

**EAS 466/566**  
(Petrogenesis)  
**Cratons, Kimberlites and Diamonds**

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**Course Objectives:**

This course will introduce concepts in mantle petrology and geochemistry, volcanology, and diamond research that form the basis of modern exploration strategies for kimberlites and diamonds. Emphasis is placed on gaining an understanding of the basic scientific principals that underlie target area selection and exploration.

**Instructor:**

Thomas Stachel  
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**Office Hours:**

Wednesday, 15:00-16:00 (or by appointment)

**Lectures:**

Lectures: ESB 4-9  
Tue, Thu  
17:30 - 18:55

**Some lectures will be presented by experts from industry and require flexible scheduling (i.e. possibly different weekdays).**

**Labs:**

ESB 3-4 (Mineralogy Lab): Tue or Thu (depending on lab number), during regular lecture hours

No lectures/labs:

Reading Week: 16.2 and 18.2

## **Course Mark-Weight Distribution:**

**50% Final Exam**

**30% Labs**

**20% Report: Indicator Mineral Assessment**

Individual components of the course will be given a numerical mark. Note that the standard letter grading system will be used for the final evaluation of course performance. The grading system will be applied using a combination of absolute achievement and relative standing in the class.

### **Exam:**

Thursday, April 8<sup>th</sup>, 2009, Room to be announced, 17:30 - 19:55

### **Report: Indicator Mineral Assessment**

You will receive indicator mineral chemistry data sets from non-disclosed locations. Based on these data you will prioritize the different properties for next year's field season. Your prioritization will be justified in a brief report (2 pages text plus figures and references) and should include typical indicator mineral classification plots for all data sets.

The assignment is due April 1<sup>st</sup>.

### **Graduate students**

Graduate students enrolled in EA566 will be given an additional assignment. This assignment carries a mark-weight of 20% (the weight of all other components will be lowered correspondingly).

- Geological evolution of the Churchill Province and associated diamond deposits
- Geological evolution of the Superior Province and associated diamond deposits

Three pages text plus references and figures.

## **Course Outline:**

### ***Lecture Topics***

#### **1. Earth's mantle**

Origin of Earth's mantle; Primitive mantle composition; Mineralogy of Earth's mantle; Peridotite xenoliths; Origin of cratonic lithosphere; Eclogites, pyroxenites and megacrysts; Geothermobarometry.

#### **2. Kimberlites and Lamproites**

Historical, definitions, mineralogy; Petrology (origin of kimberlites and lamproites); Mineral and whole rock chemistry; Isotope geochemistry; Spatial and temporal distribution.

#### **3. Volcanology**

Types of Pyroclastic Rocks (air fall, surge and flow); Emplacement of kimberlites and lamproites; Description of pyroclastic rocks.

#### **4. Kimberlite Exploration**

Indicator minerals and geochemical assessment of diamond potential.

#### **5. Diamonds and their sources in Earth's Mantle**

(1) Morphology, surface features, nitrogen in diamond, color centers;

(2) Microdiamonds in exploration

(3) Inclusion in diamonds: suites, major elements, trace elements, geothermobarometry, diamond recipes, fO<sub>2</sub>, ages;

### ***Laboratories***

Seven practical sections will be in lieu of seven regular lectures. Assignments should be completed and handed in at the beginning of the Tuesday lecture in the following week.

Lab 1: Petrography of peridotites

Lab 2: Petrography of eclogites and pyroxenites

Lab 3: Geothermobarometry (**bring laptops!**)

Lab 4: Petrography of kimberlites

Lab 5: Petrography of pyroclastic rocks

Lab 6: Kimberlite indicator minerals

Lab 7: Diamonds

## **Reference Texts (basic reference texts):**

### **Kimberlite magmatism and mantle xenoliths**

- Dawson JB (1980) Kimberlites and their xenoliths. Springer, Berlin, p 252
- Harte B (1977) Rock nomenclature with particular relation to deformation and recrystallisation textures in olivine bearing xenoliths. *J Geol* 85: 279-288
- Mitchell RH (1986) Kimberlites: mineralogy, geochemistry, and petrology. Plenum Press, New York, p 448
- Mitchell RH (1991) Kimberlites and lamproites: Primary sources of diamond. *Geosci Can* 18(1):1-16
- Pearson DG, Canil D, Shirey SB (2004) Mantle samples included in volcanic rocks: xenoliths and diamonds. In: Carlson RW (ed) *Treatise on Geochemistry. Volume 2: The Mantle and Core*, Elsevier-Pergamon, Oxford, pp 171-275

### **Kimberlite emplacement and pyroclastic rocks**

- Cas RAF, Wright JV (1987) *Volcanic successions*. Allen & Unwin, London, p. 528
- Field M, Scott Smith BH (1999) Contrasting geology and near-surface emplacement of kimberlite pipes in Southern Africa and Canada. In: Gurney JJ, Gurney JL, Pascoe MD, Richardson SH (eds) *The J.B. Dawson Volume, Proceedings of the VIIth International Kimberlite Conference*, Reed Roof Design, Cape Town, pp 214-237
- Lorenz V, Zimanowski B, Büttner R, Kurszlaukis S (1999) Formation of kimberlite diatremes by explosive interaction of kimberlite magma with groundwater: field and experimental aspects. In: Gurney JJ, Gurney JL, Pascoe MD, Richardson SH (eds) *The P.H. Nixon Volume, Proceedings of the VIIth International Kimberlite Conference*, Reed Roof Design, Cape Town, pp 522-528
- Schmincke HU (2004) *Volcanism*. Springer, Berlin, p 324

### **Diamonds**

- Gurney JJ (1989) Diamonds. In: Ross J et al. (eds) *Kimberlites and related rocks*. GSA Spec Publ 14, vol Vol 2. Blackwell, Carlton, pp 935-965
- Wilks J, Wilks E (1991) *Properties and applications of diamond*, Butterworth-Heinemann Ltd, Oxford, p 525

## **Specialized Support and Disability Services**

Students who require accommodations in this course due to a disability affecting mobility, vision, hearing, learning, or mental or physical health are advised to discuss their needs with Specialized Support and Disability Services, 2-800 Students' Union Building, 492-3381 (phone) or 492-7269 (TTY).

## **Miscellaneous**

Policy about course outlines can be found in Section 23.4(2) of the University Calendar.

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 Behavior (online at <http://www.uofaweb.ualberta.ca/governance/studentappeals.cfm>) and avoid any behavior 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.