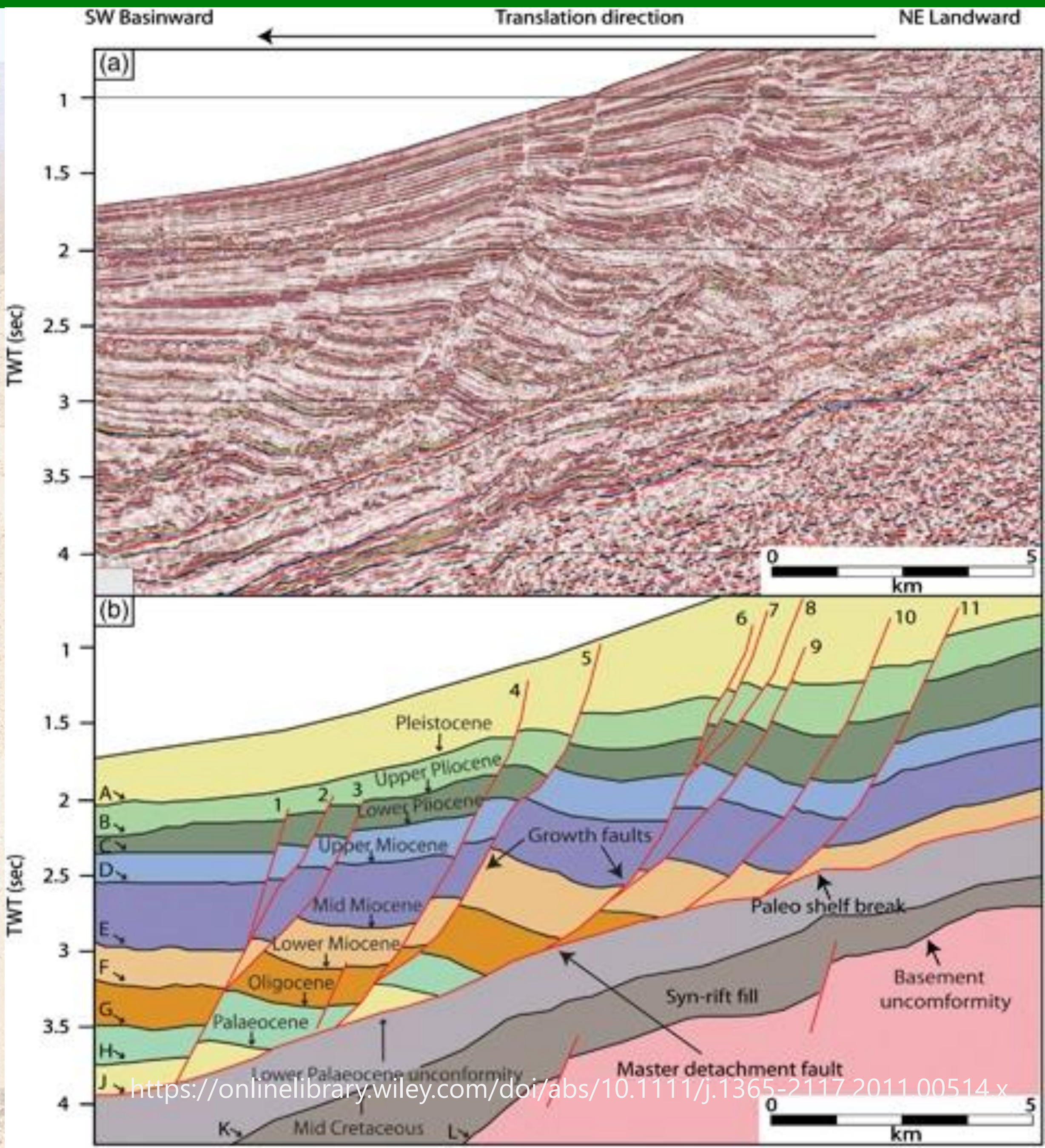
The basin forms in the interior of a continent, perhaps over an old rift.

