

NATURAL BRIDGES FIELD EXERCISE – DATA COLLECTION AND ANALYSIS
ES150: Structural Geology, Winter 2005

Before the field trip

1. Familiarize yourself with the geologic setting, as reported in the online Field Trip Guide which will be presented to you in class.
2. Practice using the Brunton compass to take the orientation of planes and lines. More help will be available in the field if you need it.

Day of field trip

1. Parking is available on Swift St. Entrance to park beach at intersection of Go to the west side of the beach, cross the creek and get on the coastal platform below the trailers. Your choice of meeting times: Wednesday Jan 12 at 2pm or Friday Jan 14 at 9am.
2. On the platform just below the cliffs, note the strong NW-oriented and less well developed NE-oriented joint set. Trace this into the cliff and checkout the more moderately dipping shear fractures. You should be able to distinguish the shear fractures by slickenlines on their surfaces. Some of the extensional fractures show a plumose structure.
3. On the coastal platform layout a tape and measure 30 to 40 extensional fractures where your tape crosses the fractures. It is OK to get some of these measurements from the cliff also.
4. On the cliff face make shear fracture (small fault) measurements that dip both SW and NE. Try to get 10 to 15 of each. The SW dipping shear fractures are more prominent—you will have to work harder to get the complementary NE dipping fractures. You will need both to orient the stress system and to estimate the coefficient of friction.

IN SUMMARY: When you leave the field you should have 30 to 40 joint plane orientation measurements, 10-15 shear fracture orientation measurements with as many slickenlines measurements as possible, and a rough count of joint density (expressed as average spacing) across the exposure face for EACH of the two joint sets.

In Lab

1. Plot up the shear fractures and determine the their angular bisector. A good way to do this is to plot up all the shear fractures of each dip direction and determine a mean orientation of each. Use the “Andersonian” relationships between principal stresses and fault geometry to determine the orientation of the maximum, minimum, and intermediate principal stresses.
2. Sketch the physical relationship of shear fractures and the principal stresses and from this determine the internal angle of friction. Is your value reasonable? How do you know?
3. On a stereonet, plot up all your measurements on the NW extensional joint set. The pole to these measurements should represent Sigma 3.

How does this compare with Sigma 3 determined from the shear fractures?

4. What is the Sigma 3 direction indicated from the SW extensional joint set? How does it compare to that determined from the NW-trending joints? What does that mean about their formation?

NATURAL BRIDGES FIELD EXERCISE - REPORT WRITING
INSTRUCTIONS
ES150: Structural Geology, Winter 2005

Show all work and use SI units (kg, m, s, N, Pa or MPa)
Complete Report due at start of lab, January 27, 2005

Submit a mini-lab report (text is 2-3pgs, must be typed double spaced) which contains the following elements, smoothly contoured into a coherent paper. This first lab report will be graded on a P/NP basis and you will receive detailed feedback. This is your low-risk opportunity to learn how to write a structure report.

1. Introductory paragraph or two describing the locality, lithology, and purpose of the exercise. This should include *basic* outcrop descriptions of all the major features of the Santa Cruz Mudstone at this location, including primary and secondary features, their chronological relationships, and any formational boundaries you observed. Extra features you saw in the field, as well as any other supplementary data, will go here. Reference any sources properly.
2. Methods paragraph describing techniques of data collection and analysis you are using.
3. Results paragraph (very short) reporting the determination of the angle of internal friction of the Santa Cruz Mudstone, and the orientations of principle stresses as independently determined by your two data sets.

THE MEAT or TOFURKEY if you prefer

4. Discussion paragraph relating your results from the two different joint sets. What would the stress field have been like at different points in time to form these structures? Do these structures preserve a record of stress changes through time? If so, what is the general sequence of events? With the data we collected, what are you able to determine about the conditions of failure? What additional information would you need to completely describe the failure events in Mohr space?

APPENDICES:

A. Data Table showing all data taken in the field

B. Stereonet showing plotted shear fracture data, including slickenlines, and determination of angular bisector and orientation of principle stresses as indicated by shear fracture data.

C. Stereonet showing plotted extensional fracture data, with different colors for different major joint sets. Include orientation of principle stresses as indicated by

extensional fracture data.

D. Any sketches or other supplementary data, which if included (not required!) should be referenced in the text.