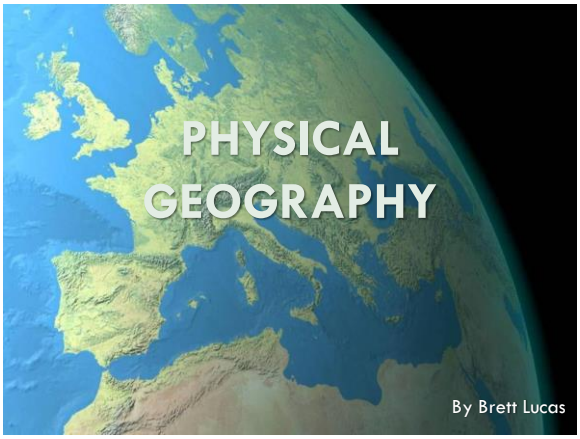


SOLUTION PROCESSES AND KARST TOPOGRAPHY

Solution Processes and Karst Topography

- The Impact of Solution Processes on the Landscape
- Solution and Precipitation
- Caverns and Related Features
- Karst Topography
- Hydrothermal Features

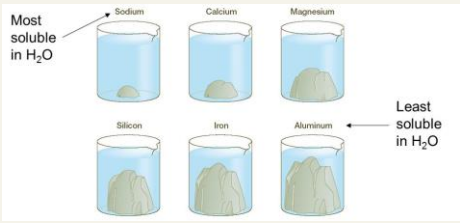
Impact of Solution Processes on the Landscape

- Underground Water
  - Slightly Acid (e.g. carbonic acid – H2CO3)
  - Dissolves certain rock-forming chemicals, especially calcium and magnesium carbonates
- Effects of Solution on the Landscape
  - Karst topography
  - Hydrothermal surface features

Karst Topography (Rolling landscape and sink holes)

Solution and Precipitation

- Dissolution – Process of going into solution
  - Solubility varies among different elements



Solution and Precipitation

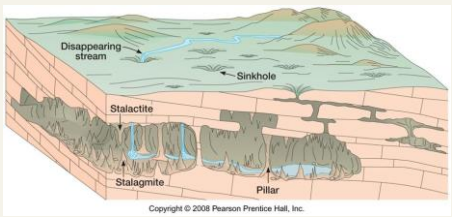
- Example of dissolution: Carbonate Rocks
  - They are common rocks and highly soluble

Dissolution (breakdown of minerals) → Solution (salts dissolved in water)

$CaCO_3$ calcium carbonate	+	H_2O water	+	CO_2 carbon dioxide	→	$Ca(HCO_3)_2$ calcium bicarbonate				
$CaMg(CO_3)_2$ dolomite	+	$2H_2O$ water	+	$2\ CO_2$ carbon dioxide	→	$Ca(HCO_3)_2$ calcium bicarbonate	+	$Mg(HCO_3)_2$ magnesium bicarbonate		

Role of Bedrock Structure

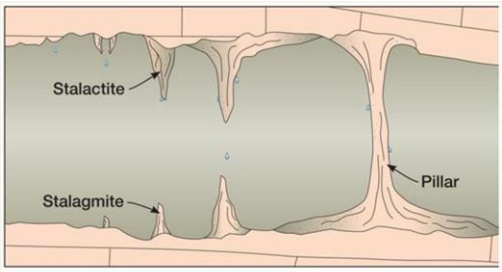
- Joints becomes solution pathways
- Network of solution tubes widen to form small rooms and large caverns (large rooms)



Caves and Related Features

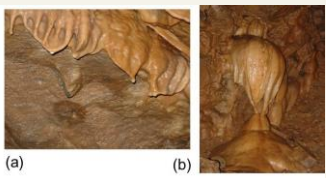
- Location
  - Usually found where there is massive limestone bedrock, and plentiful underground water
- Formation: Two-stage process
  - Initial excavation stage by solution action
  - "Decoration stage" by precipitation of minerals
    - Speleothems: e.g., stalagmites, stalactites, and pillars

Caves and Related Features

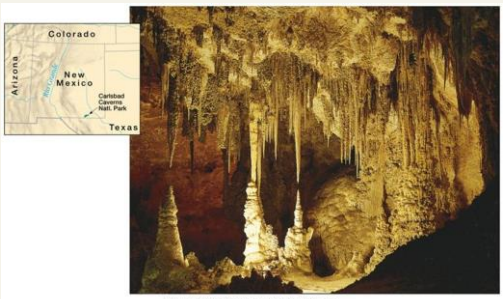


Caves and Related Features

- Precipitate formations
  - Speleothems
    - Decorative features formed from deposits
    - Precipitated mineral deposits are usually *calcite*.
    - On walls, roofs, floors of caves
- Lost River Caverns, Hellertown, PA



