Society for Creative Oceanographic Studies
Request for Proposals (RFP)

Oceanography: The College of Wooster
Lori Bettison-Varga

Society for Creative Oceanographic Studies (SCOS) will consider new proposals in Spring 2004 as part of the Oceanography course. The SCOS is a fictitious organization supporting creative oceanographic research and educational programming. The Society accepts proposals as a requirement for Geology 103 (oceanography) to encourage individual research by students, and to foster proposal writing experience for undergraduates. Furthermore, the Society encourages all investigators to discuss their proposal ideas with the Program Officer, Lori Bettison-Varga through e-mail or by individual appointment. All proposals with topics related to oceanography will be accepted, with a $50,000 maximum budget. Proposals must meet the following requirements:

1) Cover page: The first page of the proposal should include the following information -

a. Title of proposal
b. Student ID number
c. Budget amount requested
d. Time period of proposed work

2) Project Summary (page 2 of proposal). This summary should not exceed 300 words and the title of your proposal should be at the top of this page.

3) Sections: Make sure that the pages are numbered. Font: Times, 12 pt. Font (nothing larger or smaller will be accepted); 1" margins (top, bottom, right and left!).

I. Purpose of Study/Mission Statement (2-3 pages),
II. Description of Research design (5-6 pages),
III. References Cited,
IV. Figures and Figure captions may be added and are not counted within page ranges noted above,
V. Budget (1 page maximum; use budget page provided),
VI. Budget Justification (1 page maximum).

4) Proposals will be submitted electronically via blackboard, with one hardcopy delivered to LBV.

5) Schedule for proposal submissions:

February 20th: Proposal title and a one paragraph description of your idea is due in class.

March 5th: Proposal outline and reference list due in class.

April 9th: Proposal due in drop box by 5 p.m. Bring hard copy to LBV's office.

<u>Society for Creative Oceanographic Studies</u>
<u>Proposal Review Process</u>
Spring 2004
Oceanography: The College of Wooster
Lori Bettison-Varga

<u>Timeline:</u>

Panel Groups identified:	April 19, 2004
Reviews due:	April 30, 2004 in class
No late reviews will be accepted	
Panel discussion and summary:	You can arrange to meet outside of class before May 5th at 7 p.m., or wait until that time.

You are responsible for one-page (single-spaced) reviews of two proposals in preparation for the panel meetings the last week of class. The proposal reviews are due on April 30th in class and posted in your blackboard group so that all panelists can read your reviews. **NO LATE REVIEWS WILL BE ACCEPTED**.

According to the class discussion, the review criteria are as follows:

<u>Review Criteria</u>

- Is the proposal well-organized and well-written?
- Is there obvious economic and social importance (even if latent) to the proposed work?
- Is the project innovative and creative?
- Is the proposed work realistic?
- Is the proposal well-researched?
- Is there a clear work plan for the proposed work?

Your review should highlight the strengths and weaknesses of the proposal, and include suggestions for improvement. You must assign a numerical ranking to the proposal according to the following guidelines:

<u>Numerical Rankings</u>

5 Outstanding proposal in all respects; deserves highest priority for support
4 High quality proposal in nearly all respects; should be supported if at all possible
3 A quality proposal worthy of support
2 Proposal lacking in one or more critical aspects; key issues need to be addressed
1 Proposal has serious deficiencies

Special Notes

Arrange each review so that the title of the proposal is centered at the top. Your name should be at the upper right-hand corner. The numerical ranking should be on a separate line at the end of the review.

Panel Summary

Panelists will meet and discuss proposals. It is important that all proposals be read by *all* panelists, even though each panelist is responsible for only two formal reviews. Your panel summary should address EACH proposal, with a summary of panelist comments about the proposal and an overall recommendation to the Society for Creative Oceanographic Studies: fund – top priority, fund – if money is available, do NOT fund.

Taconic Orogeny

Prior to the tutorial: Everyone reads the required reading and the revised paper. "A" writes a five page paper based on the required readings, "B" critiques the paper, "A" revises the paper and puts a copy on "collaboration\geology\Courses\geo343s04\projects" by noon the day before the tutorial, and "C" prepares a list of questions based on the required reading and on "A"'s paper. At the tutorial "A" will begin by reading his/her paper, then "C" will initiate discussion.

Required reading (Available on-line):

Karabinos, Paul, Samson, Scott D.; Hepburn, J. Christopher; and Stoll, Heather M., 1998. Taconian Orogeny in the New England Appalachians; collision between Laurentia and the Shelburne Falls Arc, Geology Boulder, March 1998, Vol. 26, Issue 3, pp.215-218.

Ratcliffe, Nicholas;Hames, Willis E.; Stanley, Rolfe S.; Karabinos, Paul; Samson, Scott D.; Hepburn, J. Christopher; and Stoll, Heather M., 1999. Taconian Orogeny in the New England Appalachians; collision between Laurentia and the Shelburne Falls Arc; discussion and reply, Geology Boulder, Vol. 27, Issue 4, pp.381-382.

Ratcliffe, Nicholas M.; Hames, Willis E.; and Stanley, Rolfe S., 1998. Interpretation of ages of arc magmatism, metamorphism, and collisional tectonics in the Taconian Orogen of western New England, American Journal of Science, Vol. 298, Issue 9, pp.791-797.

Further reading:(On course reserve in Hatch Library)

Drake, A.A., Jr., Sinha, A.K., Laird, J., and Guy, R.E., 1989. The Taconic Orogen. In Hatcher, R. D., Jr., Thomas, W. A., and Viele, G. W., eds., The Appalachian Ouachita Orogen in the United States. Boulder, Colorado: Geological Society of America, F-2: 101-177.

Rachel Beane, Bowdoin College

This is an example of a weekly assignment in a tutorial-format class that was divided into groups of three students (A, B, and C) whose weekly ‘duties’ rotated.

Final Paper

This course has focused on the geology and tectonics of Appalachians. For this final paper, you will take one (or more) of the papers that you have written previously for this course, and revise and expand it. The final paper should be approximately 8-10 pages, with all text double-spaced, 2.5cm margins all around, and a 12-point type-size. The paper needs to incorporate one reference to an article not previously required in this course. For the paper, please do not simply summarize the articles. Instead, consider interpreting one article in light of another, comparing two regions, integrating your knowledge of a subject, or developing an argument. Your paper should add to our understanding of the Appalachians.

Option: If you wish, then you may elect to write on a subject, related to the Appalachian orogeny, but not covered in this course. This option is instead of revising and expanding a paper that you have previously written. If you elect this option, then please talk with me about your topic.

As you write this final paper, please let me know how I may help you in the development of ideas or in the search for references for your paper. Please place a copy of your final paper on "collaboration\geology\Courses\geo343s04\projects" by noon the day before the tutorial. You should be prepared to read and discuss your paper during our tutorial.

Your paper should include:

Title: A few connected words that tell something about the paper.

Introduction: Two - three paragraphs that capture your readers' attentions, and that orient them as to the subject and purpose of the paper. The introduction may highlight the basic geography and geology of the Appalachians, in order to place the rest of the paper in context.

Body: Several paragraphs that are informative and that have a clear flow.

Conclusion: One or two paragraphs that bring your paper to a close.

References: A listing of the sources you have used to write the paper. Use the format as listed in your previous assignments.

Take care to avoid plagiarizing the resources you use. Be sure to give the authors of the resources credit when you use their ideas or information, and if you borrow their exact words, then place those words in quotation. If you use ideas or quotes from classmates' papers, then be certain to reference those. For the references cited in the text, you should use parenthetical documentation in the form of (author, year). For example: The geologic history of the Appalachians provides a good example of a Wilson cycle (Hatcher, 1989). Or Hatcher (1989) states "Eastward the foreland fold and thrust belt consists of a belt of Alleghanian imbricate thrusts and folds." If you have questions regarding what constitutes plagiarism, then you might refer to the Sources web page. If you have further questions, then please ask.

