



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



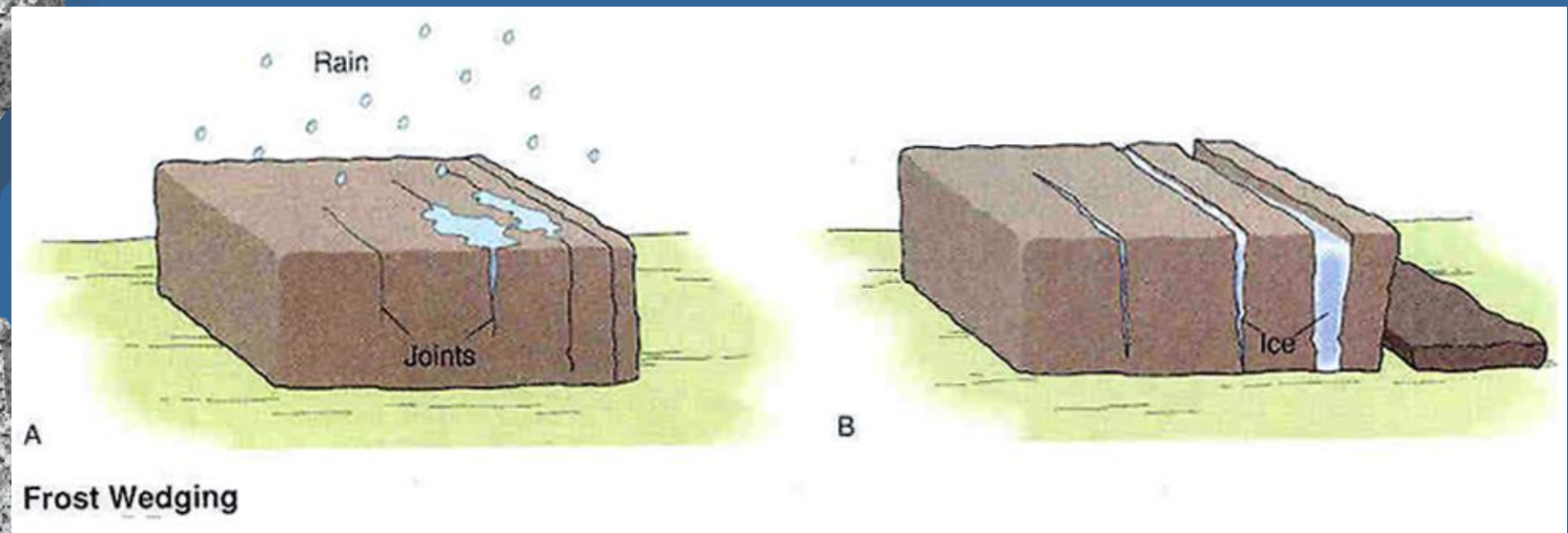
Processes and Agents of Mechanical Weathering

