Weathering and Erosion

S6E5. Students will investigate the scientific views of how the earth's surface is formed.

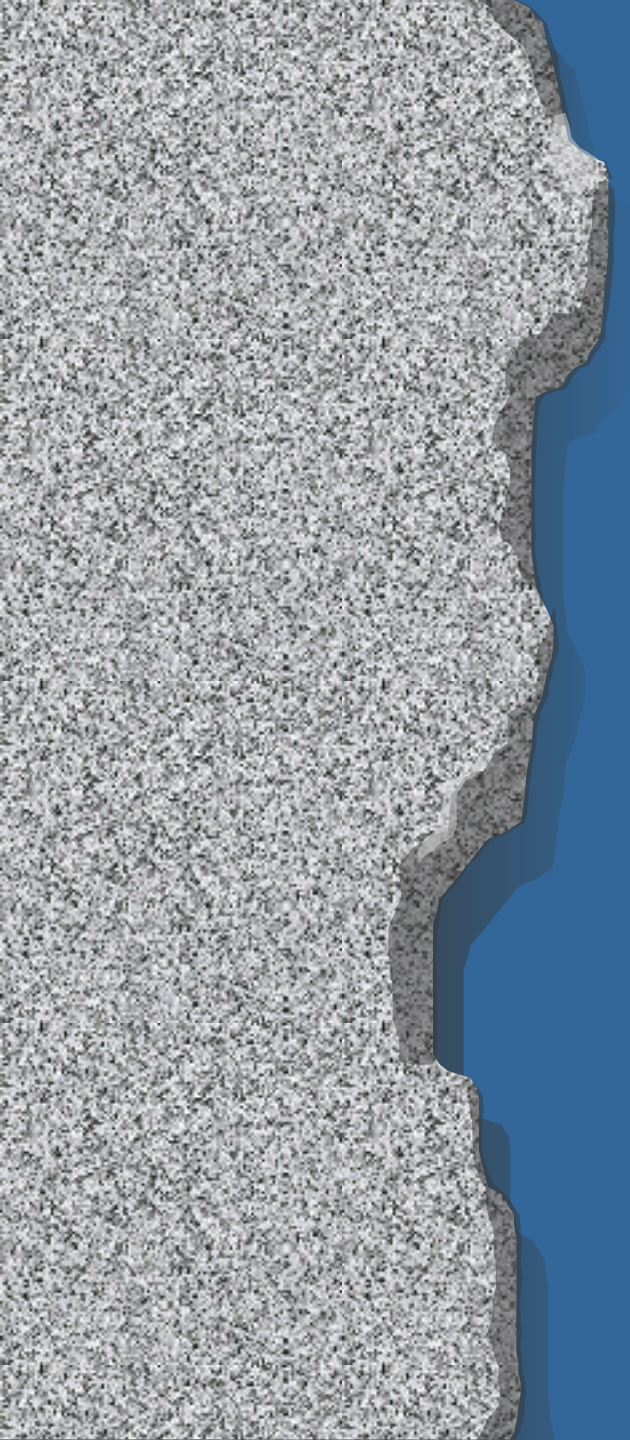
d. Describe the processes that change rocks and the surface of the earth.

Weathering and Erosion

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

Weathering and Erosion

Erosion - process of removing Earth materials from their original sites through transport to another.