Subsidence occurs over thinned crust at the edge of an ocean basin.

https://geologylearn.blogspot.com/2016/03/sedimentary-basins.html

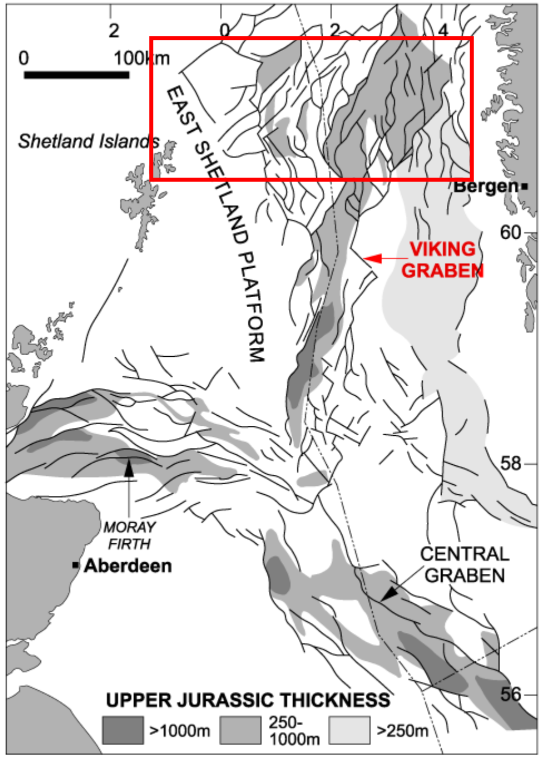
Accommodation space – Normal faults

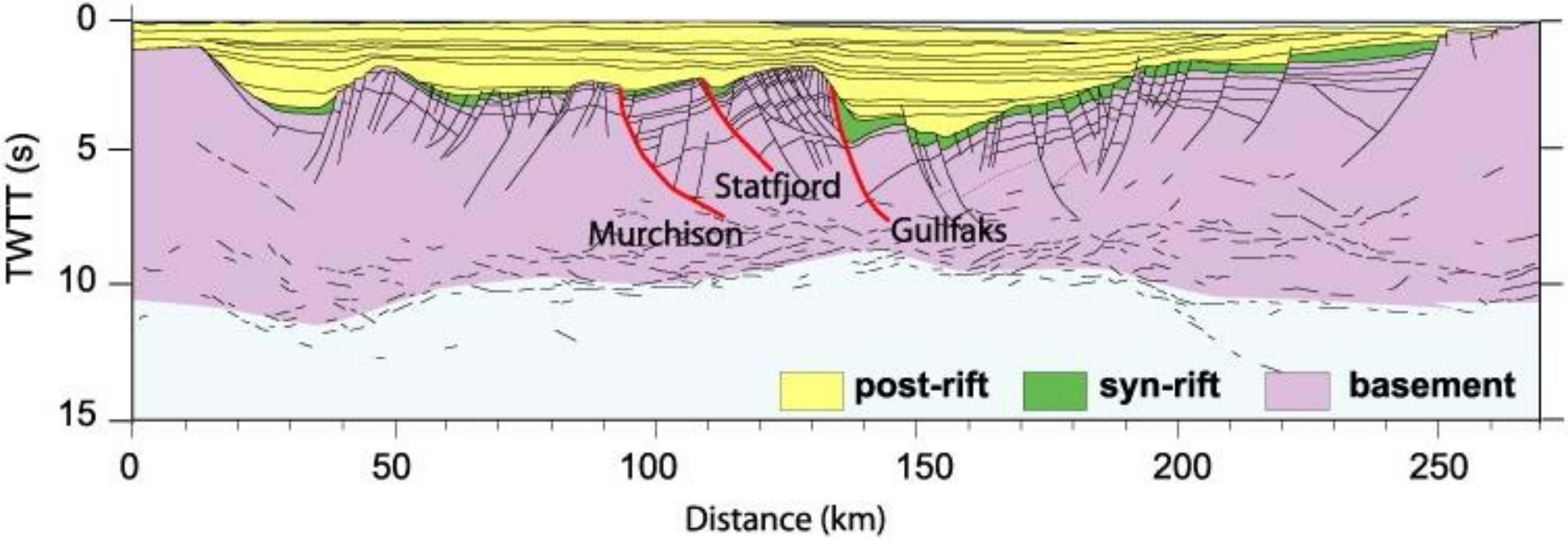




https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2117.2011.00514.x

Accommodation space – rift basins (the North Sea, Viking Graben)





