Lecture 10

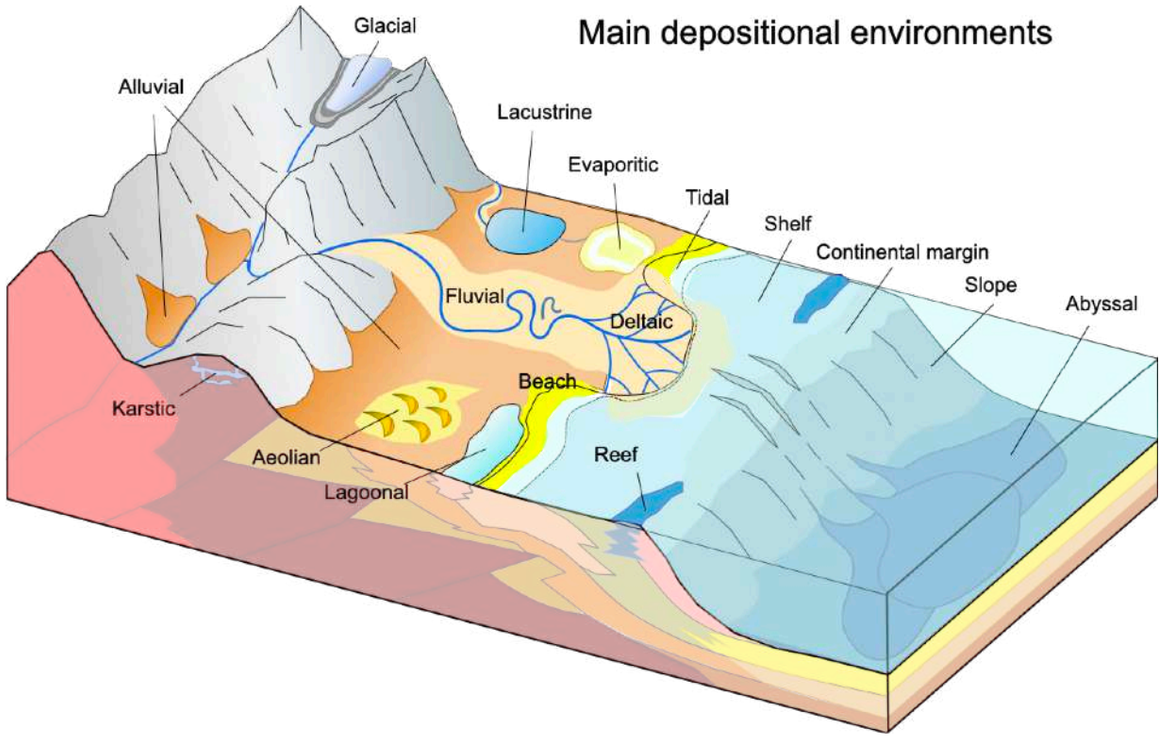
Sedimentary Environments

Depositional Environments

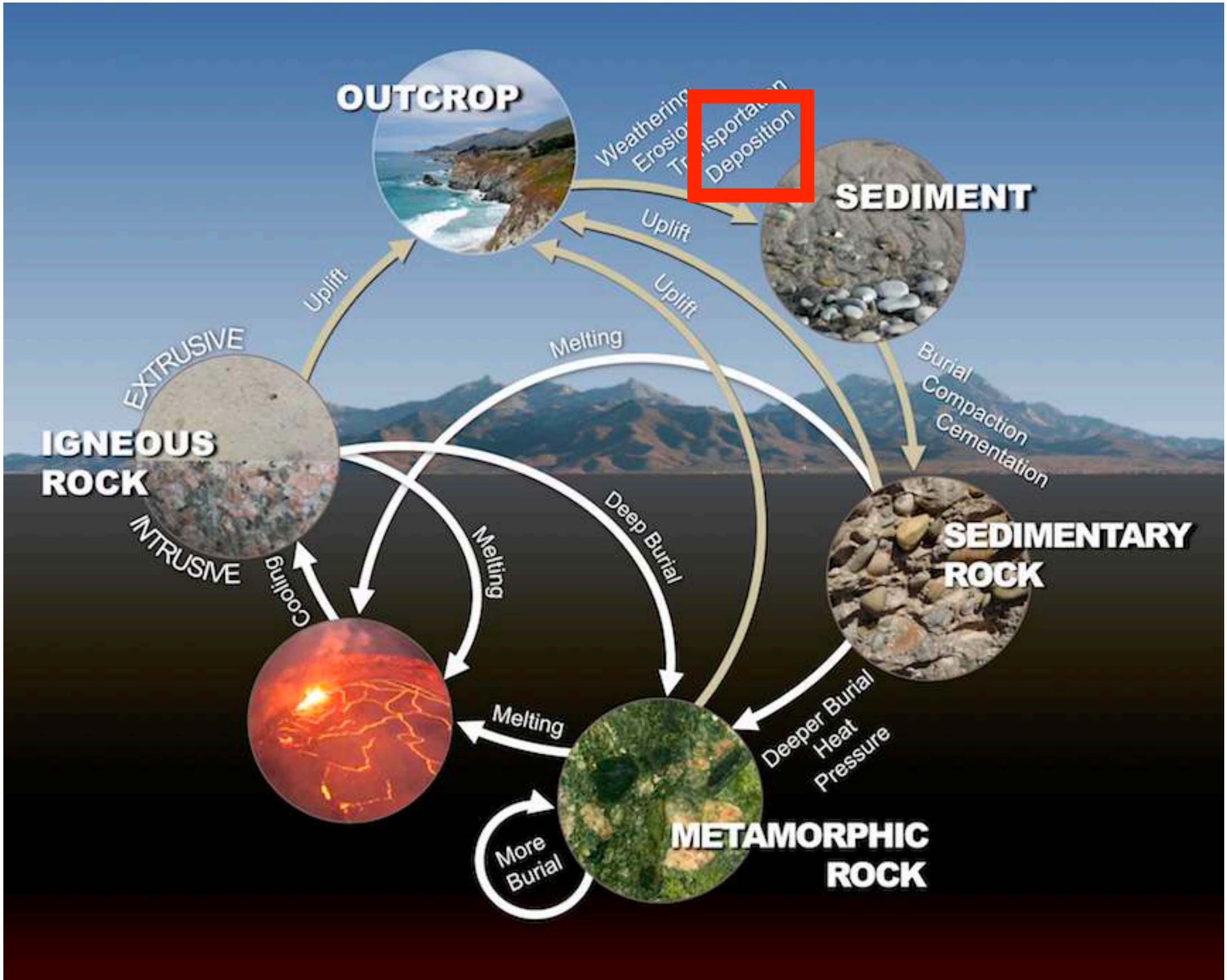
Continental Environments

Marine Environments

Transitional Environments

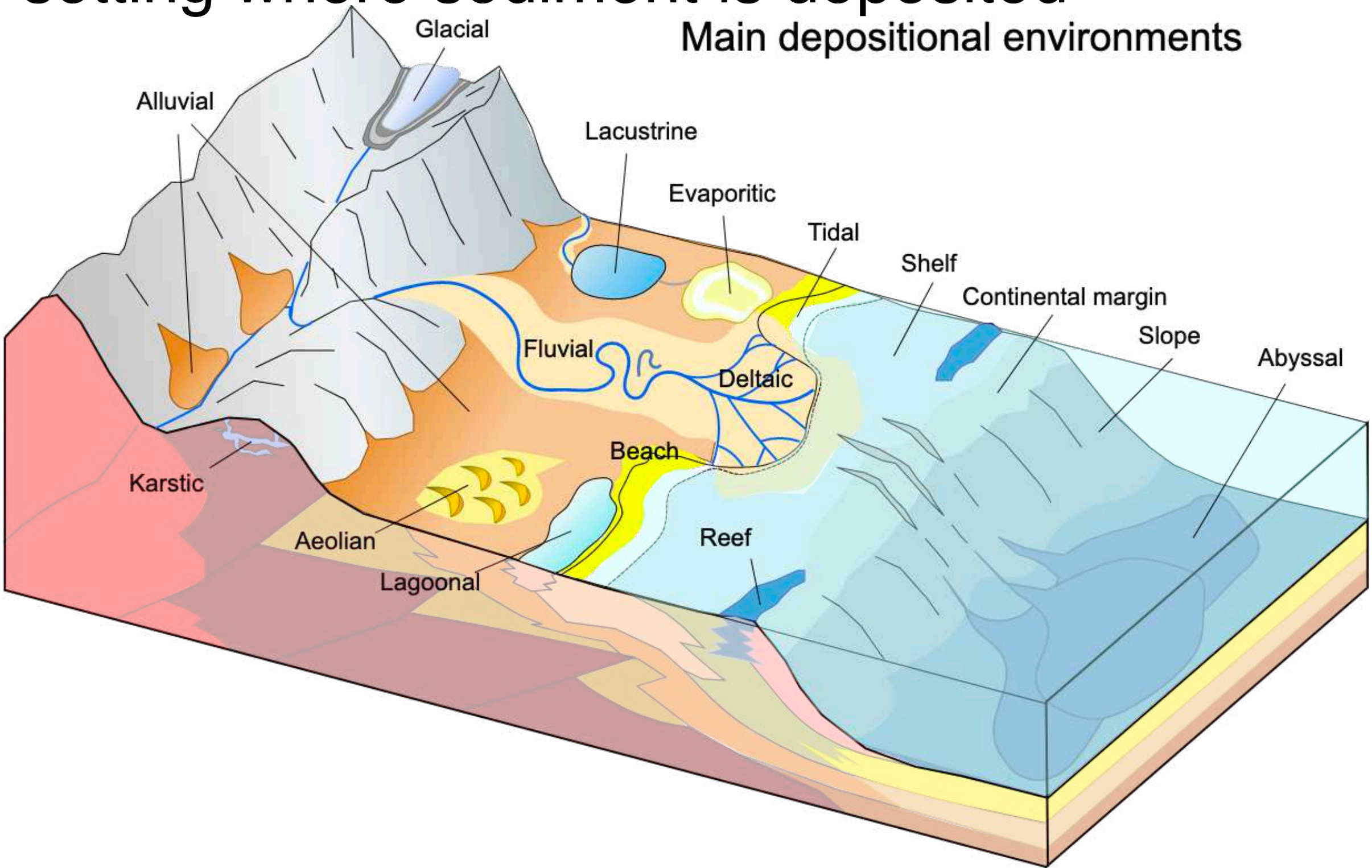


Depositional Environments



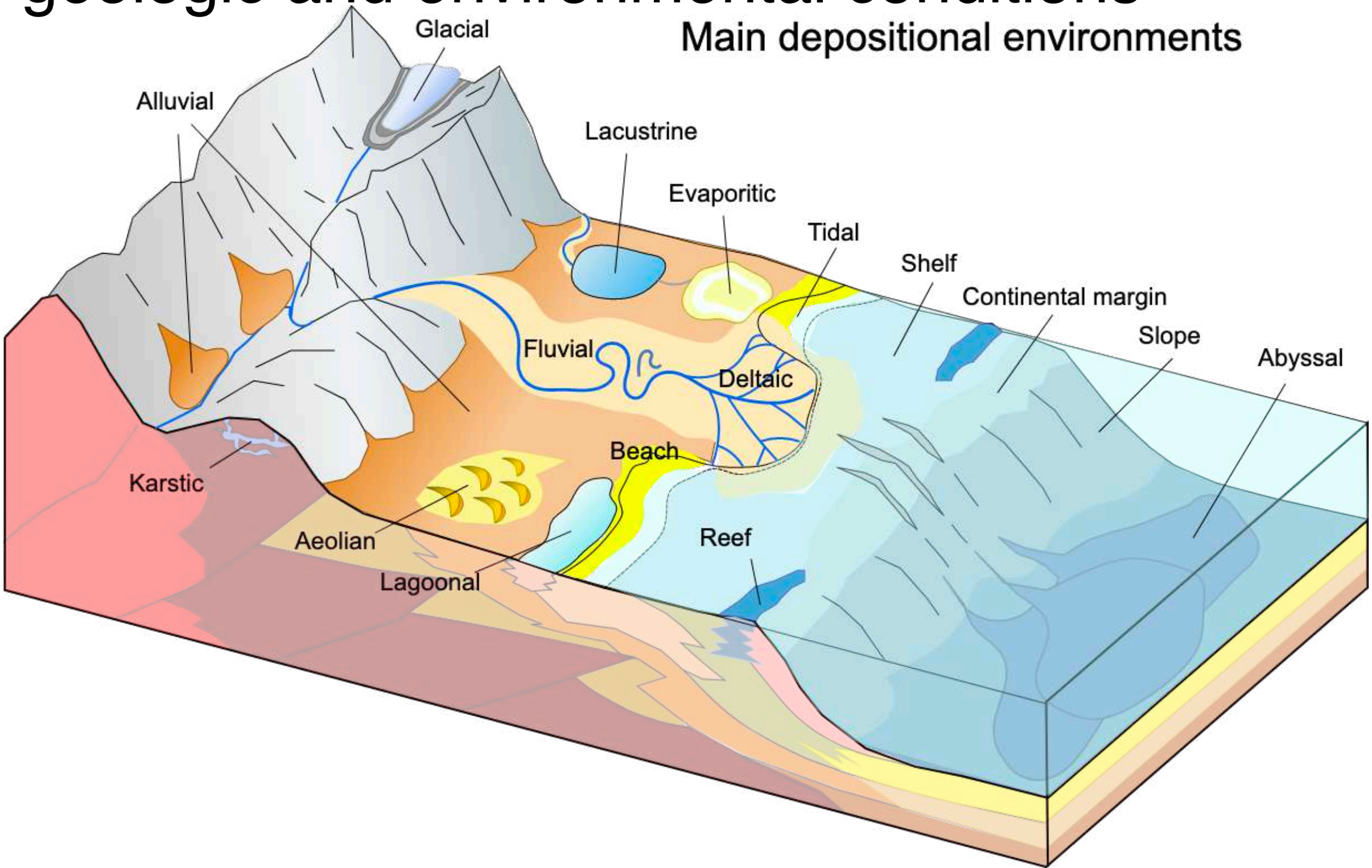
Depositional Environments

- A **depositional environment** is the geologic setting where sediment is deposited



