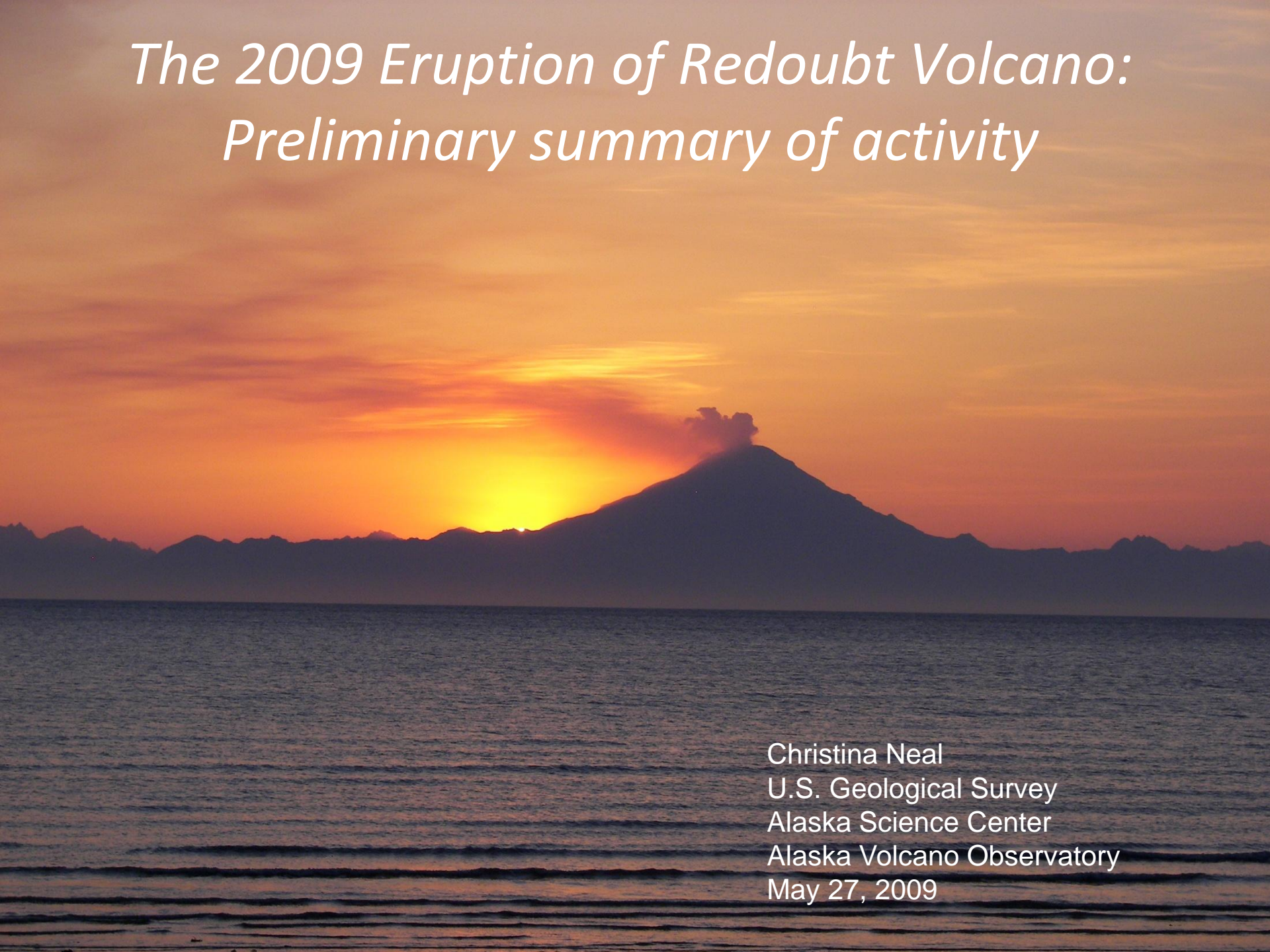


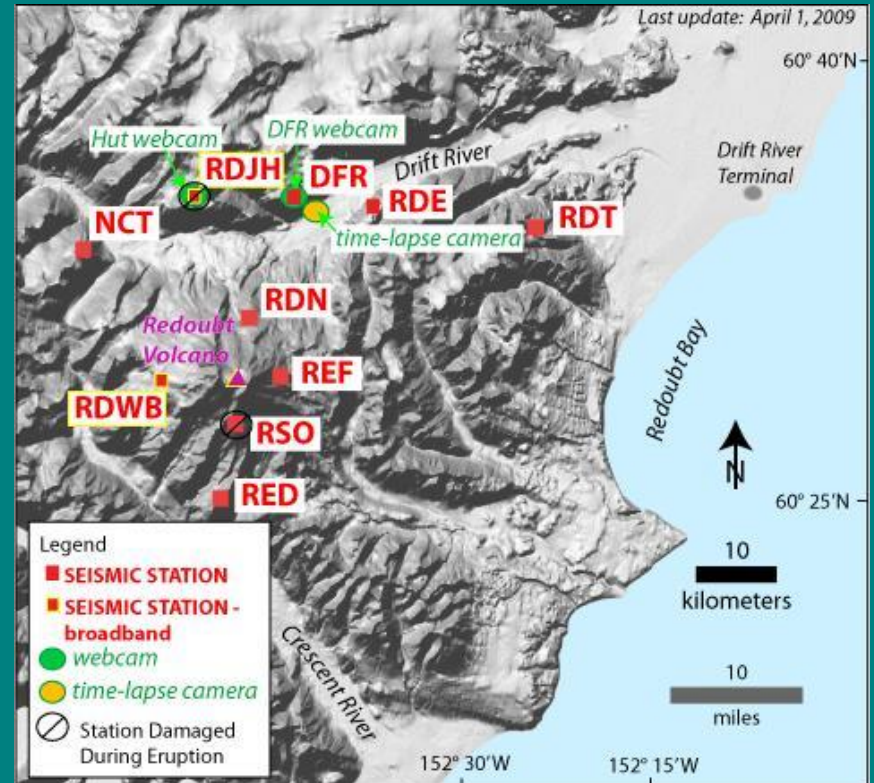
# *The 2009 Eruption of Redoubt Volcano: Preliminary summary of activity*