These are actions or things that break down Earth materials

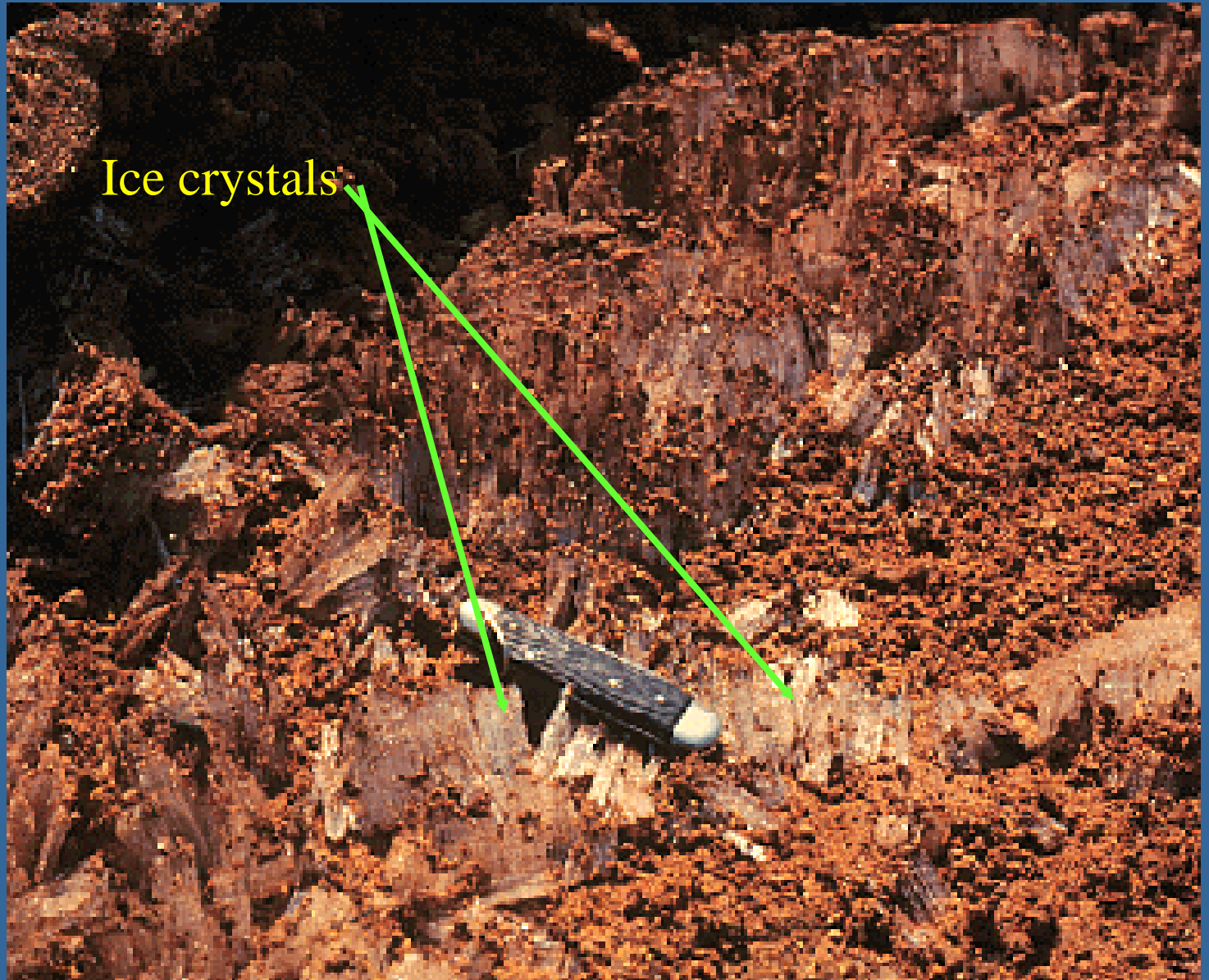
- frost wedging
- thermal expansion and contraction
- mechanical exfoliation
- abrasion by wind, water or gravity
- plant growth

Processes and Agents of Mechanical Weathering

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



Frost Wedging (in soil)



