**SIO 152: Petrology & Petrography**

Spring 2024

Lecture: Tu/Th 9:30–10:50

Lab: Tu 1–3:50

**Instructor**: Emily J. Chin (Van Allen), Sverdrup 3161, e8chin@ucsd.edu

 Office hours: Monday 10-11am (VH 147)

**TA**: James Muller, Sverdrup 3139, jamuller@ucsd.edu

 Office hours: Wednesdays, time/location TBD

**Final exam**: tbd (during finals week)

This course will cover the fundamentals of igneous and metamorphic petrology. We will examine how magma is generated within the Earth, how it makes its way to the surface, and how it erupts. We will learn how to identify rocks using both hand specimens and optical microscopy techniques. We will also investigate the metamorphism of rocks and the various effects of pressure, temperature, and fluid/melt interaction. The course will also cover basics on isotope and trace element geochemistry and geochronology. The study of igneous and metamorphic rocks will be put into context of tectonic and geologic evolution of the Earth through time. Particular emphasis will be placed on the Western US.

**Learning objectives:**

* Understand the processes responsible for forming igneous and metamorphic rocks
* Understand how the chemical composition, structure, and texture of rocks can be used to interpret past geologic events
* Gain a basic understanding of rock and mineral ID using hand samples and optical microscope skills
* Gain a basic understanding of compiling, analyzing, and manipulating geochemical data using Excel

Textbooks

Essentials of Igneous and Metamorphic Petrology, B. Ronald Frost and Carol D. Frost, 1st ed (2nd edition is OK, but chapter numbers differ) – hereafter “F&F”

Lab Textbooks (copies of these will be available in lab):

* Introduction to Optical Mineralogy, William Nesse (various editions)
* Petrography: An Introduction to the Study of Rocks in Thin Section, (2nd edition, 1982), Williams, Turner, and Gilbert, W. H. Freeman & Co.
* An Introduction to the Rock-Forming Minerals, (2nd edition), Deer, Howie, and Zussman, Pearson Prentice Hall
* A lab manual will also be provided. Do not distribute lab manual outside of class.

**Required lab materials:**

B and HB pencils, erasers

Set of colored pencils (12)

(optional) set of fine-liner pens (e.g., Sakura Micron)

(optional) white drawing/sketch paper

\*A limited amount of drawing supplies will be available during lab. Students are strongly recommended to purchase their own pencils and colored pencils.

**Grade breakdown:** 15% midterm, 15% final, 30% lab, 15% homework, 15% final presentation, 10% quiz

**Grading policy:** Midterm and final will be closed book and will take place during the normal lecture period. Exams should not take more than the allotted lecture time (1 h, 20 min). “Cheat sheets” will not be permitted. We will have 4 microscope-based labs. The remaining labs will be problem sets and will likely involve significant use of a spreadsheet program like Excel. For microscope labs, students are expected to use the full lab period to complete the lab. Additional time may be needed and can be arranged with the instructor or TA. For problem set labs, students are highly encouraged to do these during the full lab period as the instructor and TA will be around to help.

Microscope-based labs will be graded primarily on effort and thoroughness – this means complete and detailed documentation, illustration, and annotation of samples. Problem-set labs, as well as homework, will be graded more “strictly” as answers to the questions are more quantitative than lab observation. Quizzes will be sporadic and in-class. Final presentation will be a 12-15 minute talk on a topic (to be chosen around midterms). Presentation will be graded on a rubric which will be distributed prior to the presentation dates.

If you miss a lab, you can make it up one week after the missed lab (you must turn in the late lab at the end of that week). If you need additional time/help, please see the TA to schedule extra time. You are allowed one late lab and one late homework without penalty. Subsequent missed labs will have 20% of the points taken off. In extenuating circumstances (medical, family emergencies), this policy will be waived, but students need to communicate with the TA and instructor to the best of their ability about any emergencies.