Christina Neal  
U.S. Geological Survey  
Alaska Science Center  
Alaska Volcano Observatory  
May 27, 2009

# Redoubt Monitoring by AVO

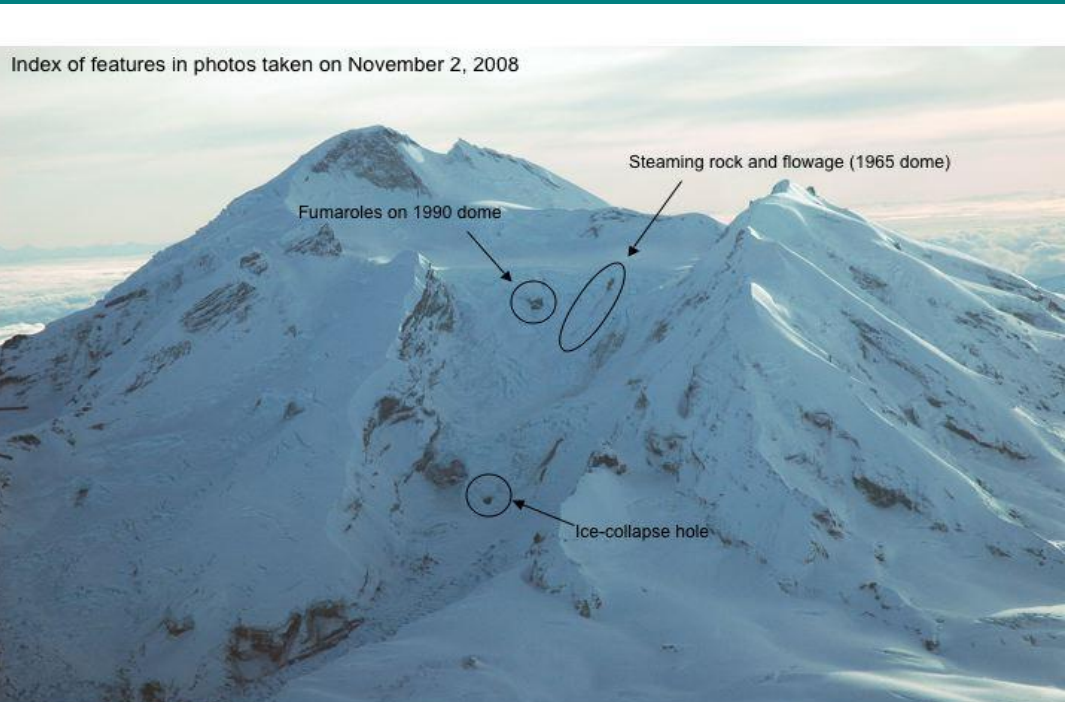
- 10 seismic stations
- 1 pressure sensor
- 3 web cameras
- Airborne and satellite gas measurements
- Thermal imaging
- Two real time GPS
- Several campaign stations for GPS and broadband seismicity
- Overflights and photography





