GEOLOGY 4376: Field Geology II

(GEOLOGY 4366: Directed Study for purposes of registration)

The University of Texas at El Paso

Department of Geological Sciences

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Instructor

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Current Circumstances: In light of the spreading of SARS-CoV-2 virus and pandemic of COVID-19, it has become necessary to develop and execute an alternative to the normal field geology course, particularly with regard to travel to remote field sites, camping, etc. Among the considerations driving this need are:

- Requirements for social distancing;
- Logistical difficulties, e.g. food, toiletries, etc.;
- University, Local, State, and Federal regulations, e.g. temporary restrictions on travel and movement.
- The recent University decisions to take all Spring, Maymester, and Summer courses online, with no face-to-face components.

The possible courses of action I could have selected included, but were not limited to:

1. Running the Maymester course as planned at a remote field site, using the time as a self-imposed "quarantine" of sorts.
2. Running the Maymester course largely as planned, but at a local field site while taking as many social distancing precautions as possible.
3. Creating an entirely online, field data intensive, project-based course.

I excluded options 1 and 2 on the grounds that the current rules in effect at the University and Local levels (and to some extent at the State and Federal levels) preclude travel. It is, granted, unclear if this will still be the case in mid-May and early-June, but there is reason to suspect that the situation may be similar then (albeit hopefully improved). Regardless, logistical planning for such a field course would need to start soon, and the current circumstances make that neither practical nor permissible. Added to that reality are potential logistical difficulties with respect to non-perishable food items and other critical field supplies that seem to be scarce at the moment. I also exclude these options on the grounds that it is unclear how to meaningfully exercise the required social distancing measures. Even if (especially if?) the course is run locally, i.e. in a "commuter

style" (which we have done in the past for portions of the course), we would need to worry about possible transmission of SARS-CoV-2 both in the field as well as among participants "after hours" while they are in the community again. As our modern mantra goes: STAY HOME!

For these reasons, I chose option 3, although I point out that this will probably be the option that will require the most effort on the part of all of us – you students and the instructors – to successfully implement. What I propose is a bit of a bold experiment and its implementation will be entirely new to me. So, this will be a learning process for all of us, not just for studying geology, but also for how to operate a field course without going to the field! If all goes well, this may be a great opportunity to begin something innovative and exciting that may lead to funding opportunities, publishable research, and, eventually, potential course alternatives to traditional field geology in the future.

Course Concept: So what is the idea? I suggest we take inspiration from field research being conducted by the planetary exploration community. For the past nearly 20 years, teams of geoscientists have been planning field traverses, collecting field data, using that field data to generate and test multiple working hypotheses, and communicating the results (all the things I want you to learn and practice in this class!) on a daily basis at field sites they will likely never visit in person. These field sites are on Mars, and the field work is being done by proxy with robotic rovers (e.g. MER-Spirit, MER-Opportunity, MSL-Curiosity, and, next, Mars2020-Perseverance). However, while the mobility and practical tasks of taking imagery, deploying instruments, and making measurements are being done *in-situ* by the rovers, the actual science is being done by humans. **Even "robotic exploration" is actually human exploration after all!**

Here is what we will do. At a local field site (where is still TBD) the instructors (Dr. Hurtado and the TAs) will go to the field and play the role of robotic explorers (rovers, if you will). The instructor-rovers will do field work, following *traverse plans* built ahead of time by you, the students, working in *science teams*. On the traverses, the instructor-rovers will follow the traverse mapped out by the science team, collecting data requested by the science team at specific stations. The data could be, for example, images (still photos or video), strike-and-dip measurements, rock descriptions, handheld X-ray florescence spectrometer measurements (a device that can give you elemental concentrations in a rock), drone imagery, etc. At the end of the day's traverse, the instructor-rovers will upload the data collected (keyed by GPS to a map of the followed traverse) to what NASA would call a *ground data system* (we will use Blackboard). The student science teams are then responsible for: (a) accessing the day's data from Blackboard; (b) organizing the new data (including integrating it with data from previous days, if available); (b) making science interpretations from the data; (c) making

(multiple) testable working hypotheses based on the data and interpretations (including those from previous days, if available); (d) constructing a traverse plan for the following day's traverse based on all the available and relevant data, interpretations, and hypotheses; (e) building a sequence of data collection tasks for the instructor-rovers to execute on the next day's traverse; (f) writing up both the traverse plan and the data collection sequence; and (g) uploading the traverse plan and data collection sequence to Blackboard in time for the instructor-rovers to access it for the following day. Rinse-and-repeat: we will probably do this evolution a total of ~4-5 times to constitute a week of field work.