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

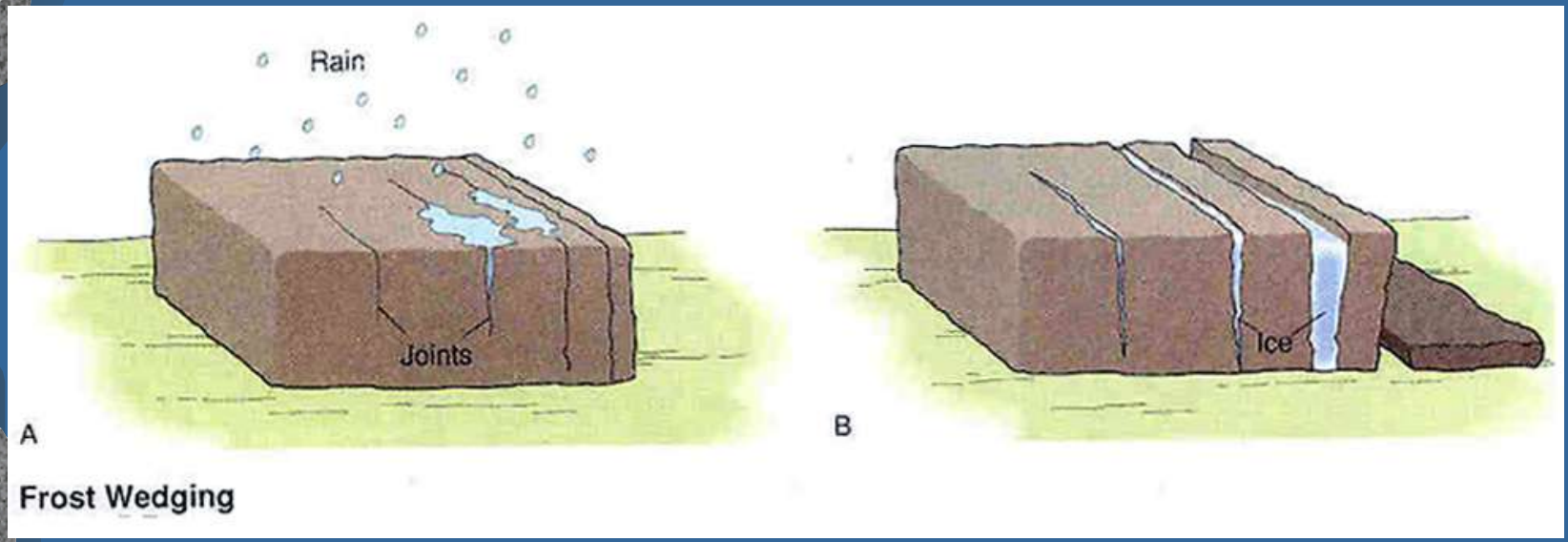
Processes and Agents of Mechanical Weathering

