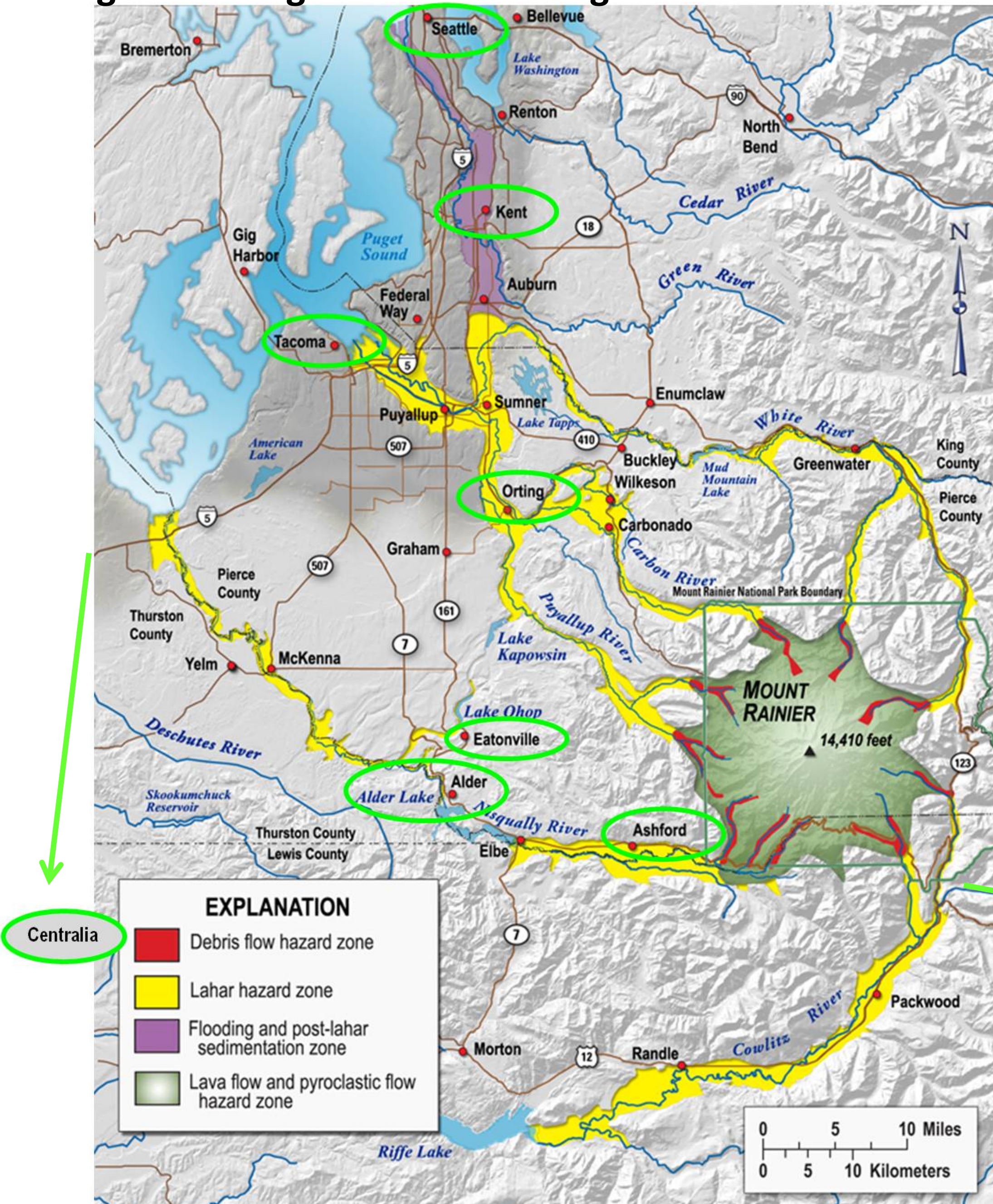
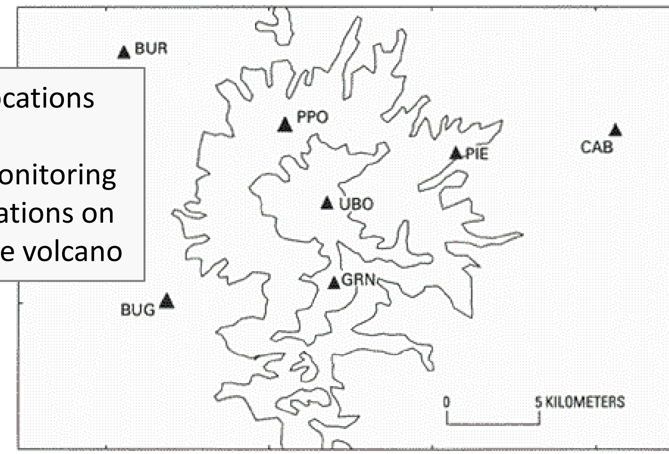
Living on the Edge: Unit 5: Convergent Plate Boundaries



