

## **GE5195 Volcano Seismology**

Spring semester 2013  
3 credits

*Description and scope of the course:* This course will prepare students, including those with no seismology background, to interpret seismic and acoustic signals from volcanoes. Topics: basic seismology, monitoring techniques, tectonic and volcanic earthquakes, infrasound, and deformation over a range of time scales.

*Instructor:* Dr. Greg Waite                      phone: 7-3554  
                      Dow 428                                    email: gpwaite@mtu.edu

*Lecture:* MW from 1530-1700 in Dow 633. Please note that these "lectures" will be part lecture, part problem solving session. I expect you to come to class having read the assigned material and prepared to ask questions and solve problems.

*Lab:* TBA in Dow 709 or 211

*Texts:* There is *not* a required textbook, but I highly recommend Aki and Richards or Stein and Wyession if you are interested in more detailed derivations than we have time for in this course. Shearer's book has enough detail for most of the introductory parts of the course.

Aki, K. and P.G. Richards (2009). *Quantitative Seismology* (2nd ed.). Sausalito, CA: University Science Books.

- This book has plenty of detail for an advanced seismology class.

Gubbins, D. (2004). *Time Series Analysis and Inverse Theory for Geophysicists*. Cambridge: Cambridge University Press.

- This is a good reference that has lots of seismology examples

Shearer, P.M. (2009). *Introduction to Seismology* (2nd ed.). Cambridge: Cambridge University Press.

- This book does not have the detail that Stein and Wyession does, but is sufficient for this course.

Stein, S. and M. Wyession (2003). *An Introduction to Seismology, Earthquakes, and Earth Structure*. Maldan, MA: Blackwell Publishing.

- This is an excellent general-purpose seismology textbook that also covers advanced topics we won't address.

Zobin, V.M. (2011). *Introduction to Volcanic Seismology*. Amsterdam: Elsevier Science.

- This is the only volcanic seismology textbook; it covers most of the topics we will cover in the course.

*Prerequisites:* MA1160/61, GE2000, PH2100, or permission from instructor. Labs and homework assignments will be done in Matlab (or R) and Seisan. You need not have prior experience with either to take the course.

*Readings:* Journal articles and book sections will be assigned.

*Course web page:* <http://www.geo.mtu.edu/~gpwaite/teaching/volcanoseismo>

*Grades:* Final grade will be based upon homework/laboratory assignments (50%), mid-term (20%) and final exams (30%).

*Homework:* Labs/homework assignments will be nearly all Matlab-based. You may also do the work in your favorite programming/scripting language, such as R. Each assignment

should be turned in electronically as a Matlab (or other executable) script. I should be able to run the script and get the solutions to all the problems. Save all your scripts because parts of them will be important for later assignments and the final.

*Mid-term exam:* This will be a short answer, closed-book exam to cover the fundamentals of seismology along with volcano-seismic sources.

*Final lab exam:* The final exam is an open book project, much like the weekly lab assignments.

*Final oral exam:* In order to gain a better understanding of how much you have learned in this class, I will give 15-30 minute individual oral exams during the last week of classes and exam week.

*General Course Outline:* (please note that some changes may be necessary)

Week	Date	Lecture Topic	Lab
1	Jan 14	Introductory earthquake seismology: stress and strain, seismometry, ray paths, source mechanisms, earthquake magnitudes, earthquake statistics, phase ID, earthquake sequences, FFT, earthquake classification.	Intro to seismology and Matlab
2	Jan 21		Seismometry
3	Jan 28		Seismogram filtering
4	Feb 04		Focal Mechanisms
5	Feb 11	Earthquake swarms and stress interactions, anisotropy	Stress modeling
6	Feb 18	LP earthquakes, harmonic and nonharmonic volcanic tremor characteristics, models, location, array analysis	Volcanic EQ discrimination
7	Feb 25		Array analysis
8	Mar 04		LP earthquakes
	Mar 11	SPRING BREAK	No Lab
9	Mar 18	Laboratory seismicity	STFT & wavelet transform
10	Mar 25	Volcanic infrasound	Infrasound lab
11	Apr 01	VLP interpretation	VLP analysis
12	Apr 08	Imaging magma systems	Tomography
13	Apr 15	Deformation on volcanoes: GPS and InSAR	Mogi modeling
14	Apr 22		No Lab