

# The Eruption of Vesuvius and the Impact of Volcanoes



**Michael Wysession**

*Dept of Earth and Planetary Sciences*

*Washington University, St. Louis, Missouri, USA*

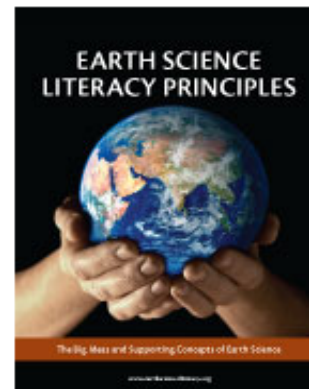


<a href="#">Home</a>	<a href="#">About ESLI</a>	<a href="#">Timeline</a>	<a href="#">Document</a>	<a href="#">Education</a>	<a href="#">Complementary Projects</a>	<a href="#">Contact Us</a>
----------------------	----------------------------	--------------------------	--------------------------	---------------------------	--	----------------------------

## PROJECT DESCRIPTION

The Earth Science Literacy Initiative (ESLI), funded by the National Science Foundation, has gathered and codified the underlying understandings of Earth sciences into a succinct document that will have broad-reaching applications in both public and private arenas. It establishes the “Big Ideas” and supporting concepts that all Americans should know about Earth sciences. The resulting Earth Science Literacy framework will also become part of the foundation, along with similar documents from the Oceans, Atmospheres and Climate communities, of a larger geoscience Earth Systems Literacy effort.

The primary outcome of the Earth Science Literacy Initiative is a community-based document that clearly and succinctly states the underlying principles and ideas of Earth science across a wide variety of research fields that are funded through the NSF-EAR program, including Geobiology and Low-Temperature Geochemistry, Geomorphology and Land-Use Dynamics, Geophysics, Hydrologic Sciences, Petrology and Geochemistry, Sedimentary Geology and Paleobiology, and Tectonics.



Now Available!

[Download the Earth Science Literacy Principles Guide](#)  
(18.6 MB pdf)

[Text Only](#)  
(Word Document)

[Download Spanish version](#)  
(Word) (PDF)



*Big Idea #1: Earth scientists use repeatable observations and testable ideas to understand and explain our planet.*





*Big Idea #2: Earth is 4.6 billion years old.*





*Big Idea #3: Earth is a complex system of interacting rock, water, air and life.*



*Big Idea #4: Earth is continuously changing.*



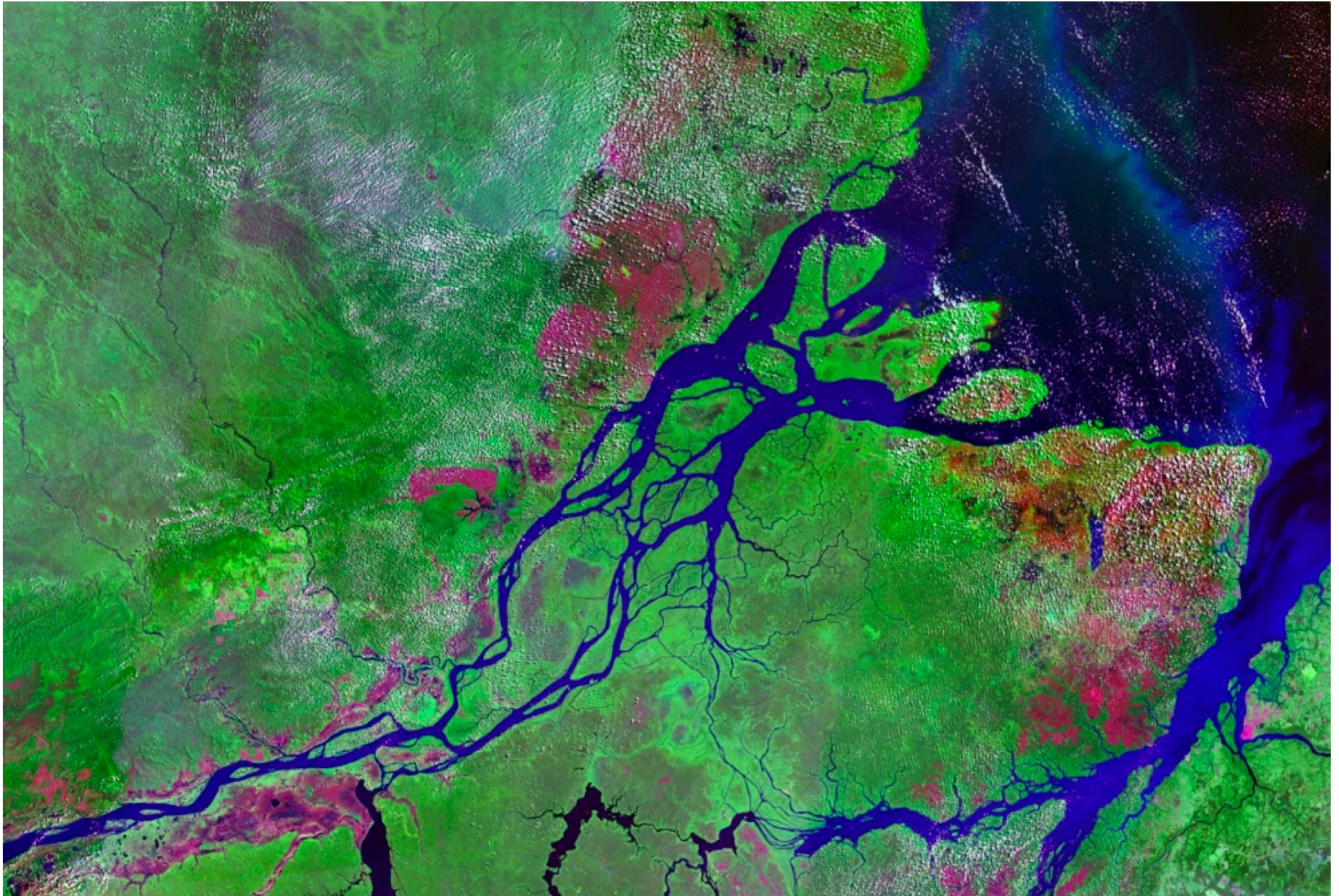


*Big Idea #5: Earth is the water planet.*





*Big Idea #6: Life evolves on a dynamic Earth and continuously modifies Earth.*



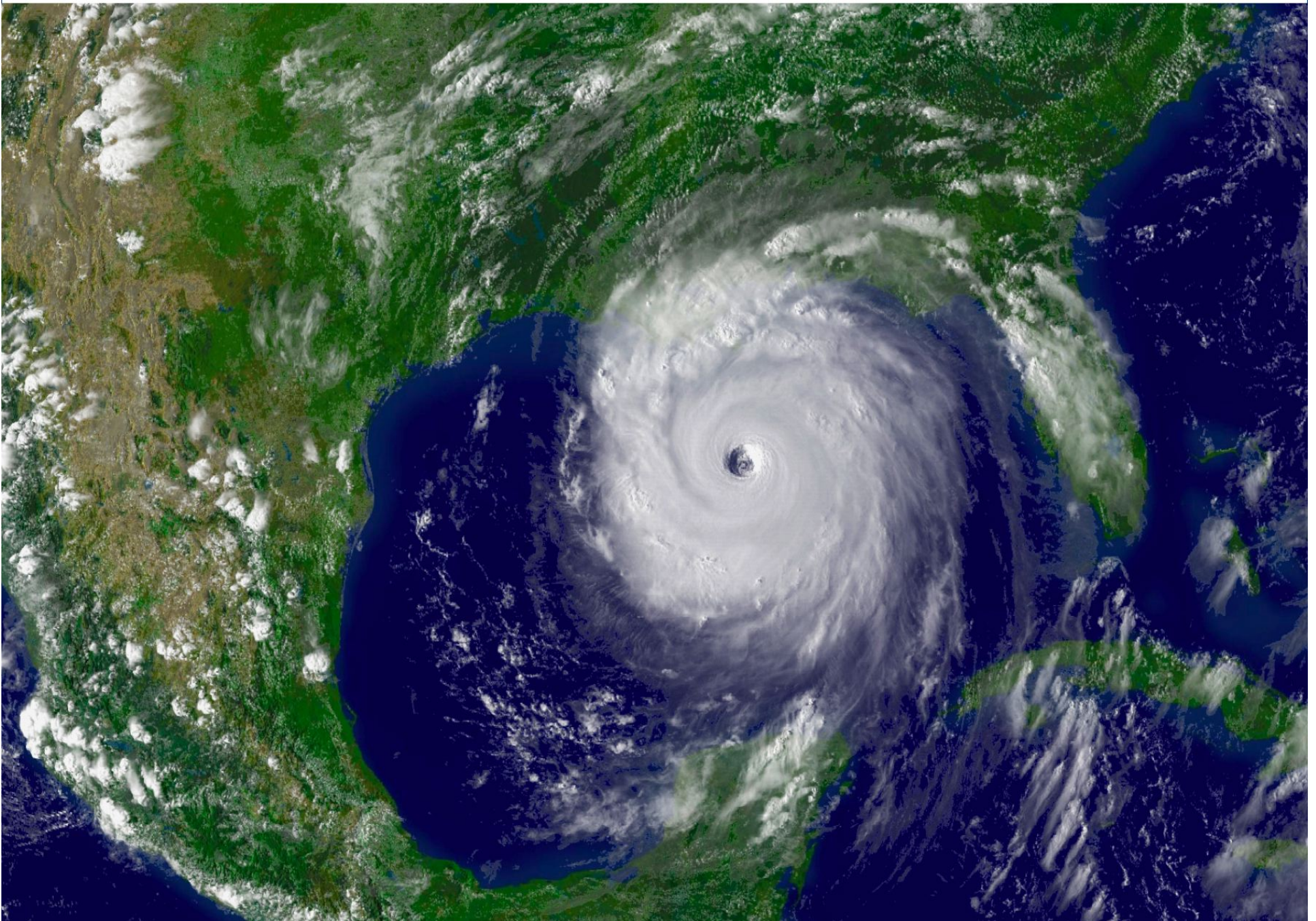


*Big Idea #7: Humans depend on Earth for resources.*





*Big Idea #8: Natural hazards pose risks to humans.*





*Big Idea #9: Humans significantly alter the Earth.*





# National Research Council's *Conceptual Framework for New Science Education Standards*

**BOARD ON SCIENCE EDUCATION**  
**CENTER FOR EDUCATION**

THE NATIONAL ACADEMIES  
*Advisers to the Nation on Science, Engineering, and Medicine*

NATIONAL ACADEMY OF SCIENCES   NATIONAL ACADEMY OF ENGINEERING   INSTITUTE OF MEDICINE   **NATIONAL RESEARCH COUNCIL**   November 01, 2010

**site\_navigation**

- BOSE HOME
- BOSE STAFF
- BOSE MEMBERSHIP
- ABOUT BOSE
- CONTACT US

**our\_work**

- BOSE MEETINGS AND EVENTS
- BOSE PROJECTS
- BOSE PUBLICATIONS
- RESOURCES

**contact\_info**

Board on Science Education  
The National Academies  
500 Fifth Street, NW – 11th Floor  
Washington, D.C. 20001  
Tel: 202-334-2164  
Fax: 202-334-2210

## Conceptual Framework for New Science Education Standards

On behalf of the National Research Council's (NRC) Committee on "A Conceptual Framework to Develop New Science Education Standards," I want to thank all of those who provided feedback on the draft framework which was available for public comment during the period from July 12 through August 2, 2010. Over 2,000 people responded to the on-line survey and hundreds more participated in discussion groups across the country. The committee has received a wide range of comments from a wide variety of perspectives; all of the feedback will be taken seriously by the committee as it finalizes its work.

The NRC committee has begun the process of summarizing and digesting the wide variety of suggestions expressed through the feedback and will be deciding on appropriate revisions to the framework as well as finishing writing the rest of its report. This process will take several months. Once the revisions are complete, the framework will undergo the traditional National Research Council confidential review by a diverse group of experts. After the committee revises its report in response to reviewers' comments, the framework report will be finalized and released to the public. We anticipate that the final version will not be publicly available until early 2011.

