

### Marin Headlands Field Report (200 Points)

**Field Notes : 10 April 2015**

**Final Report : 17 April 2015**

**Please Note : The reports need to be complete, neat, and well produced.**

#### Overall Expectation

Your report summarizing this field exercise should be comprehensive and professional looking. It should also be concise.

#### Field Notes (40 pts)

Please turn in a copy of your field notes. In some disciplines, field notes are considered legal documents and modifying them after you leave the field renders them inadmissible in a court of law, so please do not make any attempts to “improve” your field notes now.

Fill out the checklist for your field notes that is on the last page of this document. I will assign grades in the end, but I want you to look critically at your own work.

#### Schmidt Quarry (10 pts)



Make a sketch of the outcrop and/or any key structural relationships. Describe all kinematic indicators you observe that allow you to constrain the tectonic history represented in this outcrop. What is the geometry of deformation? How is this deformation related to your observations at the Marin Headlands and the overall tectonic setting?

#### Kirby Cove (20 pts)


Finalize or redraw your map of Kirby Cove. Your report should include a textual description of the lithology and deformation features you observed here. What appears to be the dominant deformation geometry? What can we infer from the paleomagnetic data?

#### Fold Analysis (50 pts)


From your data collected at the Headlands folds outcrop (Coordinate your field measurements and use everybody's data).

-  1. Plot your Headland fold measurements on a stereonet. Use the Stereonet program to accomplish this task. Plot the fold axes and poles to fold-axial planes on one stereonet. Add labels that refer to a designated fold or location. Can you make out representative sets of bedding orientations that can be related to the geometry of folding? What is the sense of asymmetry of the folding at this site?
2. Add a second stereonet layer and plot the data from Kirby Cove (as 3 different symbols).
3. Measure bedding thickness on the outcrop photos along different segments of your folds, parallel to the axial plane of each fold and perpendicular to bedding. **Draw dip isogons** on each sketch. Determine the classification of your fold (See Ramsey's fold classification scheme in T&M). Do the chert layers behave differently than do the interbedded shales? Why? In order to do the above project more easily, you may want to enlarge the photo of the fold in a program like Powerpoint or Photoshop. What is the regional sense of shear implied by these folds? (Remember that when you are discussing the folds formally, you should say overturned to the southwest or northeast, not "Z" or "S" or clockwise or counterclockwise). How does your special fold compare to other folds around it and the regional deformation field?
-  Discuss any evidence that bears on the mechanisms for folding and/or the physical conditions or rheology of the strata during folding.


**One Page Report** (80 pts)


 **A.** Provide a general overview of the timing and sequence of events in the Bay Area that are relevant to your observations on this trip. What appears to be the dominant deformation geometry of Franciscan structures in the Bay area (from stop 1, description of other outcrops, and generalized structure of the Franciscan subduction complex)?

**B.** Write a couple of sentences on purpose of this study and the type of data collected.

 **C.** Discuss the mesoscale structures in the chert beds:

- Describe concisely the style and geometry of the folds measured. Use your dip isogon study here to document in more detail the geometry of the folds in the chert and shale.
- Concisely describe the orientation data of folds from your stereonet, i.e. average and spread of fold axes, average and spread of axial planes.
- What is the regional sense of shear implied by these folds? How does this inferred shear relate to the direction of underthrusting inferred for the Marin Headlands during Franciscan subduction? (Remember that when you are discussing the folds formally, you should say overturned to the southwest or northeast, not just clockwise or counterclockwise).

 **D.** Discuss the mechanisms for folding and/or the physical conditions or rheology of the strata during folding.

 **E.** Discuss the relationship of the geometry of folding, as well as the mapped relationships on the Kirby Cove road, to plate margin tectonics: If one assumes that the continental margin was parallel to the trend of the Sierra Nevada and Great Valley during the time of Franciscan deformation, and that subduction was directed eastward under this margin, is the attitude and sense of asymmetry of Marin chert folds compatible with this scenario? What can we infer from the paleomagnetic data? Could you have predicted these data?

Use YES, NO, ONCE, or SOME to indicate whether or not your field notes include the following crucial items:

|  |  |
|--|--|
| <i>General</i>   |  |
| Page Numbers   |  |
| Beginning of Day comments  |  |
| End of Day summary   |  |
| <i>Locations</i>   |  |
| General Location Sketch  |  |
| Station Numbers (on sketch)  |  |
| Orientation (North Arrow, Direction of X-Section)  |  |
| Scale bar (approximate)  |  |
| Description of location (optional if map is excellent)   |  |
| Times Visited (optional)   |  |
| Use of Standard Mapping Symbols  |  |
| <i>Lithology</i>   |  |
| Individual Units   |  |
| Individual Unit Names (granite, gneiss, sandstone...)  |  |
| Color  |  |
| Compositon (minerals or clasts)  |  |
| Grain/Clast Size   |  |
| Structure (ie: massive, cross-bedded, sorting)   |  |
| Structural Observations (Joints)   |  |
| Thickness, where appropriate   |  |
| <i>Stratigraphy/Structural Observations</i>  |  |
| Sketches   |  |
| Measured the orientations of contacts  |  |
| Description of what orientation is<br>(ie: strike and dip are useless without comments about what you took the strike and dip of!) |  |
| Nature of contact (unconformity, bedding, etc.)  |  |

**Grade:**

|                                   |     |
|-----------------------------------|-----|
| Completeness                      | /10 |
| Neatness / Organization           | /10 |
| Scale Bar & Orientation           | /10 |
| Station Locations/Spatial Control | /10 |