

## Volcanic Debris Avalanche

References:

*Encyclopedia of Volcanoes*, pp. 617-626

Voight, B, and others, 1980. Bezymianny and mechanics of the Mount St. Helens rockslide-avalanche of 18 May, 1980. *Geotechnique*, 33:243-273.

## Debris Avalanche Topics

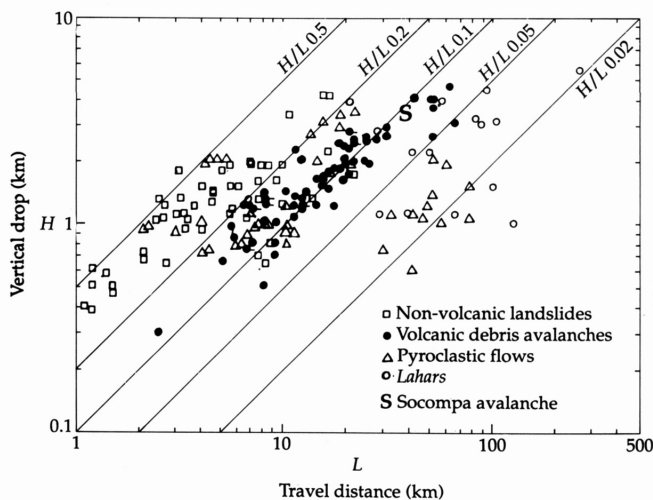
- Types
- Characteristics
- Potential Hazards
- Lateral Blasts
- Characteristics

## Deposit Size

- Several orders of magnitude
- Largest is  $>10^{10} \text{ m}^3$
- Comparable with debris flows
- Actually many transform into debris flows

## H/L Characteristics

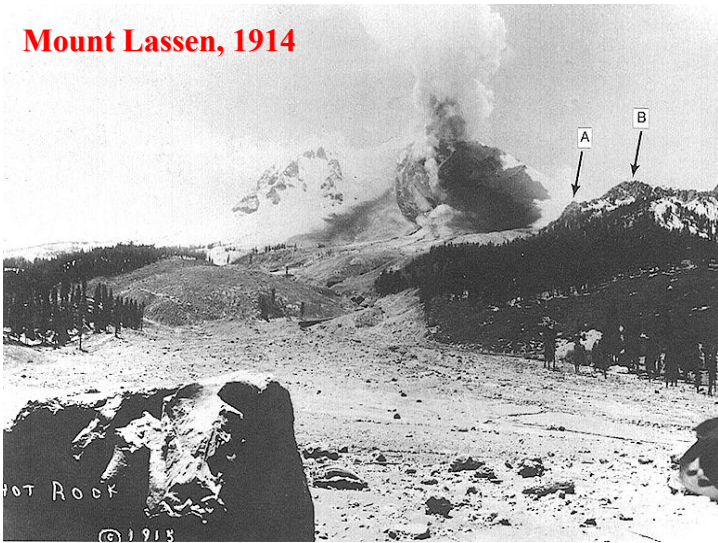
- More mobile than non-volcanic slides
- Less Mobile than pyroclastic flows and lahars
- H/L in the range of  $0.10 \pm 0.05$



