Volcanoes

Slides from lectures preceding exercise on Volcanoes and Subduction Zones

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Volcanoes

- **Def: mountain formed by lava + ash**
  - **Named for Vulcan = Roman god of fire**
- **Lava flows**
  - **Cool rapidly, so fine-grained or glassy**
- ***Pyroclastic debris***
  - **Volcanic ash; *volcanic bombs***

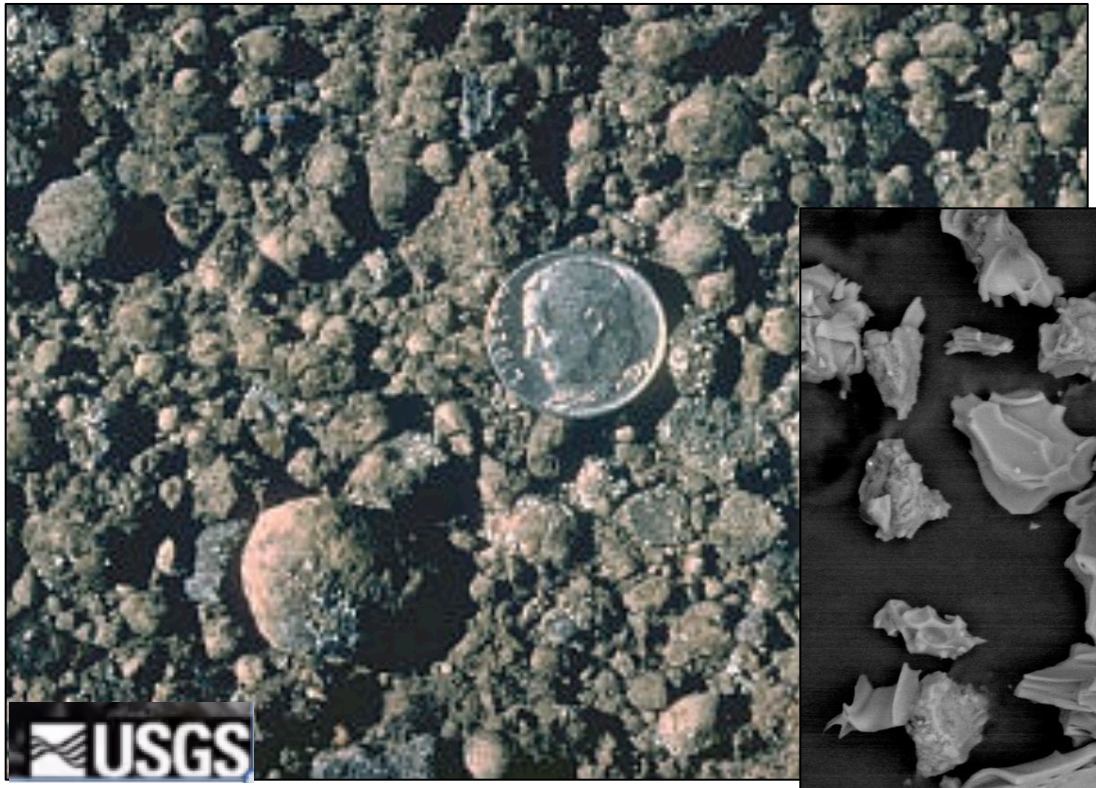
https://commons.wikimedia.org/wiki/File:Vesuvio_landscape.jpg

Products of Eruptions

https://volcanoes.usgs.gov/volcanoes/st_helens/st_helens_gallery_23.html
https://volcanoes.usgs.gov/volcanoes/kilauea/archive/multimedia/2003/Apr/20030401-2511_DAS_large.jpg
https://commons.wikimedia.org/wiki/File:Lava-bomb-01.jpg