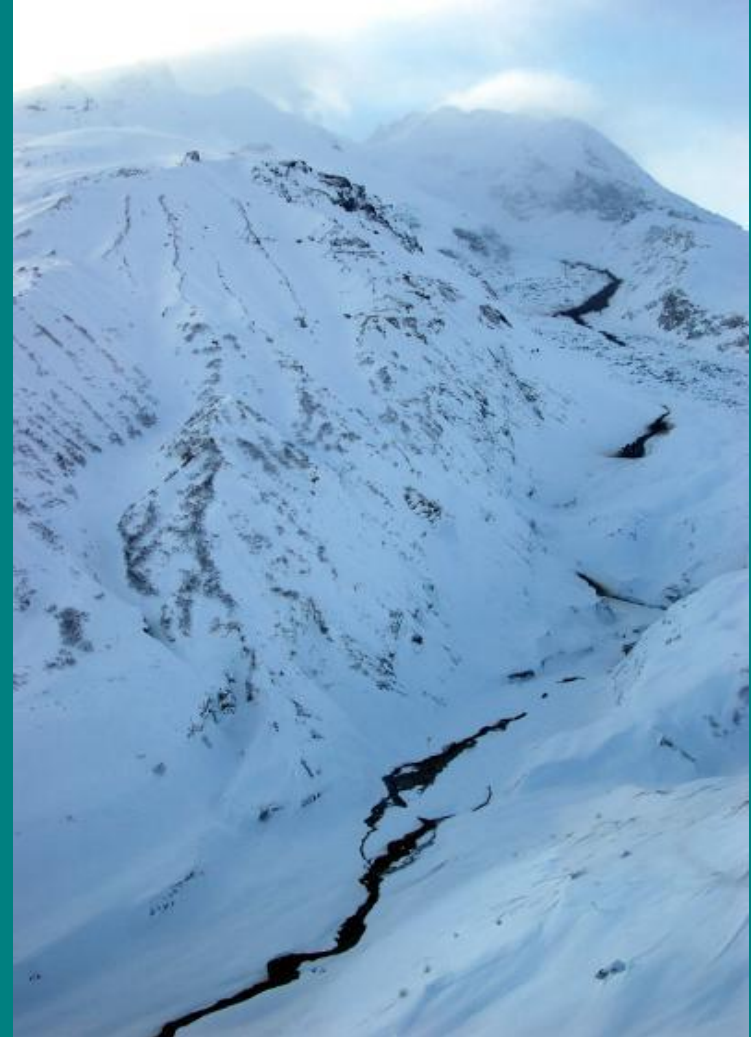
# Redoubt 2008-09 Precursory Unrest

- Late July – mid Sept 2008: unusually strong H<sub>2</sub>S odor
- Late Sept: volcanic-tremor, explosions reported from Waddell Lake  
Measured H<sub>2</sub>S, steaming, 50-m-wide hole on upper Drift Glacier
- October: H<sub>2</sub>S, SO<sub>2</sub> CO<sub>2</sub> above background
- October 3: Information Statement describing unrest and possibilities
- November 5
  - Color code changed from **GREEN** to **YELLOW**
  - Alert level changed from **NORMAL** to **WATCH**



# Precursory Unrest

- Jan. 22-29, 2009
  - Seismicity dramatically up
  - New mudflows appear along the margin of Drift Glacier and at north base of volcano
  - Elevated  $\text{SO}_2$
  - Elevated seismicity, small LP events occurring every hour on stations RSO and REF
  - AVO begins 24/7 staffing
  - **ORANGE**/WATCH declared January 25
  - **YELLOW**/ADVISORY on March 10 after 6 weeks of little change

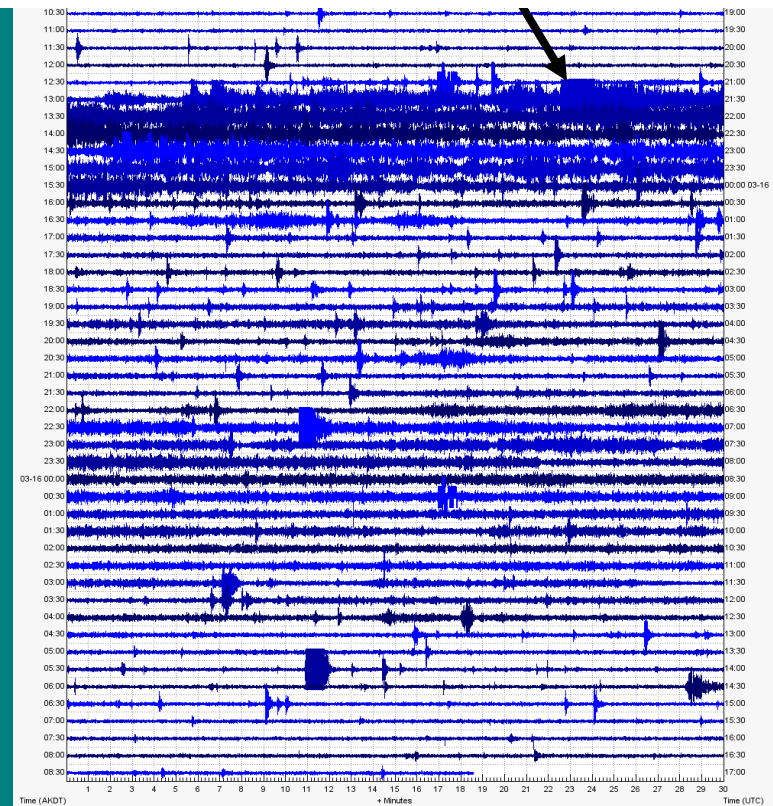


# Phreatic explosion as magma nears surface

- March 15, 2009
  - 1:00PM AKDT: increase in seismicity
  - Small ash eruption, high levels of gas, water vapor plume observed during overflight
  - **ORANGE**/WATCH declared



