

## EAS 332 - METAMORPHIC PETROLOGY

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### COURSE OBJECTIVES

The main objectives of the course are as follows:

- 1) To gain a basic understanding of the petrographic and petrologic techniques used to study metamorphic rocks.
- 2) To gain first hand experience in the identification and classification of metamorphic rocks in hand specimen and thin section.
- 3) To put metamorphic rocks into a larger geologic and tectonic context.

### TEXTS

Winter, J.D. (2010) *Principles of Igneous and Metamorphic Petrology*. Pearson , Upper Saddle River, New Jersey. (required)

Yardley, B.W.D. (1989) *An Introduction to Metamorphic Petrology*. Longman Scientific and Technical. Essex, London. (reference)

Yardley, B.W.D., MacKenzie, W.S. and Guilford, C. (1990) *Atlas of metamorphic rocks and their textures*. Longman Scientific and Technical. Essex, London. (reference)

Spear, F.S. (1993) *Metamorphic Phase Equilibria and Pressure-Temperature-Time Paths*. Mineralogical Society of America Monograph. (reference)

### GRADING

Laboratory reports	15%
Laboratory mid-term	12.5%
Laboratory final	12.5%
Problem Sets	10%
Mid-term exam	20%
Final exam	30%

# EAS 332 Course Outline - Metamorphic Petrology

## Lecture Topic

## Reading

### Preliminaries

- objectives of course
- texts
- grading
- course outline

### Introduction

- definition of metamorphism
- main types of metamorphism
- metamorphic processes
- metamorphic variables
- metamorphic minerals
- classification of metamorphic rocks
- metamorphic textures

Winter chapter 21 (21.1-21.5)  
Winter chapter 22  
Winter chapter 23 (23.1-23.2, 23.4-23.6)

### Chemical equilibria as applied to metamorphism

- introduction to chemical thermodynamics
- thermodynamics versus kinetics
- phase rule
- phase diagrams
- graphical techniques
- metamorphic reactions
  - graphical representation
  - types of reactions
- metamorphic facies
- Gibbs free energy
- quantitative estimates of pressure and temperature
  - slopes of reactions (geothermometers and geobarometers)
  - discontinuous and continuous reactions

Winter chapter 24 (24.1-24.3.2)  
Winter chapter 25 (25.1)  
Winter chapter 27 (27.1, 27.3, 27.4.0)  
Winter chapter 26 (26.3, 26.5)

## **Midterm Exam- Tuesday, February 23**

### Metamorphism of pelites

- definition of pelites and possible protoliths
- AFM diagrams
- low and medium grade Barrovian sequence
  - effect of changing Fe/Mg ratio
- high grade Barrovian sequence
  - partial melting and migmatites
  - assemblages and textures of low pressure metamorphism
- petrogenetic grid
- bathozones and barric types
- geothermometers and geobarometers in pelites

Winter Chapter 28  
Winter Chapter 27 (27.4.1-27.4.2)

## EAS 332 Course Outline - Metamorphic Petrology - (continued)

<u>Lecture Topic</u>	<u>Reading</u>
<b><u>Metamorphism of mafic rocks</u></b> <ul style="list-style-type: none"><li>- protoliths and chemical composition</li><li>- mechanisms for hydration of basaltic rocks</li><li>- ACF diagrams</li><li>- Barrovian sequence</li><li>- granulites</li><li>- blueschists and eclogites<ul style="list-style-type: none"><li>- mineralogy</li><li>- lawsonite and epidote blueschist subfacies</li><li>- subduction zone metamorphism</li></ul></li></ul>	Winter chapter 25 (25.3)
<b><u>Metamorphism of calcareous rocks</u></b> <ul style="list-style-type: none"><li>- protoliths</li><li>- marbles and calc-silicate<ul style="list-style-type: none"><li>- role of fluids (internal and external buffering)</li><li>- an example of internal buffering from the Alps</li><li>- an example of external buffering from Ontario</li></ul></li><li>- skarns</li></ul>	Winter chapter 26 (26.4) Winter chapter 29 (29.1)
<b><u>Metamorphism and tectonics</u></b> <ul style="list-style-type: none"><li>- heat sources for metamorphism</li><li>- paired metamorphic belts</li><li>- P-T-t paths</li><li>- continental collision zones</li></ul>	Winter chapter 21 (21.6)

### LABORATORY SCHEDULE

Labs begin the week of Jan. 11

1. Metamorphic minerals and classification of metamorphic rocks in hand specimen
2. Metamorphic minerals and textures
3. Pelites I
4. Pelites II
5. Lab Midterm (week of February 8)
6. Pelites III
7. Mafics and ultramafics
8. Blueschists and eclogites
9. Marbles and calc-silicates
10. Lab Final

### **A message from the University:**

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at <http://www.uofaweb.ualberta.ca/tie/>) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.