Landscape Forms

References:
Encyclopedia of Volcanoes. pp 643-662; 663-682;6 83-696

Topics

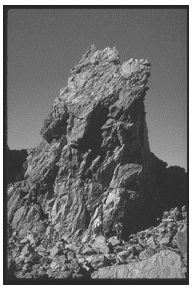
- **Small monogenetic volcanoes**
- **Large polygenetic volcanoes**
- **Effects of erosion**
- **Volcanic topography**

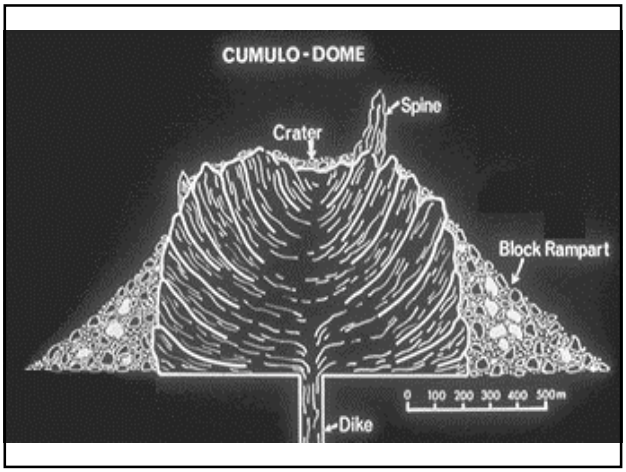
Small Volcanoes (Generally Monogenetic)

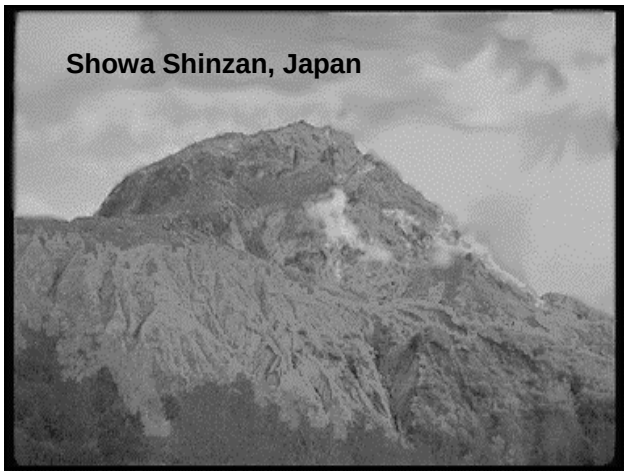
- **Domes**
- **Scoria cones**
- **Maars**
- **Tuff rings**
- **Tuff cones**
- **Diatremes**

Dome Features

- **Spines**
- **Rough top surface**
- **Steep flanks**
- **Marginal breccia**
- **Inverted cup form**

