



# EVOLUTION OF THE GEOLOGY UNDERGRADUATE RESEARCH EXPERIENCE AT FORT LEWIS COLLEGE, 1964 TO PRESENT

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## ABSTRACT

Research projects have been part of the geology major at Fort Lewis College since 1964, when geology majors chose between original research and a literature review. Some original research (often mapping) began to be required for all senior projects in the 80s. In the 90s, projects expanded to a 1.5 year process including proposal-writing during junior year, followed by a full year of research. Both expectations and numbers of majors have increased in the past 15 years, leading to conflicts.

Our program has recently expanded its options for senior projects to reduce the demands on faculty and students. FLC seniors now have four options for their projects (original research, often related to faculty projects; REUs; internships; and literature reviews). All options include a final paper and an oral GSA-style presentation. In addition, REUs and internships require a portfolio summarizing the student work; literature reviews require an interview with a primary author and a focus on historical development of the ideas. All students begin their work in a junior research course, in which they explore possible topics, contact other organizations about collaborating, write proposals (including external) for funding, and begin writing a thesis background; work continues through their entire senior year.

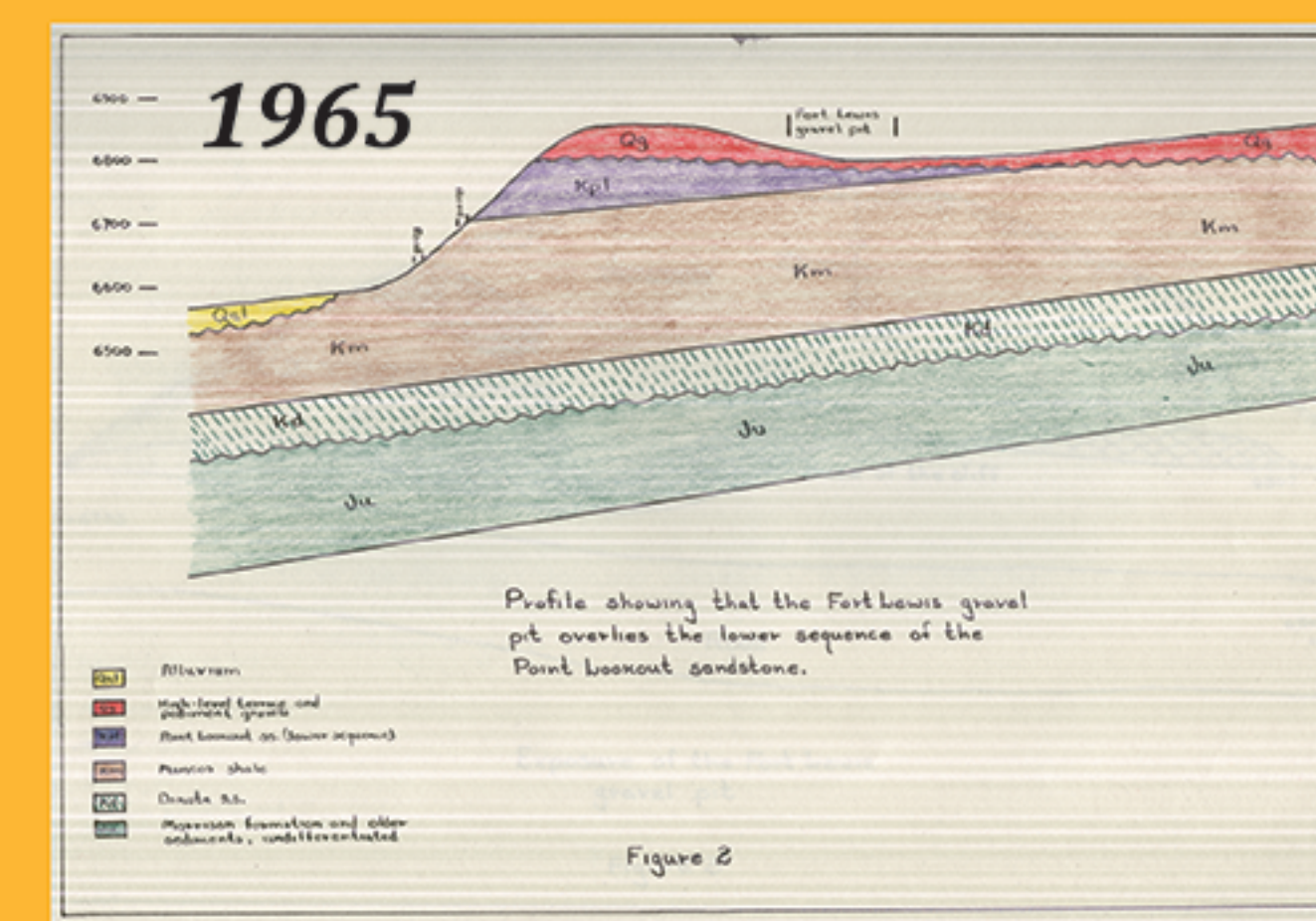
Each option has pros and cons. Internal (FLC faculty) and external (REU) research projects prepare students for graduate school, may provide experience with techniques not available at FLC (e.g. stable isotopes, cosmogenic nuclides, U-Pb zircon), and may pay students for summer work. However, advising these projects is time-consuming, creating extra demands on faculty with heavy teaching loads, and funding 20+ students per year is challenging. Literature reviews are inexpensive and allow students to explore topics beyond the expertise of FLC faculty, but do not provide experience doing science and look weaker on a resume. Internships provide valuable work experience, but any data that the students collect may be proprietary. Both internships and REUs suffer from late decisions (making preparation difficult) and uneven communication between the summer mentor, the student, and the FLC faculty advisor. Despite their weaknesses, the four options are a necessary response to increases in numbers of majors.