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

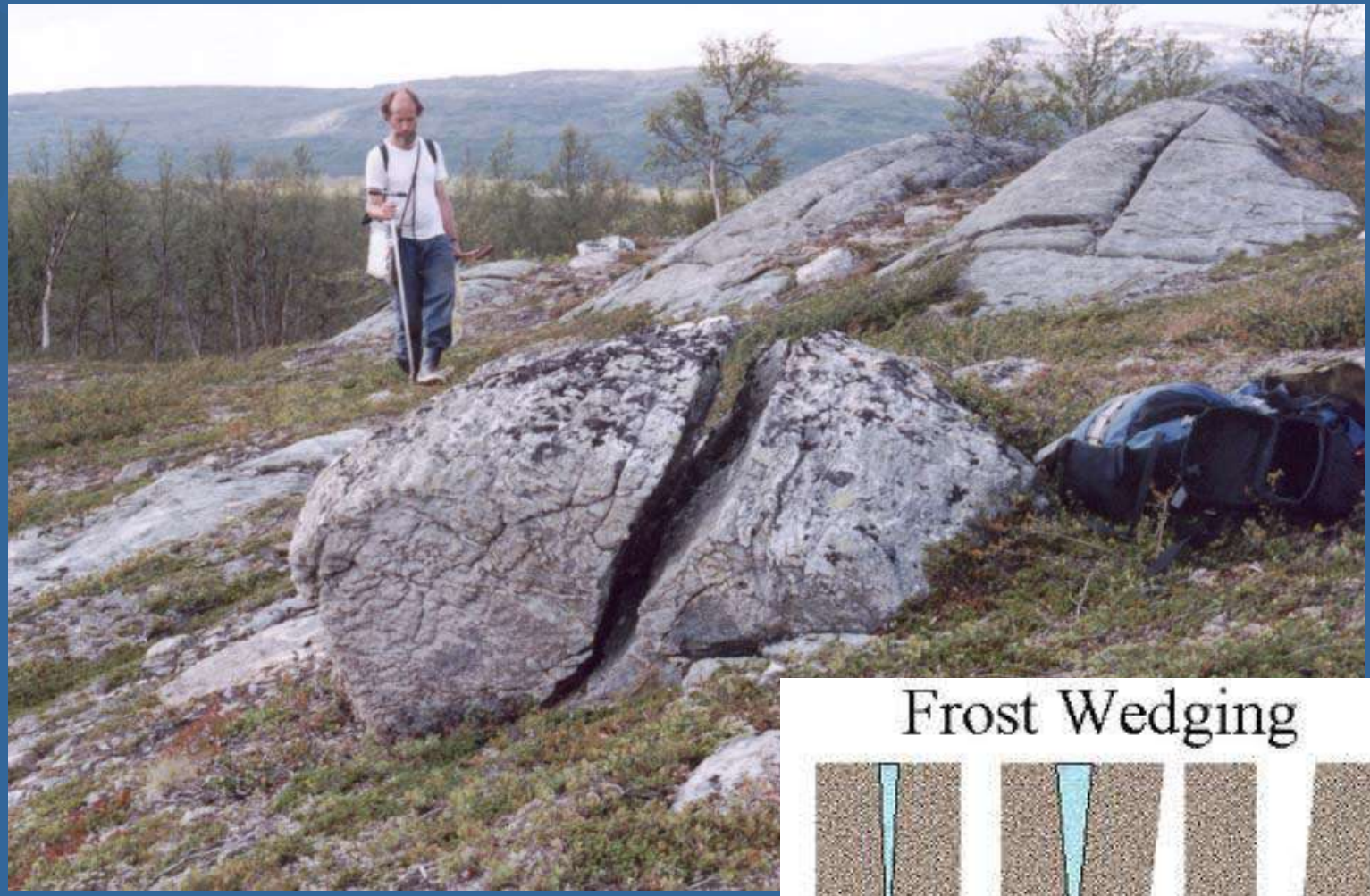
Processes and Agents of Mechanical Weathering

