

Earth & Atmospheric Sciences Department, SUNY Oneonta

Mojave-Mecca Geology Field Trip Guide Book

Geol 394 Special Topics, Spring 2010

Compiled by Les Hasbargen

2/20/2010

Being a series of maps, exercises, and general information for the field trip course to various locations of tectonic, lithologic, fossiliferous, volcanic, and sculpted lands of the Salton trough and Mojave Desert.

Mojave-Mecca Field Trip Guidebook

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Overview Map and Itinerary

Web Images Videos Maps News Shopping Gmail more

Google maps las vegas, nv to yucca valley, ca Search Maps Show search options

Find businesses, addresses and places of interest.

Get Directions My Maps

- A Las Vegas, nv
- B Yucca valley, ca
- C nyon Rd, White Water, California 92282
- D Palm Springs, Ca
- E Thousand palms, ca
- F al Diablo, Desert Hot Springs, CA 92240
- G lox Canyon Rd, Mecca, California 92254
- H Calico, ca
- I Afton, ca
- J Zzyzx, ca
- K Kelbaker Rd/Kelso-Amboy Rd
- L Las Vegas, NV

Add Destination - Show options

By car Get Directions

Driving directions to Las Vegas, NV
734 mi – about 17 hours 1 min
Via CA-247 N/Old Woman Springs Rd - [remove](#)

- 1. Head north on Las Vegas Blvd S toward Dunes Rd/W Flamingo Rd 43 ft
- 2. Take the 1st left onto Dunes Rd/W Flamingo Rd 0.5 mi
- 3. Slight left to stay on Dunes Rd/W Flamingo Rd 377 ft
- 4. Turn left to merge onto I-15 S toward Los Angeles 151 mi

Entering California

Locations of the stops for the Mojave-Mecca field trip, listed in order for the trip, A through L. A few locations have been omitted for clarity.

Exercise Summary

Students will be evaluated based on the following:

Participation (10%) on the field trip, which includes asking questions in the field, doing pre-trip exercises, assisting with tent set-up and tear down, doing dishes at the camp, helping with food preparation, cleaning up the camping area, and assisting with packing up camping gear

Field notes (20%). These must include a record for each stop, including date, time, location (UTM GPS location), description of the stop, and detailed notes and sketches when appropriate.

Field copy and finished **geologic maps** for Painted Canyon, complete with legend (20%). The finished map (the desk copy) should have **inked** lithologic contacts, folds, faults, and rock orientation symbols. Lithologic units must be color-coded in the map and on the legend (desk copy only).

Stratigraphic column (15%) for Box Canyon. A finished copy is all that is needed, as your field notes will be handed in. The column should have title, author, graphic column, verbal description and interpretation, and vertical scale.

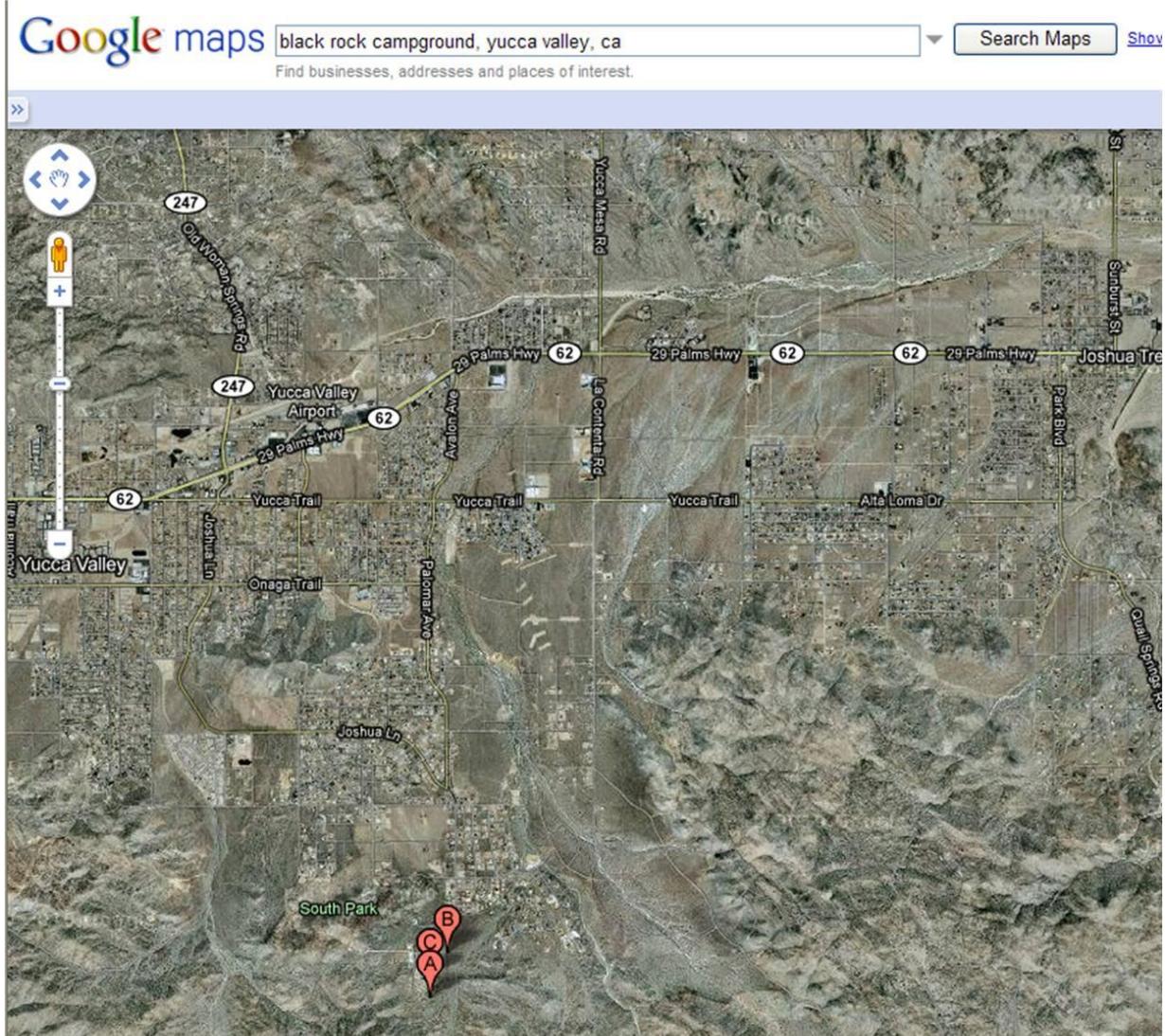
Geologic cross section for Painted Canyon (15%). The cross section should show the rock types, dips, fold axes, and faults correctly along the cross section line. Provide horizontal and vertical scale, legend, title, author, and date. The location must be noted in the title.

Post trip **presentation** (20%). Students will choose a topic on the trip to investigate further in the scientific literature, and present their findings to the group. The presentation must be in the form of a slide show; must have a title, author, and date; must provide new information about the site not contained in this guide book, and should give a more detailed picture of what is known about the topic or site.

Day 1 Travel

Sat. February 20, 2010

Oneonta to Albany to Las Vegas to Blackrock Campground Joshua Tree National Park

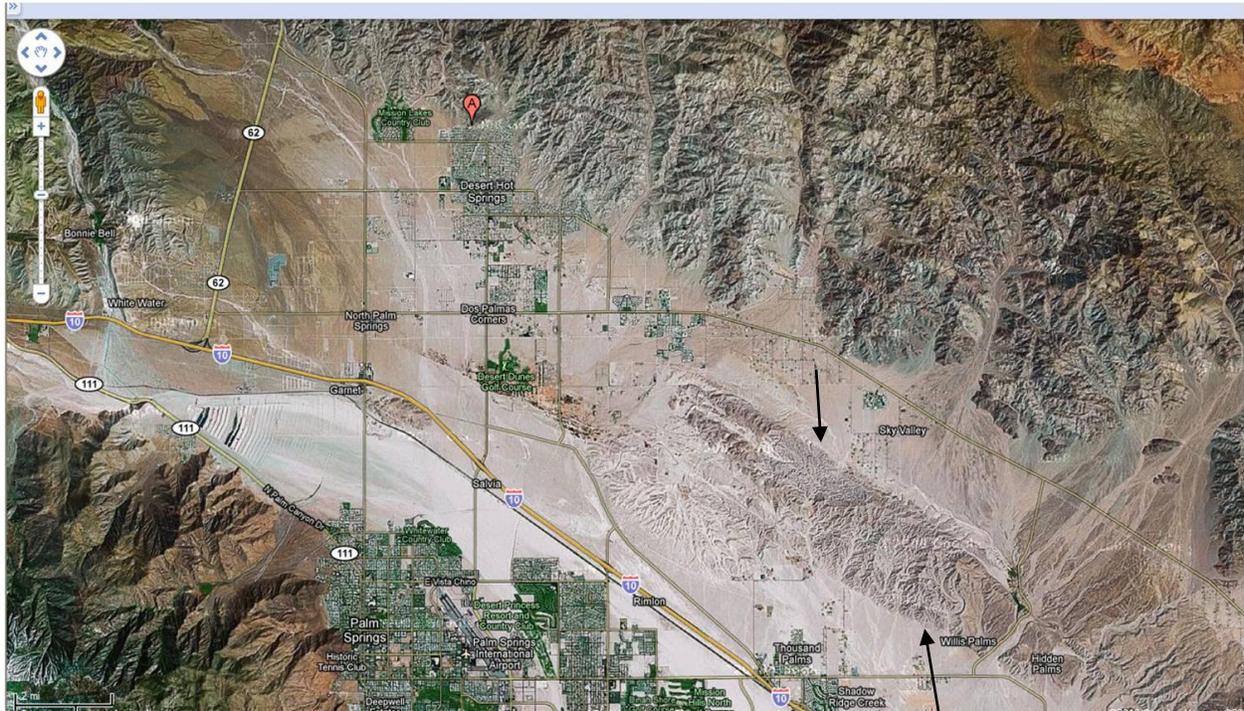


We arrive in Las Vegas about 5 pm, and we will take I-15 south to Barstow, then follow Highway 247 south to Yucca Valley to Yucca Trail (in Yucca Valley), then turn east (left) to Palomar, then south (right) to Black Rock Campground in Joshua Tree National Park. We'll have to set up in the dark.

Day 2 Palm Springs Area

Sun. February 21, 2010

We will need to eat, pack and leave by 8:45 am. If we could leave by 8 am, we could stop at Whitewater Canyon before hitting the tram. This would give us more time to stop at 1000 Palms in the early afternoon. We will follow Highway 62 west and south to Palm Springs.



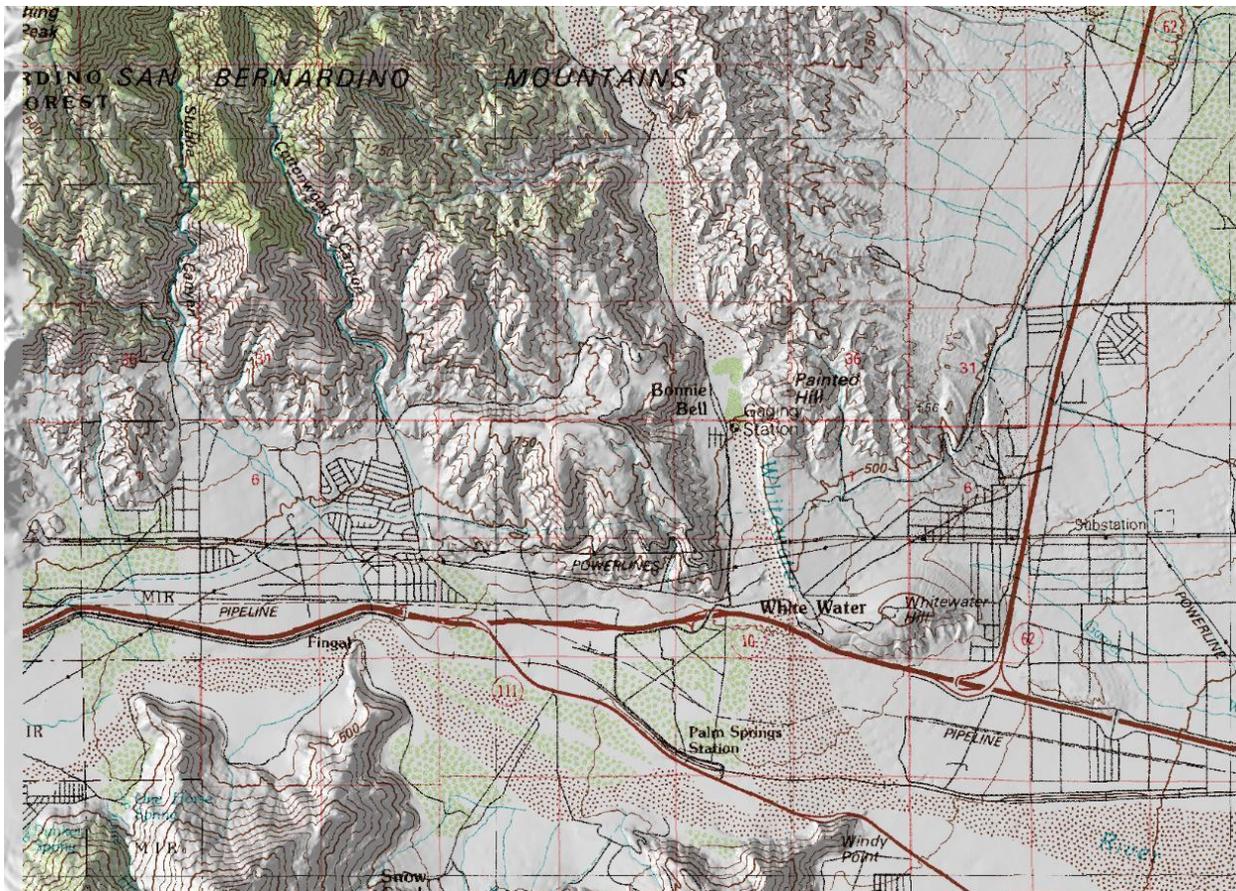
Overview of the northern Coachella Valley, showing Desert Hot Springs (where our evening hosts Lee and Chris Totten live—see the A), the linear trends of the Banning (southern) and Mission Creek (northern) faults, by the arrows.

Palm Springs Tram

We have tram ride reservations for 10 am. We'll take the ride up the mountain, a 8500' climb, and then get a birds-eye view of the tectonic borderland to our east and north. The Coachella Valley is the northern extent of a rifted valley, as the Pacific plate is both sliding northward and pulling away from the North American plate in this location. We'll have a catered lunch at the top of the tram. With any luck, this will be the coldest moment on the trip! Bring a jacket.

Whitewater Canyon

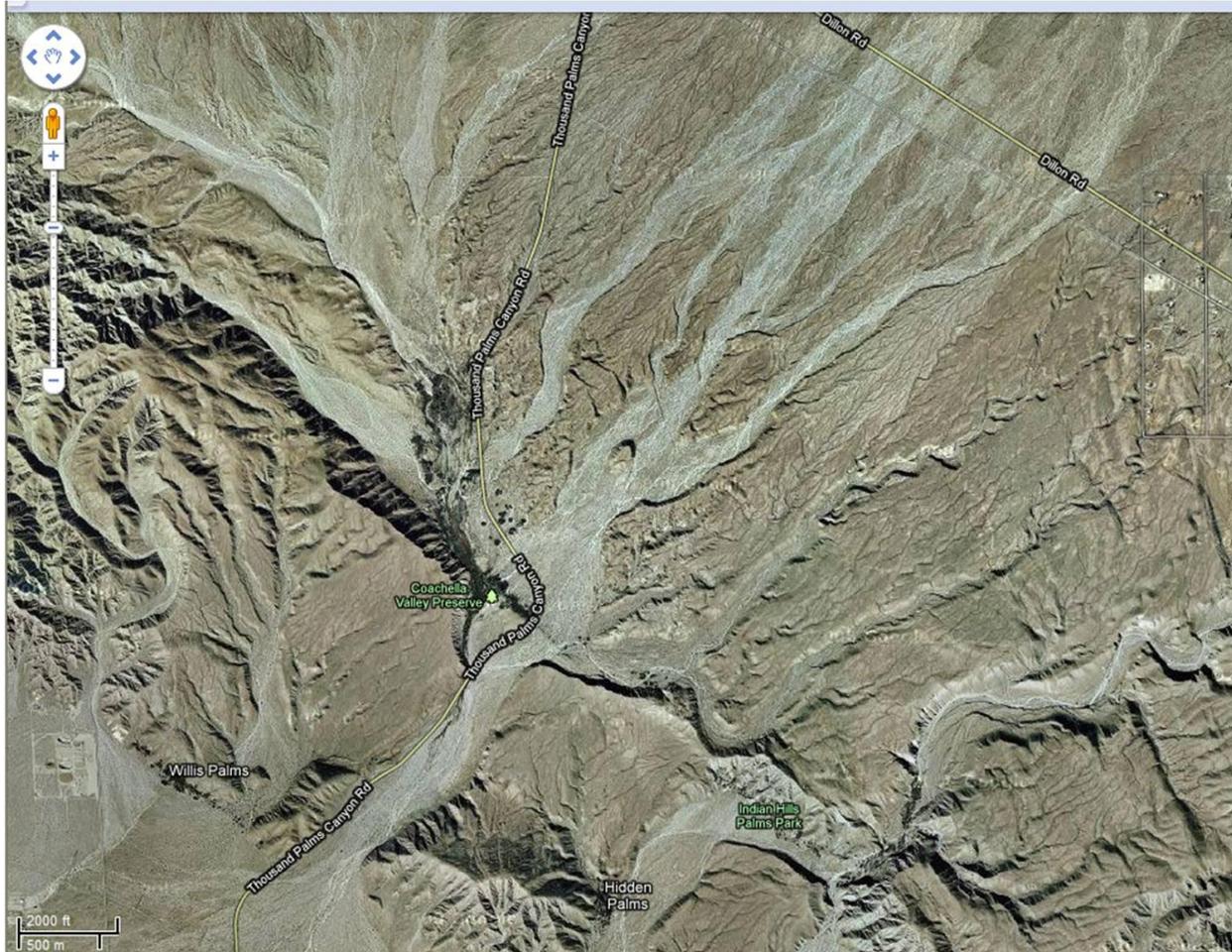
After returning to the valley floor, we will go to Whitewater, at the junction of Highway 111 and I-10 in San Geronio pass. To the north lie the San Bernardino Mountains. To the south, the San Jacinto Mountains rise in a steep escarpment. A few strands of the San Andreas fault work their way through the pass and the San Bernardino mountains. One of these, the Banning fault, crosses Whitewater River just north of I-10. We will drive up to investigate. We will also stop by the wind turbines, and look for ventifacts (essentially, sand-blasting features on rocks, fence posts, etc). The turbines have been placed here for a reason! It could get breezy. We will also contemplate the fate of the Whitewater River as it moves out of the high mountains and heads south to the Salton Sea. We won't be able to follow its course on this trip, but it is well worth following the course of the river in Google map/Earth. A study of land use along the river would be worth a report at the end of the semester.



Shaded relief topographic map of White Water. North is “up”. The Banning Fault cuts the channel at Bonnie Bell.

Try to determine the relative motion of the Banning Fault. Is there evidence for long term displacement here? Look for such evidence when we arrive.

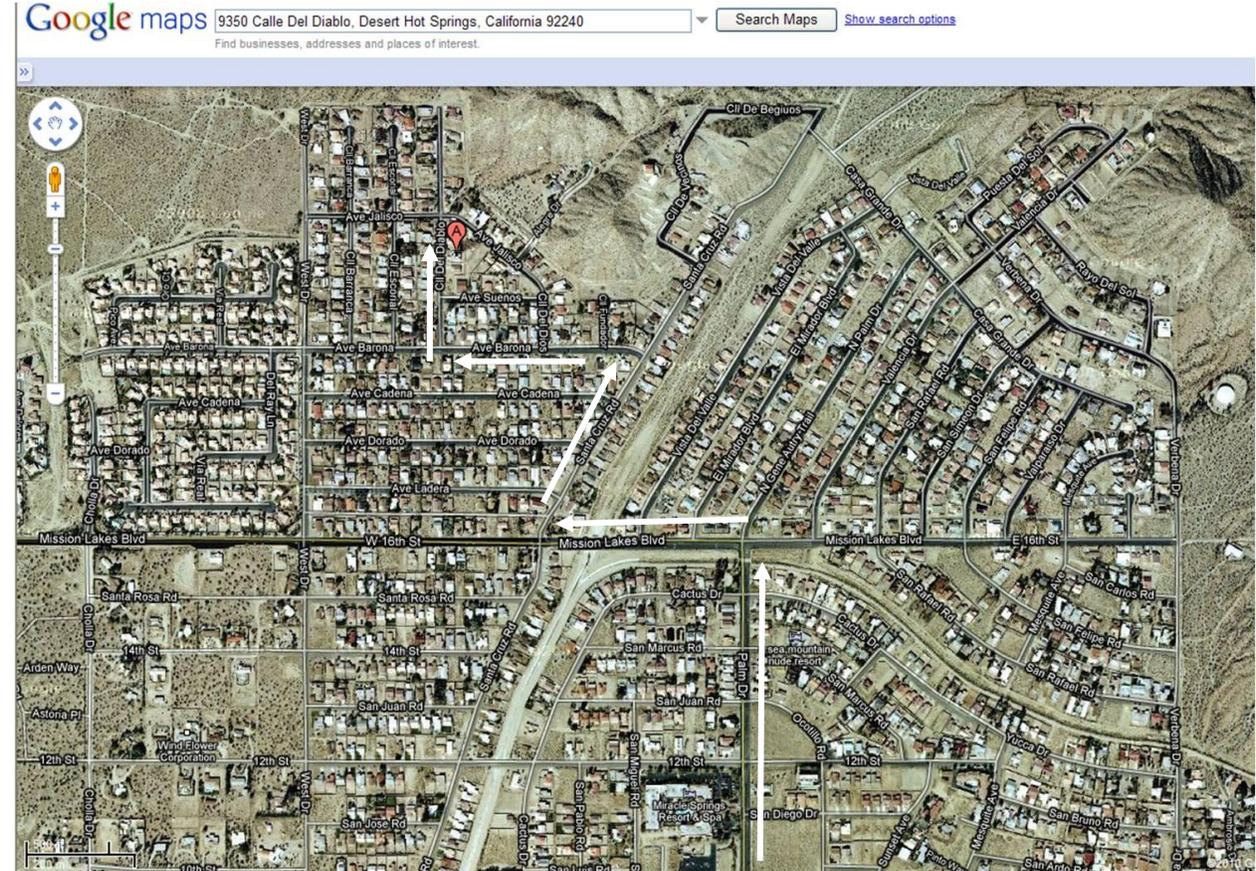
1000 Palms



Aerial view of Coachella Valley Preserve. The Mission Creek fault cuts across the alluvial fans here like a knife. Note how some fans have been uplifted and now are separated from their original headwaters. Also, note how some channels appear displaced horizontally—what is the relative sense of motion? Faults can act as a groundwater flow barrier, and springs often mark fault locations in this part of the world. The California fan palms take advantage of the water, and large groves of them thrive here. We will look at various aspects of the location, including tectonic and alluvial processes, and whether these have left a mark on the palms... Then we will head up to our campground, and set up camp. Then we're off to our dinner hosts in Desert Hot Springs.

Directions. Head north 2 miles on Thousand Palms Canyon road to Dillon Road. Then turn left (northwest) and go ~8.3 miles to Sam's Family Spa—it's on the left after an angular turn west. After setting up camp, take Dillon Road west for ~4.4 mi to Palm Drive. Turn right (north), and follow for 3.5 miles to Mission Lakes Boulevard. Turn left and go 0.25 mi to Santa Cruz Rd and take a right. Go north for 0.25 mi and take a left on Ave Barona. Go 0.23 mi and take a right on Calle del Diablo, and go to 9350 Calle del Diablo—it's on the right.

Desert Hot Springs



Our hosts live at the “A”. Our camp is at Sam’s Family Spa, below, just off of Dillon Road.

Sam's Family Spa Hot Water - more info »
 70875 Dillon Road, Desert Hot Spgs, CA
 - (760) 329-6457
 11 reviews - Write a review
 "Sam's Family Spa was created and designed as a family park, so that both children and adults could enjoy the facilities. You can stay for a day, a week, ..." samsfamilyspa.com

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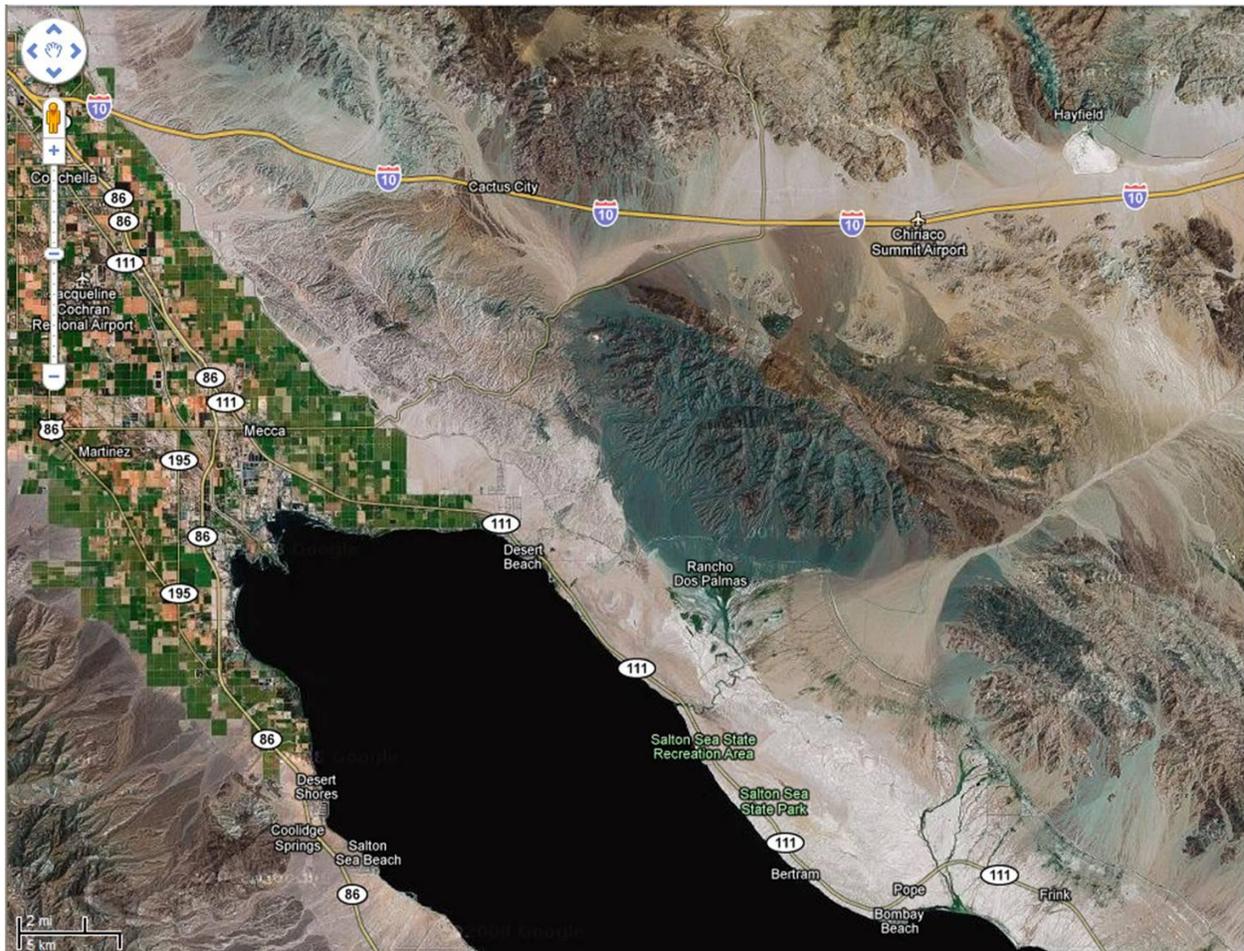
Aerial view of Sam’s Family Spa Campground. A strand of the San Andreas fault is buried under the alluvial cover here, but trends northwest-southeast, about ½ mile southwest of the campground. The hot springs are actually from wells (relatively shallow) that tap into water that

is much warmer than one typically finds at 30-100 m depths. There is higher heat flow in this area due to continental rifting.

Day 3 Box Canyon

Mon. February 22, 2010

We rise and depart as soon as we can in the morning—hopefully by 8 am. We then take Dillon Road south for about 25 miles, crossing I-10 to Highway 111. We follow Hwy 111 south to Mecca, turn left onto 60th Avenue to Box Canyon Road, and follow this up to the uphill side of the Mecca Hills. We begin our reconnaissance there.



Overview map of Salton Sea, Mecca Hills (northwest of the dark colored Orocochia Mountains), and the Salton Sea State Recreation area, where we will be camping for the next 3 nights.

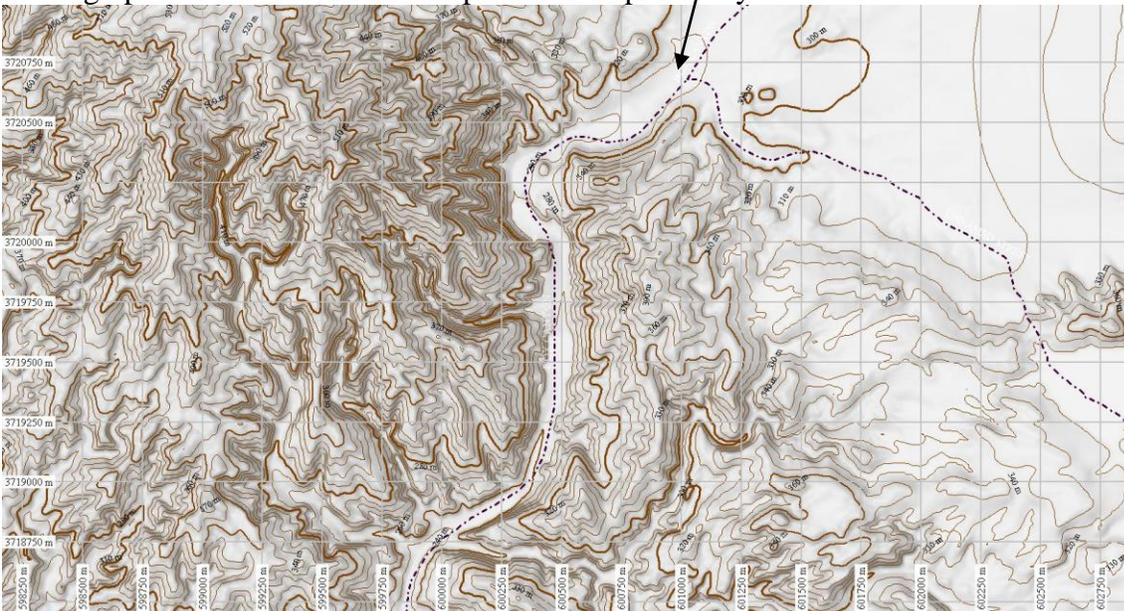
This next part of the field trip is meant to give you practice in describing rocks in the field, and mapping them. Along the way, you will see some quite spectacular structures. The Mecca Hills occupy a small section of the North America-Pacific plate boundary where rocks are being squeezed. There is a gentle left bend in a right lateral fault here, which leads to a restraining bend. The rocks get turned on their heads in this region. Your job will be to determine what a normal stratigraphic sequence is, and discover how the plates distribute deformation across this

borderland. To do this, you will generate a stratigraphic column; map folds, faults, rock orientation and contacts; and construct a geologic cross section. You will have to make detailed notes and sketches in your field book! You will also map your locations on the maps provided below. We will accomplish this in the next three days. Our first day will have a reconnaissance of Box Canyon in the morning, then you will make a stratigraphic section for the afternoon. The next day will involve mapping in Painted Canyon. On the third day we will finish mapping, and have a couple hikes to good overview locations.

Reconnaissance Box Canyon



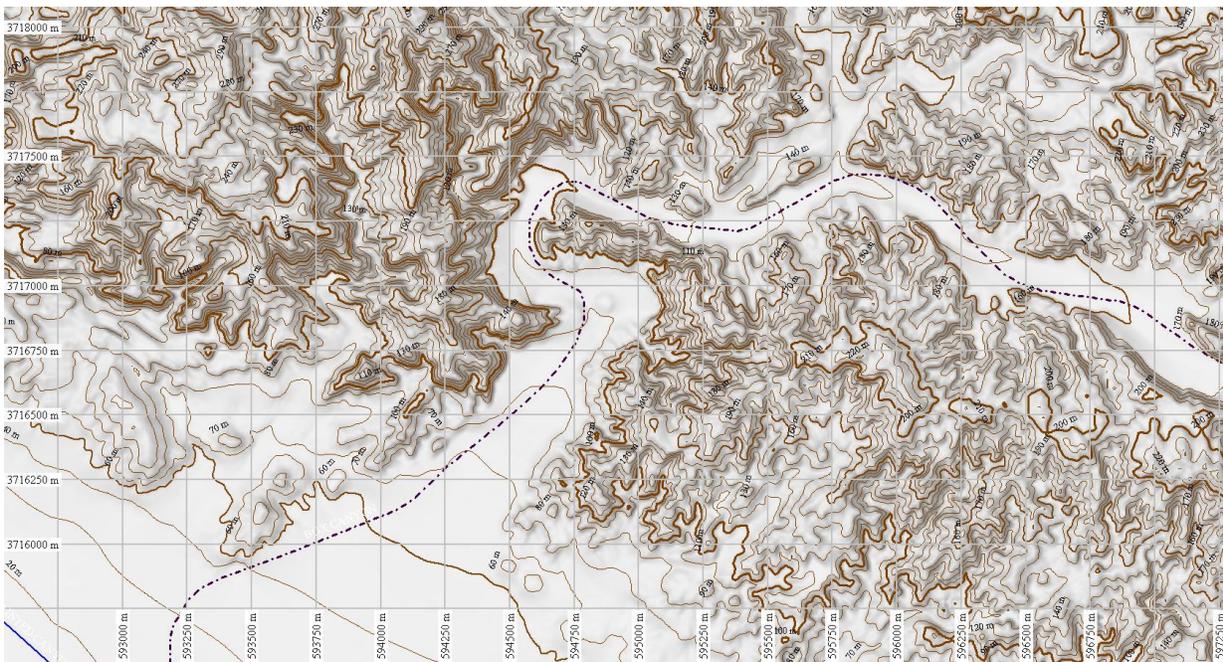
The map above provides an overview of the Mecca Hills. On our first day here, we will drive up Box Canyon and make several stops to learn about the stratigraphy and sedimentary structures, note any major folds and faults and contacts between units, and locate the best place to generate a stratigraphic column. Label the stops on the map and in your notes!



The map below is for the central section of Box Canyon. Note that the map has a UTM grid of light gray lines at 250 m spacing. Contour interval is 10 m. Darker brown contours occur every 50 m.



The map below is for the lower reach of Box Canyon. The dot-dash line is Box Canyon road.



Stratigraphic Column: Box Canyon

For the afternoon, we will work out the basic stratigraphy in the Mecca Hills. We work from the bottom up, that is, from oldest to youngest. Your job is to group the rocks into mappable units, describe the rocks within each group, and determine the thickness (roughly) of the units. Keep in mind the basic features you must always note: bed thickness, nature of the contacts, grain size and distribution, clast composition, sedimentary structures (ripples, stratification, cross bedding, graded bedding, etc), color, and degree of lithification. Estimate bed thickness using a pencil and human for scale. Stand back from the outcrop. Hold a pencil out at arm's length. Measure the human (or scale object) with the pencil, then use this scale to measure the total thickness of the outcrop. You should make a sketch of the stratigraphic column in your field book, scaled, with appropriate symbols and description. You will create a desk copy of this later, so don't be afraid to make a few mistakes here. Just get the measurements you need, fill in as many of the pertinent details as you can, especially ones which seem distinctive to the rock unit.

Day 4 Painted Canyon

Tues. February 23, 2010

The exercise for today is to map the rock types, contacts, rock layer orientation, folds, and faults in a transect from the mouth of Painted Canyon eastward for about 2 km. The instructor will show you where to stop. You have all day to collect measurements. You will have to gage your efforts at capturing all the pertinent detail with the need to collect data for the entire transect. Feel free to work together, but everyone will have to present their own field notes and map for a grade. After you have finished with your field mapping, make an initial geologic cross section in your field notes to summarize what you have mapped. If you find some parts of the cross section where you need more info, return to that spot before you leave. We will return to Painted Canyon on Day 3, and you can collect a few more points as we hike to Ladder Canyon and hopefully get up on Art's Hill, a spectacular overlook of the structures in the area.

Mapping Painted Canyon

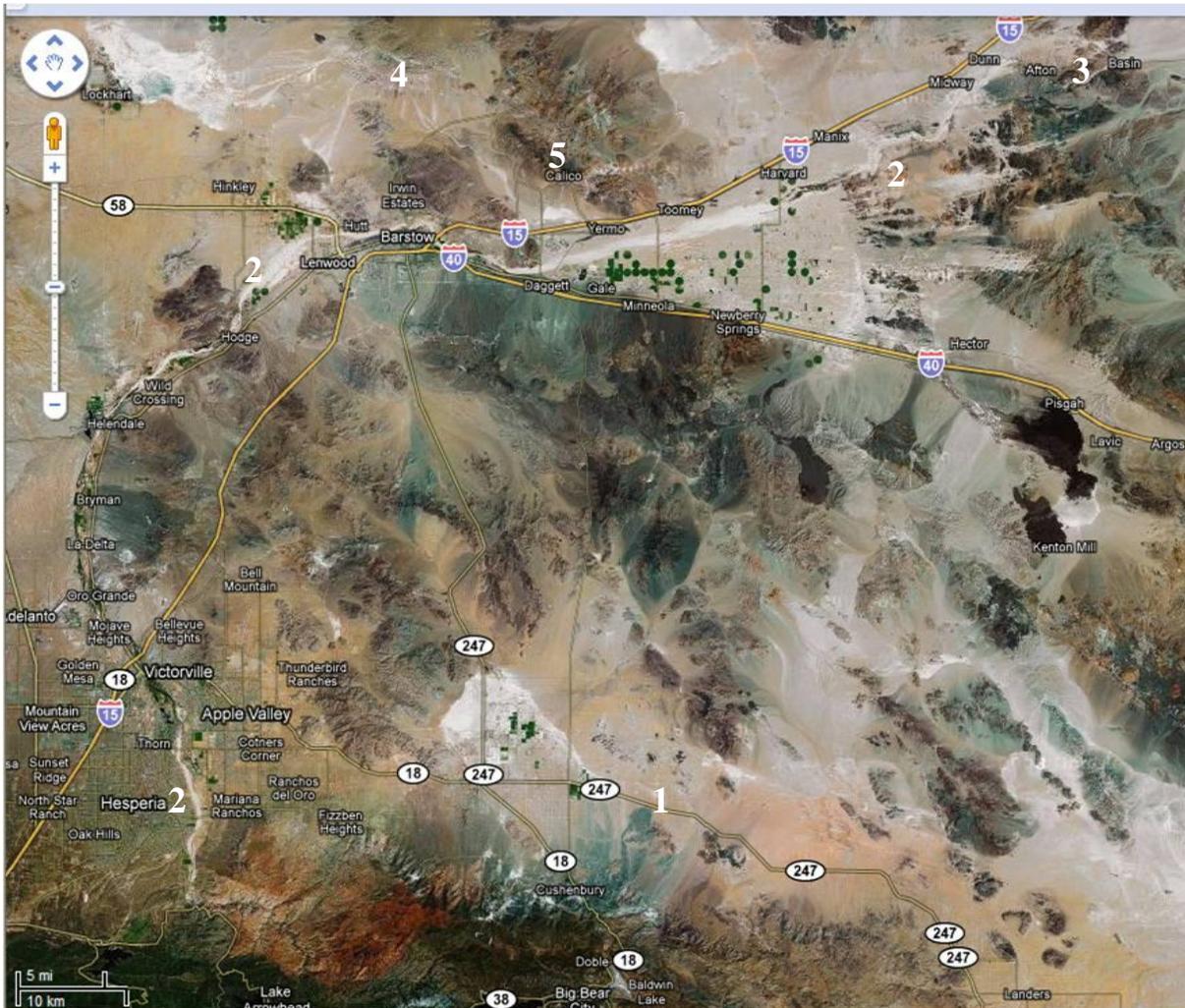
Topographic map of Painted Canyon.

Contours at 20 ft intervals.
UTM grid spacing = 250 m.
North is aligned with the
arrow. Map created by L.
Hasbargen, using data from
the USGS Seamless server
(1/3 arc second elevation

Day 6 Blackhawk Slide and Rainbow Basin

Thurs. February 25, 2010

We will travel from the Salton trough northward into the Mojave desert. En route, we stop at the Blackhawk slide. If there is time, we will see if we can still spot the Landers earthquake offset. This rupture was a M7.3, and surprisingly, ruptured 5 separate faults in the matter of a couple minutes. The rupture made it up to Earth's surface—something which doesn't happen all that often. In fact a road was offset some 20', and if we have time, we will see if we can still spot the offset.

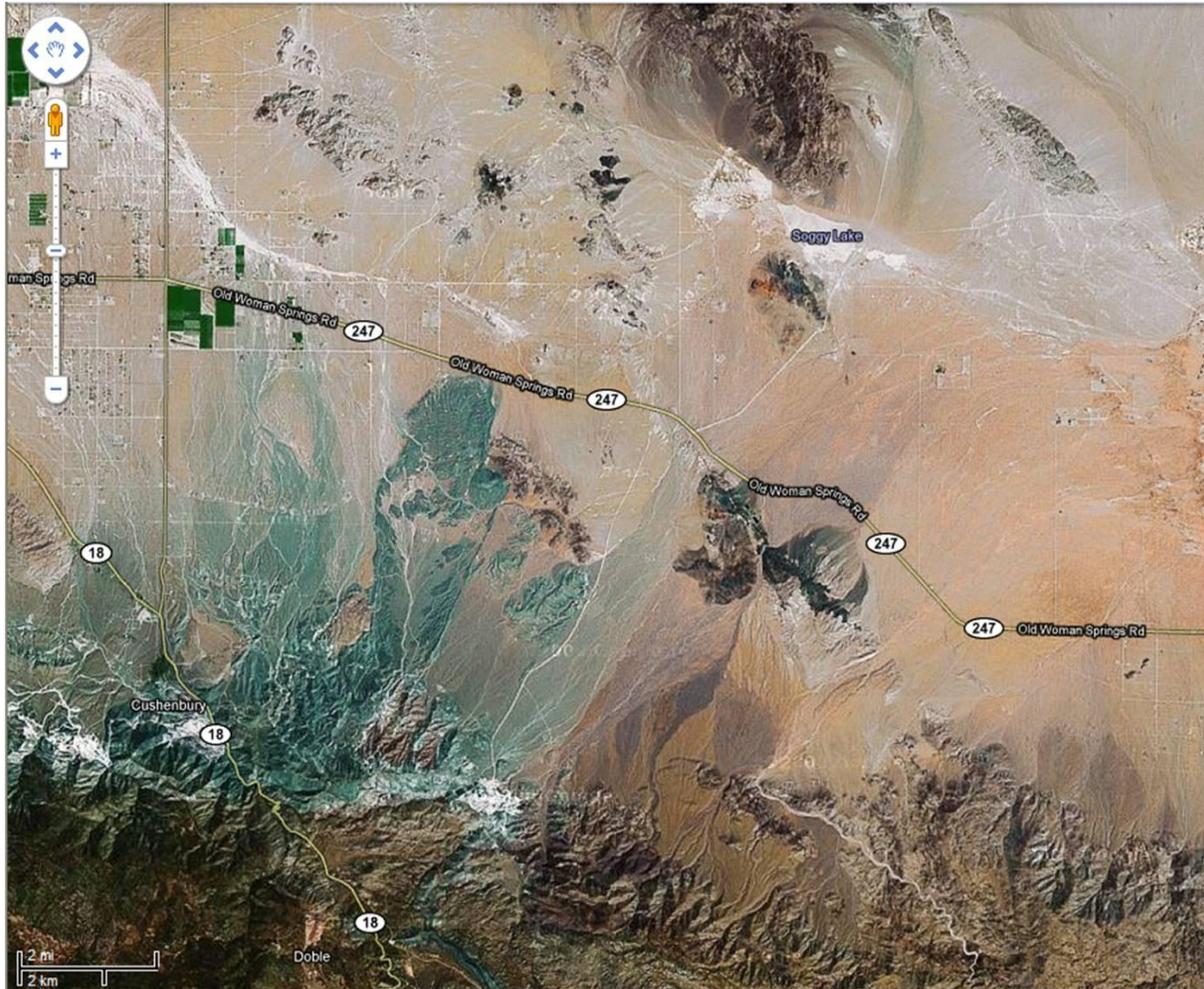


Overview of the Mojave Desert. 1) Blackhawk Slide; 2) the Mojave River; 3) Afton Canyon and Lake Manix, 4) Rainbow Basin and 5) Calico.

Blackhawk Slide



You can see the ghostly outline of the head of the mass movement, clearly and cleanly separated from its source region. There are still levees that delineate the lateral edges of the flow. Note that the grid spacing is 2 km, so this movement made it quite some distance from its source area. This is not the kind of event you want to see racing over the desert floor at you! The Blackhawk slide is another feature that would be worth investigating further for a presentation.

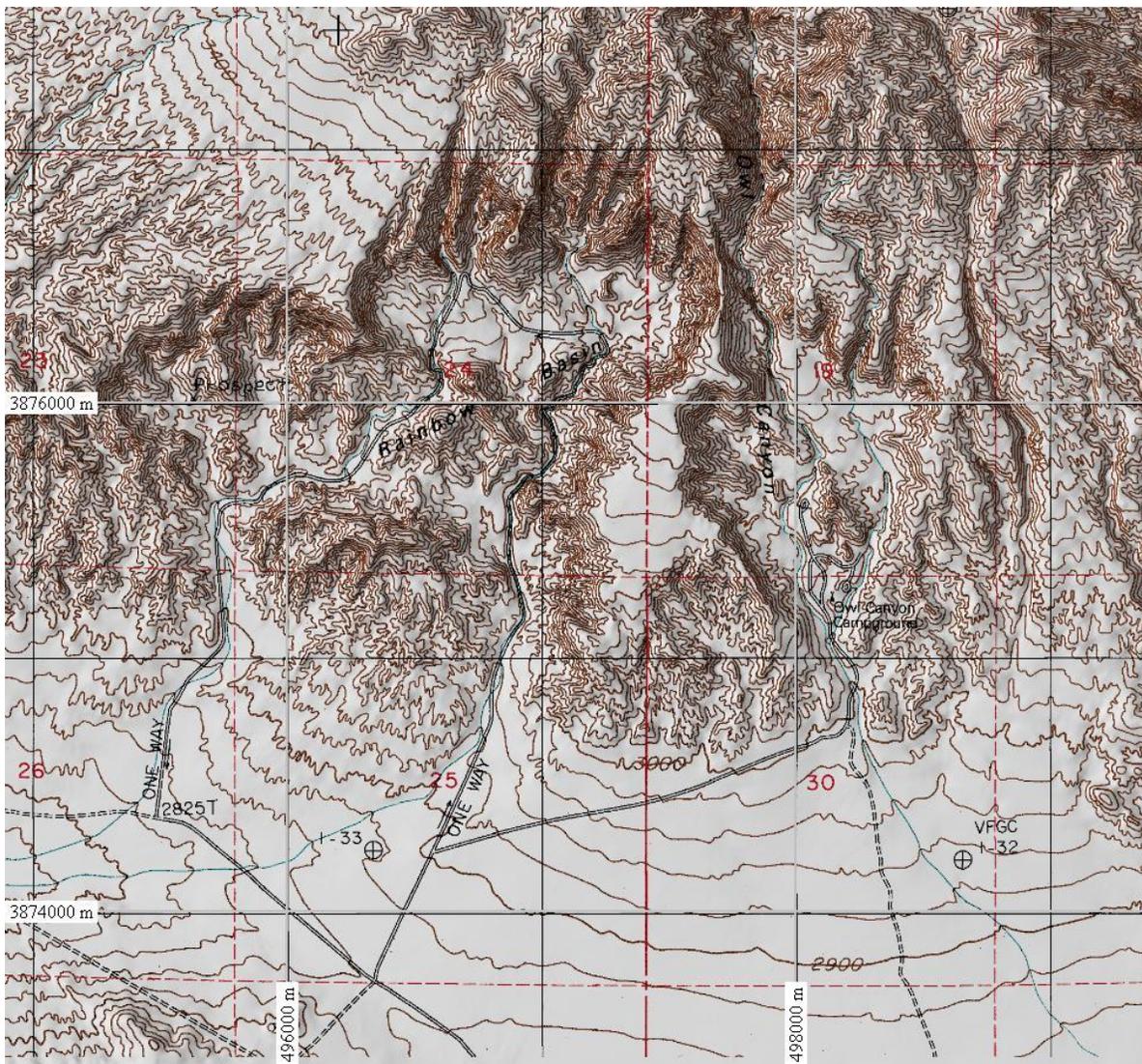


Aerial image of the Blackhawk Slide. Green colors are associated with the limestone unit that outcrops in the mountains, erodes (at least once in a huge landslide!), and is deposited in the alluvial fans along the range front.

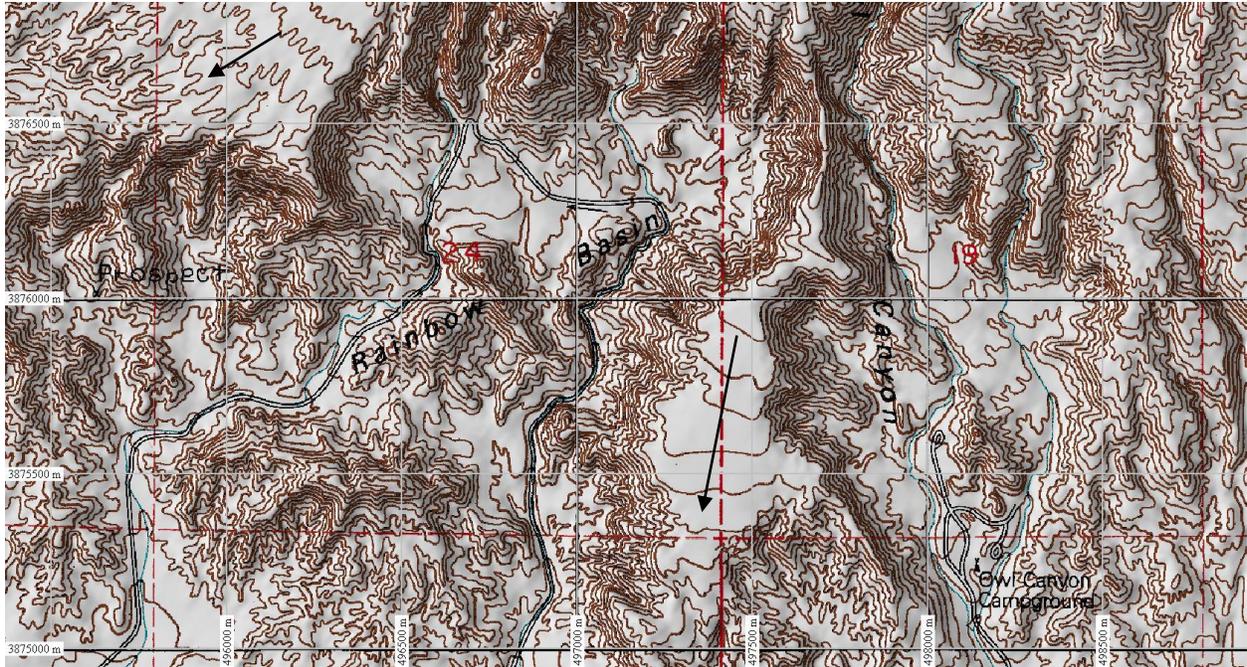
Rainbow Basin

Rainbow Basin displays several really cool features, including a perfectly exposed syncline and fault, an angular unconformity par excellence, slot gorges, colorful rock layers, and if you look in the right places, Miocene mammal fossils. We will spend some time walking around. You will be responsible to record the fold axis, and plot it correctly on the map on the next page. You will also be expected to sketch and describe the unconformity in your field notes.

Directions: Follow 247 north into Barstow to Main Street, take a left to First, travel north on First Avenue and turn left on Irwin Road. Proceed out of town until you see the sign for Rainbow Basin. Turn left on Fossil Bed Road and follow signs either to Owl Canyon Campground or the Fossil Canyon Loop Road. The loop road returns to Fossil Bed Road just west of this entrance.



USGS topographic map of Rainbow Basin. UTM projection, with 2000 m grid spacing.

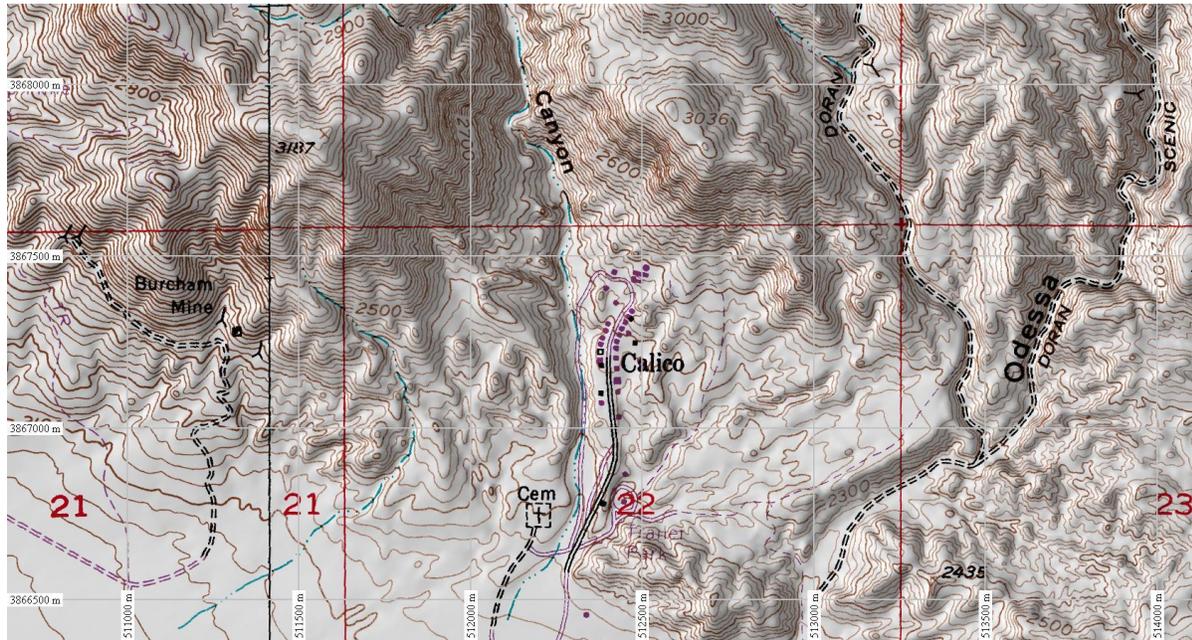


Expanded view of Rainbow Basin. Plot in this map the trend of the major fold(s) and fault(s). You can also see the surface morphology of the capping unit above an erosional unconformity. You can't see the unconformity easily in this view, but you do get a clue to the depositional character of the capping unit from uniform slope to the surface, typical of alluvial fans (depicted by the arrows).



Roads from Rainbow Basin to Calico (marked by stars). Return to Irwin Road from Rainbow Basin, turn northeast (left) on Irwin Road, to Old Yermo Cutoff/Fort Irwin Road—turn south (right) to Yermo Cutoff, left (southeast), to Ghost Town Road and turn left to the park entrance.

Calico Ghost Mining Town

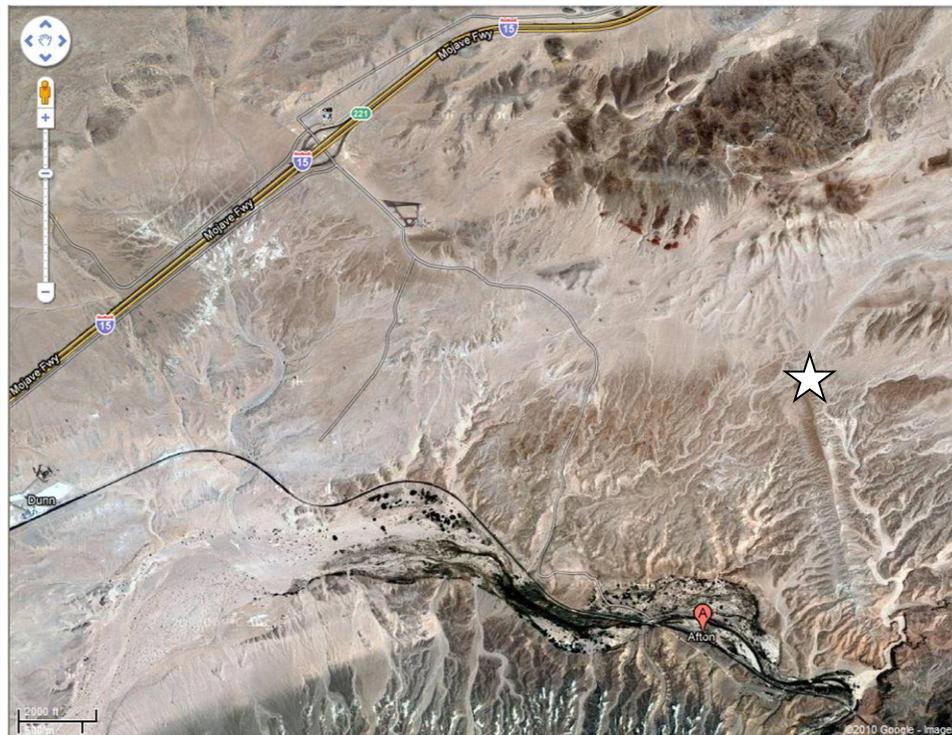


We will camp close to Calico, and this is the main purpose of our visit. There are, however, extraordinary geologic structures nearby, and lots of mines to investigate. Hopefully, you will have an hour or two of daylight for independent wanderings among the ghost town or the nearby area.

Day 7 Afton and Cima Volcanics

Fri. February 26, 2010.

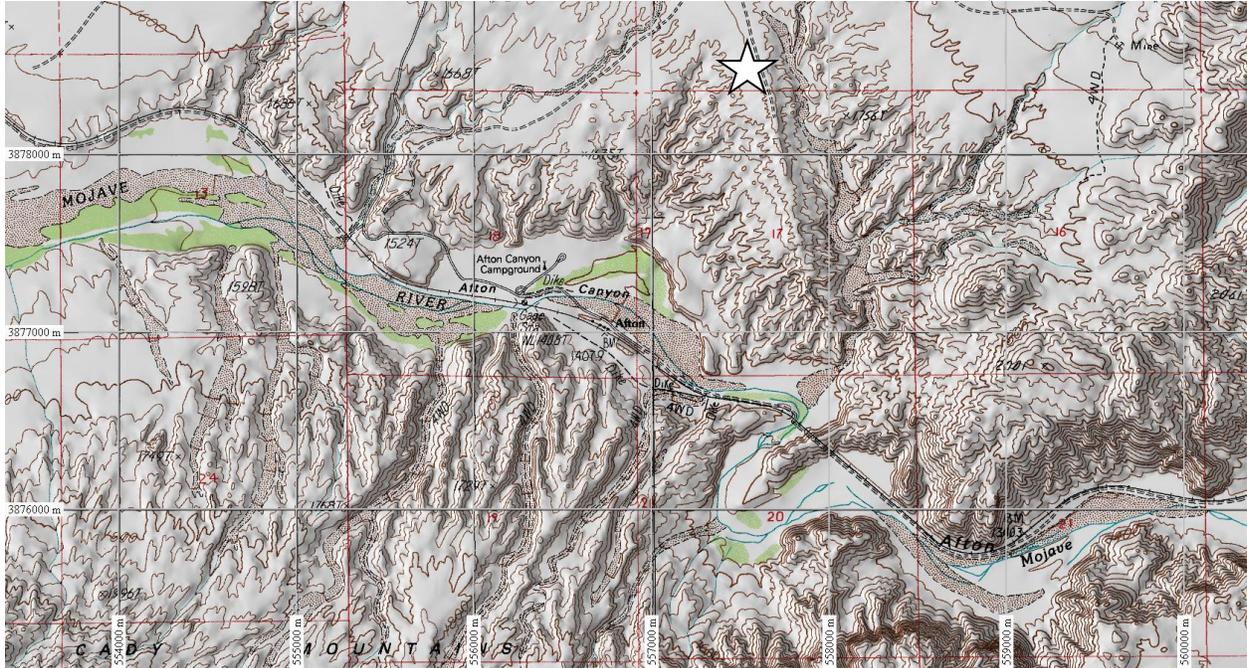
In the morning, we will turn left onto Calico Road as we are leaving the ghost town, take this to I-15, and head northeast to the Afton Canyon exit.



Note star on the map to the left marks a linear ridge. This is an old beach ridge, left over from Lake Manix. The southern end of the ridge marks the approximate location of the sill which the lake overtopped, then the erosion of Afton Canyon ensued. The lake deposits in this area are rich with Pleistocene fossils, so we will look

around for fossils. This is a protected site, so we won't be able to bring anything we find home. However, if you develop an abiding passion for delving into research in this area, you can contact the BLM for a permit to collect for scientific research.

Afton Canyon



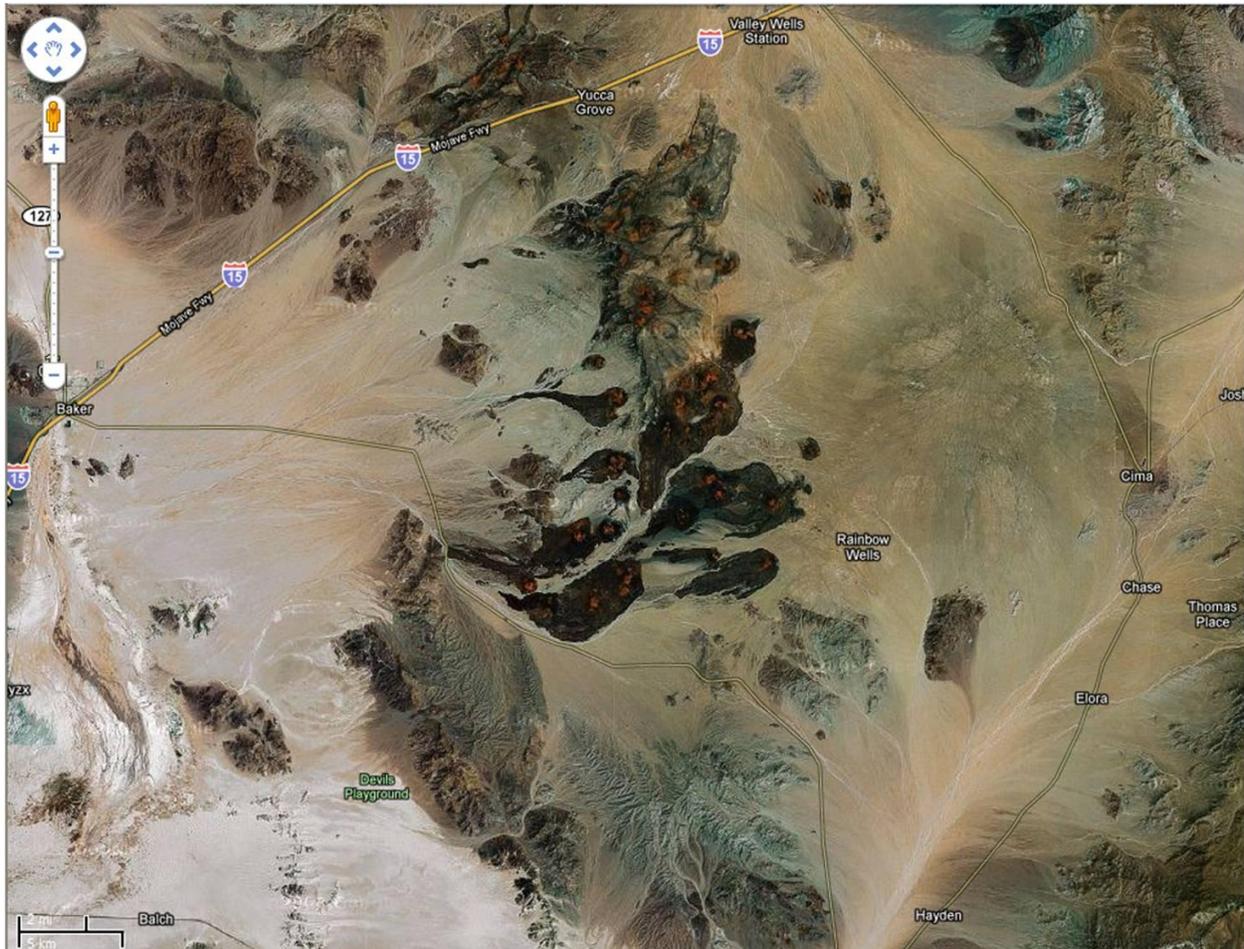
Relief map of Afton Canyon, with the star marking the old beach ridge. The canyon was cut when a Pleistocene lake overtopped a sill to the basin to the east, and cut down into the rocks here. We will try to get to the beach ridge, and check out the sedimentologic evidence that it is indeed a beach ridge. There are some very cool slot canyons in the vicinity of the campground, and we will park there and do a reconnaissance.



Lake Manix, displayed at 538 meters above sea level on digital topo map. Mojave River flows from west to east. UTM grid, spacing = 20 km. Star marks the downstream end of Afton Canyon.

Cima Volcanics

We will move on to Cima Volcanic Field in the Central Mojave in the afternoon. We return north to I-15, and head northeast to Baker, then follow Kelbaker Road east to the Cima Volcanics. These are young lavas, and we will look for various types of structures that provide a view into the eruptive style and history of the flows. Key things for this stop: style of lava flow (pahoehoe vs aa); phenocrysts; location of vents; degree of weathering of the flows; desert soils and pavement.



Overview map of the central Mojave Desert. Lava flows mark the Cima Volcanic field. East of this field lies Cima Dome, marked by radiating channels. This enigmatic structure could be an erosional remnant (an incipient peneplain?), or it could also be a crustal welt or domal uplift, perhaps related to magmatic intrusion?!? The Dome comprises granitic rocks, thinly mantled by desert soils.

We will return west on Kelbaker Road to Baker, then head south on I-15 to the Zzyzx exit, and head down to our resting place for the evening, Desert Studies Center, a research station run by Cal State Fullerton. Hopefully, you will have an hour or two in the evening to look for evaporite minerals in the old lake bed, and perhaps try to spot Pleistocene shorelines on the mountain range east of the station.

Day 8 Kelso Dunes and Marble Mountains (Trilobite Wilderness)

Sat. February 27, 2010

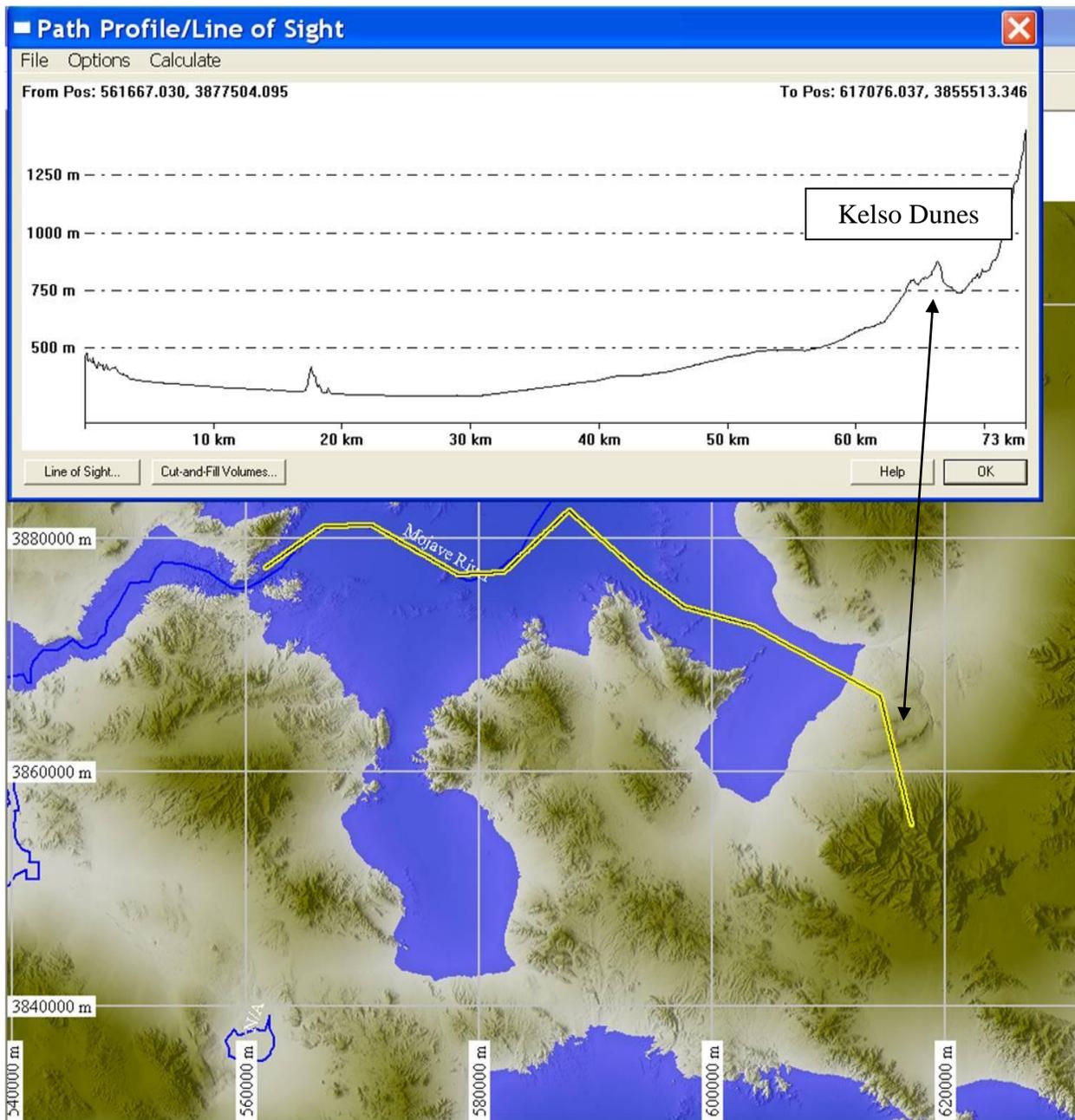
Today we have a fair amount of desert driving. We will return to Kelbaker Road, and follow this east and south to Kelso Dunes. Then we will head for the Trilobite Wilderness area in the afternoon, and return north our resting place for the night at Sweeney Granite Mountains Research Station, operated by UC Riverside.

Kelso Dunes



Aerial image of Kelso Dune Field (the A), the Granite Mountains, and the Marble Mountains. Trilobite Wilderness Area occupies various pieces of the Marble Mountains.

We will hike up onto the crest of the Kelso Dunes, and hopefully experience their sonic quality (these are the booming or singing dunes). The sand which has accumulated here is thought to have derived from sediments dropped into lower Lake Manix by the Mojave River. The prevailing winds in this area are from the northwest, and thus the wind has dragged, bounced and hurled the sand southeast to its resting place here. The total path length of a particle dropped at the mouth of Afton Canyon is about 60 km. From the basin floor back up to Kelso Dunes, the path is about 30-40 km. A topographic profile and map view of the potential path of sand particles appears on the following page.



Map of Lake Manix, and the hypothetical path of a sand particle from the mouth of Afton Canyon to a home in the Kelso Dunes.

The climb from the basin floor to the peak of the dunes represents a height change of ~570 m—that's not what we usually think the path of erosion and transport might look like! Key features of the dunes: grain size, shape, and mineralogy; dune morphology (make a sketch of the windward face and the slip face); and orientation of the crests. This is another very cool project to work on for a student presentation.

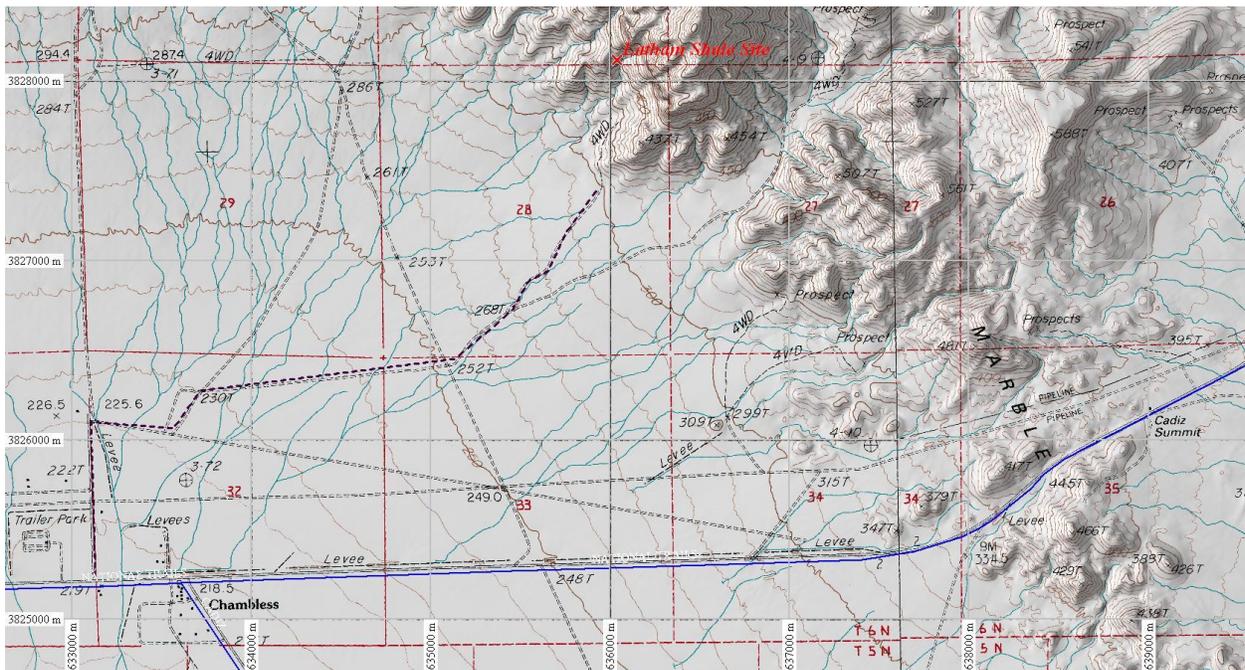
After we spend time amongst the dunes, we will head south to “hunt for ores”, uh, that is, Trilobites in the Marble Mountains.

Marble Mountains

We should arrive in the early afternoon. We will have to hike a little bit to get up into the fossil zone. The Marble Mountains expose Cambrian sediments including from oldest to youngest, the Zabriskie quartzite, the Latham shale (with orcs! pinkish, green, to light brown shale), the Chambless Formation, which contains carbonates with oncolites (algal secretions), and overlying the Chambless are more shales and sandstones of the Cadiz formation. These units dip moderately to the east. We'll need to find the contact between the Zabriskie quartzite and Latham shale. Also, there is a resistant brown marker bed at the top of the Latham shale, which should help us better bracket the Latham shale.

The directions to the site are: We follow Kelbaker Road south to Hwy 66 (yes, THAT Hwy 66, with the Kicks and All), then turn east and drive to Chambless, where the turnoff to Cadiz meets Hwy 66. We then try the desert roads. The following are measurements made in Google Earth imagery, dated March 5, 2005. Imagery from 2003 looks very similar.

- Take Mac Tull Rd north 0.54 miles, turn right.
- Go 0.64 miles on dirt road (should be a fork). Turn left (northeast).
- Go northeast (47 degrees) for 0.37 miles.
- Road angles east (084), follow for 0.34 miles.
- Road angles northeast (042), follow for 0.82 miles. Park. There may be a fork in the road at 0.27 miles—bear left. Drive to range front and park.



Marble Mountains, as depicted by the USGS Topo relief map, with a dirt road path to the trilobite collecting site marked as a black dashed line. UTM grid, spacing = 1 km.

We need to be at the Sweeney Granite Mtns Research station by 5, so we should leave by 4 pm.

Day 9 Travel

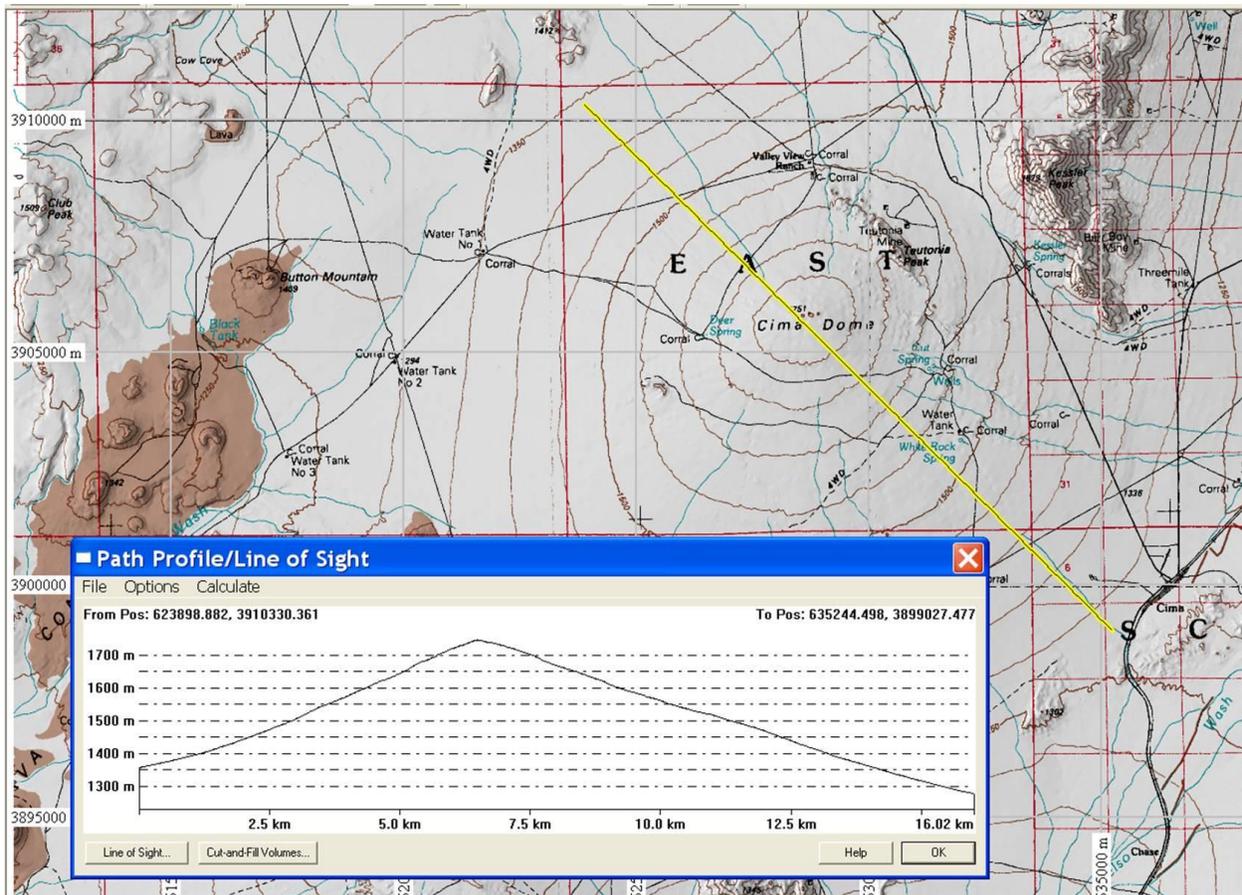
Sun. February 28, 2010

Las Vegas to Albany to Oneonta

We depart from camp at 8 am. It takes about 2 ½ hours to get to Las Vegas from camp. Our flight leaves at 4 pm, so we should be in LV by 1 pm, return the vehicles, etc. We should have time to stop by Cima Dome, and Hole in the Wall—maybe.

We head north on Kelbaker Road for 14-15 miles to a junction, and take the Kelso-Cima Road northeast. In another 14-15 miles, a Cedar Canyon road comes in from the east. If we have time, we'll follow this to Black Canyon Road, which heads south to Hole in the Wall (yes, about 15 miles). We would then turn around to retrace our route back to Kelso-Cima road, and proceed north. In about 4.3 miles, we reach a junction with Cima Road, and turn left (northwest) onto Cima Road. We will follow this for 7.5 miles to Valley View Ranch Road, and look for a place to pull over and check out the dome up close and personal.

Cima Dome



Shaded relief map of Cima Dome, showing the remarkable shape of this landform. It is quite reminiscent of a shield volcano, only this landform is largely an erosional structure. At least, that is one of the ideas for it. Interestingly, the west side exhibits some concavity. Concave profiles usually develop in erosional systems where runoff (or some other mechanism) both erodes and transports away sediment. Convex (or rounded) hillslopes tend to form where local movement of

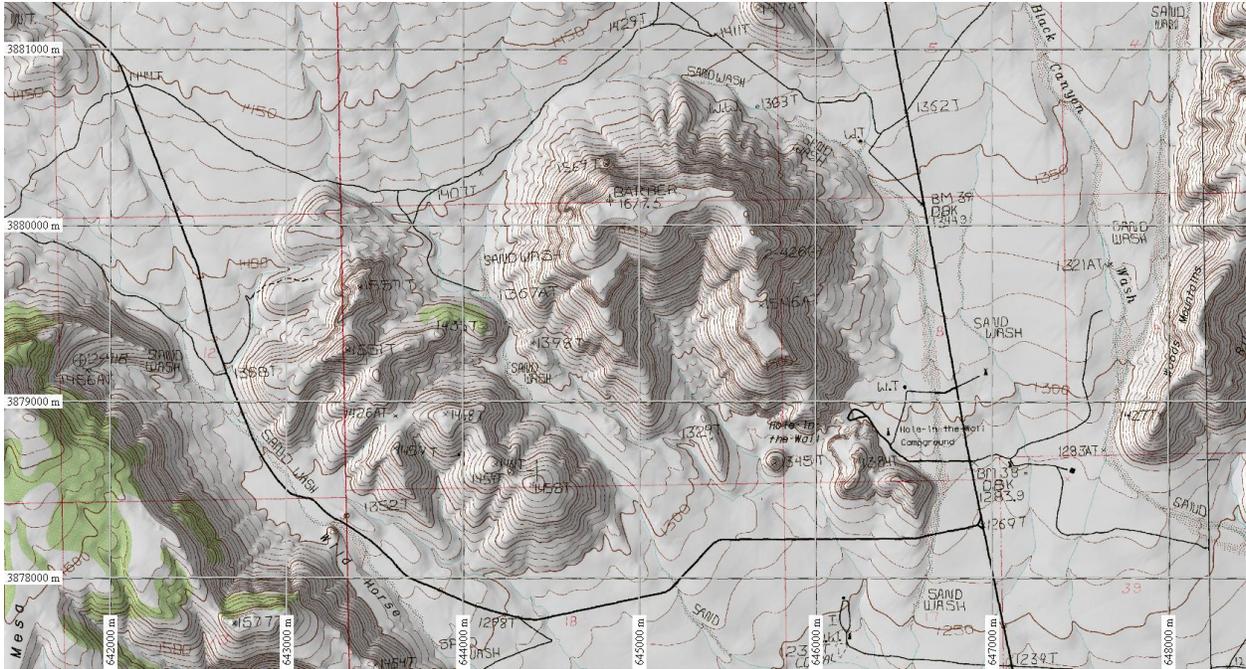
sediment dominates. The linear slope on the east face is clearly neither. There's clearly more to work on here. Also of note, apparently one of the largest Joshua tree "forests" in the world covers the Dome.

Upon ending our brief view of the Dome, we will head north on Cima Road to I-15, and from there head to Las Vegas.

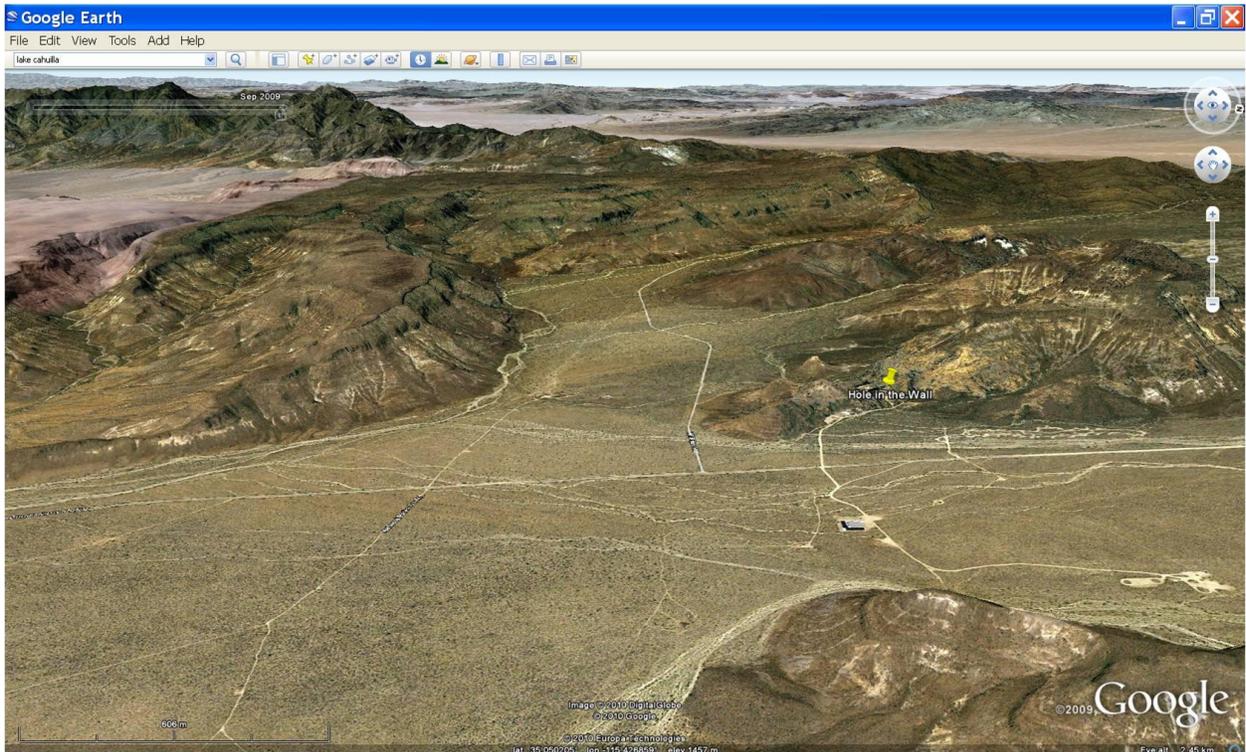
Hole in the Wall?



The rocks at Hole in the Wall comprise explosive remains of Miocene rhyolitic eruptions. I hate to bypass the site. Let's hope we don't have to!



Hole in the Wall relief map. UTM grid spacing at 1000 m.



Google Earth perspective view southwest at Hole in the Wall. Providence Mountains fill the skyline in the upper left distance.

References and Sources

Google Maps and Google Earth provided the imagery for many of the figures in this guidebook.

Field Research Stations in CA: <http://cbc.berkeley.edu/ucbfieldstations.htm>

Wilderness Areas in CA: http://www.blm.gov/ca/pa/wilderness/wa/wa_list.htm

Hi-Res Topography data: <http://opentopo.sdsc.edu/gridsphere/gridsphere?cid=otgoogleearth>

USGS National Geologic Map Database viewer: <http://maps.ngmdb.us/dataviewer/>

Joshua Tree National Park: <http://www.nps.gov/jotr/planyourvisit/maps.htm>

Joshua Tree National Park, USGS site: <http://3dparks.wr.usgs.gov/jotr/index.html>

Lower Gear Camping supplies: <http://www.lowergear.com/>

Local Camping Outfitters near Joshua Tree NP: <http://www.joshuatreeoutfitters.com/>

Whitewater Preserve: http://www.wildlandsconservancy.org/twc_preserve_whitewater.html

Coachella Valley Preserve, <http://www.coachellavalleypreserve.org/locate.html> and USGS site: <http://3dparks.wr.usgs.gov/jotr/html/coachella.htm>

San Andreas Fault (USGS): <http://3dparks.wr.usgs.gov/pp1515/chapter3.html>

Geologic map, Salton Sea area: http://ngmdb.usgs.gov/ngm-bin/ILView.pl?sid=333_1.sid&vtype=b&sfact=1.5

For a reference list of some things San Andreas:

<http://www.gps.caltech.edu/classes/ge111/reading.html>

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http://www.blm.gov/ca/pa/wilderness/wa/areas/mecca_hills.html

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<http://3dparks.wr.usgs.gov/jotr/html/paintedcanyon.htm>

Photos of Mecca Hills (Earth Science Image Bank):

<http://www.earthscienceworld.org/images/search/results.html?Keyword=Mecca%20Hills>

Salton Sea State Recreation Area: <http://www.saltonseaca.gov/recreation/camping.htm>

Rainbow Basin Natural Area, BLM site: <http://www.blm.gov/ca/st/en/fo/barstow/basin.html>

The Barstow Fossil Beds (Rainbow Basin area): http://www.co.san-bernardino.ca.us/museum/exhibits/geological_sciences/slideshow.htm

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Mojave River overview: <http://digital-desert.com/mojave-preserve/geology/13.html>

Lake Manix: <http://inyo2.110mb.com/manix/manixlake.html>

Recent article, Lake Manix: <http://specialpapers.gsapubs.org/content/439/227.abstract>

Mojave Paleohydrology: <http://esp.cr.usgs.gov/info/mojave/drainage.html>

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Mojave National Preserve, USGS site:

<http://www.nature.nps.gov/geology/usgsnps/mojave/mojavetech.html>

Mojave National Preserve, Wikipedia: http://wikitravel.org/en/Mojave_National_Preserve

Desert Studies Center at Zzyzx, Cal State Fullerton, <http://biology.fullerton.edu/dsc/>

Sweeney Granite Mountains Research Station: <http://granites.ucnrs.org/Index.html>

Soda Lake, at Zzyzx: <http://digital-desert.com/soda-lake/>

Cima Dome, USGS site: <http://www.nature.nps.gov/geology/usgsnps/mojave/cima1.html>

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Haff, P. K. (1979) *Booming sands of the Mojave Desert and the Basin and Range Province, California*. California Institute of Technology, Pasadena, CA.

<http://resolver.caltech.edu/CaltechAUTHORS:Haffpk79>

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Trilobites site in Marble Mountains: <http://www.gtlsys.com/Trilobites/frame104322.html> and

<http://www.ucmp.berkeley.edu/cambrian/marblemts.html>

Western Science Center museum: <http://www.westerncentermuseum.org/>

Fossil Hunting in the Southern California:

http://westerncentermuseum.org/index.php?option=com_content&task=view&id=42&Itemid=53

Desert landforms and surface processes: <http://digital-desert.com/mojave-preserve/geology/>

Appendix 1 Syllabus

Syllabus for Geol 394: Mojave-Mecca Geology Field Trip
Spring 2010

Credits: 3.0; Section 01: CRN 1319; Section 02L CRN 1419

Section 01 meets: MW, 8:00-8:50 a.m., 205 Science 1 and Feb 20-28, 2010 in the field.

Section 02 meets: M, 5:00-5:50 p.m.; Th, 8:00-8:50 a.m., 205 Science 1 and Feb 20-28, 2010 in the field.

Prerequisite: an introductory Geology course and Geol 220 or Geol 201

Instructor: Les Hasbargen

Office: 219 Science 1 Ph. 607-436-2741

Office hours: M,T,Th: 11:00-11:50 a.m.;

Personal web site: <http://employees.oneonta.edu/hasbarle/index.html>

Required Textbook: Rite in the Rain Geology field note book. You can find them online at <http://www.amazon.com/gp/product/B0011DGJSC>, ISBN 978-1-932149-35-7.

Optional Textbook: If you anticipate field work in your future, I recommend purchasing a copy of *Geology in the Field*, by Robert Compton (John Wiley and Sons, 1985; ISBN: 0-471-82902-1). This text provides a wealth of standard approaches to geologic data description and collection.

Course objectives. Students gain experience with geologic materials in field settings. They will characterize sedimentary rocks and mappable stratigraphic units, measure rock orientation, identify faults and folds and measure fault displacement, recognize effusive and explosive volcanic rocks, and understand how arid region geomorphic features form. Students will be able, after finishing this course, to:

describe in detail sedimentary rocks and structures

develop a reference stratigraphic column

measure strike and dip of sedimentary layers with a compass

plot locations of field measurements on a topographic map

locate contacts between mappable units, and plot the contact correctly on a topographic map

make accurate and complete field notes

construct a geologic map from field data

recognize unconformities

measure geologic structures

Course Narrative

This course examines tectonic, volcanic, and geomorphic features along an active plate boundary in southern California. Students will map geologic structures around and including the San Andreas fault in the Mecca Hills, investigate groundwater disruption near 1000 Palms, take a tram ride to 8500 feet above local valley floors for a birds-eye view of a tectonic valley, visit a wind farm in a tectonic gap, measure offset along the 1992 Landers earthquake zone, trek over the gigantic Blackhawk landslide shed off a tectonic thrust fault, peer into folded layers in

Rainbow Basin for fossil camel footprints, stand on effusive and explosive volcanoes (now extinct), squeeze into slot canyons cut by drainage from Pleistocene lakes, gaze at cave formations, listen to singing sand dunes and probe desert geomorphology.

The trip runs for 9 days including travel, February 20-28, 2010 over the first spring break. Students will fly to Las Vegas, NV, and then take vans to field locations. We will stay at places ranging from undeveloped campgrounds to university research stations with dorm rooms and a kitchen.

Course Justification

There is a persistent need for trained geoscientists with experience in geologic field mapping. This course will bring students in Earth Sciences, Environmental Sciences, Water Resources, and the Energy Minor to an active plate tectonic boundary in southern California. The Mojave Desert and Salton trough provide extraordinary teaching opportunities for students, exposing numerous faults and folds, a spectrum of rocks including sedimentary units, both effusive and explosive volcanic rocks, intrusive igneous and metamorphic rocks. In addition, desert springs associated with groundwater flow, topography, and faults provide superb examples of hydrology and geology interactions. Power plants which take advantage of the tectonic setting and atmospheric flow to generate power from wind and sun will be visited as examples of working alternative energy fuel sources. Finally, desert landscapes in the area exhibit prime examples of arid region landscape processes and geomorphology, including huge landslides, dunes, playas, fans, exfoliation of granite, pediments, desert pavement, paleolakes, and mountain erosion.

After returning from the trip, students will select a location/topic for greater examination, and present their investigation to the class. Topics could include: style of faulting and folding around a strike-slip fault; Pleistocene lakes in the Mojave; Mio-Pliocene fauna in the Mojave; water use in Palm Springs; hot spring characteristics in the Coachella Valley; wind power in southern California; interpreting the Blackhawk landslide; desert geomorphology (pediments, dunes, desert pavements, alluvial fans, etc); explosive volcanism in the Mojave; interpretation of the Orocochia schist, or some other subject which captures your imagination about the field trip.

Grades

Students will be evaluated based on **participation (10%)** on the field trip, **field notes (20%)**, **field maps, stratigraphic sections and cross sections (30%)**, and a post-trip **presentation (40%)**. All efforts will be assessed with a weighted rubric, where separate aspects of the exercise will receive a mark ranging from excellent to no credit. Each aspect will have a weight (content and analysis is more important than spelling, for instance). Aspects of an exercise might include grammar, scientific writing style, content, analytical treatment, overview of the problem, summary of the project, recommendation for action, and the like. Rubrics for field notes, stratigraphic and cross sections, and the presentation will be handed out early in the course. The rubric score will be re-scaled to the University curve, and final grade assignments will be guided by the standard University curve given below.

Percent	Grade	Percent	Grade	Percent	Grade	Percent	Grade
93-100	A	87-89.9	B+	77-79.9	C+	67-69.9	D+
90-92.9	A-	83-86.9	B	73-76.9	C	63-66.9	D
< 60	F	80-82.9	B-	70-72.9	C-	60-62.9	D-

Lecture and Lab Schedule (this schedule is subject to minors changes as needed).

Date	Day	Topic/Reading
Jan 20	W/Th	Class does not meet
Jan 25	M	Meet to discuss course; handouts
Jan 27	W/Th	Rock descriptions
Feb 1	M	Rock descriptions
Feb 3	W/Th	Measuring strike and dip/Mapping
Feb 8	M	Stratigraphic columns/Cross Sections
Feb 10	W/Th	California Geology
Feb 15	M	
Feb 17	W/Th	
Feb 20	Sat	Fly to Las Vegas from Albany, NY; drive to Joshua Tree NP
Feb 21	Sun	Joshua Tree/1000 Palms/Mt. San Jacinto/Desert Hot Springs
Feb 22	M	Mecca Hills Wilderness
Feb 23	T	Mecca Hills Wilderness
Feb 24	W	Mecca Hills Wilderness
Feb 25	TH	Rainbow Basin: folds and fossils
Feb 26	F	Mojave National Preserve: Afton Cyn, Soda Lake, Cima Volcs
Feb 27	SAT	Mojave National Preserve: Hole in the Wall, Kelso Dunes
Feb 28	SUN	Trilobites; Drive to Las Vegas; Fly to NY
Mar 1	M	Rest!
Mar 3	W/Th	Rest!
Mar 8	M	Students select topics for presentation
Mar 10	W/Th	Review of topics with instructor
Mar 15	M	Work on presentation
Mar 17	W/Th	Work on presentation
Mar 22	M	Work on presentation
Mar 24	W/Th	Work on presentation
Mar 29	M	Work on presentation
Mar 31	W/Th	Work on presentation
Apr 5/7	M/W	SPRING BREAK!! NO CLASSES
Apr 12	M	Work on presentation
Apr 14	W/Th	Work on presentation
Apr 19	M	Work on presentation
Apr 21	W/Th	Student Presentations
Apr 26	M	Student Presentations
Apr 28	W/Th	Student Presentations
May 3	M	Student Presentations
May 5	W/Th	Student Presentations
May 10	M	Student Presentations
May 12	W	Student Presentations
May 19	T/W	8:00-10:30 a.m. Maps, Notes, Sections Due; Course Evaluations

Emergency Evacuation/Shelter-in-Place Procedures In the event of an emergency evacuation (i.e. fire or other emergency), classes meeting in Science I are directed to reassemble at Chase Gymnasium so that all persons can be accounted for. Complete details of the College's emergency evacuation, shelter-in-place, and other emergency procedures can be found at <http://www.oneonta.edu/security> .

Course Guidelines and Expectations for Students

The following list provides a baseline of what is expected from students in this course (quoted section from the list of *Student Responsibilities* approved by SUNY Oneonta).

“In class responsibilities

Students will:

- Attend all classes and arrive punctually.
- If unavoidably late for a class, enter quietly and unobtrusively, and behave in other required ways to minimize distraction.
- Remain alert and attentive during lectures, discussions, and other class/lab activities.
- Avoid unnecessary conversation during lectures, discussions, and other class/lab activities.
- Contribute to class experiences by asking relevant questions, offering relevant examples or views, adequately answering questions posed by others, engaging in critical and independent thought, and challenging both the instructor and the curriculum materials assigned for the course.
- Demonstrate courtesy and respect in dealing with instructors and classmates.
- Recognize and seek to understand diverse points-of-view.”

In the field responsibilities

Students will:

- Assemble all materials they need to conduct field investigations and bring these items with them (this list will be supplied at the start of the semester)
- Participate in group camping activities, such as setting up and taking down tents, preparing food and cleaning up after meals
- Be respectful of fellow students on the trip and of other campers in the campground
- Maintain quiet time from 10 pm to 6 am in the campground (or according to the local campground guidelines)

Appendix 2 Contacts

Cynthia LaSala, Joshua Tree National Park
US DOI, NPS
74485 National Park Drive
Twentynine Palms, CA 92277-3597
Fax: 760-367-5586

Palm Springs Aerial Tramway
1 Tram Way
Palm Springs, CA 92262
Phone: 760.325.1449

Lee and Chris Totten
9350 Calle Del Diablo
Desert Hot Springs, CA 92240-1648
760-329-5218

Coachella Valley Preserve
29200 1000 Palms Canyon Rd
Thousand Palms, CA, 92276
Visitor center 760-343-2733, Preserve Office 760-343-1234

Salton Sea State Recreation Area
Salton Sea Authority
78-401 Highway 111, Suite T
La Quinta, CA 92253
Email: info@saltonsea.ca.gov
Phone: (760) 564-4888
FAX: (760) 564-5288

Mecca Hills Wilderness, BLM
Jack Hamby, Acting District Manager
Bureau of Land Management
California Desert District
22835 Calle San Juan De Los Lagos
Moreno Valley, CA 92553
Main Contact Number: 951-697-5200
Fax Number: 951-697-5299

Rainbow Basin Natural Area
Roxie Trost, Field Manager
Bureau of Land Management
Barstow Field Office
2601 Barstow Road
Barstow, CA 92311
Main Contact Number: 760-252-6000, Fax Number: 760-252-6098

Desert Studies Center (Zzyzx)
California Desert Studies Consortium
c/o Department of Biological Science
California State University, Fullerton
P.O. Box 6850
Fullerton, CA 92834-6850
Phone: (657) 278-2428
Fax: (657) 278-4289
E-Mail: wpresch@fullerton.edu

Tasha La Doux, Assistant Director
Sweeney Granite Mountains Desert Research Center
University of California, Riverside
HC1 Box 101, Kelso, CA 92309
(760) 733-4222

On SUNY Oneonta Campus
Nancy Wolters, Associate Provost—Academic Support
Phone: 436-2950
Email Address: WOLTERNE@ONEONTA.EDU
Department: Continuing Education
135 Netzer Administration Building

Lisa Hoffman, Secretary for Earth Sciences Department
Phone: 607-436-3707
Email: hoffmalr@oneonta.edu
209 Science 1 Building

James Ebert, Chair of Earth Sciences & Distinguished Teaching Professor
Phone: 607-436-3065
Email Address: EBERTJR@ONEONTA.EDU
Mailing Address: 209A Science Building 1

Les Hasbargen, Instructor for Mojave-Mecca Geology Field Trip
Office phone: 607-436-2741; cell phone (on trip only) :607-287-7435
Email: hasbarle@oneonta.edu
219 Science 1 Building

Keith Brunstad, Driver and Co-instructor for field trip
Office Phone: 607-436-3066
Email Address: BRUNSTKA@oneonta.edu
210 Science Building 1

Camping and Useful Items

Check list of Useful Items (Think Christmas Wish List!)

- Hat—preferably wide brim to shade the ears/neck
- Sunglasses
- Hiking shoes
- Sunscreen
- Warm jacket
- Gloves
- Rain jacket
- Undergarments
- Long-sleeved and short-sleeved shirt
- Several pair of socks
- A pair of long pants and shorts
- Toiletries (check with airlines for permissible container sizes)
- Towel
- Flipflops or shower sandals
- Sleeping bag (to 25°F)
- Sleeping mattress
- Flashlight/headlamp
- Eating utensils (fork, spoon, knife, plate/bowl, cup)
- Water bottle (just make sure it's plane transport friendly; or buy water bottles in CA)
- Camera (optional)
- Field book
- *Compass with azimuth and inclinometer
- Hand lens (see Geo-Tools for geology hardware: <http://www.geo-tools.com/index.htm>)
- *Rock hammer (protective eye wear/goggles are a good idea)
- Calculator
- Whistle (in case you get lost)
- Clipboard and/or map case (you can make your own with a clear plastic cover)
- Pencils (mechanical pencils, or wood pencils with sharpener)
- Pens and Permanent Marker
- Protractor/6" ruler
- *GPS unit
- Charger for cell phone/electronic devices
- Medium size duffel bag for clothes, sleeping bag, mattress, and personal items (<http://www.overstock.com/Sports-Toys/Texasport-Canvas-Tactical-Bag/3298166/product.html>) for a good size and durable duffel
- Day pack for lunch/snack items, pockets for water bottles, room for rain jacket, misc. tools

* means item can be checked out from Earth Sciences Dept