As you may know, the education nonprofit organization Achieve ([www.achieve.org](http://www.achieve.org)) will then work with a group of states to develop a set of standards for K-12 science education based on and guided by the final NRC committee framework report. Achieve's science work will be led by Stephen Pruitt who has recently joined the Achieve staff (and thus has resigned as a member of the NRC framework committee due to this appointment). Achieve has already begun planning and is currently developing a network of state partners. Further opportunities for public comment will be managed by Achieve as its work on the science education standards proceeds in 2011.

Thank you again for taking the time to review the committee's draft framework and for providing feedback. The input we received is invaluable to the committee as it moves forward with this important work.



**SIGN UP TODAY FOR EMAIL UPDATES**



[HOME](#)

[ABOUT THE  
DEVELOPMENT](#)

[WHY SCIENCE  
STANDARDS?](#)

[NEXT GENERATION SCIENCE  
STANDARDS](#)

[IMPLEMENTATION](#)



**Add Your  
Voice of  
Support**

CURRENT PHASE

## Standards development is underway!

Learn more about the standards development process

Roll over the arrows to the right to see upcoming development phases

1

2

3

4

5

6

7

8

9

### About NGSS

*Next Generation Science Standards for Today's Students and Tomorrow's Workforce:* Through a collaborative, state-led process, new K–12 science standards are being developed that will be rich in content and practice, arranged in a coherent manner across disciplines and grades to provide all students an internationally benchmarked science education. The NGSS will be based on the *Framework for K–12 Science Education* developed by the National Research Council.

### Latest News

**States to Lead Effort to Write New Science Standards**

September 20, 2011

**Maine Picked to Help Develop New Science Standards**

September 14, 2011

**National Research Council Releases Science Framework**

July 19, 2011

### Resources



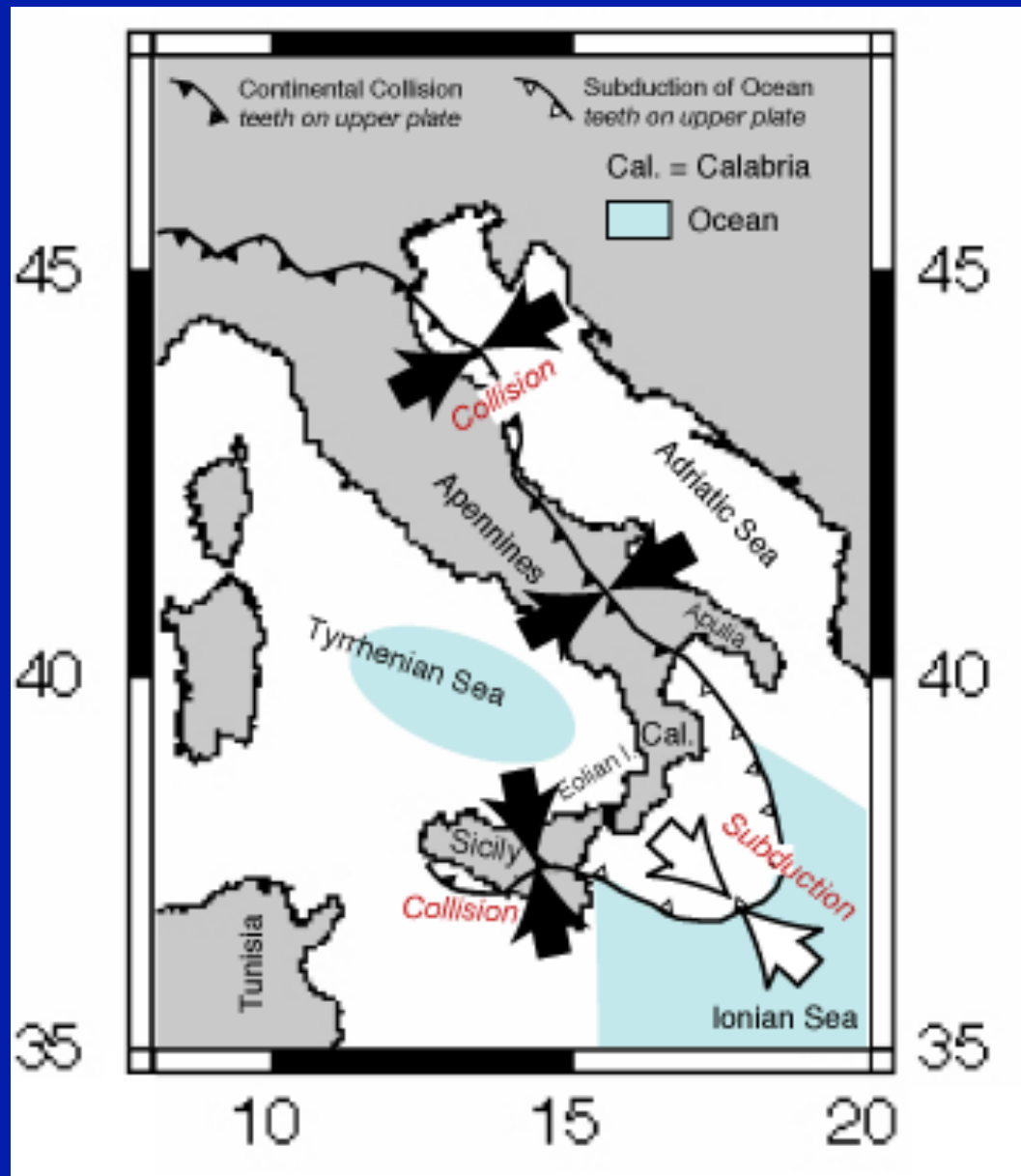
Coming Soon





**Volcanoes of Italy**





**Geotectonics of Italy**





**Stromboli, Italy**





**Stromboli, Italy**





**Stromboli, Italy**





**Stromboli, Italy**

Stromboli, Italy

©2014 by [www.volcanoreport.com](http://www.volcanoreport.com)





**Mt. Etna, Italy**





**Mt. Etna, Italy (2002)**



**Mt. Etna, Italy (2004)**





**Mt. Etna, Italy (2004)**



**Mt. Etna, Italy (2004)**





**Mt. Etna, Italy (2004)**



**Mt. Etna, Italy (2004)**





**Mt. Etna, Italy (2005)**



**Mt. Etna, Italy (1931) - Postcard**





**Mt. Etna, Italy (1914) - Reggio Calabria woodcut**





**Mt. Etna, Italy (1895) - Wilhelm von Gloeden photograph**





**Mt. Etna, Italy (1844) - Thomas Cole**





**Mt. Etna, Italy (c. 1780) - J. Houel**





**Vesuvius, Italy**



Ash Fall, Vesuvius, 79 CE

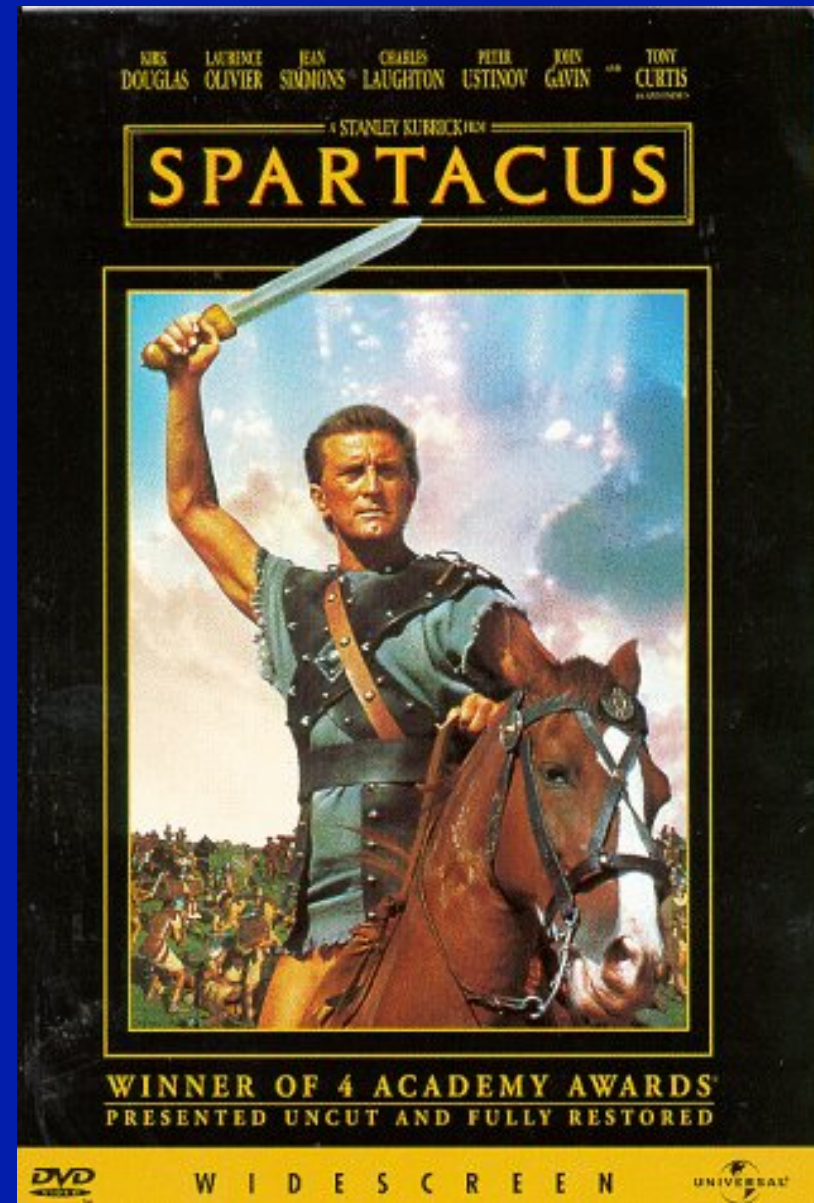




possibili dimensioni  
del vulcano antico

Vesuvio

Somma



**Spartacus - 73 BCE**



## 62 CE: Large Earthquake

- Extensive damage to Pompeii
- Some buildings not repaired



## 62 CE: Large Earthquake

- Extensive damage
- Some buildings not repaired

## 64 CE: Another Earthquake

- Nero singing in Naples
- Theater collapsed after he finished



**Emperor Nero**





August, 79 CE - many small earthquakes

August 24, 79 CE - Major eruption begins

- Starts with Plinian Eruption
- Develops into Pelean Eruption (pyroclastic flows)