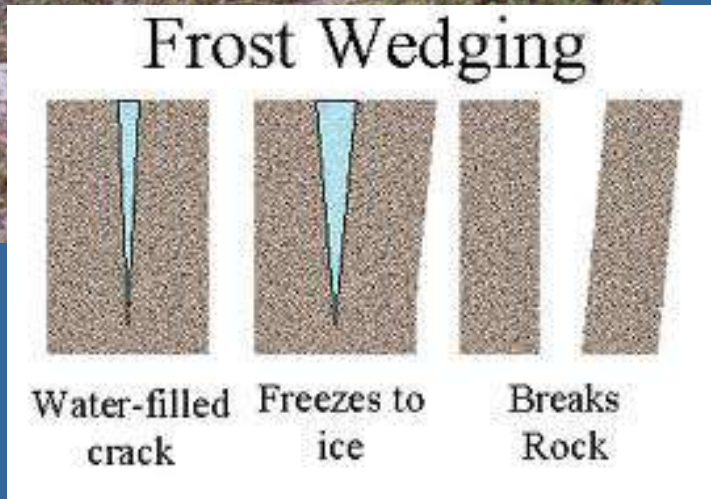
- Frost Wedging – cracking of rock mass by the expansion of water as it freezes in crevices and cracks



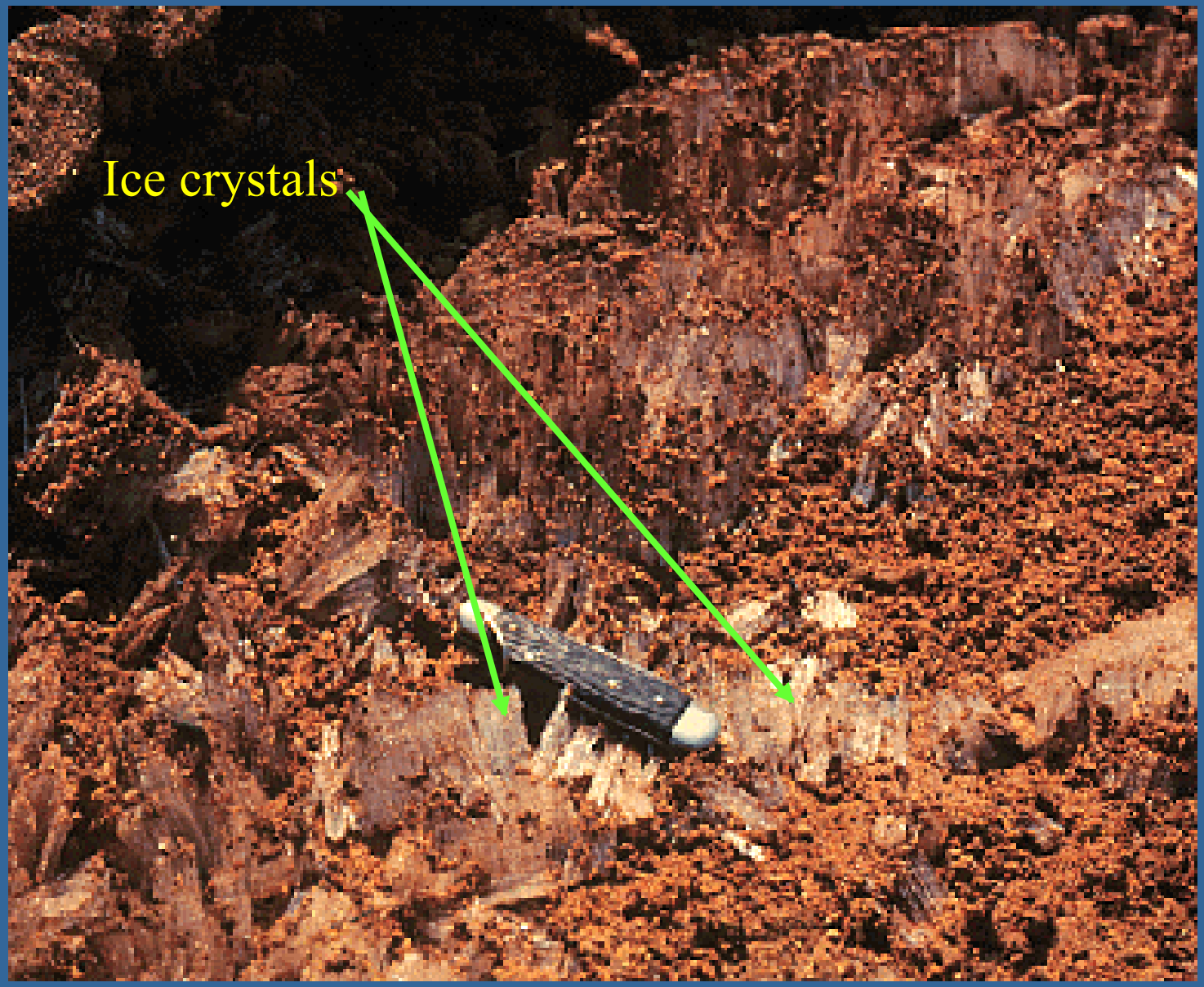
http://www.uwsp.edu/geo/faculty/ozsvath/images/frost%20wedging.jpg

Frost Wedging (in rocks)





Frost Wedging (in soil)