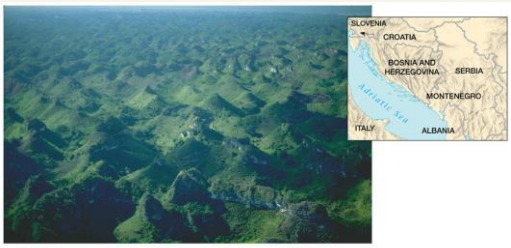
Caves and Related Features



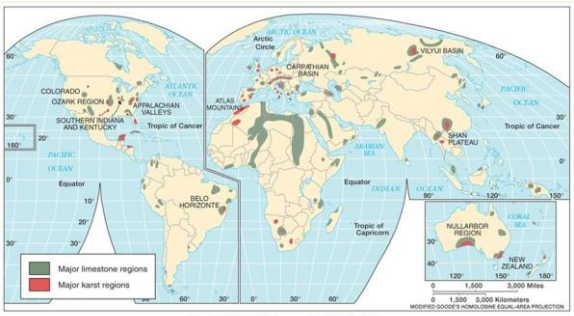
Karst Topography

- 'Karst'
  - Ancient Slavic word (Germanized), meaning "barren land"
  - Name of Karst region of the former Yugoslavia with this kind of topography
- Topography
  - Rugged hilly area shaped by solution of limestone (sometimes contains dolomite, gypsum, or halite).
- Extent
  - 10% of Earth's land area has soluble carbonate rocks at or near surface. In the U.S. lower 48 states, it's 15%. Limestone leads to Karst Regions.

Karst Topography

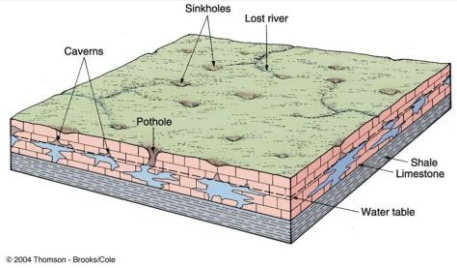


Karst Topography



Karst Topography

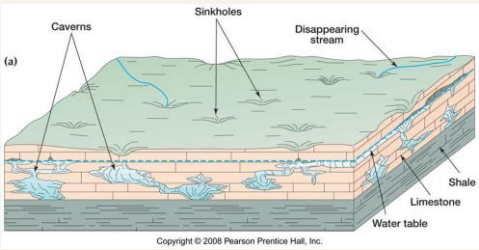
- *Notable in Karst Landscapes are the absence of surface streams. They're sometimes "lost rivers".



Lost River Cave & Valley, Bowling Green, KY

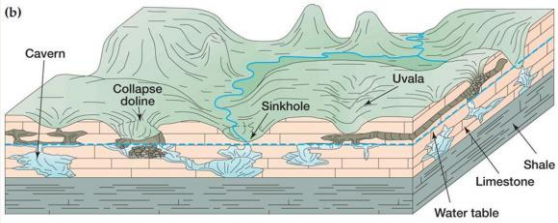
Surface Features

- Early development: sinkholes (or dolines) and disappearing streams (a.k.a. "lost rivers").



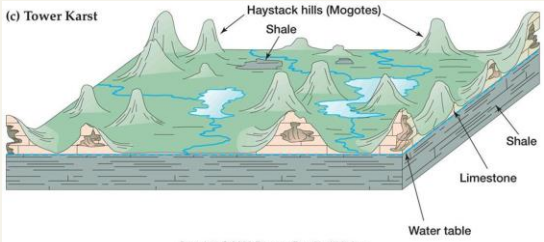
Surface Features

- Advanced development: sinkholes (or dolines), collapse dolines, and uvala (chain of intersecting sink holes).