*BBC: Pompeii: The Last Day*



BBC: *Pompeii: The Last Day*



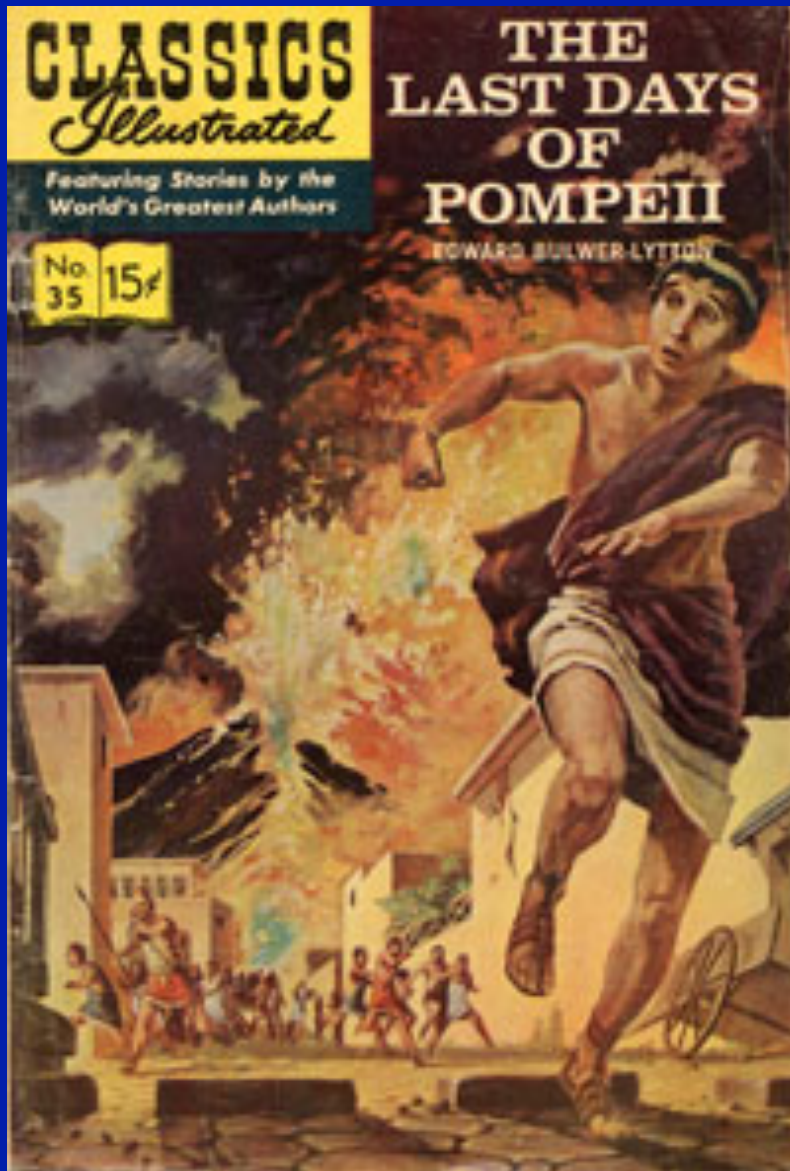
Actual





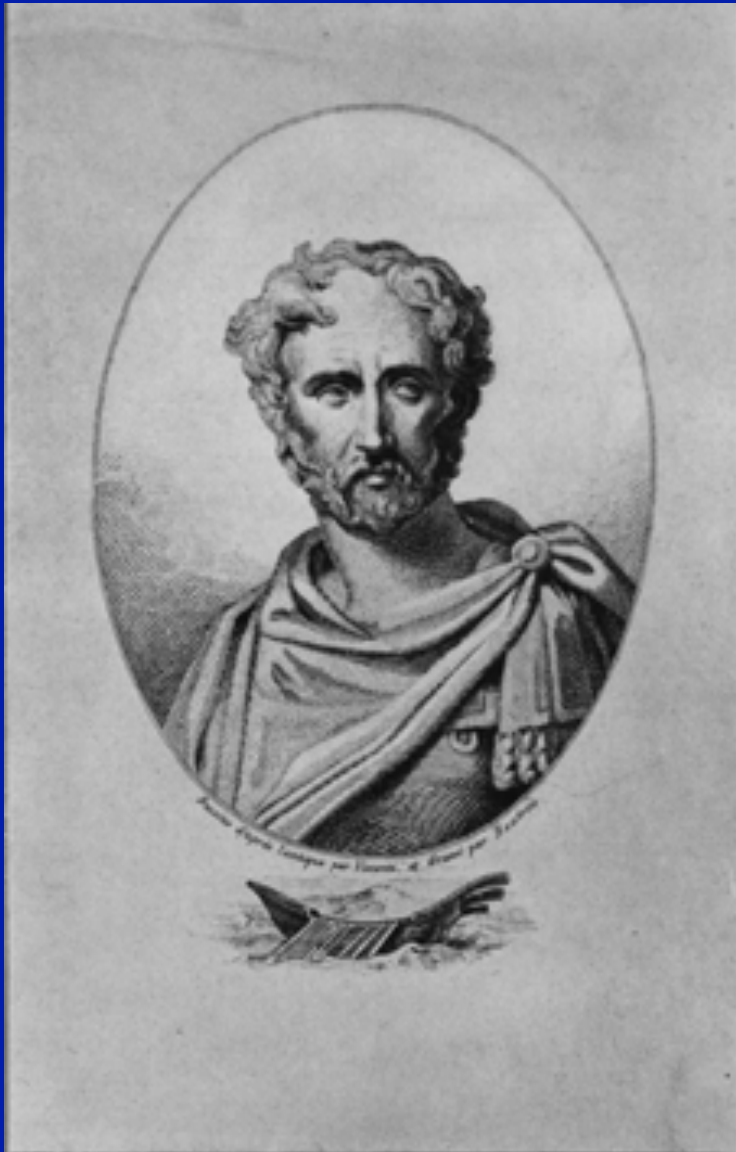
Karl Briullov: *The Last Day of Pompeii*, 1827-1833