Because of its elevation (4,392 m), relief, hydrothermal alteration, icecap, glacier-fed radial valleys, and proximity to suburbs of the Seattle-Tacoma area, ***Mount Rainier is the most threatening volcano in the Cascades***. Its next eruption could produce volcanic ash, lava flows, and *avalanches of intensely hot rock and volcanic gases, called pyroclastic flows*. Some of these events swiftly melt snow and ice and could produce torrents of melt water that erode loose rock and become *rapidly flowing slurries of mud and boulders known as lahars,* which is the greatest risk at the volcano, rather than from an eruption itself.
http://volcanoes.usgs.gov/volcanoes/mount_rainier/mount_rainier_hazard_49.html

Locations of monitoring stations on the volcano



"We call it low probability, high consequence," Steven Bailey, Pierce County, Washington's director of emergency management. "It's a low probability it's going to occur in our lifetime. But if and when it does, the consequences are going to be huge."
www.geographyalltheway.com/igcse_geography/natural_environments/plate_tectonics/igcse_volcanoes_manage.htm

Above left, modified from: USGS Fact Sheet 2008-3062; http://volcanoes.usgs.gov/vsc/images/image_mngr/300-399/img350.jpg; Map above right from Lockhart et al., 1996

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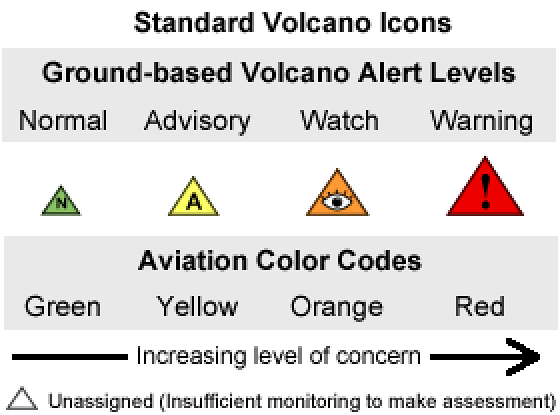
The USGS has established an alert level system to communicate the likelihood of increasing or decreasing volcanic activity. Keep these alert levels in mind as you look through the geologic activity data attached.