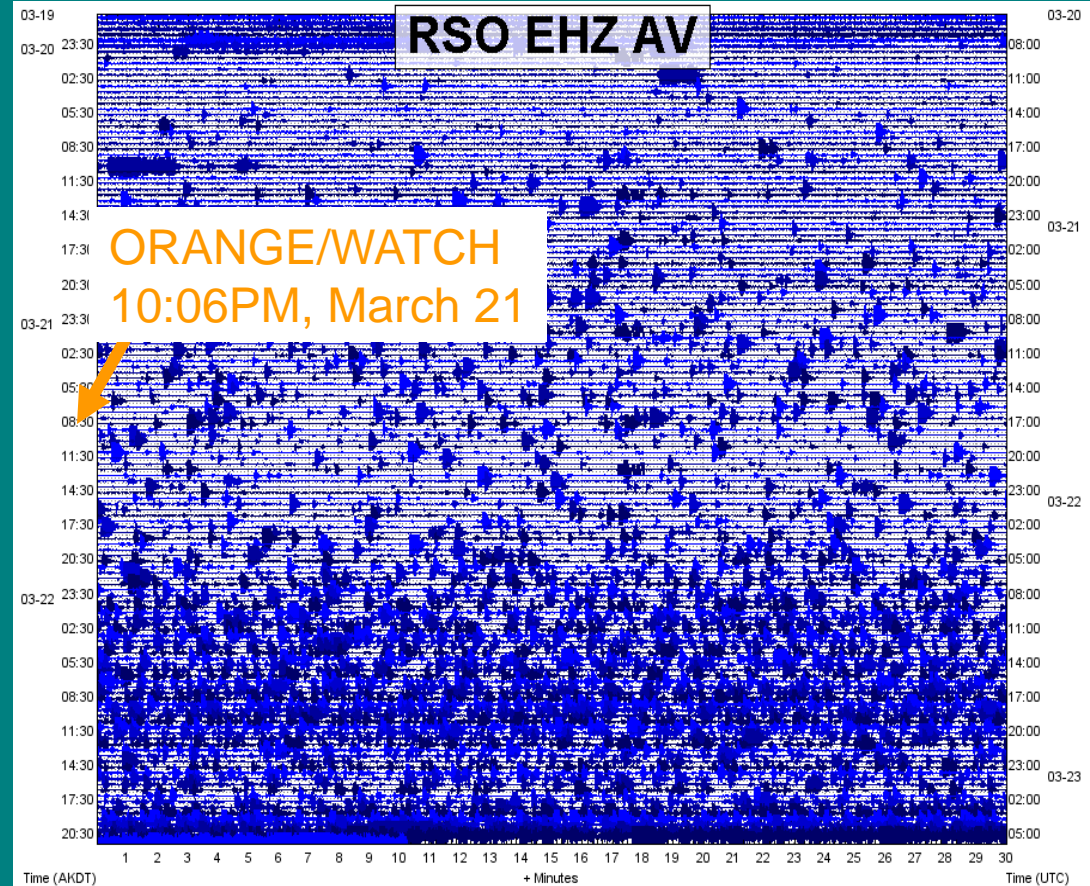
## 1:00PM AKDT - increase in seismicity





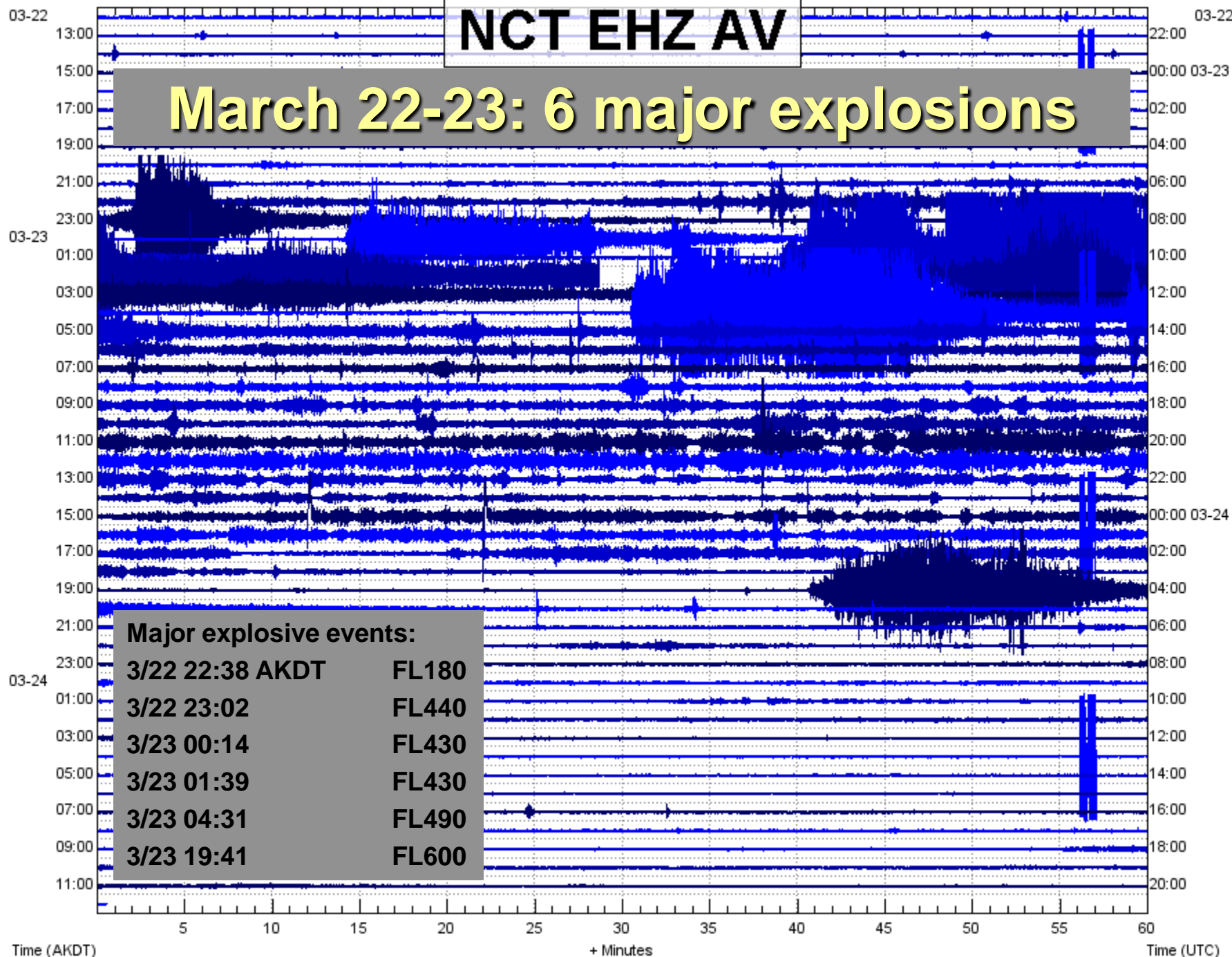
# ~24 h prior to first major explosion

- Returned to **YELLOW**/ADVISORY on March 18
- March 21: High rate of seismicity
- **ORANGE**/WATCH



