

SOIL GEOMORPHOLOGY FIELD STUDY

Geography 408

Fall Semester, 2009

Instructor: Dr. Randall Schaetzl

Office: 128 Geography Bldg

soils@msu.edu I will always answer my email.

Office Hours: 10:15-12:15 M, W, and by appointment, and after class

Contacts, emergency or otherwise: Ph. 353-7726 (office)

347-0164 (home)

648-0207 (cell)

Texts:

1. Schaetzl and Anderson. 2005. *Soils: Genesis and Geomorphology*. Cambridge Univ. Press. 832 pp.

2. Schoeneberger, P.J., Wysocki, D.A., Benham, E.C., and W.D. Broderson. 2002. *Field Book for Describing and Sampling Soils*. USDA-NRCS, National Soil Survey Center, Lincoln, NE.

Lectures: 7:00 - 8:50 p.m. Wednesday, 120 Geography Bldg

Prerequisites (and they will be enforced): a grade of 2.0 or higher in any ONE or more of the following (or their equivalents elsewhere): CSS 210 (Intro Soil Science) or GEO 306 (Geomorphology) or GLG 201 (Intro Geology) or GLG 412 (Glacial Geology) or ISP 203 (Geology of the Human Environment), or permission of instructor. This class is not open to freshmen or sophomores.

Course Goals: This course is intended for those students who have a basic background in physical geography, geology and/or soils, and who wish to advance their knowledge of soils, geomorphology and soil-environment interactions, *especially in a field-based setting*. The major goal of GEO 408 is to provide students with the ability to differentiate soils as they view them on the landscape, and to be able to propose scientifically sound reasons for these differences in morphology and chemistry, both at a site and from place-to-place, *based primarily on landform-soil, stratigraphy-soil, and sediment-soil relationships*. The course is designed to include a weekly lecture and several *required* field trips; the field trips end by early November to allow time for work on individual projects. Topics to be examined in GEO 408 include: (1) soil profile concepts and horizonation, (2) soil stratigraphy, (3) soil genesis, (4) soil geomorphology and soils as dating tools, (5) paleopedology and landscape evolution, (6) soil classification and taxonomy, and (7) soil mapping and the use of soil surveys. The course has a regional focus on Michigan and the midwest. The student is reminded that, because lectures provide important background information on the upcoming trip AND summarize important concepts from the previous trip, missing even **one** lecture unnecessarily can be very detrimental. Therefore, regular attendance at lecture is absolutely essential.

Field trips: All **eight days** of field trip are required. Field trips are the most essential and important part of any field course, and GEO 408 is no exception. They are invigorating, vital learning experiences. Missing a field trip will result in a loss of exposure to vital course material, which will come back to haunt you on the exams. The trips are long, time-consuming and tiring, but remain the best (perhaps the only) way to *really* learn this material. Hence, you have the potential to get a great deal out of them; do not waste this opportunity by partying at night such that you are dragging the next day, or by maintaining a lazy, negative or slipshod attitude. MSU will cover the transportation cost of the trips; at the end of the semester the students will be notified of the amount they must contribute to defray the lodging (and some of the meal) expenses. Likely amount: \$125 per person.

Grading: A total of 500 points can be earned in this course. Final grades are based on a curve of the student's overall point total. Points are assigned as follows:

Midterm exam	100 pts
Final exam	140 pts
Three unannounced quizzes (at the start of a class period)	60 pts
First soil landscape project	40 pts
Second soil landscape project	80 pts
Attitude, class and field trip participation, effort, brownie points, etc.	80 pts
TOTAL	500 points

Exams: There will be a midterm and final exam in GEO 408. The midterm will stress essential concepts covered in the field, with a small (but significant) component of material from lecture. The final exam is more lecture-text based in its approach. On the final exam only, students will have access to information they choose to write (not type) on *one side of a 4x6 inch notecard*. The final exam is cumulative. Both exams will be of essay/short answer format, with some objective questions or definitions. Exams *will* include material from the readings, and are mostly short answer and essay format.

Quizzes: Three surprise quizzes will be given during the semester. Each will occur at the beginning of class. Quizzes will cover the readings assigned for that particular lecture, as well as the lecture material covered in the previous class period. Makeup quizzes are not given.

