Weathering and Erosion

OBJECTIVE:

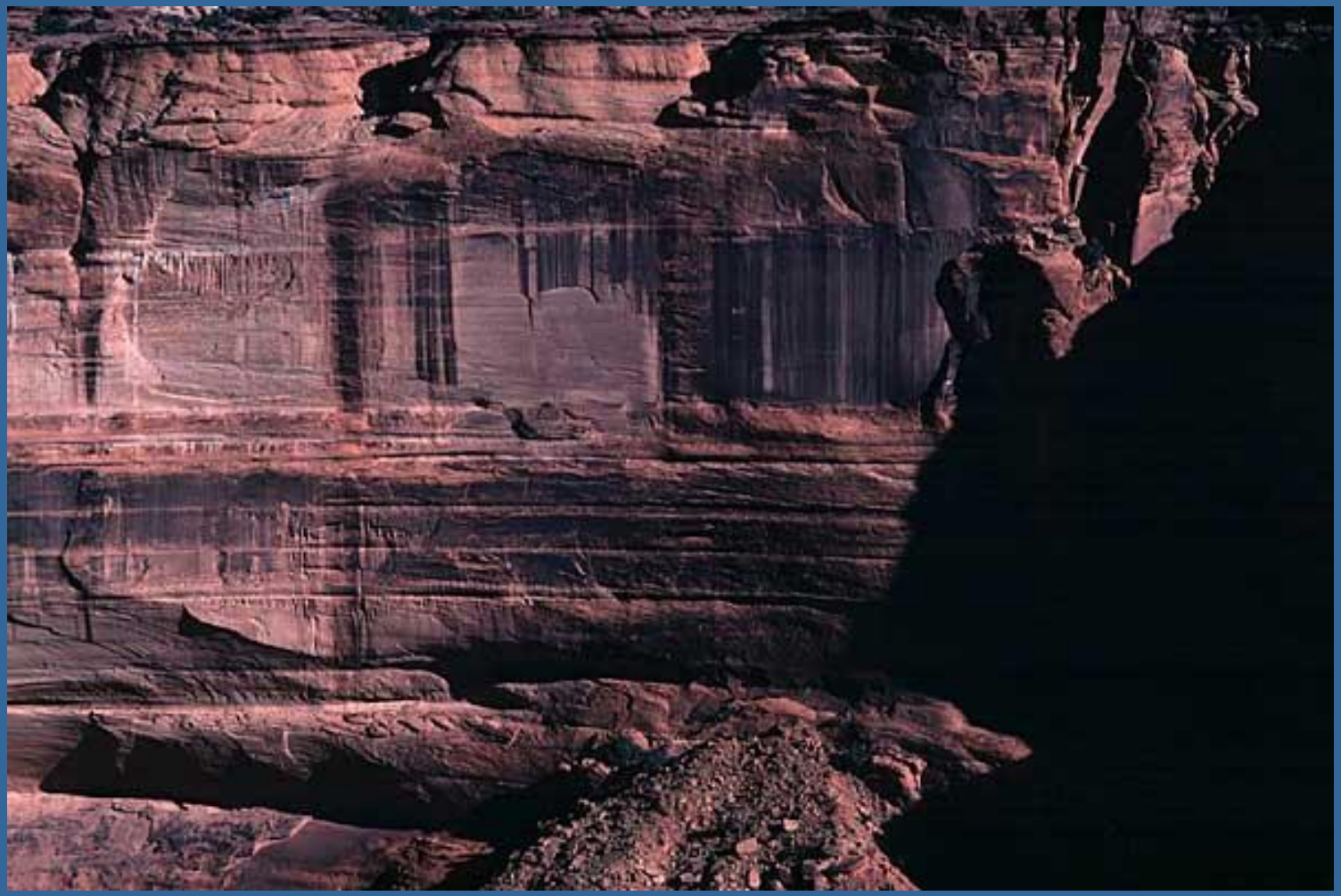
- Explain how erosion and deposition shape Earth’s surface by matching and using models

How do erosion and deposition shape Earth's surface?

Deposition Formation

Transported sediments are deposited in layers and generate strata like those found in the Grand Canyon.

Deposition Formation



Glaciers

Glaciers are large ice fields that slowly flow downhill over time.

http://images.encarta.msn.com/xrefmedia/sharemed/targets/images/pho/t628/T628797A.jpg

Glaciers

Glacial ice drags rocky material that scours the surface it flows over . The glacier deposits debris as it melts.

