

Flows

1. Crater flows

- Crater flows – classic flow of lava and/or pyroclastic material from the top of a volcano



Maui Lava Flows, Several Hundred Years Old

Flows – 2. Fissure

- lava flows from a crack below the summit of a volcano
- Hawaii, Iceland

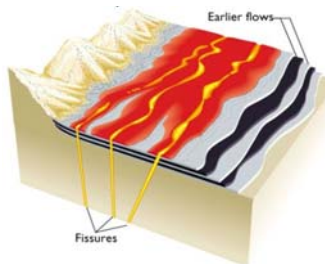


Drained Fissure on Kilauea – Note Layers of Lava Flows



Flows – 3. Flood (basalts)

- Not associated with a specific volcano. Lava flows across the surface like water. Because cooled lava becomes basalt, it is called a 'flood basalt'.

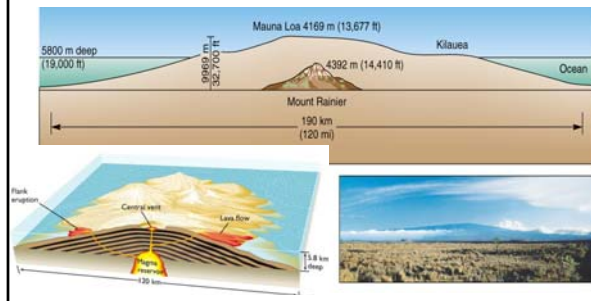


Types of Volcanoes

- Shield volcano
 - Composite
 - Plug
 - Cinder
- List is in descending order of size. Type depends on viscosity, gaseousness, and amount of lava present.

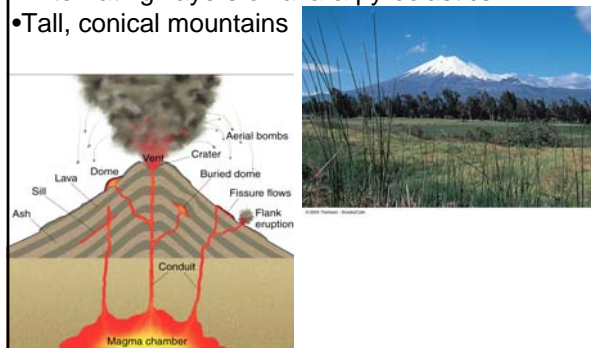
Shield volcanoes

- Large structures
- Have the appearance of shield – convex side facing upward



Composite Volcano

- Alternating layers of lava & pyroclastics
- Tall, conical mountains



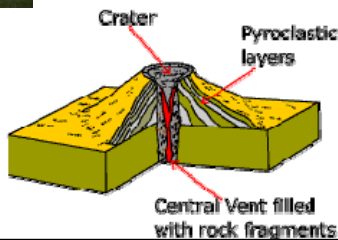
Plug volcanoes

- Often explosive eruptions
- Steep sided, but irregular summits
- Lava flow concentrated around volcano



Cinder cones

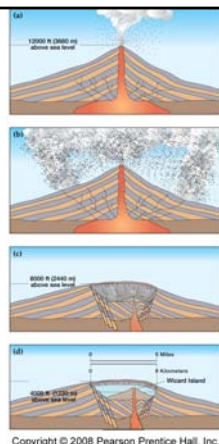
- Small volcano
- Can occur in conjunction with shield volcanoes



Calderas



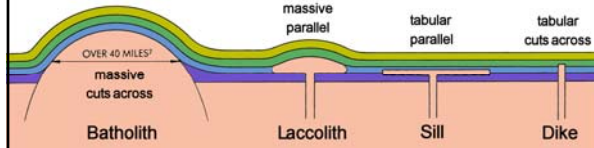
A landform but not a volcano!
Summit collapses inside an existing volcano



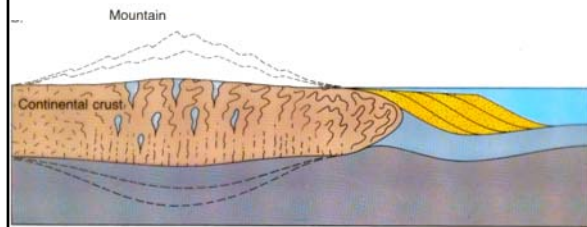
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Plutons

- Magma bodies that solidify beneath earth's surface = "plutons"
 - Plutonic rocks are intrusive igneous rocks
- Classified by
 - Size
 - whether parallel to or cut across "country rock"



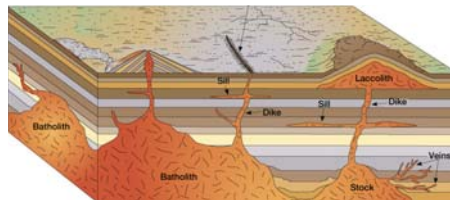
Plutonic rocks reach the surface by process of erosion and isostatic adjustment