Writing has been an emphasis of this course. For this final paper, I ask that you continue to focus on improving your writing. Before submitting your paper, please consider the following:

Is the thesis precise and clear?
Can you state the thesis?
Does the thesis govern the paper?
Analyze the internal organization.
Does each paragraph establish and pursue a discrete topic?
Does one paragraph lead to the next?
Do thoughts follow from a topic sentence within each paragraph?
Do sentences follow each other within the paragraph?
Are transitions between thoughts/paragraphs/sections adequate?
Are parts repetitious or unfocused?
Examine the uses of evidence.
How compelling is the evidence that you use?
How strong is the evidence that the author presents?
Have you fully cited all sources you have referenced.
Check for grammatical, spelling, and punctuation errors

I encourage you to peer-review each other's papers, considering the questions above, before you turn in your paper to me. I also encourage you to visit the Writing Project which offers drop-in writing conferences in evening workshops. Finally, as we have done during tutorial, I suggest that you read your paper out loud to ensure that what you want to communicate is communicated.

The grading scheme I will use for this assignment is one that I have adapted from Robert Bain's essay "Reading Student Papers." Assuming a paper follows the assignment, then it will be graded as follows:

A

- ✓ Clear thesis that governs paper
- ✓ Strong interpretations
- ✓ Rich content, excellent detail, strong use of evidence
- ✓ Careful organization and development of ideas
- ✓ Clear, interesting and connected introduction and conclusion
- ✓ Artful transitions
- ✓ Memorable - leaves the reader satisfied and eager to reread the paper

B

- ✓ Clear thesis
- ✓ Substantial interpretations
- ✓ Substantial information
- ✓ Specific ideas logically ordered and developed around a clear organizing
- ✓ principle
- ✓ Interesting and connected introduction and conclusion
- ✓ Transitions are mostly smooth
- ✓ Pleasurable reading with few distractions

C

- ✓ Stated thesis
- ✓ Insubstantial interpretations
- ✓ Competent but thin information with vague generalities
- ✓ Adequate organization and development
- ✓ Perfunctory introduction and conclusion
- ✓ Bumpy transitions
- ✓ Few grammatical, spelling, and punctuation errors

D

- ✓ Lacks thesis
- ✓ Rudimentary treatment and development of subject
- ✓ Unclear and ineffective organization
- ✓ Overall impression of haste - not a revised piece of writing

F

- ✓ Superficial treatment of subject
- ✓ Lacks organization
- ✓ Below the acceptable level of college writing

GEOL 190 - Modern Geologic/Geographic Mapping & Analysis *Spring 2004*

Guidelines for Projects

We believe that you will understand the surveying and GIS techniques we present in lectures more deeply if you use them to conduct independent research on a project of your own choosing. Still, it may seem daunting to learn new techniques and devise and conduct research using those techniques simultaneously. For this reason, we want to outline the character of the work we expect from you, provide some advice about the scope of your projects, and provide you with a clearer and more detailed timetable for work you submit to us.

We have the following goals in having you undertake projects. First, such a project will induce you to gain more than a passing understanding of the surveying and GIS techniques we cover in class. Second, working on a project may provide you an opportunity to work with and understand in detail aspects of surveying and GIS that we covered quickly in class, to learn more about a particular technique that is important to work that you wish to undertake in your major or a field of interest (e.g. to apply these techniques in archeology, biology, land use planning, etc.), and to learn more about northern Ohio. Finally, we hope that you will use the presentation as an opportunity to improve your oral presentation skills and the paper as an opportunity to work on your skills in analytical reading and expository writing (the two cannot be separated).

You may identify a person with whom you share interests and with whom you would be comfortable working throughout the semester, or you may chose to work individually. If you work with a partner, **you will each be responsible for presenting 1/2 of each oral presentation** and for **submitting your own, independently written final paper**. Below are the steps to be followed as you develop and carry out your project. The last page of this document has a copy of our grading rubric that outlines the criteria we will use to assess your projects.

Research Question: Due March 19

With your partner or individually, we would like you to identify a question that you would like to answer. As we will outline in lectures, the techniques we cover in this class are well suited to address questions where (1) portraying and understanding the areal distribution of a parameter or characteristic provides significant insight to a phenomenon, (2) comparing the distribution of a parameter across a particular area at two different times provides insight to a phenomenon, or (3) devising a way to assess abstractly spatial distribution patterns in two different areas thereby enabling you to compare different areas provides insight to a phenomenon. You can focus on natural phenomena such as growth and succession of vegetation, erosion, faunal distributions, etc., or you can focus on social phenomena such as what factors appear to govern choice of housing locations, what are optimal locations for roads, what are the effects of differences in policy, etc. Your project will be easier to undertake and the final report you write will be easier to complete if you constrain as tightly as possible your topic, and generate a carefully-conceived question. Your research question and a paragraph of explanatory text (if necessary) should be typewritten and submitted to Laura by 4:30 pm on Friday March 19.

Research Project Proposal: Due March 26

In your 1-2 page (double-spaced) research proposal, you will need to address several issues. First, state the research question in greater detail and provide the motivation for addressing this question, e.g., why is this particular question of importance or relevance? Second, describe the data sets that you will need to collect to address this problem and how you propose to gather these data sets. Third, describe the analyses you propose to carry out once the data has been collected, providing justification for the appropriateness of the analyses. It is also useful in a research proposal to provide a statement or two regarding your hypotheses or anticipated outcomes. We will provide you with feedback on your proposals to assist you in refining your projects before you move forward into the data acquisition and analysis stages.

Final Presentation and Report: Due May 12, May 14 (Draft Report) and May 20 (Final Report)

Finally we ask that you prepare a final presentation (or if appropriate a joint final presentation) and an individual written report on your project. To provide you with the opportunity for direct feedback and to improve your final product, a draft of your final paper is due on Friday May 14th (the last day of classes). Reports should be typed (or printed), and should include an abstract, body, and reference list. The *abstract* should be about 250 words long, and should (*i*) introduce the paper's primary question or focus (*without* writing, "This paper will consider..."), (*ii*) outline your approach to the question, and (*iii*) present the conclusions you reached. The *body* of the paper should be 10 or fewer typewritten (double-spaced) pages. Separate sections labeled "introduction" and "conclusion" may help you to direct readers (i.e. us) to the salient points in the body of the paper. Well-written pieces introduce the question they intend to address and enumerate one or more conclusions at end of the paper. List *references* in a reference list in alphabetical order. Provide citations for all ideas and figures that are not your own. Feel free to consult with us for information on how to do so. On a technical note, please avoid footnotes. In many journals, citations take one of the following forms:

> *Snyder (1987, p. 157) stated that the U.S. Geological Survey use azimuthal stereographic projections to construct base maps for nearly all their maps of Antarctica.*

or

> *The U.S. Geological Survey uses azimuthal projections as base maps for all their maps of Antarctica (Snyder, 1987, p. 157).*

The complete citation for Snyder's book or article should then appear in the reference list. Concerning the format of citations in the reference list, we have no preference. Please choose one format and use it for all references, however. This will help assure that you include complete citations. If you cite a textbook or monograph, please include in the citation the page numbers where the author discusses ideas that you cite (as we did above in citing Snyder's book *Map Projections - A Working Manual*). We learn things from papers that students submit, and often wish to follow up the ideas that students raise in their papers. Likewise, we hope to collect a library of data and research questions regarding the Old Woman Creek area for other students. Complete citations make it easier for us or for other students to follow the reasoning that you followed.