http://www.geology.um.maine.edu/user/Leigh_Stearns/teaching/kelley_island.jpg

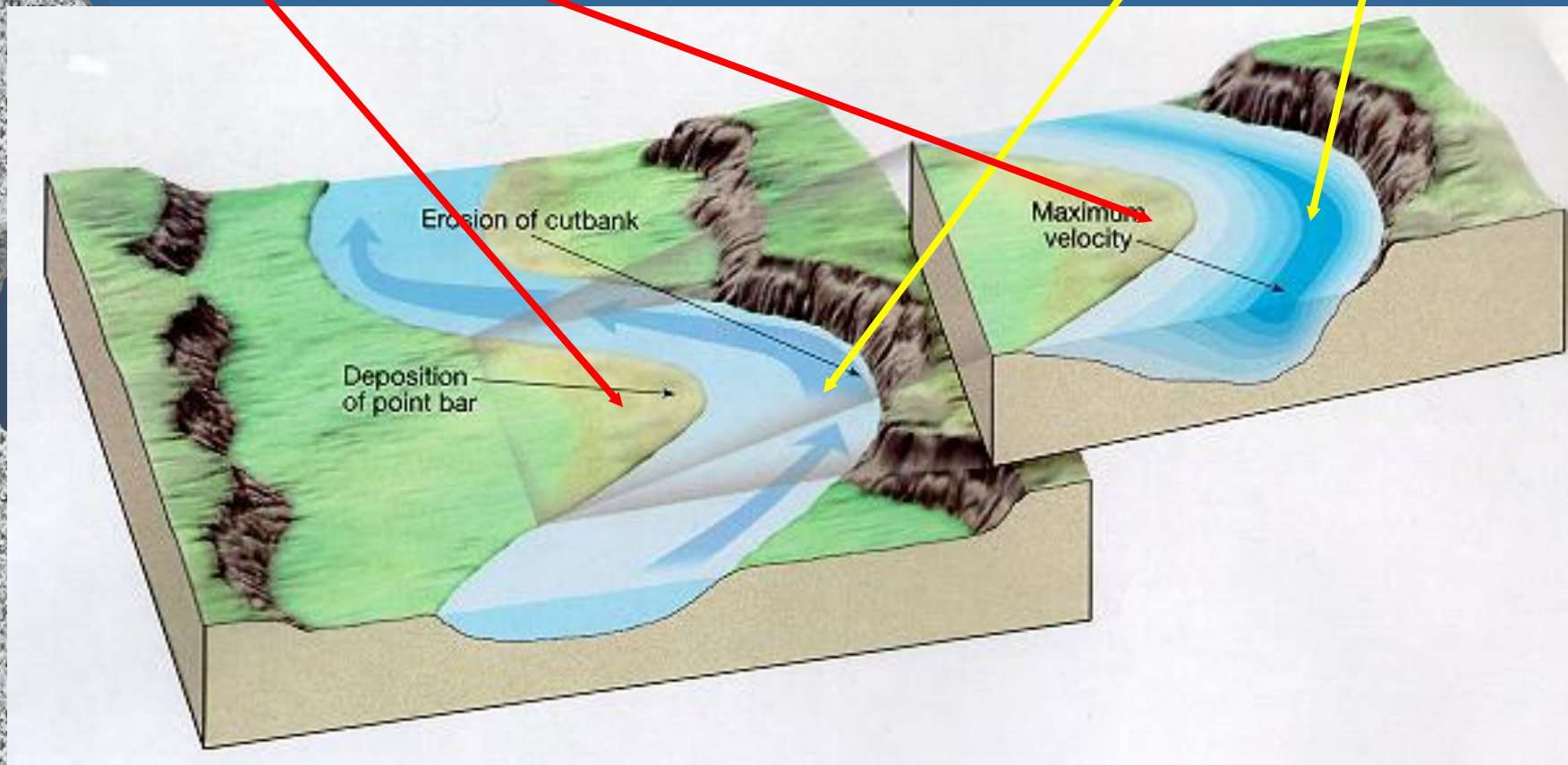
Streams

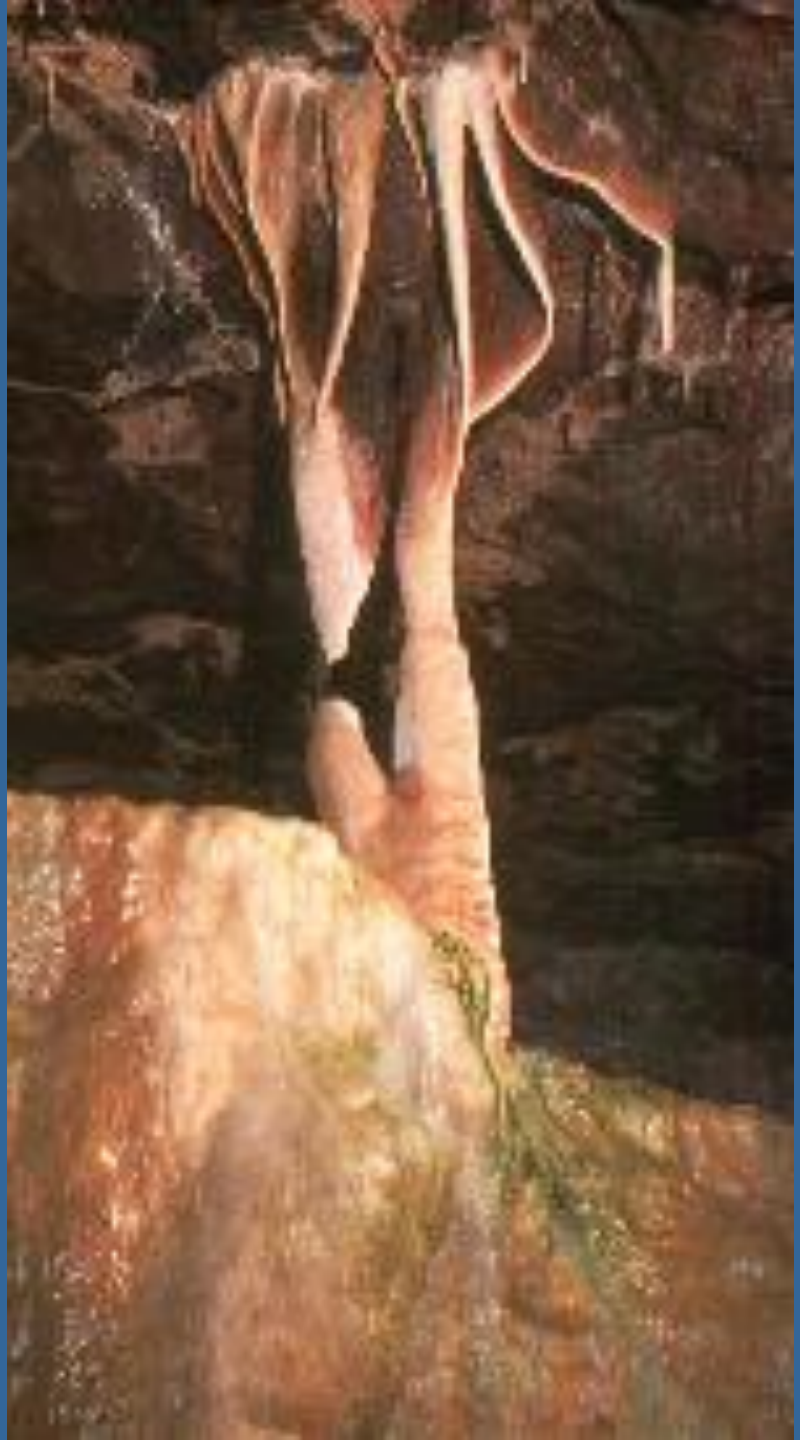
Flowing water will lift and carry small sediments such as silt and sand.

Stream Erosion and Deposition

Where water moves more swiftly there will be more erosion.

Where the water slows down, sediments will be deposited.