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

Processes and Agents of Mechanical Weathering

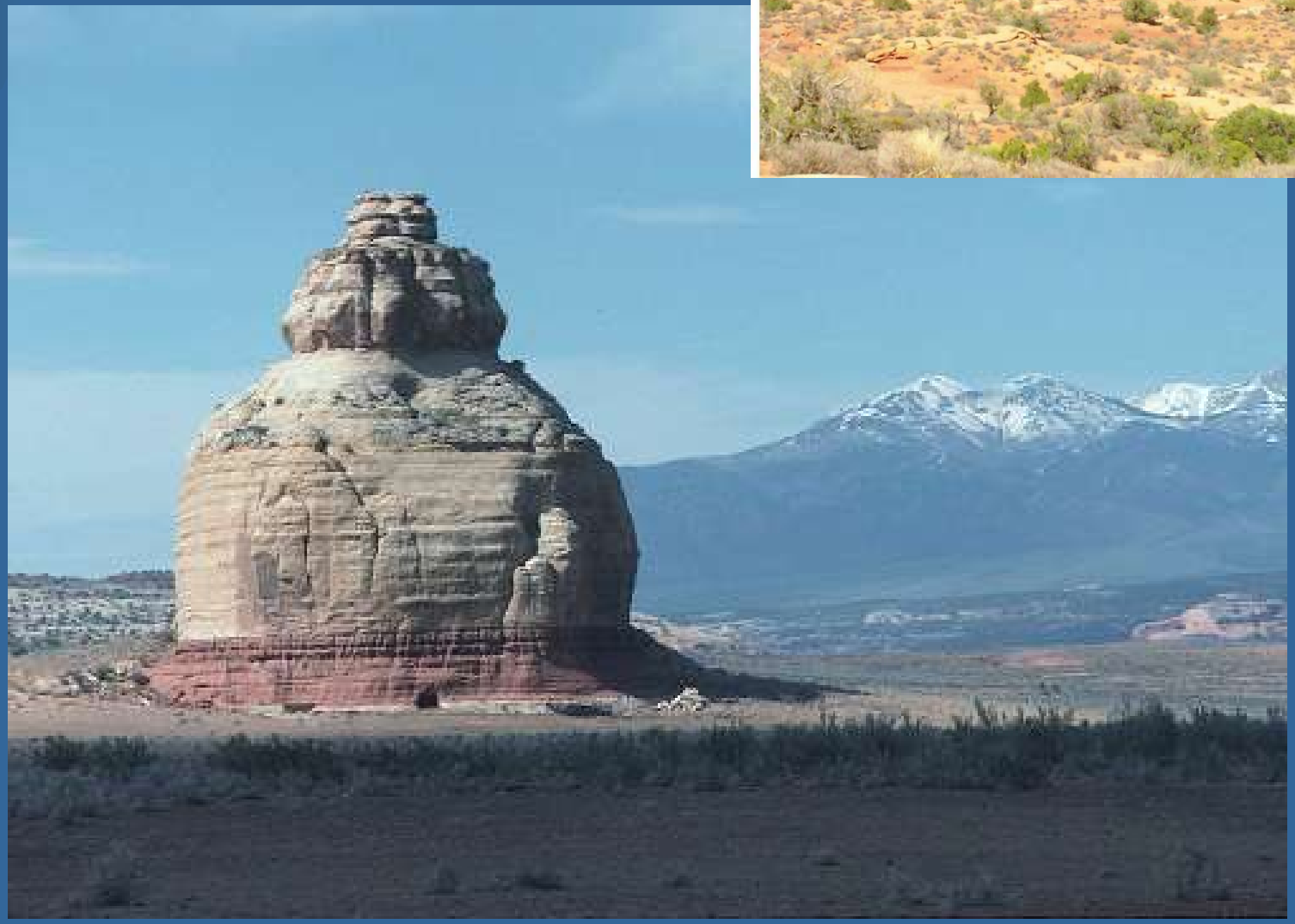
- Exfoliation – As underlying rock layers are exposed, there is less pressure on them and they expand. This causes the rigid layers to crack and sections to slide off (similar to peeling of outer skin layers after a sunburn). The expanding layers often form a dome.

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.

Wind Abrasion



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

Wind Abrasion

This "moon looking" picture of an Antarctic rock, shows weathering from the wind blown sands.

Wind and Water Abrasion

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

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.