## HISTORY

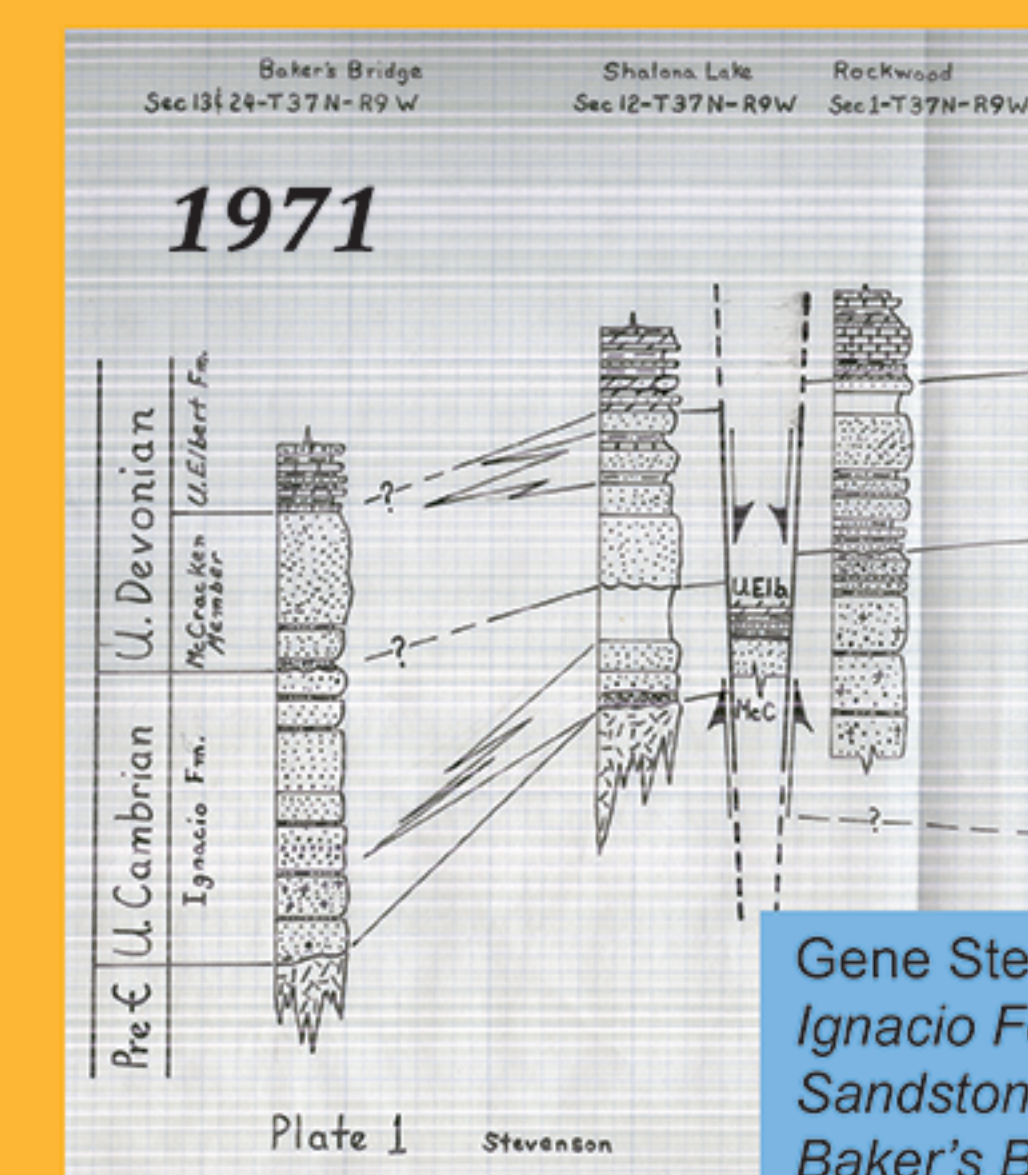
### 1960s - 1990s

Choice: research project or literature review

- Research
  - Field-based
  - Local geology