Limestone cave feature

result of dissolution

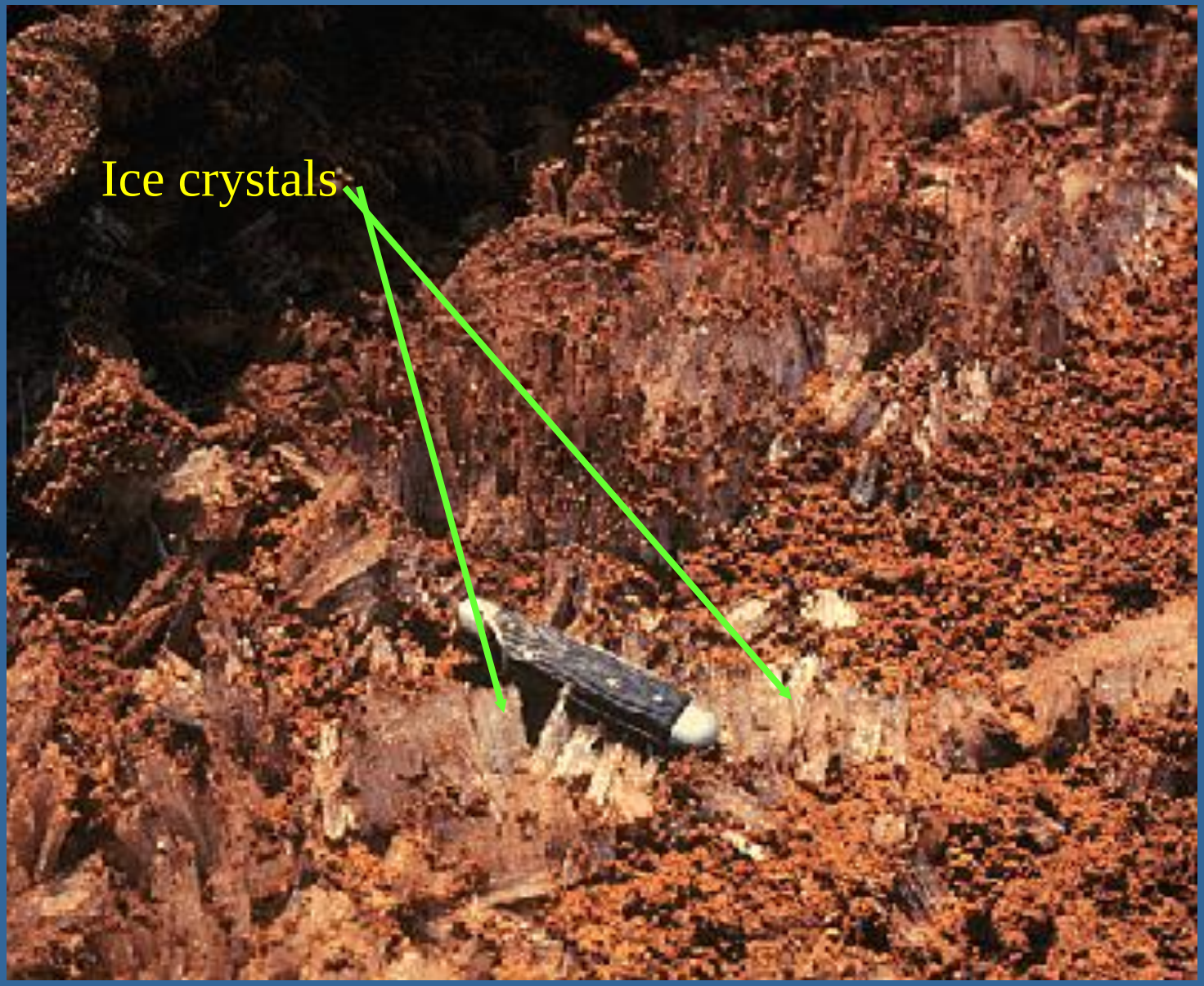
Plant Wedging

Plant Wedging

Processes and Agents of Mechanical Weathering

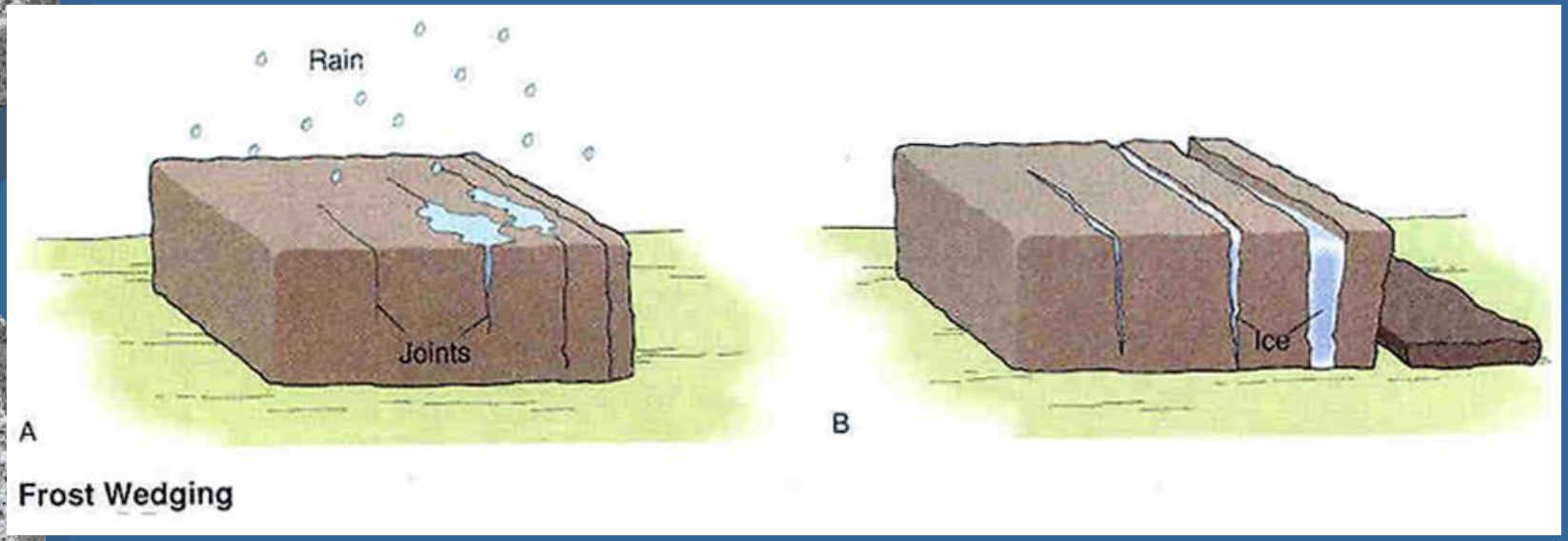
- Plant Growth – As plants such as trees send out root systems, the fine roots find their way into cracks in the rocks. As the roots increase in size, they force the rock sections apart, increasing the separation and weathering.

Frost Wedging (in soil)



Processes and Agents of Mechanical Weathering

- Frost Wedging – cracking of rock mass by the expansion of water as it freezes in crevices and cracks



http://www.uwsp.edu/geo/faculty/ozsvath/images/frost%20wedging.jpg

Processes and Agents of Mechanical Weathering

- Thermal expansion and contraction –

  repeated heating and cooling of materials cause rigid substances to crack and separate

http://content.answers.com/main/content/wp/en-commons/thumb/d/dc/250px-Weathering_freeze_thaw_action_iceland.jpg

Wind and Water Abrasion

http://www.gsi.ie/Education/European+Landscapes/United+Kingdom.htm Photo Ref: P211442, "IPR/52-34CW BGS©NERC

Ocean Dynamics

- Tidal action and waves carry away weathered materials.

http://edge.tamu.edu/waves2001/PC_tour/erosion_files/image002.jpg

http://www.dkimages.com/discover/previews/1000/50195183.JPG

Transport by Gravity

When sediments are weathered they may be transported downward by gravity. The general term for this is mass wasting.

http://en.wikipedia.org/wiki/Mass_wasting

Transport by Gravity

When sediments are weathered they may be transported downward by gravity as a slump.

http://new.filter.ac.uk/database/image.php?id=594

Transport by Gravity

Loose sediments transported by gravity are called scree.

http://www.dave-stephens.com/scrambles/banff/aylmer/aylmer013.jpg

Wind Abrasion

http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/images/lithosphere/eolian/rock_wind_abrasion_p0772932441_NRCS.jpg

Wind Transport of Sediments

Wind will carry fine, dry sediments over long distances.

Wind Transport of Dust

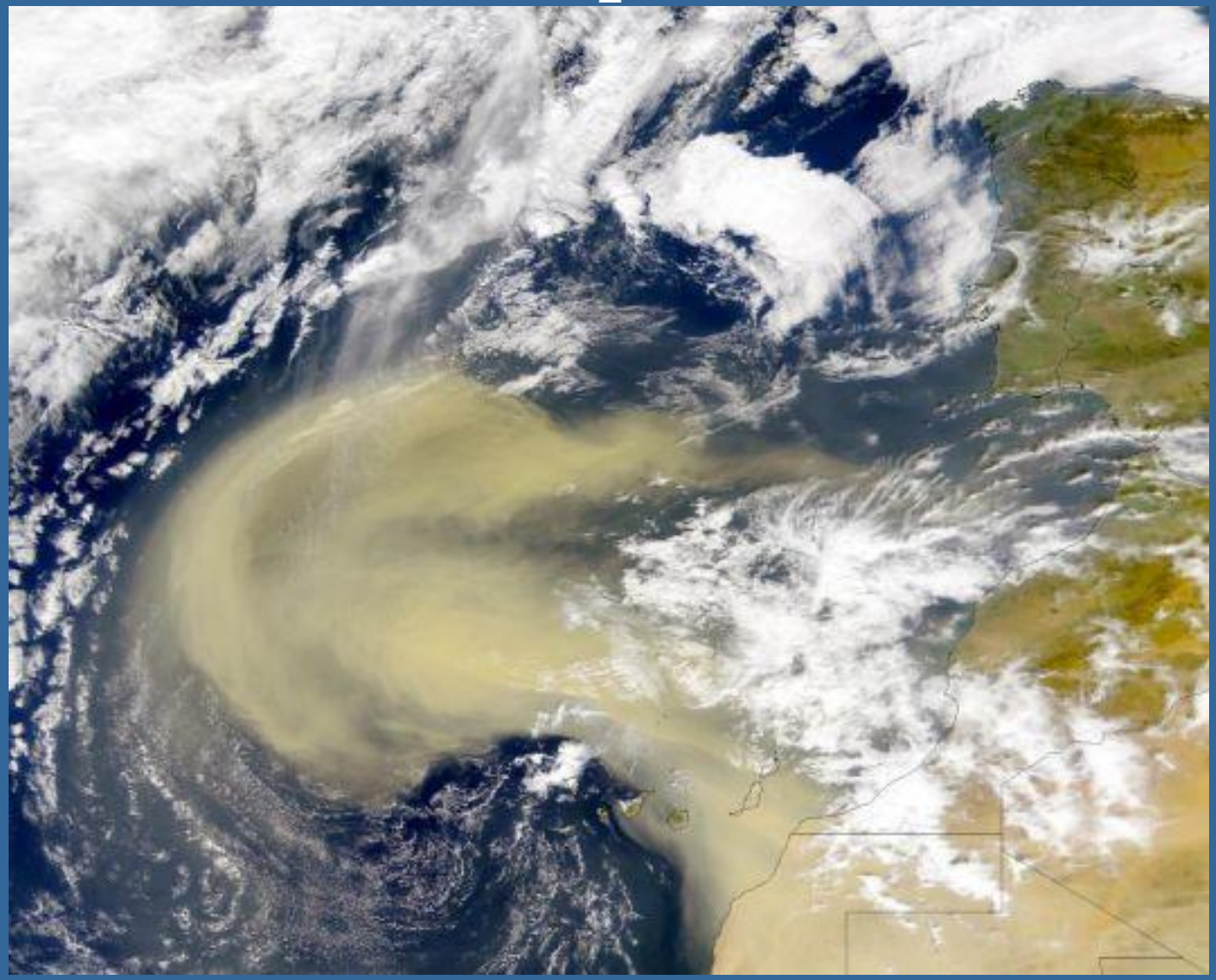


Photo shows Sahara Desert sand being transported over the Atlantic Ocean.