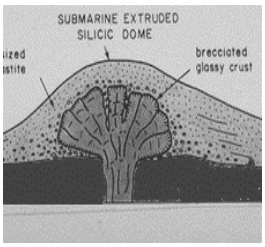


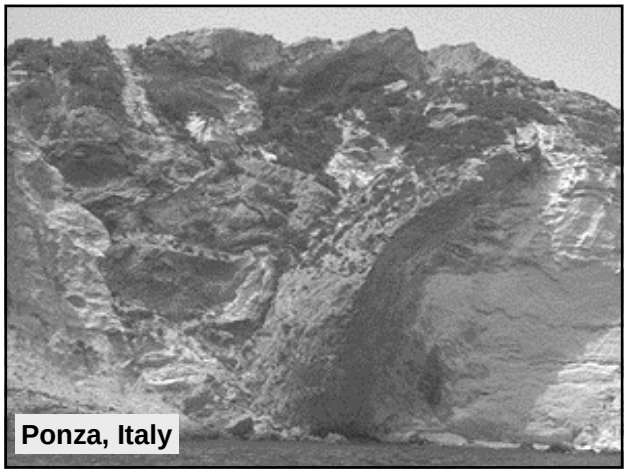




Submarine Rhyolite Domes

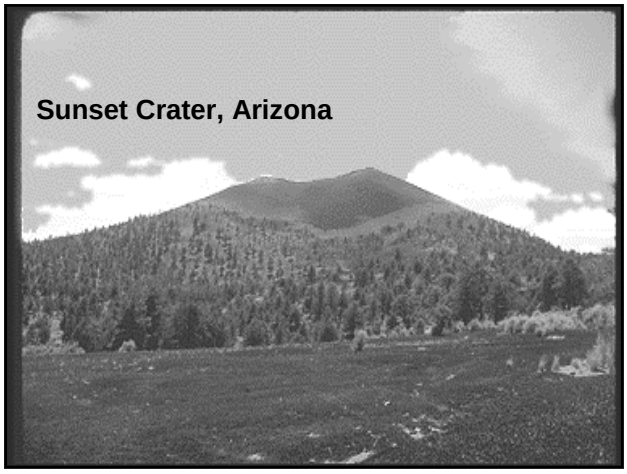
- Hyaloclastite pile
- Brecciated rhyolite
- Dikes, vitric selvage
- Hydrothermal zones
- Palagonitization

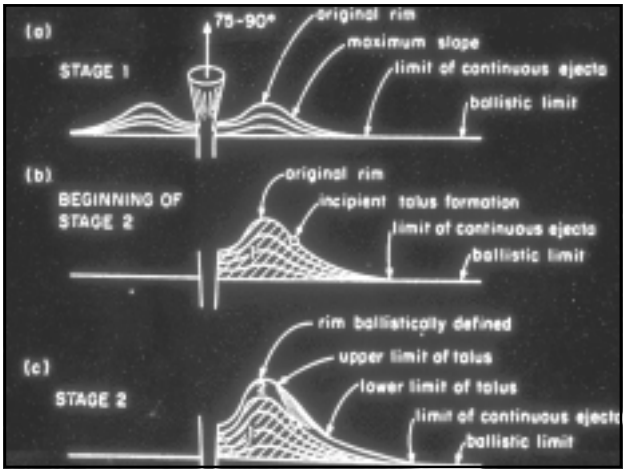


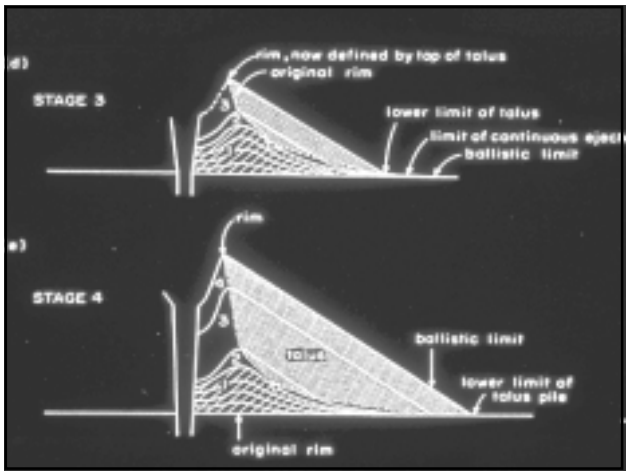


Scoria Cones

- Simplest and commonest volcanic form
- Characterized by three parameters
  - Height, width, crater width
- Standard initial slope of 30^{o}
- Conical shape
- Occur in several environments
- McGetchin model of cone growth
- Erosion is systematic







Basaltic Monogenetic Fields

- 10s to 1000s of cones
- General elliptical shape
- Aspect ratio of 2:1 to 5:1
- 10 to 70 km in length
- Areas of extensional tectonics
- Elongate perpendicular to tension
- Widespread in western USA
- Pinacate example

North rim of Grand Canyon

Scoria cones aligned along fault planes

Maars

- Result from hydromagmatic explosions
- Simple circular water-filled depression
- Low rims of ejecta (tuff ring)
- Vertical crater walls
- Pre-eruption rocks exposed in walls
- Abundant pre-volcanic boulders
- Typical diameter of 1 km
- ~ 100 m deep