  - One semester
- Literature review
  - Majority of projects



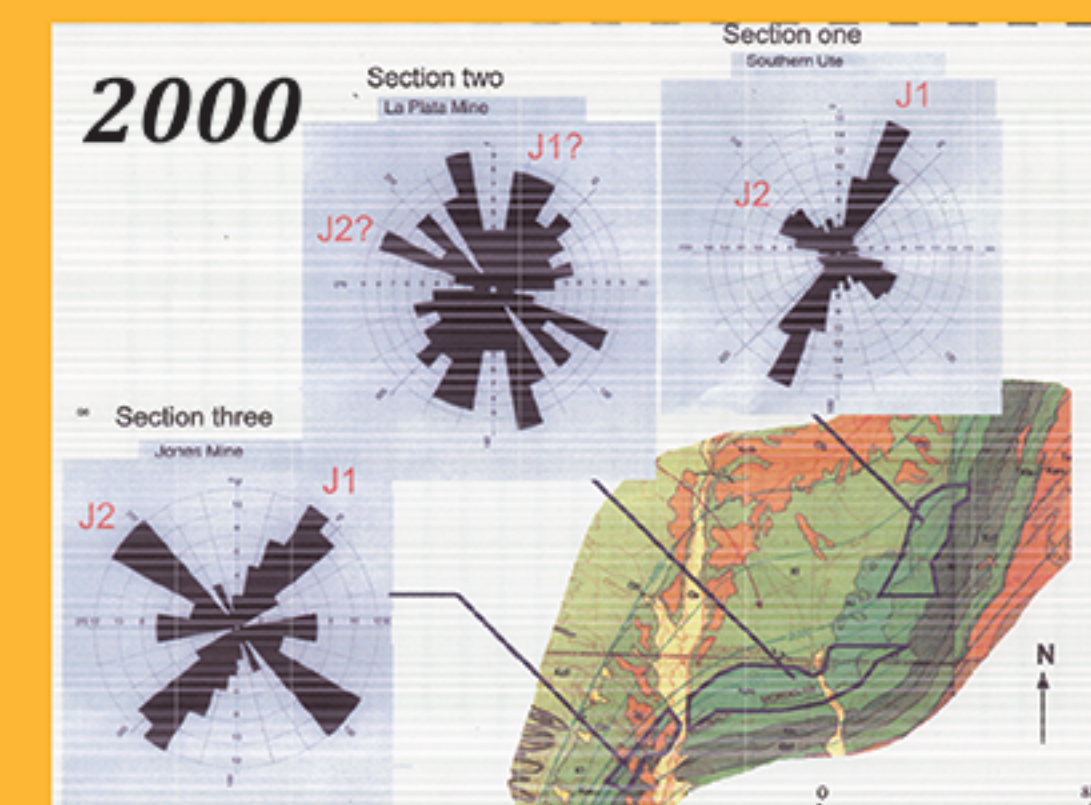
Wayne Miller, *Geology of the Fort Lewis Gravel Pit*