With this method of asynchronous, time-delayed, remote exploration, the student science teams will explore (and map!) their assigned field areas. Both as teams and individually (remember you are, in the end, going to turn in individual field reports, maps, cross-sections, etc. that the bulk of your grade will be based on) your objective in these exercises will be largely the same as in a normal field exercise: to explore a field site and use field observations and data to (1) produce a geologic map, (2) construct a geologic cross-section, (3) deduce the geologic history, and (4) communicate your results in a written report. The final products, while informed by your science team discussions, etc., will be prepared and graded individually, just as in Field Geology I.

I hope we achieve what I think are the benefits of this approach:

1. It allows the easiest implementation of social distancing practices within the (current) constraints and avoids the logistical problems we (currently) face.
2. It provides you students with a unique, meaningful, and realistic exercise in: field traverse planning; field data acquisition; field data analysis and interpretation; collaborative decision-making and problem solving (both science and operational); and individual integrative scientific reasoning. A lot of these skills are things you may not have experienced otherwise!

Course Objectives: Along with Field Geology I, this course is your "capstone" class in Geology. It is where you bring together everything you have learned in your time as a major and apply it to solving problems in the field. Think of it in many ways as a real research experience. Unfortunately, it will not be possible to completely replace the entirety of the field experience, but other pertinent course objectives should be met. These broadly include:

- Critical thinking
- Synthesis of geologic information obtained in the field with subject matter from throughout the undergraduate curriculum
- Communication, principally in the form of written, technical reports and illustrations (maps, cross-sections, etc.)

Your primary activities will be traverse planning, analysis of data, building a geologic map and cross-section, and writing professional reports. You will work individually and in your science team groups to plan traverses, make observations and descriptions, and analyze data. In field geology, construction of a geologic map (and cross-section) is the primary method used to collect, illustrate, and communicate field data, and you will use yours to explain (and I to evaluate) your understanding of the geologic history of your field area. You will work individually to create your own final maps and cross sections with the goal of solving the specific stratigraphic and/or structural problems posed by your project area.

The skills that you will practice in this class are those that were developed in "Geoscience Processes", Mineralogy, Petrology, Structural Geology, and Sedimentology and Stratigraphy. Included among the bodies of knowledge you will draw from (and should have already learned in your previous classes) are:

1. Use of a topographic map for navigation and recording of geologic data.
2. Construction and use of topographic maps, topographic profiles, stratigraphic columns, and geologic maps.
3. Use of (digital) maps and aerial imagery.
4. Keeping organized and complete notes.
5. Analysis, interpretation, and plotting of structural data collected with a Brunton compass.
6. Basic concepts and analytical tools/methods used in structural geology.
7. Visualization and interpretation of geologic data and relationships in three-dimensions.
8. Analysis of crosscutting relationships.
9. Description of rocks and recognition of formational/structural geologic contacts.
10. Identification and description of common rocks, minerals, soils, and other geologic materials.
11. Identification and interpretation of tectonic, volcanic, geomorphic and other landforms/structures.

Ideally (and most importantly), you will learn to operate as a scientist when solving problems: asking questions; making careful observations; thinking critically and quantitatively about those observations; developing multiple working hypotheses; and testing those hypotheses. Part of this will involve working cooperatively and communicating your ideas to others. Most importantly, you must learn to be honest with yourself and trust your own observations and, in the end, do your own mapping.

Assignments and Schedule: We will target the first day of our class to be on May 18, 2020. The course will run for 3 weeks, ending on June 7, 2020. Expect to be working on traverse planning and data analysis, either individually or in your science teams (but always following social distancing protocols), every weekday of the three-week course. These weekdays will also be field days for the instructor-rovers. Weekends will be devoted for group and individual work to produce final products.

The following is my tentative schedule for the 3 weeks:

- **Week 1:** Reading/writing assignments on robotic exploration; reading/writing assignments on geology of the project area(s); testing and familiarization of software, workflows, and communications. Science teams for week 2 will be assigned (and will later be reassigned for week 3). We will likely have at least one live Zoom webinar (which will be recorded) during this week. There will be several recorded videos you can watch asynchronously as well. Readings and the associated assignments will be posted to Blackboard by the first day of class.
- **Week 2:** Rover mission project #1 (~4-5 daily evolutions of traverse planning-data collection-data analysis).
- **Week 3:** Rover mission project #2 (~4-5 daily evolutions of traverse planning-data collection-data analysis).