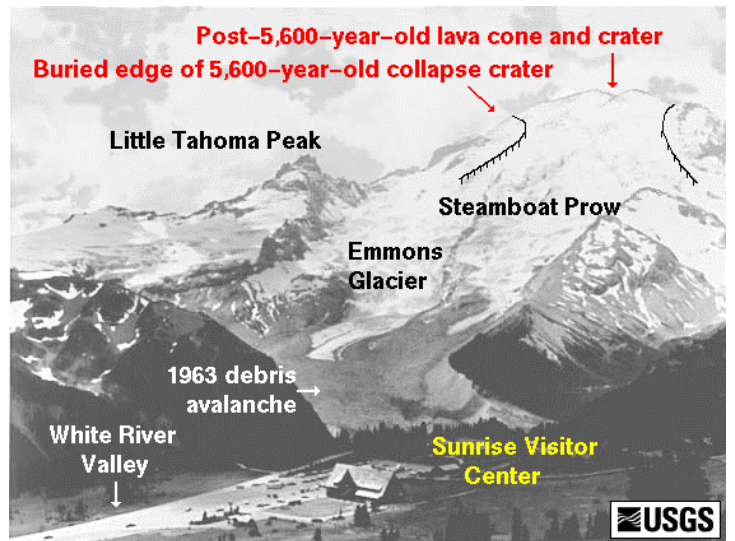
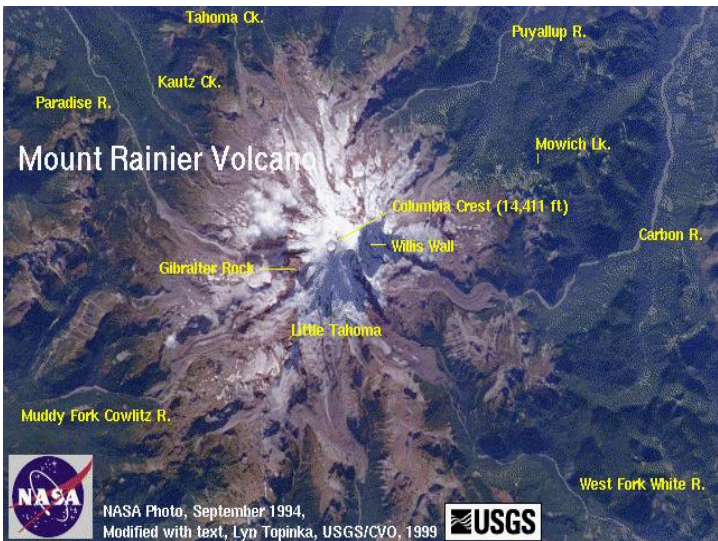
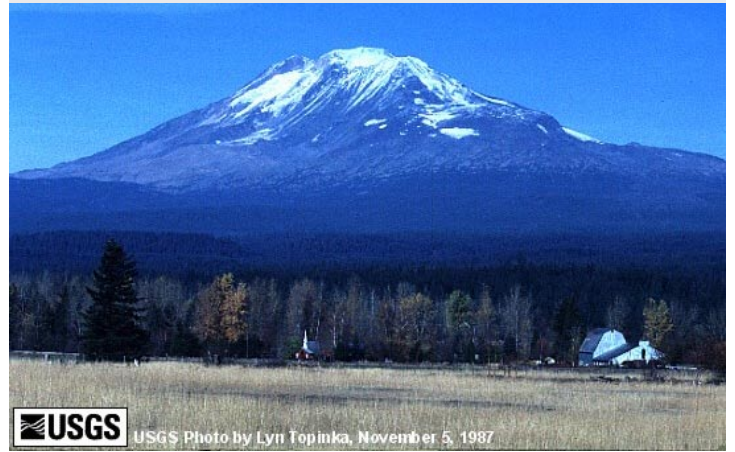
## Small Historic Avalanches

- $\gg 1 \text{ km}^3$  volume
- Typical Cascade examples
  - Mount Lassen
  - Mount Adams
  - Mount Rainier

## Mount Lassen, 1914



## Mount Adams



## Little Tahoma Creek, Mt. Rainier



## Mount St. Helens



## Large Holocene avalanches

- 50-100 km flowage distance
- 500-1500 m<sup>2</sup> area

## Debris Avalanche Types

- Bezymianny type
- Bandai type
- Unzen type

## Bezymianny Type

- Magmatic component
- Lateral blast common
- Pumiceous pyroclastic flows
- Construction of lava dome or pyroclastic cone
- Bezymianny, 1957
- Mount St. Helens, 1980

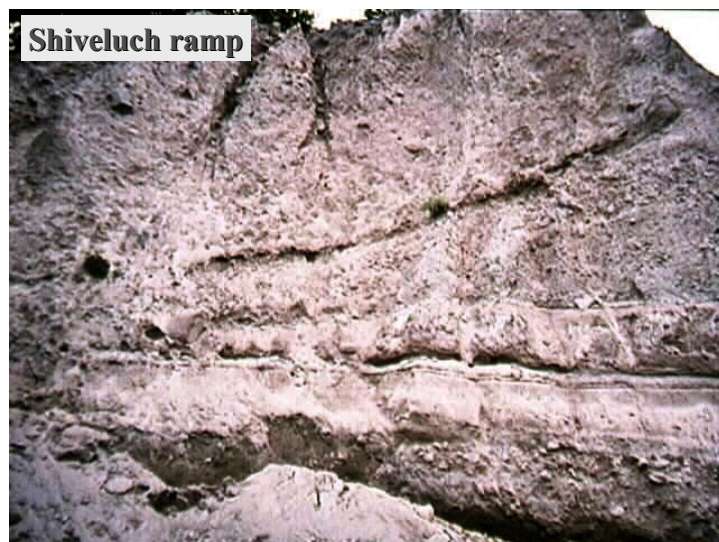
## Bezymianny type

- Pre-paroxysmal phreatic activity
- Paroxysmal eruptions are magmatic plus hydromagmatic
- Later blast is probable [ $10^7$ - $10^8$  m<sup>3</sup>]
- Tephra fall [ $10^7$ - $10^9$  m<sup>3</sup>] mostly juvenile
- VEI 3-5
- Construction of post paroxysmal dome likely