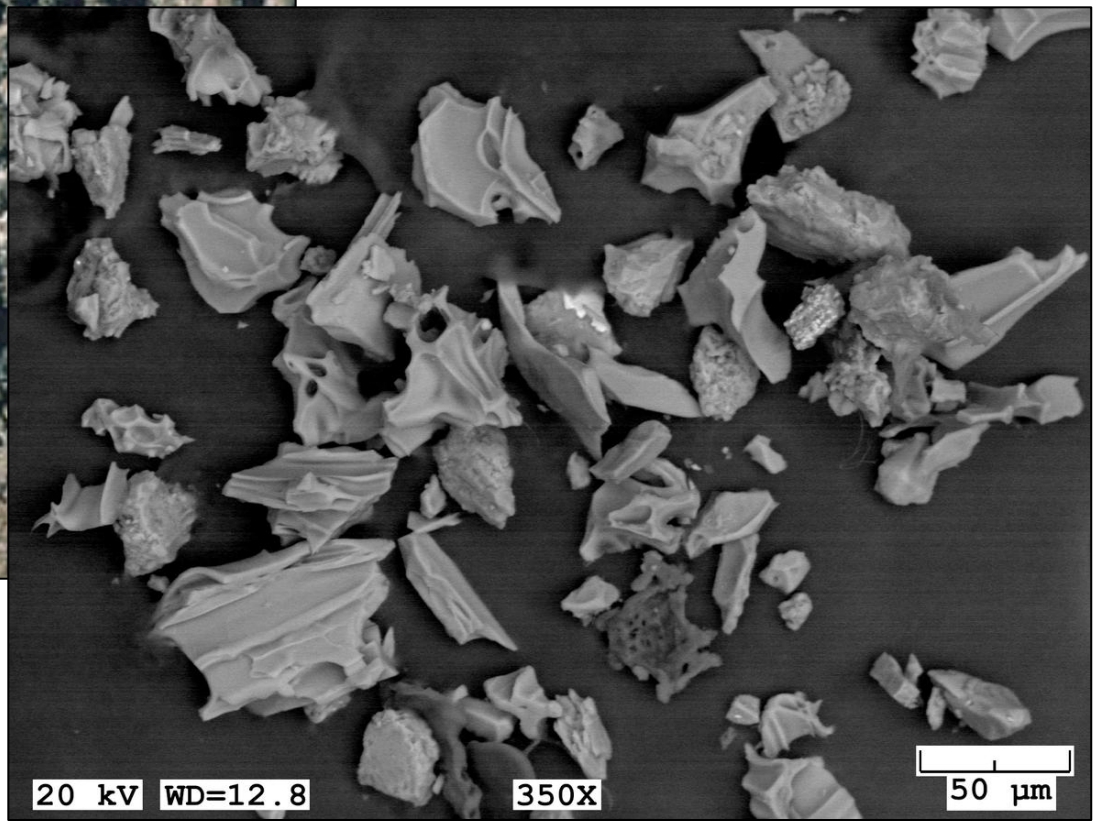
A Closer Look at Pyroclastics

Lapilli



http://volcano.oregonstate.edu/book/export/html/130

Volcanic ash

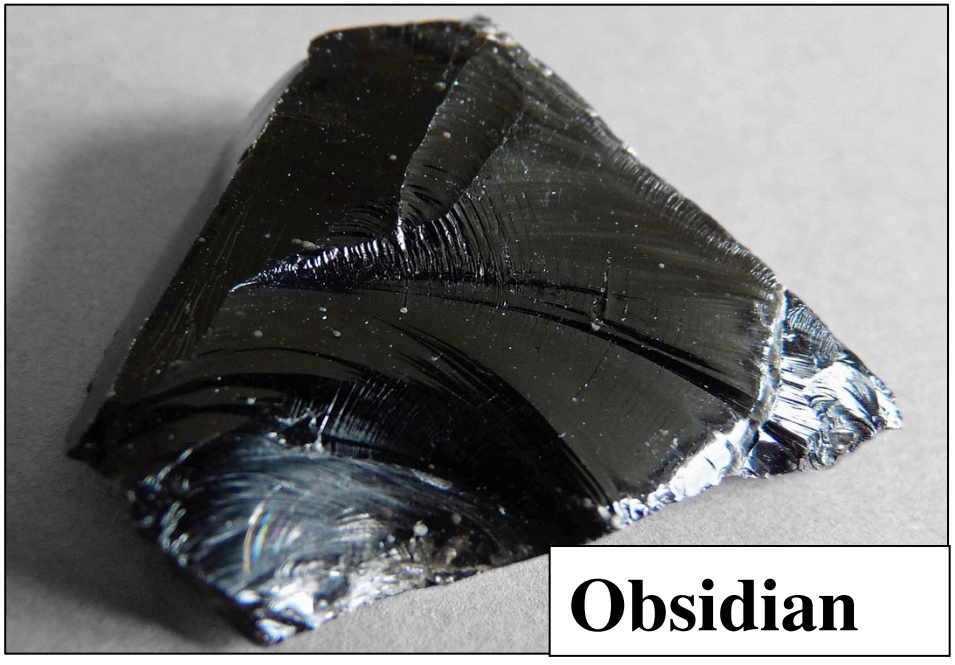