A few suggestions on grammar:

1. Avoid *passive-voiced* sentence constructions like, "the map was completed by Van der Grinten (1904)...," or "these differences were analyzed to show ..." Writing is ***not*** any less objective if you say that you did something rather than saying that it "was done." Let the sentence's subject be the active agent.

2. Even though the insidious and all-pervasive *they* say that it is okay to split infinitives, we think it preferable not to split them.

3. Check your spelling and remember that a spell checker will not catch all errors. Use a dictionary if you must.

Geology 190 – Modern Geologic/Geographic Mapping and Analysis
Final Project Evaluation Form - Spring 2004

Extra Credit (5 points)

____ Additional library session with Science librarian (5 pts.)

Rough Draft of Paper (20 points)

____ Draft is generally well organized (5 pts.)
____ Draft outlines problem effectively (5 pts.)
____ Draft describes data utilized, analytical approaches followed, & points toward conclusions (5 pts.)
____ References sufficient in number and content (5 pts.)

Oral Presentation of Project (30 points)

____ Presenters are professional & understand the material (5 pts.)
____ Both participants contribute materially to the presentation (5 pts.)
____ Presentation is organized, on topic, & reaches a conclusion or has a "take home message" (5 pts.)
____ Presentation has effective graphics & maps (5 pts.)
____ Presentation completed within time limits (12 minutes + 3-5 minutes for questions) (5 pts.)

Final Paper (50 points)

____ Introduction accurately reflects content, succinctly tells reader the problem to be considered, the methodology to be used, & compels the reader to continue on (6 pts.)
____ Main text is well written without errors in punctuation, spelling, or grammar (8 pts.)
____ Main text is well organized into appropriate sections & is *concise* (8 pts.)
____ Material is covered in sufficient depth to give the reader a full picture (8 pts.)
____ Figures are clear, with appropriate labels and captions (8 pts.)
____ Conclusion section is succinct & gives an accurate summary of arguments; could stand-alone (6 pts.)
____ References are properly cited with author name & date throughout text & in the reference section (6 pts.)

Additional Comments:

Controls on Groundwater Flow in Karst Aquifers - A Collaborative Project with the Berks Products Ontelaunee Quarry, Pennsylvania

Kurt Friehauf – Kutztown University of Pennsylvania – July 2005

Introduction

The Berks Products dolostone aggregate quarry is located near the confluence of the Maiden Creek and Schuylkill River. The active mining levels are below the regional water table, so pumping creates a hydraulic gradient centered on the pit. This hydraulic gradient drives groundwater flow into the pit. As with many carbonate rock aquifers, groundwater flow is primarily through dissolution channels. Understanding the controls on dissolution channel formation in these rocks is therefore useful information for the mining company for predicting groundwater flow paths.

Mapping the water table and how the water table changes in response to storms and changes in the rate of pumping are the first step to analyzing the local hydraulic gradient and permeability of rocks surrounding the quarry. We will measure the water table elevations using an electronic tape, as well as with In Situ minitrolls (water level loggers).

Procedure

1. The Minitroll water level loggers are pressure transducers with data loggers, so they record pressure changes and not actual water table elevations. Changes in pressure correspond to shifts in the height of the water column in the well, so given the specific gravity of water, we can translate minitroll data into changes in the elevation of the water table. Minitrolls, however, only measure changes in the water level, so to create a map of the water table, we need to know the initial elevation prior to installing the minitrolls.
   As a class, we went out to the well field and measured the elevation of the water table in wells using an electronic tape. We also installed a single minitroll so that students learned the basic protocol.

2. Students then used this data (summarized on the attached lab handout) to calculate water table elevations, plot the data, and then use excel to linearly interpolate elevations between wells prior to contouring.

3. A small group of students who showed particular interest in hydrogeology then followed up on this by doing a more in depth research project with me involving pit mapping, petrography, sampling water chemistry, and monitoring with minitrolls.

Water table monitoring lab

Monitoring groundwater movement is important both for predicting water resource availability and for tracking the migration of pollutants in our drinking water supply.

Part 1 – fieldtrip to groundwater monitoring well

1. What is the difference between a cased and an uncased well?

2. What kinds of things can be monitored using groundwater monitoring wells?

3. What potential problems might be *created* when drilling groundwater monitoring wells in contaminated aquifers?

4. What tools would you use to sample water from an aquifer for chemical analysis?

5. What do pressure transducers with data loggers (i.e., mini-trolls) tell us? Why is that information useful?

Part 2 – contouring water table data - predicting groundwater flow

- Plot groundwater elevations next to each well on an overlay to the map of the area (data on next page – the EL elevations are those of the Schuylkill River).
- Draw lines connecting the wells to their three closest neighbors, creating a "net."
- Use linear interpolation to calculate the elevations of the water table along each line between wells. Because this is a calculation you will have to repeat for each and every line connecting wells, you should create an Excel spreadsheet that will calculate the distances for you need to measure on your map. (Hint: this is a *linear* interpolation so think in terms of $y = mx + b$).
- Post your Excel spreadsheet on your website.
- Use the interpolated points to contour the elevations of the water table.
- Draw groundwater flow arrows that are perpendicular to water table contours and pointing down gradient (i.e., toward lower water table elevations). Don't be afraid to curve your flow lines – water flow paths will curve as the gradient changes. Flow lines should be continuous across the field from one edge to another.

6. Does groundwater generally flow toward the quarry, or away from the quarry?

7. How might this affect quarry operations?

Well	Collar elevation	depth to water table
1	310.89	50.15
2	297.56	53.75
4	275.43	57.85
5	269.66	78.3
11	265.67	70.8
12	275.24	62.8
13	287.74	72.9
14	306.22	52.9
15	281.22	76.65
26	264.88	73.75
32	261.02	42.8
EL1	250.15	---
EL2	248.26	---

Regional trends in the petrology and hydrothermal alteration in the Proterozoic iron deposits of the Mid-Atlantic iron belt

Kurt Friehauf – Kutztown University of Pennsylvania – July 2005

Introduction

The Proterozoic igneous and metamorphic rocks of the Reading Prong belt host many small magnetite iron mines that fed the early American iron furnaces of the 1700's and 1800's. Mining in most of these districts ceased after World War II, so underground exposures are flooded and only small pits and partially reclaimed mine dumps remain. One of my research projects involves a regional comparison of the petrologic characteristics of the host rocks, hydrothermal alteration, and ore mineralogy of these deposits.

Individual mines in this belt are ideal for student projects in mineralogy and petrology classes because the sites are small, petrologically relatively simple, and within a few hours drive of the university. Each class studies one mine. To date, we've studied the Rittenhouse Gap mine (Pennsylvania), Richard-Teabo/Dover mine (New Jersey), and Lyon Mountain mine (New York) in 2000, 2002, and 2004, respectively.

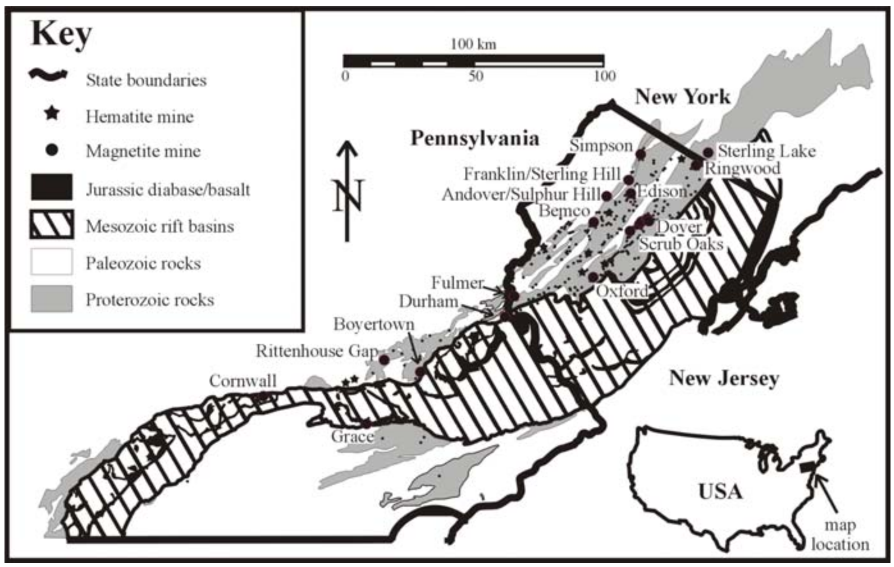

Figure 1. Major iron oxide deposits of the Mid-Atlantic region.

