

VOLCANOLOGY – GEOL 687

Vic Camp

Book:: Peter Francis,
*Volcanology, a planetary
Perspective (Optional)*

Website:
(How Volcanoes Work)
[http://www.geology.sdsu.edu/
how_volcanoes_work](http://www.geology.sdsu.edu/how_volcanoes_work)

Readings:
Compiation available at
Aztec Shops (Camp, 2003)

Class Schedule:

CHAPTER

Web sections – Subsections

Papers

Properties of Lava, Eruption Dynamics, and Landforms

Classification and physical properties of volcanic rocks	5	Eruption Dynamics - <i>Controls</i>	Le Bas et al. (1986)
Magma generation			Fririch and Mahood (1987)
Variations in eruptive style, vent types, and explosivity		Eruption Dynamics - <i>Variability</i>	Pallister et al. (1992)
Volcano types and explosivity	17	Eruption Dynamics - <i>Variability</i>	Newhall and Self (1982)
Eruption Mechanism and Principle Eruption Types	6	Eruption Types - <i>all sub-sections</i>	
Volcano types: <i>Scoria Cones</i> and <i>Shield volcanoes</i>	16	Volcanic Landforms	
Volcano types: <i>Stratovolcanoes, Domes,</i> and <i>Calderas</i>	16 & 14	Volcanic Landforms	
Volcano types: <i>Maars, Tuff Rings,</i> and <i>Tuff Cones</i>	16 & 15	Eruption Types - <i>Hydrovolcanic</i>	
<i>Mid-term Exam – (date to be announced in class)</i>			

Eruption Phenomena and the Products of Eruption

Volcanic gases and their effect on climate		Eruption Products - <i>Gases, climate</i>	
Lava Flows - general characteristics	7	Eruption Products - <i>Lava flows</i>	
Basaltic lavas	7	<i>same</i>	
Basalt Volcanism: example = <i>Hawaii</i>		Eruption Types - <i>Fissure & Haw.</i>	
Basalt Volcanism: example = <i>Columbia River Basalt</i> (and Arabia -?)			Hooper (1982); Camp (1995)
Andesitic and felsic lavas		Eruption Products - <i>Lava flows</i>	
Mt. St. Helens		Historical Eruptions - <i>MSH</i>	
Volcaniclastic terminology		Eruption Products - <i>Tephra</i>	Scmidt (1980); Wright et al. (1980)
		Eruption Products - <i>Lava & Water</i>	
Pyroclastic <i>Falls</i>	8	Eruption Products - <i>Tephra</i>	
Pyroclastic <i>Flows</i>	10 & 12	Eruption Products - <i>Pyro. flows</i>	Sparks et al. (1973)
Pyroclastic <i>Surges</i>	11		
Post-depositional features (welding, etc.)			
Ancient Volcanic Successions			
Rock avalanches, debris flows, and lahars	13	Eruption Products - <i>Lahars</i>	
Long Valley Caldera; Yellowstone			

Final Exam – December 17 (Wednesday) at 1300

Final grades will be based on the following:

Mid-term exam	100 pts.
Final exam	100
Project	100 (paper = 70; presentation = 25; map = 5)

– *There will be two mandatory field trips, to be announced in class*

THE PROJECT:

Due Dates: September 16 – World map of 30 volcano locations
September 16 – Your three volcano choices
December 8-12 – Paper presentations
December 12 – Papers due

Each of you will choose a volcano of your very own, which you will monitor (via *Volcano Listserver* - see below) throughout the semester; this will be the focus of your class project. This means that you should check up on your volcano on a regular basis, keeping the class up to date on any recent activity or debates as close to the active events as possible (e.g., any seismic events, eruptions, regional issues, political debates, etc). Of course, volcanoes are unpredictable and some may be particularly active during the semester whereas others will not.

On or before Sept. 16, I must have (1) a world map showing the exact location of each of the active or recently active volcanoes in the list below, and (2) your *first, second, and third* choices, preferably from this list. If you are interested in a recently active volcano not on this list, then run it by me first before adding it to your three choices.

Etna, Italy	Ebrebus, Antarctica	Unzen, Japan
Vesuvius, Italy	Lascar, Chile	Miyakejima, Japan
Stromboli, Italy	Galeras, Columbia	Usu, Japan
Nyiragongo, Congo	Arenal, Costa Rica	White Island, New Zealand
Mt. Cameroon, Cameroon	Guagua Pichincha, Ecuador	Ruapehu, New Zealand
Soufriere Hills, Montserrat	Colima, Mexico	Mayon, Philippines
Hekla, Iceland	Popocatepetl, Mexico	Bezymianny, Kamchatka Peninsula
Redoubt, Alaska	Anak Krakatau, Indonesia	Axial Seamount, Pacific Ocean
Piton de la Fournaise, Reunion	Fuego, Guatemala	Kliuchevskoi, Kamchatka
Semeru, Indonesia	Erta Ale, Ethiopia	Ol Doinyo Lengai, Tanzania