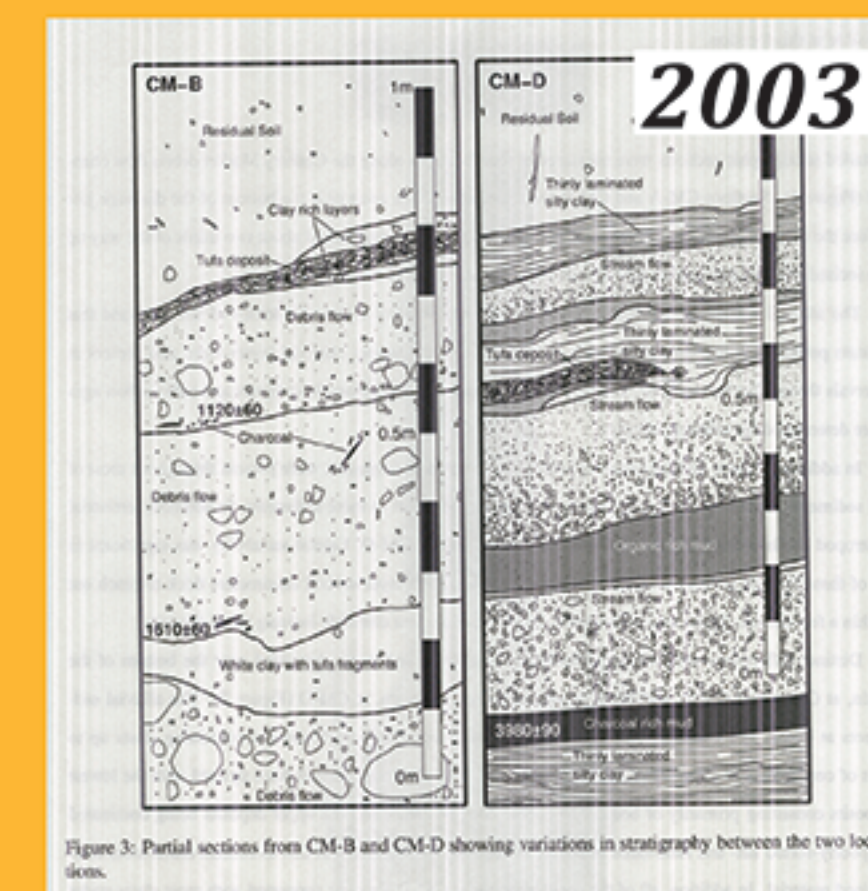
Gene Stevenson, *Stratigraphy of the Ignacio Formation and McCracken Sandstone Member-Coalbank Pass to Baker's Bridge, southwestern Colorado*

### 2000s

- Required research project
- Proposed during Jr. writing course
- Two-semester sequence
  - Fall: data collection
  - Winter: presentations
- Mentored by faculty (no teaching credit)
- REUs, internships needed to continue work during academic year
- Encouraged: presentations at GSA, AAPG, and/or AGU meetings



Cyndi Hilliker, *Joint Analysis of the Hogback Monocline around La Plata Mine, San Juan County, New Mexico and La Plata County, Colorado*



Jedediah Frechette, *Postfire basin response and the history of wildfires and debris flows near Vallecito Reservoir, Colorado*

Shannon Boesch, *Stromatolitic weather vanes in Western Pangea? Current oriented stromatolites in the Pennsylvanian Hermosa Group, western shelf of the Paradox Basin, SE Utah*