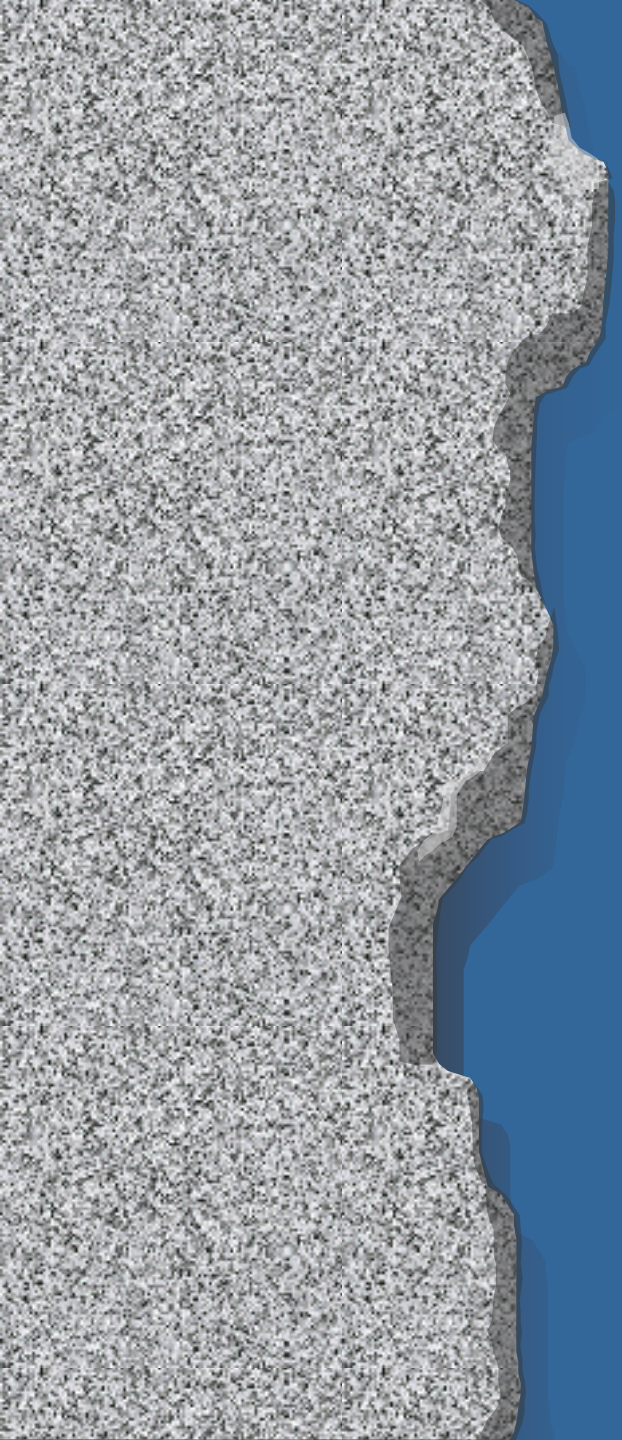
Think !?!

- What is the difference between erosion and weathering?

Weathering and Erosion

Weathering - processes at or near Earth's surface that cause rocks and minerals to break down

Erosion - process of removing Earth materials from their original sites through weathering and transport



Weathering

Mechanical Weathering - processes that break a rock or mineral into smaller pieces without altering its composition

Chemical Weathering - processes that change the chemical composition of rocks and minerals

Processes and Agents of Mechanical Weathering

These are actions or things that break down Earth materials

- frost wedging
- thermal expansion and contraction
- mechanical exfoliation
- abrasion by wind, water or gravity
- plant growth

Processes and Agents of Mechanical Weathering

- Exfoliation – As underlying rock layers are exposed, there is less pressure on them and they expand. This causes the rigid layers to crack and sections to slide off (similar to peeling of outer skin layers after a sunburn). The expanding layers often form a dome.

Dome Exfoliation

Processes and Agents of Mechanical Weathering

- Abrasion – Moving sediments or rock sections can break off pieces from a rock surface they strike. The sediments can be moved by wind or water and the large rock sections by gravity.

Processes of Chemical Weathering

- dissolving (dissolution)
- oxidation
- hydrolysis

Statue of Liberty

http://www.cleanvideosearch.com/media/action/yt/watch?v=_ZSLrXtg1-o

After watching the video, explain why the Statue of Liberty is a blue/green color!!!!!

Processes of Chemical Weathering

Dissolving (dissolution)

Water, often containing acid from dissolved carbon dioxide, will dissolve minerals from a rock body leaving cavities in the rock. These cavities may generate sinkholes or cave features such as stalactites and stalagmites.

Processes of Chemical Weathering

Oxidation

Minerals may combine with oxygen to form new minerals that are not as hard. For example, the iron-containing mineral pyrite forms a rusty-colored mineral called limonite.

Pyrite Oxidation

http://www.windows.ucar.edu/earth/geology/images/pyrite_sm.jpg

Pyrite

http://www.dkimages.com/discover/previews/965/75014124.JPG

Limonite

Processes of Chemical Weathering

Hydrolysis

Minerals may chemically combine with water to form new minerals. Again these are generally not as hard as the original material.

Feldspar Hydrolysis

http://www.mii.org/Minerals/Minpics1/Plagioclase%20feldspar.jpg

http://www.uwm.edu/Course/422-100/Mineral_Rocks/kaolinite1.jpg

Feldspar → Kaolinite (clay)

Factors in Chemical Weathering

- Climate – wet and warm maximizes chemical reactions
- Plants and animals – living organisms secrete substances that react with rock
- Time – longer contact means greater change
- Mineral composition – some minerals are more susceptible to change than others

Weathering and Erosion

Weathering produces regolith (“rock blanket”) which is composed of small rock and mineral fragments.

When organic matter is mixed into this material it is called soil.

Erosion Transport Agents or Forces

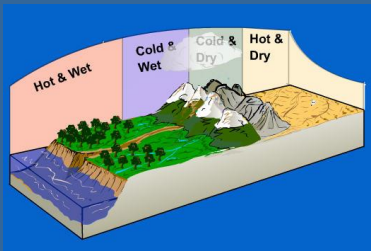
- Water
  - rain
  - streams and rivers
  - ocean dynamics
  - ice in glaciers
- Wind
- Gravity

Humans and Erosion

What are some ways that human activity can affect the way land erodes?