Accommodation space – lithospheric flexure and foreland basins

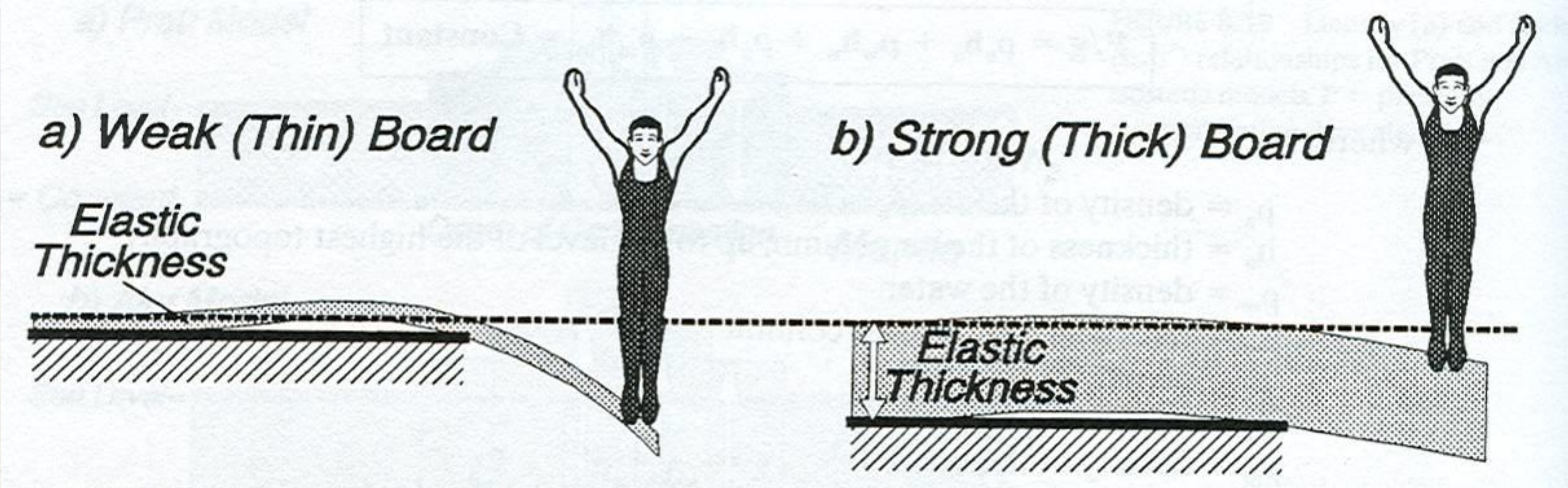
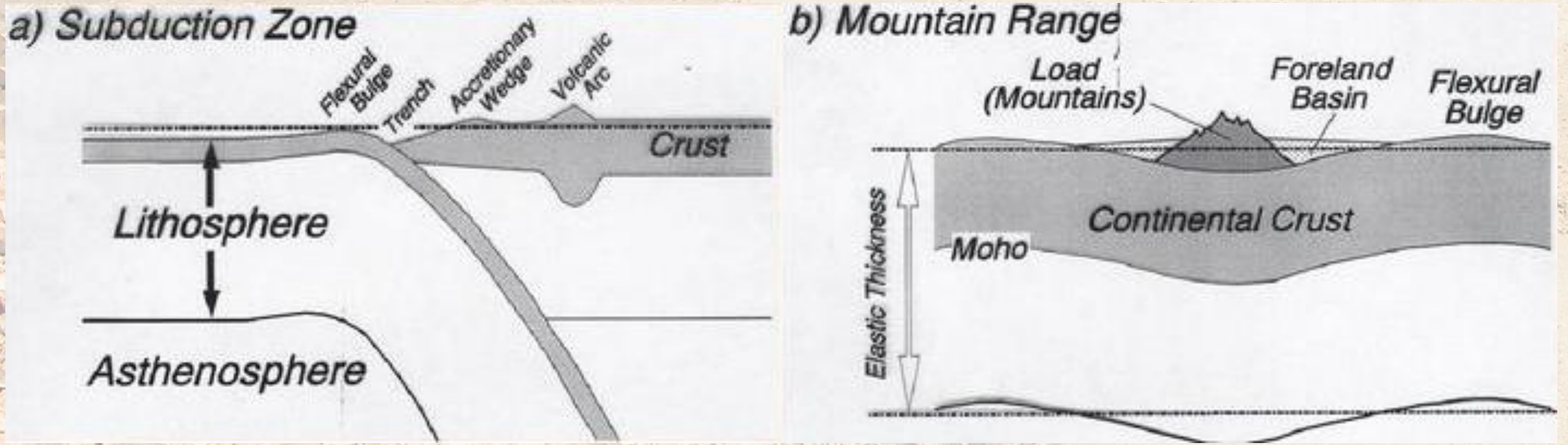
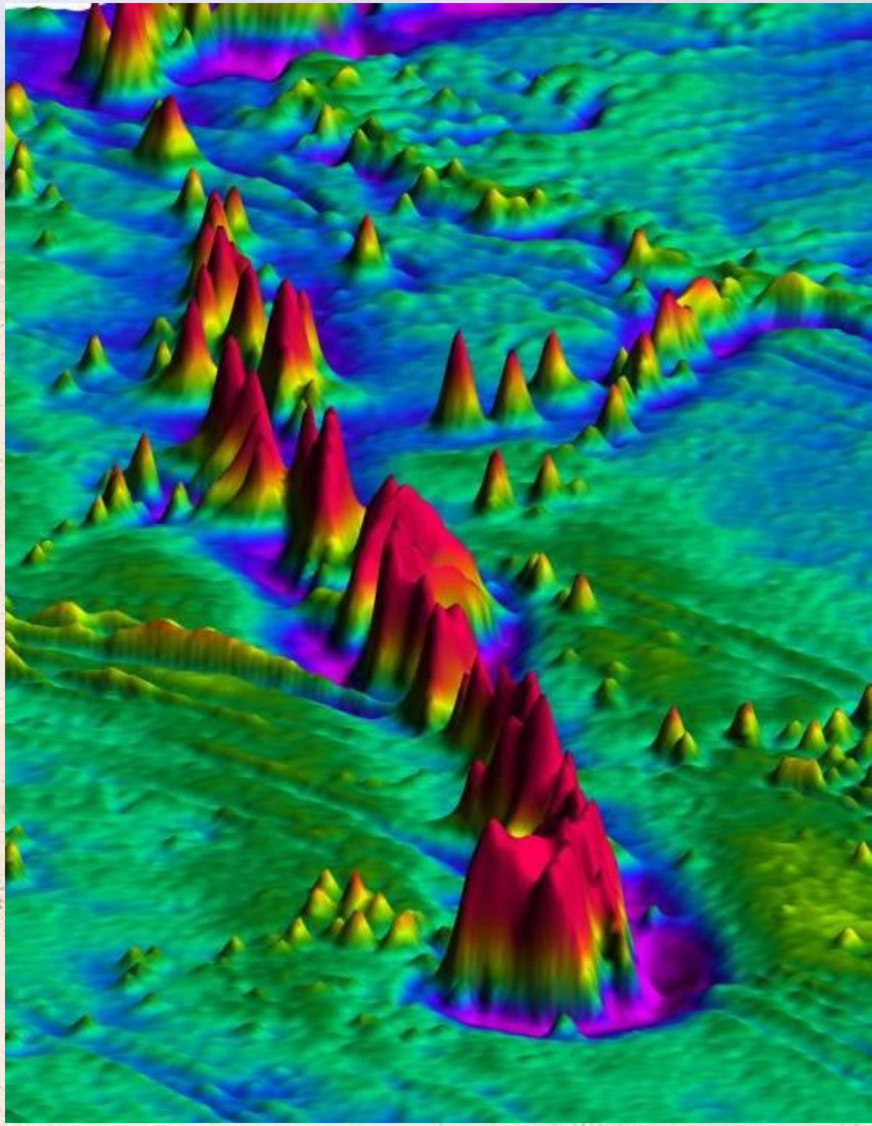