Procedure

1. Class fieldtrip to mine site where students break up into groups of four and must devise rock classification scheme – students collect samples of each rock type for lab study
2. Students cut and describe rocks in slab and thin section
3. Students report results in mid-study as progress report formatted like typical mineral industry report
4. Different groups compare classification schemes

friehauf@kutztown.edu

Dover Iron Mining District Fieldtrip – Classifying Rocks

Introduction

The purpose of this fieldtrip is to get you thinking about real-world rocks – not just ordinary GEL100 rocks, but rocks that have been altered by metamorphism and hydrothermal activity. So far in this class you've learned your way around a petrographic microscope – a handy tool for seeing far, far into a rock. You'll ultimately need those microscopes to document the mineralogy and mineral intergrowths of these rocks. On this fieldtrip to the Dover mining district (Figure 1), you will survey the mine area, put together a rock classification scheme in the field, sample each of the rock types and each important variant in your scheme, and then study the samples in detail in the lab.

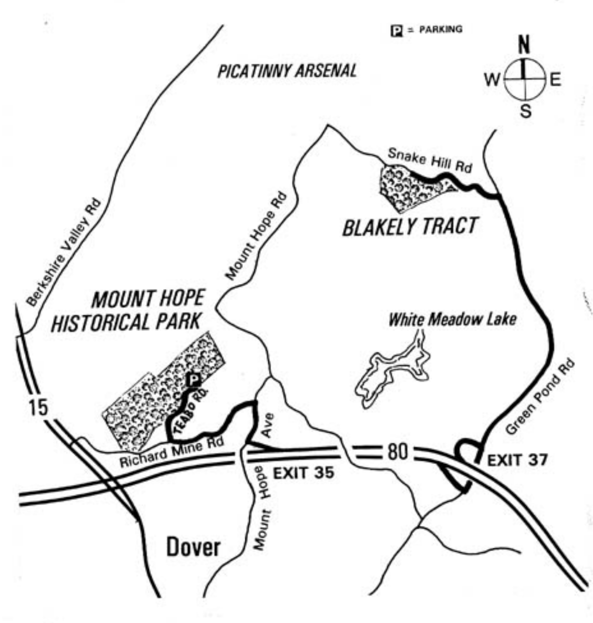

Figure 1. Driving directions to Mount Hope Historical Park, New Jersey
http://parks.morris.nj.us/parks/directions/mhdir.htm

Assignment

Working in groups of 3-4 students, study the rocks in the mine dumps of the Richard and Teabo mines – part of the Mount Hope group of mines in the Dover mining district. Use the map of the district provided to record your observations and sample locations. Break open a lot of rocks, study the mineralogy and textures of the rocks using your hand lens, and create a classification scheme for naming the different rock types present. As with GEL100 rocks, there will likely be some variation between rocks of a given designation. Carefully collect samples of each of your rock types and the important variants. You will cut these samples in the coming months, describe them using binocular microscopes, and then cut your own thin sections for study using petrographic microscopes.

In designing your classification scheme, think about how you've distinguished rocks from one another in GEL100 – mineralogy (minerals present, relative abundances, mineral associations), textural differences (grain size, grain size distribution, grain shape, foliation, lineation, etc.), and other, less conventional characteristics.

Warning: You will only be at this location once so make the most of your time!

GEOLOGY 340 - STRUCTURAL GEOLOGY
Final Project on the Geometry of & Regional Strain Patterns in Orogenic Belts

Background:

We recognize four different tectonic provinces in the continents:

- *Cratons* are the parts of continents that have not undergone any significant deformation for several (usually 5 or more) 100's of millions of years. Most cratons have both *platform* areas where old deformed and metamorphosed rocks are covered by a relatively thin veneer of sedimentary rocks and *shield* areas where old (usually pre-Cambrian) deformed and metamorphosed crystalline rocks (what we call *basement*) are exposed at the surface.

- *Continental rifts* are zones of localized volcanism (either bimodal volcanism with a felsic component and a basaltic component, alkaline, or calc-alkaline volcanism), crustal uplift, extensional faulting, crustal thinning (due to erosional removal of rock and the extensional faulting), and the deposition and accumulation of sedimentary rocks. Rifts can initiate in association with and along the axes of volcanic arcs, in association with and along the axes of mountain belts, at right angles to continental collisional sutures, or in association with and along a trend between two or more 'hotspots.'. In some cases, continental rifts develop into stable or passive continental margins.

- *Transform fault zones* are locations where one continental crustal mass moves past another along a complex zone of anastomosing and/or discontinuous, mainly strike-slip faults. Where two faults in one of these complex zones separate, the strike-slip motion is accompanied by localized crustal extension and subsidence. We call this combination of strike-slip motion and extension normal to the fault trace *transtension*. Where two faults rejoin, the strike-slip motion is accompanied by localize localized crustal shortening and uplift. We call this combination of strike-slip motion and shortening normal to the fault trace *transpression*. Where individual fault traces end, there are local normal faults (and topographic basins) or local folds and thrusts faults (and topographic uplifts). Where faults overlap we observe either dilational jogs and anti-dilational jogs. Associated with the different types of jogs are local topographic depressions (such as *pull-apart basins* or *sag ponds*) or topographic uplifts.

- *Orogenic belts or mountain belts* are arcuate belts composed of thick accumulations of sedimentary rocks that are intensely deformed. The aggregate thickness of sedimentary rocks ranges from 5 to 7 times that on the cratons. Because of this great thickness, early geologists imagined that these rocks accumulated in huge down-warpings of the crust called *geosynclines*. Some geologists still refer to these sedimentary rocks as *geosynclinal accumulations*, but there is a growing tendency to call the package of sedimentary rocks a *miogeocline* (to indicate that its origin was not a geosyncline). A miogeocline includes shallow water, continental shelf sedimentary rocks (*miogeosynclinal rocks*) and deeper water continental slope and rise sediments (*eugeosynclinal rocks*). Orogenic deformation of the miogeocline typically accomplishes significant crustal shortening and generates organized arrays of folds, faults, foliations, and lineations. In most orogenic belts, we can identify an *external* part, where deformation occurred without significant metamorphism. Deformation in the external parts of orogenic belts (called the *foreland*) produces *foreland fold-thrust belts*. In fold-thrust belts, sedimentary rocks are shortened by thrust faulting and folding; the underlying crystalline basement is often not involved in the deformation. The crystalline rocks that compose the basement become involved in the deformation in the *internal* parts of mountain belts (called the *hinterland*). Moreover, significant metamorphism accompanies deformation in the internal parts. Metamorphism in the internal portions of the belts often has a distinctive distribution, with belts of high pressure/low temperature metamorphism aligned subparallel to belts of low pressure/low to high temperature metamorphism (geologists often speak of *paired metamorphic belts*). Separating the two in most orogenic belts is a region of extensive igneous activity (zone of *plutonism*).