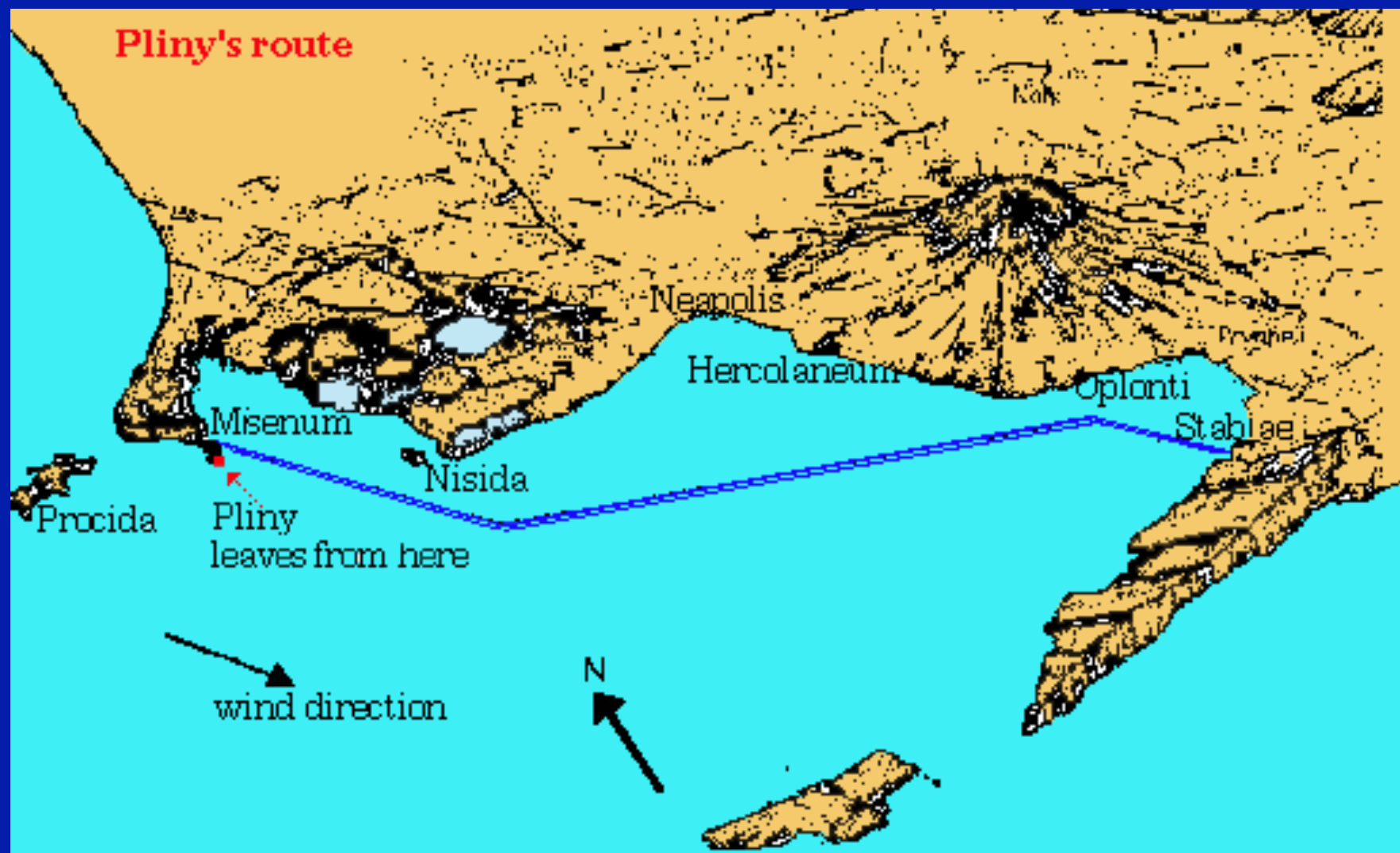


Edward Bulwar-Lytton: *The Last Days of Pompeii*, 1834





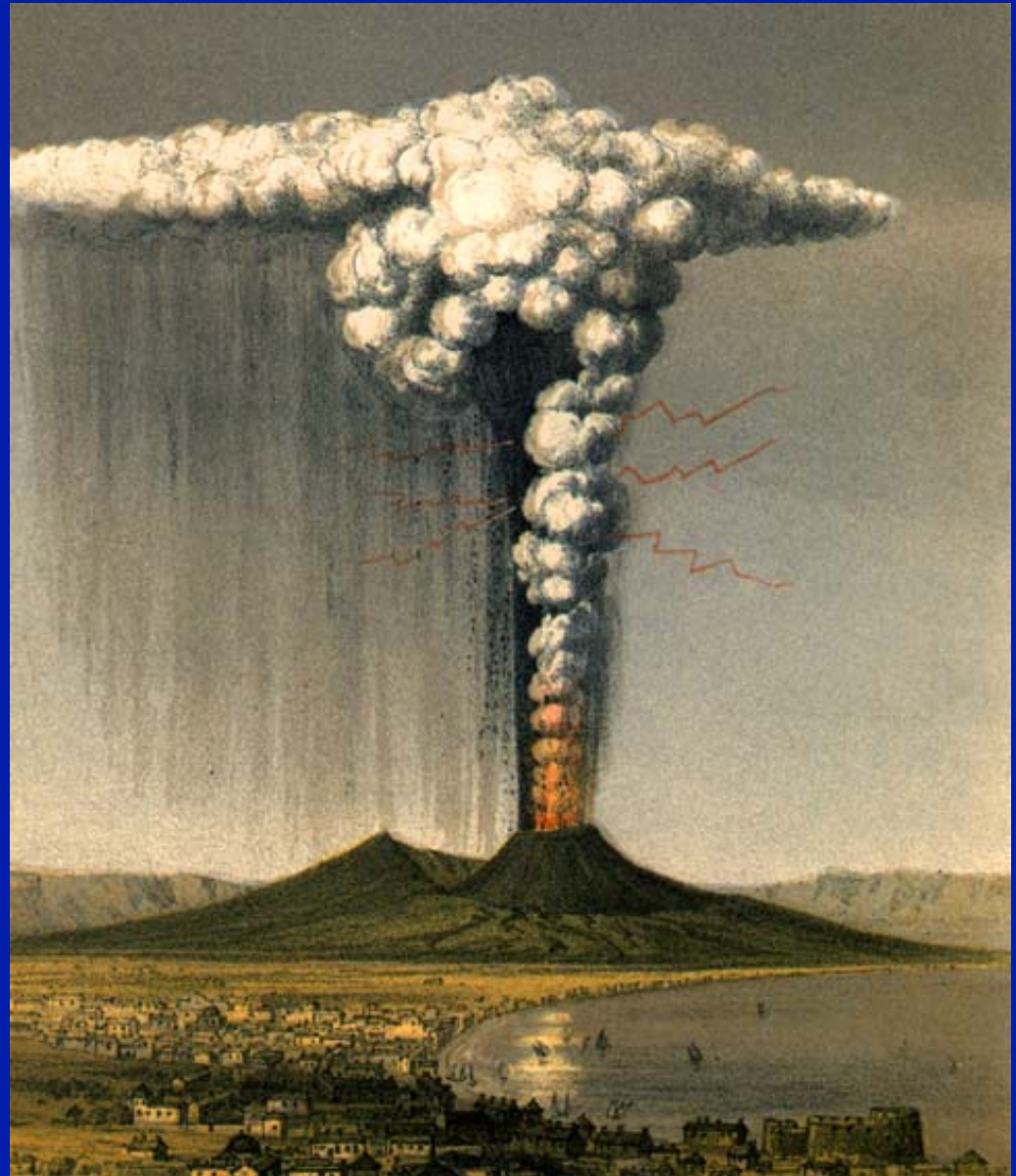
**Pliny the Elder / Pliny the Younger**



**Pliny's The Elder's Route**



On Aug 24, 79:  
Eruption column  
estimated to be 32 km  
high



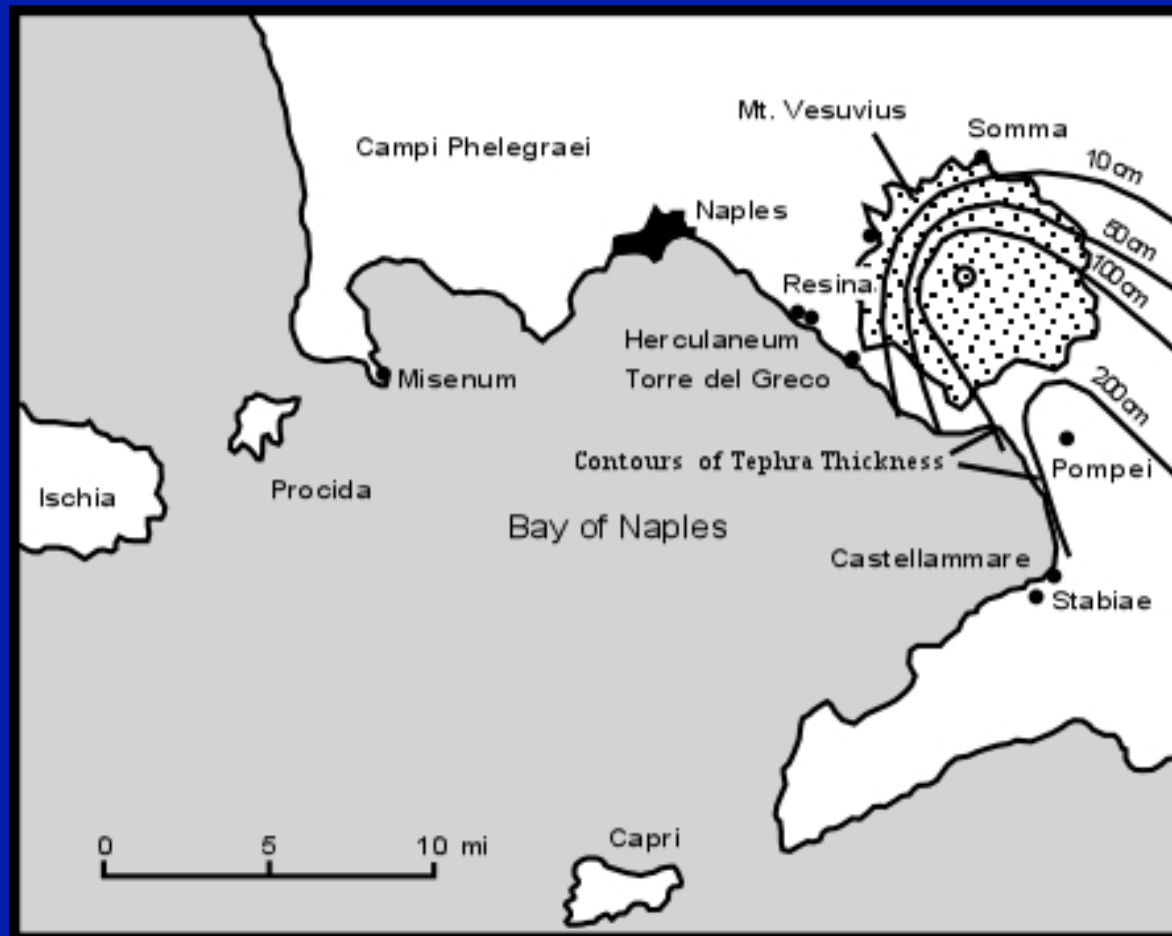
"The Eruption of Vesuvius as seen from Naples, October 1822", 1864.  
George Julius Poulett Scrope (1797-1876)





Stone Pine Tree





## First Stage: "Plinian" Eruption Buries Pompeii

\* 38% of Pompeians die (of 1150 found), largely from roof collapse





















9357



9357 CORA FIVIERE DI DONNE  
(IN UNA TERRA RUVINATA DEL VI SECOLO)  
RUVO





*Mayon  
Volcano,  
Philippines -  
1984*

## Second Stage: Start of August 25, 79 CE

- “Pelean”-style pyroclastic flows bury Herculaneum
- Flows are 150-300 km/hr
- Temperatures are 300°-400°C





L'Eruzione del Vesuvio. 26 Aprile 1872 ore 3. P. M. V. 6102.

Vesuvius (1872) - Photo by Giorgio Sommer, from Naples





## Herculaneum:

- Up to 20 meters of pyroclastic flow debris
- Cools to be hard and dense (compared to Pompeii ash falls)
- About 350 bodies found -- very well preserved





Third Stage: Later in the day of August 25, 79 CE

- “Pelean”-style pyroclastic flows bury Pompeii
- Cause of death of remaining 68% of bodies found
- Up to 5 meters thick (easier to dig out)





Petrified tree stumps, Sea Garden, Varna, Bulgaria





Mount Vesuvius





Vesuvius (2004)





## Vesuvius: Very high volcanic risk

- High levels of historic activity
- High population density (~3 million)
- Increasing time since last eruption







Mt Vesuvius Erupting in March, 1944.

Photo by John Reinhardt, B-24 tailgunner in the USAAF

- Eruption Destroyed 88 B-25s







Vesuvius (just before 1906 eruption)





Vesuvius (just after 1906 eruption)





Pompeii and Vesuvius, Frederick Federer (1850)





Vesuvius: Johan Christian Clausen Dahl (1826)





Vesuvius: J. M. Turner (1817)





Vesuvius, from Gulf of Naples: Josef Rebell (1813-1815)





Vesuvius: Michael Wutky (c. 1789)





Vesuvius: Michael Wutky (c. 1789)





Vesuvius, from Portici: Joseph Wright (1774-1776)



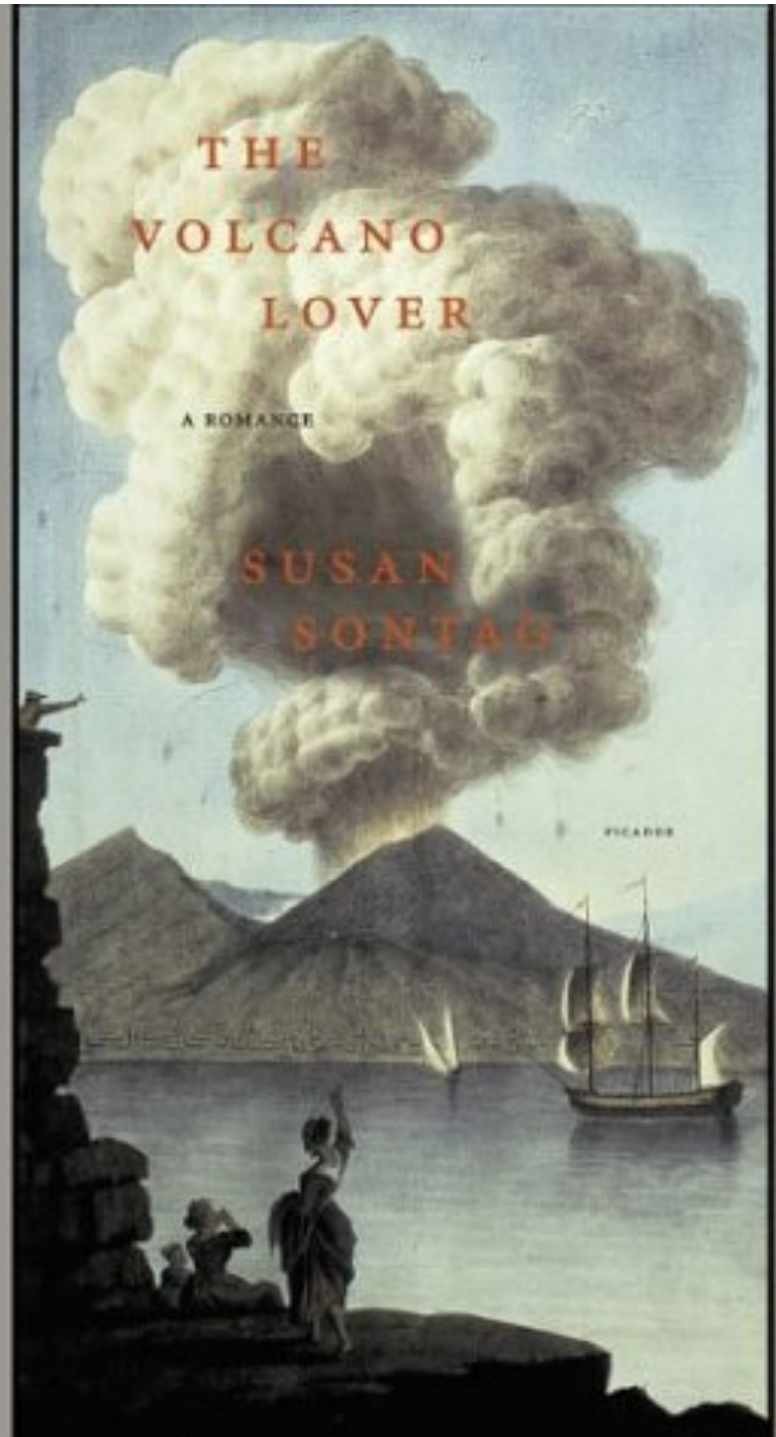


*The Eruption of Vesuvius, Voltaire (1771)*



## Sir William Hamilton:

- British envoy in Naples, 1764-1800
- “Father of Volcanology”







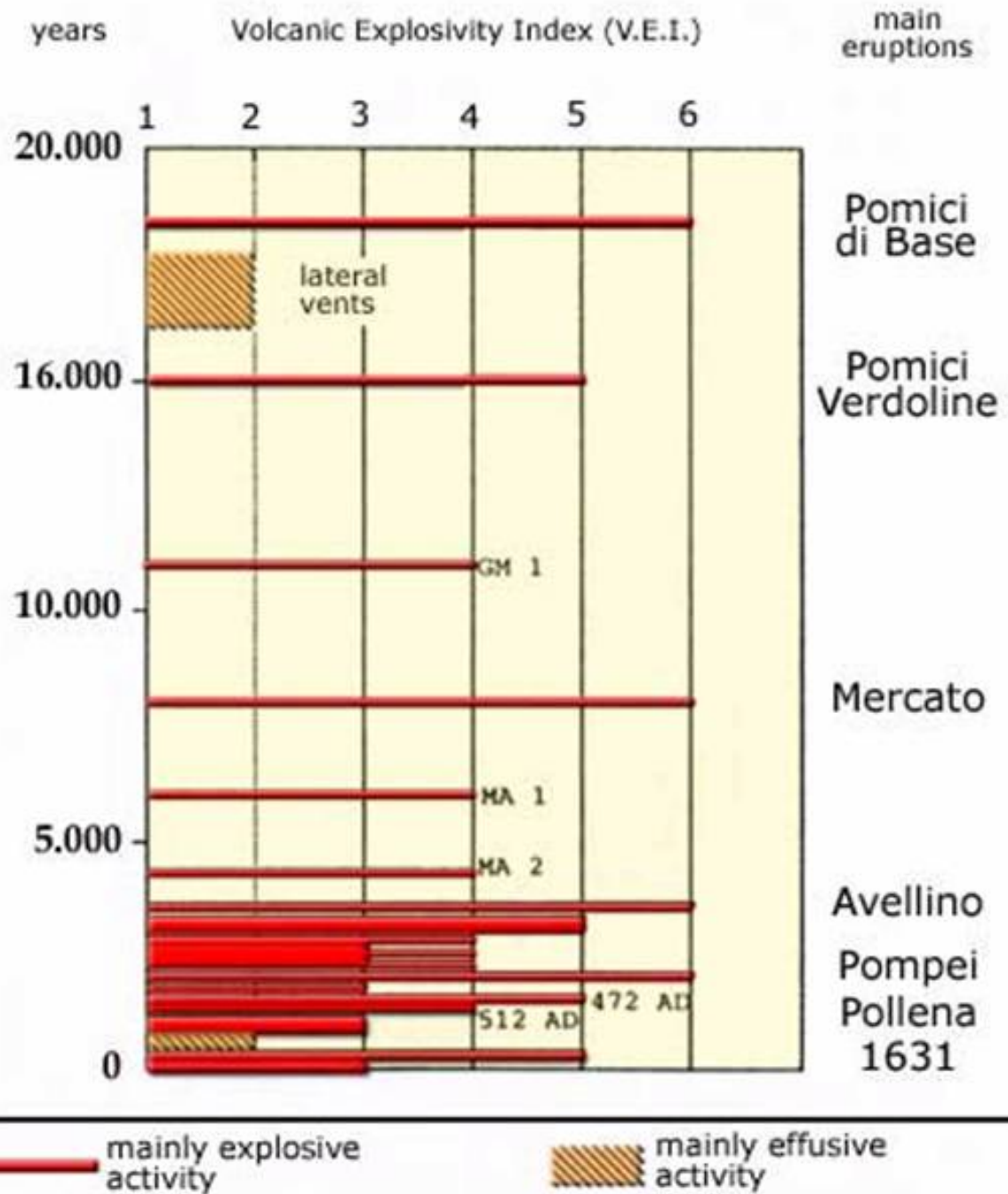
Vesuvius: Pietro Fabri (1760-1761)







