Early Emersion: A Sophomore Level Field Project-Based Core Course in Geology

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A Fall semester field course for approx. 20 students

Approach:

Geology 101 is a project-oriented course. There are no examinations. Final grades are based on 4 to 5 written reports, numerous field projects, field notebooks, class assignments, and class participation. This last item is based on the student's understanding of the material and concepts developed throughout the course. I assume that the students have had only 1 course in Introductory Geology. The course emphasizes concepts and analytical reasoning and we develop the necessary geological terminology during the semester.

Impact of the field class on the remaining curriculum:

∑ Faculty teaching the introductory and advanced Geology classes can assume a set of skills in their students, including map and compass, field note-taking, three dimensional visualization, computers (graphics, stereonet, etc), and scientific writing

∑ The three common core courses (Earth History, Field Geology and Earth Materials) guarantee a focus on field work and rocks and minerals early in a student's training, prior to specialization in surficial, environmental, solid earth and other sub-disciplines in Geology.

∑ The many hours in the field and in van rides to and from project sites provide a bonding experience for the students in each year's class.

History of the Field Course at UVM:

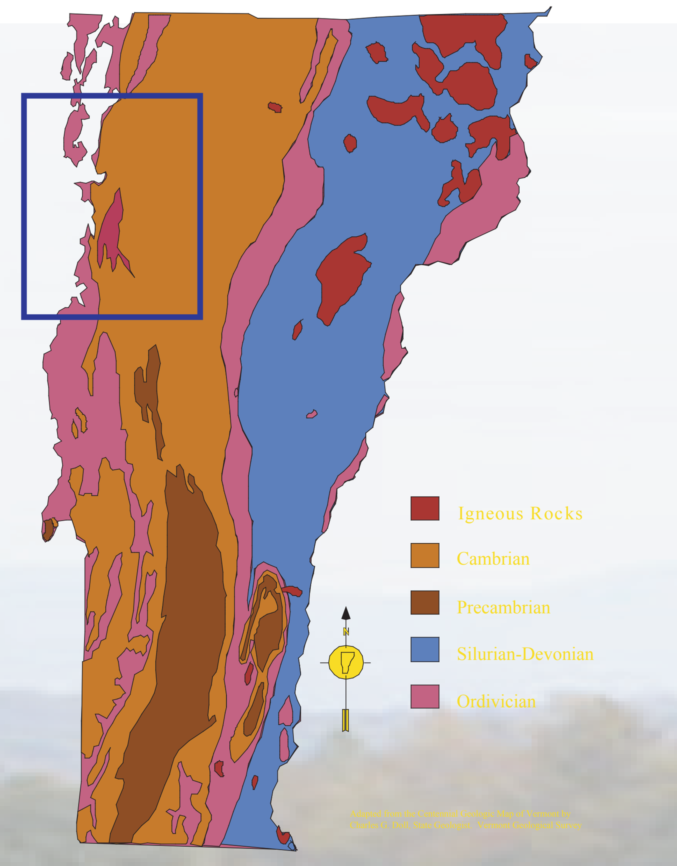
The course was designed and offered by the late Rolfe Stanley upon his arrival at UVM in the early 1960's. While all other components of the Geology curriculum have evolved over the years, Field Geology has remained the bedrock of the UVM Geology major. This illustrates the centrality of this class to both the Geology major and minor at UVM.

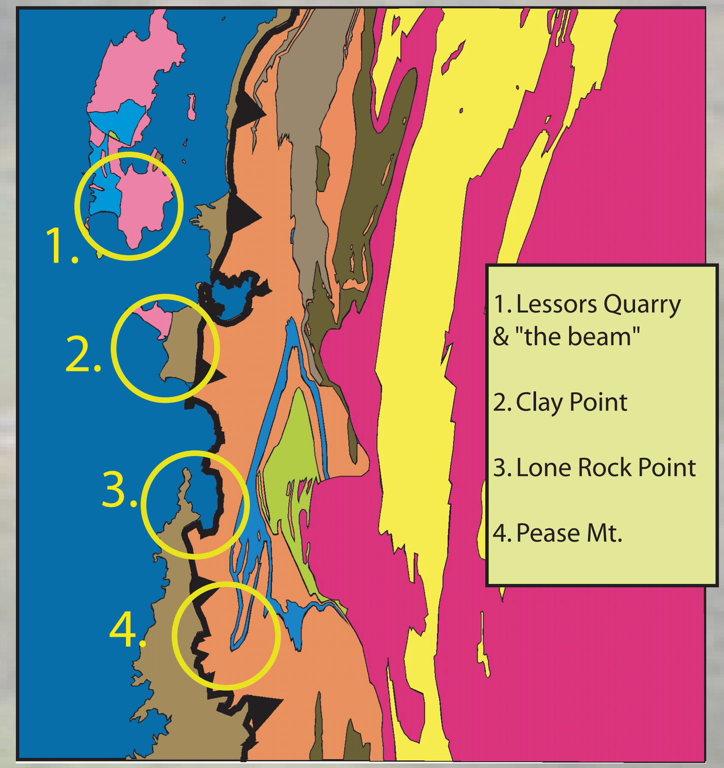
Course Goals:

∑ To develop an understanding of earth materials and their spatial relationship in field outcrops, and an ability to document and interpret such materials in the context of global earth processes.
∑ To develop an understanding of the scientific method and an understanding of geologic processes within the framework of plate tectonics using local geologic outcrops as data sources.
∑ To develop an ability to apply mapping and field measurement techniques to understand and interpret new or unknown geologic environments.
∑ To develop an ability to use mathematics in field mapping, drafting, data reduction, and graphical representation of both three- and four-dimensional information.

Skills Taught:

∑ Field Geology is an investigative course conducted in the field and computer laboratory without formal exams. The field excursions challenge groups of students to apply understanding to new or unknown geologic environments preserved in Vermont.
∑ Students complete several professional-style reports that synthesize geologic information collected by teams of 2-3 students. Reports include maps, graphics, and interpretive text. The field reports follow a logical progression through the scientific method thought process.
∑ The course involves numerous field excursions to local rock, sediment, and soil outcrops. At specific sites students collect and interpret numerical data in the form of compass readings, surface geometry measurements, vertical profiles, subsurface geometric projections, survey points, length and angular measurements, latitude and longitude measurements, and elevation measurements in the field and from maps.
∑ Other detailed geologic information is collected using mapping, sketching, and orienteering skills, and reducing these data into graphical presentations using computer technology. Mapping exercises require students to scale features from field observations to map and notebook representations.
∑ Oral presentations are conducted using Graphics & PowerPoint software following the format of a professional meeting.
∑ Calculations, trigonometry, three-dimensional graphs, basemaps and geo-referencing techniques are used in the field reports and oral presentations.





THE GEOLOGY MAJOR AT UVM

1st or 2nd year:
Fall semester: a variety of courses at the introductory level
Spring semester:
Earth History
Math and Ancillary Science
General Education Requirements

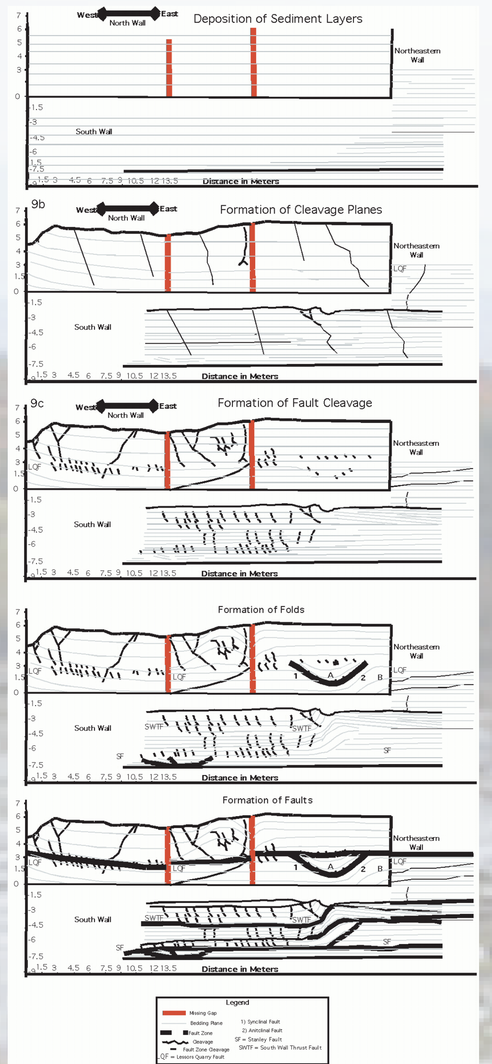
2nd or 3rd year:
Fall semester: Field Geology
Spring semester:
Earth Materials
Math and Ancillary Science
General Education Requirements

3rd or 4th year:
3 or more Geology courses at the intermediate level or above
Math and Ancillary Science

