Name: _____

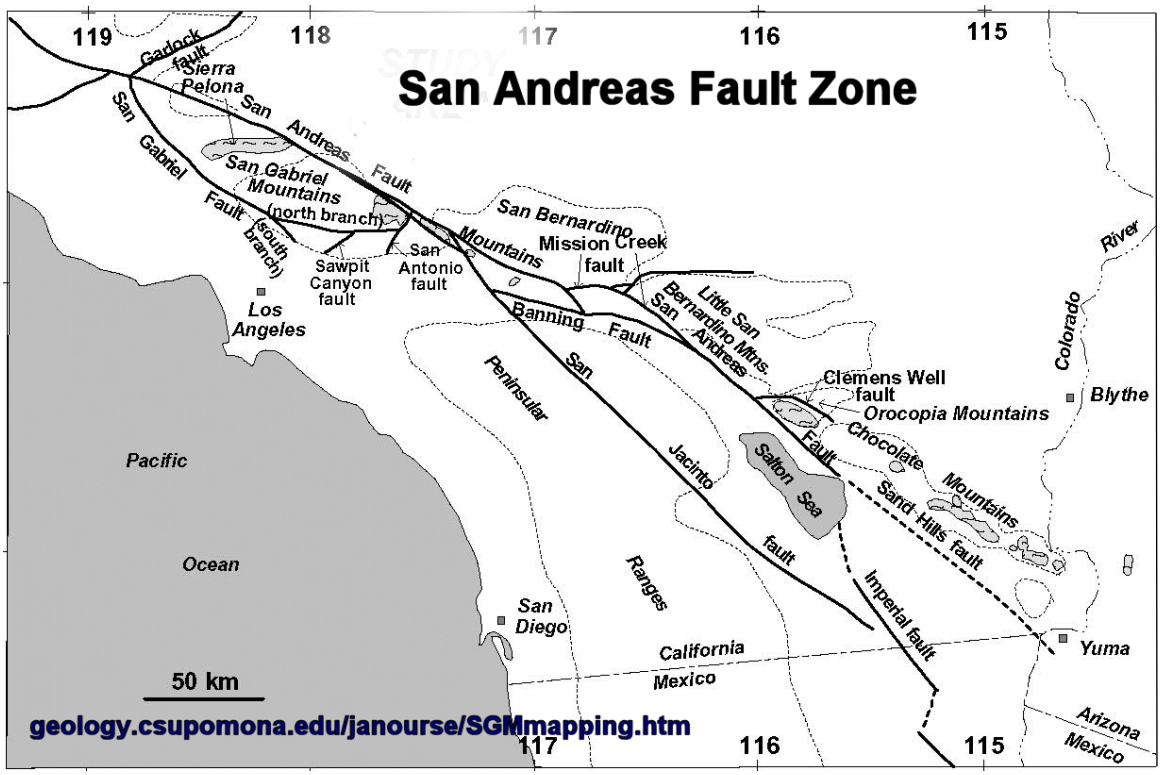
Geology 1 Field Trip – Field Exercises

Background – Geologic Setting of the San Gabriel Mountains

The San Gabriel Mountains are part of the "transverse ranges", an east-west trending belt of mountains that have been thrust up by compression of the crust at a "restraining" bend in the San Andreas fault. The following rocks are exposed in the range:

- Precambrian (~1.7 Ga) granulite gneiss and schist (metamorphic) intruded by
- Precambrian (~1.2 Ga) anorthosite and gabbro which in turn is intruded by
- Mesozoic granitic rocks (plutonic) (~70 Ma) which is overlain by
- Miocene (~20-5 Ma) to Recent course sandstone and conglomerate

The regional tectonics are dominated by the boundary between the North American and Pacific plates which changed from subduction to transform motion about 30 Ma ago.



