

# INTRODUCTORY IGNEOUS AND METAMORPHIC PETROLOGY

## GEOL 308 - Spring 2024

### *Syllabus for Lecture and Laboratory*

**Lecture room:** Exploratory Hall L505

**Lecture time:** MW, 1:30-2:45 PM - Lab time: M 3 – 5:45 PM

**Instructor:** G. Mattiotti, PhD **E-mail:** gkysar@gmu.edu

**Office Hours:** Wednesday 3:30 to 5:30 PM

**Instructional Material:** John D. Winter, principles of igneous and metamorphic petrology. The textbook is available from: <https://www.pearson.com/us/higher-education/program/Winter-Principles-of-Igneous-and-Metamorphic-Petrology-2nd-Edition/PGM146492.html>

The textbook is out of print, so a used one and/or sharing the textbook is fine. Make sure you are buying the book by Winter, there are Petrology textbook with the same title but by other authors. Handouts and other course materials distributed through Blackboard.

### **Course Objectives and Goals**

This is a junior-level igneous and metamorphic petrology course, designed to give students the knowledge and skills for identifying and classifying igneous and metamorphic rocks, and interpreting their petrogenesis in the tectonics context.

By the end of this course, students who applied themselves to the study of Petrology should be able to:

- To understand the formation and evolution of igneous and metamorphic rocks and their relationship to their structures and tectonic context.
- To understand the general petrogenetic reactions and place these reactions in a PTX context,
- To identify and classify igneous and metamorphic rocks samples at macroscopic and microscopic and through geochemistry.
- To use petrochemistry databases to analyze and interpret analytical data in their tectonic context.

### **Course Prerequisites**

This is an upper level geology class for geology, chemistry, and chemical engineering majors. The topics discussed in this class require a basic solid knowledge of mineralogy and chemistry. The class covers a significant amount of material so you should not assume that topics will be reviewed starting at the basic level. A grade of C or higher in mineralogy is required. Students enrolled in this class should have already successfully taken a general chemistry course.

### **Course requirements and grading**

*While attendance is not mandatory, the course is intensive; missing class may result in falling behind the fast pace of this class. Hence, try your best not to miss any class.*

Course Assessment is based on the results of three 3 lecture exams laboratory exercises, one final project and two lab exams. Each assessment component contributes as follows to the final grade:

- **3 lecture exams** and 1 final project – For a total of 75% of the final grade (exam 1: 24%, exam 2: 20%, exam 3 25% final project 6%). The exams are non-cumulative.
- **Lab portion: 25% of the course.** Laboratory exercises consists of 10 exercises that can be carried out collaboratively, but submissions are individual for each lab. The Laboratory portion of the class includes 2 laboratory exams on petrographic analysis of igneous and metamorphic rock specimens. The lab exercises contribute cumulatively to 16% of the final grade, lab exam 1: 6%, lab exam 2 3%), Lab exams are non-cumulative.

Unless otherwise indicated, all laboratory assignments are by the end of the lab. Details of the laboratory assignments are distributed in class. Penalty for late submission is 10% of the score.

**Final grade is assigned based on the following scale, with no exceptions:**

A+ ≥ 99%, 94 ≥ A < 99%, 90 ≥ A – < 94%; 85 ≥ B+ < 90%; 80 ≥ B < 85%; 77 ≥ B- < 79%; 73 ≥ C+ < 77%; 70 ≥ C < 73%; 65 ≥ C- < 70%; 50 ≥ D < 65%; F < 50%

- No lowest exam score dropped.
- No final curve, unless the end-of-semester final MEDIAN for the whole class (based on all lecture exams and lab scores) falls below 80%
- Absence/fail to submit an exam will result in a 0 (zero) score for that exam. No make-ups granted unless evidence of extenuating circumstances is provided. Make ups carry a 10% penalty.
- No Extra-credit available. Extra-credit based on individualized assignment is not available under any circumstance. The course is intensive and content heavy, there is no time for extra credit.
- There are no field trips planned for this course

## **Course Policies**

*Read CAREFULLY this syllabus. By staying enrolled in this course, you agree to the following course policies:*

- **Attendance:** not mandatory, but highly recommended if you want to do well.
- **Communications: Email is the only official way** of communicating with students. Any email from me will come from gkysar@gmu.edu or through blackboard. In accordance with protection of privacy best practices, I will not respond to email sent from non-GMU email accounts. It is your responsibility to make sure that your GMU email is set up properly and to check your email regularly. Your email must have a subject line because emails without subject are filtered as spam mail.
- **Class etiquette:** All students in attendance have the right to a safe and quiet learning environment. Respect all rules and regulations established by GMU (see university policies below). Come to class on time and if you must leave earlier do so in a way that will not disturb the other people present in the room. During class, mute your cell phones. Class disruption of any sort will not be tolerated.
- **Extenuating circumstances** might occur that prevent you from taking an exam. If such circumstances can be justified, a make-up session with no penalty is available. NOTE CAREFULLY THE DAY OF THE EXAMS; if you realize that you cannot take an exam as scheduled, inform the professor immediately. As per GMU policy on religious festivities, you must inform the instructor at the beginning of the semester if you will be absent from an exam in order to schedule a make-up.
- **Course materials:** all course material distributed to students is protected by U.S. copyright law and/or is intellectual property of the course instructor; you cannot repost this material on the web, on online study sites or distribute in any other format outside the class.

