EARTH 331

FIELD PROBLEMS IN SEDIMENTARY GEOLOGY

# Fall Quarter

Instructors: Brad Sageman \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 TECHF397, 467-2257 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Fieldtrip: late AUG to mid SEPT in CO and UT

Lecture: 3:30-5:00 T-TH

Reading

Compton, R., 1985, *Manual of Field Geology*, Wiley & Sons, NY, 378 pp.

Chap 1-5, 11, and 16 (Chaps. 9-10 optional).

 Articles from the literature on the stratigraphic units examined in the field

Evaluation

 •Fieldwork (20%)

 •Report on field work (80%)

**INTRODUCTION**

This course focuses on field-based application of the basic information and fundamental concepts that were introduced in EARTH 330 – *Sedimentary Geology*. The course assumes that students have had little or no experience in the field and it is designed to teach the basic practices of field stratigraphy and sedimentology. In addition, because the development of process sedimentology, facies models, and sequence stratigraphy have come to dominate the fields of stratigraphy and sedimentology in recent years, this course is aimed at strengthening knowledge of these areas. In addition to discussions on the outcrops, we will have the opportunity during the Fall Quarter to explore topics that are relevant to the units we study in the field, by comparing our own observations, as well as reading the literature.

Field courses require unconventional efforts – review of prior course work before the start of the field trip will significantly improve your ability to function on the outcrop. Then there will be long days working under challenging conditions, eating, camping, and being together with a group for 24 hours a day, over three weeks. Although this may be richly compensated by the benefits of a hands-on learning experience, it requires patience and understanding from all.

The field trip leaders have a responsibility to make sure the trip runs safely and smoothly, and this requires significant logistical effort. You can help by being considerate, by thinking first about the goals of the trip before your own interests, and by asking how you can assist us. One critical rule of thumb….***NEVER MAKE THE FIELD TRIP WAIT FOR YOU***. This applies to highway meal stops and outcrops alike. When the leaders of the trip are ready to move, you should be on board and ready to roll.

**Goals of the course:**

 A) Understanding the scientific method as applied in sedimentary geology

 practical side of hypothesis testing

 nature of geological knowledge

 B) Understanding sedimentary geology

 fundamental principals (facies, uniformitarianism, sedimentation, etc.)

 data collection methods (observation, description, measurement, sampling)

 sub-disciplines (stratigraphy, sedimentology, paleontology, structural geology)

 facies models (as working hypotheses = interpreting depo environments)

 sequence stratigraphy and process sedimentology

 cyclostratigraphy and event stratigraphy

 C) Understanding geologic history of Colorado and Utah (Penn. to Cret.)

There are four major phases of the course, as described below.

**Course outline**

a) Lecture (1 day): After arrival in Colorado, there will be a day of lecture to review concepts (stratigraphic principles, depositional systems-facies models, sequence stratigraphy, and field methods) and provide instructions for the format of field notebooks and field exercises.

b) Field trip/field exercises (approx. 18 days of field work): A series of specific field exercises will be performed at sites from Boulder, Colorado to central Utah. Students will record measurements and observations in field notebooks. See Itinerary below for sites and exercises (in boldface).

c) Fall quarter meetings: After returning from the field we will meet as a class during the Fall Quarter. The main purpose of our meetings is to assist you in the construction of your field report. We may discuss research papers that are relevant to the stratigraphic units we have seen in the field, and which explore pertinent aspects of facies analysis and sequence stratigraphy. We will also work on specific skills related to presentation of field data (drafting sections, presenting observational data).

d) Final Project: The field report will be due at the end of the quarter (NOV. 30). The report will focus on observations from the field exercises, but you may incorporate information from the literature as well.

Preliminary Reading List

 **Review material**

Chapters on depositional environments from Nichols (or Boggs) and the *Facies Models* books.

**New material**

Compton, R., 1985, *Manual of Field Geology*, Wiley & Sons, NY, 378 pp.

Chap 1-5, 11, and 16 (Chaps. 9-10 optional as they likely repeat above review material) .

Additional reading materials pertaining to the regional geology of our field areas will be available on the trip and thereafter.