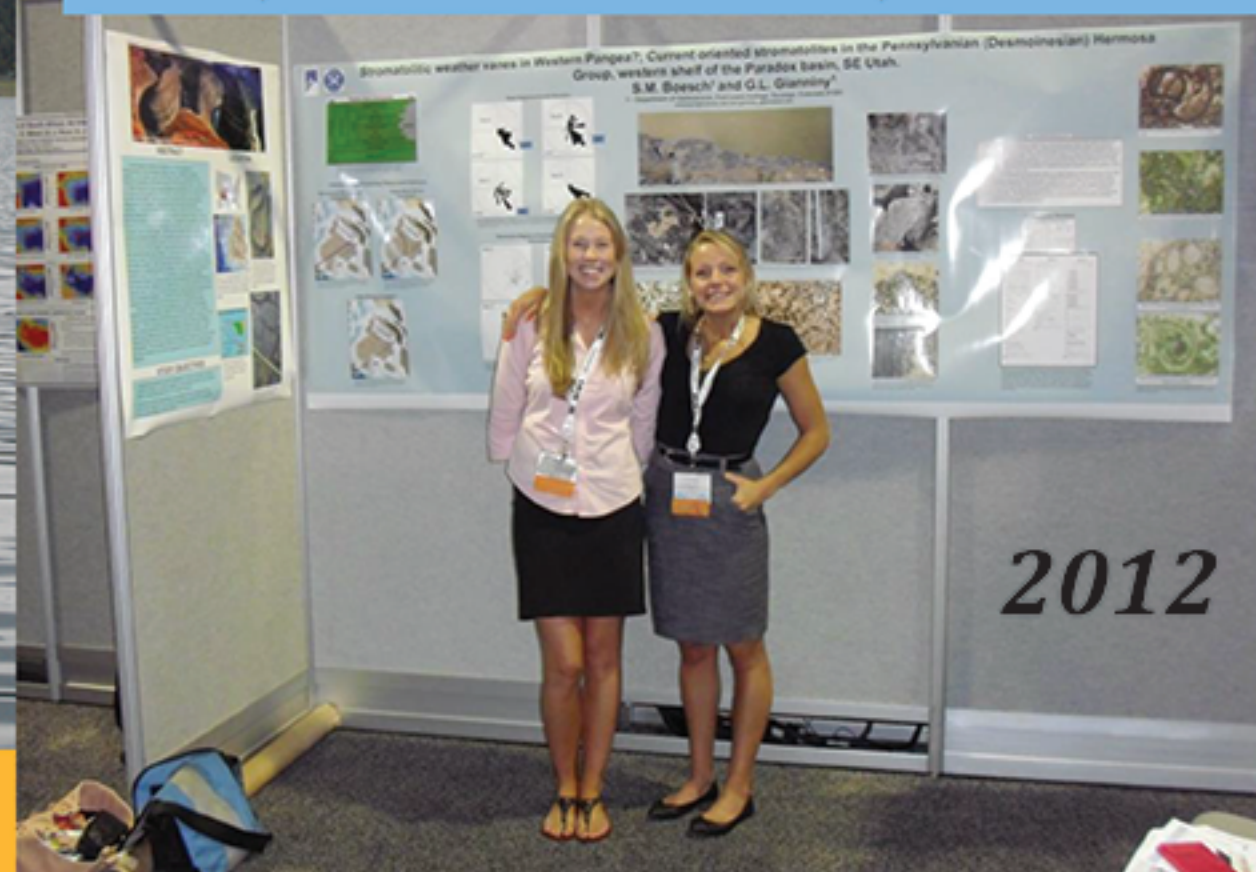
and Amanda Peterson, *Late Carboniferous (Moscovian) Microbial "shrubbery"? Intricate Digitate Stromatolites of the Barker Creek Interval, Western Paradox Basin, SE Utah*

2011



Cody Mason, *Rate and Timing of Deglaciation Using <sup>10</sup>Be Cosmogenic Nuclide Surface Exposure Dating, Mt. Massive Wilderness, CO, USA*

2012



2012



2012

Trevor Downing, *GIS and Soil Analysis to Determine Slope Stability and Trail Opportunities: Lake Nighthorse, Durango, CO*

## Introduced in core courses

### Freshman

Florida River Project in some intro courses

- Graphing
- Data collection & analysis
- Scientific-style paper
- Powerpoint-aided research group discussion



### Junior

#### Geomorphology

- Data collection & analysis
- Powerpoint presentations

#### Stratigraphy & Sedimentology

- Propose group research projects
- Poster presentations



#### Structural Geology

- Separating observations and interpretations

#### Field Camp

- Professional reports & maps
- Collecting field data to test hypotheses

## Extended in elective courses

### Igneous & Metamorphic Petrology

- Literature review
- Thin section analysis of research samples
- Travel to labs to use instruments
- Hypothesis testing