You will write a paper and give a 12-15 minute talk about your volcano. Most papers should be between 8 and 15 pages long and include illustrations. As you gather information, be sure to keep careful track of your sources and include them in a *References Cited* section at the end of the paper. Make sure that your references are thorough and complete. You must cite every concept, image, and all data by including the author and date in parentheses in the text; for example: “The height of the eruptive column was 50 km (Smith et al., 1981).” Follow the GSA format in

referencing your sources. You may begin your research via the internet, but your paper must be based on articles in the volcanological literature. The paper should include a thorough description of your volcano. However, you may choose to focus on some particularly important aspects of your volcano, as long as the description is complete. The form the paper takes is completely up to you, but an example outline could be:

- I. Introduction** - Geographic and tectonic setting, volcano form and dimensions
 - II. Eruptions** - Eruption types, eruption history, description of vents/craters/calderas/ volcanic hazards.
 - III. Rock types** - Description of volcanic deposits, geochemistry and petrology, fumarolic activity
 - IV. Geophysical Monitoring of the Volcano**
 - V. Interpretations**
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VOLCANO Listserver:

Everyone should sign up for the VOLCANO Listserver, which provides a means of rapid communication among members of volcanological community. It is used for announcements or inquiries about any aspect of volcanology. All subscription requests and postings must be approved by the moderator. *Do not submit basic research questions to the server! It is not a suitable means for a literature/web search.* To join the list, send the message:

‘**SUBSCRIBE VOLCANO John E. Doe**’ (but of course use your full name) to: listserv@asu.edu
You will receive notification that you have joined from the listserv if you did it correctly.

REFERENCES -- *The lecture material is drawn from a variety of sources, which includes the following texts and publications. This not required reading, but rather a partial compilation of sources on volcanology for your own use.*

Chemical Classification of Volcanic Rocks

- Le Bas, M.J., Le Maitre, R.W., Streckeisen, A., and Zanettin, B., 1986, A chemical classification of volcanic rocks based on the total alkali-silica diagram, *Jour. Petrol.*, v. 27, pt. 3, p. 745-750.
- Irvine, T.N. and Baragar, W.R.A., 1971, A Guide to the chemical classification of the common volcanic rocks: *Canadian Jour. Earth Sci.*, v. 8, p. 523-548.

Magma Generation and Magma Chamber Processes

- Camp, V.E., Hooper, P.R., Roobol, M.J., and White, D.L., 1987, The Madinah eruption, Saudi Arabia: magma mixing and simultaneous extrusion of three basaltic chemical types, *Bull. Volcanol.*, v. 49, p. 489-508.
- Fridrich, C.J. and Mahood, G.A., 1987, Compositional layers in the zoned magma chamber of the Grizzly Peak tuff, *Geology*, v. 15, p. 299-303.
- Pallister, J. S., Hobbliit, R. P., and Reyes, A. G., 1992, A basalt trigger for the 1991 eruptions of Pinatubo volcano?, *Nature*, v. 356, p. 426-428.

Volcaniclastic Terminology

Schmid, R., 1981, Descriptive nomenclature and classification of pyroclastic deposits and fragments: Recommendation of the IUGS Subcommittee on the Systematics of Igneous Rocks, *Geology*, p. 41-43.

Fisher, R.V., 1966, Rocks composed of volcanic fragments and their classification, *Earth-Sci. Rev.*, v. 1, p. 287-298.

Ross, C.S., and Smith, R.L., 1961, Ash-flow tuffs: their origin, geologic relations, and identification, *Geological Survey Prof. Paper 366*, 81 p.

Sparks, R.S.J., Self, S., and Walker, G.P.L., 1973, Products of ignimbrite eruptions, *Geology*, v. 11 p., 115-118.

Walker, G.P.L. and Croasdale, R., 1971, Characteristics of some basaltic pyroclastics, *Bull. Volcanol.*, v. 35, p. 303-317.

Eruption Types and Eruption Mechanisms

Newhall, C. G. and Self, S., 1982, The volcanic explosivity index (VEI): An estimate of explosive magnitude for historical volcanism, *Jour. Geophys. Res.*, v. 87, p. 1231-1238.

Wright, J.V., Smith, A.L., and Self, S., 1980, A working terminology of pyroclastic rocks, *Jour. Volc. Geotherm. Res.*, v. 8, p. 315-336.

Walker, G.P.L., 1973, Explosive volcanic eruptions -- a new classification scheme, *Geol. Rundsch.*, v. 62, p. 431-446.

Pahoehoe Sheetflows

Hon, K., Kauahikaua, J., Denlinger, R., Mackay, K., 1994, Emplacement and inflation of pahoehoe sheet flows: observations and measurements of active lava flows on Kilauea, Hawaii, *Geol. Soc. of Am. Bull.*, v. 106, p. 351-370.