Depositional Environments

- Type of sediment deposited depends on geologic and environmental conditions



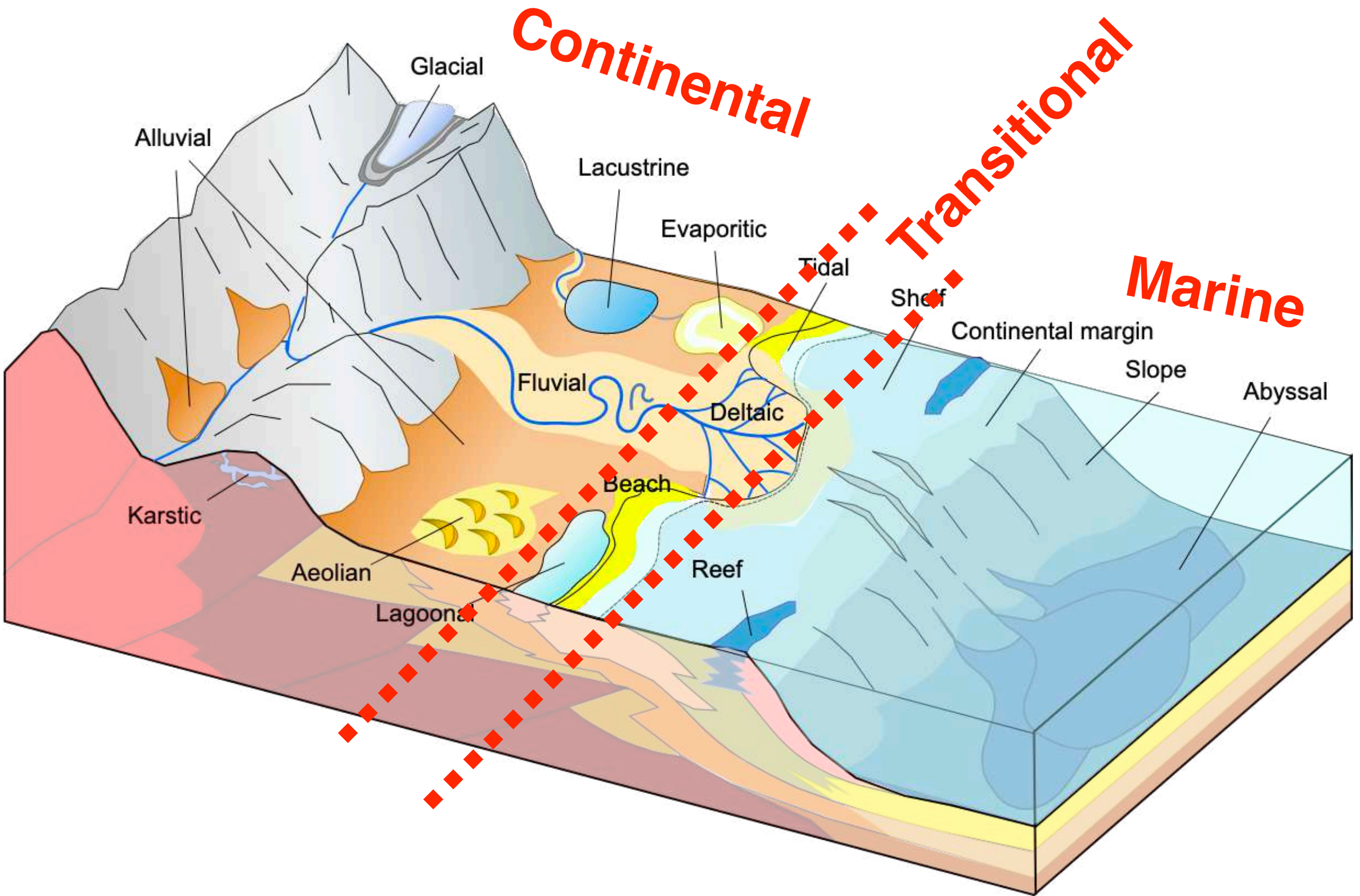
Depositional Environments

- We can study past environments by looking at sedimentary rocks and comparing them to modern environments

- **The present is the key to the past**
- Called “uniformitarianism”
- Processes occurring today occurred in the past