### Advanced Structural Geology

- Modeling
- Mini-project
- Proposal writing



### Advanced Sedimentology & Stratigraphy

- Advanced literature review

## Final Capstone Project

### Winter Junior Year: Research Methods

- Explore possible research topics
- Select research topic & advisor
- Write proposals for funding
- Internal undergraduate research grants
- Colorado Scientific Society
- GSA Rocky Mountain Section
- Apply for REUs, internships
- Contact outside organizations about collaboration
- USGS / BLM / BoR
- Labs (NM Tech, Arizona, Purdue, Texas, UNM)
- Begin writing thesis background
- Exposure to research topics
- Research ethics
- Citation style
- Data analysis & presentation
- Scientific critique & peer review
- Formulation & evaluation of hypotheses
- Safety
- Professional writing styles (consulting reports, scientific articles, popular science articles)

## TODAY

### Senior Seminar Options

#### Initial planning

- Faculty approval to serve as advisor on project.
- Primary research may also include mapping project with geological interpretation & include a geologic problem that can be addressed using mapping.

#### Preparation

- Submission of a research proposal / mapping project before work is initiated (faculty will determine designated map area, etc.)
- Submit a request for funding from a source other than the Geosciences Department (does not preclude attempting to get funds from the dept.)

#### Final Products

- Presentation of research at a regional scientific meeting or FLC Senior presentations.
- Final Research paper.

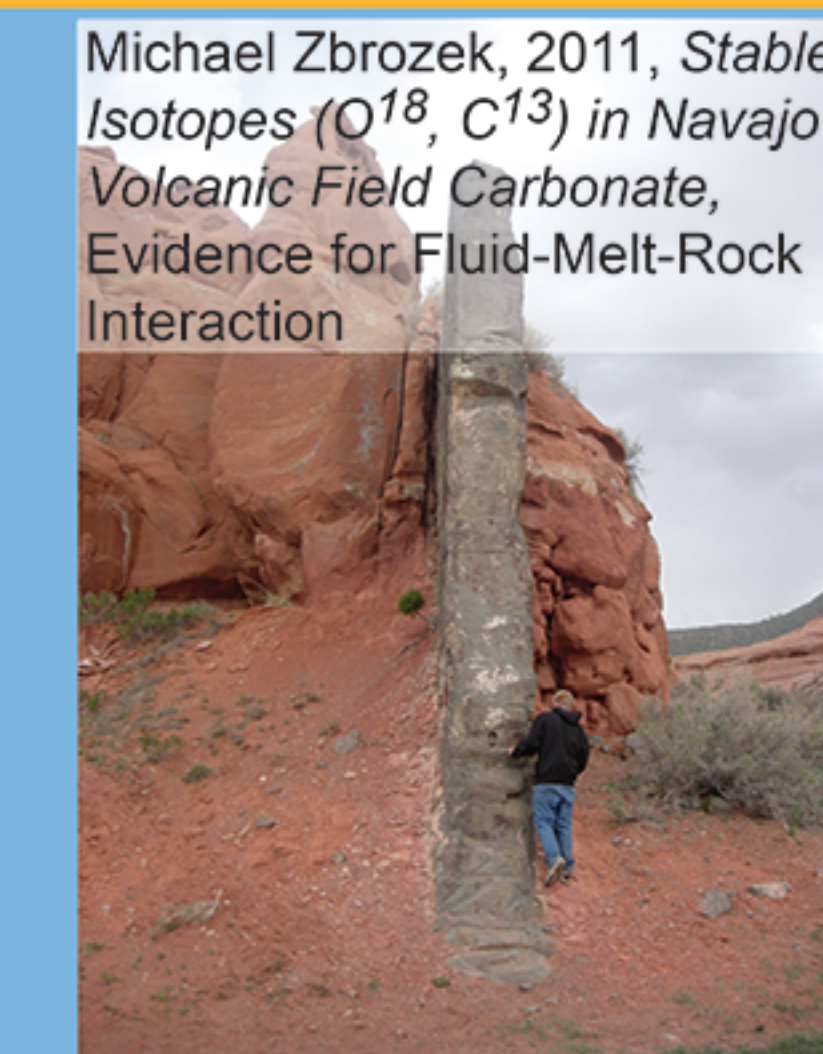
#### Pros

- Good preparation for graduate school.
- Experience with techniques not available at FLC.
- May be paid (depending on funding).
- Authentic experience of scientific inquiry.
- May contribute to publishable research by faculty.
- Experience writing proposals for their own funding.