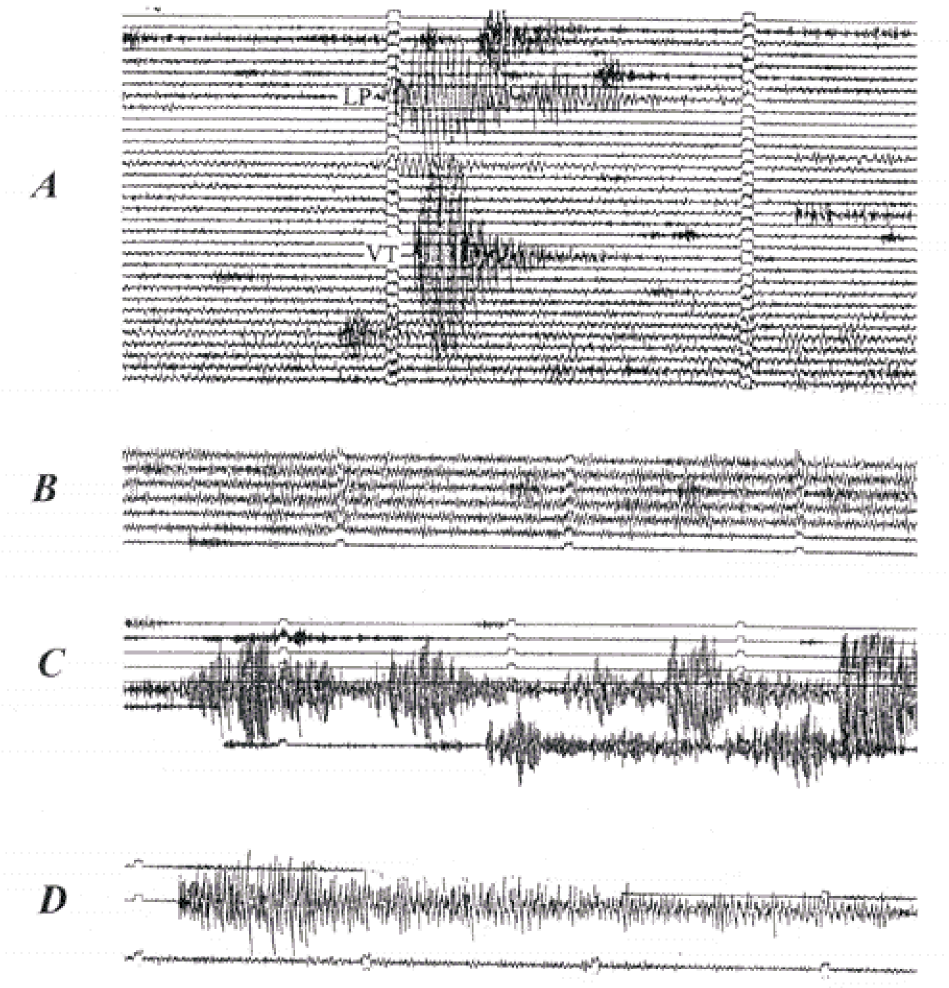
Alert Level	Description
NORMAL	Volcano is in typical background, non-eruptive state *or, if changing from a higher level*: The activity has ceased and volcano has returned to non-eruptive background state.
Advisory	Volcano is exhibiting signs of elevated unrest above known background level; *or, if changing from a higher level:* Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
Watch	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain OR eruption is underway but poses limited hazards
Warning	Hazardous eruption is imminent, underway, or suspected

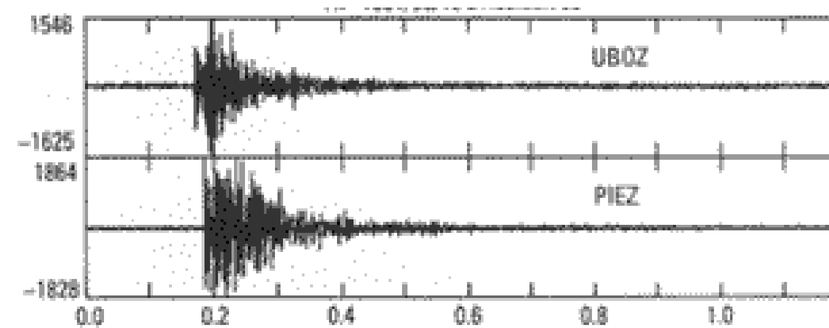
http://volcanoes.usgs.gov/activity/alertsystem/index.php#alertlevel

Note: Data included in the following handouts are from the USGS. References for specific figures and information can be obtained from your instructor.