## **University policies**

*As GMU student, you are required to be aware of all policies set by the University that affect you. The following are some of the GMU policies most pertinent to our course.*

- **Privacy** is covered by the [Family Educational Rights and Privacy Act \(FERPA\)](#) and is an essential aspect of this course. Students must use their GMU email account to receive important University information, including communications related to this class. In accordance with FERPA regulation, I will not respond to messages sent from a non-GMU email address.
  - **The Honor Code** is an integral part of the educational process, and GMU takes these matters very seriously. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, cheat during exams and in other ways outlined in the [Honor Code](#). Students accused of academic integrity violations should contact the Office of Academic Integrity to learn more about their rights and options in the process. Outcomes can range from failure of assignment to expulsion from the University, including a transcript notation. The Office of Academic Integrity maintains a permanent record of the violation. For more information, please refer to the [Office of Academic Integrity website](#).
  - Be aware of the issues related to the use of study sites, refer to the instruction from the **Office of Academic Integrity** with important information about study sites. All students must watch this video: <https://youtu.be/oKbTrgBCN7c>
  - **TITLE IX** – Keep in mind that the professor is required to report all disclosures of sexual assault, interpersonal violence, and stalking to GMU-Title IX coordinator at <https://diversity.gmu.edu/title-ix> If you wish to speak with someone confidentially, contact the Title IX office at <https://diversity.gmu.edu/title-ix/who-can-i-call>
  - **Disability Services.** <https://ds.gmu.edu/> Any student who may need an accommodation based on the potential impact of a disability should contact Disability Services [ods@gmu.edu](mailto:ods@gmu.edu) to establish eligibility and to coordinate reasonable accommodations. In order to receive accommodation for exams students must submit their DS paperwork before the exam.
  - **Counseling and Psychological Services** <https://caps.gmu.edu/> GMU offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success.
  - **Diversity and Inclusion:** <https://diversity.gmu.edu/diversity> Faculty, staff and students in this course welcome and value individuals and their differences including race, economic status, gender expression and identity, sex, sexual orientation, ethnicity, national origin, first language, religion, age, and disability.
  - **Observance of religious holidays.** In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance if that should coincide with an exam. For details and policy, see: <https://ulife.gmu.edu/religious-holiday-calendar/>
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## Course Calendar\*

- This calendar displays dates of lectures and labs only. See Academic Calendar for standard holidays.
- Notes and reading assignments for each lecture/lab are posted on blackboard the day before class

Date	Lecture topic	Laboratory
Jan 17	Phase diagrams, single and two components. Solid solution, Eutectic, Peritectic and Solvus.	
Jan 22	Multiple components magmatic systems	Lab 1 - What previous knowledge and skills do you need for this course. Practice with Phase diagrams
Jan 24	Chemical petrology of major elements oxides – TAS, Harker and Fenner diagrams. CIPW Normative classification	
Jan 29-31	Chemical petrology of trace elements. Goldschmidt rules. Variation chemical diagrams for magmas	Lab 2 – Classification of igneous rocks using CIPW and Modal classification. Review of identification of minerals in hand sample and thin section.
Feb 5	Chemical petrology of isotopes	Lab 3- Petrography: mafic and ultramafic rocks. Phaneritic textures
Feb 7	Conditions for formation and evolution of magmas.	
Feb 12	Review of igneous structures of emplaced magmas: intrusive, extrusive, flows and falls	Lab 4- Petrography: mafic and ultramafic rocks. Aphanitic and porphyritic textures
Feb 14	Review - Q&A session for exam 1	
<b>Feb 19</b>	<b>LECTURE EXAM 1</b>	Lab 5 - Petrography: Intermediate compositions: phaneritic, aphanitic and porphyritic textures
Feb 21	Petrology of tectonics environments - Oceanic Basalts: Ridges and Rises. Komatiites and ophiolites	
Feb 26	Hot spot magmatism in oceanic environments – volcanic islands	Lab 6 - Petrography: Felsic compositions: phaneritic, aphanitic and porphyritic textures
Feb 28	Convergent plate magmatism: volcanic arcs	
Mar 4-10	<b>SPRING RECESS</b>	

Mar 11	Continental magmatism: rocks mantle plumes CRB-Yellowstone	Lab 7: Petrography of Pyroclastic rocks
Mar 13	Continental magmatism: kimberlites - Carbonatites	
Mar 18	Layered Mafic Intrusions and Granitoids	Lab 8 - Introduction to IGPET software and database use. Reminder of lab time is used to review in preparation of lab exam 1 – Review for lab exam 1
Mar 20	Q&A for exam 2	
<b>Mar 25</b>	<b>LECTURE EXAM 2</b>	<b>LAB EXAM 1</b>
Mar 27	Database used for petrology research. Introduction to petrology project	
Apr 1	Metamorphic phase diagrams Geothermobarometers	Lab 9: introductions to petrographic analysis of metamorphic rocks – Metamorphic minerals
Apr 3	Metamorphism of mafic and ultramafic rocks	
Apr 8	Metamorphism of Pelitic Rocks	Lab 10: Metamorphic textures - Analyses of metamorphic rocks in thin section
Apr 10	Metamorphism of Carbonates	
Apr 15	The role of fluids, metasomatism	Review of how to prepare chemical petrology diagrams.
Apr 17	Metamorphic Associations	
Apr 22-24	Petrology project work week – No class this week – students receive individualized feedback on their project while they work at it.	
Apr 29	Q&A for exam 3 – Petrology project due today	Time to wrap up project – Due today
<b>May 1</b>	<b>FINAL EXAM = Exam 3 lecture and lab exam 2: 1:30 to 4:15 PM</b>	

*\*Lecturer reserves the right to change lecture topics to fit class needs and learning objectives*