ASU (GLS 494/598) UNR (701J) Main Mapping assignment

Over the first part of the semester, we discussed and demonstrated fault zone geomorphology and fault mapping in several tectonic contexts. For the rest of the semester, you will apply your new mapping skills in two individual projects.

Students will each complete two main mapping assignments, spending an average of five hours a week for four weeks on each project (~20 hours total). This does not include any mapping that you complete during class time. It is much more important to produce high quality and well-documented mapping over a smaller location than to have less complete and lower quality mapping over a large portion of fault length. See below for guidelines on fault mapping.

We plan to use your fault maps in subsequent analysis to understand probabilistic fault displacement hazard. We plan to write a peer-reviewed manuscript which includes the mapping and subsequent analysis. Students who complete this mapping assignment with care and professionalism will be invited to be coauthors.

What to include in your mapping project:

Morphology/ Geomorphology: At the beginning of each project, emphasize mapping either the morphology or geomorphology (or a hybrid of both) to gain context to the area. Pick an area that will take one to two hours to map. Create an explanation with a description of your mapping notation and units. Once you have completed this mapping, it is your choice if you think this scale of mapping is beneficial to the rest of the project.

Geomorphic Indicator Ranking: Use your GIR shape file to map the landforms throughout the area covered in your mapping area. Work to use a consistent scale of observation for mapping. You can create more features, as needed. The features must be explained in your report and you must use a consistent lettering for them in your shape file.

Fault mapping: In the fault shape file, include line work showing the fault.

> Confidence ranking: Based on your mapping of the geomorphic features and your geologic intuition, develop a ranking system to place a qualitative uncertainty on the fault traces. Confidence options include strong, distinct, weak, and uncertain. We expect the fault segments to be ~500 m – 1.5 km in length and to break along changes in the landscape that alter your confidence in the fault's existence and/or location. The segment length can vary but we do expect that there is some averaging of nearby features— so 50 m fault segments of varying confidence ranking is too fine, and 5 km segments too is coarse.
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> Primary vs. secondary: Primary: Long, along-strike continuity. Primary faults are continuous at depth but at the surface can be en echelon splays, flower structures that represent shallow complexity in push/ pull-aparts, and parallel traces. Primary faults can be conjugate. Secondary: Offset from the primary fault, may be antithetic, along the

hanging wall of the primary rupture, synthetic fault unconnected to the main fault. We will discuss the distinction more in class.

Progress check:

We will spend approximately one class period each week discussing the mapping projects. We will often use break-out rooms to have smaller size discussions, and instructors will rotate between rooms. We expect that everyone will be professional and follow the guidelines in the Code of Conduct. We expect that your mapping will benefit greatly from these discussions and feedback so take advantage of the opportunity.

When you present weekly in the breakout room, prepare a 2-3 slide presentation showing a location where your mapping is going well and an area where you have a question or are less sure how to map. Do not be shy to show areas where you are unsure how to map; the point of this activity is to learn from those examples.

If you have questions, please do not hesitate to get in touch with an instructor. This is a research project where we do not know the answers a priori and cannot anticipate all the problems that you may encounter. We do not want you wasting time because you hit a roadblock. Get in touch.

Guidelines:

Do not use any other datasets or references other than what we give to you. Specifically, do not consult post-earthquake topography or imagery, including basemaps in GIS programs. This completely defeats the point of the exercise, is not necessary, and will probably be obvious in your results.

Do not research the earthquake. It is important that you remain unbiased by observations of how the earthquake ruptured the surface. Please speak to an instructor if you think particular knowledge about the earthquake or area would benefit your mapping. In rare cases, this may be ok, but we must discuss it first.

You must work individually. We will discuss mapping in class and in office hours, but do not discuss mapping with classmates out of class. We fully expect mapping to vary by individual and need to capture these differences.

Some of the datasets are publicly available. Others, colleagues have shared with us prior to the publication of the dataset under the expectation that we do not share the datasets beyond this class. Do not share any of the data that we give you.

Data quality/ geologic map projects: In several of the projects, we will iteratively give you more information to use to update the map. Before you get that new information, you must save your current work in a zipped folder and send the file to Chelsea Scott (cpscott1@asu.edu). Do not go

back and edit the old files, even if the new data helped you to see what in retrospect was in the earlier datasets. This defeats the entire point of the exercise.

Report:

In your report, include the following as appropriate for your area:

Datasets:In one paragraph, include basic metadata like where you accessed the data, what type of data you used, data resolution, acquisition date. What scale did you use while mapping. If you used multiple scales, state the range or the most common scale.

Confidence Ranking: In one paragraph, give a brief description of how you assigned the certainty ranking to the faults.

The rest of the report should consist of three figures each with ~half a page of text. Here is what to cover:

> *Repeatability Project:* Discuss three areas in different mapping locations and describe your mapping. Possible topics to include: What were important features for determining the confidence ranking? How did you distinguish between primary versus secondary faulting? Where the fault was challenging to map, what landscape features were important?
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> *Data quality/ geologic map projects:* Pick one area and discuss how the additional information informed your mapping.
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> *New pre-rupture mapping:* Discuss three areas in different mapping locations and describe your mapping. Possible topics to include: What were important features for determining the confidence ranking? How did you distinguish between primary versus secondary faulting? Where the fault was challenging to map, what features were important in the landscape?
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> *Characteristics of Missed faults:* Discuss with Chelsea Scott

All maps should have scale bar, legend, north arrow and a caption

Report Due dates:

> Report1: March 31, 2022
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> Report 2: April 29, 2022

Helpful YouTube Videos:

Save imagery from Google Earth: https://youtu.be/VbX-ja3602I

Save and submit shape file datasets: https://youtu.be/xuxXi9SCu-I

Make a map/figure in QGIS: https://youtu.be/OFaMbM15MPc

Grading:

Mapping Assignment

Grading		
On-time (minus 4 points/day)	(20 pts)	
Datasets: Type of data, where the data was accessed, resolution, date of dataset acquisition, mapping scale	(40 pts)	
Morphology and/or Geomorphic mapping: Meets minimum expectation for one to two hours of time. Use of morphology units and/or geomorphic units and relative ages, even coverage, few to no holes in mapping	(25 pts)	
Geomorphic indicator ranking: The GIR is used at a consistent scale throughout the area to map landforms that may provide evidence for faulting.	(55 pts)	
Fault confidence: Description of quality ranking with reference to the local faulting and geomorphology. Description is consistent with mapping results.	(30 pts)	
Fault mapping: A fault shape file (and auxiliary files) with quality rankings and primary/ secondary faulting is turned in. Report shows a clear fault. Mapping is well supported by the datasets, correctness relative to quaternary and bedrock geology, even coverage, no missing features	(100 pts)	
Special areas: Good discussion of the faulting in the selected areas showing varying quality ranking, primary vs. secondary faulting and quality of exposure	(80 pts)	
Presentation of maps: Maps have a scale bar, legend, north arrow, and a caption. Units can be distinguished.	(25 pts)	
Style: Logical organization and correct grammar and spelling	(25 pts)	