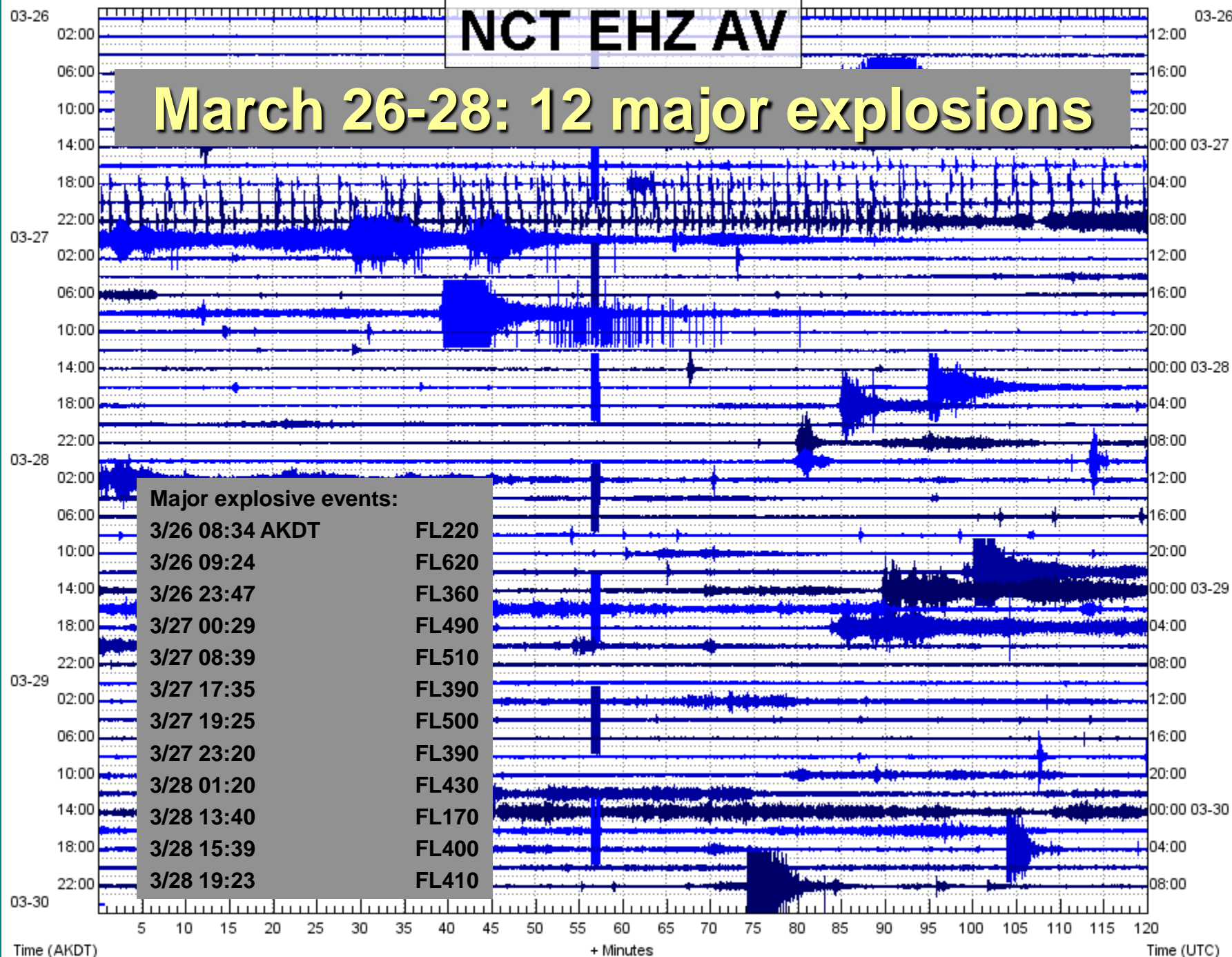
# NCT EHZ AV

## March 22-23: 6 major explosions



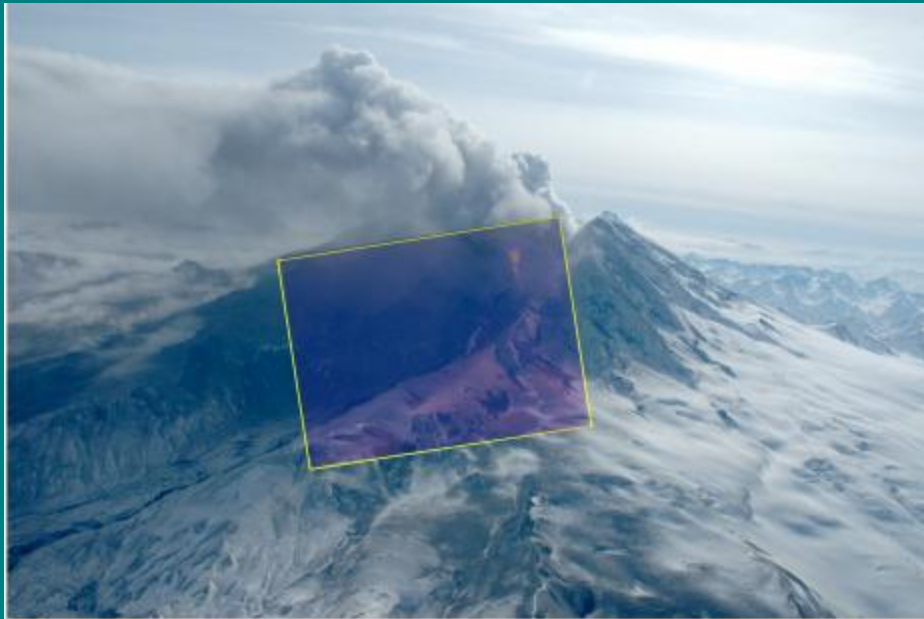
# NCT EHZ AV

## March 26-28: 12 major explosions

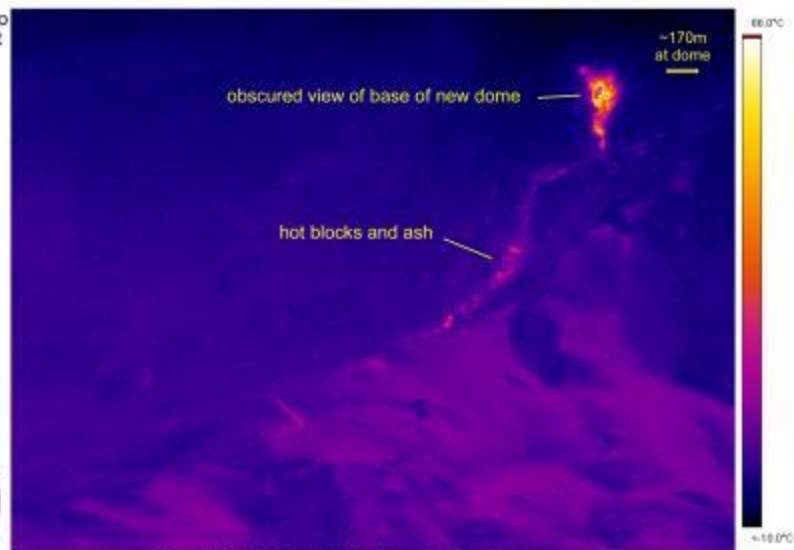




# 31 March: lava dome growth



Redoubt Volcano  
Visible and FLIR  
3/31/2009  
1:44 PM

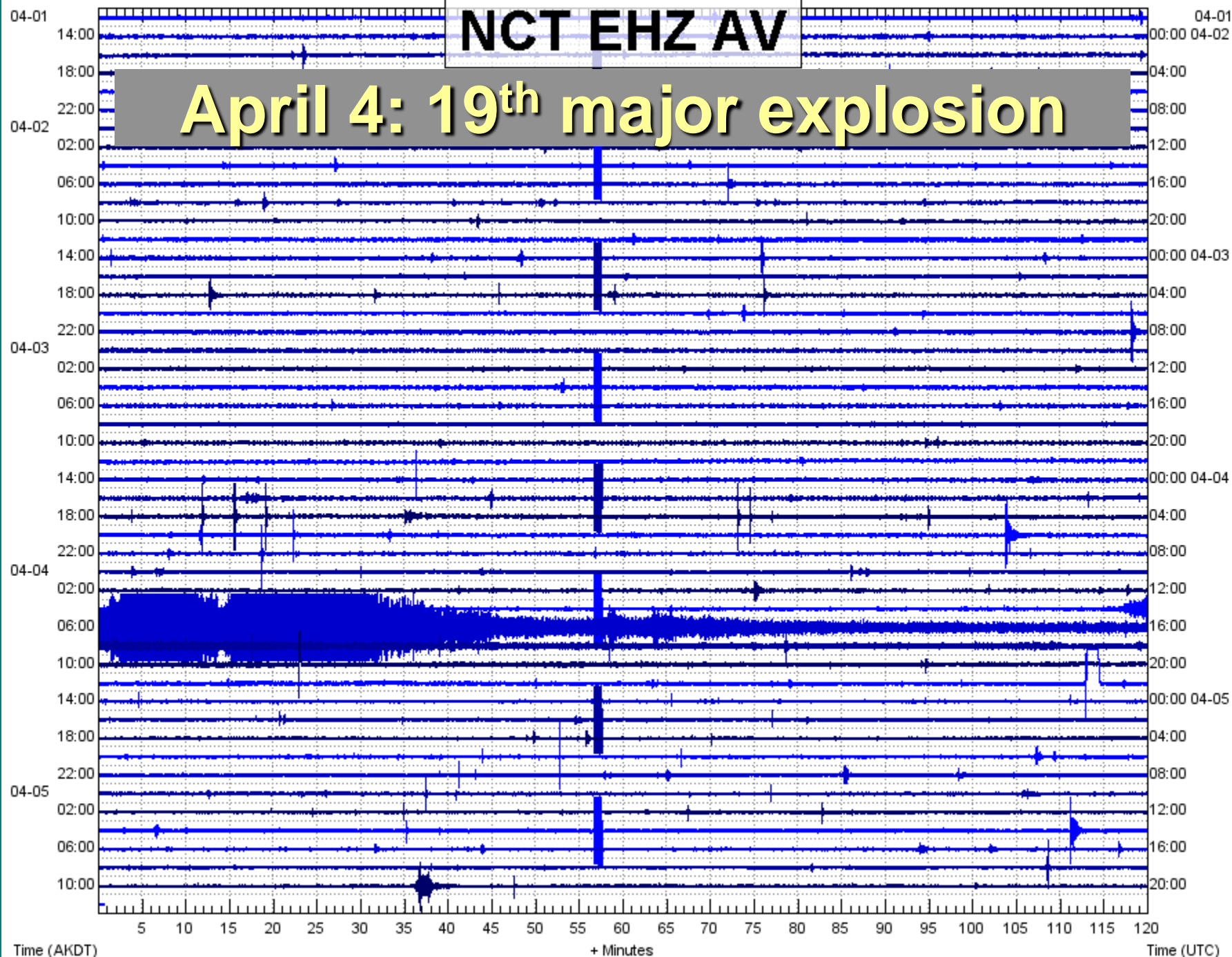


# March 30 – April 3: low level ash and gas emissions, haze in Cook Inlet



# NCT EHZ AV

## April 4: 19<sup>th</sup> major explosion





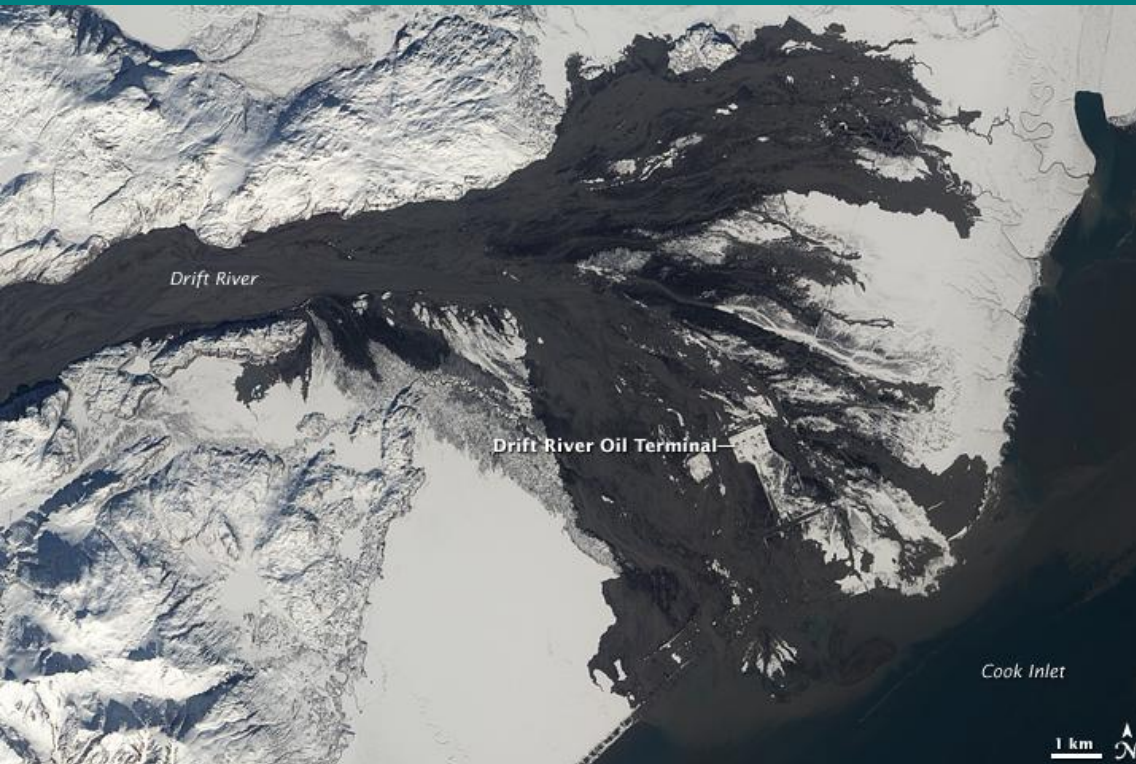
# COLOR CODE HISTORY THROUGH APRIL 6

■ ORANGE	April 06, 2009	14:55
RED	April 04, 2009	06:35