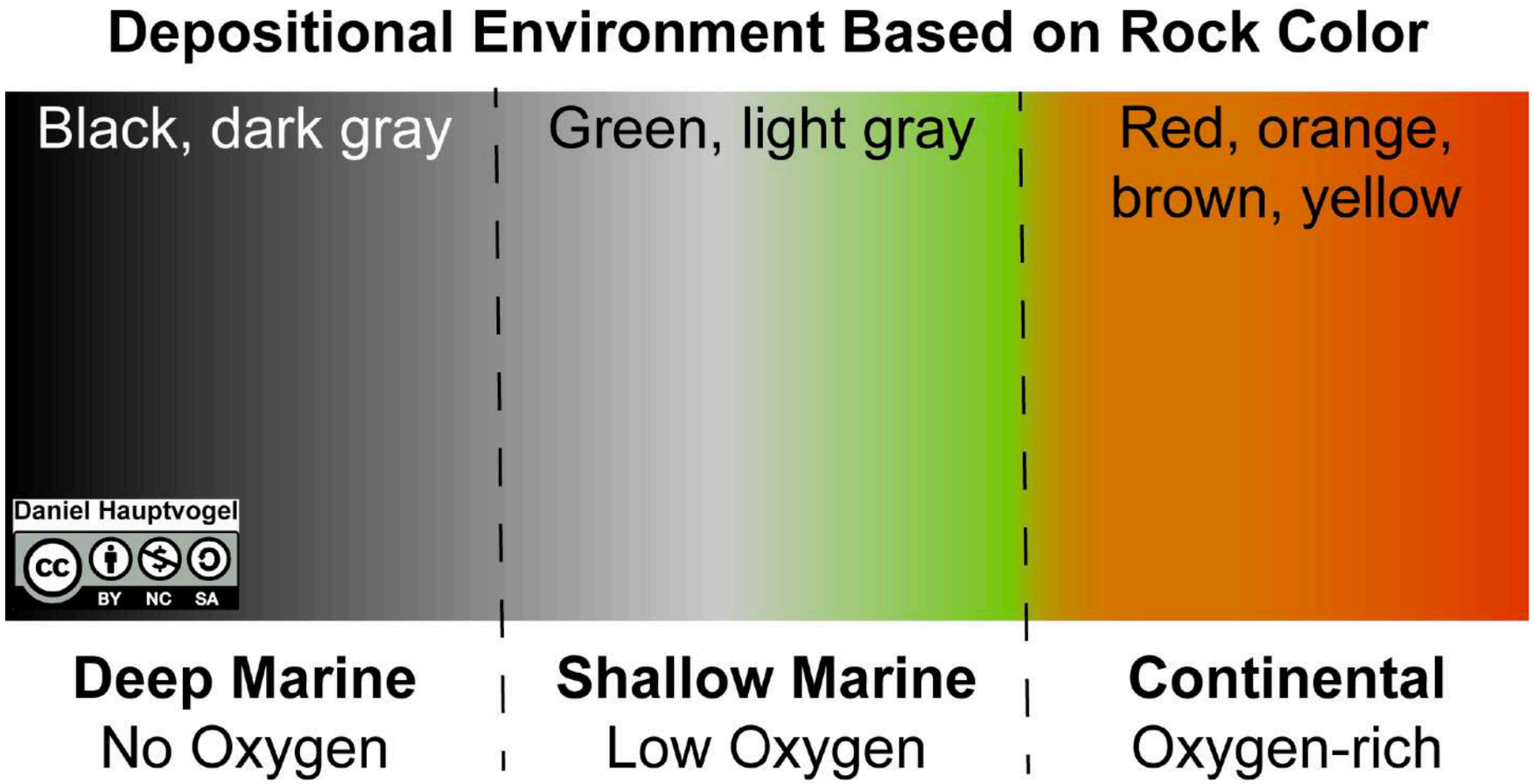
Depositional Environments

- Three broad depositional environments



Depositional Environments

- Where do you start?
- Rock color can help determine the environment (marine vs continent)
- Minerals and grain characteristics
- Sedimentary structures - patterns found in sedimentary rocks created by the environment



[Link to the table]

Environment	Description	Common Types of Sedimentary Rocks
Continental		
Aeolian	Sediment deposited by wind; primarily deserts and coastal regions; well-sorted sand; can be red in color; variable energy. Example in Google Earth: Algeria.	Sandstone
Alluvial	Fan-shaped deposits caused by moving water; usually found in arid or semi-arid regions; contains gravel, sand, silt, and/or clay; poorly sorted; high energy; creates alluvial fans. Example in Google Earth: Death Valley National Park, California.	Conglomerate, breccia, sandstone, shale
Fluvial	Sediment deposited by moving water, primarily rivers; can contain gravel, sand, silt, and/or clay depending on how fast the water moves; variable energy; commonly red in color from oxidation. Example in Google Earth: Upper Mississippi River in Illinois/Missouri.	Conglomerate, sandstone, shale
Lacustrine	Lake settings that can contain sand, silt, or clay; generally low energy. Example in Google Earth: Lake Winnipesaukee, New Hampshire.	Sandstone, shale
Glacial	Sediment deposited by glaciers; variable grain sizes; poorly sorted. Example in Google Earth: Southern Patagonia, Argentina.	Conglomerate, breccia, sandstone, shale
Evaporitic	Forms where water evaporates and leaves behind mineral precipitates. Example in Google Earth: Utah.	Limestone, rock salt, rock gypsum.
Transitional		
Beach	Along coastlines, sediment transported by wave action; contains well-sorted gravel and sand; high energy. Example in Google Earth: Island Beach State Park, New Jersey.	Sandstone
Deltaic	Where a river empties into a body of water; contains gravel, sand, and silt; low energy. Example in Google Earth: Yukon River, Alaska.	Sandstone, shale
Lagoonal	A shallow body of water separated from a larger body of water by barrier islands or reefs; very low energy; contains silt and clay. Example in Google Earth: East Matagorda Bay, Texas.	Limestone, shale, coal (swamps)
Tidal	Affected by the tides; mainly silt and clay; can create tidal flats; low energy. Example in Google Earth: Bay of Fundy, Nova Scotia.	Shale
Marine		
Shallow	Located on the continental shelf; mainly sand and silt; energy decreases with distance from shore. Example in Google Earth: Eastern Gulf of Mexico.	Sandstone, shale, limestone
Deep	The deep ocean; very low energy; mainly clay; can contain turbidite deposits of variable sediment sizes. Example in Google Earth: Pacific Ocean.	Shale, chert, limestone
Reef	A bar of rock, sand, or coral. Example in Google Earth: Great Barrier Reef, Australia.	Limestone

Continental Environments

- Continental environments include rivers, lakes, deserts, mountains, and glaciers

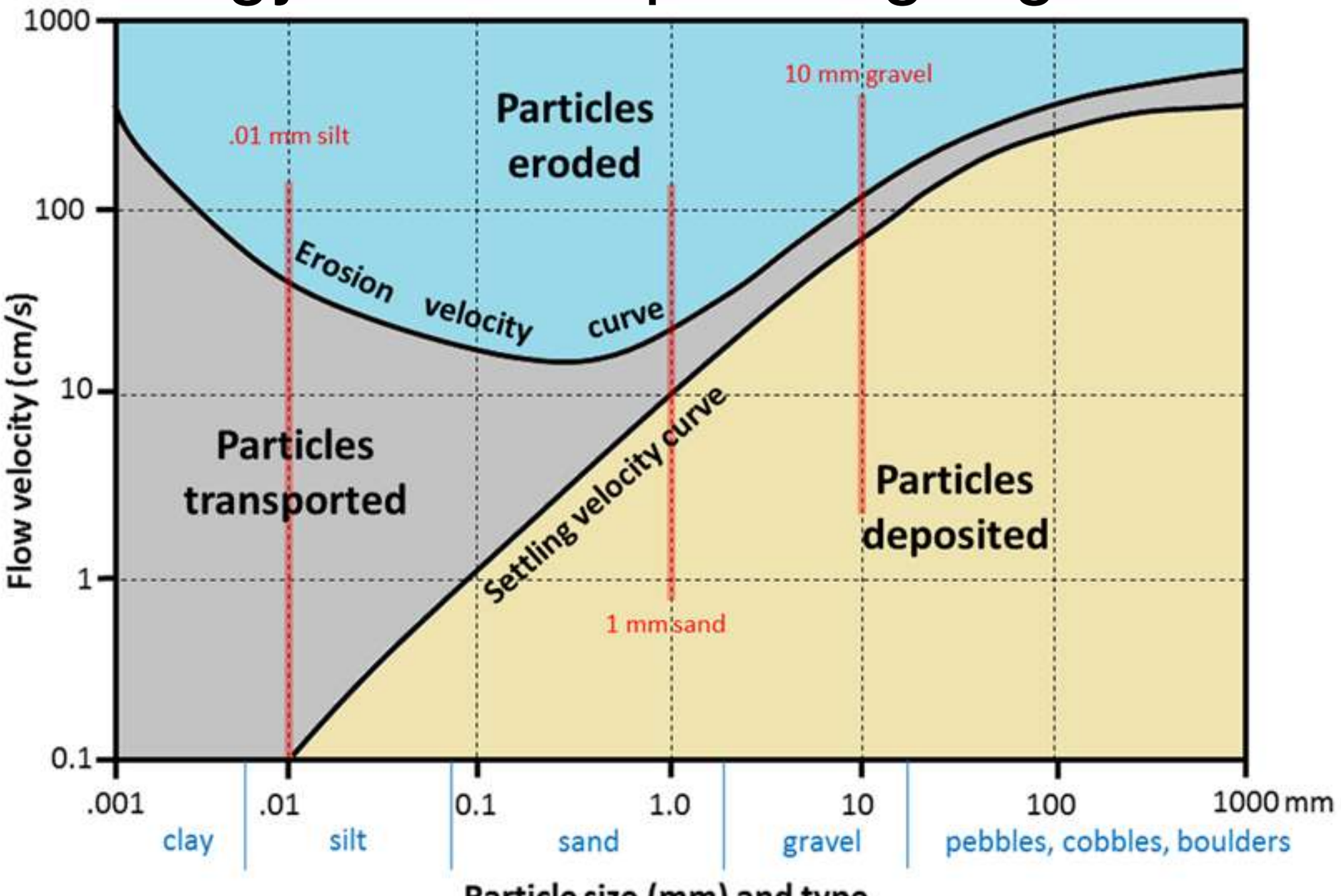
15, 2005 Tunghannock Creek photo by Bill Hecht

