Nevado del Ruiz and the town of Armero: November 13, 1985

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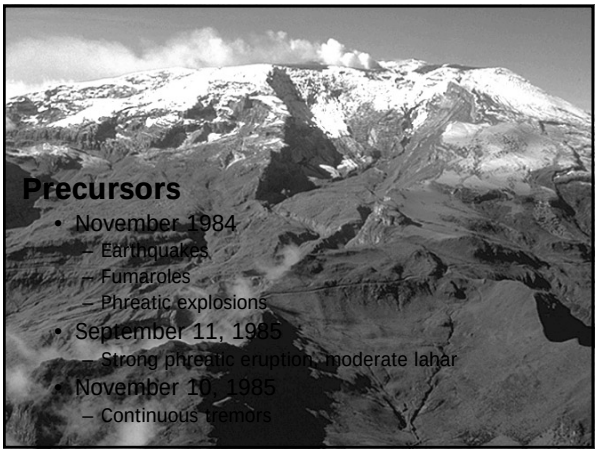
10/7/05

Nevado del Ruiz

- 100 km west of Bogota, Colombia
- 4.88°N, 75.37°W
- 5389 m (17784 ft)
- Known for its lahars

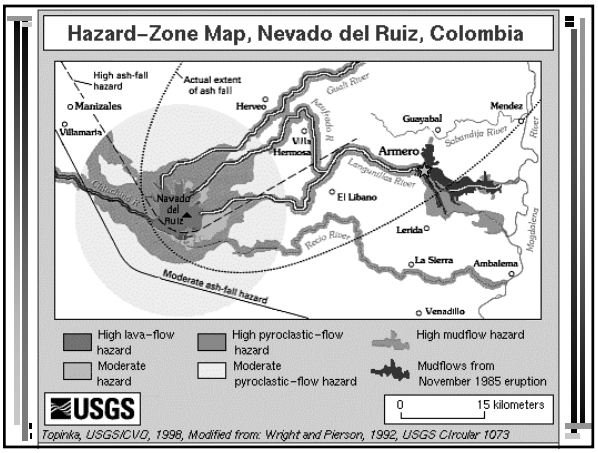
November 13, 1985

2nd largest volcanic disaster in the 20th century



Preparation

- Seismically monitored (July 1985, Manizales)
- Colombian emergency response coordinators
- October 7, 1984 – hazard maps completed, government called report "too alarming"
  - Moderate eruption: "a 100% chance of mudflows... with great danger for Armero..." (INGEOMINAS)
- Eruption predicted, but warnings were ignored



November 13, 1985

- 3:06 pm – first blast from summit
- 5 pm – pumice and ash fall on Armero
  - Mayor reassures residents over radio
  - Priest reassures over PA system
- 7 pm – Red Cross orders evacuation
- Just after 7 pm – ash stops, "end of abnormal conditions"

- 9:08 pm – Main eruption begins
  - 8m of pumice and ash fall on summit
  - Rain continues
  - Hot ash melts 10% of ice cover (2.5 km^2)
  - Water, ice, pumice, and debris flow down river channels

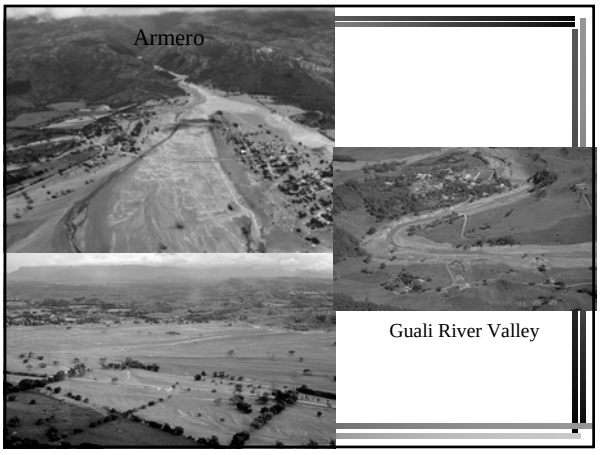
The Lahar

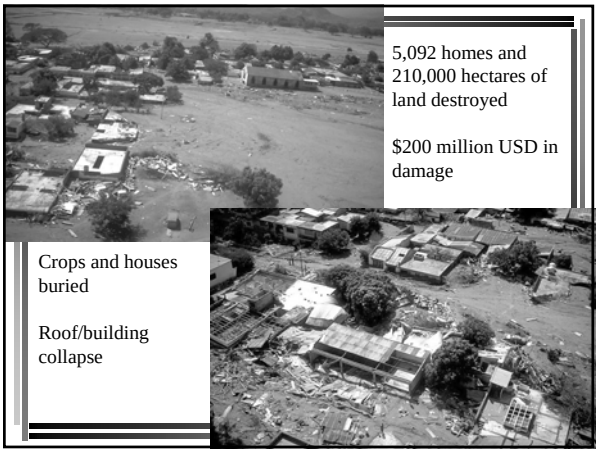
- Up to 60 km/hour
- Grows up to 4x original volume by erosion of valley walls (6 x 10^7 m^3)
- Up to 50 m thick

http://www.geo.mtu.edu/volcanoes/hazards/primer/lahar.html

Armero

- Located on Rio Lagunillas
  - Azufrado and Lagunillas lahars join just upriver of Armero
- Lahars reach town (74 km) in 2.5 hours
- Came in several pulses