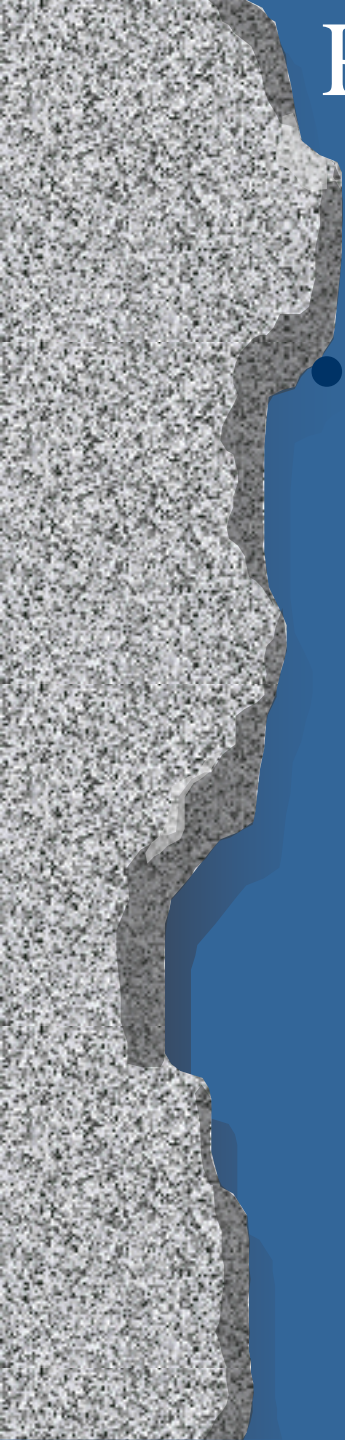
Processes and Agents of Mechanical Weathering

- **Thermal expansion and contraction** – repeated heating and cooling of materials cause rigid substances to crack and separate