Continental Environments

- Continental environments are dominated by erosion and deposition of sediment by streams/rivers
- In some cold areas glaciers are the dominant process
- In arid regions (i.e. deserts) wind is the primary process
- Sediment deposited in continental environments is dependent on climate

Continental Environments

- Size of sediment deposited is dependent on the energy of the erosion medium
- Higher energy can transport larger gains

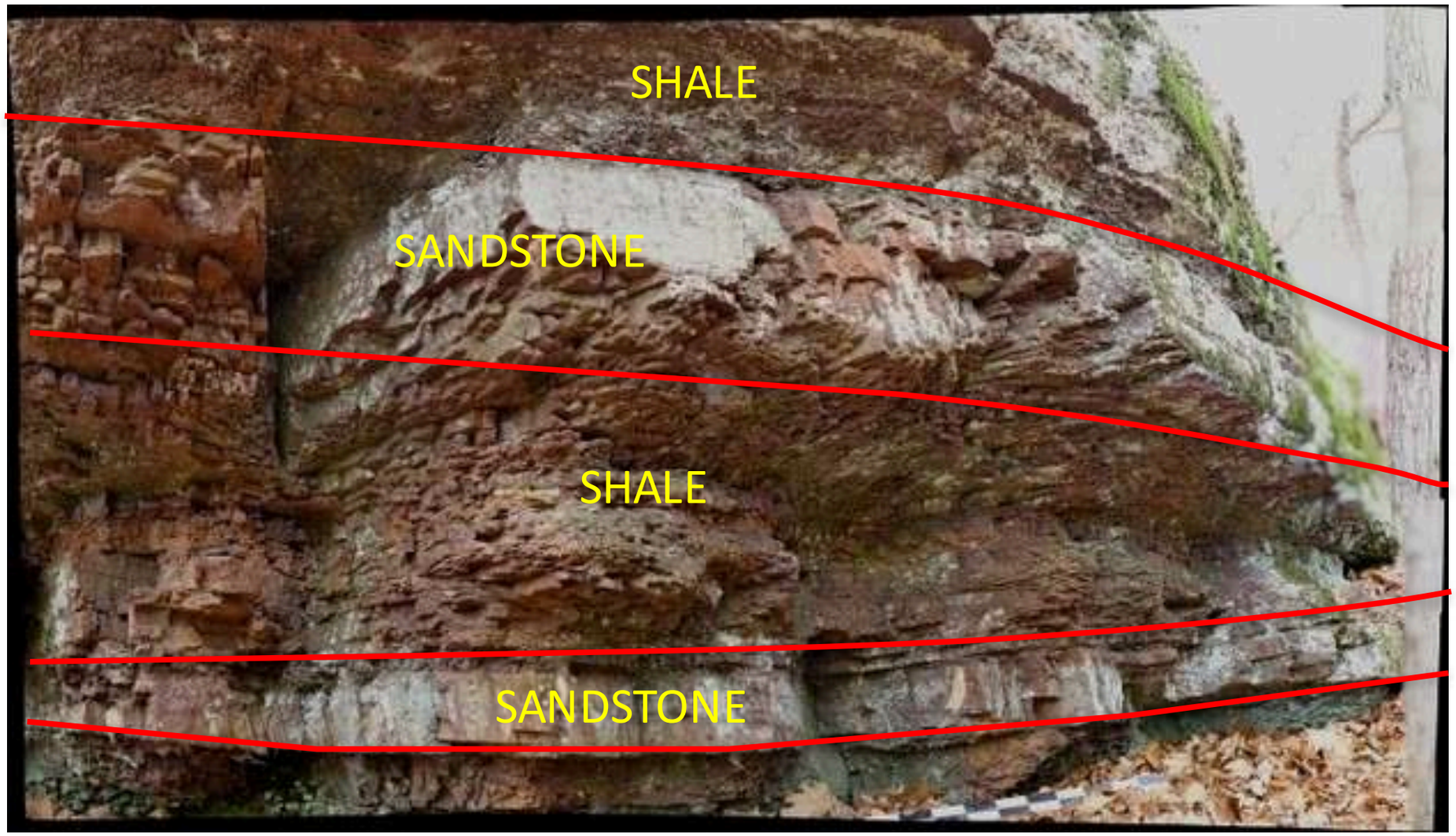


Continental Environments

- **River** environments will deposit sediment based on the energy of the water (how fast the river is flowing)

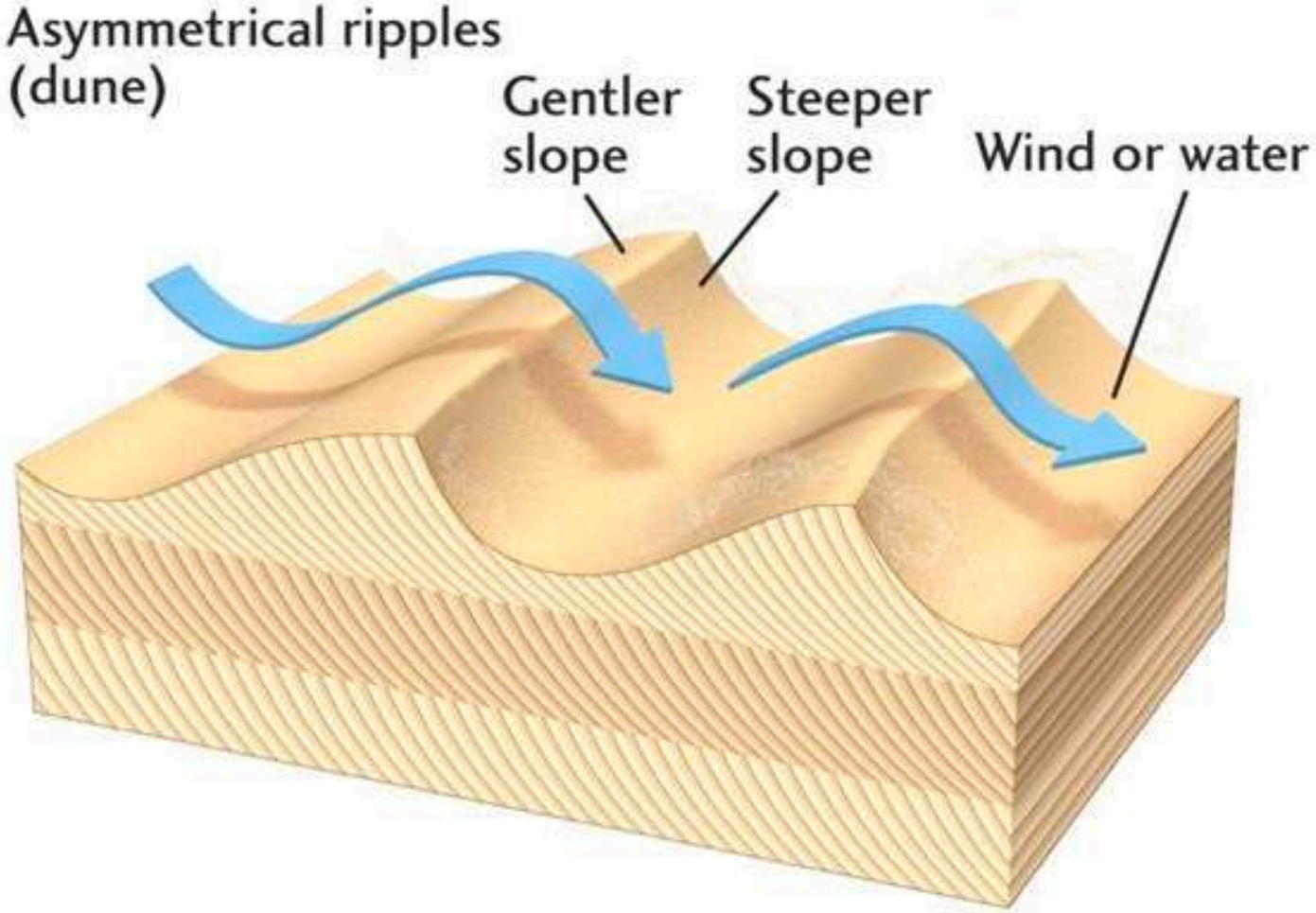
Continental Environments

- The sedimentary rocks formed from a river environment are usually red from oxidation
- Usually have alternating layers of sandstone and shale due to changes in flow velocity