SEISMIC DATA SET 1: THROUGH JUNE 8

SEISMOLOGY: EARTHQUAKES





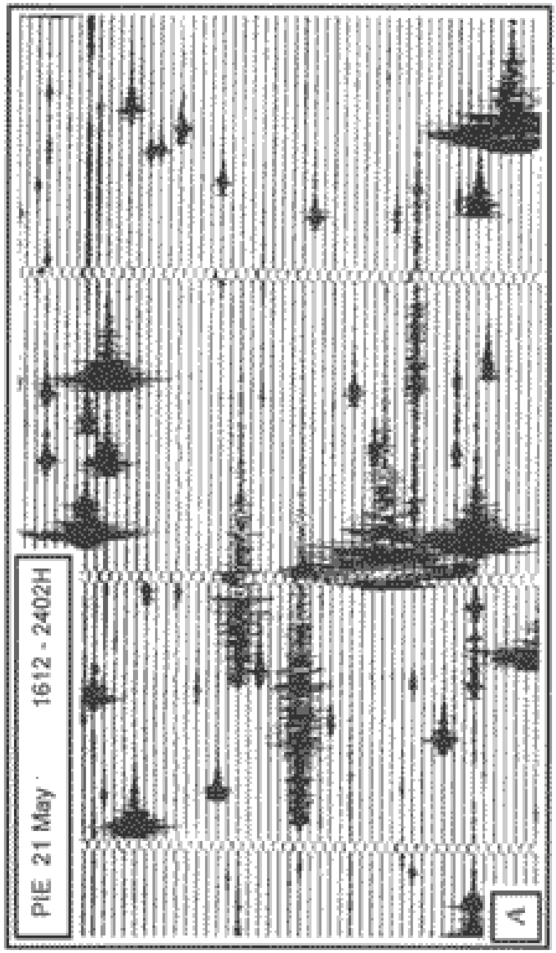
Seismograms of May 15 recorded at stations UBO and PIE (Z). Time marks in seconds are shown.

Examples of seismic event types: A. **VT = Volcano-Tectonic** earthquake (associated with deep earthquakes indicating stress changes in solid rock due to injection or withdrawal of magma) and **LP = Long-Period** (associated with shallow injection of magma into surrounding rock) often associated with shallow magma movement, suggesting imminent eruption. **B. Tremor-like** episode of closely-spaced long-period events; **C. Harmonic tremor** (long-lasting, continuous release of seismic energy typically associated with shallow, underground movement of magma; harmonic tremor contrasts distinctly with the sudden release of seismic energy associated with slippage along a fault.

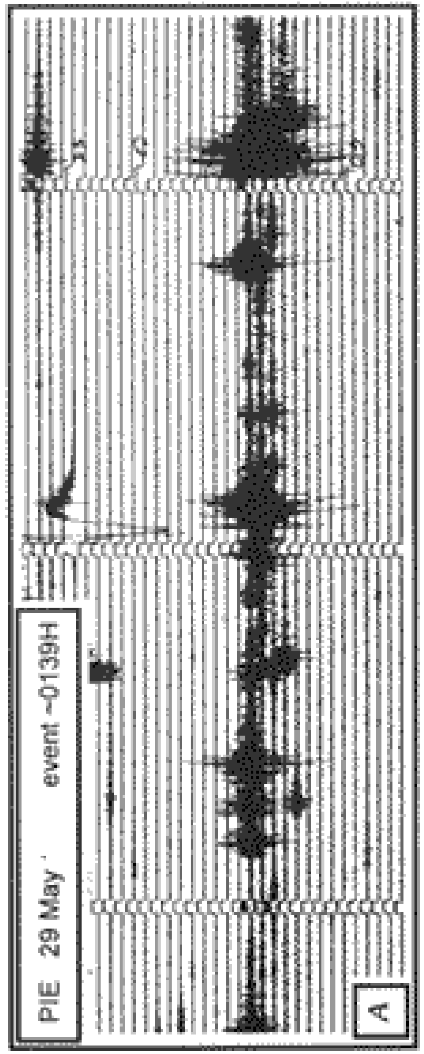
D. Seismic signal from **explosive eruption** at station CAB (see map of stations in this data set). Time marks represent 1-min interval.