We would use the same techniques to study deformed rocks in each of these different tectonic provinces. We have time only to examine deformation patterns in one type of tectonic province, however. I have, therefore, assembled rock samples and maps from a portion of a well known orogenic belt for you to examine in detail. The central Appalachians in Maryland (and adjacent Pennsylvania and West Virginia) contain a variety of rock types and rock structures typical of orogenic belts. The federal and several state governments have printed excellent large- and small- scale geological maps of the region; at least two different academic consortia and several independent geologists have constructed well-constrained sections drawn across the region. I list some of these publications and a few additional references on the geology of the area at the end of this handout.

The Problem

I ask that you use maps, publications, and your own observations of rock samples to develop an understanding the present structure and geological history of the central Appalachian portion of the Appalachian-Caledonian orogenic belt. In a 5-7 page essay, I ask that you (1) describe briefly the geometry of map-scale structures in this portion of the Appalachians, (2) outline the deformation conditions at different locations across this portion of the orogenic belt, (3) examine any correlation or other relationships between the map-scale structures and deformation conditions, and (4) the compare the patterns you observe with the patterns in other orogenic belts on earth (especially the North American Cordillera, which I will be describing in lectures; the Alps, as described in Boyer & Elliott 1982; or Taiwan as described in Davis *et al.* 1985). I expect that your essay will draw upon (and therefore cite where appropriate) lectures, handouts, and readings assigned during the earlier part of the semester. I also expect you to draw upon the two papers you have critiqued during the semester. I recommend that you consider questions raised in one of the following articles, which provide additional context for an analysis of orogenic belt development:

- Boyer (1995), who examines the large-scale architecture of fold-thrust belts and how the geometry of the pre-deformation sedimentary wedge might affect the final geometry of the orogenic belt.
- Mitra (1994), who examines factors that affect the magnitudes of strains at different points within individual thrust sheets and in different thrust sheets in different segments of orogenic belts.
- Decelles & Mitra (1995), who analyze how the architecture of a deforming wedge affects the development of synorogenic sedimentary accumulations, and vice versa.

If you interested in this region, I recommend examining one or more of a series of interesting papers published in the last decade. These papers outline the geological history of the northern portion of the central Appalachians:

- Faill, R. T. 1997. A geologic history of the north-central Appalachians. Part 1. Orogenesis from the Mesoproterozoic through the Taconic orogeny. *American Journal of Science* **297**, 551-619.
- Faill, R. T. 1997. A geologic history of the north-central Appalachians. Part 2. The Appalachian Basin from Silurian through Carboniferous. *American Journal of Science* **297**, 729-761.
- Faill, R. T. 1998. A geologic history of the north-central Appalachians. Part 3. The Alleghany orogeny. *American Journal of Science* **298**, 131-179.

I have placed in Carnegie 412 geologic maps and cross sections of the area and selected publications on the area. I expect that you will use these maps and publications to come to an understanding of the structure in different parts of the belt. THE MAPS AND PUBLICATIONS SHOULD NOT LEAVE CARNEGIE 412. I have also placed samples from selected locations in Allegany County, Frederick County, and Washington County in Maryland and from nearby locations in Pennsylvania and West Virginia. You should examine these samples and use the mesoscopic (i.e. hand-sample scale) or microscopic structures you see in the samples to inform your understanding of rock structures in this part of the belt. At the end of this handout is a list of samples available and their locations. You have already examined some of the samples for other laboratory exercises during the second half of the semester. Finally, I will also provide a carousel of slides showing the locations where I collected many of the samples; we visited several of these locations on our field trip to western Maryland. For this exercise, I ask that you use the map reading skills acquired in the first half of the semester to place individual samples into a regional context. Answering the following questions may help you to define the structural geometry, to estimate the deformation conditions at different parts of this area, and to compare this belt with other orogenic belts:

- Examine the legends of geologic maps of the area (i.e. the Geologic Map of Washington County) to determine what ages and types of rocks crop out there. What patterns emerge in the age, origin, and distribution of different rock types? What are the ages of any volcanic or plutonic rocks? What does their composition tell you about likely tectonic settings for volcanism or plutonism? What are the ages of any sedimentary rocks? What does their composition, sedimentary structures, or overall packaging tell you about likely tectonic settings for their accumulation? What are the ages of any metamorphic rocks? What does their mineralogic composition tell you about likely tectonic settings for metamorphism? Can you recognize evidence for volcanism, metamorphism, rifting, passive continental margin sedimentation, foreland basin sedimentation, etc.?

- Are the rock samples from different areas fractured, faulted, folded, foliated, or lineated? What do the map patterns indicate about the orientation and character of fractures or faults at different locations, the orientations and shapes of folds at different locations, and the nature of the foliations or lineations in these rocks? What relationships do the structures exposed at the surface have with the mesoscopic or microscopic structures you see in hand samples? What evidence exists to constrain inferences on the extent of deformation at depth?

Faults can, of course, be normal, reverse, contractional, extensional, etc., and the geometry of faulting may help you to infer deformation kinematics. Likewise, one can use the structures associated with a fault to determine the sense of movement on the fault and to infer the conditions under which faulting occurred. As we have noted in class, orogenic belts often contain fold-thrust belts; you will have read three papers discussing the structural geology of fold-thrust belts. Does the deformation you infer from the maps and hand samples conform with that expected in fold thrust belts?

Folds may form by one of several different mechanisms. Both the shapes of folds and strain distributions in folded layers give information of deformation kinematics and deformation conditions. In my view, the best way to classify fold shapes is Ramsay's scheme of *Type 1A*, *1B*, *1C*, *2*, or *3* folds. Different fold mechanisms sometimes generate distinctive fold shapes, so examining fold shapes with an eye toward differentiating fold mechanisms (flexure folding vs similar folding, kink folding vs buckle folding, etc.) may help you to discern how the rocks behaved. Of particular relevance here, you might wish to determine whether the folded layers exhibit significant changes in their thickness. In flexure folding, for example, layers move past neighboring layers, either by slip along discrete bedding planes or by flow within beds of finite thickness with little change in layer thickness.

Some argue that fold-thrust belts are terranes where flexure folding predominates, and argue that most folds have approximately parallel geometries. In detail, most folds in fold-thrust belts are Type 1C folds, where bed thickness in the hinge region is greater than bed thickness in the limbs (this may result from hinge thickening and/or limb thinning). Parallel folds cannot persist indefinitely below the surface *and* maintain equal amounts of shortening at all stratigraphic levels. The cores of parallel folds do not have enough room for the entire lengths of the lower layers if we require all layers in the sedimentary sequence to shorten the same amount. One way to resolve this "room problem" is to allow the layers to deform internally. In order to accommodate the fold amplitudes in typical foreland fold-thrust belt folds, we would need sizable strains in layers. Strata in foreland fold-thrust belts rarely exhibit such strains, however. Another way to resolve the room problem is to *detach* the folded layers from underlying strata and deform them independently of the rocks beneath the detachment zone. Drill-hole data, seismic data, and regional map patterns indicate that most foreland fold-thrust belt folding affects only the uppermost layers in the sedimentary sequence - what we call the *cover* or *supracrustal* rocks. We draw *detachments* or *décollements* between the folded supracrustal sedimentary rocks and the underlying basement.

- What deformation mechanisms dominated in different parts of area you chose to study? In order to compare the deformation conditions at different locations, I find it most useful to compare the structures and microstructures seen in similar rock types at different locations. Thus, I recommend that you compare the structures seen in siliciclastic (i.e. quartz-rich) sandstones (or shales) in the eastern, central, and western portions of the region, or compare the structures seen in limestones in the different portions of the region. Does the pattern of which deformation mechanisms dominate at different locations indicate anything about deformation conditions (temperatures, pressures, magnitudes of differential stress) at different places? What do the temperature or pressures you infer for deformation indicate about the depth of burial at the time of deformation? How does that pattern conform with metamorphism in these rocks? Are the patterns you recognize similar to those seen in other mountain belts?