Tuff Cones

Massive deposits

Thickly bedded

Palagonitized

Bedding up to 30°

Wet surges


Vulcano, Italy

Tuff Rings

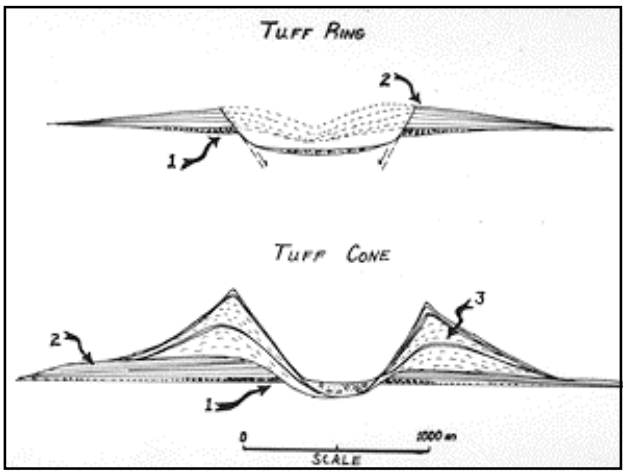
Thinly-bedded

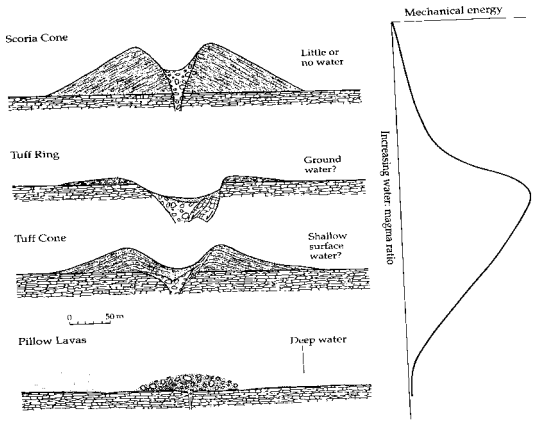
Poorly-indurated

Beds less than 12º

Sandwave beds

Dry surges





Diatremes

Breccia pipes

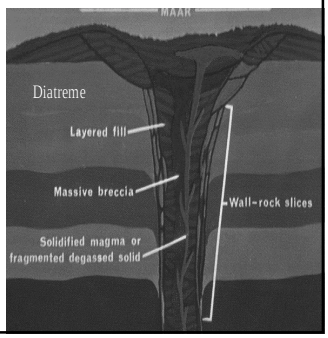
Kimberlite

Contains diamonds

Ultramafic magmas

Mixture of rocks

Driven by deep CO_2



Subglacial Volcanoes

Pillow lavas

Pillow breccias

Hyaloclastites

Dikes

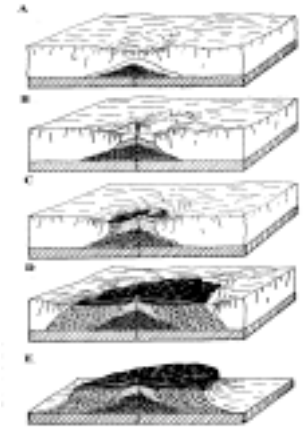
Flat top with lava

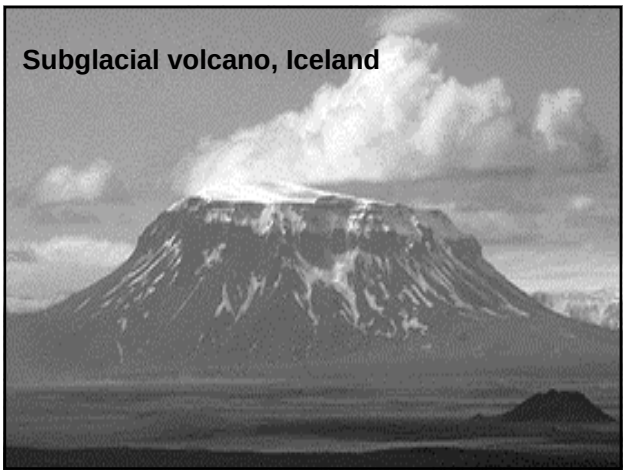
Sub-glacial

Sequence of intrusion

Pillow lava, pillow breccia, stratified hyaloclastite, lava

Final form is a table mountain



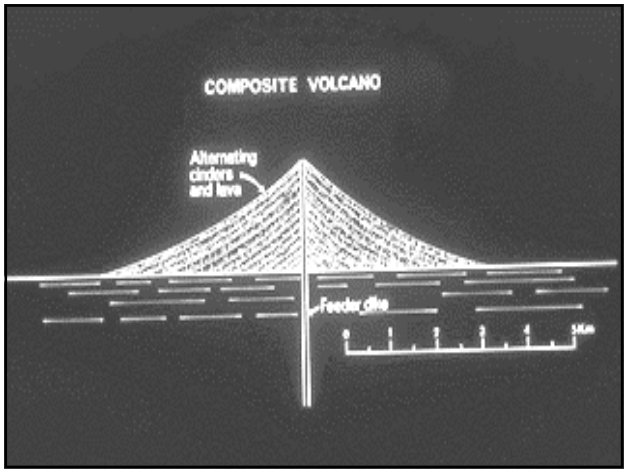


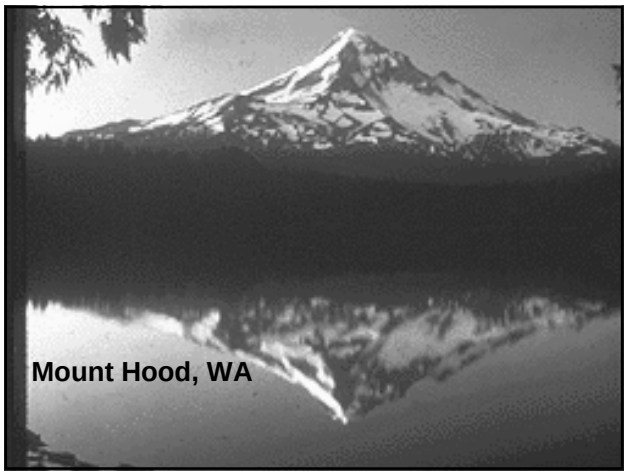
Large Volcanoes

- Generally polygenetic
- Simple cones
- Composite cones
- Compound volcanoes
- Volcano complexes

Simple Cones

- Single summit vent
- Small crater (<200 m diameter)
- Radial symmetry
