ERTH 456 / GEOL 556
Volcanology
Fall 2018, 3 credits
Lecture: MW 09:00-09:50, room: Bureau 111A
Lab: W 14:00-16:55, room: MSEC 349, Speare 3
Syllabus v.1.0

Instructor(s): Ronni Grapenthin, Matt Zimmerer, Nels Iverson
TA: Logan Fusso
Office: MSEC 356
Phone: 835-5924
Email: rg@nmt.edu
Office Hours: M 4-5 PM, R 3-4 PM, or when office door is open
Course Website: `http://grapenthin.org/teaching/volc_2018`

Course Description: The first 2/3 of the class give an overview of volcanic processes roughly from magma chamber to plume. This involves the investigation of magma storage genesis, conduit dynamics, effusive and explosive eruption processes, and exceptionally large, caldera forming eruptions. The last 1/3 of the course will look into tools for volcano monitoring and analysis. This will be paired with several case studies that require very active student participation. In lieu of homework assignments, the students can expect to be required to read assigned papers particularly for the case studies.

Pre-requisites: upper division earth sciences.

Class Website: Assignments and supplementary material will be posted on the class website `http://grapenthin.org/teaching/volc_2018`. Grades will be posted to canvas.

Required Text: No textbook required, but required readings will be posted on the class website.

Tentative Schedule: (subject to change)

Week 1	Aug 20	Lecture 1	RG	Introduction, logistics, Examples
	Aug 22	Lecture 2	RG	Volcano Distribution, Magma Origin & Composition
	Aug 22	LAB 1	RG	Viscosity
Week 2	Aug 27	Lecture 3	RG	Types of Volcanism & Development of storage systems
	Aug 29	**no class, RG out, read Cashman & Sparks**		
	Aug 29	**no lab, RG out, read Cashman & Sparks**		
Week 3	Sep 03	**Labor Day, no class**		
	Sep 05	**no class, RG out, read Sigmundsson et al.**		
	Sep 05	**no lab, RG out, read Sigmundsson et al.**		

Week 4	Sep 10	Lecture 4	MZ	Calderas I
	Sep 12	Lecture 5	MZ	Calderas II
	Sep 12	**no lab, RG out**		
	Sep 15	Field Trip I		*Jemez*
Week 5	Sep 17	Lecture 6	RG	Discuss papers
	Sep 19	Lecture 7	RG	Discuss papers
	Sep 19	Lab 2	RG	Calderas
Week 6	Sep 24	Lecture 8	RG	Conduits
	Sep 26	Lecture 9	RG	Magma Chemistry
	Sep 26	Lab 3	RG	Magma Chamber experiments I
	Sep 28	**5 PM, Term project idea due**		
Week 7	Oct 01	Lecture 10	NI	Volatiles
	Oct 03	Lecture 11	RG	Effusive Eruptions
	Oct 03	Lab 4	RG	Magma Chamber experiments II
Week 8	Oct 08	Lecture 12	RG	Explosive Eruptions
	Oct 10	Lecture 13	RG	Volcanic Plumes
	Oct 10	Lab 5	RG	Grain Size Distributions
	Oct 13	Field Trip II		*Joyita Hills*
Week 9	Oct 15	Lecture 14	MZ	NM Volcanism
	Oct 17	Lecture 15	MZ	Volcanic Hazards
	Oct 17	Lab 6	LF (RG out)	Igneous Rock Identification
Week 10	Oct 22	Lecture 16	RG	Volcanoes from Bottom to Deposit
	Oct 24	Lecture 17	NI	Tephra, Tephrochronology
	Oct 24	Lab 7	RG	Plume modeling
Week 11	Oct 29	Lecture 18	RG	Monitoring overview & Volcano geodesy
	Oct 31	Lecture 19	RG	Case Study from list
	Oct 31	Lab 8	RG	Tephra Fallout modeling
	Nov 02	**5 PM, term paper due**		
Week 12	Nov 05	Lecture 20	RG	Volcanic Gases
	Nov 07	Lecture 21	RG	Case Study from list
	Nov 07	Lab 9	RG	Hazard mapping
Week 13	Nov 12	Lecture 22	RG	Volcano Seismology
	Nov 14	Lecture 23	RG	Case Study from list
	Nov 14	Lab 10	RG	Observatory - An End-of-Times Game
	Nov 17	Field Trip III		*Grants*
Week 14	Nov 19	Lecture 24	RG	Remote Sensing & Infrasound
	Nov 21	Lecture 25	RG	Case Study from list
	Nov 21	*Thanksgiving, no lab*		
Week 15	Nov 26	Lecture 26	NI	Volcanoes and climate
	Nov 28	Lecture 27	RG	Case Study - from list
	Nov 28	Lab 11	RG	Flows and Tubes
Week 16	Dec 03	*Project Presentations*		
	Dec 05	*Project Presentations*		

	Dec 05	*Project Presentations, lab 15 due*
	Dec 07	**5 PM, final term paper due**
Week 16	Dec 10-16	*Finals week, AGU no class*

Possible Case Studies: This class will contain a number of case studies of eruptions. For each of these, we will answer these and other questions based on reading of the respective literature:

- What was the precursory activity?
- How was the eruption recorded?
- Eruptive products?
- How did the eruption compare to prior activity
- What did we learn form the event?
- Impact of the event?

List of options:

- Socorro Magma Body
- Iceland: Holuhraun/Barðabb́unga 2014 (vs Laki 1783?)
- Redoubt 2009
- Erebus
- Mt St Helens 1980 / 2006
- Pinatubo 1991
- Yellowstone - recent activity vs caldera forming eruptions
- Nevado del Ruiz 1985
- Krakatoa 1883
- Tambora 1816
- Kilauea ongoing (incl. 2018 episode)
- other suggestions?

