**Ghost Ranch Mapping Project**

*Required Materials (Web/Computer)*

1. GoogleEarth Pro Download (<https://www.google.com/earth/versions/#earth-pro> ).
2. Adobe Illustrator, CorelDraw, AffinityDesigner or other drawing package
3. Stereonet for Windows/Mac
4. Excel or spreadsheet program

*Required Materials (Dropbox link)*

1. Instructions for downloading/using GoogleEarth files listed below (youtube)
2. Base Map-Ghost Ranch (available dropbox)
3. NGS National Topo Grid KMZ file (<http://services.arcgisonline.com/ArcGIS/rest/services/NGS_Topo_US_2D/MapServer> )
4. 4 .kml files downloaded from canvas or dropbox
5. All associated high-resolution imagery (jpg, png and jpeg files from canvas)
6. Listing of Photos.doc (Subject/bearing)
7. USGS Lithological Symbols (if desired)

*Required Materials (Desktop)*

1. Colored pencils
2. Ruler
3. Protractor
4. Pencil
5. Field Notebook

*Lectures accompanying the Project (recorded and live)*

1. Lesson 1- Working with Google Earth, loading kmz files- Dropboxfolder
2. Lesson 2- Mesozoic sedimentary rocks in the Ghost Ranch area (<https://youtu.be/hFtTN8wHGuc> )
3. Lesson 3- Live with TA’s and instructor day 1 field mapping.
4. Lesson 4- Live with TA’s and instructor day 2 field mapping

Final Product

1. Geological Map and A-A’ Cross-Section (1.5-2.0x vertical exaggeration) of the Ghost Ranch area. Legend for both map and cross-section and small index map. This should be completed on a legal size (8.5 x 14 inch sheet). You can rescale map and cross-section as needed, but don’t forget to recalculate scale.
2. Index Map showing study area (Base map is provided to you). You need to place it in the proper location indicating the study site.
3. Rose diagram showing trends of calcite veins (see calcite.xlxs for strikes/dips).
4. Paragraph explaining the relationship between calcite veins and other features on the map. Rose diagram and paragraph on a separate sheet of paper.
5. Brief (single page) geological history of the map area include any lacunae and approximate duration.
6. Stratigraphic column of the region with a detailed description of the units. Strat column should be made on Adobe/Corel/Drawing package with a complete legend. Separate sheet of paper. Use 8.5 x 14 paper size.
7. Copy of your field notes. You should comment on each of the photos, what you see, how that helps your interpretation. Make sketches of at least 12 of the photos that seem to be most important in your fieldbook.
8. NOTE: Assume beds to be of equal thickness throughout the field area.

**Pre Mapping Questions to Answer:**

1. How do you recognize faults in the field? Please give a detailed answer as this will help you and your partner as you map.
2. This mapping area is technically within the Colorado Plateau region, but within miles of the Rio Grande Rift. Given the fact that the sediments are all flat-lying, what type of deformation might you see in this field area?
3. Sketch the principal stress directions for normal and reverse faults according to the Anderson model.

**Day 1-Walk and Map the top of Ghost Ranch (Three Sisters area)**

**Word of caution**: There are lots of photos and pins on this map. It is easy to treat the area as a scavenger hunt. Don’t! Be methodical in your approach and talk to your partner. Ask her/him “What do you see?”. “How can we check that?”. Where should we look next?

Colors to Use on your working map

Trcl= Lower Chinle- pastel orange (lump Mesa Montosa, Poleo and Shinarump)

Trcu= Upper Chinle- Pastel Red (note: lump Petrified Forest/PaintedDesert and Rock Point units)

Jre= Entrada (undifferentiated)- pastel Light green (color variations are only to help identify)

Jrt= Todilto (undifferentiated)- pastel Light Blue

Jrs= Summerville- 20-30% Grey

Qal=Quaternary Alluvium- pastel Light yellow (use sparingly, most of the units are obvious and we will not worry about this. Mainly use within the seasonal stream beds). Choose an elevation cut-off and map everything above that elevation as the correct unit).