1. Project #1: Lessors Quarry: Building basic field skills.

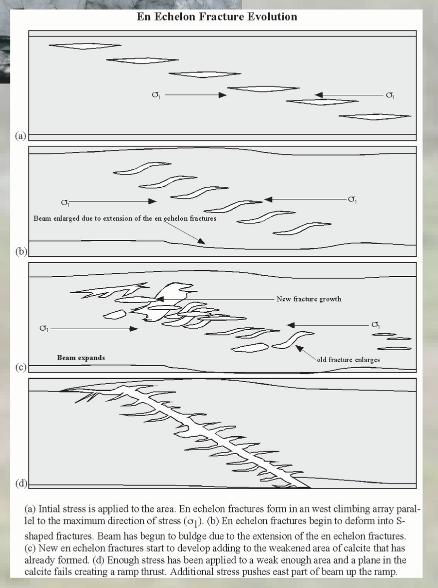
4 week project that develops students foundation in observation, note-taking skills, sedimentary rock descriptions and interpretation, measurement and analysis of structures using a compass, orienteering skills, trigonometry, profile construction and use of graphics software (Adobe Illustrator). At the end 4th week the students synthesize their data sets and observations into a time-sequential model where they test theoretical models of fault bend folding. In the process they develop and test models involving fault-bend folding. They generally conclude that the quarry is composed of two superposed fault-bend fold systems.

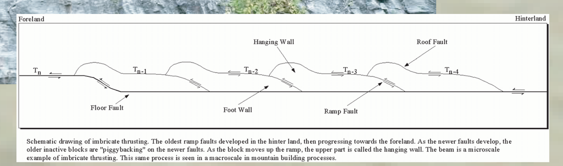
Time-sequential model

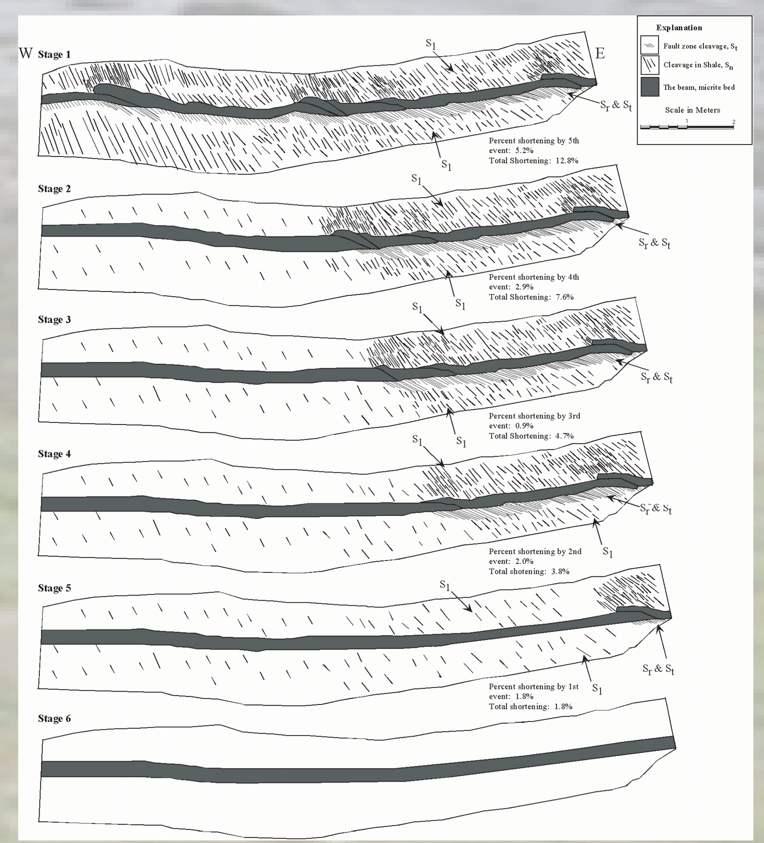


2. Project #2: "The Beam": Building quantitative analytical skills.

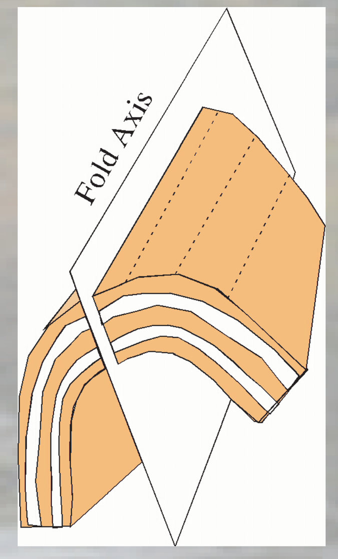
Measuring and calculating the percent shortening of the beam.
The beam refers to the distinctive micrite limestone bed surrounded by shaley-limestone. It has accommodated compressional stresses through the formation of five discrete ramp faults. We can use these structures to help us determine the amount of shortening the beam has experienced.
Measuring the amount of displacement along each ramp fault can be accomplished by following these steps carefully...
Lastly, use the following equations to determine the total shortening of the beam.
St = sum of measured shortening lengths; Lf = length of the final beam (at present); Lo = length of the original beam,
(St + Lf) a minimum length for Lo.
(Lo – Lf)/Lo x100 = % shortening of the beam.
Going further questions:
1. The beam accommodated the compressional stresses by faulting and folding, how does the surrounding shale accommodate these same stresses? Is the response different, why?