Plant Wedging

Plant Wedging

Processes of Chemical Weathering

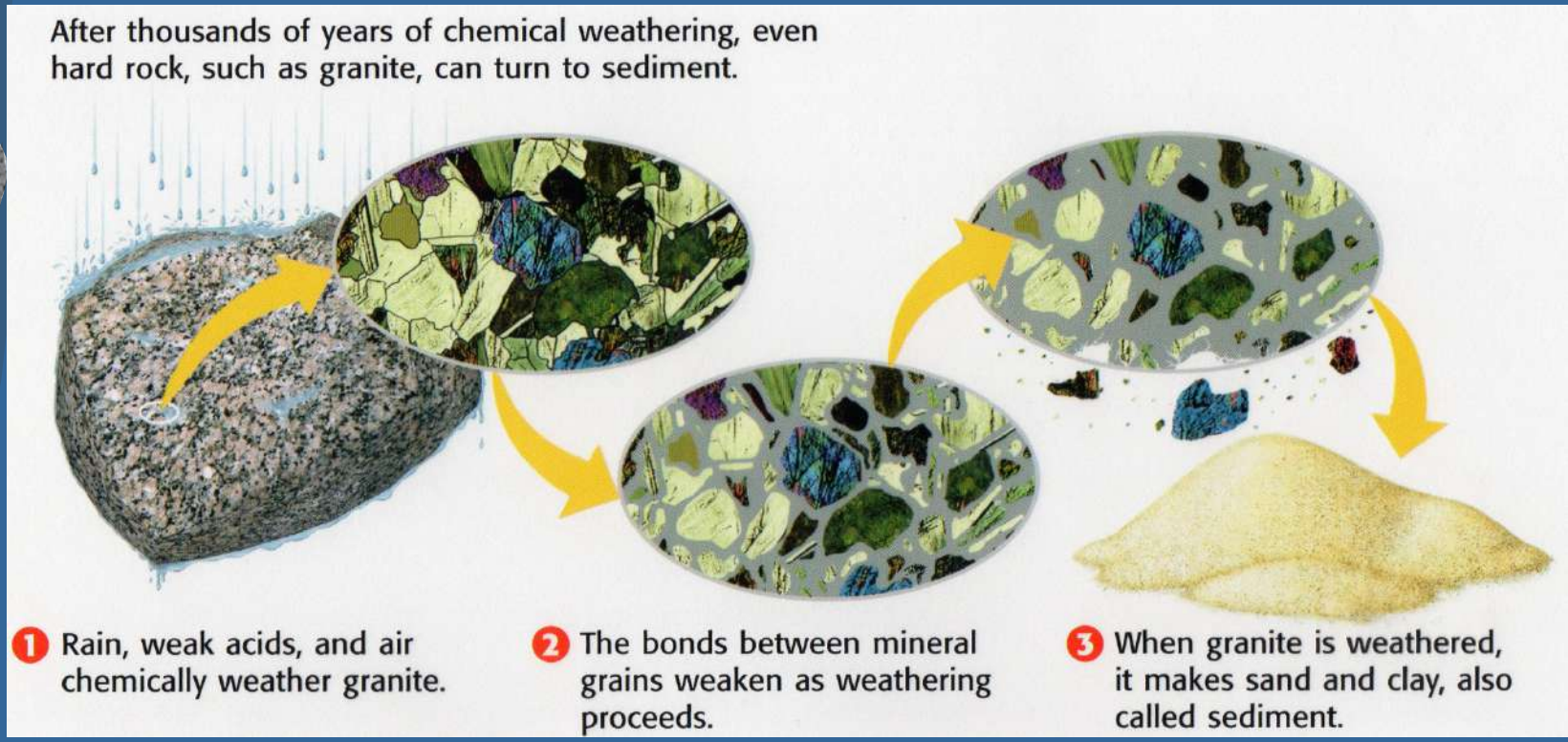
- dissolving (dissolution)
- oxidation
- hydrolysis

