Soil and Environmental Mineralogy

ENR 7530 (Lecture- 32623 (Columbus)/33856 (Wooster), Lab- 32624)

Autumn, 2019

Instructor: Dr. M. Scott Demyan, demyan.4@osu.edu, Kottman Hall 408B

Lecture: Tuesday/Thursday 10:20-11:15 AM, Kottman Hall 333C/Williams Hall Video Link
Lab: Thursday 12:40-3:40 PM, Kottman Hall 423

Soil and environmental mineralogy is the study of the crystalline and non-crystalline inorganic phases of soils, sediments, and other environmental samples which play an important role in many ecosystem processes in the critical zone.

Theoretical: This course will give a broad overview of the fundamentals of mineralogy and importance in agroecosystems, nutrient cycling, carbon storage, water quality, soil development, and formation of clay minerals

Applied: We will undertake proper field sampling and sample preparation. In the lab analytical techniques will include x-ray diffraction (XRD), thermogravimetric analysis/differential scanning colorimetry (EGA/DSC), infrared spectroscopy (IR), total and external surface area, heavy liquid density separation, and thin section micromorphology along with routine soil/environmental sample characterization.

Motivations: In completing this course students will be able to apply mineralogical concepts and methods to their own work resulting in a project proposal which with proper formatting could be submitted for funding consideration to a relevant funding source (e.g. Clay Minerals Society Student Research Grant, Soil Science Society of America, or others). Laboratory data generated during the course could also be used to strengthen the proposal.

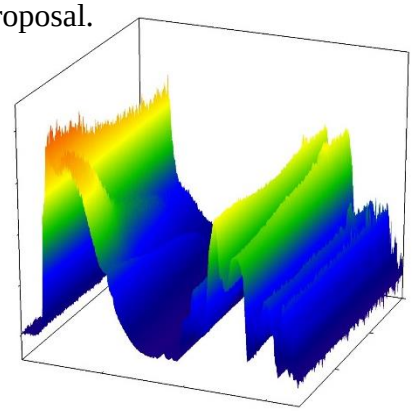

Figure 1.A) Crosby soil exhibiting well developed A-horizon; never cultivated, B) temperature resolved mid-infrared thermogram of soil sample during heating from 25-700°C .

Course goals:

1.) The students will know the major classes of minerals and their genesis relevant in soil and environment contexts.

2.) The students will appreciate how mineral characteristics are linked to different environmental cycles and processes.

3.) The students will learn the theoretical principals behind the main mineralogical analyses.

4.) The students will be able to critically read scientific literature, reports (e.g. soil surveys, lab reports), and data to draw appropriate conclusions.

5.) The students will learn how minerals are or can be used to solve current environmental problems.

6.) The students will be able to think of how mineralogy can be integrated into their own research topic(s).

Prerequisites: graduate student standing or permission of the instructor

Recommended texts:

Texts and readings will be provided via Carmen.

Notes on Field work:

During the first lab session, we will go to Waterman Farm to do soil sampling of a representative soil profile (pedon). For this field trip you will need to wear appropriate clothes and footwear for soils work in potentially hot or wet conditions.

Notes on Lab work:

After the first lab session (which will be in the field), we will be meeting in Kottman Hall 423. Proper attire in the lab for safety regulations is closed toe shoes and pants. You will be provided with personal safety equipment (e.g. gloves, masks, lab coat, safety glasses) when required. Please follow all safety requirements given by the instructor. You should also bring to class a notebook and something to write with to take notes and record measurements. You will be provided with hard copies of the lab procedure materials prior to or during the lab, so there is no need to print those out. They will also be available on Carmen.

Week	Content	Assignments	Learning Outcome(s)
1	Lectures: What is soil/environmental mineralogy? Soil mineral classes Lab: Sampling representative pedon at Waterman Farm	Lecture: Pre-test knowledge assessment on basic soil background information (Tophat link to be emailed) Lab: Pre-test knowledge assessment on basic field characteristics of soil (Tophat link to be emailed)	1.1, 2.1, 2.2, 2.4 3.1, 3.2
2	Lectures: primary minerals, silaceous/quartz Lab: Prepare soil samples (dry, sieve, etc.), ID of primary minerals	Lab: **Notes/reflections from weeks 1 and 2**	3.1, 3.3, 3.4, 3.5, 4.1
3	Lectures: soil organic matter-mineral interactions, carbon permanence Lab: sample pretreatment, routine analyses (pH, CEC, PSA)	Lab: **student lead discussion on pre-lab readings**	3.1, 3.2
4	Lectures: Phosphates (struvite, P-loading in soils) Lab: soil organic matter size/density separation	Brainstorm a problem/open question in own work and one way that soil/environmental mineralogy may be used to solve this problem for an "**elevator speech**"- due Thursday Lab: **Notes/reflections from weeks 3 and 4 -due Tuesday**	3.5 ,6.1 3.1, 3.2, 3.3
5	Lectures: serpentinitic, amorphous/volcanic Lab: XRD1/NIRS	Develop a **lightning talk**- due Thursday Lab: **student lead discussion on pre-lab readings**	1.1, 1.2, 1.3, 3.5 3.2
6	Lectures: kaolinite (ultisols), oxisols Lab: XRD2 (heated/ethylene glycol), Fe, Al, Mn extractions	**Develop scientific questions and related hypotheses** – due Thursday Lab: **Notes/reflections from weeks 5 and 6** – due Tuesday	6.1 3.1-3.5