https://www.usgs.gov/media/images/scanning-electron-microscope-image-volcanic-ash

https://commons.wikimedia.org/wiki/File:PinkRhyolite.tif

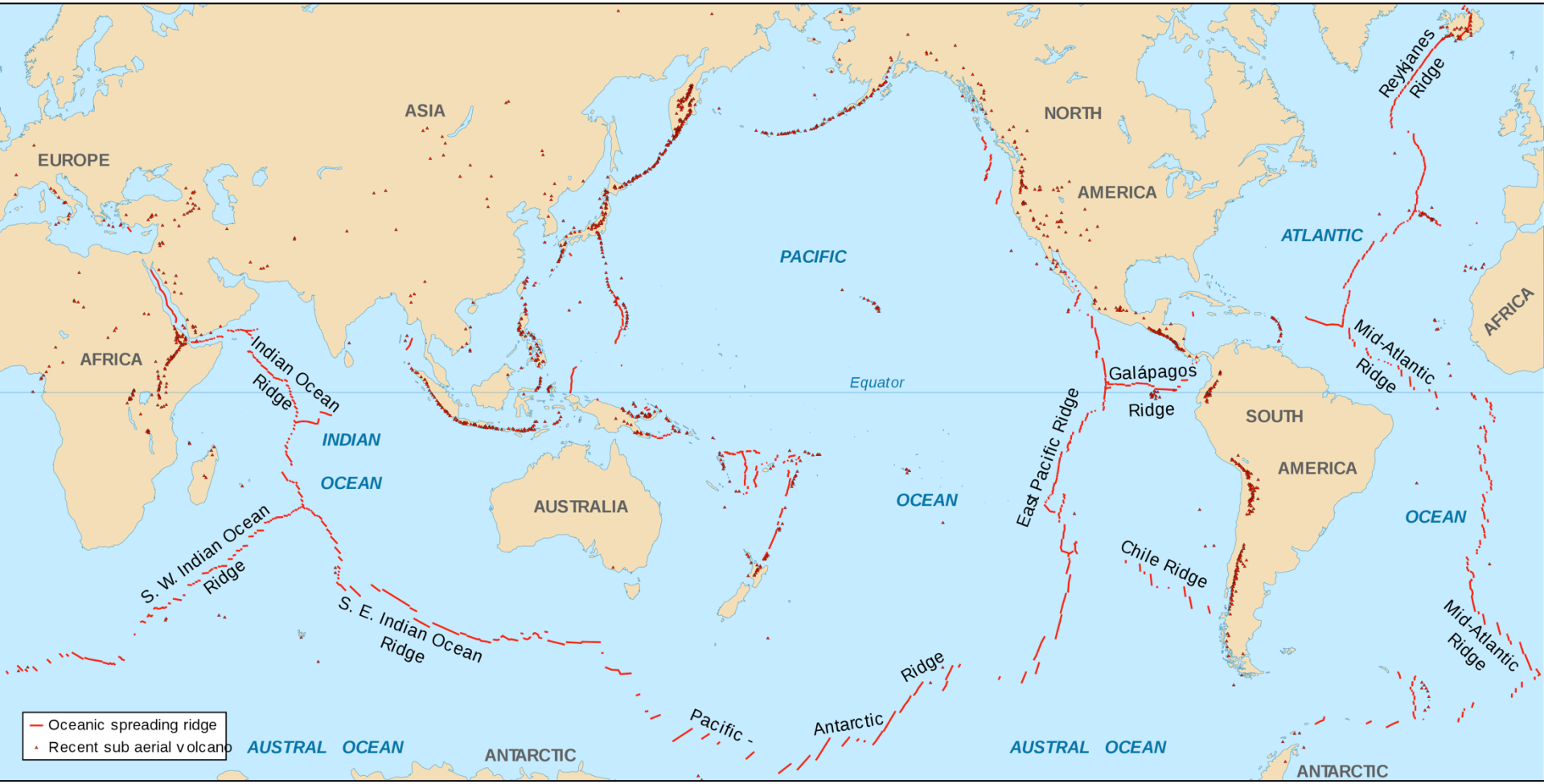
https://commons.wikimedia.org/wiki/File:HoleInTheWallTuff.JPG

