Volcanic Debris Avalanche

References:

Encyclopedia of Volcanoes, pp. 617-626

Deposit Size

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

Debris Avalanche Topics

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

H/L Characteristics

- More mobile than non-volcanic slides
- Less Mobile than pyroclastic flows and lahars
- H/L in the range of 0.10 ± 0.05
Small Historic Avalanches

- > 1 km³ volume
- Typical Cascade examples
  - Mount Lassen
  - Mount Adams
  - Mount Rainier

Mount Adams

Large Holocene avalanches

- 50-100 km flowage distance
- 500-1500 m² 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 Characteristics

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

Shiveluch mound

Shiveluch shadow zone

Shiveluch blocky surface
Bandai type

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

Bandai Characteristics

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

Unzen type

- Avalanche without related explosions
- Unzen, 1792

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 km² of devastation
- > 100 m/s velocity
- Potential for blast highest when magma is in the upper edifice (cryptodome)
Deposition from Blast

- Dilute flow suspended sedimentation
- Sedimentation
  \[ S = S_0 e^{-\beta x} \]
  \( S = \text{kg/m}^2 \)
- Exponential decrease in sedimentation with distance for MSH (Bursik et al., 1998)

Debris Avalanche

- Velocity > 100 m/s
- Distance in terms of km
- H/L for small (0.1 to 1 km³) avalanches
  - Average 0.13 ± 0.04
- For large (>1 km³) avalanches
  - Average 0.09 ± 0.04

Mount St. Helens Case

Precursors:

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