Continental Environments

- Rivers can produce **asymmetrical ripple marks** and cross-bedding sedimentary structures
  - Indicator of unidirectional flow in air or water
  - Up the shallow side, down the steep side



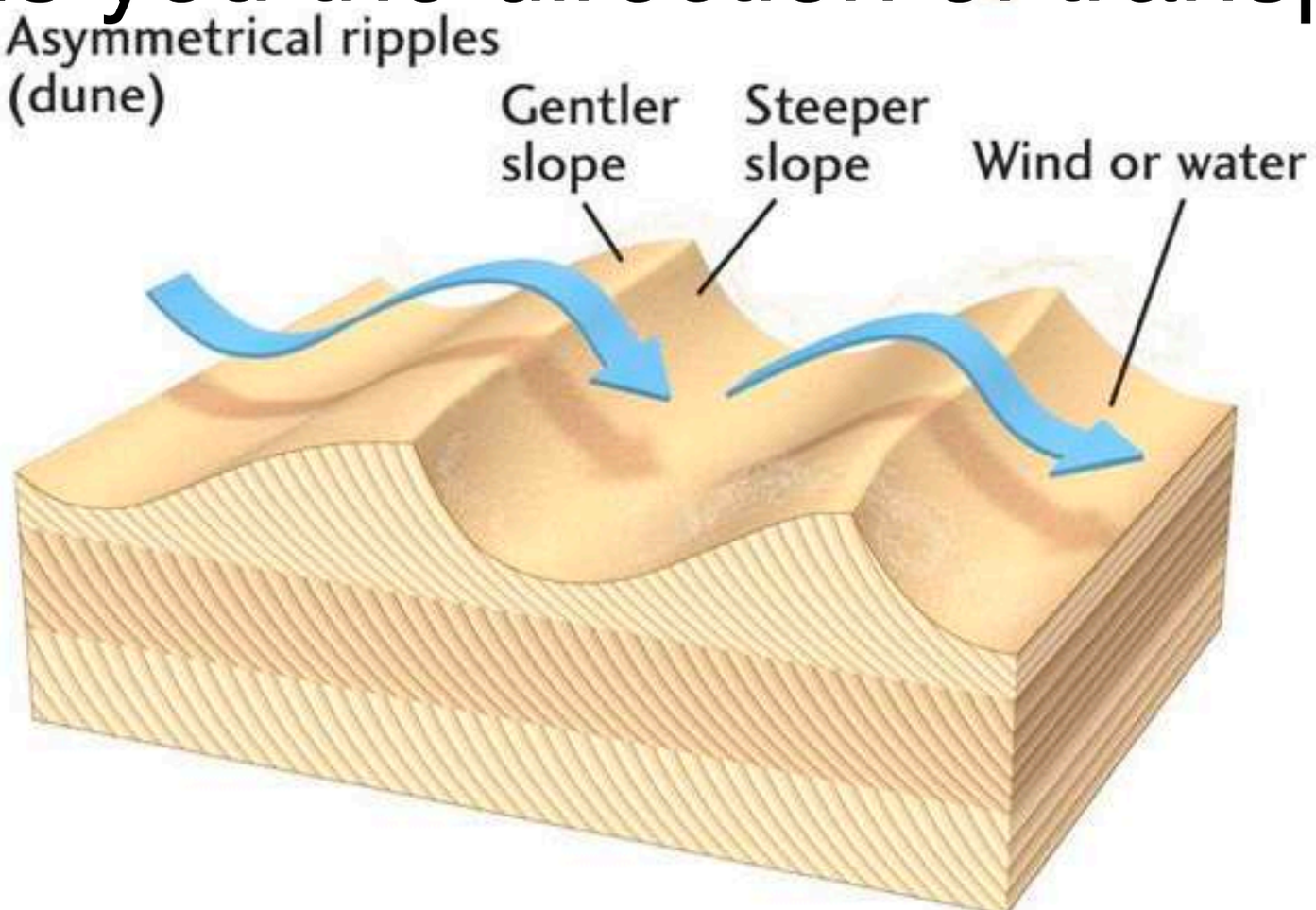
Continental Environments

- Rivers can produce **asymmetrical ripple marks** and cross-bedding sedimentary structures
  - Indicator of unidirectional flow in air or water

Continental Environments

Continental Environments

- When asymmetrical ripple marks pile on top of one another, they form **cross-bedding** sedimentary structures
  - Looks like small, angled layers within a sedimentary bed
  - Also tells you the direction of transport



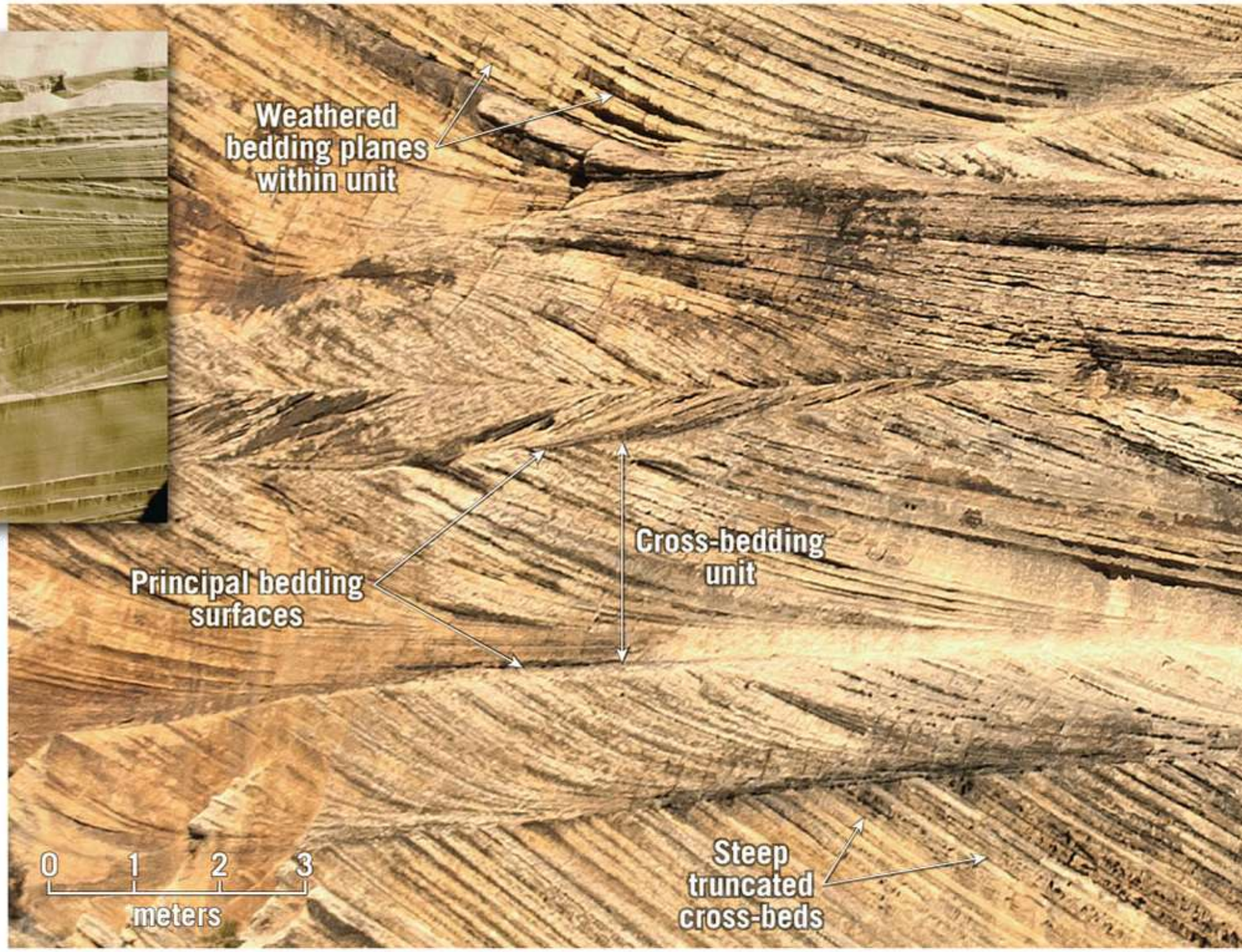
Continental Environments

Cross-Bedding:

Non-horizontal layering within individual beds.