Previous  
Somma/  
Vesuvius  
Eruptions:





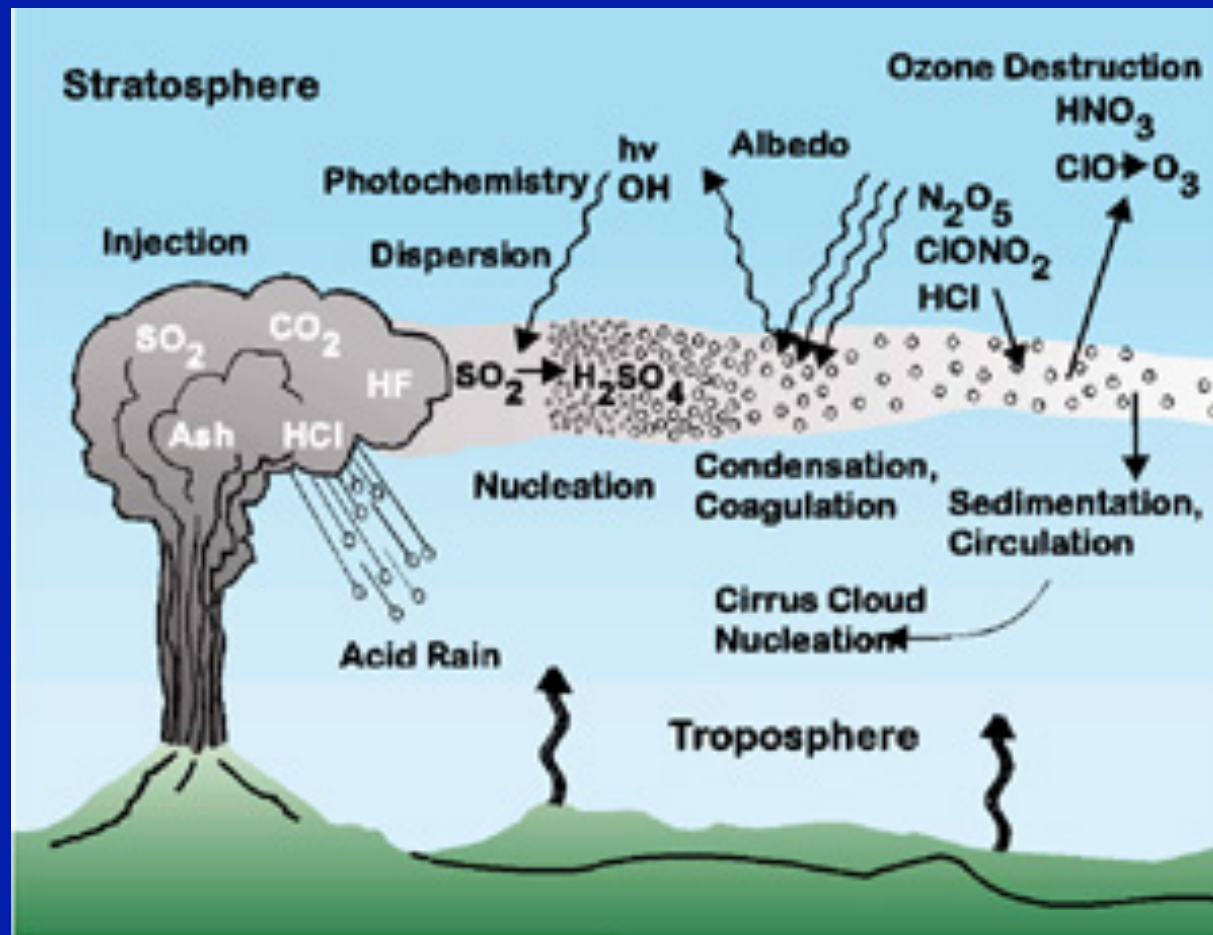
Thousands of footprints in the surge ash deposit of the Avellino Eruption (1660 BCE) testify to large exodus from the area.





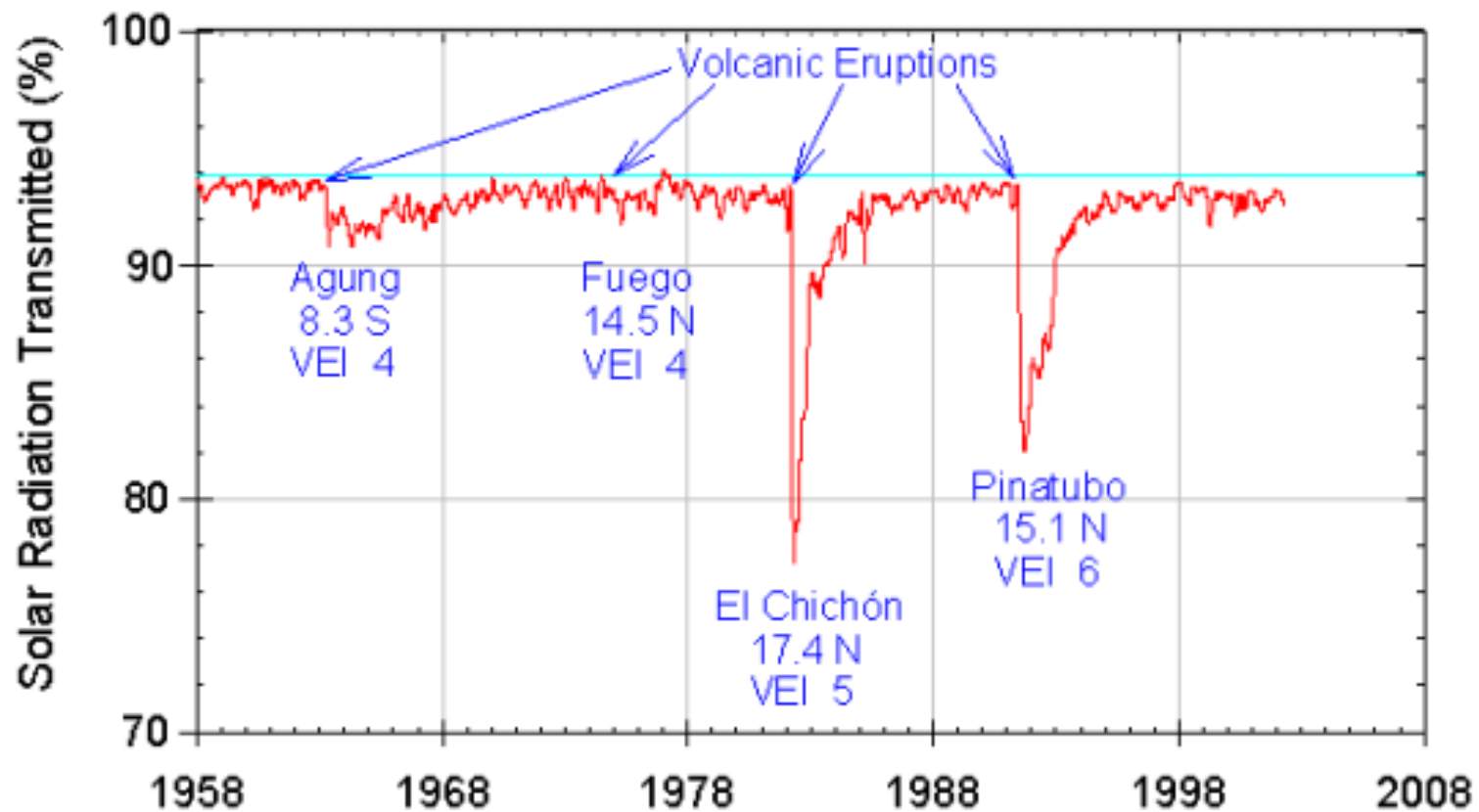
Volcanic eruptions can lower temperatures through ejection into the atmosphere of

