GEOL 346 Petrology
Class meetings: MTTH 11-11:50 (lecture); T 1-4 p.m. (lab)
Location: Sci 112 (lecture and lab)

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I find petrology fascinating because it enriches and elucidates our understanding of Earth's interior as much as geophysics does. Without understanding the links between petrology and the Principle of Plate Tectonics, one can only have a superficial understanding of how plate tectonic processes have created the Earth.

The organization of this class is transitioning from a traditional lecture-lab format to a course that will ask the group to design and accomplish a research project related to an aspect of the region's igneous history. This year we'll focus on the Columbia River Basalts (CRB). This is a fascinating province that has kept several professional geologists completely occupied during careers spanning three decades. There is so much more to investigate! By designing the class around a major project, I hope you deepen your relationship to the igneous geology of the Pacific Northwest and learn skills that would help you design and accomplish any research experiment, not just one in igneous petrology. Necessarily, we'll have to omit some material traditionally covered in a petrology class in order to participate in an authentic research experience.

Goals: The goal of the lab portion of the class is to enable you to identify and interpret the geologic history of igneous and metamorphic rocks based on 1) their mineralogy and textures as seen in hand sample and thin section and 2) their chemical compositions.
Specific goals and skills At the end of this course you should be able to:

- interpret the geologic history of igneous rocks based on mineral assemblage and textures using both hand sample and microscope techniques
- design and implement a field sampling campaign
- use a portable X-Ray Fluorescence Spectrometer to collect elemental analyses
- evaluate the quality of data using basic statistics
- use MS Excel to organize, plot, and evaluate the petrogenesis of CRB using elemental data
- explain to a peer how magma is generated in the Earth's mantle
- explain at least three ways magma typically evolves en route to the surface
- interpret isotopic composition diagrams to identify continental, mantle contributions to a magma
- predict what suites of igneous and metamorphic rocks should be found in different plate tectonic settings

Text: J. Winter, An Introduction to Igneous and Metamorphic Petrology, 2001, Prentice Hall.

Additional texts: Bring your mineralogy text from last semester to all labs except field trips. WTG refers to Williams, Turner, Gilbert's book Petrography which is the source of some lab reading assignments. This text is available in the classroom.. The classroom has several additional reference texts including copies of Petrography of Igneous and Metamorphic Rocks by Philpotts and An Introduction to the Rock-Forming Minerals by Deer et al. The former is helpful for seeing examples of minerals and texture in thin section, whereas the latter has a list of the optical characteristics of various minerals. Please leave these in Sci. 112 or 114 (microscope room).

Web resources: webmineral.com,
http://www.science.smith.edu/departments/Geology/Petrology/default.html (compiled by John Brady - great stuff)

Videos: We will look at short excerpts from one or more of the following videos.
Lava flows and lava tubes
The Eruption of Mt. St. Helens
Texturing of Rocks in the Earth's Mantle

Other resources: John Winter's website is still operational and has Min-Pet links, Text support (this is mainly replaced by the 2nd ed. changes posted on CLEo), and **most importantly POWERPOINT lecture files** under Petrology.

Grading:

Lab and class activities not related to the project: 45%

Lab quizzes: 10%

Project: 25%

Exam I: 10%

Final Exam: 10%

Class project: The class project will focus on original research of a local Columbia River Basalt using the portable X-Ray Fluorescence spectrometer (PXRF). The write-up of the class project will be completed individually and will include field description of the locality; sampling protocol, data table (compiled by group), major and trace element figures (compiled by group), and your interpretation of the petrogenetic history of the feature based on your analysis of the figures. I will provide access to a comparative database of CRB and to many pertinent publications.

Academic honesty: All of my classes have the same policy; I don't anticipate any issues coming up this semester. Most labs, I expect or encourage you to work with a partner, however your answers need to be your own, not copied from your partner. Obviously take-home exams are an individual endeavor, and I'll ask that you sign an honor statement. Cheating or plagiarism in this class will be rewarded 1) with a grade of zero on the pertinent assignment or exam, 2) with a report to the Dean of Students, and 3) possibly greater penalty. If this is a second transgression, the case will be referred to the Board of Review and the Dean of Students; they may recommend more serious consequences. By cheating I refer to looking at a neighbor's work or the use of an unauthorized aid of any kind on an examination, quiz, or assignment. Please see http://www.whitman.edu/content/academic_resources/rights-and-responsibilities/academic-dishonesty-and-plagiarism for a complete definition of plagiarism. If you are uncertain how best to indicate a reference to someone else's idea, writing, etc…, please ask me.

**I am awaiting confirmation from the guest speaker, and the timeline of the class project will depend largely on the weather. Detailed reading assignments will be given in class and will generally not encompass entire chapters. THIS SCHEDULE WILL CHANGE AS THE SEMESTER PROGRESSES.

Class	Date	Topic	Reading	Lab topic	Lab reading
Week 1	Jan 14-17	Optical- biaxial minerals; Fundamental concepts	Nesse p. 133-151; Ch 1	Lab 1 Biaxial minerals	
Week 2	Jan 22-24	*No class Monday* Rock classification; Intrusive textures	Ch 2 Ch 3	Lab 2 Mafic intrusive rocks Read LMI chapt.	Ch 3 and WTG 161-171
Week 3	Jan 28-31	Volcanic textures; Thermo and phase diagram review	Ch 3	Lab 3 Mafic volcanic rocks	Ch 3 and WTG 138-47, 188-191, 260-274
Week 4	Feb. 4-7	Ternary phase diagrams M-Di-An-Fo T-review and Still Th-Fo-An-Q	Ch 6, 7	Lab 4 – Field or Intermediate rocks	
Week 5	Feb 11-14	M-CRB, T-XRF, Th-sick – next year cooling Long & Wood and Philpotts and Burkett papers	TBA	Project – field day	Stillwater question
Week 6	Feb 19-21	T-ME, Th-M&M	Ch 10	Project – field day	
Week 7	Feb 25-28	M-M&M project – questions?, Inflated flows, Magma generation T- discuss_Self et al paper, Reidel, 1998; Lab-Data evaluation - ME Th-M&M, project day	Rollinson Ch 2; Ch 8	Project – Data evaluation	
Week 8	March 3-6	Trace elements	Ch 9 to pg 165; Ch 11 to pg 210	Project – Data interpretation	
Week 9	March 24-27	Isotopes Forum – project discussion and reports due (March 27)	Ch 9; Ch 11 pg 211-213	Lab 5 - Felsic intrusive rocks	
Week 10	March 31-April 3	Isotope exercise	TBA	Lab 6 – Felsic volcanic rocks	
Week 11	April 7-10	M-Isotopes T-hotspots, ridges, SZ Th – Wolff paper discussion	Wolf reading	Lab 7 Metamorphic rocks - contact	
Week 12	April 14-17	M- Protoliths, metm zone, isograds. T- no class Th - Classification and textures of metamorphic rocks	M: p. 422-432; Th: Ch 22 p. 433-439	NO LAB – Undergrad conference	

Week 13	April 21-24	M – Textures of high strain, regional metm. T: same Th – Metm reactions and mineral assemblages	Ch 23, p 477-481	Lab 8 Mafic metm rocks	Ch 25
Week 14	April 28 - May 1	Chemographic diagrams (ACF, AFM, AKF); Metamorphism of pelites	Ch 24, Ch 28	Lab 9 – Pelitic metm rocks	
Week 15	May 5-6	M-Review T-Field trip to see metm rx (all day)		Field – metamorphic rocks	
Final	**M May 12**	**9-11 a.m. Final exam (metamorphic topics)**			