- What is the deformation plan in the region? Is crustal shortening at the surface accommodated by folding, thrust faulting, or a combination of folding and thrusting? Are the folds *cylindrical*, approximately cylindrical or *cylindroidal*, or *non-cylindroidal*? What can you infer (or what have others inferred) about how crustal shortening is accommodated at depth? If the folds are cylindrical or at least approximately cylindrical, using the down-structure viewing and freehand sketching technique outlined on p. 287-290 in Marshak & Mitra (1988) will help you to determine more accurately the shapes of folds, how folds interact with other structures, etc.

- How do body strains contribute to crustal shortening? What is the principal shortening direction at different places in the county? Much of the published work on deformation fabrics is directed toward elucidating the relationships between the deformation fabrics in rocks and the strains responsible for them. Recall the discussion of *fabric reference axes* or *kinematic axes*. What patterns do you see in the orientations of fabrics or kinematic axes? What do those patterns tell you about the variations in strain magnitudes or geometry at different points in the belt?

- What evidence exists to constrain the absolute age of and duration of deformation in these rocks?

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An asterisk (*) indicates particular relevance to this area.

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Selected rock samples (listed in order of their ages)

Sample number	*Formation name and age*	*Location*
94100, 94101 94102, & 94103	Sandstones from the Permian Dunkard Group	Along I-68 W near Frostburg, MD
80A01	Devonian Woodmont Formation	Western Maryland Railroad Line just W of where the Potomac R. crosses Tonoloway Ridge
Dor	Devonian Oriskany Sandstone	Sandy Mile Quarry, on Sandy Mile Rd, along Tonoloway Ridge W of Hancock, MD
79-5	Silurian Tonoloway Formation	Western Maryland Railroad Line near Hancock, MD
80-18, 80-19 88031, & 89190	Silurian Tonoloway Formation	From a fold exposed in along US Rte 40, at crest of Martin Mtn, just E of Cumberland, MD
81A01	Silurian Tuscarora Sandstone	Hanging Rock Rd, just N of Clear Spring, MD
M7	Ordovician Stonehenge Limestone	Along the Potomac R., just S of Williamsport, MD
81-31, 81-33	Ordovician Rockdale Run Formation	Western Maryland Railroad Line E of Charlton, MD
79-2, 79002A	Cambrian Elbrook Formation	South side of the Potomac R., just E of Shepardstown, WV
80-1	Cambrian Tomstown Formation	Quarry just W of Smithsburg, MD, just W of South Mountain
M5, 79-4, 82005	Cambrian Weverton Formation	from Elk Ridge N of the Potomac R. across from Loudoun Heights
M-4, M-14	Cambrian Weverton Formation	South Mountain between Fox Gap & Lambs Knoll
81013	Cambrian Weverton Formation	High Knob on Catoctin Mountain
80012A, 80-14	pre-Cambrian basement	Along Rte. 17 S of Middletown, MD, but similar to that exposed between Elk Ridge and South Mountain

Key to slides of sample locations:

Sample 80A01 ***Devonian Woodmont Formation***

1. View, looking N, of the outcrop showing the general character and orientation bedding.
2. Photograph showing the character of the interbedded sandstones and shales.
3. Photograph showing the character of the beds and the mineral-filled veins that cut across sandstone beds.
4. Photograph showing the bottom of one of the sandstone beds.
5. View of 'down-to-the-west' contraction faults cutting through the interlayered sandstones and shales (see Perry, 1978).

Sample 79-5 ***Silurian Tonoloway Formation***

7. Photograph of core of a ~100m wavelength fold in Silurian Bloomsburg Formation, which is stratigraphically just beneath the Tonoloway Limestone and Wills Creek Formation.
8. Small folds in interlayered sandstones and siltstones in the core of the anticline in #7.
9. Photograph showing interlayered calcareous mudstones and limestone arenites of the Tonoloway Limestone on limb of ~100m wavelength fold.
10. Close up of bedding-normal stylolite in limestone arenite.
11. View of the top of a bedding surface; note axes of small folds and traces of bedding-normal stylolites.
12. View of top of mudcracked horizon in the Wills Creek Formation, which occurs immediately below the Tonoloway Limestone.
13. View, looking NNE, of a syncline (one of the ~100m wavelength folds) in Bloomsburg Formation,.
14. View, looking NNE, of an anticline (one of the ~100m wavelength folds) in the Bloomsburg Formation.
15. View of bedding and cleavage in the core of the anticline.
16. View of bedding, bed-parallel slip surface, and cleavage on the SE-dipping limb of anticline.
17. West dipping limb of an anticline (one of the ~100m wavelength folds). Note prominent cleavage roughly normal to bedding.
18. Close up of #17, showing thick siltstone with cleavage nearly perpendicular to bedding and 'down-to-the-west' shearing in strata just above cleaved siltstone.
19. Oblique view of the same.

Samples 80-18, 80-19 ***Silurian Tonoloway Formation***

21. View, looking NNE, of small anticline in the Tonoloway Limestone.
22. Close up of the core of the anticline, showing small fault in white-weathering dolomite and deformed gray-weathering limestone.
23. Subhorizontal bed (in core of anticline) cut by bedding-normal stylolites and containing an array of sigmoidal veins.
24. SE-dipping bed (in SE limb of anticline) cut by bedding-normal stylolites and containing arrays of sigmoidal veins.
25. Limestone arenite cut by veins overlain by muddy limestone with prominent cleavage; NW limb of anticline.

Sample 81A01 ***Silurian Tuscarora Sandstone***

27. View of the general character of the unit.
28. View of the character of beds; note cross-bedding and mud chips.
29. Slickensided bedding surface.

Sample M7 ***Ordovician Stonehenge Limestone***

31. View, looking E, of the top of a steeply-inclined bed; note pinch-and-swell boudinage with gentle northerly plunge.
32. Cross section of the same bed, showing profile of boudinaged bed.
33. Deformed pisoids in one of the limestone beds.

Samples 81-31, 81-33 ***Ordovician Rockdale Run Formation***

35. View, looking SSW, of a portion of the exposure showing a small anticline.
36. Close-up of the core of the anticline.
37. Gently SE-dipping bedding with steeply SE-dipping cleavage.
38. White-weathering calcite-filled veins in steeply dipping limestone.

Samples 79-2, 79002A ***Cambrian Elbrook Formation***

40. View, looking SSW, of SE-limb of a small anticline, showing gently SE-dipping beds with steeply SE-dipping cleavage.
41. View, looking SSW, of core of a small anticline; note prominent SE-dipping bed at left side of photograph.
42. Nearly the same field of view as #29, but from a different angle. Note the steeply NW-dipping bedding at the right side of the field of view.
43. Steeply-inclined strata from the NW limb of small anticline; note prominent pinch-and-swell boudinage.
44. Another small anticline at this location.

Sample 80-1 ***Cambrian Tomstown Formation***

No slides of these exposures included here.

Samples M5, 79-4, 82005 ***Cambrian Weverton Formation***

46. View, looking NNE, of the core of a small anticline, with bedding curving from gentle NW dip (in SE limb) to a steep SE dip (in NW limb). Cleavage dips very gently to the SE.
47. Close up of coarse-grained sandstone from this location (sample M5).
48. View, looking NNE, of the core of a small syncline, with bedding curving from nearly horizontal (in NW limb) to moderately SE-dipping in SE limb. Cleavage dips gently to the SE. Samples 79-4 and 82005 from the core of the syncline.
49. Close up of NW limb of syncline.
50. Sigmoidal veins in sandstone.
51. Pinch-and-swell boudinage in overturned, SE-dipping beds

Samples M-4, M-14 ***Cambrian Weverton Formation***

No slides of these exposures included here.

