GG 4446/6446
Summer Geology Field Camp
6 credit hours

Catalog Description: Three hours lecture and three hours lab. Geologic maps, stratigraphic columns, structural cross-sections and reports will be prepared based on field data collected by the student.

***Introduction and Course Goals*:** Field geology is, essentially, a comprehensive practicum of geologic training in a field setting. Field geologists must synthesize all of their knowledge (i.e., mineralogy, petrology, structural geology, geomorphology, paleontology, sedimentology, hydrology) to adequately observe and describe features (i.e., rocks, structures, landforms, sediments, water) in order to interpret geologic history (e.g., tectonics) and/or contemporary dynamics (e.g., seismicity, groundwater flow) of a study area. Field observations of geologic phenomena range from measurements of rock orientations using a compass-clinometer to advanced geophysical surveys — and every field technique in between. Irrespective of the technology used to make observations in the field, the ability to take detailed and organized notes, make effective sketches, and accurately determine geographic position is paramount to any successful geologic investigation. Further (and not merely as a side note), field geologists must maintain a professional attitude during the course of a trip, make observations consistent with the objectives of the field investigation, and prioritize safety. Good field geologists are good teammates – they help solve problems instead of create them. This course requires each student to commit to long working hours, commonly in physically demanding conditions (e.g., high elevation, hot or cold temperatures, long hikes), while exhibiting determination and focus to complete each geologic project. Successful completion of this hands-on, project-oriented course will serve as affirmation that students are prepared to effectively and safely implement field projects designed to solve both applied and theoretical problems in geology.

Learning outcomes: By the end of the course, students should be able to:

1. Make appropriate observations in the field consistent with project objectives.
2. Accurately determine geographic position in the field using topographic maps or other instructor-supplied media.
3. Accurately determine mineral and rock composition at exposures in the field.
4. Accurately identify fossils (or trace fossils) at exposures in the field.
5. Accurately identify stratigraphic units at exposures in the field.
6. Competently apply traditional field techniques (e.g., Brunton compass strike/dip measurements, Jacob staff) to determine orientation, thickness, and/or internal fabric of geologic features.
7. Competently use technology (e.g., GPS, photography, water-quality instruments), as necessary, in the field.
8. Take effective and detailed notes in the field.
9. Make effective sketches of rock exposures or other geologic features in the field.
10. Competently measure geomorphic and hydrologic variables in the field.
11. Prioritize safe practices and good judgment while working in the field.

12. Accurately prepare geologic cross-sections and fair-copy geologic maps based on field data.
13. Offer logical hypotheses based on field observations to explain formation of observed geologic strata, intrusive igneous and metamorphic units, and geologic structures.
14. Accurately compute and interpret geomorphic and hydrologic field data sets.
15. Prepare professional reports based on field projects.
16. Exhibit good team-player qualities through participation in cooking, cleaning, organizing, and supporting all logistical components of the course.
17. Exhibit personal qualities that are conducive to a professional work environment by respecting instructors, other students, and other supporting personnel.

Methods of Evaluation: Student Interpretations of field geology will be compared to published documents. Work will be graded on neatness, accuracy, professionalism, standard map components (title, scale, key, etc.) and demonstration of a fundamental understanding of the geologic questions asked.

Standards of achievement: Letter Grades for this course will be assigned on a scale of:
A= >90, B=80-89, C=70-79, D=60-69, F=<60%. The projects will be graded using rubrics. The value of each graded project is included in the Course Topics and Schedule and will be based upon the following.

900–1,000 points	A
800–899 points	B
700–799 points	C
600–699 points	D
≤ 599 points	F

Typical Course Topics (with Points):

2 field geology warm-up exercises @ 50 points each: 100 points

- At the beginning of the course, students will individually hone their field geology skills to prepare for more extensive projects. These skills include, but are not limited to: (i) efficient, organized, thorough, and appropriate field notation; (ii) diagrams and/or sketches of geologic exposures; (iii) accurate identification of rocks, minerals, and fossils; (iv) orientation measurements with a Brunton compass; and/or (v) stratigraphic thickness measurements using a Jacob staff. Student field books will be collected and reviewed to assess these fundamental skills and remediate deficiencies as necessary.

    - *Llano Uplift, Texas*, geology warm-up exercise → Students will submit field books complete with notes, diagrams, sketches, rock and mineral descriptions, fossil descriptions, structural orientation measurements, formation thicknesses, contact types, and/or other appropriate geologic information at each stop in the

region. Field books will be temporarily submitted, and will be returned the following morning.