**Expectations**

Students should review facies models and complete the Compton reading before the course starts in Boulder. Bear in mind that reading will not be impossible, but it is more challenging to make progress once the field work starts.

A note on the nature of field work – because there is only a limited opportunity to make observations, field geologists endeavor to maximize the experience. This can mean long days, working in less than optimal weather, etc. But these hardships are more than compensated by the beauty of the places we visit, the amazing geology we see, and our irrepressibly positive attitudes.

Do not be afraid to ask questions. Do not be afraid to call for help in the field. Do not be afraid to ask us to SLOW DOWN. This experience is for you – we want you to learn as much as possible and to enjoy the field as much as we do. But those of us who do field work can tend to move quickly when we are on the outcrops.

Evaluation of performance in the class will be based on the following criteria:

1) knowledge of the reading material and participation in the lecture phase

2) field notebook - format and style, neatness and legibility (see Compton for guidance)

3) field exercises – participation and application of knowledge on the outcrop

4) final report - completeness, presentation style, integrity with field notes

2016 EXAMPLE ITINERARY



Itinerary specifics on following page…

Vans will leave Evanston on **SUNDAY** August 21.

• TUES 8/23 - LECTURE

 DEPT. OF GEOLOGICAL SCIENCES, UNIVERSITY OF COLORADO

• WED 8/24 through MON 8/29 – ***Boulder-Denver* *Field Work Area***

Lee Hill Rd. sections –

 **Fountain Fm. (Pennsylvanian) through Lyons SS (Permian)**

 **Lyons SS to base Dakota Group (Cretaceous)**

 **Dakota Group (Kd) section**

Core Description exercise USGS-CRC) – **Dakota Formation**

 6-Mile Fold - **Mapping Cretaceous folded strata (Carlile and Niobrara Fm.s)**

Alameda Roadcut - **top Morrison Fm. (Jurassic) thru Dakota Group (Kd)**

• TUES 8/30 through FRI 9/2 – ***Pueblo State Park* *Field Work Area***

 Drive to Pueblo - Camp at Lake Pueblo State Park

 Rock Canyon Anticline

  **Greenhorn & Niobrara Cyclothems (Cretaceous)**

 **Dakota Sandstone, Graneros Shale, Greenhorn Formation, Carlile Formation**

 **Niobrara Formation (Ft. Hays LS)**

• FRI 9/2 - Drive to ***Great Sand Dunes Natl. Monument***

 observe/discuss modern eolian processes

**•** SAT 9/3 - Drive to ***Mesa Verde National Park* (MVNP)**

visit Lower Piedra section: **Mancos Shale (Cretaceous)**

camp at MVNP

**•** SUN 9/4 – Drive to Page, AZ and Wahweap Campground

 visit roadcuts in MVNP - **Mesa Verde Fm. (Cretaceous)**

visit Red Wash Section **- Dakota SS and Mancos Shale (Cretaceous)**

• MON 9/5 through WED 9/7 – Dakota Formation field work

***Wahweap Wash & Cottonwood Canyon* *exercise***

**Dakota SS and Tropic SH**  **(Cretaceous)**

• THURS 9/8 – ***Drive through with stops, Zion National Park***

 Jurassic eolian facies and climate cycles preserved in cross bedding

• THURS 9/8 through SUN 9/11 - Castle Valley & San Rafael Swell, UT

 ***Castle Valley Field Work Area***

**Ferron SS** **(Cretaceous)** – fluvial-deltaic facies

Ferron State Park Campground

• SUN 9/11 through TUES 9/13 – Book Cliffs, UT and Green River Fm., CO

***Book Cliffs Field Work Area***

 **Castlegate and Starpoint Sandstones (Cretaceous)**

 **Greenriver Fm.**

Green River State Park Campground

• THURS 9/14 – Home to Evanston.

**EARTH 331 EQUIPMENT LIST**

Equipment/clothing

Bring old clothes suitable for outdoor activity (they will get muddy, dirty, etc.). Be prepared for cold and snow, rain at any temperature above freezing, and oppressively sunny and hot (but relatively dry, in general) weather. Bring several changes of clothes so that you always have a dry pair in the event of rain. Specifically, we recommend:

CLOTHES

 • Hiking boots, preferably waterproof • Sun hat, sunglasses

 (plus dry pair of shoes for evening) • Hiking shorts, T-shirts, etc.

