

Volcanic Cycles

Reference:

Sheridan and Wohletz (1983) JVGR 17:1-29

Definitions

- Cyclic
 - A series of events that repeats in a more or less regular pattern
- Episodic
 - A series of events, unequally arranged in size or time, that represent an evolution in characteristics of an eruption

Short Temporal Cycles

- Years ($\sim 10^1$ years)
 - Kilauea events
 - Last eruptions of Mount St. Helens
- Century ($\sim 10^2$ years)
 - Colima example

Long Temporal Cycles

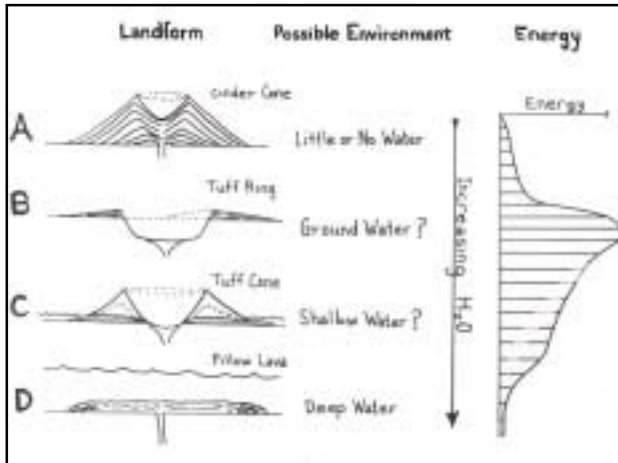
- Millennium ($\sim 10^3$ years)
 - Plinian phases of Vesuvius
 - Pinatubo?
- Long term ($> 10^4$ years)
 - Yellowstone caldera ($\sim 10^6$ years)

Duration of Events

- Period of one eruption
- Life of the volcano
- Life of a volcanic field

Nature of the Changes

- Physical
- Explosive to effusive
- Hydrovolcanic to magmatic
- Geochemical
 - Primitive to evolved
 - Depleted to enriched

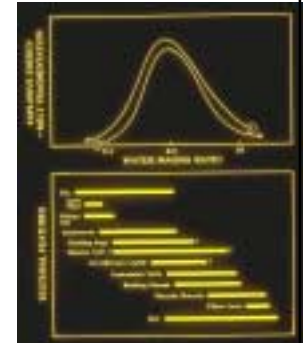


Characterization of Cycles

Water/melt interaction curve

Tuff cone to scoria cone cycles

Explanation by energy diagram



Case Examples

- Ubehebe
- Vulcano
- Vesuvius
- Colima

Ubehebe Example

- Eruption started with ejection of scoria
- Moved to hydromagmatic phase
- Ended with a tuff ring

Ubehebe



Vulcano Case

Cycles of the Fossa cone progress through three stages

1. Wet surge
2. Dry surge
3. Sub-plinian fall and lava extrusion



Vesuvius Plinian Case

- Starts with a strong plinian eruption
- Entirely magmatic at start
- Changes to dry surge eruptions
- Ends with wet surge events
- Dry to wet cycle

Vesuvius Stratigraphy

Wet surge

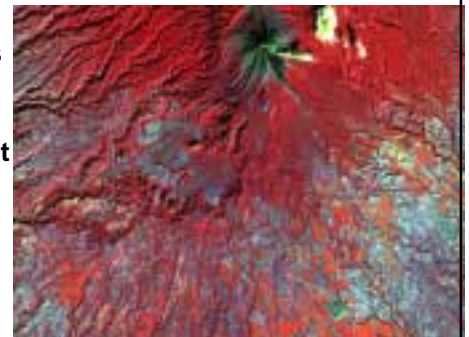
Dry surge

Plinian fall



Historic Eruptions of Colima

Four cycles
after the
European
settlement



Cycle 1

- 1576 - explosion
- 1590 - extraordinary ash fall
- 1611-13 - violent PFs with strong earthquakes

Cycle 2

- 1613-1749 no activity reported
- Large earthquakes
 - 1743 & 1806 (2000 people killed)
- Eruptions
 - 1749, 1770, 1795, 1806-1809
- 1818 (very large eruption)

Cycle 3 (Early Stage)

- 1818-69 (no eruptions, lava plug filled the crater)
- 1869 parasitic Volcancito cone formed
- Eruptions
 - 1885-86, 1892, 1898-1903

Cycle 3 (Late Stage)

- Dome extruded from crater 1906
- PFs in 1908-09
- 1913 climactic eruption

Cycle 4 (Early Stage)

- 1913-61 - no eruptions
- 1941 - strong earthquake
- Lava flows
 - 1961-62, 1975-76, and 1982, 1991, 1998-99

Cycle 4 (Late Stage)

- Block & ash flows
 - 1975-76, 1991, 1994, 1998-present
- Summit explosions
 - 1988, 1994, 1998-present
- Climactic phase 200?