For the two rover projects, expect that the daily schedule will be something like this:

- **7am:** Traverse plan for the day must be posted to Blackboard by this time.
- **8am:** Daily (~30 minute) tag-up opportunity via chat on Blackboard (or other mechanism TBD).
- **~9am:** Field day for instructor-rovers begins
- **~2pm:** Field day for instructor-rovers ends
- **3pm:** Daily (~30 minute) tag-up opportunity via chat on Blackboard (or other mechanism TBD)
- **4pm:** Acquired data for the day will be posted to Blackboard by this time
- **~5pm:** Instructors will examine the day's communications record (on Blackboard, Slack, or other TBD) to evaluate science team and individual progress.

While the schedule is subject to change, you can see there will be a substantial amount of time during the day while the instructor-rovers are out executing traverses (as well in the afternoons and evenings) that you will be able to work. The expectation is that you make effective and efficient use of this time:

1. **Individuals and science teams** should be working with data they already have, discussing science observations and hypotheses, and making

operational decisions for traverses. Traverse planning should be done by the science teams in both a strategic mode (i.e. what is the overall plan for the whole week) as well as a tactical mode (i.e. what is the specific plan for the next day).

2. **Individuals** should be incrementally working on their maps, cross-sections, and reports so that you have informed discussions with your science teams and so you continually make positive progress towards the deliverables you will be graded on at the end of the week.

For each individual student, the result of each week of "field work" will be a set of deliverables for grading: (a) a digital geologic map and your "digital notebook"; (b) a PDF of the final geologic map; (c) a PDF with one or more geologic cross-sections; (d) a PDF of the report. These are all expected to be of professional quality.

The digital geologic map will be your working shapefiles, archived daily as in Field Geology I, which you will be editing with QGIS. The "digital notebook" will be the portfolio of notes, communications, etc. that I will require each student to keep using a tool (TBD) on Blackboard.

The PDF of the geologic map can be made either by hand as in Field Geology I, and then digitized, or made entirely digitally. Similarly, the PDF of the cross-sections can be either hand drawn and then digitized or it can be prepared entirely digitally.

Access to a scanner, while helpful, is not required. There are a number of scanning apps for your camera-enabled devices (phone, tablet, computer) that can be used to scan/digitize hardcopies of work. Similarly, access to a printer, while helpful, is not required since work will be submitted electronically. See "Access to Internet and Information Technology Tools and Resources" below for more about technology and this class.

Of particular importance will be your reports. The field geology courses at UTEP are typically writing intensive as well as field intensive, and they are designated as such in the geology curriculum. Your reports will be based on your science team's observations and data, your own geologic map, and your own interpretations of the geology made through constructing your own geologic cross sections. Your reports must also contain appropriate/relevant (and properly cited) background material. The reports you will write are critical because they will teach you how to write a technical paper and will focus your understanding of the geology and history of the field areas. Reports should be prepared with word processing software and submitted in PDF format. They must follow the structure and style of a professional paper/journal article.

Grading: Your reports will be graded for their scientific merit and the style and clarity of the writing. The maps and cross-sections will be graded on their scientific merit and their aesthetic quality (completeness, neatness, etc.). Digital data and notes will be graded on their organization, completeness, and clarity. Scoring rubrics and detailed descriptions of expectations for these deliverables will be provided on Blackboard by the first day of class.

Your course grade will primarily (**~70%**) be based on your individual scores on the two field projects. Your individual scores will be earned based on a rubric similar to the following breakdown (total of ~140 points or so per project; more details will be provided on Blackboard by the first day of class):

- Geologic map (graded for content, correctness, neatness, etc.): 40 points
- Map details (e.g. explanation, north arrow, scale, legend, etc.): 10 points
- Digital data (e.g. shapefiles, notes etc.; graded for completeness, effective use of technology, etc.): 25 points
- Cross-section(s): 25 points
- Report: 40 points

Other components to your grade (**~20%**) will be based on ~2 reading/writing/discussion assignments during the first week.

In addition, for each field project week, each science team will be required to submit a short group report of how it operated, including lessons learned and feedback for the instructors on how the class experiment is going. Details on this deliverable (expectations, format, rubric) will be made available on Blackboard by the first day of class. The remaining **~10%** of your individual grade will be based on this group report (i.e. your contribution to your science team) and the instructors' assessments of how individuals and the science team as a whole are communicating and collaborating (see "Civility and Teamwork" below).