Shiveluch blocky surface



Shiveluch ramp

### Bandai type

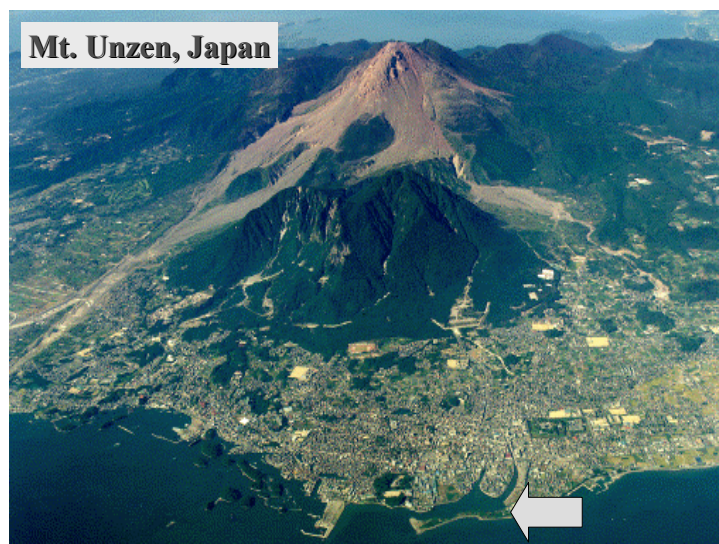
- Only phreatic component
- Begin with paroxysmal phase
- Bandai, 1888

### Bandai type

- Sudden initiation of paroxysmal phase
- Non magmatic paroxysmal eruptions
- Lateral blast less likely
- Debris avalanche [ $10^4$ - $10^{10}$  m<sup>3</sup>]
- No pumiceous pyroclastic flows
- Tephra fall [ $10^6$ - $10^8$  m<sup>3</sup>] contains only accessory material
- VEI 2-4
- Eruption ends with paroxysmal stage

### Unzen type

- Avalanche without related explosions
- Unzen, 1792



Mt. Unzen, Japan

# Horseshoe-shaped Depressions

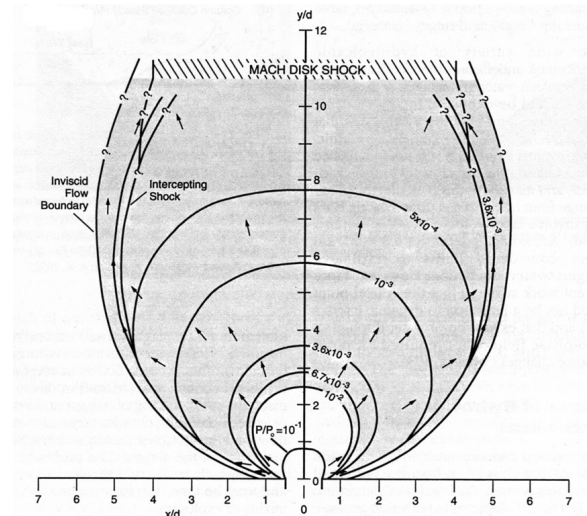
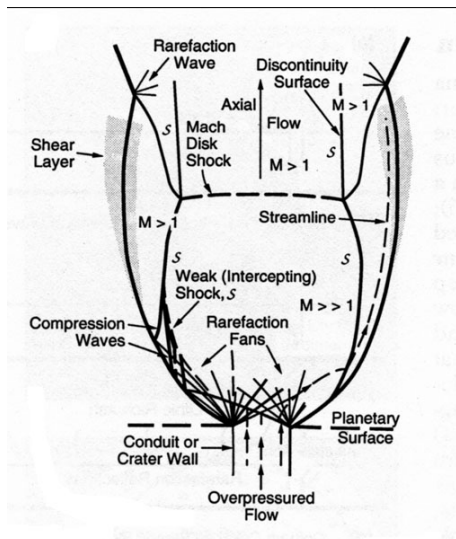


# Potential Hazards

- Lateral blasts
- Debris avalanches
- Debris flows (lahars)
- Avalanche-induced tsunamis

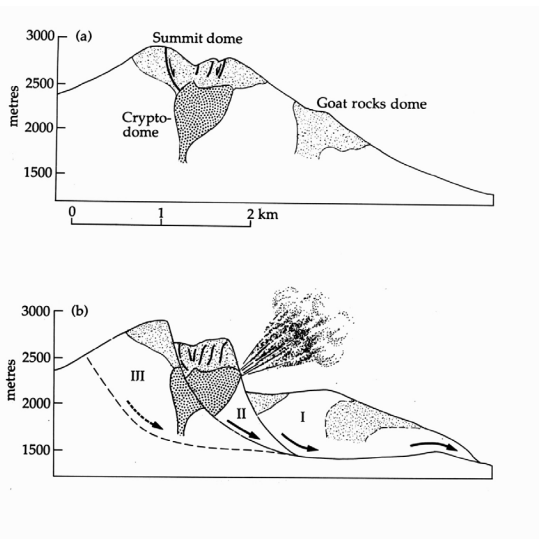
# Lateral Blasts

- Caused by decompression of hydrothermal and/or magmatic systems
- > 500 km<sup>2</sup> of devastation
- > 100 m/s velocity
- Potential for blast highest when magma is in the upper edifice (cryptodome)



## Debris Avalanche

- Velocity > 100 m/s
- Distance in terms of km
- H/L for small (0.1 to 1 km<sup>3</sup>) avalanches
  - average  $0.13 \pm 0.04$
- For large (>1 km<sup>3</sup>) avalanches
  - average  $0.09 \pm 0.04$



## Mount St. Helens Case

- Precursors
- Large-scale deformation of the edifice
- Intense local seismicity