#### Cons

- Challenging to find research topics for >20 students per year.
- Time-consuming for faculty (mentoring student research is not part of teaching load).
- Funding is limited.
- Few students can be paid for their time; most have to fit field work around other summer jobs.

### Primary research



Michael Zbrozek, 2011, *Stable Isotopes (<sup>18</sup>O, <sup>13</sup>C) in Navajo Volcanic Field Carbonate, Evidence for Fluid-Melt-Rock Interaction*

- Letter indicating acceptance; must have a FLC faculty agree to review progress and products. Faculty approval

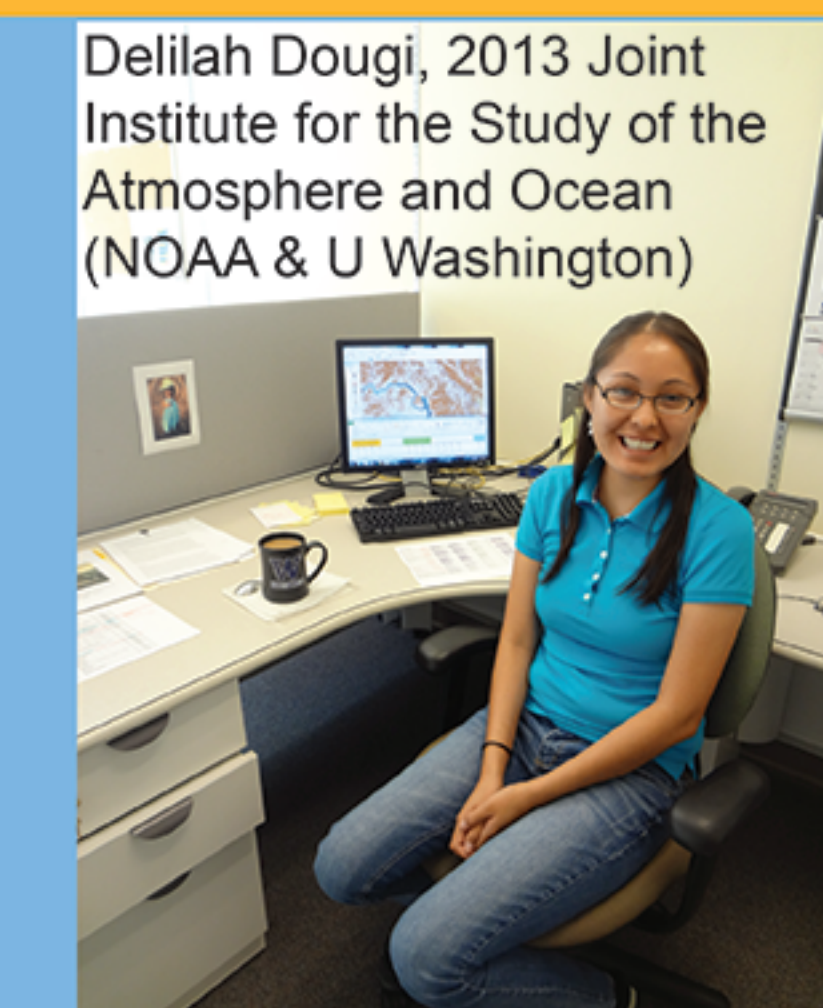
- Portfolio detailing the record of work / contribution done during the project

- Presentation of research at a regional scientific meeting or FLC Senior presentations.
- Final Research paper.

- Good preparation for graduate school.
- Experience with techniques not available at FLC.
- Possible field work in a new location.
- Access to research expertise beyond FLC faculty.
- Paid.