John S. Shelton/ University of Washington Libraries

The cutaway section of this sand dune shows the characteristic cross-bedding



The cross-bedding in this sandstone indicates it was once a sand dune

Dennis Tas

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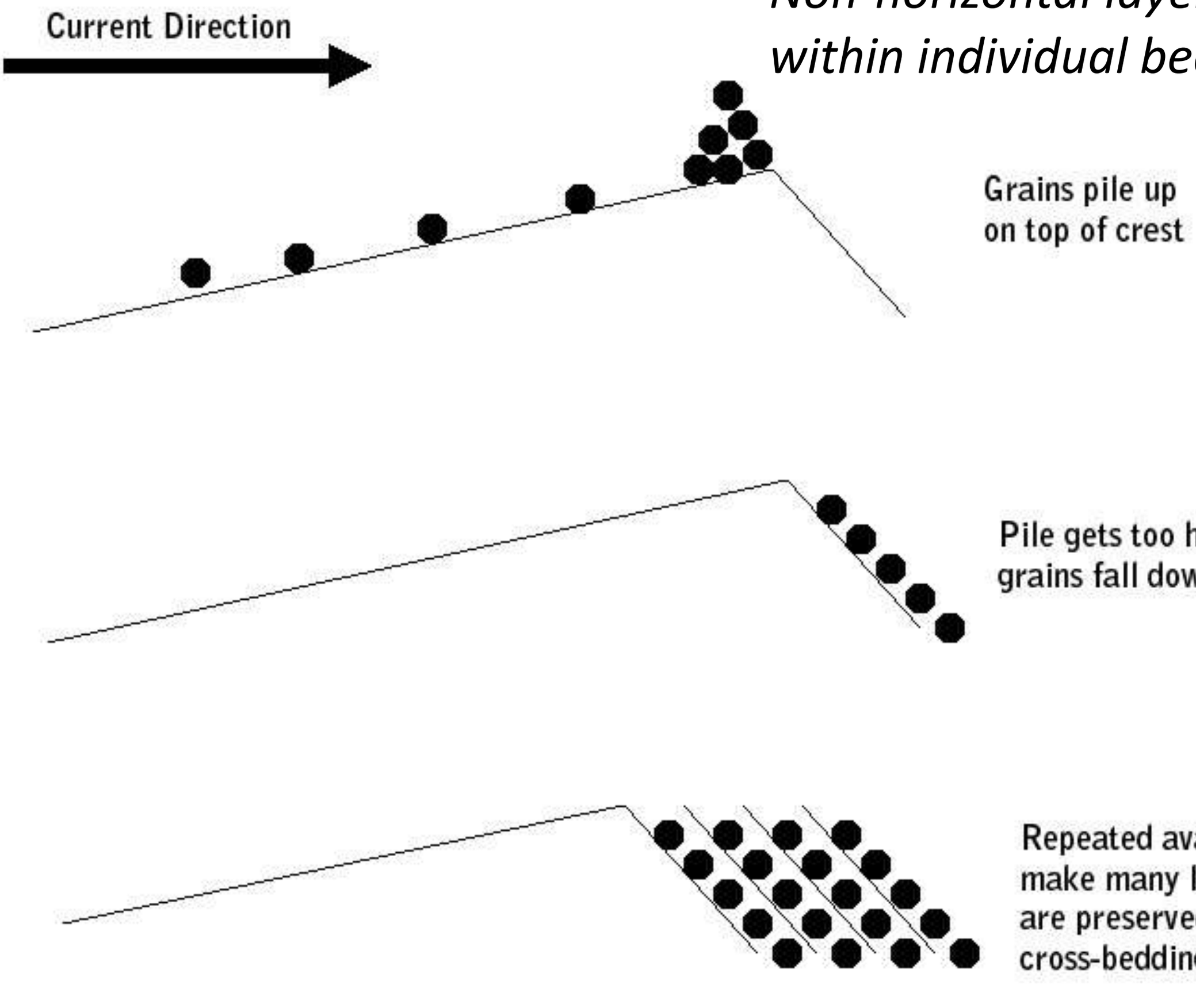
Continental Environments

Cross-Bedding:

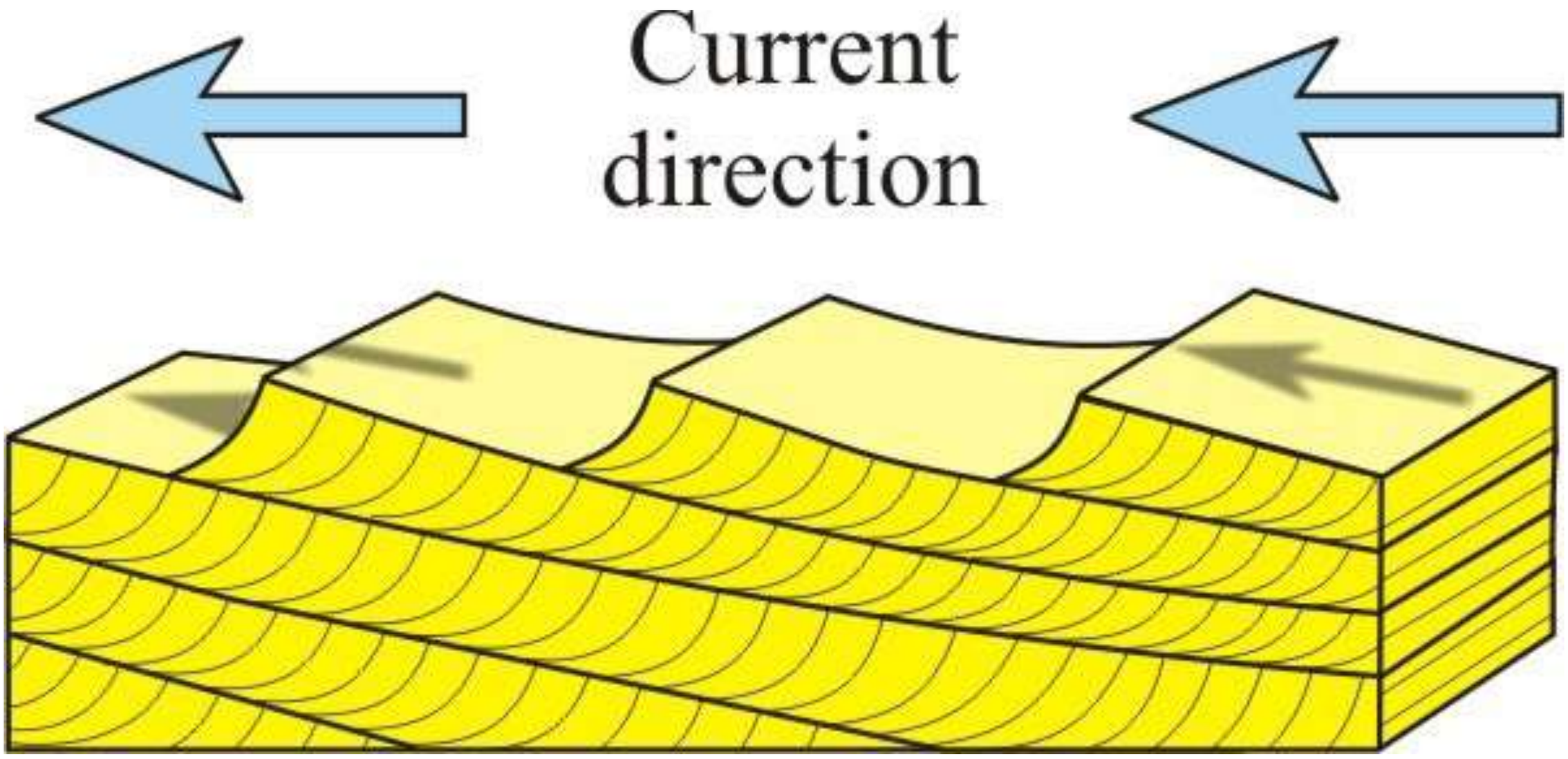
Non-horizontal layering within individual beds.



Continental Environments

Cross-Bedding:

Non-horizontal layering within individual beds.



Continental Environments

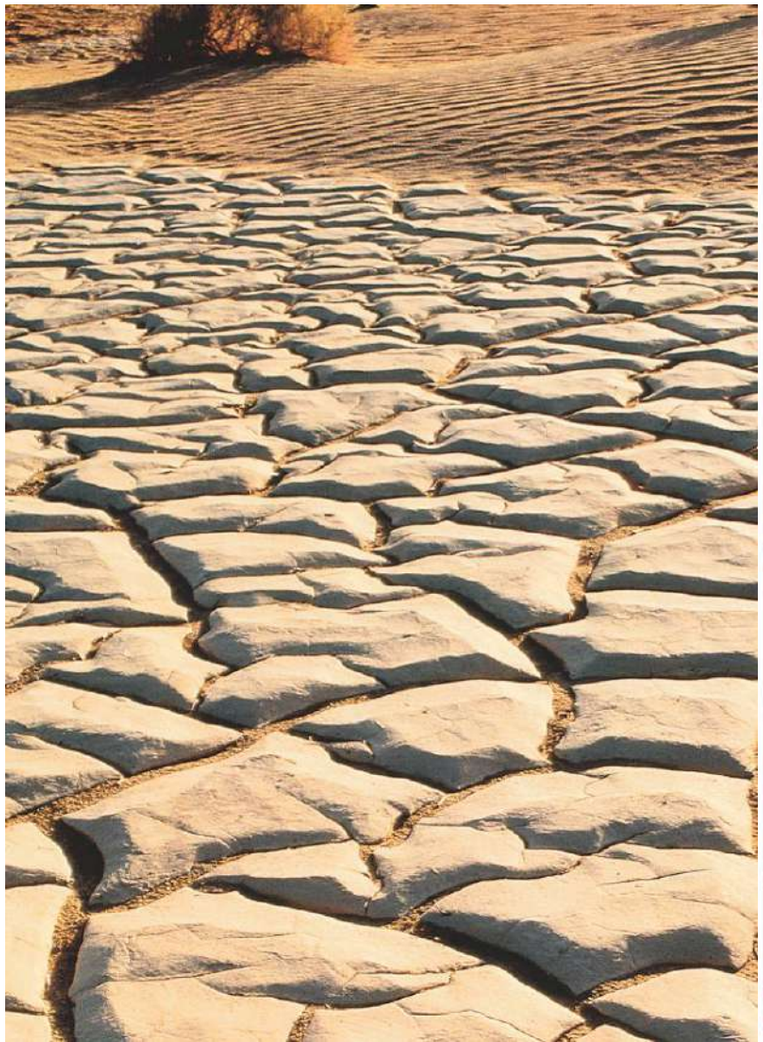
- Large-scale cross-bedding forms in arid environments from wind