Sample 81013 ***Cambrian Weverton Formation***

53. View, looking NNE, of gently SE-dipping bed with well-defined, steeply SE-dipping cleavage.

Samples 80012A, 80-14 ***pre-Cambrian basement***

55. View, looking ESE, of outcrop. Note prominent foliation dipping to E, i.e. into the plane of the photograph and to left.
56. Close up of the deformed gneiss.
57. Dike of Catoctin greenstone, folded into an anticline with gneiss preserved in the core of the fold. View to SSE.

UNIVERSITY OF VERMONT

Department of Geography
Geotechniques - GEOG 081

Dr. L.-A. Dupigny-Giroux

Laboratory / Exercise 3 - **DUE February 24, 2005**

This exercise uses ArcGIS to allow you to explore a digital elevation model (DEM) and hillshading of the Missisquoi and Lamoille River Basins in northern Vermont. We shall begin the exercise in class and you shall complete it for submission.

TO SUBMIT: Typed responses to questions 1-4 (paying attention to grammar & spelling).
A correctly annotated colour map showing a drape of the DEM on the hillshaded model on the two basins.
Include your course ID on all work.

DATA DOWNLOAD

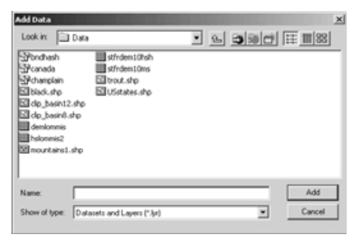
Copy the 081_DEM_exercise folder from http://www.uvm.edu/~ldupigny/081 into the My Documents folder on the desktop.

Open ArcMAP and start it with a new empty map.

1/ ADDING DATA TO A NEW DATA FRAME

Use the ADD DATA icon to add the following layers.

- Missisquoi river basin	missisquoi3
- DEM of the Missisquoi and Lamoille river basisns	demlommis
- hillshade of the Missisquoi and Lamoille river basins	hslommis2
- selected mountains in the Missisquoi river basin	mountains1



In the display page, click and drag the layers around so that they are in the following order - mountains1, missisquoi3, demlommis and then hslommis2. If you cannot see the full extent to both basins:
- go to VIEW -> ZOOM DATA -> FULL EXTENT (or use the globe icon)

2/ CHANGING THE APPEARANCE OF A LAYER

To change the mountains' symbols so that they are more visible:
- in the Table of Contents, left click on the symbol to open the Symbol selector window.
- click on the colour to change it to red.

- choose the filled diamond symbol and experiment with the size. Choose a value that will allow you to differentiate between neighbouring peaks.

To change the Missisquoi basin's appearance from a solid, opaque colour to an bold outline:
- right click on the layer and select no colour.
- left click on the layer to open the Symbol selector box. Notice that the fill colour has already been set to nothing. Click on the outline colour to change it from grey to black. Click on the outline width to change the value from the 0.40 default to 1 or 2. Click okay to see the changes.

Q1. With the current grey shading for the DEM, where are the flattest parts of the landscape?

To change the colour scheme for the DEM:
- left click on the shaded symbol to open the Select colour ramp box.
- Click on the down arrow and notice that the current shading is highlighted in a stipled outline.
- scroll down to select the ramp that shows green-yellow-brown-purple-white. This will be automatically applied when you hit okay.

Q2. Does this new DEM shading improve your perception of the overall topography in these two basins? Give 3 specific examples.

3/ INVESTIGATING THE HILLSHADE MODEL

Turn off the demlommis2 layers (uncheck the box).
The hillshade model is now visible, now that the opaque layers ahead of it in the Table of Contents have been turned off.
Zoom to the area on either side of the drainage divide between the two basins.
[If you cannot see all the peaks, use the fixed zoom out button]

Q3. Using the identify tool, what are the two mountains/ranges that lie along the southern Missisquoi watershed boundary?

Q4. What is the elevation difference (in metres) between Jay Peak and Big Jay?

Zoom to the full extent.

4/ MAKING A LAYER TRANSPARENT

Turn the DEM layer back on in preparation for making transparent.
- Double left click on the name (demlommis2).
- In the Layer properties box that opens, choose the display tab.
- Note that the transparency is currently set to 0% meaning that it is fully opaque (blocking any other layers listed after it in the Table of Contents). Experiment with the other end of the spectrum (e.g. 80% or 90%). These are rather washed out.
- Select an appropriate transparency value, apply it and close the dialog.

5/ CREATING A PRINTABLE MAP

In preparation for the final print out, we need to make the layer names more meaningful and add the ancillary elements of a good map.

Make sure that you are in the data view (VIEW -> DATA VIEW)
- Double left click on the layer name mountains1 and select the General tab. Change the layer name to Peaks. Click OK
- Repeat the process to rename the demlommis to DEM; hslommis2 to Hillshade; missisquoi3 to Missisquoi River basin.
- Double click on the DEM layer and go to the Symbology tab. Replace the 133906 (in the high value) with < 4375m and the 2396 with > 69m. OK

Make sure that you are in the layout view (VIEW -> LAYOUT VIEW)
- Insert a title (DEM & Hillshade of the Missisquoi & Lamoille River basins)

Click outside of the title box, then select it to drag it about the map.
- Insert a Legend, using all 4 layers. Click next to make any changes you would like to the font and pitch. Click next and add a border with a 1.0 point. Click next and accept the remaining defaults and click finish. Drag it to the upper left and reduce it using the lower right corner.
- Insert a graphic scale and drag it to the lower left. Double click on it to change the division units to kilometres in the Properties window.
- Insert an ESRI North 3 arrow and drag it to the upper right of the map. Resize if necessary.

Click outside the map so that it is no longer selected and go to FILE -> PRINT PREVIEW to view your handiwork. When you are satisfied ***print to the HP DESKJET 9600 series printer***.

The lab monitor will retrieve this for you.

Assignment for the
Field Trip to the Ordovician of Indiana

Mark Wilson, The College of Wooster

April 7, 2002
Geology 250: Invertebrate Paleontology

We will be leaving Scovel Hall at 6:00 a.m. to explore the sediments and rocks in the wonderful Cincinnati Group in southeastern Indiana. We are collecting from three localities within the Richmondian stage (Upper Ordovician) at the top of the Cincinnatian where the fossils are extraordinarily abundant and diverse. There is no better place in the world to see Ordovician marine life.

Your job will be relatively straightforward: collect representative fossils from each of the three sections (keeping them separate!), prepare and identify these back in the Wooster lab, and then write a report describing the taxa found and their relative abundances, and then comparing the paleoecosystems represented by the three units. This field studies report will be due on the last day of classes (May 2nd) at 8:00 a.m. We will talk in the next few labs about preparing and identifying your fossils and structuring this report.

Enjoy the trip. The fossils you collect are yours to keep, although if you find something of considerable scientific significance I'm sure you'll do the right thing!

GEOLOGY 250

Invertebrate Paleontology

Field Studies Report Instructions

(Reports are due May 2, 2002, at 8:00 a.m.)

Mark Wilson, The College of Wooster

You have large collections of beautiful fossils from our field trip earlier this month, and you have nearly completed your identifications. Now it is time to construct your final report.

Please divide your report into the following sections --

Introduction.--Tell the reader where you went, when you went and what you did. This shouldn't be too hard since the information you need is in the field guide I gave you. This introduction is not to be more than a paragraph.

Stratigraphy.--Briefly describe the rock units you collected from. I don't expect much more here than what you find in the field guide and the Davis book.