Weathering & Erosion Vid

- EXPLAINED



Weathering, Erosion and Deposition

Weathering

- Chemical and physical breakdown of rocks into sediment
- Occurs when the rock's environment changes and the rock is exposed to some form of water and the air

Weathering, Erosion and Deposition

Chemical Weathering

Chemical change within the rock's minerals breaking down the bonds holding the rocks together, causing them to fall apart into smaller pieces.

Weathering, Erosion and Deposition

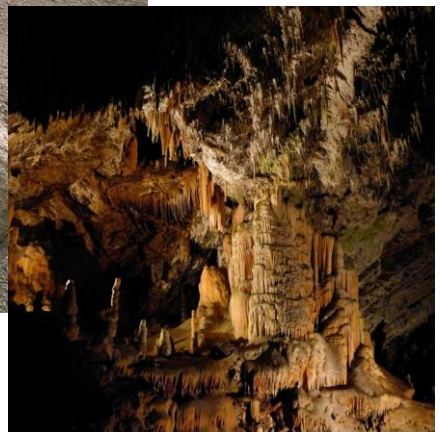
Chemical Weathering (Cont.)

Causes rock to break:

- (A) Oxidation – Iron combines with oxygen making rust.
- (B) Hydrolysis – Water softens minerals in rocks.
- (C) Carbonation – Carbon dioxide in rain water creates carbonic acid. Ex. acid rain, cave creation

A

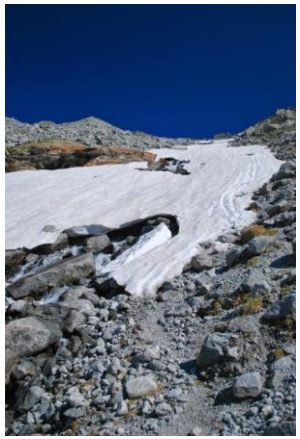
B



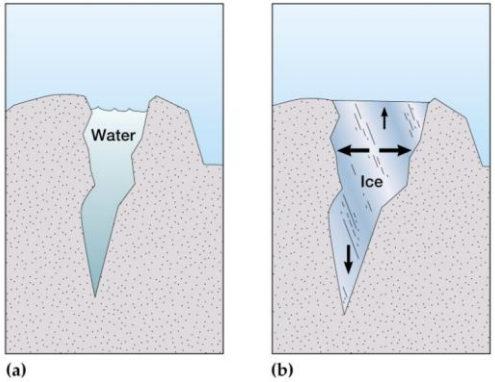
C

Weathering, Erosion and Deposition

A1



A2



Physical (Mechanical) Weathering

The process that breaks rocks apart without changing their chemical composition caused by:

Glacial/Ice:

- (A1) Abrasion - by rapidly moving water, glaciers or wind.
- (A2) Ice wedging - by freezing and thawing (contracting and expansion).

Weathering, Erosion and Deposition

Physical Weathering (cont.)

Causes rock to break:

- (B) Plant Roots - grow into cracks and break apart rock.
- (C) Burrowing – animals scrape and dig the terrain.
- (D) Temperature Change- cold to hot expanding and contracting.
- (E) Gravity - falling rocks or debris, compression

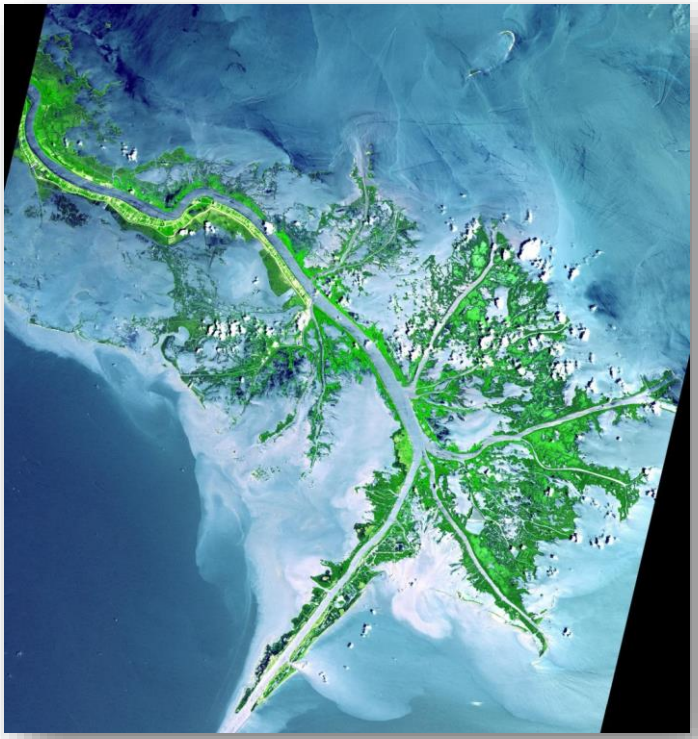
Weathering, Erosion and Deposition

Erosion

The process that moves bits of rock or soil from one place to another by:

- Gravity
- Water (rivers, waves)
- Wind
- Ice (glaciers)

Weathering, Erosion and Deposition



Deposition

The process in which sediments, soil, and rocks are added to a landform such as:

- Deltas
- Flood plains
- Sandbars
- Dunes

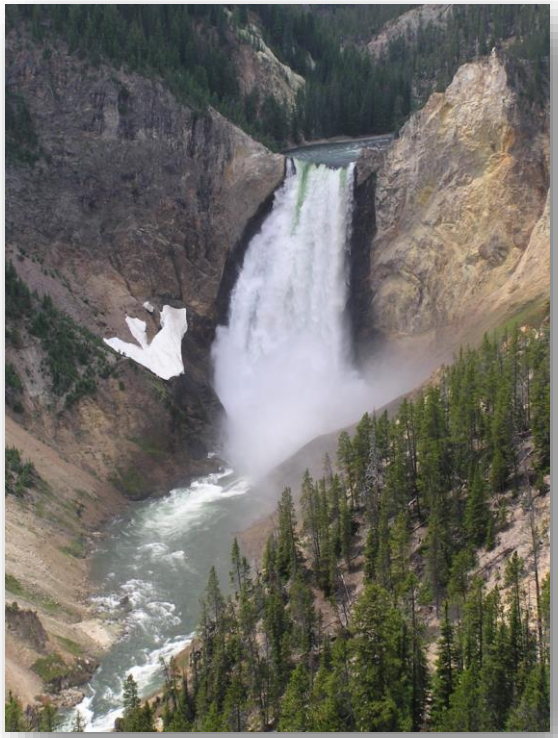
Weathering, Erosion and Deposition

Deposition

Occurs when the forces moving sediments are no longer able to overcome the forces of gravity and friction.