https://commons.wikimedia.org/wiki/File:VessicularBasalt1.JPG



https://commons.wikimedia.org/wiki/File:Lipari-Obsidienne_(5).jpg

Where Are Volcanoes?



https://commons.wikimedia.org/wiki/File:Spreading_ridges_volcanoes_map-en.svg

Tectonic Activity and Plate Tectonics

Boundary	EQs	Volcanoes
Ridge	**Yes**	**Yes**
Trench	**Yes**	**Yes**
Transform	**Yes**	**No**
Hot spot	***No***	***Yes***

“Quiet” Eruptions

- **Non-explosive; *effusive***
  - **Basalt lava flows & lava fountains**
    - **Common at divergent boundaries & hotspots**

https://commons.wikimedia.org/wiki/File:Lava_flow_at_Krafla,_1984.jpg

“Loud” Eruptions

- *Explosive*
  - **Pyroclastic debris**
    - **Common at convergent boundaries**

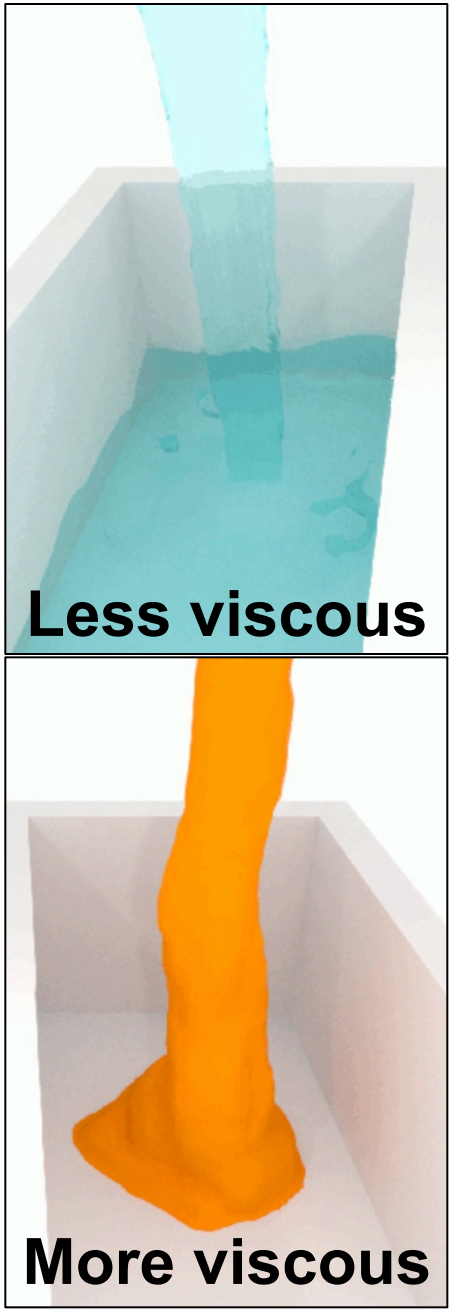
https://volcanoes.usgs.gov/vhp/pyroclastic_flows.html

Why Explosions?