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



Wind and Water Abrasion



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

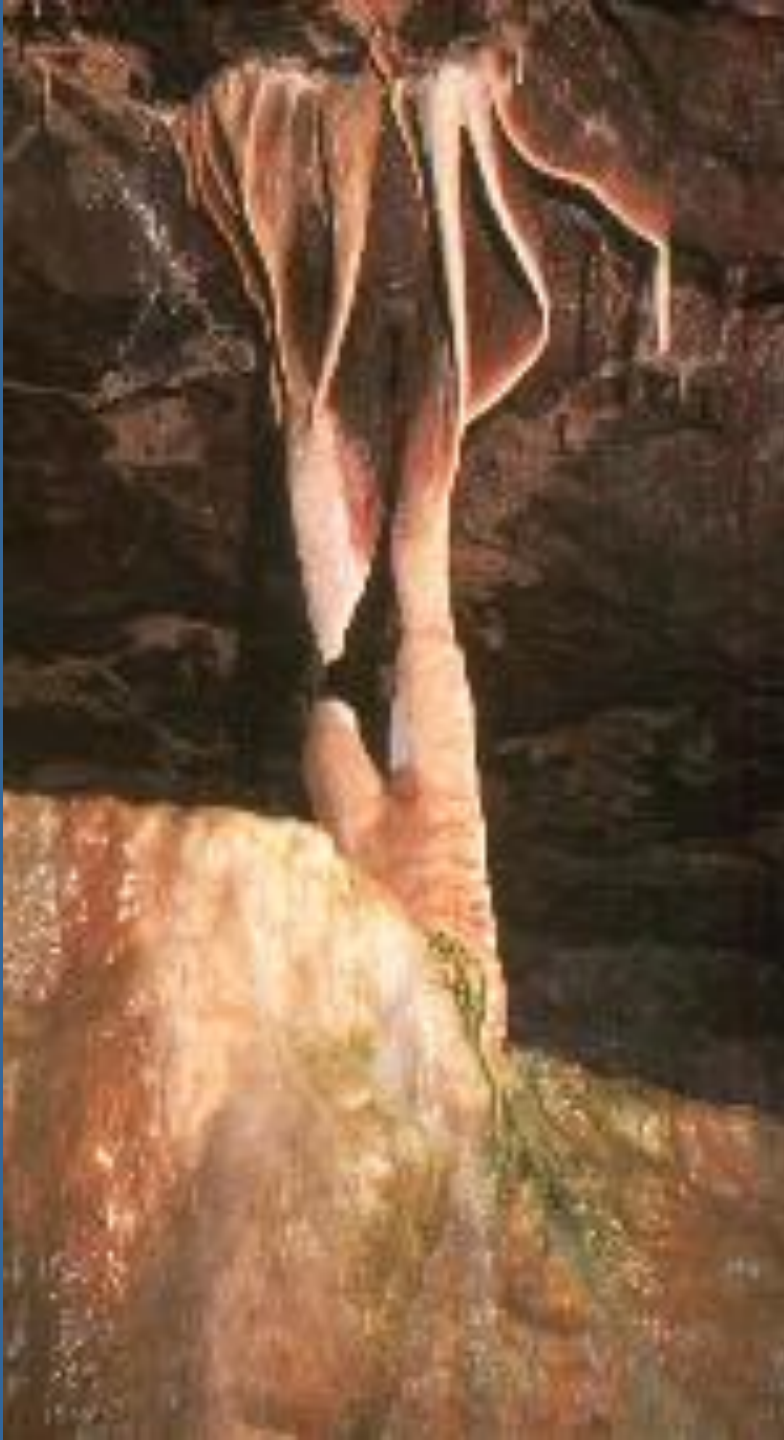
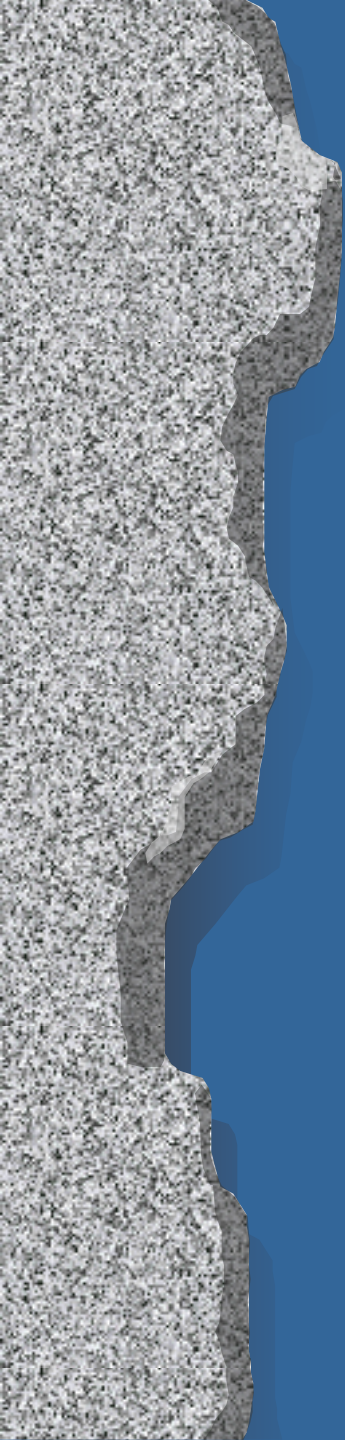
- dissolving (dissolution)
- oxidation
- hydrolysis