Readings: Most of the readings will come from the text. Additionally, however, several research papers will (may) be read during the term; these will be placed on reserve in the file drawers in Room 102. Please do not remove these papers from the room except to photocopy them! I expect everyone to have read the papers and text pages BEFORE the lecture for which they are assigned. Overachievers are especially invited to read regularly and repeatedly from the text and the papers.¹

¹ Gross underachievers are not required to attend class or to read anything.

General **FIELD TRIP "RULES"** for GEO 408:

1. *Stay positive.* Keep smiling despite rain, cold, mud, wet feet, cold feet, smelly feet, (apparently) dense, ditty, know-it-all, or obnoxious classmates, long drive-times, boredom, impatience, etc. No sourpusses or fussbudgets, and especially no weenies. Adhering to the above instructions will not only make the course more enjoyable, but you will learn more and earn more brownie points (see **Grading** above). Participation and discussion is an important part of this class/field experience. Questions are not only encouraged----they are expected. I WILL be calling on you for questions during the field trips (translation: putting you on the spot in front of your peers). If you look dazed, bored or otherwise disinterested the likelihood that I will be calling on you increases substantially.

2. *Take diligent notes.* Taking good field notes is a talent that is easy to acquire; it does not take a 160 IQ, only hard work. It will require you to *work* in the vehicle, rather than chit-chat with your classmates, sleep, or munch on Fritos. If you think you can write your notes when you return to Lansing, or at night after the trip is over, you are sorely mistaken. I strongly encourage everyone to take notes in a *weatherproof field book*, obtainable from most book stores. The notebook might, for example, contain notes on soils, soil profile descriptions, stratigraphy, summary tables and other items. Within the notebook, basic soils data will be recorded. For example, soil series and taxonomic classification, topographic position, and drainage class, field textures of major soil horizons, depth to carbonates where appropriate, moist color of major horizons, including mottling where applicable, soil structure, evidence of erosion, current land use practice, landform, and other pertinent information. It is suggested that the student compile the views of the group regarding the genesis of the soil, and how the soil relates to similar soils (as in a catena or development sequence).

3. *Prepare for the worst possible weather conditions*, without bringing undue amounts of clothing. Better to have rain gear and not need it. Better to wear heavy shoes and stay dry than to take a chance with your Reeboks and regret it. Bring a hat. When conditions are at their worst and you have NOT prepared adequately, refer back to rule #1.

4. *Brownie and attitude points* (see **Grading** above) can be earned by:
 - always being on time (or early) for field trips, both at the main departure from the Stock Pavillion parking lot, and at each individual stop,
 - paying for the field trips well before the stated deadline,
 - volunteering to dig or turn the auger, drive (where appropriate), navigate, or pack and load the vehicle,
 - maintaining a serious attitude about the field learning experience,
 - cheerfully awakening in the morning and *not being the last one to be ready to depart*,
 - not being hung over such that you are a liability to the class and yourself,
 - assisting the professor in picking up or dropping off the vans, etc.

5. *Equipment.* Field notebook, pen/pencil are required. If you have a **non-folding** pocket knife, bring it. (Some will be provided.) Cameras are encouraged too.

Soil-landscape projects: In GEO 408 students will do research and write a report on two soil landscapes (*aka* soil associations), using NRCS Soil Surveys as their main source of information. Essentially, each project is an application of the skills learned in class, to the soil landscape at large. Each report will center on a major soil association, initially depicted in a county soil survey but much expanded upon in the report. YOU choose the soil associations (which cannot be from Michigan), under my guidance. Working alone, each student will request a soil association to work on. Fieldwork is optional but can be a part of Project 2. The report for Project 2 should be “better” and more in depth than for Project 1, because of the likely addition of fieldwork, but also because you will be better dirt people by then, and you will have been able to apply the skills you learned from Project 1 to Project 2.