- Ash
- Aerosols like  $\text{H}_2\text{SO}_4$  droplets



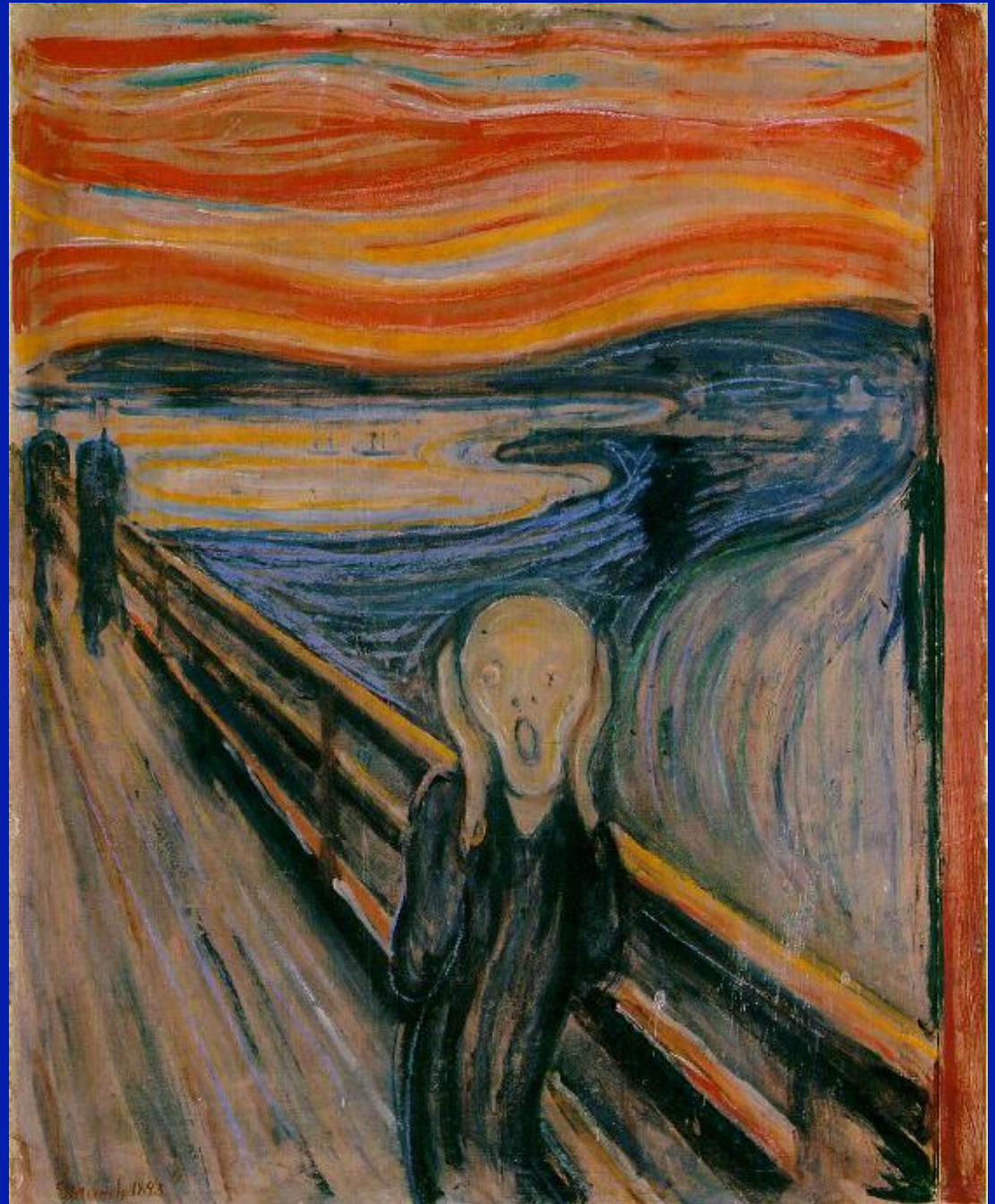


## Mauna Loa Observatory Atmospheric Transmission





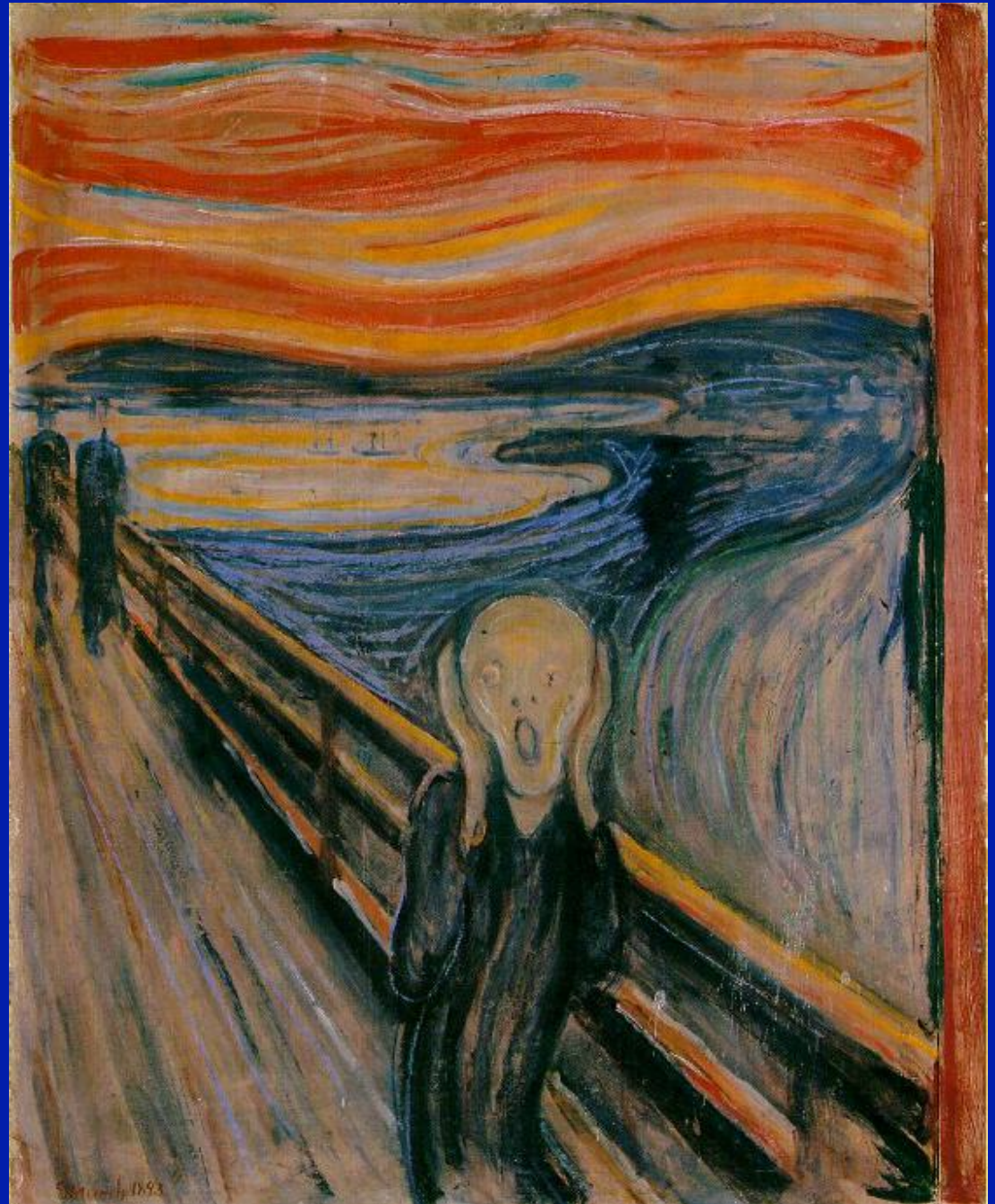
**Edvard Munch:  
The Scream (1893)**





**Edvard Munch:  
The Scream (1893)**

***Started 1883! (just  
after the eruption  
of Krakatau!)***





TWILIGHT AND AFTERGLOW EFFECTS AT CHELSEA, LONDON.  
NOV. 26<sup>th</sup> 1883.

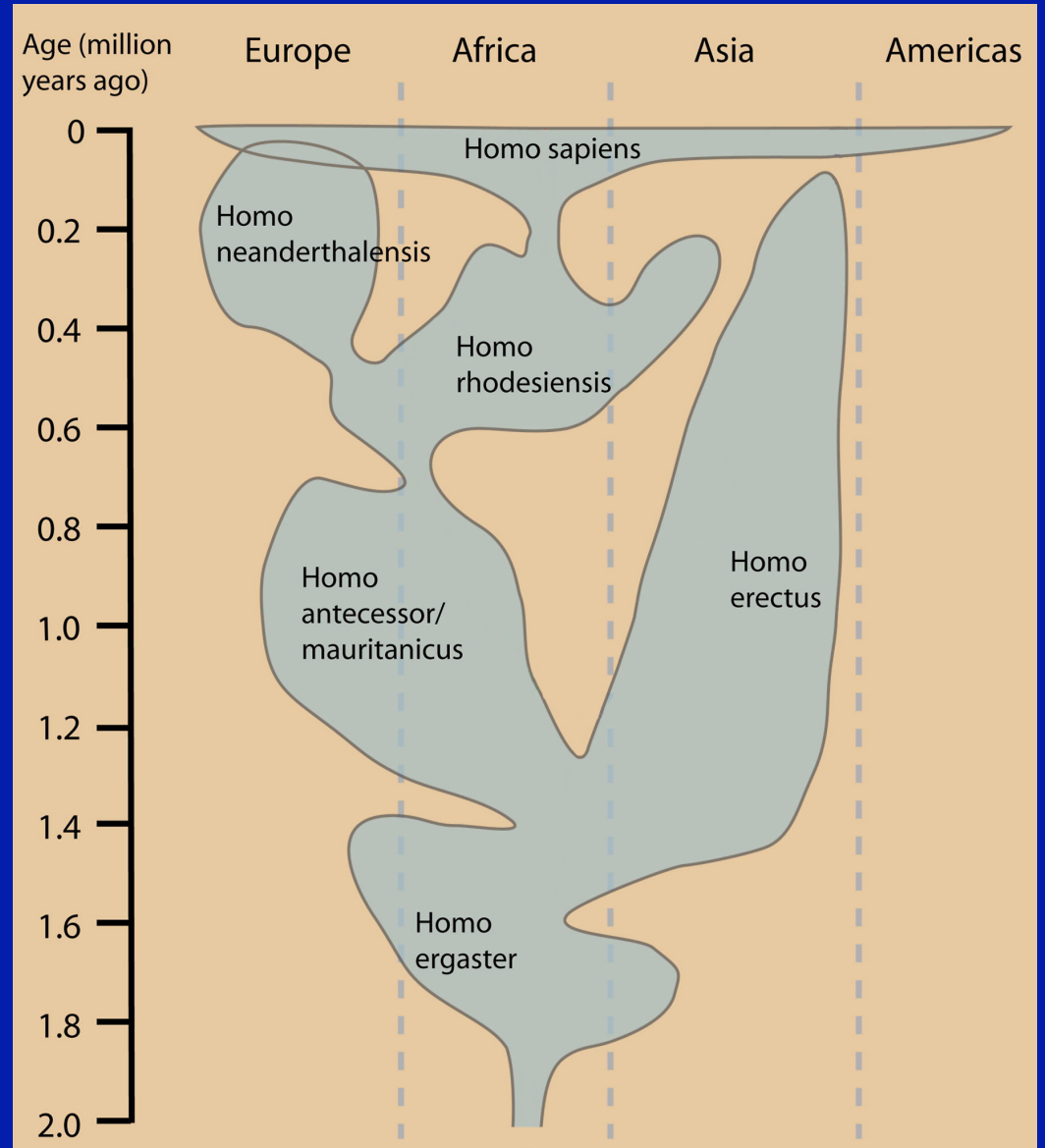


Nº 4. ABOUT 4-40 PM.

**William Ascroft 1883**

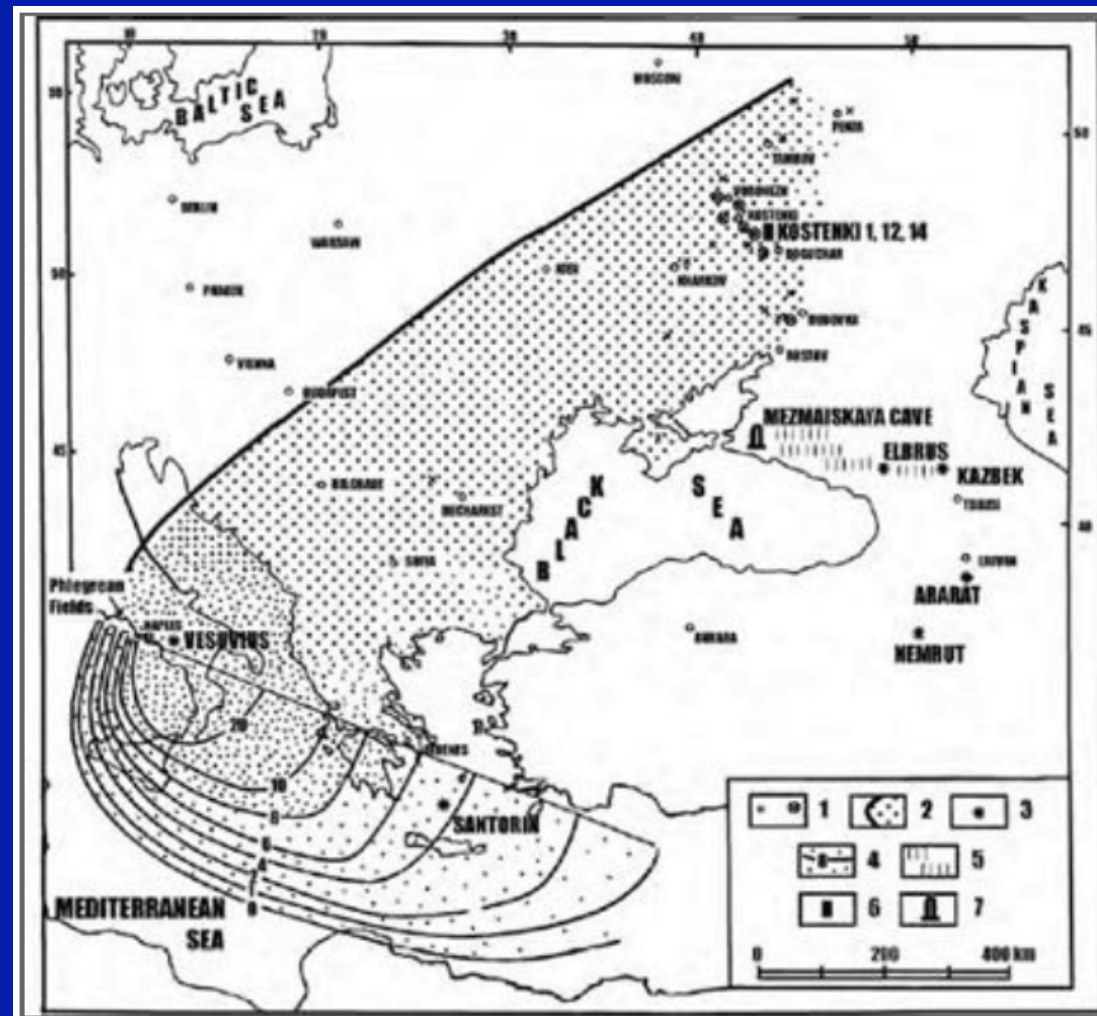


**By 100,000 years ago, Homo Sapiens was emerging as dominant hominid. Why?**





# Possible cause/contribution to the collapse of Neanderthals: Campanian Ignimbrite (CI) eruption from the Phlegrean Fields, southern Italy, 40,000 years ago



# Rock of Gibraltar





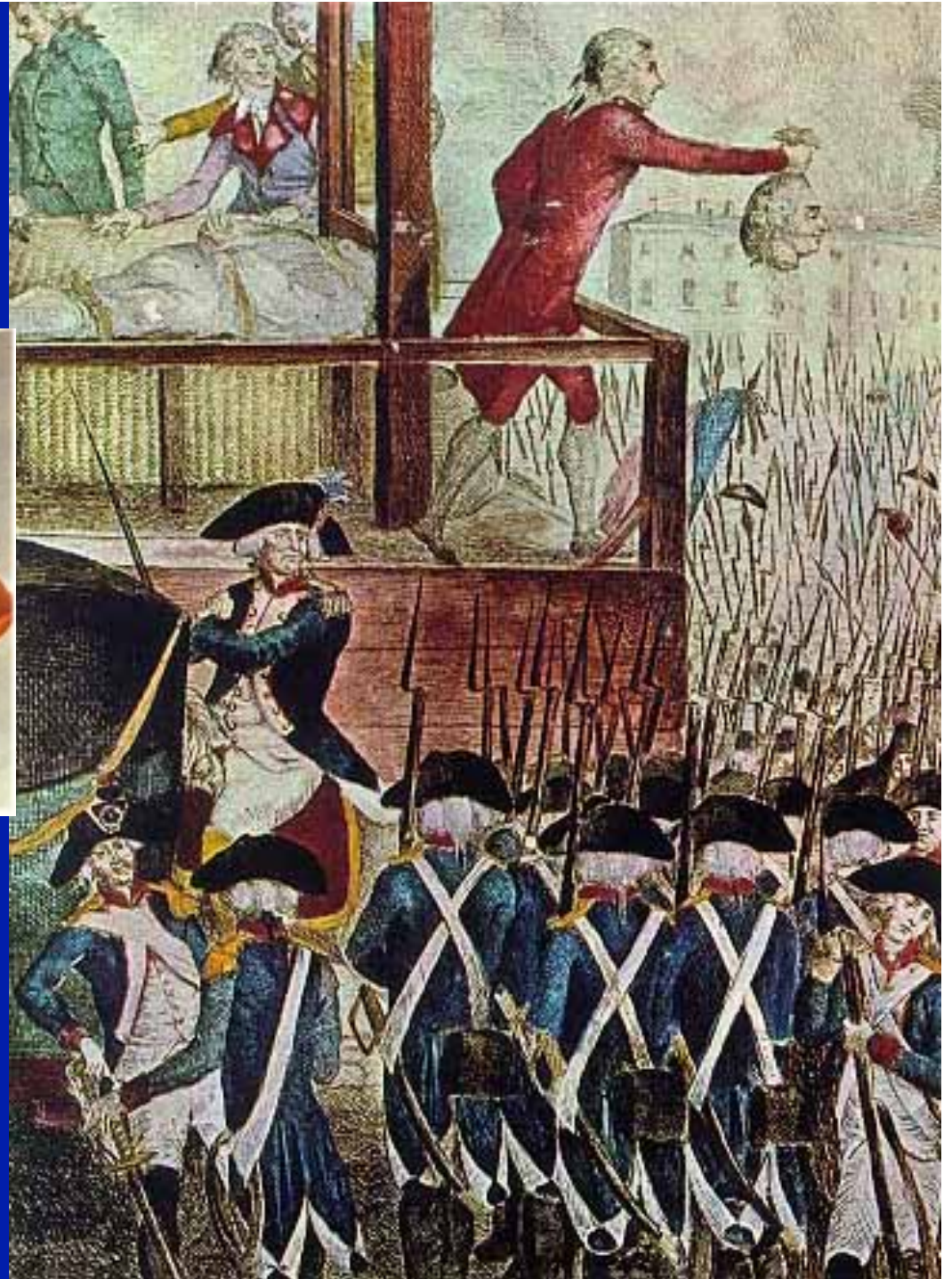
But..... Reconstruction of a Neanderthal child, from remains found in Gibraltar caves:

Neanderthals found in Gibraltar 125,000 – 24,000 b.p.

Homo Sapiens don't arrive until after 40,000 b.p.







*Why does the French Revolution occur in 1789?*





1783-5: Laki volcano, Iceland; Asama volcano, Japan

Laki was a basaltic fissure eruption, rich in sulfur dioxide



**2010: Eyjafjallajökull volcano, Iceland**



*After 1815 there is a huge push of U.S. Westward Expansion. Why?*





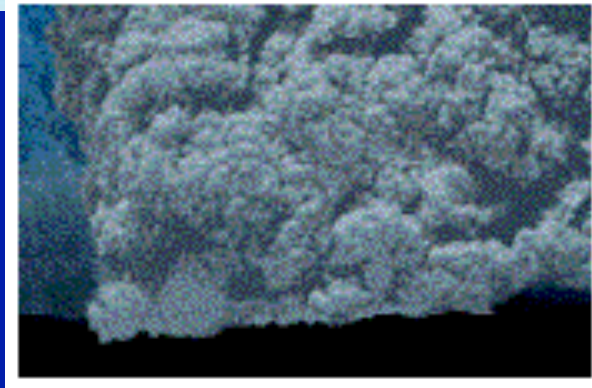
**1816 is known as the “Year without a summer.”**

**It snows in New England in the summer.**





## Volcanoes!



**1812: Soufriere volcano, St. Vincent Island**

**1814: Mayon volcano, Philippines**

**1815: Tambora volcano, Indonesia**

## 1600: Volcano Huaynaputina erupts in Peru (largest recorded volcanic eruption in South America)



1601: Recorded temperatures in Switzerland, Latvia, and Baltic Sea were coldest in a 300-yr period

1602: Chinese cherry blossoms bloomed 17 days late; Japanese lakes froze weeks early

1602: German wine production decreased by 95%!!!!



1601-1604: Severe famines in Russia kill up to 500,000 people.

1604: Weakened government allows invasion by pretender to the throne

1605: Boris Gudunov dies with government in disarray



## Examples of some other historic volcanic eruptions:

536 CE: Mt. Rabaul (New Guinea)

- \* Procopius (Byzantine historian): “The sun gave forth its light without brightness, like the Moon,” “darkness lasted 18 months, and each day the sun shone for only 4 hours,”
- \* 80% of the population starved to death

209 BCE: Possibly Iceland

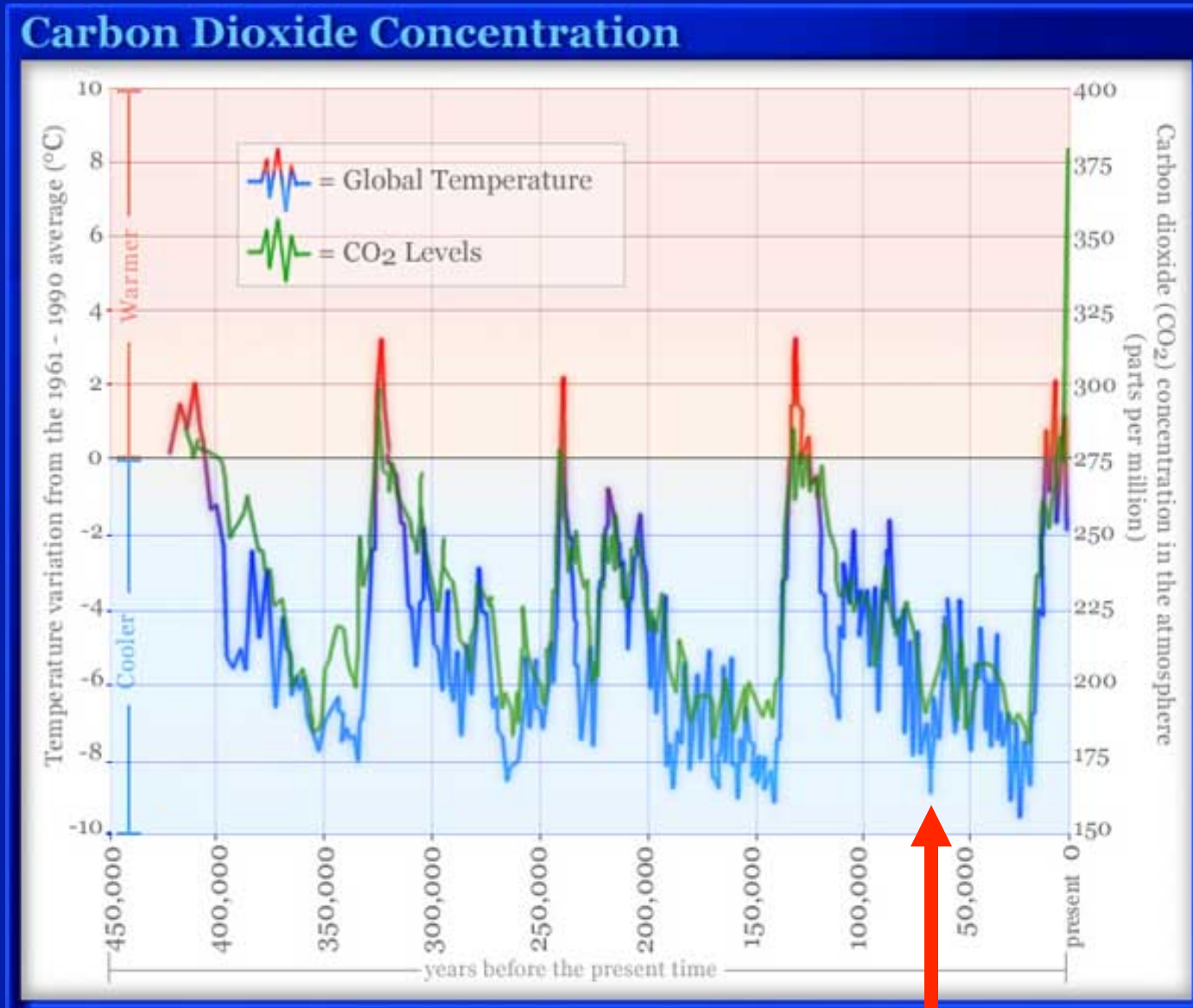
- \* Pan Ku (China): “great famine killed more than half the population,” “people ate each other,” “the Emperor lifted legal prohibitions against the sale of children”
- \* Stars were not seen at night in 208 BCE for 3 months

1150-1136 BCE: Hekla, Iceland

- \* Ashes rained in China for 10 days
- \* 90% of population of Scotland and North England died