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.



Limestone
cave feature

result of
dissolution



Processes of Chemical Weathering

Oxidation

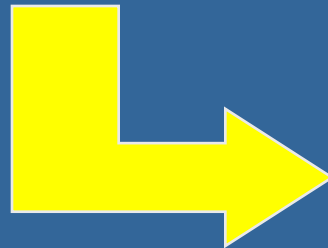
Minerals may combine with oxygen to form new minerals that are not as hard. For example, the iron-containing mineral pyrite forms a rusty-colored mineral called limonite.

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

Streams

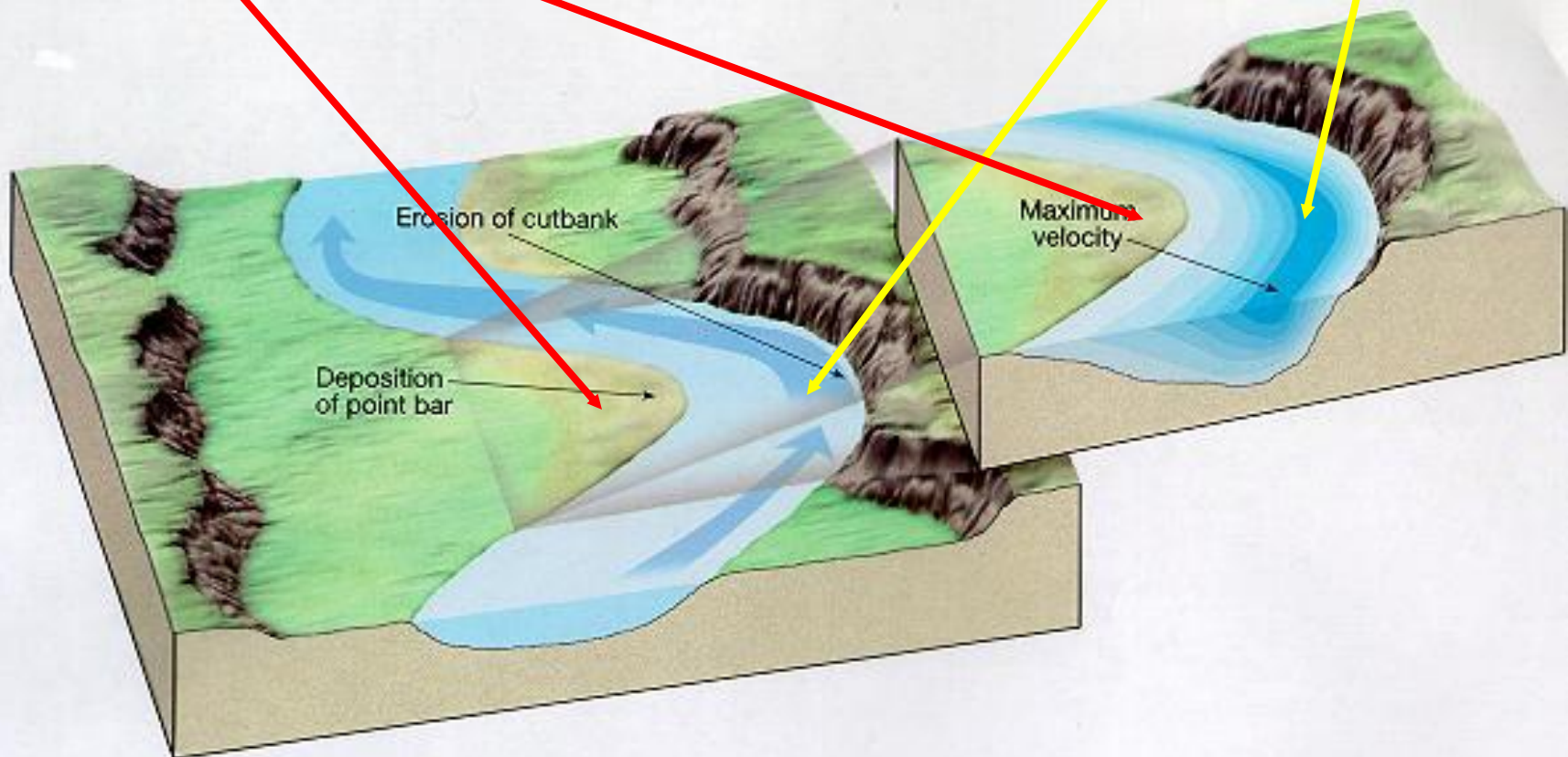
Flowing water will lift and carry small sediments such as silt and sand.



Stream Erosion and Deposition

Where water moves more swiftly there will be more erosion.

Where the water slows down, sediments will be deposited.



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>

Glaciers

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



Glaciers

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



Wind Transport of Sediments

Wind will carry fine, dry sediments over long distances.