Week	Content	Assignments	Learning Outcome(s)
7	Lectures: Oxides (Fe-, Al-, Mn-), Maghemite for environmental proxy Lab: measure extracts on ICP/total element analysis XRF	Lecture**: Write a critical review of topical, peer-reviewed article on mineralogy**- due next Tuesday Lab: **student lead discussion on pre-lab readings**	4.2, 4.3 3.2
8	Lecture: open (no Thursday lecture) Lab: (no lab, fall break)	Lab: **Compile 1st lab report**- due Thursday Lab: **Create outline for video journal on selected lab protocol**- due Tuesday	3.1-3.5 3.1-3.3, 4.1
9	Lectures: carbonates (pedogenic, limed, soda waste) Lab: Surface area (BET, EGME), magnetic susceptibility	Lecture: **Complete a brief literature review on own scientific questions developed during week 6**.- due Friday In-class: apply model to environmental case study (XRD/XRF data) Lab: **student lead discussion on pre-lab readings**	3.5, 6.1 2.5, 5.1, 5.2 3.1-3.3
10	Lectures: Acid mine drainage, sulfidic soils Lab: TGA/DSC	Lecture: **Create a scientific blog entry**- due Thursday Lecture: **Formulate the methodological approach to developed scientific questions and provide a timeline**- due Thursday of week 11 Lab: **Notes/reflections from weeks 9 and 10**- due Tuesday	1.1-1.3, 2.1, 3.5, 4.2 6.1, 6.2 3.1-3.5
11	Lectures: advanced techniques (SEM, TEM, Nano-SIMS, atomic force microscopy) Lab: prepare thin sections	Lecture: Funding proposal- due next Tuesday Lab: **student lead discussion on pre-lab readings**	6.1, 6.2 3.1-3.5

Week	Content	Assignments	Learning Outcome(s)
12	Lectures: open Lab: analyze separated fractions in microscope	Lab: **student lead discussion on pre-lab readings**	3.1-3.3
13	Lectures: open Lab: work on video logs	Lab: **Video log due**	3.1-3.3, 3.5, 4.1
14	Lectures: review of funding proposals Lab: view video logs	Lecture: **In the role of a funding review panelist, write a peer review of proposals for funding** Lab: **Final lab report due**	2.1-2.4, 3.1, 3.2, 4.1, 4.2 1.1-1.4, 3.1-3.5, 4.1
Exam week			

Grading: Grades will be based upon the following scale:

A (100—93%)
A- (90-92.9%)
B+ (87-89.9%)
B (83—86.9%)
B- (80-82.9%)
C+ (77-79.9%)
C (73-76.9%)
C- (70-72.9%)
D+ (67-69.9%)
D (60-66.9%)
E (59-0%)

The breakdown of points is as follows:

Participation in lecture/student-led lab discussions	**10%**
Lecture assignments (elevator speech (**5%**), lighting talk (**5%**), scientific blog entry (**5%**), peer review (**15%**)	**30%**
Lab reports (including lab notes/reflections)	**30%**
Funding proposal (including all subparts)	**30%**

Due dates and late assignments: All assignments, unless otherwise noted, should be turned in at the beginning of class on the due date. The grade for late submissions will be lowered by 5% per day unless due to an excused reason.

Academic Misconduct

Academic integrity is essential in maintaining excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the University's Code of Student Conduct, and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the University's Code of Student Conduct and this syllabus may constitute "Academic Misconduct."

The Ohio State University's Code of Student Conduct (Section 3335---23---04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the University's Code of Student Conduct is never considered an "excuse" for academic misconduct. Please review the Code of Student Conduct and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by University Rules to report my suspicions to the Committee on Academic Misconduct (COAM). If COAM determines that you have violated the University's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the University.

Disability

Students with disabilities that have been certified by the Office for Disabilities Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs.