FIELD TRIP 1  
Geologic Mapping, Rainbow Basin  
(Vicinity Barstow, California)  

Ge 101  
Fall Quarter 2013  

General Information: We will be departing at 8:00 a.m. on Friday, November 1 from the parking area in front of Arms ("Arms Circle"). Please arrive by 7:45 so there is time to get the trucks packed etc. Attached is a map of how to get to the field area. We will be staying in a motel in Barstow on Friday and Saturday nights (California Inn). We will depart from the motel parking lot for the field area at 8 a.m. on Saturday and Sunday mornings. We will leave the field area at 4 p.m. Sunday, and arrive back at Caltech by 7 p.m.  

Meals: Rainbow basin is remote and there are no options to purchase food there. We will make a brief stop at a supermarket in Barstow Friday morning to purchase lunch food, snacks and drinks. You may however opt to bring your own food and pack it in ice chests before we leave, up to and including three lunches, two breakfasts and two dinners. Prof. and TAs usually opt for breakfast at Carrows (a short drive from the motel) at 7 a.m., but the California Inn has a free breakfast. There are lots of restaurant options for dinner, from McDonalds up to various moderately priced restaurants. If you opt to purchase lunch food Friday morning in Barstow and otherwise eat in restaurants, you should budget about $80-100.  

Report: The field report will be an inked and colored geologic map with a map legend and cross section, plus a short description of the geologic history of the map area, listing events depicted on the geologic map, plus additional information compiled in Lab. It will be turned in at the end of lab period next week.  

Preparation: You will receive a topographic map on Friday morning prior to departure for the field. You will find it convenient to plot a grid of north-south and east-west trending pencil lines on your base map just before you go into the field. Use a mechanical pencil (see below) and plot lines about every two inches.  

Warning: Some rattlesnakes. Always look where you step or put your hands. Do not attempt to climb steep slopes, the kind of rock in the study area is not suitable for rock climbing. For example, do not attempt to climb The Sphinx (peak 3195).  

Equipment: (*supplied by instructor)  

Field Equipment:  
Covered clip board (plexiglas best for cover), 8 1/2 x 11"  
Thick rubber band for holding map on clipboard  
Protractor (6")
Mechanical pencil + at least one spare, Pentel 0.5 mm, including an eraser; you will do a lot of erasing. Available at Caltech bookstore.
Engineer’s scale (ruler), 6 inch w/ $\frac{10}{1}=\text{inch divisions}$
Drafting Pens (00 and 2, Koh-I-Noor rapidograph or equivalent)
Pen containing liquid paper or “white out” for correcting map
Colored pencils (yellow and orange required, plus at least 4 other colors)
*Brunton compass
*Topographic base map of Rainbow Basin area

Personal items:

Knapsack or day pack
Canteens/water bottles with 2 liters capacity
Wide-brimmed hat (avoid baseball caps)
Sunscreen and lip balm
Shirt with front pocket
Light jacket for wind protection
Heavy jacket in case of cold weather
Sturdy footwear (study ankle protection; avoid running shoes)
Folding beach chair (optional)
A few good cigars (optional)

Geology: The principal rock unit for the mapping exercise is the Barstow Formation, which contains numerous middle Miocene mammalian fossils and trace fossils. It is unconformably overlain by dissected alluvial fan gravel at two levels and Holocene (Recent) alluvium in the stream channels. The Barstow Formation consists of massive brown to reddish or greenish brown mudstone and clay with localized thin layers of light-colored tuff, sandstone, and siltstone. The Barstow Formation is folded into an east-west trending syncline which crosses the middle of Rainbow Basin. The syncline is offset at both ends by northwest-trending faults. The central portion of the basin where we will be mapping is locally complicated by additional faults and minor folds.

The older fan gravel caps the highest ridges around Rainbow Basin to depths as great as 30 m. The younger terrace gravel covers extensive interchannel areas at lower elevations to depths of a few meters. These gravels are usually buff colored, are moderately well stratified, and dip gently southward. They are composed of fragments ranging in size from sand to boulders of granitic and volcanic rocks derived from exposures to the north. Most of the vegetation in the area is restricted to these units.

Field Work: Start at the vista point directly east of the parking area and north of B.M. 3123 along the road. Orient your map with north in the proper direction and try to identify the following topographic features:

Cope: highest, gravel-capped peak rising above ridge of light-colored rock on the skyline to north.

3418: High peak to northeast formed by steeply dipping resistant bedding.
3195: The Sphinx: the sharp, reddish point rising from basin floor 500 feet to northeast.

3323: To southeast on rim of basin.

Double peak, 3258 and 3244 on skyline to southwest.

Finally try to locate the vista point and parking area which are not shown on the map. It may help to identify the topo point represented by the small closed loop in the (heavy) 3150 foot contour near the vista point. You will find that the work will go more easily if you make constant reference to your map and always keep track of your location as accurately as possible.

You should begin by mapping the resistant yellow to brown weathering tuffaceous sandstone that forms the bare, ripple-marked slope 250 feet north of the parking area and parallels the north side of the entrance road south of the parking area. This will be designated “Puma Tuff.” Plot attitudes of bedding at least every 300 feet along your traverse, more closely on the axis of the syncline and next to faults. Try to find some attitudes directly on the axis of the syncline so you can determine the plunge. Map the Puma Tuff on both flanks of the syncline as far east as 3195. Initially do not attempt to map this unit where it crops out on the low hill just west of the parking area. Be sure to include a description of this and all other marker beds in your notes so you can identify them on both flanks of the syncline and in and across the zone of northwest trending faults, which crosses the area west of the parking lot.

Also map the stream alluvium and terrace gravels and plot the axis of the syncline. Keep moving, and be sure to differentiate between solid, dashed and dotted contact lines. It will be convenient to color the stream alluvium yellow and the terrace gravel on your map orange as you go. Map the tuff beds down section from the Puma Tuff on both flanks of the syncline from 3195 as far west as Cuvier if you have time. The north-south limits of your area should lie between 3323 and Cope. You will receive more credit for accuracy within a small area rather than mapping a larger area poorly. Be sure to describe the marker beds in sufficient detail in your notes so you can identify them when the going gets tough. You may find that some markers are only present on one flank of the syncline.

As you work west you will cross some faults. Measure and plot attitude of fault surface where possible. Faults are not as well exposed as marker beds; their position will be established in part by accurately plotting locations where marker beds are truncated.

Office Work: Ink all contacts (#00 pen) and faults (#2 pen) and color the map. Show direction of separation on faults with appropriate symbols. Do not draft a separate office map, rather keep the field map as neat and clean as possible. Follow the map symbol handout and be sure to describe and illustrate all symbols and types of contacts in your legend. Content and arrangement of your legend are both important. Be sure to color the explanation boxes to match the map. The following general layout for the explanation box of the Barstow Formation is recommended:
On a separate sheet of graph paper construct a north-south cross section at the location you believe will best illustrate the structure. Be sure to show line of section on your map.

In addition to the map and cross section, include a one-page summary of the geologic history of the map area, including a listing of events as in Problem Set 1.

<table>
<thead>
<tr>
<th></th>
<th>Tbu3</th>
<th>Puma tuff (~14.0 Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tbu2</td>
<td>Thin tuff (~14.8 Ma)</td>
</tr>
<tr>
<td></td>
<td>Tbu1</td>
<td>Skyline tuff (15.0 Ma)</td>
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<tr>
<td></td>
<td>Tbm</td>
<td></td>
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</tbody>
</table>

Barstow Formation
(brief description); Tbu3;
(brief description); Tbu2 etc.
Driving instructions: Allow 2 - 3 hours driving time from Pasadena. Drive east Interstate 210 to Interstate 15 and turn north to Barstow. Take the Central Barstow exit and proceed as follows:
<table>
<thead>
<tr>
<th>Mileage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Central Barstow exit</td>
</tr>
<tr>
<td>0.3</td>
<td>Stop sign, turn left (north) to central Barstow on Barstow Road</td>
</tr>
<tr>
<td>1.0</td>
<td>Main Street, turn left (west)</td>
</tr>
<tr>
<td>0.3</td>
<td>First Street, turn right (north) and drive over railroad yard.</td>
</tr>
<tr>
<td>0.9</td>
<td>Irwin Road, turn left (northwest)</td>
</tr>
<tr>
<td>2.5</td>
<td>Fossil Bed Road, sign to Rainbow Basin, turn left (northwest)</td>
</tr>
<tr>
<td>6.1</td>
<td>Turn right to Rainbow Basin</td>
</tr>
<tr>
<td>8.6</td>
<td>Intersection. One way road to north goes through map area. (Park at 1.6 miles). Road to right (east) to Owl Canyon Campground (1.1 miles).</td>
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