Wind Transport of Dust

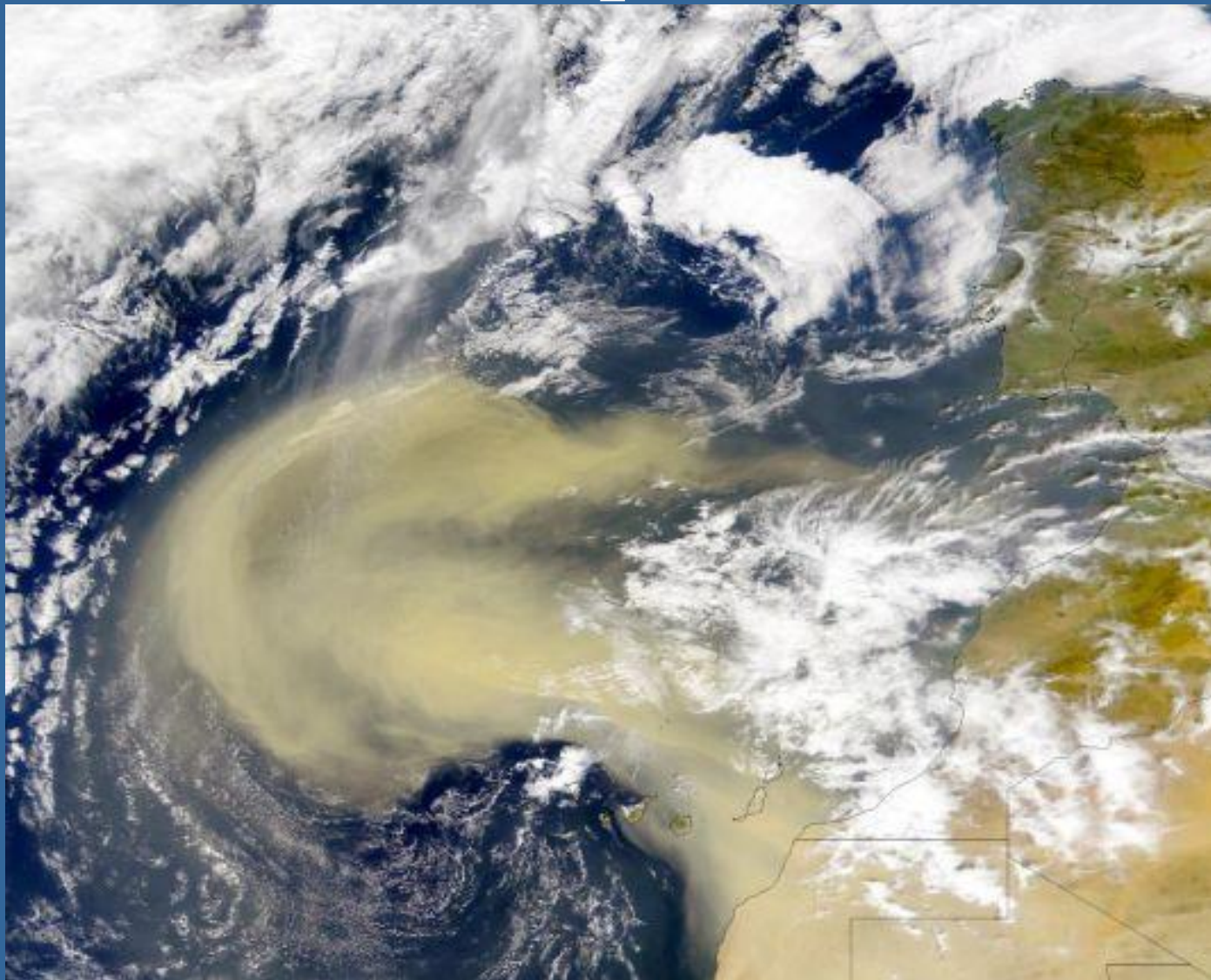


Photo shows Sahara Desert sand being transported over the Atlantic Ocean.

Transport by Gravity

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



Transport by Gravity

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



Slump

Transport by Gravity

Loose sediments transported by gravity are called **scree**.



Scree field

Deposition Formation

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



Deposition Formation



Weathering Tutorial

- This tutorial requires Flash but is a nice review of mechanical and chemical weathering with some animations.

http://www.as.uky.edu/academics/departments_programs/EarthEnvironmentalSciences/EarthEnvironmentalSciences/Educational%20Materials/Documents/learning/module07swf.swf