ORANGE	April 03, 2009	11:44
RED	March 26, 2009	08:56
ORANGE	March 25, 2009	13:35
RED	March 22, 2009	22:56
ORANGE	March 21, 2009	22:09
YELLOW	March 18, 2009	09:41
ORANGE	March 15, 2009	14:50
YELLOW	March 10, 2009	09:56
ORANGE	January 25, 2009	02:09
YELLOW	November 05, 2008	14:52
GREEN*	October 03, 2008	15:42

\*Information Statement on activity

# Impacts: lahars (mudflows)

Two major lahars down Drift River to Oil Terminal

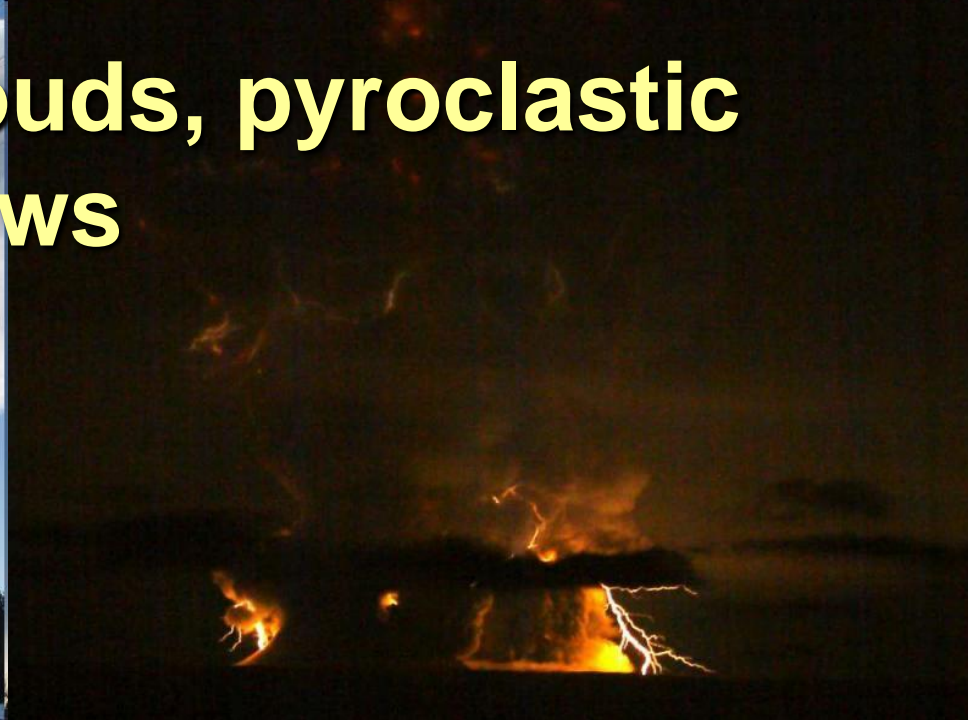


# Drift River - 23 March





# Impacts: ash clouds, pyroclastic flows



# Impacts: ash fall







Daylight turns to night in Homer on the morning of April 4. Photo by Larry Goode.





Since April 4, lava has been erupting from the summit vent.



The lava dome is now (early May) more than 1300 ft wide, 2200 ft long, 500 ft thick: volume would fill ~150 Fed Ex hangars at TSIA.



# Growth of Redoubt lava dome April 16 – May 12





# Summary of key eruption impacts

- Repeated trace to minor ash fall on south central communities and as far downwind as Delta Junction and possibly Tok.
- Significant disruption of air traffic with resulting economic impacts.
- Closure of Ted Stevens Anchorage International Airport for clean up on one occasion.
- Elmendorf assets temporarily relocated.
- Halt of oil storage at Drift River Oil Terminal, associated impacts upstream at production wells, economic losses.

# Prognosis

- Dome growth interspersed with explosions or dome collapse – additional ash clouds, ash fall, lahars.
- Significant ice volume to produce lahars remains.
- Time between significant ash producing events could be weeks to a month or more.
- Explosions typically last tens of minutes and are small in volume.
- Ash clouds could rise well above FL300.
- Eruptive cycle could continue months (or longer).
- Pause or slow waning of effusion also possible.
- AVO remains 24/7.