**Academic Integrity:** Everyone at UC San Diego is responsible for upholding academic integrity. Please review the university policy on Academic Integrity here: <https://academicintegrity.ucsd.edu/process/policy.html>
Cheating, lying, copying another student’s work, and other forms of academic dishonesty will not be tolerated. Violation of Academic Integrity on an assignment or exam will result in an automatic 0 on that assignment or exam, a potential F in this course, as well as mandatory reporting to the university Academic Integrity office. Students are allowed to work together (and this is highly encouraged) on labs and homework assignments, but all worked turned in by a student must be their original work. This includes computer spreadsheets – you can work together on one person’s computer to figure out a problem, but you must turn in your own spreadsheet and work. Assignments and labs that contain text, figures, and/or images created using generative AI (e.g., ChatGPT) are not allowed and will result in an automatic 0 on that assignment.

**How to do well in this course:** In this petrology course, you will draw on knowledge from your other geology courses, especially mineralogy, geochemistry, and structural geology/tectonics. Many times, a petrological problem will not have one “right” answer (in fact, this is how science works!). However, we come up with potential solutions to these problems through a combination of careful, thoughtful observation (looking at the rocks), interpretation of what we see using what we know from theory (thermodynamics, physics, chemistry) and lab experiments (experimental petrology), as well as experience and synthesis from disparate sources of knowledge. A future analysis may prove use wrong, and this is fine. To do well in this course, you should:

* Come to lecture having already done the assigned reading. I can’t stress this enough. Much of the things we discuss in lecture are meant to flesh out what you’ve read beforehand. Think of lecture as the tip of the iceberg; you should be coming to lecture prepared with questions, thoughts, comments.
* Make good use of the lab period. Document and draw what you see; use the provided mineralogy and lab manuals and texts to help you figure out what you’re looking at. A lot of petrography is digging deeper into the material and trying to infer what a mineral or rock texture is instead of doing a simple google search. This takes time, but you’ll emerge with a deeper understanding.

**Lecture & Weekly Lab Schedule (subject to change, advance notice will be given)**
M = microscope lab
PS = problem set lab
EoC = end of chapter

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Date | Topic | Reading | Lab | Homework |
| Wk 1 | 4/2 (T) | Melting, magmatic structures & textures | F&F Ch. 1 | Scientific Drawing (M1) |  |
| 4/4 (Th) | Properties of silicate melts, Bowen’s reaction series & BADR⭐️Excel Power Hour ⭐️ | F&F Ch. 3 |  | EoC problems,Mineral Formula HW |
|  |
| Wk 2 | 4/9 (T) | Rock Chemistry | F&F Ch. 4 | Basalts & Gabbros (M2) |  |
| 4/11 (Th) | Phase Diagrams | F&F Ch. 2 |  | EoC problems |
|  |
| Wk 3 | 4/16 (T) | Basalts & mantle melting | F&F Ch. 5 | Finish up Lab M1, M2 |  |
| 4/18 (Th)\* | Oceanic magmatism\*  | F&F Ch. 6 |  | EoC problems |
|  |
| Wk 4 | 4/23 (T) | Convergent margin magmatism | F&F Ch. 7 | Intermediate Rocks (M3) |  |
| 4/25 (Th) | Convergent margin magmatism | F&F Ch. 10 |  |  |
|  |
| Wk 5 | 4/30 (T) | Midterm- presentation topics due - |  | Ol-liq equilibria (P1)  |  |
| 5/1 (Th) | Isotopes & radiometric dating | tbd |  | Geochronology HW |
|  |
| Wk 6 | 5/7 (T) | Intra-continental magmatism | F&F Ch. 9 |  | EoC problems |
| 5/9 (Th)\* | Recorded lecture: peridotites, kimberlites\* |  |  |  |
|  |
| Wk 7 | 5/14 (T)\* | TBD |  | REE modeling (P2) |  |
| 5/16 (Th) | Intro to metamorphic rocks | F&F Ch. 11 |  |  |
|  |
| Wk 8 | 5/21 (T) | Metamorphic facies | F&F Ch. 13 | Metamorphic rocks (M4) |  |
| 5/23 (Th) | Thermobarometry | F&F Ch. 14 |  | EoC problems |
|  |
| Wk 9 | 5/28 (T) | Metabasites | F&F Ch. 15 | Finish up Lab M4 |  |
| 5/30 (Th) | Metapelites & metacarbonates | F&F Ch. 16 |  |  |
|  |
| Wk 10 | 6/4 (T) | Regional associations & Rocks through geologic time | F&F Ch. 18 | Student presentations I |  |
| 6/6 (Th) | Student presentations II |  |  |  |