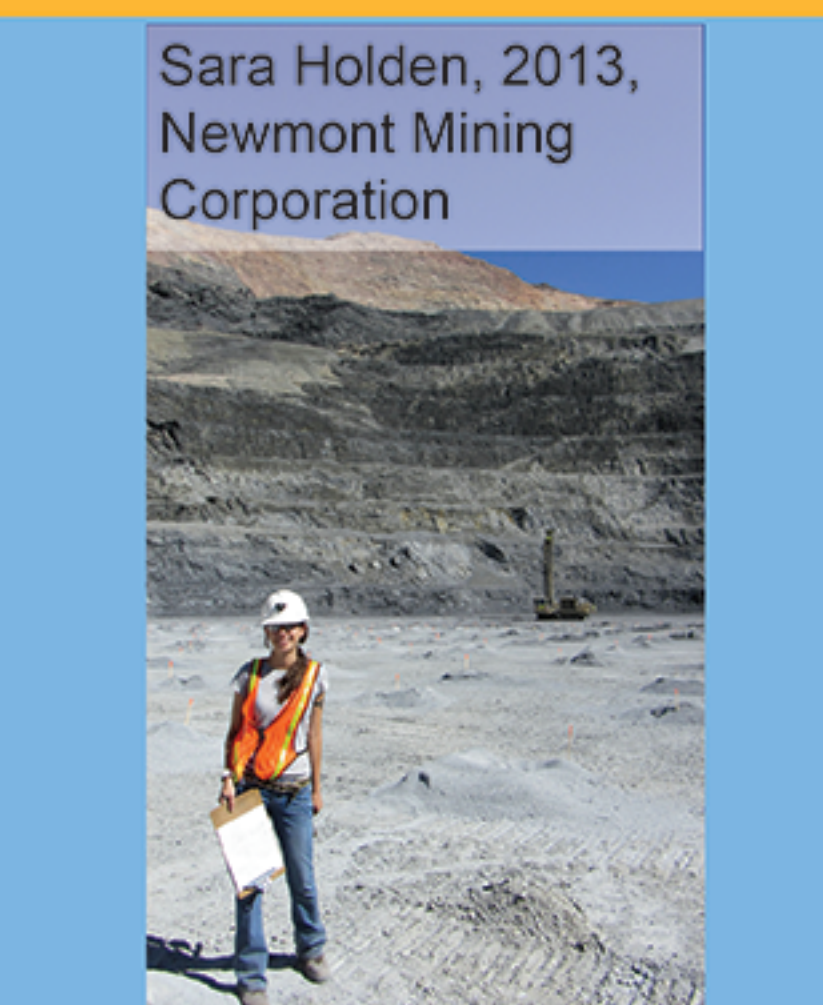
- Limited opportunities.
- Admission to REU programs usually happens in March or later, leaving little time to read relevant literature and write a proposal before summer work begins.
- Uneven communication between REU mentors and FLC advisor creates challenges for writing final paper and preparing oral and poster presentations.

### REU



Delilah Dougi, 2013 Joint Institute for the Study of the Atmosphere and Ocean (NOAA & U Washington)

### Summer internship



Sara Holden, 2013, Newmont Mining Corporation

- Letter indicating acceptance into internship; must have an FLC faculty agree to review progress and products.

- Portfolio detailing the record of work / contribution done for the company including specific information on job duties, accomplishments, etc.
- Statement of how this internship contributed to career interests.
- An essay that details one of the job duties & outlines the tasks performed.

- Final report should include importance of the job/skills obtained/contributions/etc.
- Presentation of research at a regional scientific meeting or FLC Senior presentations.

- Valuable work experience.
- Enhance students' resumes.

- Limited opportunities.
- Selection for internships may happen late compared to senior thesis preparation.
- Nature of project uncertain before summer work begins.
- Data collected may be proprietary.
- Scientific inquiry may not be emphasized in project.

### Literature review



Adam Zurn, 2013, *Proposed Dating of Mass-wasted Rock Slabs from Varnish Microlaminations: Castle Valley, Utah*

- Faculty approved topic; might want more than one advisor on these projects to provide a breadth of perspective.

- Topic must be current / topical & relevant & include recent research published in peer-reviewed journals.
- Topic should include a way to test competing models, if possible.
- Outline of topic must be approved before proceeding.

- Final report shall include at least one interview with one of the primary authors who have published on the topic. Report must address the relevance of the topic in the advancement of geologic ideas.
- The chronological & historical evolution of the topic & its development must be presented.
- Presentation at FLC Geosci Symposium

- Inexpensive.
- Allow students to explore topics outside the expertise of FLC faculty.
- Develop sense of history of the discipline.

- Does not provide direct experience with scientific inquiry.
- Looks weaker on resume.

What are we really trying to achieve with undergraduate research - is it the product, or is it the process?  
Is one model best for all students?