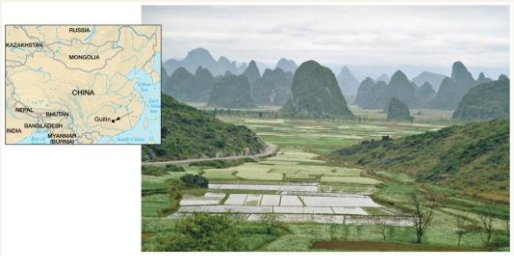


Surface Features

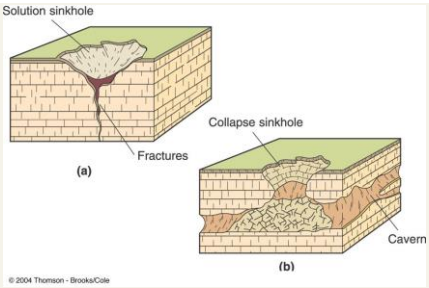
- Tower Karst (late development): haystack hills (mogotes) and exposure of non-soluble bedrock



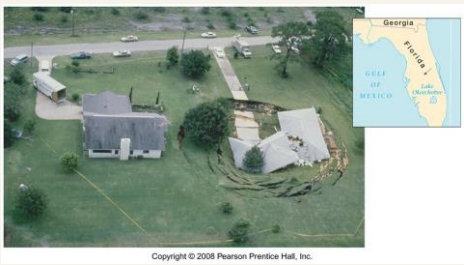
Tower karst in Guilin, China



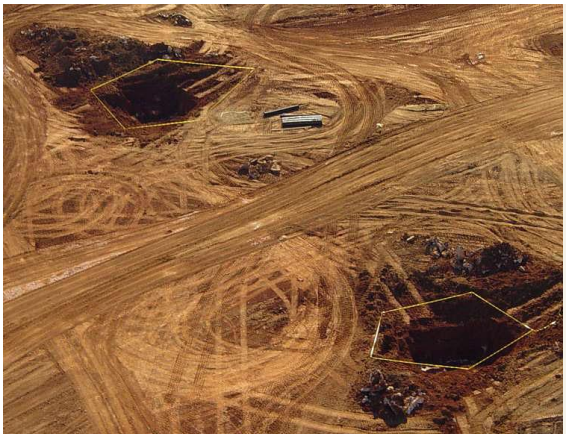
Sinkholes as Natural Hazards



Sinkholes as Natural Hazards




STOP



Precipitation Processes

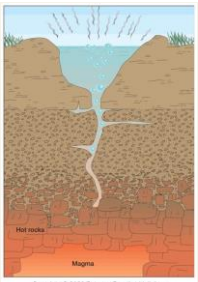
- "Precipitation" in this sense, means the elements recombine, and are removed from water and deposited. Here, it has nothing to do with "rain".
- Caves, geysers and hot springs encourage these deposits, as the pressure in caves drop, or as temperatures drop around the lip of a hot spring.

Precipitation Processes

- In caves, air pressure is lower than in joints and bedding planes.
- In geysers and hot springs, air pressure drops suddenly, and there is also rapid heat loss to air.
- Think of the mineral 'ring' that is left behind in a pot when you boil water.

Hydrothermal Features

- Hot Springs
  - Eject hot water
  - Source is volcanic heat and pressure
  - Calcium carbonate precipitates when water reaches surface
  - Calcium carbonate deposits could be:
    - Travertine (massive)
    - Tufa (porous)

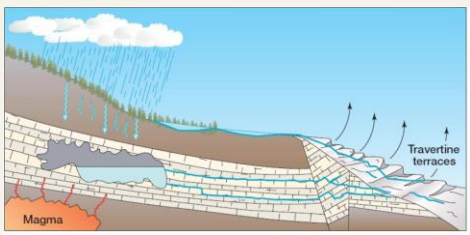


Carbonate terraces

- Hot spring atop a carbonate terrace. Algal growth highlights the spring.

Travertine terraces

- Hot spring is on top of terrace

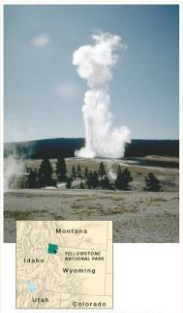


Travertine terraces

- Mammoth Mountain

Geysers

- A hot spring that is intermittent
- Usually hot water ejects (erupts) sporadically instead of flowing continuously. It's a temporary eruption that reverts to dormancy, and then the cycle starts again
- Shoots up into the air; this eruption releases pressure build-up within a restricted subterranean tube.



Fumaroles

- Unlike a geyser, very little water drains into the tube of a fumarole
- It's a hot spring that lacks water; it sends out only steam

Yellowstone National Park, Wyoming

- America's showcase of hydrothermal features