Volcanic Processes and Hazards
A synopsis

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http://vulcan.wr.usgs.gov
http://www.dnr.wa.gov/geology/

Pahto (Mount Adams) and Wy-east (Mount Hood) fought over a young maiden, Loo-wit Lat-kla.

An eruption from the Goat Rocks dome as painted by Paul Kane in 1847.

Volcano Hazards

- Tephra
- Pyroclastic flows
- Debris avalanches (volcanic landslides)
- Lahars
- Lava flows
- Volcanic gases

Subduction

Mount St. Helens
Plinian column during cataclysmic eruption of May 18, 1980
View to the north-northwest after noon; photo by Bob Krimmel, USGS
Tephra Hazards

- Loads structures
- Reduces visibility
- Abrasive and conductive
- Health risks
- Large areas, long duration
- Danger to aircraft

Hazards in proximal areas:

- Lava flows
  - Hot, dense, slow moving, destructive
- Lava domes
  - Collapse

Pyroclastic flows
- Hot, fast, dense, mobile, destructive
**Pyroclastic flow of August 7, 1980 at Mount St. Helens**

**Unzen Volcano, Japan**, showing path of 1991 pyroclastic flow and surge that killed 39 including Maurice and Katia Krafft and vulcanologist Harry Glicken.

1792 debris avalanche from Mount Mayuyama buried a city and caused a tsunami killing 15,000.

**Nine victims of a pyroclastic surge from Mount Vesuvius AD 79, Pompeii.** ➡️ *Flow direction of pyroclastic surge.*

**Martinique, 1902, Mount Pelee**

**After the explosive eruption**

**Lahar Hazards**

- Origins:
  - Eruption-induced melting of ice and snow
  - Debris avalanche
  - Lake breakout
  - Erosion of tephra and other sediments
Lahar Hazards
- Erosion
- Burial
- Impact
- Altered channels

May 14, 1984 explosion and lahar

Montserrat Volcano Observatory

explosion and lahar

Old Maid lahar 1781
Flood of record mid 1400s

Old Maid lahar 1781
Flood of record mid 1400s

Buried forest of Mount Rainier

Buried forest of Mount Rainier

Bonneville landslide

Bonneville landslide

Ghosts forest

Ghosts forest

Columbia River

Columbia River

Sandy River

Sandy River

Mount Hood

Mount Hood
Armero, Columbia: >22,000 people killed by a lahar Nov. 1985. –cause
= relatively small eruption of Nevado del Ruiz ~ 50 km away.

Volcanic disturbances
Effects may last for decades:
elevated erosion and sedimentation rates.
Sediment-augmented floods

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Debris Avalanche

Mount St. Helens May 18, 1980, seconds after the beginning of the eruption. Photo by Gary Rosenquist from Bear Meadow, ~11 km northeast of the volcano.

Hummocky terrain of the Mount St. Helens 1980 debris-avalanche deposit as seen from the Hummocks Trail, about 9 km from the volcano.

http://motion.wr.usgs.gov/
Mount Rainier Animation Project
Large Hawaiian debris avalanches

Lahar Lookout, 81 Road; Mount St. Helens NVM

Mount St. Helens Tree-ring studies

Wn – AD 1480
We – AD 1482
X – AD 1489-1510
T – AD 1800
Floating Island Lava – AD 1800
Goat Rx dome – AD 1843-5

Dave Yamaguchi, 1980s (many papers)

*Kalama Eruptive Period
AD 1480 to mid 1700s
*Goat Rocks Eruptive Pd.
AD 1800 to ~1859

Mount Rainier from Sunrise

The summit collapsed to generate the Osceola Mudflow about 5,000 yr B.P. The Columbia Crest cone grew in the crater formed by the collapse, one of the world’s 20 largest lahars. The Osceola buried a native American site in Enumclaw.
Above: 1995 Emerald Downs racetrack excavation at Auburn. Subfossil trees buried by andesitic sand. Stump dated at 1,080 yr B.P.

Below: 1995 Port of Seattle excavation at Auburn. Subfossil trees buried by andesitic sand. Stump dated at 1,080 yr B.P.

Orting buried forest—buried by the Electron Mudflow ~A.D. 1500

Radiocarbon wiggle matching date for the Electron Mudflow

Outer rings of two bark-bearing trees cross dated to A.D. 1781

Hidden Lake outlet Zigzag River
Mount Rainier hazard map

Mount Baker and Glacier Peak

From Dragovich and others, 2000

Fraser River
Nooksack River

Mount St. Helens
• Highly explosive
• Widespread ash
• Growing mass of snow and ice
• Lahar hazards
Monitoring

Thermal Imaging (FLIR)
http://vulcan.wr.usgs.gov/

Volcanic gases

Mount St. Helens Earthquakes 1993-2003

Mount Rainier Lahar-Warning System
Pierce County DEM; WA; EMD; USGS

Monitoring (cont)

GPS, seismic, sound, tilt

http://volcanoes.usgs.gov/About/Highlights/RainierPilot/Pilot_highlight.html

West Sister uplift
Central Oregon Cascades

http://vulcan.wr.usgs.gov/home.html
http://www.panga.cwu.edu/
Volcano Web Resources

- [http://www.geophys.washington.edu/SEIS/PNSN/NW EQ](http://www.geophys.washington.edu/SEIS/PNSN/NW EQ) ash advisories
- [http://www.ssd.noaa.gov/VAAC/ash advisories](http://www.ssd.noaa.gov/VAAC/ash advisories)
- [see Pat’s links](http://www.geocities.com/buried_forest)
- [http://www.geocities.com/buried_forest/critical-areas.htm](http://www.geocities.com/buried_forest/critical-areas.htm)