5,092 homes and 210,000 hectares of land destroyed

$200 million USD in damage

Crops and houses buried

Roof/building collapse

Casualties, Injuries, and Homeless

- 24,000 deaths total
  - 23,000 deaths in Armero, 1,000 in Guali River Valley
  - Buried, crushed, severe lacerations, acid burns
  - 15,000 animals killed
- 4,500 injured
- 8,000 homeless

What went wrong?

A result of "cumulative human error – by misjudgment, indecision, and bureaucratic short-sightedness."

- Geologists visited summit crater Nov. 12th and didn't see "anything alarming"
- No money or skilled geologists to monitor volcano, had to rely on other countries
- Storm obscured summit, residents couldn't see eruption, were reassured by mayor and priest
- City officials wouldn't release hazard map, only printed 10 copies

Where does Armero fit in?

2nd largest volcanic disaster in the 20th century

- Mount Pelee: May 8, 1902
  - Largest volcanic disaster in the 20th century
  - 30,000 killed (Martinique) by PF
- Mount St. Helens: May 18, 1980
  - 57 killed by PF, lateral blast
  - Lahars
    - 10 – 25 mph
    - Damaged 27 bridges, 200 homes, 185+ mi of highways/roads, 15 mi of railways
    - No known casualties

Nevado del Ruiz only erupted 3% of the 1980 Mt. St. Helens volume

Where does Armero fit in?

The fourth largest death toll in history for a single eruption

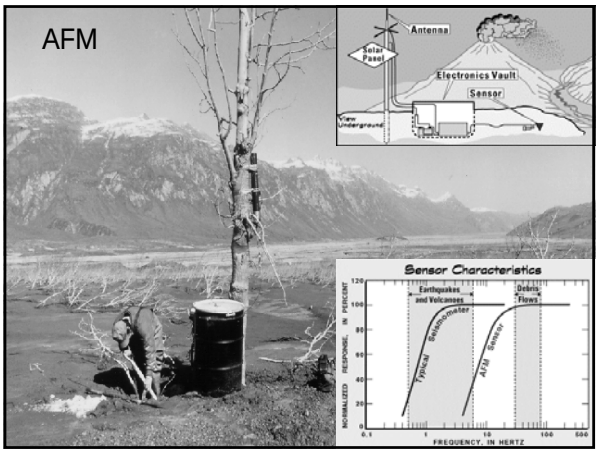
- Tambora (1815): 92,000
- Krakatau (1883): 36,000
- Mt. Pelee (1902): 28,000 – 30,000
- Nevado del Ruiz (1985): 24,000

What could have been done?

- Publish and circulate hazard map
- Evacuate city
- Supply residents with more information regarding possible hazards
- Better communication between government branches

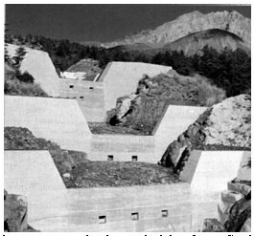
Mitigation

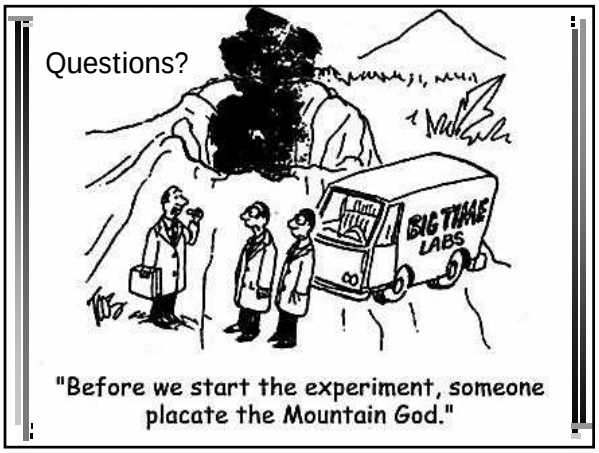
- USGS International Volcano Disaster Assistance Program (VDAP) established
  - Mission: "to reduce eruption-caused fatalities and economic losses in developing countries"
  - Volcano monitoring (portable)
  - Eruption forecasts
  - Hazard analysis
- Lahar detection system developed: Acoustic Flow Monitor (AFM)



Future Mitigation

- Work with VDAP
  - Establish alert levels
  - Better communication
- Educate population
  - Evacuation drills
- Lahar Engineering





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