 • Waterproof jacket (essential) • Lots of socks (no kidding)

 • Warm sweater, sweat shirt, or jacket • Warm socks, gloves & hat

CAMPING/HIKING GEAR

 • Water containers – CAMELBACK or similar advised. • A sleeping pad (e.g., Thermarest)

 ***AT LEAST 2.5 QUARTS/PERSON/DAY*** • Tent (we will work out sharing)

 • A daypack to carry everything you're not wearing • Flashlight and batteries

 • A sleeping bag (for summer/fall camping - a cotton liner/sheet is good for hot weather)

 • Toiletries - soap/shampoo/toothbrush/sunscreen/medicines (e.g.,analgesics)/bug spray etc.

WORK EQUIPMENT

*You should get:*

 • Work Gloves

 • Pens, pencils, eraser (plastic cover if not write-in-the-rain)

 • Clipboard (is always helpful for notes/handouts/maps)

 • Camera (a key item for geological field work)

*We can provide:*

 • Bruntons • Hammer /belt loop • Hand lens

 • Jake staffs • Tape measures • Acid bottles • Field Notebooks

**CONTACT LENS WEARERS** – *we strongly recommend that you bring glasses as there will be times that contacts may not be wearable due to wind/dust.*

**Medical Conditions**

Be sure to inform us if you have any condition or physical disability that could require special attention in the field, or if you are taking any prescriptions with potentially adverse side effects (***remember*** - dehydration is a likely condition at some point during field work). Let us know IMMEDIATELY if are injured in the field. We will have cell phones for emergencies and contact numbers for medical assistance in the areas we are visiting. Lastly, as a precaution, each student should give us a family telephone # to call in the event of an emergency. Have this ready when we meet for class on 8/25.

**PART I - 8/24** - 9:00 am, Dept. of Geological Sciences, University of

 Colorado: Introductory lecture and discussion

LECTURE OUTLINE AND BACKGROUND MATERIAL

**A)** **Review of Basics** – Stratigraphy and Sedimentology

Lithologic description – texture and composition

Lithologic classification – arenites, mudrocks, carbonates

Additional observations: bedding, contacts, sedimentary structures,

biogenic structures, fossils, etc.

Strike and dip: Brunton compass; trig methods

Section thickness: Jacob staff/measuring tape

Goal: ***Develop methodology and criteria for measurement and***

***description of stratigraphic sections.***

**B) Review of *Facies Models* (Walker and James, 1992)**

Chap. 1 - Facies, facies models and modern stratigraphic concepts

Chap. 7 - Alluvial deposits

Chap. 8 - Eolian systems

Chap. 9 - Deltas

Chap. 10 - Transgressive barrier island and estuarine systems

Chap. 12 - Wave and storm dominated shallow marine systems

Chap. 14 - Intro to carbonate and evaporite facies models

Goal: ***Develop working facies models for selected facies types.***

**C) Overview of Sequence Stratigraphy and Dynamic Sedimentology**

Walker and James (1992): Chap. 2 - Control of sea level change

Boggs (1995), sections on sequence stratigraphy

This Coursebook - Sequence Stratigraphy/Dynamic Sedimentology

 Goals: ***Review sequence stratigraphic concepts and nomenclature***

 ***Introduce concepts of dynamic sedimentology (energy profiles)***

 ***Integrate stratigraphy and dynamic sedimentology = genetic***

 ***sequence stratigraphy.***

**D) Overview of** *Manual of Field Geology* (Compton, 1985)

 Essential reading

Chap. 1 - Introduction Chap. 4 - Identifying rocks in field

Chap. 2 - Basic equipment Chap. 9 - Primary features marine sed rx

Chap. 3 - Basic outcrop procedures Chap. 11 - Stratigraphic sections

 Supplemental reading

Chap. 5 - Mapping rocks and structures Chap. 16 - Preparing reports

Goals: ***Review principles and field methods for sedimentary geology***

 (scientific method; techniques for observation, data collection and presentation)

 ***Develop protocols for field notes, lithologic descriptions, etc.***