Plutonism creates landforms that are not visible until they are exposed at the surface after eons of erosion and uplift

Types of Igneous Intrusions

- Sill
- Dike
- Laccolith
- Stock
- Batholith
- Volcanic Neck



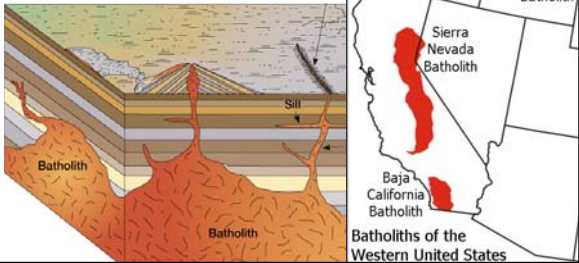
Volcanic Neck

- A cylindrical-shaped landform created by magma solidifying in the vent of a volcano.
- Erosion of the sides of the volcano exposes the neck.



Batholiths

- Largest plutonic feature
- Dome-like appearance
- Over 40+ square miles



Yosemite National Park, part of the Sierra Nevada batholith



Stock

Stone Mountain, GA, a “stock”

- Smaller than batholith
- Still dome shaped

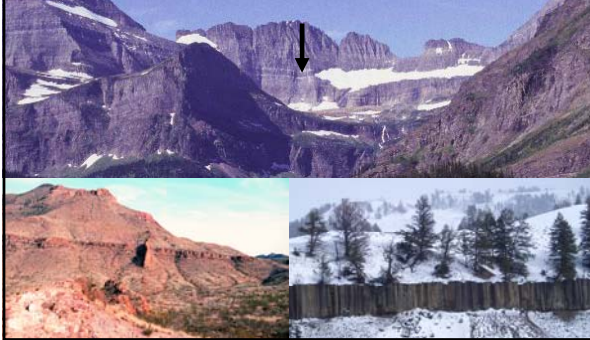
Dikes

- Magma injected into a crack, resulting in a sheet of igneous rock that cross cuts adjacent layers.
- Frequently occur as swarms near volcanoes, or near other plutonic features

Radiating dikes

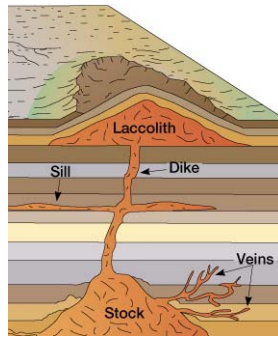
Photo: DMB

- **Sill:** A small intrusion in which magma was injected between two pre-existing rock layers.
- Sills (like dikes) are comprised of very hard, resistant rock that may form near-vertical cliffs



Laccolith

- Basically an inflated sill
- Magma is injected between two layers with enough pressure to force the overlying rock to dome upward, producing mushroom-shaped intrusions that create “domal uplift” overhead.



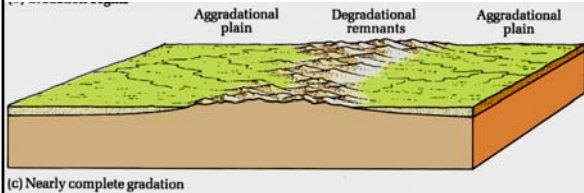
Laccolith

- Best, “type”, examples are the La Sal, Henry, and Abajo Mountains of SE Utah, first described by Grove Karl Gilbert.



Weathering

Tectonic processes build up land
Gradational forces level off highs and fill in lows.



Weathering Defined

- The *disintegration* and *decomposition* of rocks and minerals at the earth's surface as a result of physical and chemical action.
- Occurs *in situ*

Controls of Rate and Character of Weathering

1. Type of rock – igneous? etc.
2. Climate – warm? dry? wet? cold?
3. Topography – hilly? Flat?
4. Time – how old is the landscape?

Surfaces exposed since ca. 1960,
Grinnell Glacier cirque, Glacier National Park.



Vertical joints cutting through bedding planes, unrelated to exfoliation, can lead to weathering and erosion that results in pinnacles and spires, such as here in Colorado National Monument, western Colorado



Two types of weathering

- Physical
- Chemical

- Processes not mutually exclusive
- One or the other may dominate due to climate or rock type

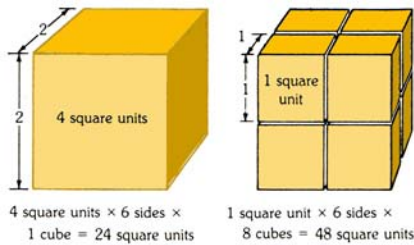
Physical (mechanical) weathering is:

- Always occurring
- More noticeable in colder climates
- Refers to *disintegration* or *breaking up* of rock by physical processes without changes in chemical or mineral composition.