Access to Internet and Information Technology Tools and Resources: To fully engage and complete the work for this course, everyone will individually need to have daily access to a reliable, preferably broadband, internet connection, ideally on a laptop or a desktop computer (most of you probably still have your tablets from Field Geology I). **If at any time you have problems accessing the internet or any of the resources described below, please reach out to the instructors ASAP.**

Each student will need the following information technology tools and resources:

1. *Microsoft Office* (Word, Excel, and PowerPoint) or equivalent productivity software (e.g. Google Docs, etc.).
2. *Microsoft Paint* (or your favorite other image viewing/editing software, e.g. GIMP, Photoshop, etc.).
3. *Adobe Reader* (or your favorite other PDF viewer).
4. *Google Earth Pro* (the desktop version of Google Earth, not the web-based version; get it at earth.google.com).
5. *QGIS* (get it at qgis.org if you don't already have it from Field Geology I) and a set of blank UTEP geologic mapping shapefiles (these can be provided to you if you don't already have them from Field Geology I).
6. Access to *your email account* (UTEP, Gmail, or whatever you use).
7. *Access to Blackboard* (we will use this for our ground data system, for uplinking and downlinking data and traverse plans, as well for its collaborative tools; there will be a shell set up for us by UTEP to use by the first day of class).
8. *Zoom video conferencing* (if necessary we may do a couple of real-time class meetings, so please download the app onto your device(s) and make yourself an account at zoom.us; I will set up a connection link by the first day of class).
9. *Slack collaborative messaging* (I would like to try this as a platform for asynchronous communication among and between teams and instructors, so please download the app onto your device(s) and make yourself an account at slack.com; I will set up a channel for us to use by the first day of class).

As we progress, you and your science teams may find it useful to establish additional (**but not replacement**) means of communication (e.g. texting, FaceTime, or whatever). If you do, **please be sure to make sure all members of your science team have access**. Also keep the instructors informed as to what your communications practices are. Note, however, that your *primary* project communications channels should *always* be those established by the instructors (i.e. Blackboard, Slack, or other TBD) so that your science team's progress can be monitored and evaluated (see "Grading" above).

Civility and Teamwork: This class requires group interactions with your fellow students in an online, asynchronous environment. Think about your colleagues and your role in this group environment and in the current global circumstances. Collegiality, teamwork, and self-organization will make this class a great experience. The instructors will be exercising important leadership skills with you throughout the course, emphasizing good team behavior and dynamics.

Because of the asynchronous, remote, and independent nature of how this class will be structured, it will be particularly important that every student maintain engagement. That means you:

- **stay in the loop on communications;**
- **participate in discussions;**
- **pull your weight in your science teams by meeting deadlines and keeping your commitments to your fellow students;**
- **be diligent in making progress on the individual work you will turn in to be graded.**

The instructors will be monitoring communications channels on Blackboard and Slack to help you in these matters. Students not pulling their weight will be easily identified and their grades will suffer. However, the onus will be on each one of you to make your own experience in the class a success as well as to ensure the success of your science team. Keep in mind that you will not be successful (i.e. get a good grade) if your team suffers. Likewise, if your team does well, it is likely you will too.

SAR-CoV-2/COVID-19: The intent of how I am organizing this course is to maintain the required social distancing. Please follow the updates and guidance from UTEP (https://www.utep.edu/ehs/COVID-19/index.html) and from our Local, State, and Federal government in that regard during the ongoing crisis. If you have any difficulties or concerns related to the circumstances, please reach out to the instructors and/or take advantage of the student support resources UTEP is providing.

Academic Honesty Policy: Academic dishonesty will not be tolerated. The University guidelines for academic dishonesty are very specific and will be strictly followed. Please read the guidelines (see https://www.utep.edu/student-affairs/osccr/student-conduct/academic-integrity.html), and contact the Dean of Students or the instructors if you have any concerns. Note that this course will require you to work in groups at times and individually at other times. Although reasonable collaboration will occur, all work you turn for a grade in is expected to be your own! You MUST learn to trust your own observations and interpretations and NOT rely on those of others. This is your opportunity to hone your skills, so don not cheat yourself by copying the work of others. Copying of other's work WILL be noticed and WILL NOT be tolerated.

Disability: If you have or suspect you have a disability and need an accommodation, you should contact the Disabled Student Services Office (DSSO) at 747-5148 or at dss@utep.edu or go to Room 106 Union East Building. You are responsible for following up with the instructors about any DSS accommodation letters and instructions.

Military Service: If you are a military student with the potential of being called to military service and/or training during the course of the semester, you are encouraged to contact the instructors as soon as possible.