- *Guadalupe Mountains, Texas*, geology warm-up exercise → Students will submit field books complete with notes, diagrams, sketches, rock and mineral descriptions, fossil descriptions, structural orientation measurements, formation thicknesses, contact types, and/or other appropriate geologic information at each stop in the region. Field books will be temporarily submitted, and will be returned the following morning

5 geological mapping or hydrogeological projects @ 100 points each: 500 points

- Geological mapping or hydrogeological projects constitute the bulk of this course. You will be assigned to a group with 2 other students and will work together to accomplish the objectives established for each project (see below). Furthermore, the instructors will periodically switch student groups during the course. It is imperative that each student equally participate to achieve the maximum score possible for each project. Each student should make their own field measurements, take their own notes, and make their own diagrams or sketches in the field. Results and interpretations will be documented and submitted from each group as geologic maps, stratigraphic columns, geologic cross sections, and/or written reports with data tables and/or figures, as appropriate, on or before the due dates shown below. Student groups will be assigned a score based on: (i) the quality of field observations; (ii) accuracy of prepared maps and figures; (iii) clarity, organization, and presentation of results; and (iv) validity of geological interpretations based on the results. Individual scores can be adjusted downward from the overall group score if it is apparent that one or more students did not equally participate in data collection and/or preparation of maps, figures, and/or reports. As one of multiple options to assess individuals within groups, instructors will collect each student's field book and compare notes and sketches to ensure individual effort and minimal duplication.

  - *North Parlin Flats and Prosser Rock, Colorado*, geological mapping exercise → Student groups will submit: (i) a geologic map with color-shaded lithostratigraphic and/or lithodemic units and explanations, appropriate map symbols to represent geologic structures, and other essential map elements; (ii) a color-shaded stratigraphic column with geologic ages, appropriate symbols, a weathering profile, essential lithologic details, and approximate thicknesses; (iii) a geologic cross-section with color-shaded lithostratigraphic and/or lithodemic units; (iv) a summary report including purpose of the field exercise, approach, results (including data tables), a stereonet, and interpretations that refer to the geologic map, stratigraphic column, geologic cross-section, and stereonet; and (v) individual field notebooks. These are the deliverables.
    - Report 25 points
    - North Parlin Flats geologic map 20 points
    - Prosser Rock / Table Top geologic map 20 points

- Stratigraphic column 15 points
- Stereonet 5 points
- References 5 points
- Individual field notebook 10 points

- *Waunita Hot Springs, Colorado*, engineering geology mapping exercise → Student groups will submit: (i) an engineering geology map with color-shaded lithostratigraphic and/or lithodemic units and explanations, appropriate map symbols to represent engineering geology features, and other essential map elements; (ii) a color-shaded stratigraphic column with geologic ages, appropriate symbols, a weathering profile, essential lithologic details, and approximate thicknesses; (iii) a geologic cross-section with color-shaded lithostratigraphic and/or lithodemic units; (iv) a summary report including purpose of the field exercise, approach, results (including data tables), a stereonet, and interpretations that refer to the engineering geology map, stratigraphic column, geologic cross-section, and stereonet; and (v) individual field notebooks. These are the deliverables.
  - Report 25 points
  - Geologic map 25 points
  - Geologic cross section 20 points
  - Stratigraphic column 15 points
  - References 5 points
  - Individual field notebook 10 points

- *Middle Quartz Creek, Colorado*, fluvial & glacial geomorphological mapping exercise → Student groups will submit: (i) a geomorphologic map with a color-shaded channel classification system; appropriate map symbols to represent fluvial, hillslope, and glacial geomorphologic features; and other essential map elements; (ii) a summary report including purpose of the field exercise, approach, results (including data tables), and interpretations that refer to the geomorphologic map; and (iii) individual field notebooks. These are the deliverables.
  - Report 25 points
  - Geomorphological map 40 points
  - References 5 points
  - Individual field notebook 30 points

- *Pitkin / Quartz Creek, Colorado*, hydrogeology exercise → Student groups will submit: (i) a hydrologic network map of the Pitkin community with appropriate map symbols to represent hydrologic features and infrastructure and other essential map elements; (ii) a summary report including purpose of the field exercise, approach, results (including data tables), and interpretations that refer to the hydrologic network map; and (iii) individual field notebooks. These are the deliverables.
  - Report 25 points
  - Data presentation 30 points