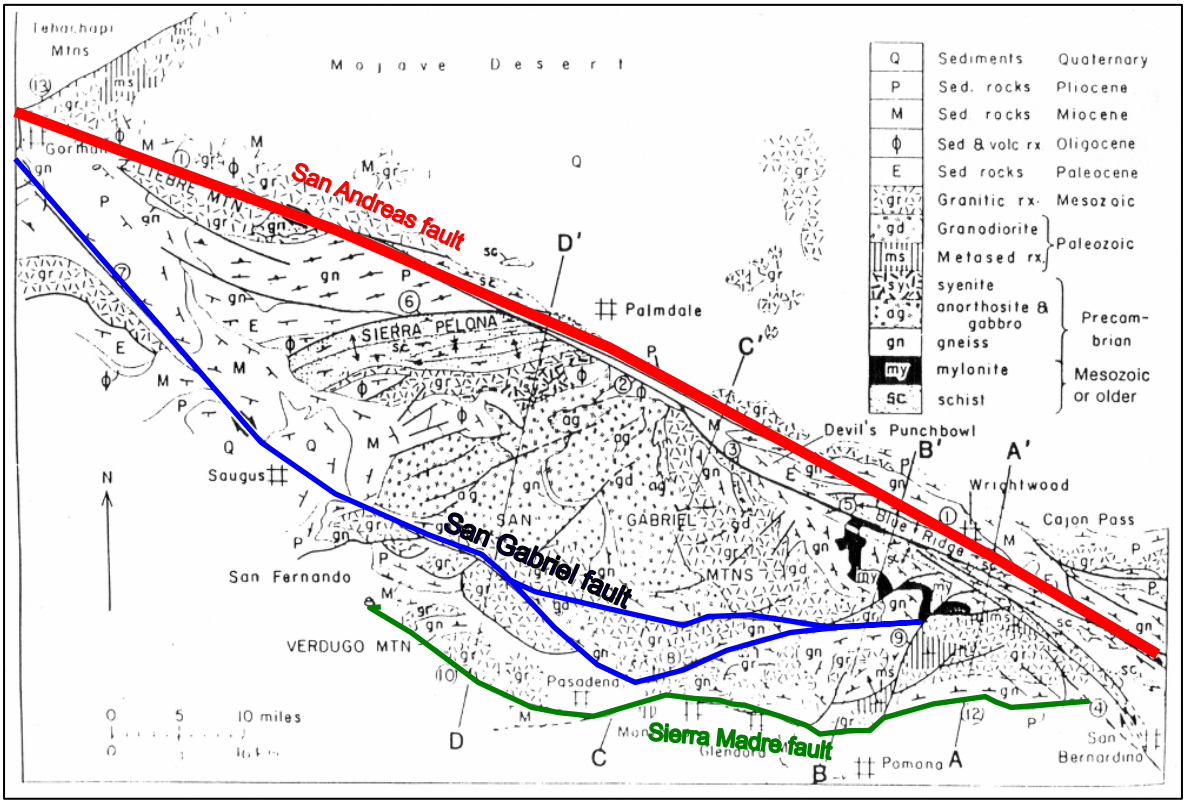


Figure 2. Geologic detail of the San Gabriel Mountains.

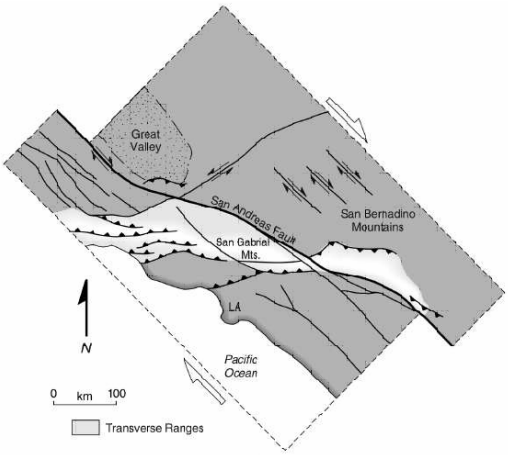


Figure 3. The "big bend" of the San Andreas fault causes compression that pushes up the Transverse Ranges.

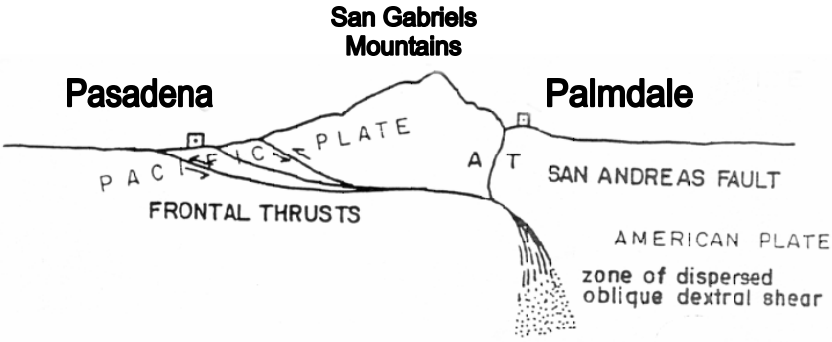
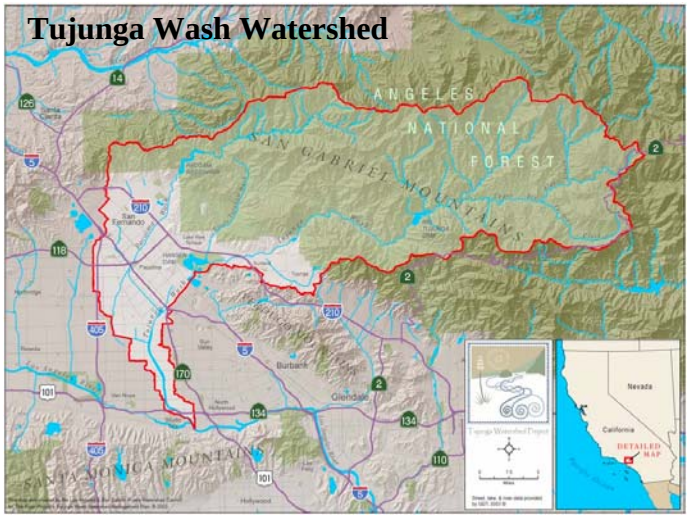
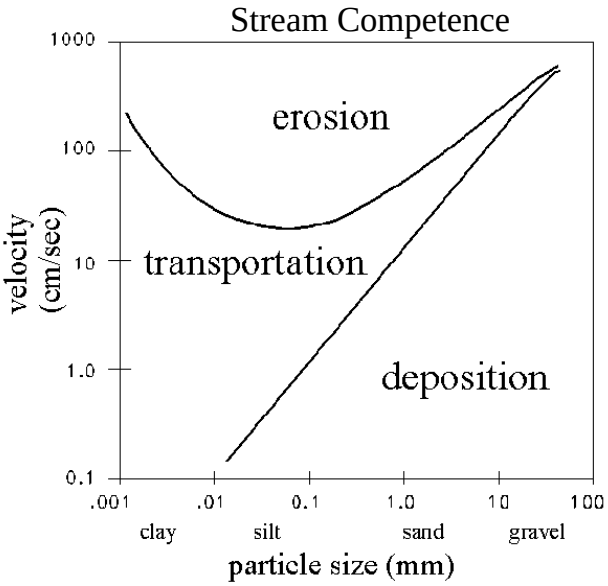


Figure 4. North-south cross-section of the San Gabriel Mountains.

STOP 1: Big Tujunga River

This stream is a major tributary of the *Tujunga watershed* which drains a 225 mi^2 area of the southwestern San Gabriel Mtns. While average annual rainfall is low, 15in/yr, it can be twice this in the higher elevations. Every few years episodes of intense rain fall, up to a record 26 inches in 24 hours, can cause "flash floods" which transport huge volumes of sediment. In 1934 heavy rains caused flooding and debris flows that killed 40 people and left 8ft boulder in the streets. Floods also occurred in 1938, 1941, 1969 and 1978. The highway was washed out just a few miles up stream in January 2005.





I. The Stream

1. What is this stream's source? _____

   What route will it take to the sea? _____

2. Examine several places along the stream. Is sediment being transported now? ***Y or N***

   What evidence do you see that the water level of the stream changes over time?

   _____

   _____

3. How big is the biggest boulder you can find in the streambed? _____ cm

   How fast must the water flow to move this boulder? _____ cm/sec
   (use the "competence" diagram above, you may need to extrapolate)

4. How fast is the water moving now? _____cm/sec

5. When do you think most sediment is transported? _____

   _____

II. The Sediment

1. Examine the sand in the wash using a hand lens. Describe it as completely as you can. Be sure to include sorting, rounding, grain size, and composition.

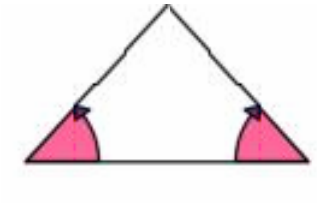
   _____

   _____

   _____

2. What is the *angle of repose* of this sand when dry?

   _____



Hint:
- Pile sand as steeply as possible
- Hold clipboard against pile
- Measure angle w/ Brunton

256 mm	Boulders
64 mm	Cobbles
4 mm	Pebbles
2 mm	Granules
1 mm	Very Coarse Sand
1/2 mm	Coarse Sand
1/4 mm	Medium Sand
1/8 mm	Fine Sand
1/16 mm	Very Fine Sand
1/256 mm	Silt
	Clay

III. Instant Rock Collection

Each team will gather an instant rock collection that includes all the rocks in the list below. The individual samples should be between 10cm and 30cm in size. Check off each sample as you find it.

ROCK COLLECTION CHECK LIST

✓	Rock	Description
IGNEOUS		
	granite	phaneritic, orthoclase > plag, accessory minerals (hornblende, biotite, etc.)
	granodiorite	phaneritic, plag > orthoclase, accessory minerals (hornblende, biotite, etc.)
	diorite	phaneritic, plag plus mafic minerals (*quartz diorite* if quartz is present)
	anorthosite	phaneritic, grayish-purple plag, <10% orthoclase, some mafics, no quartz
	gabbro	phaneritic, mostly mafic minerals (hornblende, augite, olivine), little plag
	basalt	aphanitic, dark gray, red, black
METAMORPHIC		
	quartzite	non-foliated, very hard, fine granular “sugary” texture; gray, yellow, tan, etc.
	marble	non-foliated, granular, scratches w/ knife, visible xls, light color (white, gray)
	schist	sparkly xls, foliated, often fine light/dark bands (micas, garnet, etc.)
	gneiss	granular with light & dark bands, often "wavy"
SEDIMENTARY		
	shale	soft, fine grained, foliated
	sandstone	sand-sized grains, may be foliated
	breccia	angular pebbles in sandy matrix
	conglomerate	rounded pebbles in sandy matrix
OTHER		
	a dike	Find a specimen that has an intrusive dike
	???	Find a rock not on this list - try to identify it

<u>STOP 2: Soledad Canyon FWY Cut</u> – Mint Canyon Fm (Upper Miocene, 8-12Ma)

To the north we can see a road cut on the other side of the freeway. In the space below draw a sketch of the geologic units exposed in the cut.

What is this stratigraphic relationship called? _____

What does it tell you about the geological history of this spot? _____

_____

_____

<u>STOP 3: Road Cut – Exercise in Crosscutting Relationships</u>

Sketch the road cut below. **!!BE CAREFUL OF TRAFIC!!**

Stop 3: continued

I. Based on your observations and the sketch, decide how many different rock units are exposed here. Give each different rock unit in the cut a letter: A, B, C, etc. with "A" being the oldest and briefly describe each.

A _____

B _____

C _____

D _____

__ _____

__ _____

II. Describe the sequence of geological events that happened to create the relationships you see in this road cut beginning with the earliest (first). Be as detailed as the evidence allows (but don't make things up). (Note: this story begins ~1.7 billion years ago!)

Deposition of sediment for A, _____

burial, metamorphism of A to granulite gneiss _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

STOP 4: Vasquez Rocks County Park.

These coarsely clastic sedimentary rocks belong to the Miocene (12 –15 Ma) *Vasquez and Mint Canyon Formations* which comprises about more than 20,000 m of course-grained conglomerate sandstone, shale, and basalt. It was deposited at the edge of the tectonically active North American continent. The situation is similar to that found today in growing coastal basins like the Los Angeles and Ventura basins.

The sediments were derived from sources as far away as present-day Mexico that have since been moved far way by movement along the plate boundary. The sediments were deposited on-shore in a river flood plain environment. The reddish hue is caused by the oxidation of iron. These *hogbacks* are folded and tilted up to 50 degrees over 8 to 15 Ma by deformation along the Elkhorn fault, an offshoot of the San Andreas Fault. They rise up to 50 m high and were sculpted by erosion by both water and wind.

Question:

1) What is the strike and dip of the highest hog back (cuestas)? (You instructor will show you how to do this with a Brunton hand transit.)

Strike = _____ Dip = _____

2) Look for green, orange, and yellow patches on the rocks. What are they?

_____

3) Explore the area and find the following:

a) a fault

b) an example of graded bedding

c) a “pedestal” or “mushroom” rock