Physical: makes smaller pieces from bigger pieces, fragmentation does not change chemical composition of rock disintegration
Important because

1. smaller pieces easier to move
2. increases surface area for chemical attack



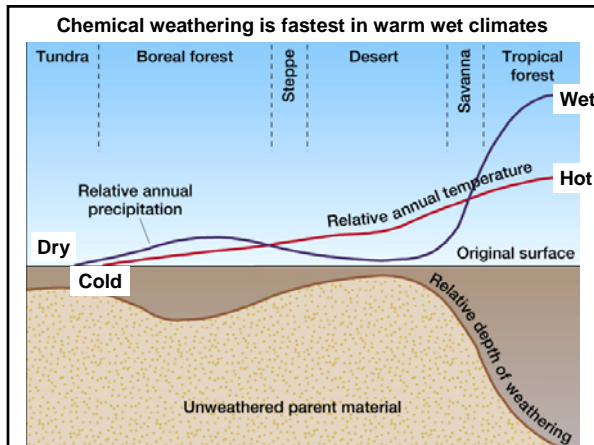
Physical (mechanical) weathering is:

- Brought about both by:
 - Stresses originating within rocks (internal stress)
 - Unloading
 - External stresses
 - Freezing and Thawing
 - Growth of Crystals
 - Thermal Expansion and Contraction
 - Organic Activity



Chemical weathering

- Decomposition of rocks by surface processes that change the chemical composition of the original material
- **Operates in three ways by creating**
 1. new materials less resistant to erosion
 2. new materials with greater volume → expansion
 3. soluble materials which are easily dissolved and transported in water
- Most chemical weathering **requires water and heat** - speeds up reaction



Forms of Chemical Weathering

- Solution
- Oxidation
- Hydration
- Carbonation

Solution...dissolves minerals

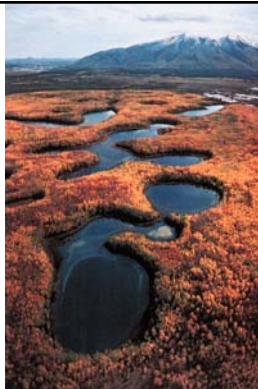
water soluble...NaCl, CaSO₄ (gypsum)

acid soluble
carbonic acid, acid rain
can dissolve limestone
and marble (CaCO₃)
Results in a karst landscape

Rock dissolves in water
and is carried away



Sinkhole in Yucatan



Uvala (several sinkholes connected), NWT, Canada

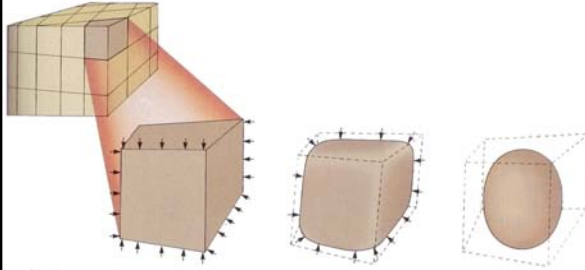
Oxidation...chemical union with oxygen
usually creates softer and finer material
increase in volume (expansion)



Important in iron-rich rocks
Rust – rock is changed
chemically and then erodes
easier

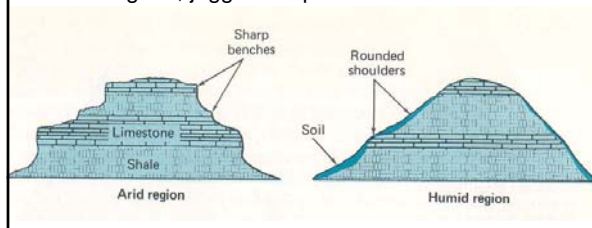


Evidence of chemical weathering
Edges and corners along joints and bedding planes are weathered more rapidly than flat surfaces → rounded edges



Chemical weathering dominates in warm & wet climates
→ rounded shapes

Physical weathering dominates in drier cooler climates
→ angular, jagged shapes



Differential weathering

one material breaks down faster than another

therefore, one is slower to erode than the other



Differential weathering in different climates

In warm, wet climates

- granite...subject to chemical weathering → saprolite (rotten rock)

In cool, dry climates

- granite is resistant → mountains



In warm wet climates limestone dissolves to yield topographic lows

Appalachian Ridge and Valley...limestone valleys and sandstone ridges

In cool or arid climates, limestone is resistant often forms topographic highs



Grand Canyon... limestone and sandstone ledges and shale slopes