- Slopes > 40^{o} near summit
- Concave profiles
- Height of a volcano is limited
- May grow to 3000 m
- Mass eruption rate is a control





Mount Hood, WA

Volume of the Cone

For a geometric cone: $V = 4/3\ \Pi\ r^2\ h$
where r is the radius and h the height

For common volcanic cones: $V = B\ e^{M/h}$
where B and M are constants and volume determined by integration

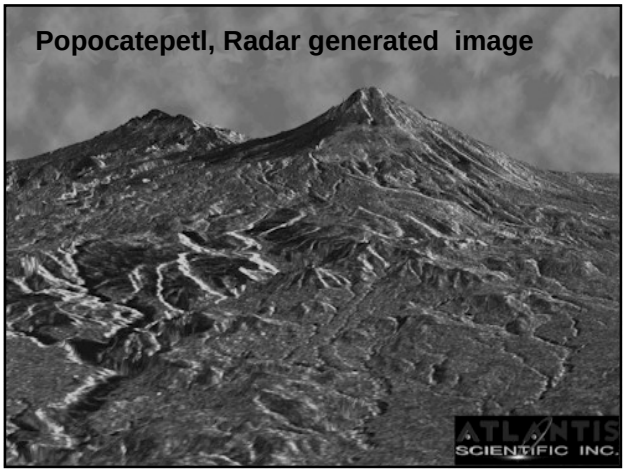
Composite Cones

- More than one stage in their evolution
- Somma type (Vesuvius)
- Debris avalanches commonly interrupt growth
- Average height is 2000 m

Mount Etna, Italy

Compound Volcanoes

- Massif formed of several volcanoes
- Volcanic complexes
- They have no defined center



Popocatepetl, Radar generated image

Shield Volcanoes

- Convex upward profiles
- Hawaiian shields
- Galapagos shields
- Icelandic shields

Hawaiian Shields

- 2 - 3^{o} slopes near base and summit
- 10^{o} slope in mid-range
- Shallow summit calderas > 200 m
- Composed of thin lava flows
- Rift zones due to lateral weakness
- Tube-fed pahoehoe lavas common