Continental Environments

Continental Environments

- Other indications of river (or lake) environments are **mudcracks**
- Form when wet mud dries and shrinks
- Cracks can be filled in with new sediment

Modern



Ancient

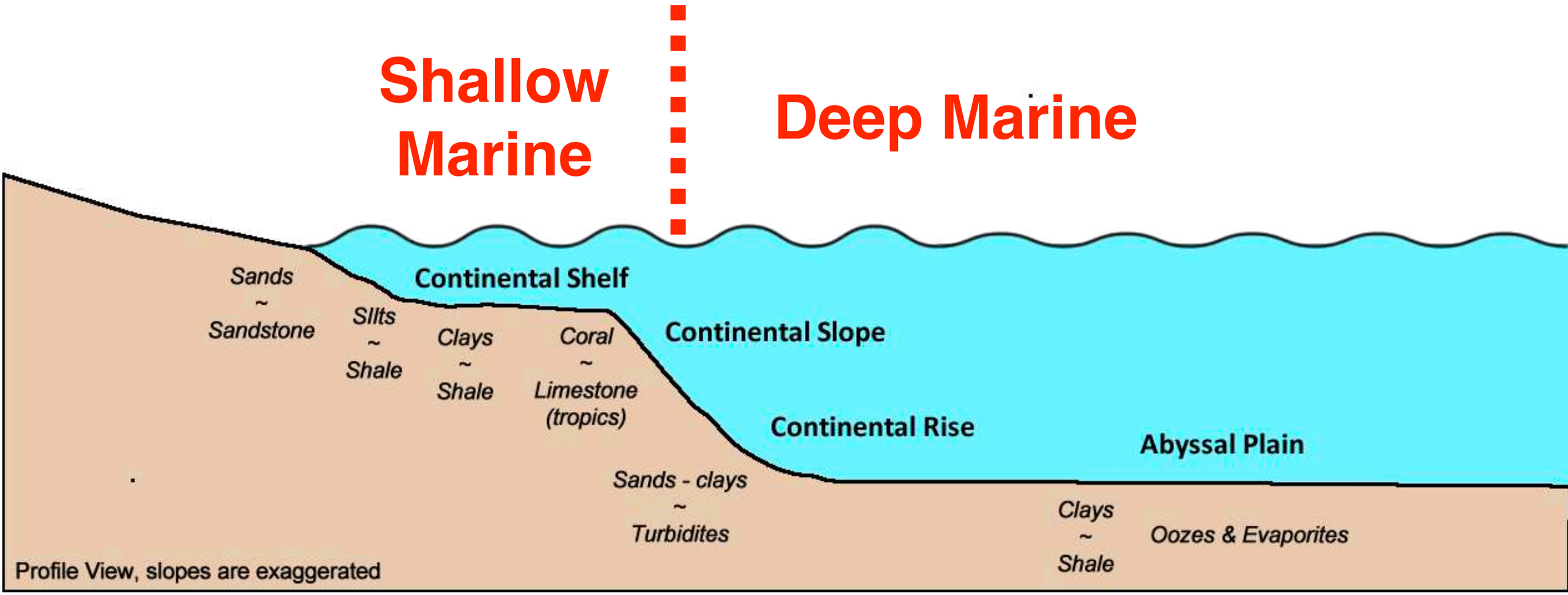
Modern Mudcracks

Modern Mudcracks

Raindrop Imprints

Marine Environments

- Marine depositional environments are located in the oceans
  - Primarily where limestones come from
  - Separated into shallow marine and deep marine

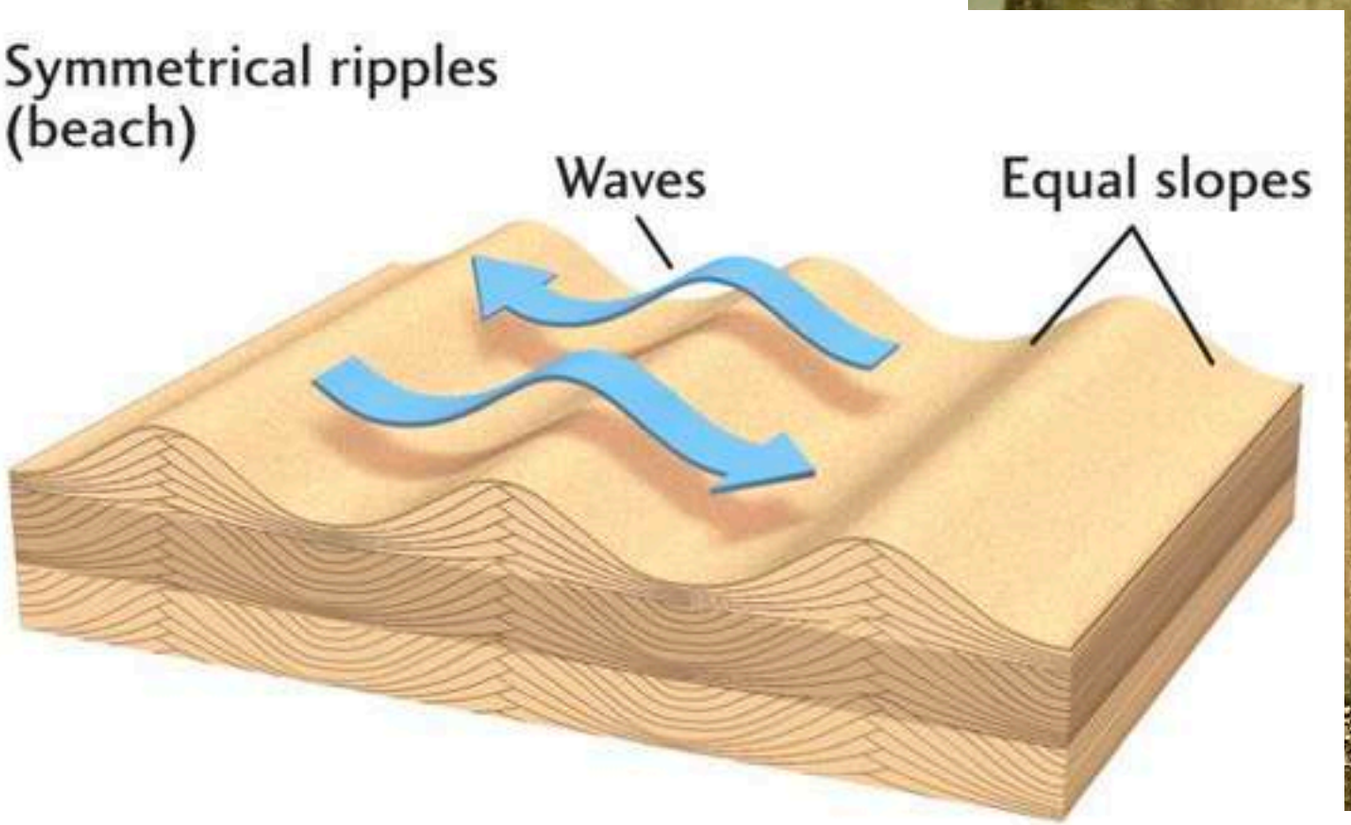


Marine Environments

- **Shallow marine** environments border the continents
  - On the continental shelf
    - Portion of the continent beneath sea level
  - Reach depths of ~200 m (656 ft)
  - Very wide at passive margins
  - Very narrow at active margins
  - Sediment deposited here is dependent on:
    - Distance from the shore
    - Elevation of adjacent land
    - Water depth and temperature
    - Climate