Figures from: Harlow et al., 1996

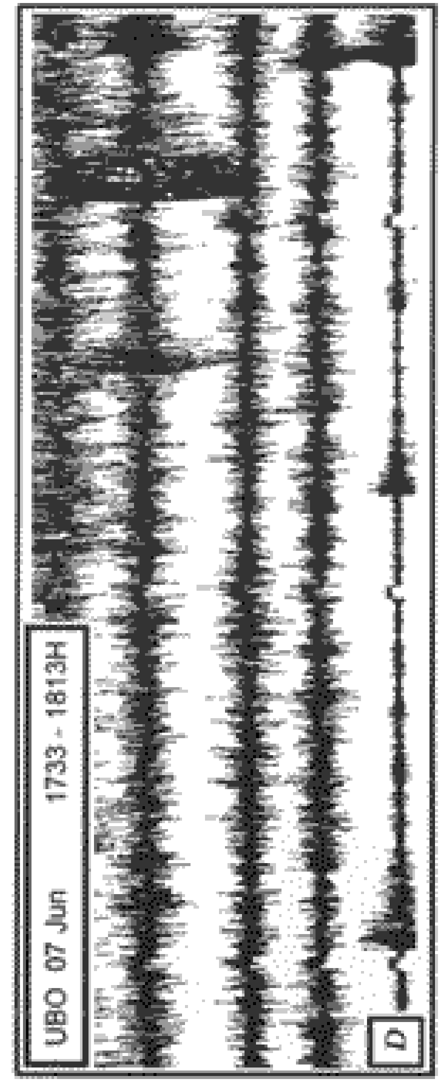
SEISMOLOGY: EARTHQUAKES



Seismogram from May 21st. Time marks are 60 sec apart.



Seismogram of station UBO (note: this signal fades to the background 2 h after the segment shown). Time marks are 60 sec apart.



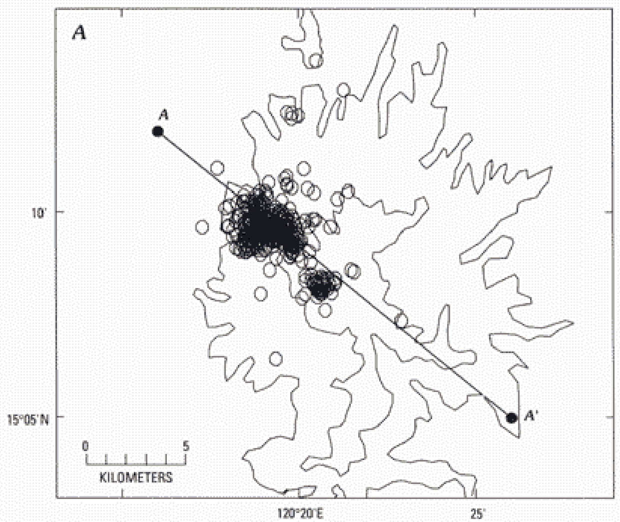
Seismogram from station PIE recorded May 21st. Time runs from top to bottom, left to right. Time marks are 60 sec apart. Date and time shown are local.