- Map 10 points
- References 5 points
- Individual field notebook 30 points

- *Arbuckle Mountains, Oklahoma*, stratigraphic and structural exercise → Student groups will submit: (i) a geologic map with color-shaded lithostratigraphic and/or lithodemic units and explanations, appropriate map symbols to represent geologic structures, and other essential map elements; (ii) a color-shaded stratigraphic column with geologic ages, appropriate symbols, a weathering profile, essential lithologic details, and approximate thicknesses; (iii) a geologic cross-section with color-shaded lithostratigraphic and/or lithodemic units; (iv) a summary report including purpose of the field exercise, approach, results (including data tables), a stereonet, and interpretations that refer to the geologic map, stratigraphic column, geologic cross-section, and stereonet; and (v) individual field notebooks. These are the deliverables.
  - Report 25 points
  - Geologic map 20 points
  - Geologic cross section 20 points
  - Stratigraphic column 15 points
  - Stereonet 5 points
  - References 5 points
  - Individual field notebook 10 points

2 geological mapping projects @ 150 points each: 300 points

- Geological mapping or hydrogeological projects constitute the bulk of this course. You will be assigned to a group with 2 other students and will work together to accomplish the objectives established for each project (see below). Furthermore, the instructors will periodically switch student groups during the course. It is imperative that each student equally participate to achieve the maximum score possible for each project. Each student should make their own field measurements, take their own notes, and make their own diagrams or sketches in the field. Results and interpretations will be documented and submitted from each group as geologic maps, stratigraphic columns, geologic cross sections, and/or written reports with data tables and/or figures, as appropriate, on or before the due dates shown below. Student groups will be assigned a score based on: (i) the quality of field observations; (ii) accuracy of prepared maps and figures; (iii) clarity, organization, and presentation of results; and (iv) validity of geological interpretations based on the results. Individual scores can be adjusted downward from the overall group score if it is apparent that one or more students did not equally participate in data collection and/or preparation of maps, figures, and/or reports. As one of multiple options to assess individuals within groups, instructors will collect each student's field book and compare notes and sketches to ensure individual effort and minimal duplication.

- *Gold Creek and Pitkin, Colorado*, geological mapping exercise → Student groups will submit: (i) a geologic map with color-shaded lithostratigraphic and/or lithodemic units and explanations, appropriate map symbols to represent geologic structures, and other essential map elements; (ii) a color-shaded stratigraphic column with geologic ages, appropriate symbols, a weathering profile, essential lithologic details, and approximate thicknesses; (iii) a geologic cross-section with color-shaded lithostratigraphic and/or lithodemic units; (iv) a summary report including purpose of the field exercise, approach, results (including data tables), a stereonet, and interpretations that refer to the geologic map, stratigraphic column, geologic cross-section, and stereonet; and (v) individual field notebooks. These are the deliverables.
    - Report 40 points
    - Geologic map 30 points
    - Geologic cross section 25 points
    - Stratigraphic column 20 points
    - Stereonet 10 points
    - References 5 points
    - Individual field notebook 20 points

- *Cumberland Pass and eastern Fossil Ridge, Colorado*, geological mapping exercise → Student groups will submit: (i) a geologic map with color-shaded lithostratigraphic and/or lithodemic units and explanations, appropriate map symbols to represent geologic structures, and other essential map elements; (ii) a color-shaded stratigraphic column with geologic ages, appropriate symbols, a weathering profile, essential lithologic details, and approximate thicknesses; (iii) a geologic cross-section with color-shaded lithostratigraphic and/or lithodemic units; (iv) a summary report including purpose of the field exercise, approach, results (including data tables), a stereonet and interpretations that refer to the geologic map, stratigraphic column, and geologic cross-section, and stereonet; and (v) individual field notebooks. These are the deliverables.
    - Report 40 points
    - Geologic map 30 points
    - Geologic cross section 25 points
    - Stratigraphic column 20 points
    - Stereonet 10 points
    - References 5 points
    - Individual field notebook 20 points

Attitude, teamwork, safety, and participation: 100 points

- High-quality and efficient field work is dependent on constructive, helpful, respectful, and level-headed individuals that display high standards of professionalism, adhere to safe practices, and use logical reasoning to solve problems in the field. An ***optimistic attitude*** is a necessity to overcome less-than-optimal conditions in the field (e.g., weather, difficult hikes, infrequent rock exposures) and make the most out of each

precious day. Students should never work alone in the field; therefore, it is critical that individuals in a working group give respect to one another, help one another, liberally offer moral support, maximize efficiency through ***effective teamwork***, and equally contribute to objectives in the field. ***Safety*** is a number one priority in the field and all individuals should use good judgment when determining the benefits gained by access to rock exposures or geologic / hydrologic features that require difficult or unsafe passage. Furthermore, group members are responsible to notify emergency workers as soon as possible if a fellow member is hurt or becomes ill. Finally, all students are expected to equally ***participate*** in all activities through the end of the course, including preparation of meals, cleaning, organization, and other housekeeping activities. Full credit will be given to those students who adhere to these principles, whereas appropriate point deductions will be levied against those who deviate from these guidelines.

TOTAL: 1,000 points