Icelandic Shields

- Moderate size
- Extremely symmetrical
- Small size >800 m high
- Uniform slope ~ 8^{o}
- Tube-fed pahoehoe lavas

Galapagos Shields

- Profile like over-turned soup plate
- Steeper mid-flank slopes > 10^{o}
- Very deep summit calderas > 800 m
- Very symmetrical volcanoes
- Circumferential fissures

Erosion of Volcanic Deposits

- Erosion of cones
- Erosion of lavas
- Erosion of tuffs
- Volcanic topography

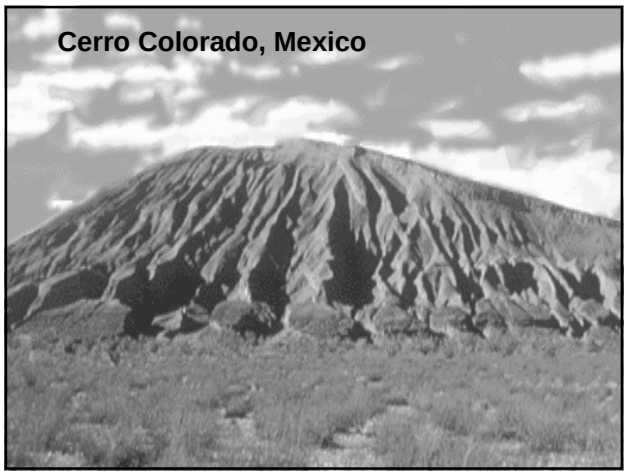
Erosion of Cones

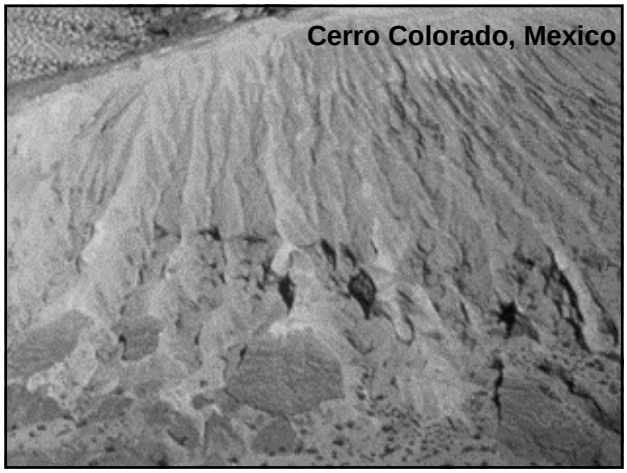
Parasol ribbing

Development of “flat irons”

Rounded hills

Necks and dikes



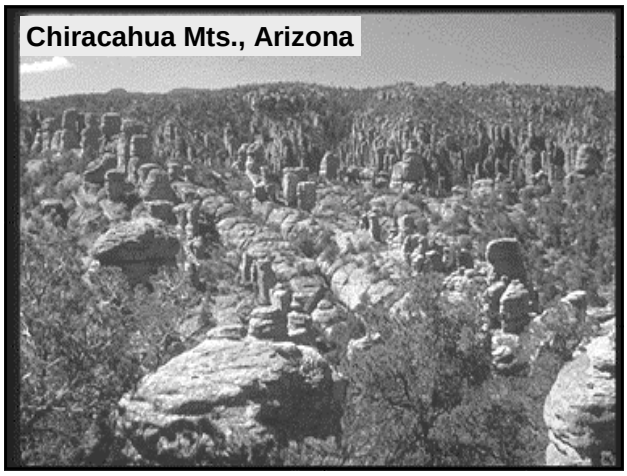


Erosion of Lavas

- Stepped topography due to layering
- Sapping produces steep canyons
- Columnar jointing exposed
- Inverted topography

Erosion of Tuffs

- Dendritic erosion
- Deep gully cutting
- Flat-topped plateaus
- Box canyons
- Castle ramparts
- Yardangs (wind eroded ridges)
- Wigwams, teepees, yahoos, etc.



Volcanic Caused Topography

- Lava dams
- Debris avalanches

Eroded Dikes

- Wall-like form
- Orientation
- Textures
- Cooling joints