Processes of Chemical Weathering

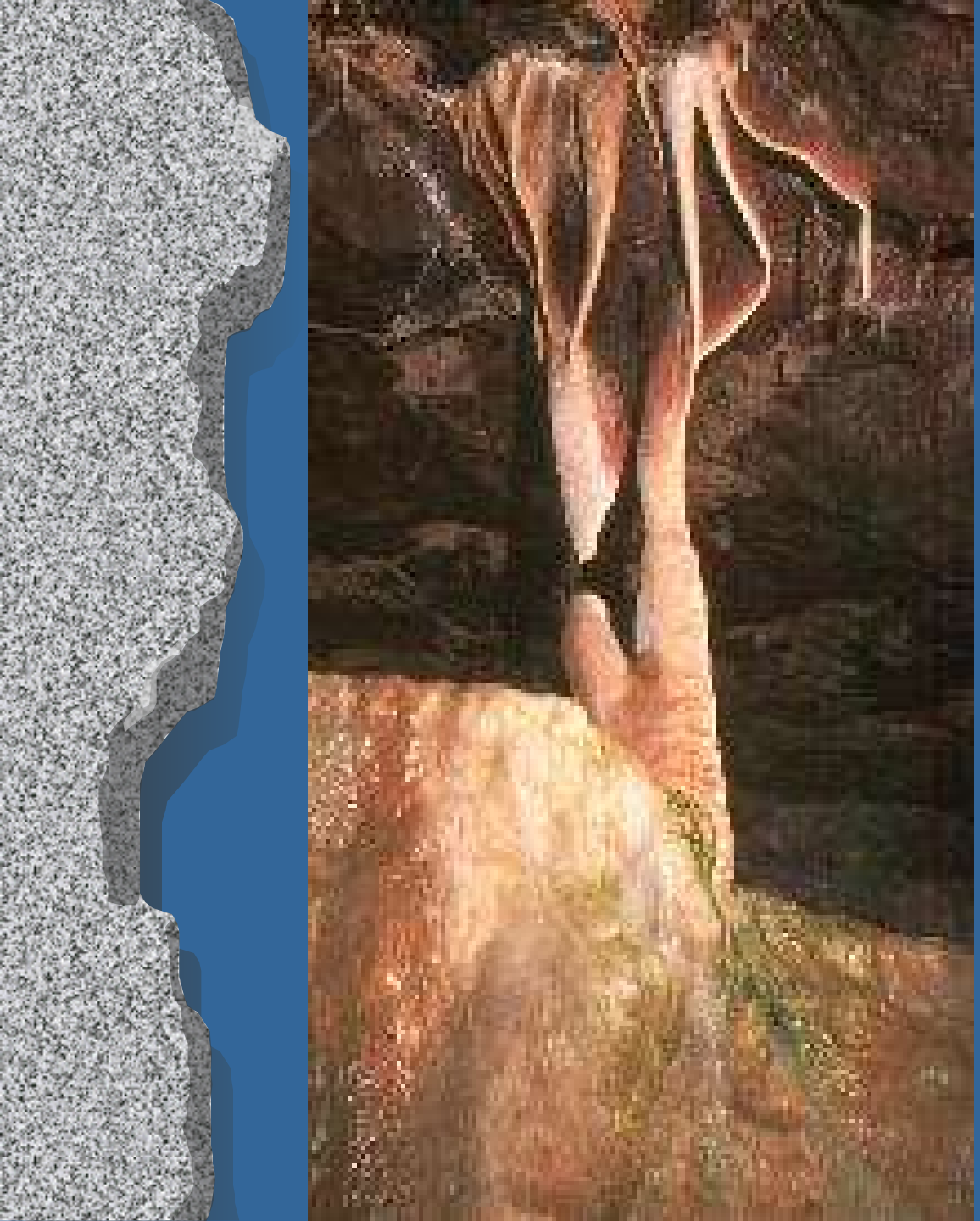
Dissolving (dissolution)

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



Chemical Weathering of Granite



Limestone cave feature

result of dissolution

The effect of acid rain on statues and rock

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

Other Agents of Weathering

Things like flash floods, mud slides, landslides, and other forms of mass wasting can cause weathering.

