Syllabus: GEOS F600-F01 Fall 2006 CRN 71759

Introduction to X-ray Spectrometry

Ken Severin X5821 • Email FNKPS@UAF.EDU • Room 324 NSF

After completing this course the student should be able to critically evaluate electron microprobe and x-ray fluorescence (XRF) analyses of materials. Students will be exposed to the theoretical and practical aspects of obtaining microprobe and XRF analyses.

Lectures will deal mainly with the theoretical aspects of x-ray spectrometry, while labs will focus on the mechanics of obtaining analyses from the electron microprobe and XRFs housed in the Department of Geology and Geophysics. At the conclusion of the course the student will present (via a 10 minute talk and 8-10 page paper) an analytical protocol that uses one or both of these techniques. Do not get the project for this class confused with a project where you are making scientific interpretations based on the data: For GEOS F600 you should be concerned with the quality of the data. To encourage this, you are limited to the analysis of three final project samples until you have a draft of your final paper approved. Notice that in the vast majority of cases the quality of the data you need is determined by the problem you are studying. No one has a big enough checkbook to get "the absolute best data" and rarely is "the absolute best data" even definable. You are welcome to use any data you gather in this class for any other classes you are taking (but if you are going to use the data commercially, talk to me first). Talks are open to the general community, expect written and oral comments from classmates and others. You will be expected to understand both the precision and the accuracy of your analyses, and to understand how your analyses are affected by sample preparation, beam (electron or x-ray)-sample interactions, and analytical conditions.

Lectures: Mondays, 2:15-4:15, 237 Natural Sciences Facility (unless otherwise noted!)
Labs: each student will have one scheduled three-hour lab session/week which meets somewhere around the Microprobe Lab, 156A NSF. Labs will be scheduled at the first class. Students will typically need 3-6 hours of additional lab time per week.

	Lecture	**Laboratory**
Sept. 11	Electron microprobe and XRF overview / organizational stuff	Lab Tour and orientation Basic probe operation
Sept. 18	Characteristics/terminology of X-ray spectra	EDS-XRF
Sept. 25	X-ray/solid interaction - mass absorption coefficients	WDS-XRF semi-quant LAB1 (EDS-XRF) Due
Oct. 2	X-ray Fluorescence Analysis **Quiz 1**	WDS-XRF full-quant
Oct. 9	Electron Microprobes	More probe LAB2 (WDS-XRF) Due
Oct. 16	Error Analysis/ Counting Statistics	Thin Sections / Sample Prep
Oct. 23	Probe for Windows	Probe LAB3 (XRF-ID) Due
Oct. 29	Elemental Mapping and Digital Imaging **Quiz 2**	Probe LAB4 (PROBE-STATS) Due
Nov. 6	X-ray Detectors	Probe

	Lecture	**Laboratory**
Nov. 13	Electron/solid interaction - implications for electron microprobe analysis.	Probe LAB5 (PROBE-IMAGE) Due **Final Project must be approved by Nov. 20**
Nov. 20	Bence Albe Correction Methods **Quiz 3**	Final Projects
Nov 27	Electron Microprobe Quantitative Methods Paper Review, published and other classes **Quiz 4**	Final Projects LAB6 (PROBE-Analytical Routine) Due
Dec. 4	Student Presentations Last day to turn in draft of final paper if you want comments.	***FINAL PAPER DUE Dec. 15***

Grading: Your final grade will be based on:
1) Labs (5% Each - Total 30%)
2) Quizzes (7% each - Total 21% - Toss the lowest score, but you do have to take them all)
3) Oral presentation (15%)
4) Term project report (35%)

A 94-100
B 86-93
C 75-85
D 70-74
F <70

Text: Goldstein, JI, Newbury, DE, Joy, DC, Lyman, CE, Echlin, P, Lifshin, E, Sawyer, L, and Michael, JR. 2003. Scanning electron microscopy and X-ray microanalysis. Kluwer Academic / Plenum Publishers, New York. 689 pages plus CD. This is the third edition, so don't get the wrong one. There are several similar books from the same group in the library.

Other reading material – much of the material is duplicated from one text to another, but every author presents things slightly differently, so if you have problems with a concept in one it is a good idea to check out the topic in another.

Potts PJ. 1987. Potts PJ. 1987. A Handbook of Silicate Rock Analysis. Blackie. Glasgow, UK. 622 pages. A great reference but WAY pricey (and I think out of print now).

Reed, SJB. 1996. Electron microprobe analysis and Scanning Electron Microscopy in Geology. Cambridge University Press, Cambridge. 201 pages.

Williams, KL. 1987. An introduction to X-ray spectrometry : X-ray fluorescence and electron microprobe analysis. Allen and Unwin, London. 370 pages. Also out of print.

Dr. James Wittke (Northern Arizona University) has a very nice set of notes and references at http://jan.ucc.nau.edu/~wittke/Microprobe/Probe.html

Oxford Instruments (http://www.x-raymicroanalysis.com/pages/main/main.htm) has some nice introductory information on both EDS and WDS as well.