- **Occur when:**
  - **Magma contains lots of gas**
    - **Mainly water**
    - **Expands rapidly near the surface**
  - **Magma is *viscous***
    - **Resists flow**
    - **Thick, or stiff**

Viscosity

- Temperature effect
  - Hotter = less viscous
  - Cooler = more viscous
- Composition effect
  - Mafic = less viscous
  - Felsic = more viscous



https://commons.wikimedia.org/wiki/File:Viscosities.gif

Mafic Magma

- Forms by melting mantle rock
  - By decompression
  - Low silica, little water
  - Hot magma (1200^{o}C)
- Low viscosity, thus effusive
  - Basalt lava

https://commons.wikimedia.org/wiki/File:Pahoehoe_toe.jpg

Felsic Magma

- Forms by melting crustal rock
  - By addition of water & by heating
  - High silica, lots of water
  - Cooler magma (800°C)
- High viscosity, thus explosive
  - Rhyolite lava / ash

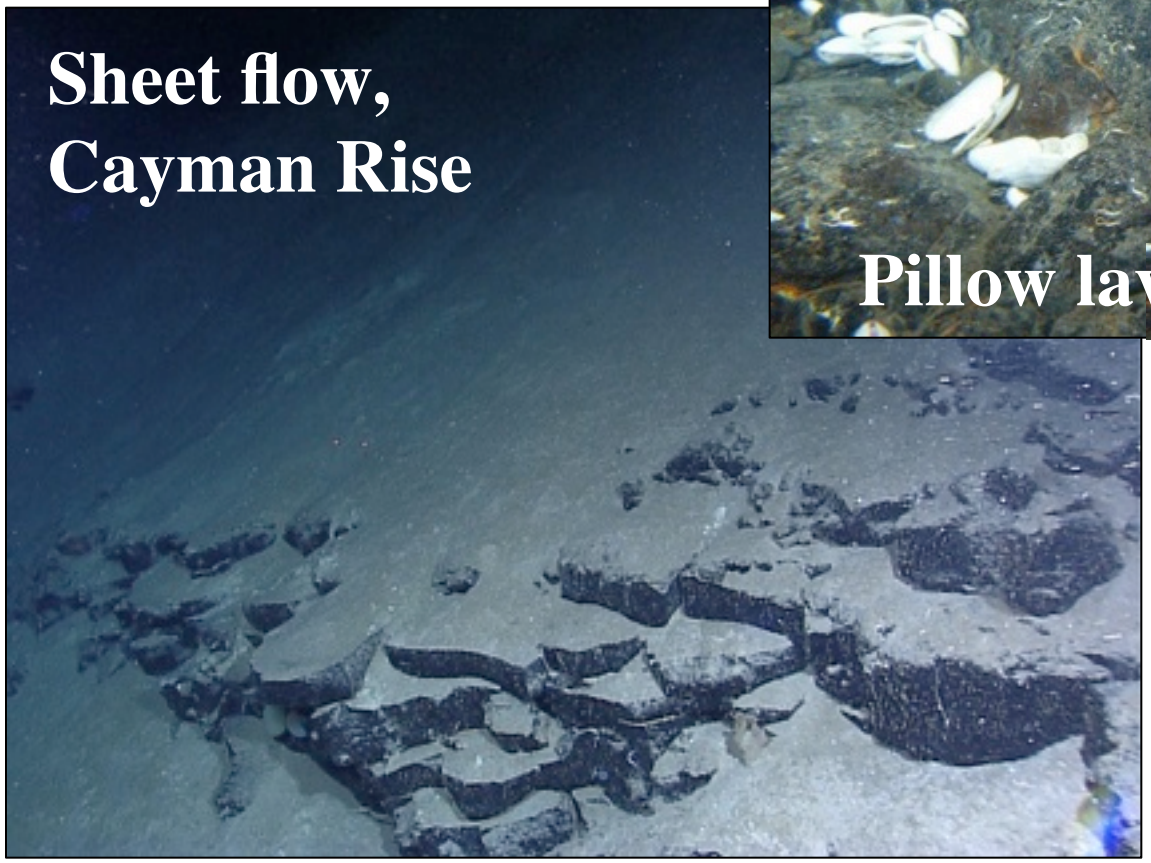
https://commons.wikimedia.org/wiki/File:Pumice_on_20_dollars.jpg