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

Streams

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

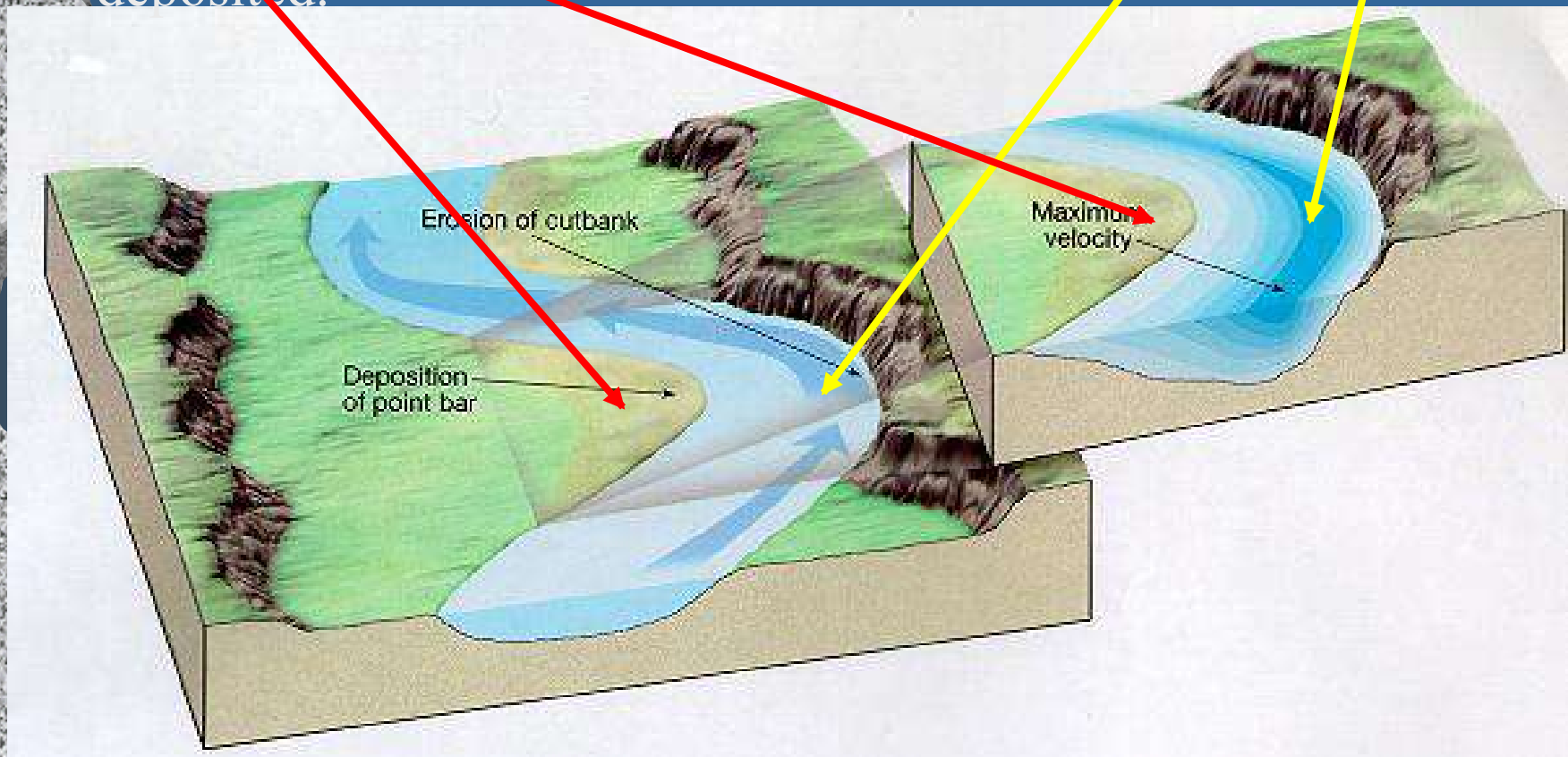
Rivers

- Moving water carries sediment.
- Faster the water the larger the sediment it can carry.
- As the water slows down the sediment drops off.

Stream Erosion and Deposition

Where water moves more swiftly there will be more erosion.

Where the water slows down, sediments will be deposited.



Ocean Dynamics

- Tidal action and waves carry away weathered materials.

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

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

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 . They break off pieces of rock and sediment, pick them up and carry them with them. The glacier deposits debris as it melts.

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

Transport by Gravity

The movement of rock, soil, or snow, down a slope.

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

Transport by Gravity

It is controlled by the force of gravity and can happen quickly or slowly. The general term for this is mass wasting.

Transport by Gravity

When sediments are weathered and are transported (slips) down along a curved surface 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.

Scree field

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

When layers of rock slip down a slope suddenly is a rock slide.

Deposition Formation

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

Deposition Formation