Systematic paleontology.--List here your identifications in the systematic fashion which characterizes all paleontological work. For example, if you identify the trepostome bryozoans *Dekayia gracilis* and *Parvohallopora* in your samples, list them as follows (with the localities):

Phylum BRYOZOA
Class Stenolaemata
Order Trepostomata
Parvohallopora
(Stop #1)

Dekayia gracilis
(Stops #1 and #3)

The only higher taxonomic levels you need to use are those in the yellow lab sheets. Try to identify most specimens to at least the genus level, but this will be impossible for some (especially bryozoans). For fossils you collected which are not represented in the lab, use the taxonomic levels from the *Treatise*. Don't forget trace fossils.

Taphonomy.--Provide an assessment of the preservation of the fossils you collected from each locality. Are the shells broken or whole? Are there any signs of predation or biological erosion (borings)? Do the fossils appear to have been transported after death or are they preserved in place? Are some taxonomic groups preserved better than others? Why? Here you are telling the reader what may have happened between the living community and the fossil assemblage. Contrast the three collections.

Paleoecology.--Now the fun part. Interpret your fossil assemblages as reflections of the original living communities. What were the most common organisms? What were the most common feeding modes? What were the relationships between the organisms? What sort of substrate was present for each community? What sort of environment do you hypothesize for each community? I'm not looking for an I.S. thesis, so keep your discussions simple and short. It is important to cite *evidence* for your conclusions. If you go beyond the evidence to develop an idea, say so. Be sure to compare and contrast the three assemblages.

Turn your report in to me at the beginning of class on May 2nd. Have all the specimens you wish to be part of this project in your drawer with all the appropriate labels. I will then read your reports and match them with your specimens.

The paper will be graded according to the criteria on the reverse sheet. This summary will be completed by me and stapled to your papers when they are returned.

Invertebrate Paleontology

Field Studies Report Summary Sheet

Spring 2002

NAME:_____________________________

I. Organization of report (20%):

Headings clear and appropriate:

Introductory materials adequate:

Logical flow within and between sections:

II. Content of report (65%):

Systematics are clear:

Specimens adequately labeled:

Accuracy of identifications:

Breadth of material assessed:

Evidence behind interpretations is clear:

Creativity and innovation:

III. Other (15%):

Typographical errors:

Spelling:

Grammar:

FINAL GRADE: _______%

Peaks Island Project

All of us participated in the field research for our class project on the geology of Peaks Island. In the week after our weekend field trip, we compiled our field data, annotated photos, and prepared rock samples. For the next three weeks, we will divide into groups to address different aspects of the project during our laboratories. Then, during the last week of the semester we will present our research through a short paper (abstract) and a presentation. Details of the abstract and presentation assignments are on the next two pages. Below are brief descriptions of the laboratory projects that focus on different aspects of the geology of Peaks Island. We'll teach you the laboratory techniques that you need to complete the projects. By Monday November 8, I ask that you email your top three laboratory project choices to me (rbeane@bowdoin.edu).

Laboratory projects

Geochemistry

What can we interpret about the type of volcano and the composition of magma that formed the Cushing Formation as observed on Peaks Island? This group will plot geochemical data for five samples using the program Igpet, examine corresponding thin sections (microscope slides) for these samples, and compare the results with data from modern volcanoes.

Cushing rocks

What do the minerals and textures of the rocks tell us about the igneous Cushing Formation? We've made over 20 thin sections (microcope slides) of rock samples we took on Peaks Island. Each person who chooses this project will individually examine 1-2 thin sections using the petrographic and scanning electron microscopes. Then, we will combine this information to describe the range of rocks exposed on Peaks Island.

Pyroclasts

What might the length and width data from the pyroclasts tell us about deformation in the area? What are the compositions of the pyroclasts, and how do they compare with the matrix composition or compositions of non-pyroclastic volcanics on Peaks Island? This group will do a strain analysis of the clasts, and examine thin sections of the clasts using the petrographic and scanning electron microscopes.

Dike

What is the mineral and geochemical composition of the dike on Peaks Island? And, how does it compare to other local dikes? This group will examine the thin section of the dike sample using the petrographic and scanning electron microscopes, and will plot the geochemical data for the dike in relation to other dikes analyzed by previous Geo101 classes.

GIS

The field and laboratory data collected for this project need to be organized using a Geographic Information System (GIS). Those who choose this project will work with Joanne outside the normally scheduled lab (instead of coming to the scheduled labs) to use GIS to place the observed geologic contacts and sample localities on a digital map and create links for photos and other data.

Webpage

Photos taken in the field will be annotated and incorporated into a web page that includes a map of the area. This project is ideal for someone who was in Scott's or John's groups. The accompanying write-up will focus on the field relations and variety of rocks found on the Peaks Island.

Blue quartz

What does the blue quartz found with the pyroclasts signify? This group will do a literature search for references and interpretations of blue quartz. They also will examine the blue quartz collected using the petrographic and scanning electron microscopes.

Peaks Island Abstract due Tuesday, December 7

Each of you will need to write a **500 word** abstract of your project. This part of the project is your own individual work; it is not to be done in collaboration with others. It is due on December 7, the same day that you give your presentation.

An abstract is a concise summary of research that precedes an article in a journal or that is placed in a volume distributed at a conference. Generally the abstract is designed to stand alone without referring to the paper or presentation. A well-prepared abstract will summarize the important points clearly, and help the reader decide whether to read the accompanying paper or attend the presentation. Concise writing is imperative: abstracts submitted to geology journals and conferences generally have word limits between 200 and 500 words. You are writing an extended abstract with a limit of 500 words. The extended abstract also should include one key figure or table and a references cited section.

Your abstract should state the main objectives of the research and explain why it is important, describe the methods used, and summarize the results and conclusion. You should put as much specific information into your abstract as possible, including locations, mineral and rock names, significant chemistry, important texture and size information, and so forth. Examples of abstracts will be available in Druckenmiller 216.

Peaks Island Project - Power Point due December 2 - Group Presentation due December 7

After completing your research, it is time to share the findings with the other students in the class through a presentation. Effective presentations promote the exchange of ideas and information between many people, and they are a primary means by which geologists share their research at scientific meetings.

For this presentation, each group will prepare a six minute Microsoft Power Point presentation. This should allow all groups to give their presentations on December 7, with a few minutes allowed for questions in between the presentation. Each group will be allowed 6 Power Point slides. Your presentation will be due December 2. You should put your final presentation on the Collaboration Server in folder Geology\Courses\geo101f04\drop_box. Choose your slides carefully to share all aspects of your research (for example field, petrographic, SEM, or geochemistry), as well as your conclusions and any insights your have made.

Assuming a presentation follows the assignment, then it will be graded primarily as follows:

A
- ✓ Strong research
- ✓ Conclusions are insightful and follow clearly from data
- ✓ Careful organization
- ✓ Photos, graphs, or illustrations in the slides substantiate the oral presentation
- ✓ Clear and artful presentation of information and ideas

B
- ✓ Substantial research
- ✓ Conclusions follow clearly from data
- ✓ Logical flow of information
- ✓ Slides support presentation
- ✓ Clear presentation of information and ideas

C
- ✓ Competent research
- ✓ Conclusions follow from data
- ✓ Adequate organization
- ✓ Slides relate to presentation
- ✓ Perfunctory presentation

D
- ✓ Rudimentary research
- ✓ Unclear how conclusions follow from data
- ✓ Unclear or ineffective organization
- ✓ Uncertain relation of slides to presentation
- ✓ Overall impression of haste

F
- ✓ Superficial research
- ✓ Lacks conclusions or conclusions don't follow from data
- ✓ Lacks organization
- ✓ Slides absent or irrelevant
- ✓ Below the acceptable level of college work