Eruptions

	Effusive	Explosive
Product	**Basalt lava**	**Felsic lava & pyroclastics**
Temperature	**Hotter**	**Cooler**
Tectonic setting	**Divergent; hotspots**	**Convergent**
What melts?	**Mantle**	**Crust**

Divergent Boundaries

https://volcano.si.edu/volcano.cfm?vn=334070



https://oceanexplorer.noaa.gov/okeanos/explorations/ex1104/logs/summary/media/sheet_flow.html

Hotspots

Galapagos

https://commons.wikimedia.org/wiki/File:Cerro_Azul_Galapagos.jpg

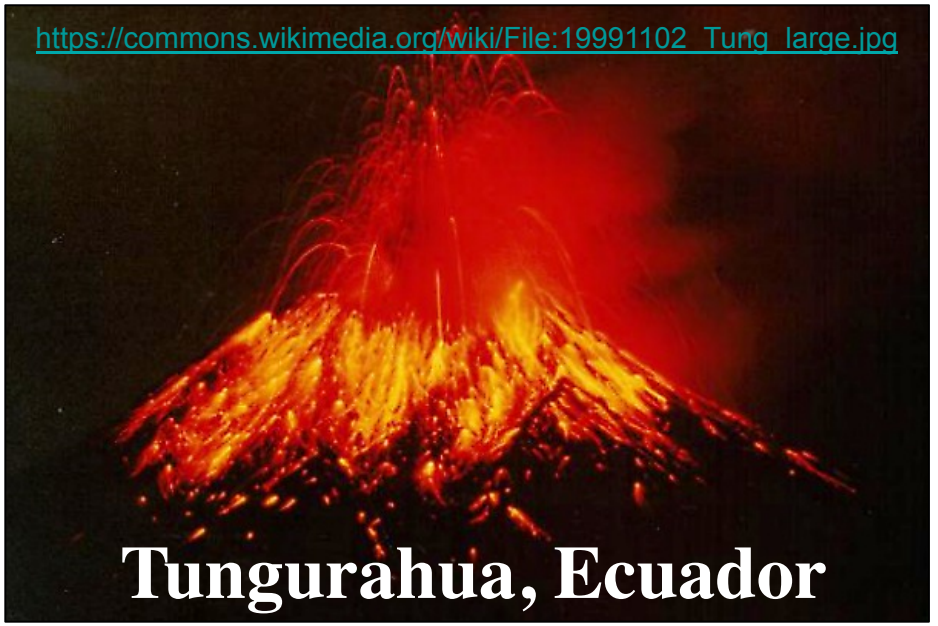
Iceland

https://commons.wikimedia.org/wiki/File:Surtsey_eruption_1963.jpg

Reunion

https://commons.wikimedia.org/wiki/File:Reunion_2004_1.jpg

Convergent Boundaries



Teaching Notes and Tips

This short activity may be completed during a laboratory period or assigned as homework.

Note that students need access to a computer to complete this exercise.

Note that the Excel workbook file includes two worksheets that contain the key. The workbook given to students should have only the Subduction Data and Subduction Graph worksheets.

This activity was designed as part of a longer laboratory activity that includes more detailed work with the 1980 eruption of Mt. St. Helens, a subduction zone volcano. These other activities may also be found on the SERC website. When all three activites are combined, the laboratory exercise consists of the following:

- Part I: Mt. St. Helens Ashfall Eruption <https://serc.carleton.edu/teachearth/activities/181097.html>
- Part II: Mt. St. Helens Topographic Profiles <https://serc.carleton.edu/NAGTWorkshops/geodesy/activities/204957.html>
- Part III: Volcanoes at Subduction Zones.

The student instructions include two separate options. In Option 1, students use Google Earth to view South American volcanoes and earthquake epicenters and to measure the arc-trench distance for other arcs. In Option 2, students use a PDF containing pertinent screenshots from Google Earth to complete these parts of the activity. Both versions include using Excel for calculations and graphing.

Some students have difficulty entering formulas in Excel, so the instructor should review the process and keep track of progress.

Because computer software changes so rapidly, the instructions for accomplishing certain tasks with Excel might differ from those given in the student instructions. Thus, the instructor should be aware of possible difficulties using Excel.