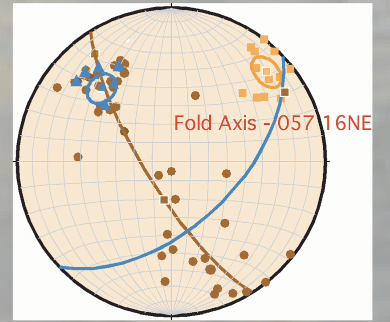


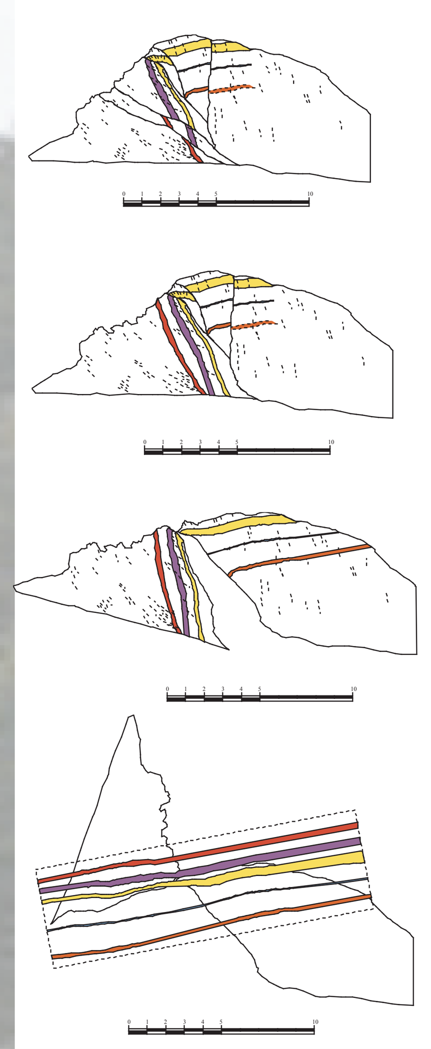




3. Project #3: Clay point: Three dimensional analyses of folds and faults using an equal-area stereonet.

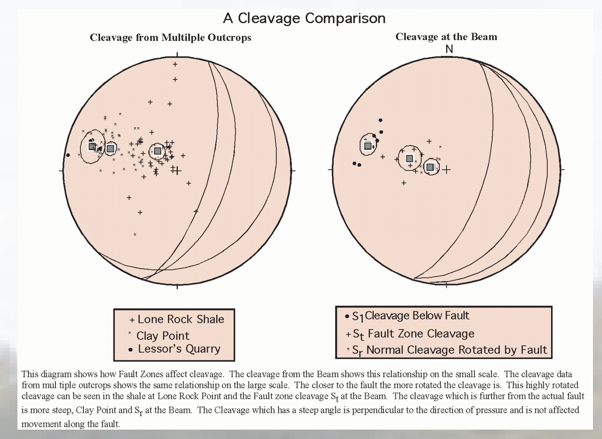






4. Project #4: Lone Rock Point: Correlations and regional synthesis.

1. What styles of deformation affected western Vermont in the Paleozoic?
2. Which model(s) of thrust tectonics best explain the places we have seen?
3. Is the deformation at these different places related to the same or similar events?
4. How were the mountains of western Vermont built?



COURSE EVALUATION

Since the Geology Department adopted a uniform course evaluation form in 2000 and could begin calculating averages, the Field Geology course has consistently received above average evaluations from students:

Year	course grade	departmental average
2003	10.4	9.3
2002	10.2	8.9
2001	10.1	8.78

Extracted student comments from the evaluation form include:

∑The fieldwork and computer lab work were very valuable, many new skills learning.
∑I learned how to approach analyzing an outcrop area.
∑Learning in the field!
∑ The field knowledge and skills in this class were priceless. They will be useful no matter which field or job one aspires to.
∑ Time in the field developing a foundation of field geology. Also creating figures and drafts of the data collected.
∑Class taught us skills that can be applied to the real world.
∑ I could see and understand what was happening
∑ The fieldwork was beneficial hands-on learning

Conclusions:

1. Students can handle doing this early in the curriculum because of the engaging format of the class (minimal lectures and lots of hands-on field projects).
2. It allows other classes to build on skills already mastered. This allows us to teach other classes (structure, geomorph) at a more advanced level than is normally possible because of the material covered in Field class.
3. With this class alone the student has a number of hours in the field approaching that of some field camps.
4. The positive reaction to early skill acquisition enhances the student's opinion of the value of majoring in geology. "I really am learning something useful and interesting that I am able to apply not only to geology but also to other disciplines."