Geology 425/525 – Environmental Geochemistry
Class Project

This course will include a class research project on a local environmental geochemistry question that we will work on during our three-hour laboratory session each week. Students will be divided into groups that will share the responsibilities of collecting samples and data. Once the data is collected, it will be shared with the entire class so that all students have the same data set. We will work on data presentation, preliminary analysis, and statistics together Then each student will write his/her own report separately.

Laboratory Schedule

Lab 1 – Introduction, literature review, goals of class project
In this lab session, the overall theme of the project will be announced (e.g., local groundwater chemistry, snow chemistry, soil chemistry). Student groups (4-5 students) will be formed. Students will search the literature for peer-reviewed papers that they think are relevant to the general topic. In groups, they will discuss possible hypotheses to be tested or questions to be addressed.
Assignment: Each group must share five relevant papers and three questions/hypotheses with the class. They must be posted on Blackboard by the end of the week.

Lab 2 – Sampling methods, design sampling strategy
At the beginning of this lab period, the class will discuss the hypotheses/questions they have come up with and decide on one or two that they wish to pursue. Then we will discuss the sampling methods (filtered vs. unfiltered, type of bottle, cleaning methods, sampling protocol, etc) and which area will be sampled by which group. Once their sampling areas have been defined, each group will come up with their own plan for sampling over the next two lab sessions.
Assignment: Each group should show their anticipated sampling sites or areas on a shared class map.

Lab 3 – Field trip to collect snow samples
All groups go out separately during lab period to sample.
Assignment: Record information about sampling site plus any field data (pH, conductivity, etc.) for each sample.

Lab 4 – Field trip to collect snow samples
All groups go out separately during lab period to sample.
Assignment: Record information about sampling site plus any field data (pH, conductivity, etc.) for each sample.

Lab 5 – ICP-MS analysis, Compilation of sample info, maps
Several tasks are accomplished during this lab period. For each task, one member from each group is assigned to that task. Task 1: ICP-MS analysis – run performance check, load standards and samples in autosampler, set up method, begin run. Task 2: Sample

map – create sample map for entire class including locations for samples from each group. Task 3: Sample table – create table with sample numbers and descriptions for each sample. Task 4: Field data – create table with field data for all samples.
Assignment: Class map, sample table, and field data table

Lab 6 – ICP-MS calibration curves and data management
During this lab period, the students will manage the raw data that comes off of the ICP-MS. The ICP-MS software is loaded on to several computers so that more than one group can look at the data and adjust the calibration parameters. Students begin this process by looking at calibration curves and adjusting the intercept and nature of the fit as well as removing any standards that appear to be problematic. As a class, they will create a table that gives information on the calibration parameters for each element.
Assignment: Class ICP-MS calibration table

Lab 7 – ICP-MS data management, graphing geochemical data (computer lab)
During this lab period, students will take the raw concentration data for all elements, including those that have been run at more than one mass. First they will reduce this data to a single set of concentration measurements for each sample by taking averages where appropriate and discarding masses that have accuracy or interference problems. They will then take this "unabridged" data table and reduce it to an "abridged" data table that only contains elements that they think are interesting and plan to analyze and discuss. Finally, students will make x-y plots and histograms of some of the data and look for and discuss any trends they see.
Assignment: Four graphs (at least two must be x-y plots) and brief discussion of trends in these graphs.

Lab 8 – Statistics (computer lab)
In this lab, students will use multivariate statistics, particularly principle component analysis, to analyze their abridged data set. We have been using the SPSS statistics program for this. We will run through one principal component analysis as a class and then students can perform more such analyses on their own.

Lab 9 – Statistics, data interpretation (computer lab)
This lab period gives students a chance to use some of the data analysis methods we have discussed to examine aspects of the data that interest them. They can also finalize some of the graphs and tables for their project write-up.

Project write-up due last week of classes or final exam week

Project Report Description
Your report must include the following sections:

Abstract
An abstract is meant to concisely highlight all of the most important points of a paper. What are the main points that you want your reader to walk away with?

Introduction
The introduction gives the reader the pertinent background information and provides motivation for the project. It should answer the following questions:
What background information do I need in order to understand this report? (This should include information about the sampling sites and their climatic conditions.)
Why was the study area/topic chosen? Why is it important?
What was done in this class project? (Be brief, you will explain this in more detail in the Methods section.)

Methods
In this section, you will describe in detail your laboratory methods. Your goal is to describe it well enough that the reader could reproduce your work if necessary.

Results
This section should contain only the results. You can include comments on trends that exist in your results but make sure that they are not subjective and that you keep interpretations out of this section. Include a spreadsheet with all of the data that the class has collected and any other tables or graphs if they are helpful in conveying your results. If a spreadsheet is too big to include in the report (like the unabridged data), it can be included as an appendix.

Discussion
The Discussion section is your chance to interpret your results. This may require some data manipulation or graphing. Try to answer the following questions:
What do your results mean?
What are the implications of these results? That is, if you make certain assumptions, can you draw other conclusions from these results? How might they affect future studies?
What were the sources of uncertainty or error in this lab? How might these uncertainties affect your results? *Graduate students: You will be judged more critically on your discussion of errors and uncertainties. You will also be expected to include some statistical analysis in your discussion.*

Summary
In this section, you should summarize your main conclusions and discuss their implications. There may be some repetition between this section and your Discussion section, but the summary is broader and less concerned with details. The Summary section is also a good place to discuss any future work that may be beneficial for understanding the questions you have been addressing. If you were to continue with this study, what would you do next? Where else would you sample and what new data would you collect?

Written Report Assessment Tools (Total 75 pts.)
5-8 pages (not including unabridged data table), written individually. Include good, readable data table(s) and graph(s), and statistical analysis to support your conclusions. Grading of the written component will be based on the following guide.

1. Introduction (~1 page, 10 pts.)

Is relevant background information presented?
Yes Yes, but not enough No

Is motivation for and/or importance of the project presented?
Yes Yes, but not clear No

Is the purpose of the project described?
Yes Yes, but not complete No

Grammar/Organization of Introduction
Excellent Good Fair Poor

2. Methods (~0.5-1 page, 10 pts.)

Are sampling methods described in enough detail?
Yes No

Are laboratory methods described in enough detail?
Yes No

If the reader wanted to perform the same study, would she/he be able to do so?
Yes, completely Almost No, major ideas are missing

Grammar/Organization of Methods
Excellent Good Fair Poor

3. Results (~1.5-2 pages, 20 pts.)

Are results presented clearly?
Yes Somewhat No

Is easy-to-read abridged data table presented?
Yes Somewhat No

Is this section free of interpretations?
Yes No

Are graphs included if needed?
Yes Incomplete No

Are tables and graphs clearly presented?
Yes Yes, with some insufficiencies No

Grammar/Organization of Results
Excellent Good Fair Poor

4. Discussion (~1.5-3 pages, 25 pts.)

Are interpretations of results presented?

Yes, well thought out Yes, but vague No

Are interpretations of results complete and easy to understand?
Yes No

Are appropriate graphs/diagrams shown to aid discussion?
Yes No Don't seem necessary

Grammar/Organization of Discussion
Excellent Good Fair Poor

(525 students) Is some statistical analysis presented and performed properly?
Yes, exceptional Yes Performed, but not properly Not done

5. Summary/Conclusion (~0.5-1 page, 10 pts.)

Are important results summarized?
Yes Yes, with some insufficiencies No

Are future recommendations made, including suggestions for changes to methods?
Yes Yes, with some insufficiencies No

Grammar/Organization of Summary
Excellent Good Fair Poor