Course Requirements: There will be no graded homework assignments, but the students will be expected to have reviewed assigned reading before lectures.

Graduate students will prepare a term project including an in-class presentation and an expository term paper of roughly 10-12 pages (NSF Formatting `http://www.nsf.gov/pubs/policydocs/pappguide/nsf16001/gpg_2.jsp#IIB`). The topic of this project should be related to the course content and objectives and should involve some data analysis, modeling and interpretation. Your topic must be approved by the instructor before you begin to work on it. You might apply techniques from the course to process, analyze and interpret data that you have gathered in your research, or you might choose one of the provided projects. If you choose thesis related work, it must be a new aspect; recycling of existing work is not permitted. In-class presentations are scheduled for the last week of classes. Note that the first term paper due date will be used to grade for completeness; the second term paper due date will grade on completeness and correctness.

Grading:

ERTH456: Labs: 50%, Field Trip Reports 30%, Class & Case study participation: 20%.
ERTH556: Labs: 40%, Term Project 50%, Case Study participation: 10%.

Grades will be assigned for each lab based upon assignment completeness and accuracy. Details for field trip reports will be made available before the trip. Unless otherwise noted, assignments will be due one week after they are assigned âĂŞ they must be submitted prior to the beginning of subsequent lab period. Assignments are due electronically (submit via canvas) and must be the work of individual students. **Assignments will not be accepted late.** There are no exams in this class.

Term Project Ideas: If you cannot come up with a suitable project of your own, I have a few that would benefit from someone working on them. Get in touch with me if any of these sound interesting:

- Edifice driven change in composition at Antarctic Volcanoes?
- Erebus tilt
- Dike propagation experiments

Place in Curriculum: This elective course is for majors and non-majors who fulfill the requirements.

Course Learning Outcomes: By the end of this course, students will have a working understanding of volcanology and a set of modern tools used to analyze volcanoes. Students will have an understanding of how magma migrates within the earth, through the crust and to the surface into the atmosphere; how different kinds of eruptions are generated and what hazards volcanoes pose to society and climate. Case studies of prominent past eruptions will put the learned materials into perspective of individual volcanoes. Field trips within New Mexico will link theory to observations in the field. The term project will allow the students to apply the materials and methods learned in

the class to one problem in depth. Students will be able to critically evaluate volcanological work presented in the research literature and be able to use the methods in their own research.

Program Learning Outcomes: The learning outcomes of the Earth and Environmental Science program are that students will be able to: (1) Understand and apply the facts and concepts central to Earth science (e.g., geological processes and materials, Earth history, application of quantitative physics and chemistry to earth processes). (2) Demonstrate a working knowledge of the skills and methods necessary to collect, analyze and report data relevant to the discipline (e.g., rock identification, field mapping, geophysical methods). (3) Conceptualize, abstract and solve both qualitative and quantitative problems in the discipline. (4) Integrate and synthesize disparate geoscientific information into a coherent understanding.

Counseling and Disability Services – Reasonable Accommodations: New Mexico Tech is committed to protecting the rights of individuals with disabilities. Qualified individuals who require reasonable accommodations are invited to make their needs known to the Office of Counseling and Disability Services (OCDS) as soon as possible. To schedule an appointment, please call 835-6619.

Counseling and Disability Services – Counseling Services: New Mexico Tech offers mental health and substance abuse counseling through the Office of Counseling and Disability Services. The confidential services are provided free of charge by licensed professionals. To schedule an appointment, please call 835-6619.

Academic Honesty: New Mexico TechâĂŹs Academic Honesty Policy for undergraduate students is found starting on page 60 of the NMT Undergraduate Catalog,

`http://www.nmt.edu/images/stories/registrar/pdfs/2014-2015_UNDERGRADUATE_Catalog_FINAL.pdf`

New Mexico TechâĂŹs Academic Honesty Policy for graduate students is found starting on page 59 of the NMT Graduate Catalog,

`http://www.nmt.edu/images/stories/registrar/pdfs/2014-2015_GRADUATE_Catalog_FINAL.pdf`

You are responsible for knowing, understanding, and following this policy.

Title IX - Reporting Requirements: New Mexico Tech is committed to upholding standards that promote respect and human dignity in an environment that fosters academic excellence and professionalism. Sexual misconduct, sexual violence and other forms of sexual misconduct and gender-based discrimination in any form are contrary to the universityâĂŹs mission and core values, violate university policies, and may also violate state and federal law (Title IX). Faculty members are considered "Responsible Employees" and are required to report incidents of these prohibited behaviors to TechâĂŹs Title IX Coordinator (Dr. Peter Phaiah, 21A Brown Hall, 575-835-5187, titleixcoordinator@nmt.edu). If you or someone you know has been impacted by sexual assault, dating and domestic violence, stalking or sexual exploitation, please visit `http://www.nmt.edu/`

`titleix` to access information about university support and resources. New Mexico Tech also prohibits retaliation against individuals who report or who are involved in the resolution process in these cases.

Respect Statement: New Mexico Tech supports freedom of expression within the parameters of a respectful learning environment. As stated in the New Mexico Tech Guide to Conduct and Citizenship: "New Mexico TechâĂŹs primary purpose is education, which includes teaching, research, discussion, learning, and service. An atmosphere of free and open inquiry is essential to the pursuit of education. Tech seeks to protect academic freedom and build on individual responsibility to create and maintain an academic atmosphere that is a purposeful, just, open, disciplined, and caring community."

Cell phones: Cell phones will be set on vibrate to accommodate potential emergencies.