*Structural Symbols to use on the map are listed in your field book*

1. Load Google Earth Pro and the 4 kml files. By now, you should have uploaded all the figures onto your computer (per video) so that you can look at the units in the photographs. These hi resolution photos are available from shared dropbox (contact [jmeert@ufl.edu](mailto:jmeert@ufl.edu) for access)
2. Make sure the NGS topo sheet is also uploaded on your computer. Using the NGS topo overlay, find the distance from the parking lot to MP2 (Geological Survey Point). Compare this distance to your working paper map (illustrator or CorelDraw file) and calculate the scale of your working map. What is the bearing from the parking lot to MP2? (Note: You can turn the topo sheet on and off as needed
3. Thought question: This region contains flat-lying strata so we don’t have to worry about strike and dip. Suppose these strata were dipping at 45 degrees or so. How might you go about measuring the strike and dip on google earth if the imagery were very good?
4. Identify the major topographic features on your paper map with those in the field area. These include Battleship Rock, The three sisters (La Buena, La Mala and La Fea) and Orphan Mesa). Mark these on your working map.
5. Once you have calculated the scale, check with me or the TA’s to make sure you are in the ballpark. The Ta’s or I will discuss your observations to make sure you have identified the major topographic features.
6. See if you can identify any units/contacts from the parking lot photos and mark these on your map.
7. You may then begin to walk along the green Path#1 through the arroyo towards MP2. As you walk, take a look at the photos and use the ruler feature in Google Earth to help you recognize the direction of the view.
8. When you identify a contact between units, it is useful to color in your working map. You can switch views between the topo sheet and imagery to place the contact at the correct elevation. It’s important to color your map even if you need to change it later.
9. Once you get to MP2, let’s verify your scale by measuring the distance between MP2 and the very top of Orphan Mesa. This ‘hump’ on Orphan Mesa is clearly visible when you zoom in on the Orphan Mesa pin. What scale did you determine using this measure? If it is close to the same as in #5, you are good to go.
10. Move up along the TopPath and start looking at the photos/outcrop as you move along. Some of the aerial views give a different perspective on the field area. Don’t ignore them as they give valuable clues to what is going on. Map as you go along, draw in contacts and any suspected structural features.
11. Once you get to the Meeting place, have a look at the photo called “StrikeDip#34”. You may want to upload the high-resolution photo. Hint: You may have seen the same thing in View#13. The strike and dip measured here was 115/84. Trace this feature across the map area and see if you can discern the structure.
12. A second interesting feature can be viewed at StrikeDip#65 where the structure measured in the photo is striking 70 and dipping 82. What is the geologist measuring in this photo?
13. Have a good look at the Valley overlooks and photos while working today and estimate the contacts between the various units from up on top of Ghost Ranch and in the vicinity of the three sisters. You can check some of your estimates on Day 2.

**Day 2-Mapping in the Valleys /Along the road/Field Book Check**

1. We will meet with each group at the beginning of Day 2 and review your working maps. You and your partner should agree on the product you present. We ask you to scan a copy of your working map and send it via email to the instructor and TA’s by 8 am. We will schedule a zoom meeting with each group starting at 9 am and review your progress. Just join the meeting at the appointed time. We will also like to see copies of your field notes.
2. We want you to work along the road and then ‘hike’ back along the red path and have a look around. Aerial photos will also allow you a good look into the valley.
3. If you enter ‘street view’ in Google Earth, you can look around at the outcrops and use that information in addition to the photos provided to you. Because this area is a popular stop for drive-by humans with no knowledge of geology, there are also plenty of photos on the online version of google Earth. Use them as needed.
4. Pay particular attention to the photos up by Battleship Rock (there is a small vehicle pull-off). As you journey around that area, think about the rocks on which you are ‘standing’ and what rocks are at eye level on the Battleship.

**Day 3- Stratigraphic column and rock descriptions/Geological History/Calcite Vein Analysis**

1. Schedule an appointment with me or the TA’s to review your map and answers to the questions from Days 1 and 2. Field Book Check.
2. Download the excel file calciteveins.xlxs which contains structural measurements for calcite veins in the area. Use stereonet program to produce a rose diagram (frequency histogram) of the data. Compare these data to your structural features in your map. What, if anything, do they indicate about the state of stress at Ghost Ranch? Be specific in your answer.
3. You have mapped flat-lying strata so you should be able to determine the thickness of each mapped unit in the field area. Note that the thicknesses of the uppermost and lowermost units will be underestimates of the true thickness. Explain why. List your approximate thicknesses for each unit below:
4. Trcl= \_\_\_\_\_\_\_\_\_\_\_\_\_
5. Trcu= \_\_\_\_\_\_\_\_\_\_\_\_\_
6. Jre= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Jrt= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. Jrs= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. Create a stratigraphic column (with an erosional profile) for your measurements on a legal-sized sheet of paper. This should include a description of each unit and USGS or created symbols for each rock type (you can get a basic idea for how this should look (sans measurements) from my strat column description in the video discussing the units. You can refer to the Servilleta strat column design in your field book for required elements.
10. Write up a geological history of the region that is as detailed as possible. For example, please include paleoflow (Chinle, Summerville) and paleowind (Entrada) directions where applicable for each unit (you will have to research these yourself).