Weathering, Erosion and Deposition

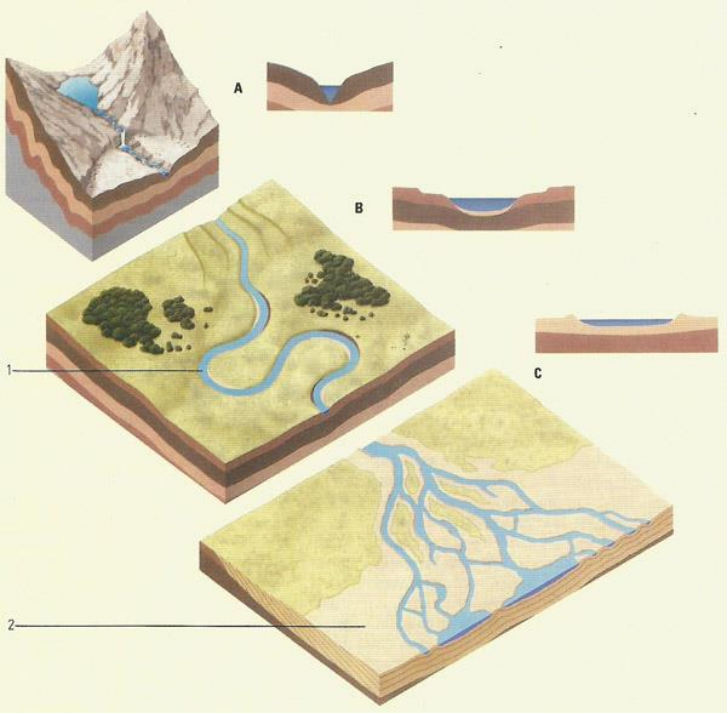
What affects transportation of sediments?



Running water is the primary agent of erosion.

- Velocity (speed) depends on gradient (slope) and discharge (amount of water).
- As velocity increases the size of particles carried also increases.

Weathering, Erosion and Deposition



Ages of Rivers

- (A) Young Rivers - fast-flowing, V-shaped valleys, waterfalls, and rapids
- (B) Mature rivers – Less energy, slower, meanders (1), sandbars
- (C) Old River – Very slow, shallow, large amounts of sediment deposited, many narrow channels, islands, deltas (2)

Quick Action – Erosion and Deposition

1. Working with a partner and decide which picture matches the description of each river age.
   - Young River
   - Mature River
   - Old River

2. Make a sketch of each picture in your INB, be sure to include labels.

A

B

C

A.

B

C

Weathering, Erosion and Deposition

Features Created by Wind

Caused by abrasion from wind blown sand.

- Arches
- Sand dunes
- Mushroom Rocks

Weathering, Erosion and Deposition

Features Created by Gravity

Gravity shapes the Earth's surface by moving weathered material from a higher place to a lower one.

- (A) Landslides (fast)
- (B) Mud flows
- (C) Slump/creep (slow)

A

B

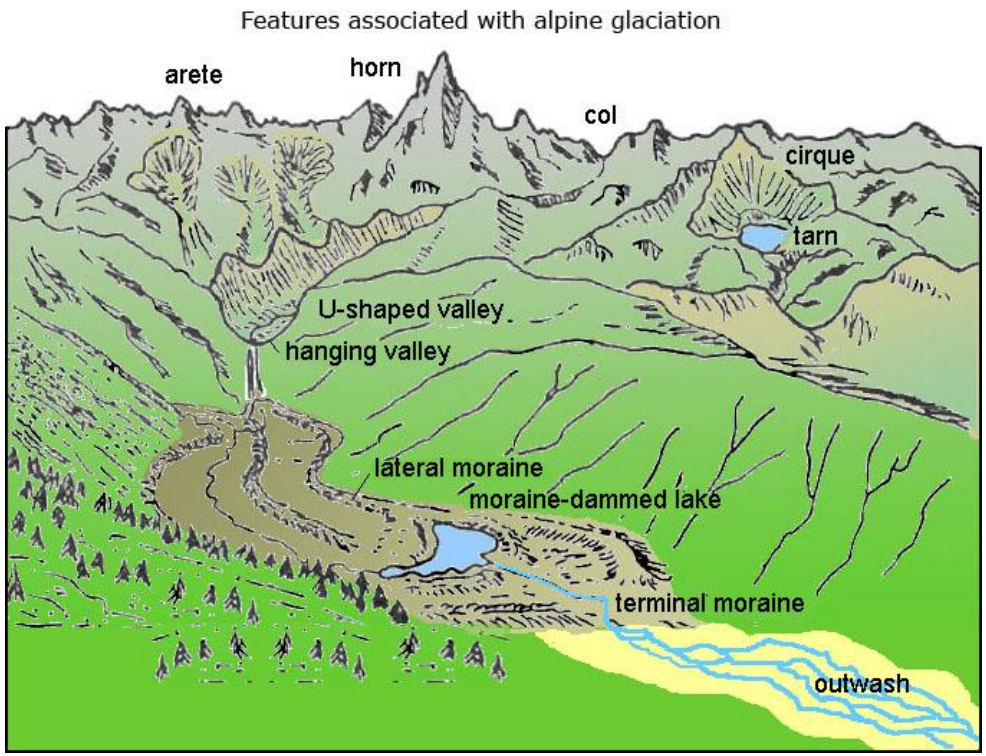
C

Weathering, Erosion and Deposition

Features Created by Glaciation

Caused as massive glaciers flow down hill bulldozing existing rocks.

