Lahars

- Flow characteristics
- Causes
- Deposits
- Flow mechanisms

Mud Flows (Lahars)

- Slurries of fine and coarse materials
- Audible from a distance
- Closely follow topography
- High range of yield strength

Lahars From Rainfall

- Pinatubo, 1991
- Caused by typhoon after eruption

Lahars From Rainfall

- Average velocity of 12 m/s
- Carried boulders > 1.5 m diameter
- ~ 100 people killed
Lahars From Crater Lakes

- Kelut, 1919 and 1990
  > 5000 people killed
- Ruapehu, 1953
  Some loss of life and property
- Possible to control by lake size?

Lahars From Snow Melt

- Nevado del Ruiz, 1985
- Small eruption
- $6 \times 10^7$ m$^3$ of lahar produced
- Mud flows traveled > 60 km
Lahars From Snow Melt

- Average $v = 36 \text{ ms}^{-1}$
- $Q = 5 \times 10^4 \text{ m}^3\text{s}^{-1}$
- 90 minutes following eruption
- 22,000 killed in Armero

Classification

- Debris avalanche
- Non-cohesive lahar
- Cohesive lahar
- Stream flow
**Deposit Morphology**

- Flow fronts
- Marginal levees
- Ogive surface ridges

**Deposit Textures**

- Unsorted
- Lack of bedding
- Basal shear layer?
- Laminated fine-grained top
- Large boulders supported

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**El Chichon lahar, 1982**

![Image of El Chichon lahar, 1982](image1)

![Image of El Chichon lahar, 1982](image2)
Risk Assessment

- One method assumes a Poisson distribution of events
- An event of some magnitude \( M_o \) is specified to take place in a specified time interval \( T_r \)

\[
P = 1 - \exp\left(-\frac{D_T}{T_r}\right)
\]

\( T_r \) is the mean return period for the event
\( T_e \) is the exposure time,
the time since the last event of that size

Osceola Mudflow, Mt. Rainier

- \( V = 3.8 \text{ km}^3 \)
- Age = 5600 yBP
- Runout > 120 km
- Area > 200 km²

Osceola Mudflow, Mt. Rainier

- Velocity at least 20 m/s
- \( Q_{\text{max}} = 2.5 \times 10^6 \text{ m}^3/\text{s} \)
- Bulking of sand and gravel
Mount St. Helens Mudflows

- Followed major drainages
- Several types represented
- Present a large geologic hazard