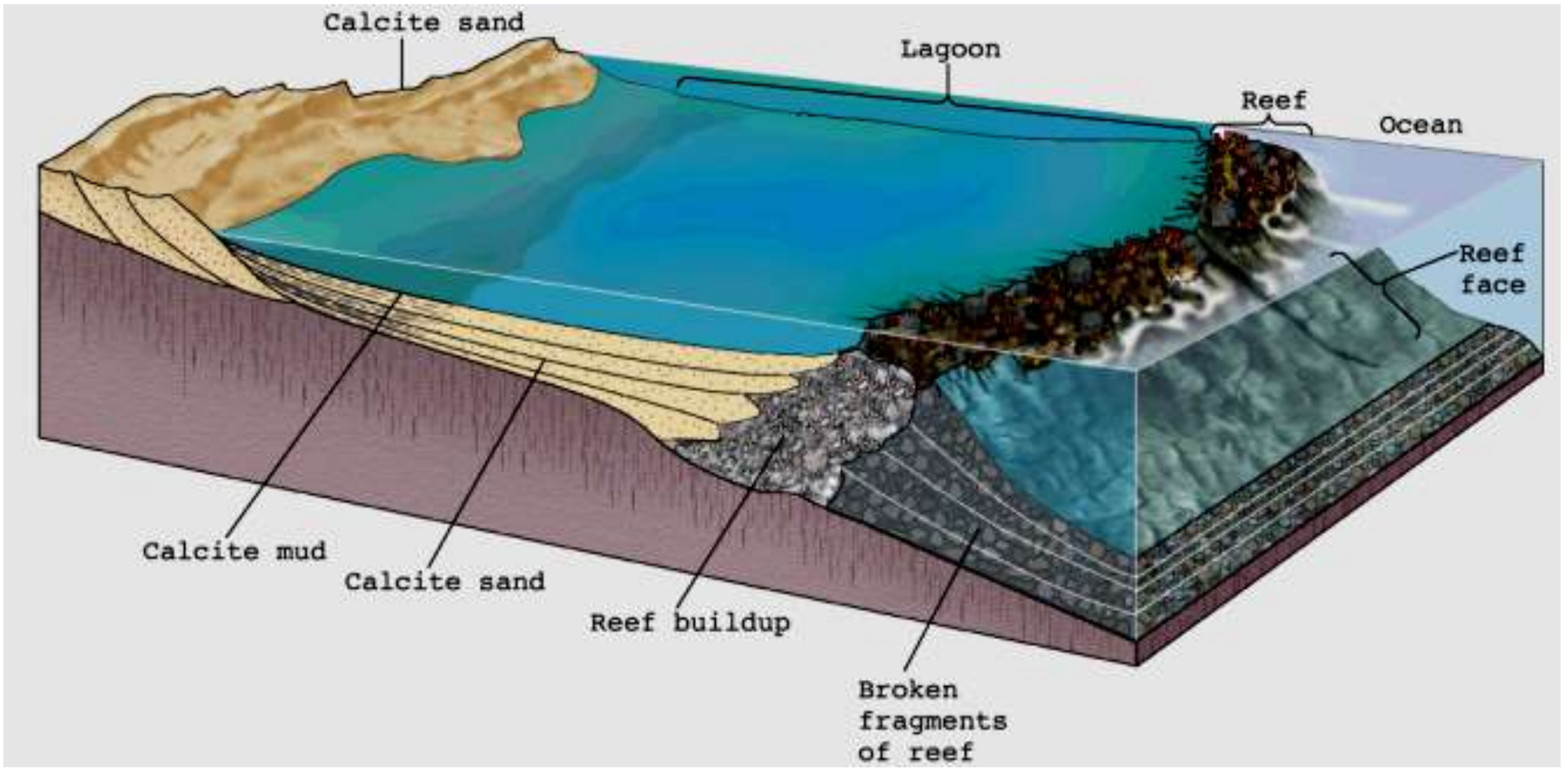
Marine Environments

- Shallow marine deposits are usually coarse grained, such as sandstone
  - May have symmetrical ripple marks preserved
  - Formed from back and forth movement of waves and tides



Marine Environments

Warm, shallow, tropical waters produce limestone



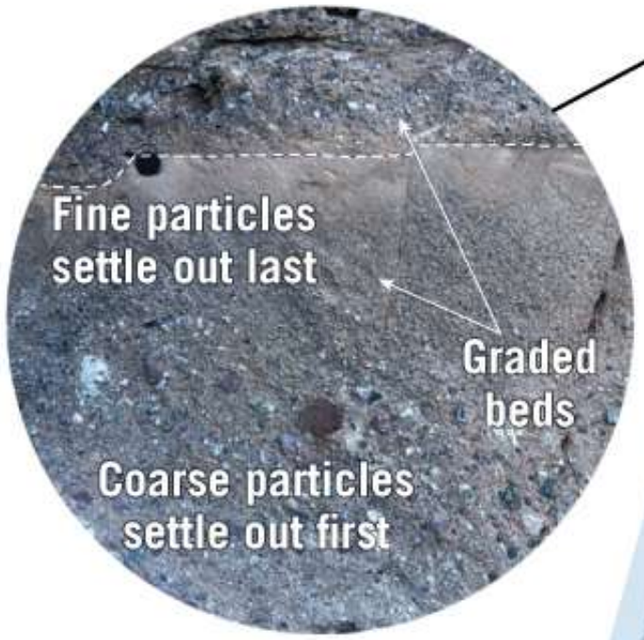
Marine Environments

- Deep marine environments include the floors of the deep ocean, far from the continents
  - Only the finest sediment particles
- Transition is the edge of the continental shelf
- Sediment moving down-slope: **Turbidity current**

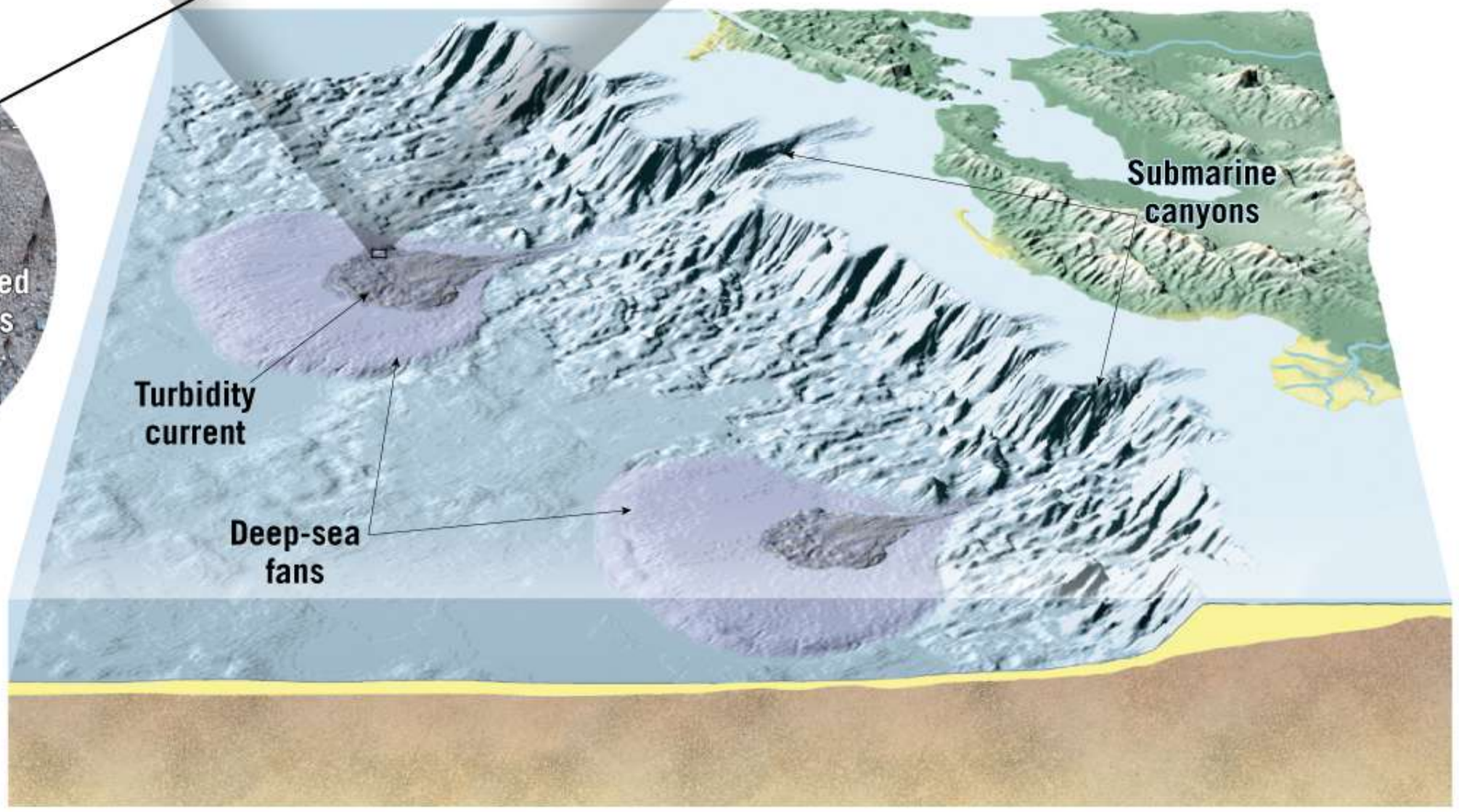
Marine Environments

Sediment moving down-slope: Turbidity current

Beds deposited by turbidity currents are called turbidites. Each event produces a single bed characterized by a decrease in sediment size from bottom to top, a feature known as graded bedding



Turbidity currents are downslope movements of dense, sediment-laden water. They are created when sand and mud on the continental shelf and/or slope are dislodged and thrown into suspension. Because the mud-choked water is denser than normal seawater, it flows downslope, eroding and accumulating more sediment



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Transitional Environments

- Transitional environments are along the shorelines and include beaches, tidal flats, lagoons, and river deltas (mouths)
- High energy environments can produce sandstones
- Low energy environments produce shales/ siltstones

Transitional Environments

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Transitional Environments

Transitional Environments

Previous Mississippi River deltas