# An extreme brief cold spell around 74,000 years ago



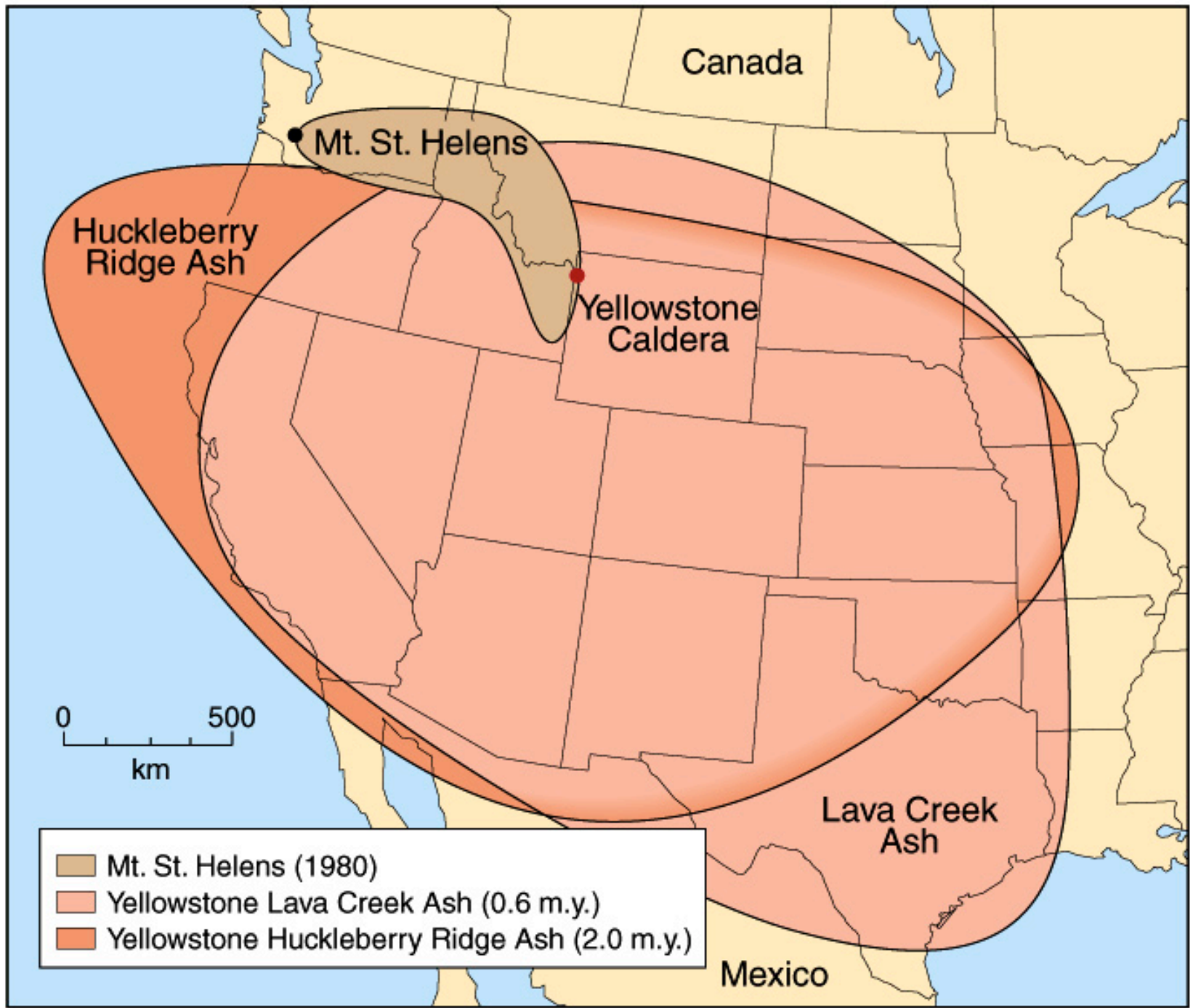
74,000 years ago

**Toba Volcano – ~ 74,000 years ago**  
**→ 2,800 km<sup>3</sup> ejected!**  
**→ 1 gigaton tnt explosion!**



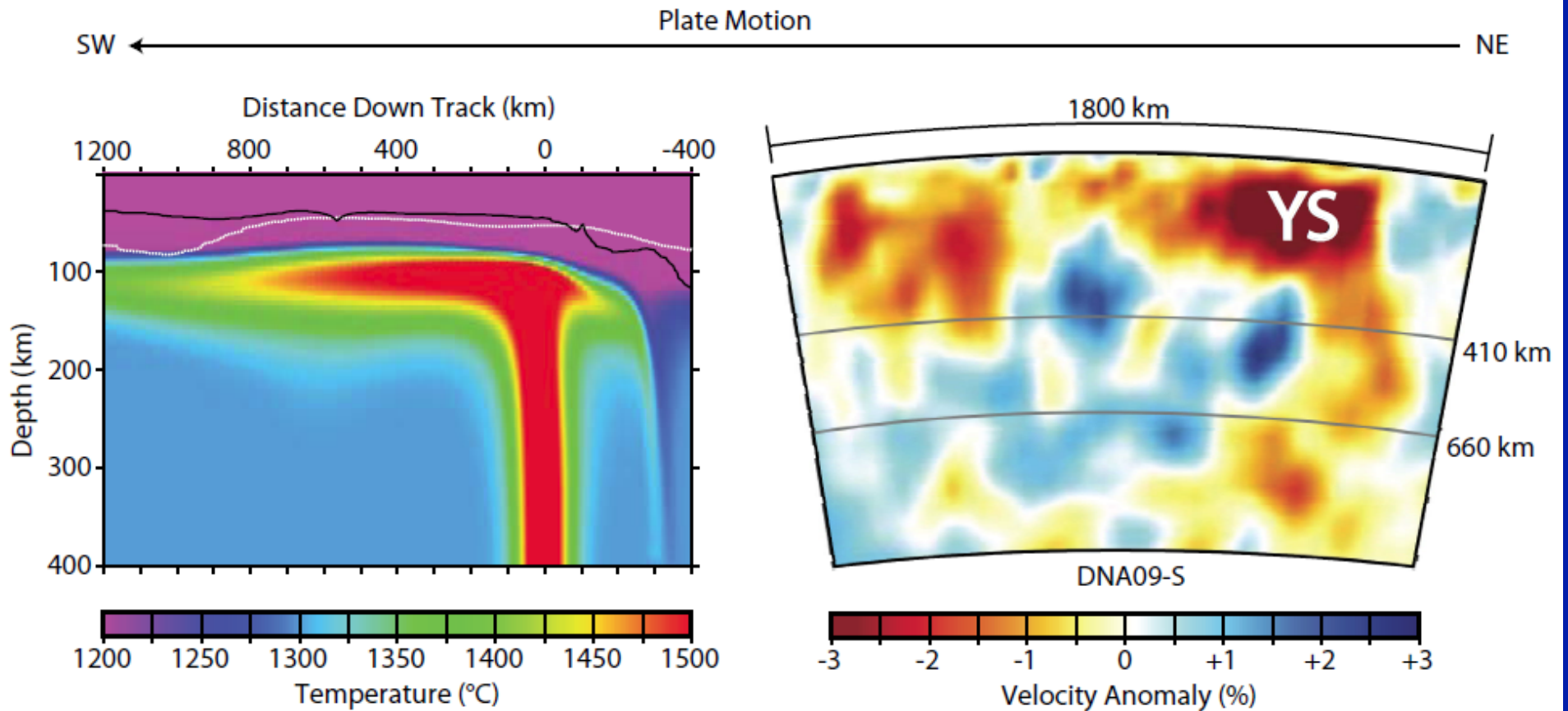


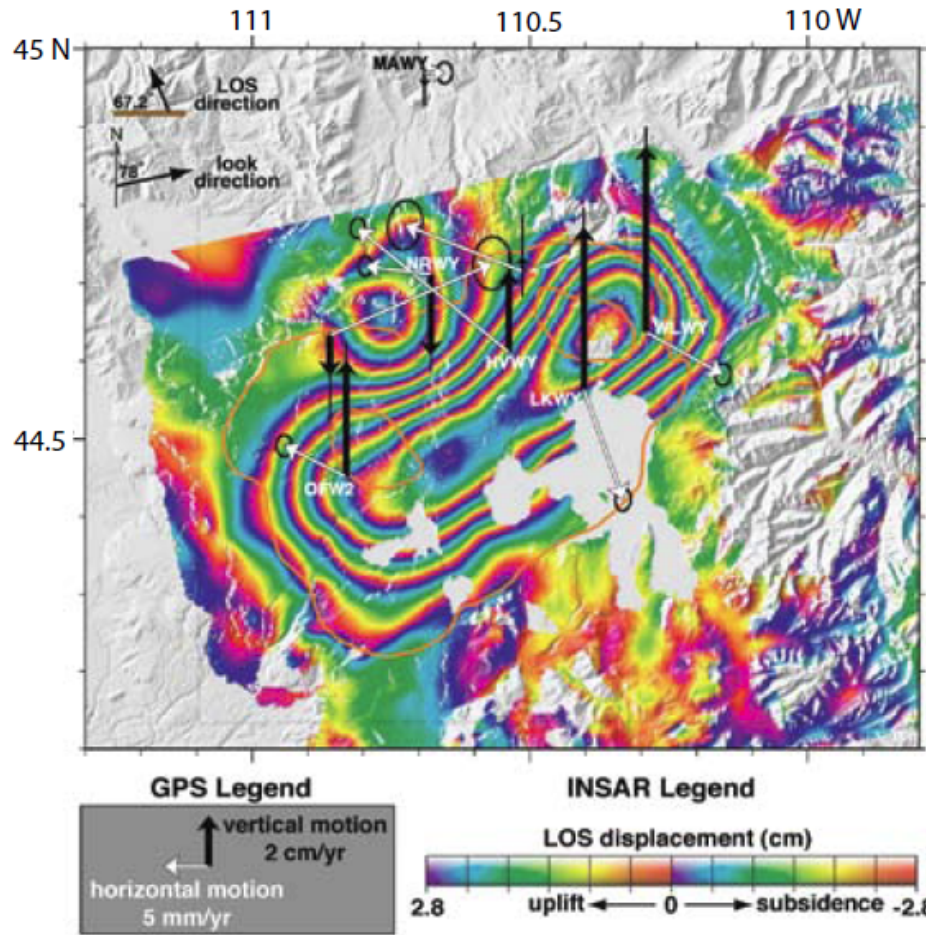




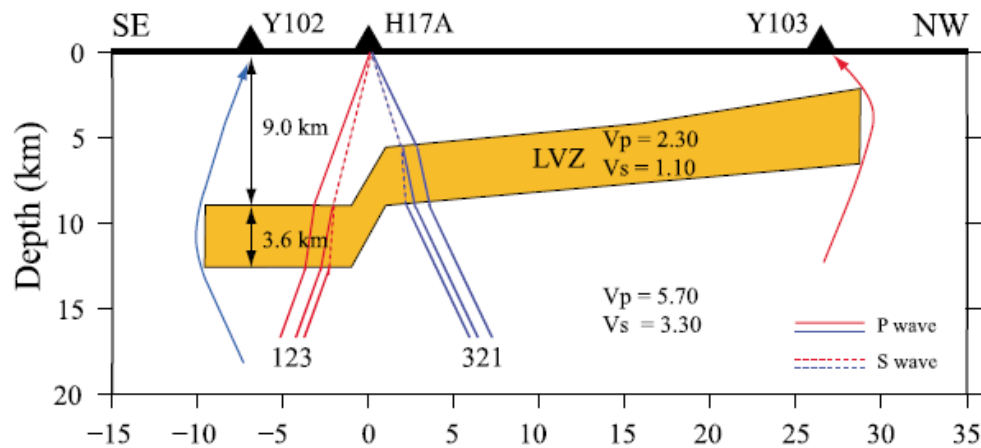


# Yellowstone Hotspot: Theory and Observations





In 2008, Yellowstone Caldera was uplifting at a rate of 7 cm/yr





***Volcanoes can change history  
in other ways!***

Opera *La Muette de Portici*, by  
Daniel Auber (1828)

- About 1647 Napoli uprising against Spanish rule led by a fisherman, Masaniello
- Vesuvius erupts in the final act!
- Performance in Brussels, 1830, sparked student riots
- Led to Belgian independence from Holland!