- U-Shaped Valley
- Hanging Valley
- Horn
- Moraine
- Cirque
- Tarn lake
- Arête

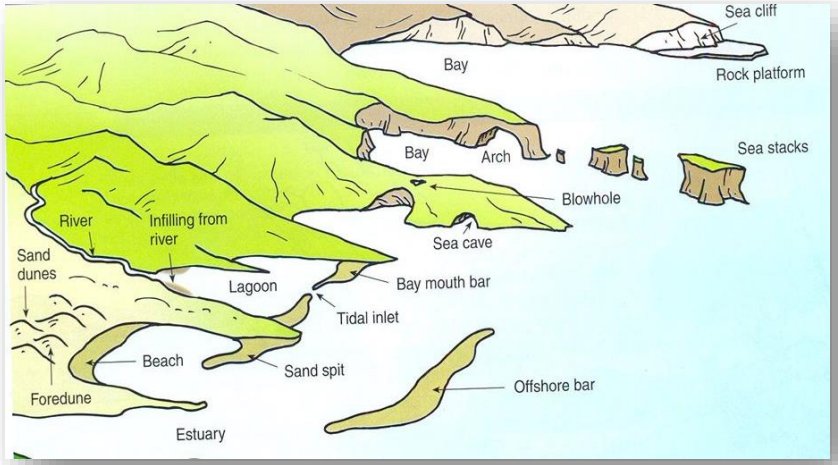


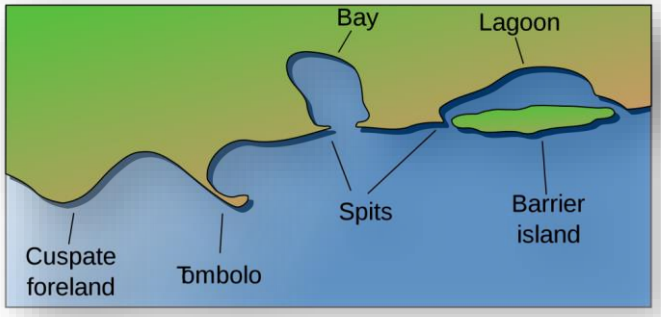
Weathering, Erosion and Deposition

Features Created by water (waves)

Erosional and depositional features which form along coastlines

- The western U.S. coastline has more erosional features.
- The eastern U.S. coast and the Gulf of Mexico has more depositional features.

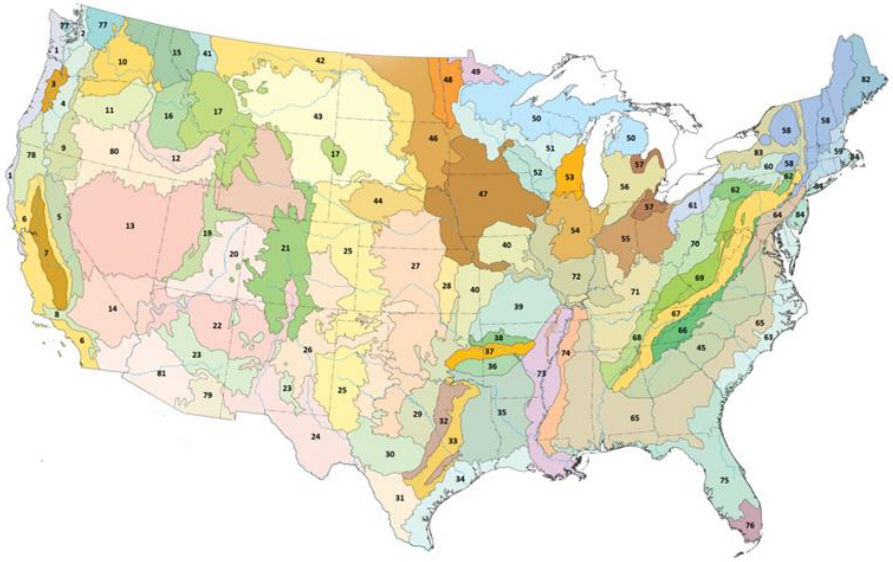




Weathering, Erosion and Deposition

Ecoregions of the United States

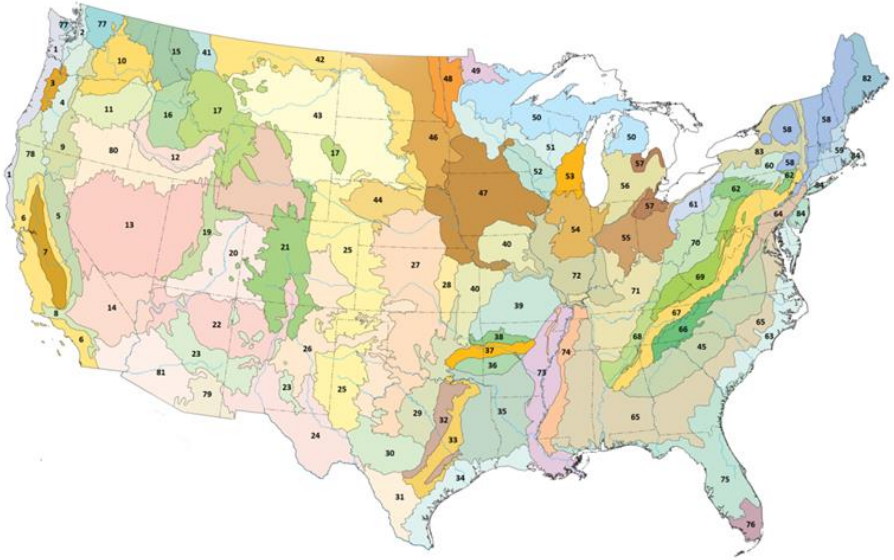
Areas defined by its environmental conditions, especially climate, landforms, and soil characteristics.



Weathering, Erosion and Deposition

Ecoregions Environmental Conditions

- Climate – weather conditions in an area over time.
  - Tropical
  - Arid
  - Mediterranean
- Landforms – crustal material
  - Mountains – high elevation
  - Plateaus – medium to high elevation
  - Plains – low elevation
- Soil characteristics
  - Amount of vegetation
    - Dry (arid) – very little vegetation (poor soil)
    - Humid – large amount of vegetation (good soil)



Weathering, Erosion and Deposition

Examples of Ecoregions

- Subtropical (Florida, South Eastern States)
- Tundra (N Alaska)
- Temperate Steppe (Great Plains
- Marine Mountains (Coastal Washington and Oregon)
- Desert and Desert Mountain (Nevada and parts of New Mexico)