Basalt Provinces (Hawaii)

Hazlett, R. W., 1987, Kilauea caldera and adjoining volcanic rifts, *Geological Society of America Centennial Field Guide of the Decade of North America*, v. 1, p. 15-20.

Ryan, M.P., 1988, The mechanics and three-dimensional internal structure of active magmatic systems: Kilauea Volcano, Hawaii, *Jour. Geophys. Res.*, v. 93, no. B5, p. 4213-4248.

Rhodes, J.M. and Lockwood (editors), 1995, *Mauna Loa Revealed: Structure, Composition, History, and Hazards*, Am. Geophys. Union, Geophysical Monograph 92, 348 p.

Stern, H., 1985, *Geology of Hawaii*, Pacific Books, Palo Alto, California, 335 p.

Basalt Provinces (Columbia River)

Hooper, P.R., 1982, The Columbia River Basalts, *Science*, v. 215, no. 4539, p. 1463-1468.

Hooper, P.R., and Camp, V.E., 1981, Deformation of the southeast part of the Columbia Plateau, *Geology*, v. 9, p. 323-328.

Camp, V. E., 1995, Mid-Miocene propagation of the Yellowstone mantle plume head beneath the Columbia River Basalt source region, *Geology*, v. 23, p. 435-438

Basalt Provinces (Saudi Arabia)

Camp V. E., and Roobol, M. J., 1992, Upwelling asthenosphere beneath western Arabia and its regional implications, *Jour. Geophys. Res.*, v. 97, p. 15,255-15, 271.

Camp, V.E., Roobol, M.J., and Hooper, P.R., 1991, The Arabian continental alkali basalt province: Part II. Evolution of Harrats Khaybar, Ithnayn, and Kura, Kingdom of Saudi Arabia, *Geol. Soc. Am. Bull.*, v. 103, p. 363-391.

Specific Volcanoes or Volcanic Regions

Simkin T. and Siebert, L, 1994, *Volcanoes of the World*, Smithsonian Inst., Geoscience Press, Tuscon, p. 349.

Luhr, J. F. and Simkin, T., 1993, *Paricutin, the Volcano Born in a Mexican Cornfield*, Smithsonian Institution, Geoscience Press, Phoenix, 427 p.

Christiansen, R.L., 1983, Yellowstone magmatic evolution: its bearing on understanding large-volume explosive volcanism, in, *Explosive volcanism, inception, evolution and hazards*, National Academy Press, Washington D.C. p. 84-95.

Christiansen, R.L., and Peterson, D.W., 1981, Chronology of the 1980 eruptive activity, in Lipman, P.W., and Millineaux, D.R. (eds.), *The 1980 eruptions of Mt. St. Helens, Washington, U.S. Geol. Sur. Prof. Paper 1250*, 843 p.

Hill, D.P., and Bailey, R.A., 1985, Active tectonic and magmatic processes beneath Long Valley Caldera, eastern California: an overview, *Jour. Geophys. Res.*, v. 90, no. B13, p. 11,111-11,120.

Smith, A. L. and Roobol, M. J., 1990, *Mt. Pelée, Martinique: A Study of an Active Island-arc Volcano*, Geol. Soc. Am. Memoir 175, 105 p.

Reidel, S. P. and Hooper, P. R. (editors), 1989, *Volcanism and Tectonism in the Columbia River Basalt Province*, Geol. Soc. Am. Special Paper 239, 386 p.

Lipman, P. W., Chapin, C. E., and Dungan, M. A. (editors), 1989, *Cenozoic Volcanism in the Western United States*, Am. Geophys. Union, a volume of selected reprints, 72 p.

Johnson, R. W. (editor), *Intraplate Volcanism in Eastern Australia and New Zealand*, Cambridge University Press, Cambridge, England, 408 p.

Volcanology Textbooks and Compilations

Sigurdsson, Haraldur (editor), 2000, *Encyclopedia of Volcanoes*, Academic Press, San Diego, 1417 p.

Cas, R.A.F and Wright, J.V., 1988, *Volcanic Successions: modern and ancient*, Unwin Hyman, London, 528 p.

Fisher, R.V. and Schmincke, H.-U., 1984, *Pyroclastic Rocks*, Springer-Verlag, Berlin, 4

Francis, P., 1993, *Volcanoes: a planetary perspective*, Oxford University Press, Oxford, 443 p.

Mursky, G., 1996, *Introduction to Planetary Volcanism*, Princtic-Hall, Upper Saddle River, New Jersey, 292 p.

Tilling, R. I., (editor) 1988, *How Volcanoes Work*, Am. Geophys. Union, a compilation of papers from the *Jour. Geophys. Res.*

Williams, H. and McBirney, A., 1979, *Volcanology*, Freeman, Cooper & Co., San Francisco, 397 p.