Each project must contain at a minimum:

1. a block diagram of the soil association (using the one in the survey is acceptable; drafting a new one or editing an existing one is viewed as a plus).
2. typical profile descriptions and classifications for the major soils of the association, with an explanation of the reasons why the soils have the morphology that they do (why they are different from each other, etc).
3. soil and/or topographic maps (DEMs are OK) of typical landscapes in which this soil association dominates, appropriately annotated and explained.
4. an in-depth discussion of the soil parent materials and their pedogenesis, and how the pedogenic state factors have come together to form this association.

Optional components of the projects that may enhance your grade:

1. images of the landscape and/or soil profiles therein.
2. land use information
3. inclusion of references to scientific papers that have studied these soils, and discussion of said papers in the context of your soil association.

Other notes and comments about writing your reports:

1. All figures and graphics must have their sources clearly listed.
2. Use of metric units only is allowed. Convert all English units to metric.
3. When you discuss a soil SERIES use the singular, e.g., The Schaetzl series has great water-holding capacity. When you discuss these types of SOILS, use the plural, e.g., Schaetzl soils are really great.
4. Deep vs thick. These are different words and their usage should not be mixed.
“The base of the horizon was deep.” OK
“The loess was deep.” Not OK, what was meant was that the loess was “thick.”
5. A personal bias of mine: “create”. Do not say that pedogenesis has “created” anything. God *creates*. Pedogenesis and surficial processes *form*. This usage applies in many, many other instances, e.g., “Plowing has formed a plowpan.”
6. Textures. Do not say, “The A horizon is silt loam” or “The A horizon consists of silt loam” Instead, say that “The A horizon has a silt loam texture.” Remember, “silt loam” and the other texture classes are adjectives, not nouns.
7. Soil orders. The taxonomic names of soils should be capitalized. Hapludalf, not hapludalf.

For each Project, members of the team will receive the same point total (grade).

LECTURE AND *FIELD TRIP* OUTLINE

DATE	TOPICS	READINGS
Sep 2	Introduction, soil characteristics and concepts Functional-factorial model of soil development	Chapter 1 (also browse Chapter 8) pp. 295-300
Sep 9	Process-systems model of soil development, soil horizons and horizonation	Chapters 2 and 3 pp. 320-323
Sep 16	The first soil processes: melanization, leucinization, acidification <i>TRIP 1: Soils of the SE Michigan interlobate area (SATURDAY Sep 19)</i>	pp. 347-361
Sep 23	Next: lessivage and Bt horizon formation <i>TRIP 2: Miscellaneous soil-y things: Soil-landform relationships in the valley of the Red Cedar River, and on the outwash plains of SW Michigan (SUNDAY, Sep 27)</i>	pp. 361-373
Sep 30	Podzolization and associated processes	pp. 440-453
Oct 7	Gleization, redox processes, ferrollysis; soil drainage classes <i>TRIP 3: Podzolization; soils and surfaces; soil geomorphology case study examples from northern lower Michigan through the eastern UP, and into northern Wisconsin (THURSDAY through MONDAY Oct 8-12)</i>	pp. 380-385; 486-501
Oct 14	Hydroconsolidation and fragipan formation, pedogenesis in dry environments	pp. 373-380; 402-439
Oct 21	Midterm exam; Project 1 assigned	
Oct 28	Soil classification and mapping, use and interpretation of NRCS Soil Surveys <i>TRIP 4: Soil-landform relationships on and near the Saginaw lake Plain (FRIDAY, Oct 30)</i>	Chapter 7
Nov 4	Soil geomorphology, geomorphic surfaces, soils-on-slopes	pp. 465-486; 506-514
Nov 11	Dating of geomorphic surfaces; soil chronosequences; quantifying pedogenesis PROJECT 1 DUE in class	pp. 460-461; Chapter 14
Nov 18	Models of soil and landscape evolution; Project 2 assigned	pp. 295-342
Nov 25	Catenas and the pedogenic effects of topography	pp. 456-460
Dec 2	Pedoturbation and lithologic discontinuities; stone lines and landscape evolution	Chapter 10; pp. 501-506 pp. 516-546
Dec 9	Paleopedology; use of soils in paleoenvironmental reconstruction PROJECT 2 DUE in class	Chapters 15 and 16
Dec 14	FINAL EXAM (8:00 pm, in Rm 120)	