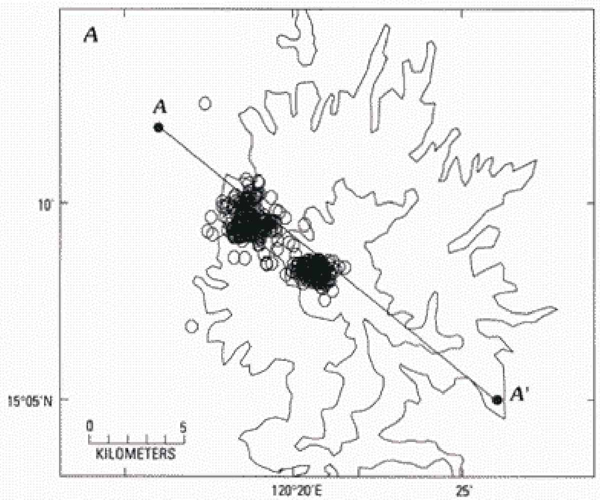
Figures from: Harlow et al., 1996

May 6- 31

June 1-7

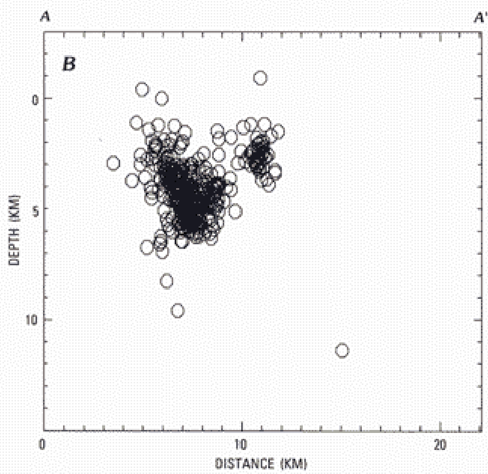
MAP VIEW

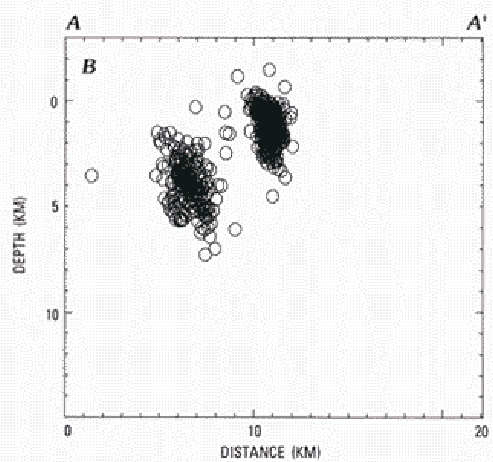




MAP VIEW

CROSS SECTION A side view of earthquake locations under the volcano (note location of line A-A' on map above)



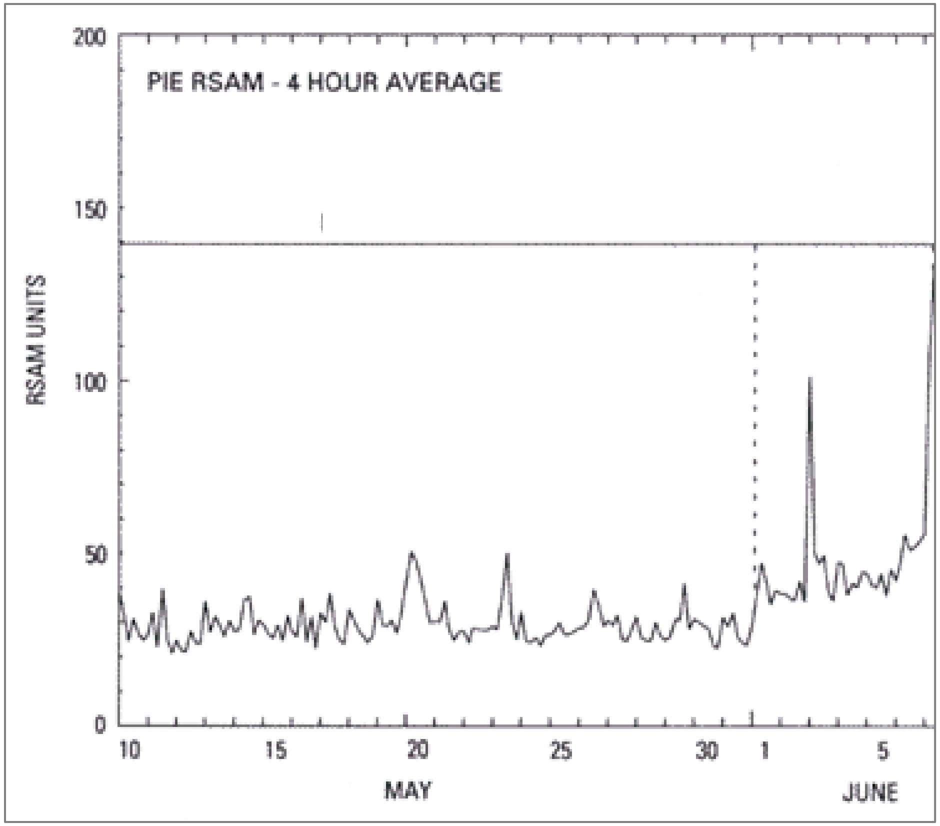


CROSS SECTION A side view of earthquake locations under the volcano (note location of line A-A' on map above)

Figures from: Harlow et al., 1996

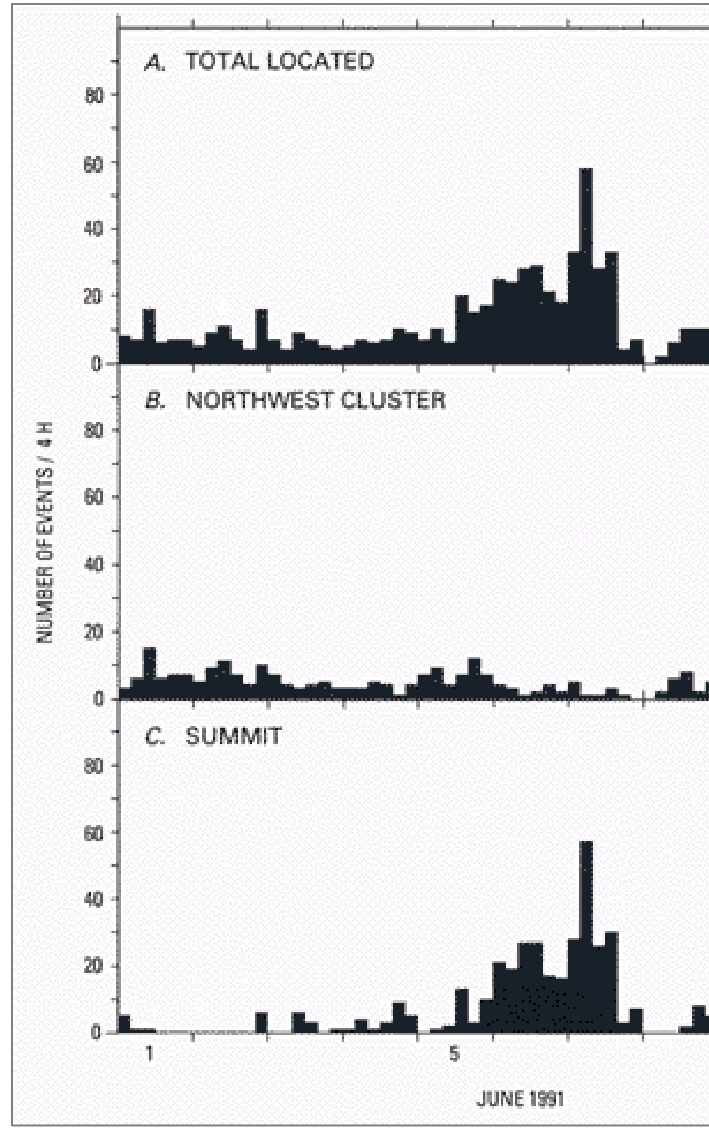
SEISMOLOGY: EARTHQUAKES

RSAM data: recall that RSAM (Real-time seismic amplitude measurement) represents an average of absolute seismic amplitudes for seismic stations. RSAM does not discriminate between *types* of earthquakes, but all seismic signals are averaged and recorded



RSAM values (averages of 4 hour intervals) from May 10-June 8 at the PIE station.

EXTENDED CAPTION: Plot of (A) the SO_2 volumes from **May 10 to June 12;** estimated from COSPEC measurements and (B) 4 hour average RSAM values from May 10-June 12



Number of seismic events per 4-hour intervals between **June 1 and June 8** from (A) the entire volcano network, (B) the cluster of seismic activity 5 km northwest of the summit, and from (C) beneath the summit.

Figures from: Harlow et al., 1996

All Image Credits:
Slide 1: Above left, modified from: USGS Fact Sheet 2008-3062; http://volcanoes.usgs.gov/vsc/images/image_mngr/300-399/img350.jpg; Accessed December 11, 2013; Map above right from USGS, Lockhart et al., 1996 (USGS publications are public domain)
Slide 2: Images from USGS, http://volcanoes.usgs.gov/activity/alertsystem/index.php#alertlevel, Accessed December 11, 2013
Slide 4: Image Credits: Left: From USGS, Harlow et al., 1996: Harlow, DH, Power JA, Laguerta EP, Ambubuyog G, White RA, Hoblitt RP, 1996, Precursory Seismicity and Forecasting of the June 15, 1991, Eruption of Mount Pinatubo; In Fire and Mud: Eruptions and Lahars of Mount Pinatubo, Philippines; CG Newhall, RS Punongbayan (Editors); Philipine Institute of Volcanology and Seismology, Quezon City and University of Washington Press, Seattle and London (USGS Publication, public domain)
Right: Ramos, E, Laguerta, EP, Hamburger, MW, 1996, Seismicity and Magmatic Resurgence at Mount Pinatubo in 1992; In Fire and Mud: Eruptions and Lahars of Mount Pinatubo, Philippines; CG Newhall, RS Punongbayan (Editors); Philipine Institute of Volcanology and Seismology, Quezon City and University of Washington Press, Seattle and London
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Slide 7: Image Credits: All from USGS, Harlow et al., 1996
Slide 9: Image Credits: All from USGS; Left image: from Wolfe & Hoblitt, 1996; Wolfe EW and Hoblitt RP, 1996, Overview of the Eruptions, In Fire and Mud: Eruptions and Lahars of Mount Pinatubo, Philippines; CG Newhall, RS Punongbayan (Editors); Philipine Institute of Volcanology and Seismology, Quezon City and University of Washington Press, Seattle and London (USGS Publication, public domain)
Upper right image from Ewart et al., 1996: Ewert JW, Lockhart AB, Marcial S, Ambubuyog G, 1996, Ground Deformation Prior to the 1991 Eruptions of Mount Pinatubo; In Fire and Mud: Eruptions and Lahars of Mount Pinatubo, Philippines; CG Newhall, RS Punongbayan (Editors); Philipine Institute of Volcanology and Seismology, Quezon City and University of Washington Press, Seattle and London (USGS Publication, public domain)
Lower right graphic from Daag et al., 1996: Daag AS, Tubianosa BS, Newhall CG, Tungol NM, Javier D, Dolan MT, DelosReyes PJ, Arboleda RA, Martinez, MML, Regalado MTM; 1996, Monitoring Sulfur Dioxide Emission at Mount Pinatubo, In Fire and Mud: Eruptions and Lahars of Mount Pinatubo, Philippines; CG Newhall, RS Punongbayan (Editors); Philipine Institute of Volcanology and Seismology, Quezon City and University of Washington Press, Seattle and London (USGS Publication, public domain)
Slide 10:Left: Daag et al., 1996; Upper right: Wolfe & Hoblitt, 1996; Lower right: Modified from Lockhart et al., 1996: Lockhart, AB, Marcial, S, Ambubuyog, G, Laguerta, EP, Power, JA, Installation operation, and technical specifications of the first Mount Pinatubo telemetered seismic network, In Fire and Mud: Eruptions and Lahars of Mount Pinatubo, Philippines; CG Newhall, RS Punongbayan (Editors); Philipine Institute of Volcanology and Seismology, Quezon City and University of Washington Press, Seattle and London (USGS Publication, public domain)
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