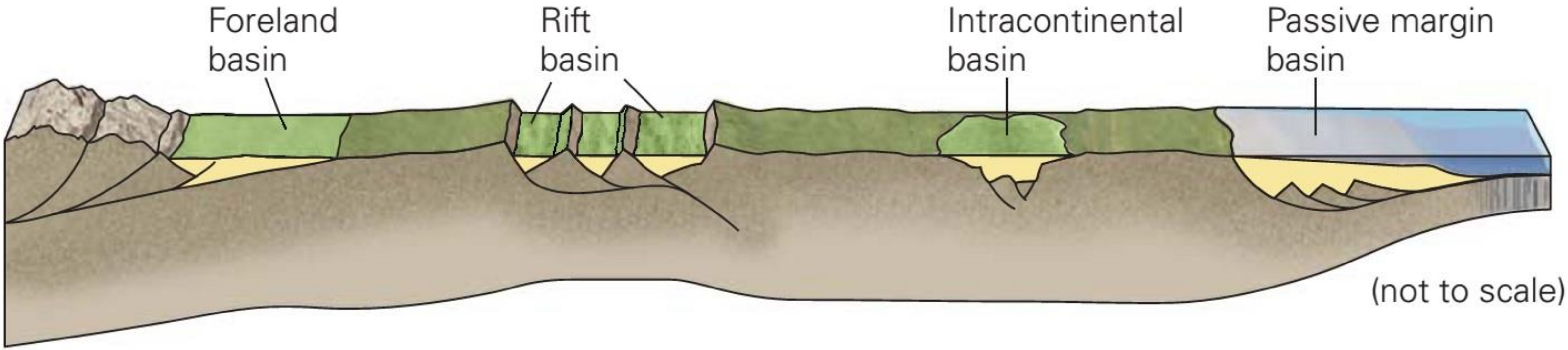
FIGURE 8.22 *Flexural rigidity*. a) A thin diving board (small elastic thickness) has low flexural rigidity. b) A thick board (large elastic thickness) has high flexural rigidity.





Accommodation space – The Alps foreland basins

Accommodation space



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