ERTH 596 Geology of Glacier National Park (2 credits)
*Summer 2018:* Callan Bentley, Instructor

**Course Goals**

Glacier National Park is a world-class showcase of geological processes. The primary purpose of this course is to gain insight into these processes and learn how to deduce a timeline of geological events from field observations. We will learn relevant material from sedimentology, stratigraphy, structural geology, and glacial geomorphology. The focus of our course is on field-based understanding.

**Expectations**

1. Students will spend all available time in the field, directly observing and working with the rock record. To enjoy the course, students should be prepared to hike from 4 to 5 miles a day for five days in a row. Each day, we will spend 8 to 9 hours a day working outside. Students should be prepared to bring proper equipment and clothing.

2. This is not a tour. Though students need not have any geological background, they will be treated as graduate students with the attendant level of intellectual rigor.

**Tentative Schedule** – subject to change due to weather, wildlife, or whim of the instructor Sunday July 22

8am Depart Bozeman
Stop at Wheat Montana for coffee?
Basic structural geologic setting near entrance to Prickly Pear Canyon.
Belt sedimentology near in Prickly Pear Canyon
Last minute shopping in Augusta?
Glacial geomorphology on road to Sun River Canyon
Imbricate thrust sheets at Sun River Canyon: Diversion Thrust, French Thrust, Beaver Thrust: 3 to 4 stops
Trellis glacial drainage pattern to Pleistocene Sun River Canyon
Mortimer Gulch Campground – Students cook for themselves. No showers.
**Daily deliverable:** Annotated outcrop sketch of French Thrust (in field notebook)

Monday, July 23

8am Depart Mortimer Gulch
Swift Dam near Depuyer – fault-bend fold viewed in 3D; Mississippian carbonates + Cretaceous shales, fossils in both!
KOA St. Mary Campground – our home for the next four nights.
In camp lecture / discussion on Proterozoic geology
GNP St. Mary Visitor Center; sketch primary structures in building stones
**Daily deliverables:** Annotated outcrop sketch of Swift Dam Anticline + annotated sketch of Belt primary sedimentary structures from visitor center (both in field notebook)
Tuesday, July 24

8am Depart camp
Going-to-the-Sun Road stratigraphy and structure, glacial geomorphology, igneous contacts (sill)
Hike on the west side of Logan Pass

**Daily deliverable:** Stratigraphic column of Belt strata in GNP (in field notebook)

Wednesday, July 25

8am Depart camp
Looking Glass Highway sedimentology and structure
Two Medicine structure and geomorphology
Lunch break in East Glacier
Chief Mountain; drive to Canadian border
Boulders and river geomorphology and dynamics in Swiftcurrent Creek near Babb
Dinner at Johnson’s of St. Mary (?)
Return to camp

Evening discussion of how the lessons of GNP might be applied in our classrooms (half an hour).

**Daily deliverables:** Annotated outcrop sketch of one Looking Glass Highway stop + one Chief Mountain conceptual sketch (both in field notebook)

Thursday, July 26

8am Depart camp (to Many Glacier valley)
Hike Grinnell Glacier: Independent field studies of Belt stratigraphy (stromatolites!) and structure, igneous intrusion (sill), glaciology
~4pm regroup and drive back to St. Mary

**Daily deliverable:** Three detailed outcrop and/or landscape descriptions, including annotated sketches. Sites to be self-selected by student interest (in field notebook)

**Field practical exam**

Friday, July 27

8am Break camp; 8:30 Departure
Collecting of salt casts, mud cracks, ripples, and other primary sedimentary structures from Belt rock north of Helena
Drive back to Bozeman

**End of course**
Logistics

Camping is the lodging on this course. Students will have access to showers, sinks, and toilets while in the KOA in St. Mary’s (but NOT in the camp at Mortimer Gulch, Sun River Canyon, on the first night). Meals include hot breakfast and dinner each day. Lunches will be student prepared box lunches. Students are responsible for personal camp gear including tents, sleeping gear, rain gear, etc.

At least one month prior to departure, an email group will be started for the purposes of pooling gear, sharing tents, etc. so as to minimize travel headaches.

Personal gear should include: rain gear (jacket and pants), warm clothes (no cotton), wool socks, very sturdy boots or shoes, water storage for at least 2L of water per day (3L would be better on the day of the big hike to Grinnell Glacier), a field notebook (I recommend Rite-In-The-Rain blank field notebooks) and writing utensil, sunglasses, sunscreen, etc., and a rucksack to throw it all into each day.

Students will be required to have bear spray handy at all times. Students cannot fly with bear spray cans, therefore, they should plan on purchasing spray in Bozeman. Prior to departure, students will be taught how to use it.

Geologic Summary

In addition to assignments while in the field, students are responsible for a Geologic Summary will be due one week after students return. Students will write a cogent, succinct geologic history of GNP. This history should pair field evidence observed on the trip with interpretive statements about conditions that prevailed or processes that occurred at different points in the past, and state when those things happened as precisely as possible.

Collaboration

Students are encouraged to work with one another at all stages of our course. Though each student will submit their own work to the instructor, collaboration is encouraged.

Grading

| Daily deliverables (5 x 10 points each) | 50 points |
| Field practical exam | 15 points |
| Participation, teamwork, positive attitude | 15 points |
| Summary of the geology of Glacier National Park | 20 points |
| (due 1 week after the trip) | |