

## PALOS VERDES FAULT - Mike Forrest

1. Meet at 8:30AM, Saturday at the parking lot below the old Malaga Cove School (presently Rolling Hills Prep). Plan to return around 12 or 12:30PM.

At the “lookout point” can overlook part of the Los Angeles Basin. There are billion year old rocks in the San Gabriel Mountains. There is a crustal “keel” which goes 240km deep. Only 4 or 5 are presently known in the world today. The Santa Monica Mountains have rotated 90° in the last 15 my. The Palos Verdes Fault enters the bay where the coastal hill slopes downward and spreads northward into the Santa Monica Bay. There is an active west branch called the Redondo Fault which can be clearly seen in a topographic map of the submarine Redondo Canyon. The water was 300ft lower in the last ice age some 20,000 years ago. Today the river of sand (some 280,000 yd<sup>3</sup>) which moves southward dumps into this submarine canyon.

The exposed rock in the bluffs are diatomite. 15 mya this land would be 2000ft deep at the bottom of the ocean. The diatoms would be dropping down and piling up. Together with a temperature of hot coffee and one million years, we get oil. One of the richest of all oil fields was the Los Angeles Basin. In the 1890’s Edward Doheny and Canfield were desert miners who bought a Los Angeles lot for \$400. They used only pick axes and shovels and found natural gas after digging only 10ft deep. They then used a 90ft long Eucalyptus tree trunk as a “bit” and drilled for a month and then struck oil. (A similar situation happened in Texas in the 1950’s where many, including George Bush, struck “black gold”.)

2. Continue to Bluff Cove and look out over Flat Rock Point.

15 mya the LA basin was spreading with a right bend or releasing bend in the right-lateral transform margin. Underwater lava flows are shown by the black basalt which has withstood the weathering and erosion better than the Monterey Shale (5-15 my old in general and about 14 my on the peninsula). The shale is the lighter, colored sedimentary strata. The progress of coastal landforms starts with headlands, then sea caves, finally carved thru to form sea arches, then sea stacks, and finally those are washed away. (No arches here but there are sea caves down south in La Jolla and some underwater caves toward White Point.)

3. Get back on the drive and head north. Veer off to the right parallel to PV Drive North to look at the Palos Verdes Golf Course. Look at the narrow bridge across the gorge, a golf hole!

Notice the mini rift valley due to a slight right bend in the PV fault. Golf course designers spend \$100,000’s to artificially make the landscape look like the glacial features of the original Scottish courses with mounds (drumlins) and lakes (kettles).

4. Take Via Valmonte left across PV Drive North. It will wind down the hill toward Hawthorne Blvd. The plan is to turn at the last boulevard stop (Las Tortugas), but if you miss this or can't make the turn go to the signal at Hawthorne Blvd and take a left and then get over and take another left onto Newton Avenue. (The plan is to back-track up Via Valmonte.) Turn left into the gas station in case it's illegal to make a U-turn at the signal. Get back on Hawthorne Blvd and turn right up Via Valmonte and right on Las Tortugas (the first stop sign). Take a right on Mesa Avenue when the road splits. Park near the house at 4137 Mesa Avenue next to an empty lot. Whew!

Notice the steep slope. We may be standing atop an active fault scarp or an eroded scarp. (There's a reason why it is so steep here.) Either way, we are within a 100m of the PV fault. This is a "terrible" place to buy a home! A 7.2 earthquake would result in a force exceeding gravity with the ground jumping up some 10ft in say two seconds. Notice the pillars in the house set in soft earth and clays. Still, there may not be an earthquake in 1,000 yrs, but then again...

5. Continue down Mesa Avenue and take a right on Via Montana and take this down to PCH. Take a right and continue north a couple miles to Narbonne and take a right up the hill. (It turns into PV Drive East.) Go past the quarry and take a quick right at Club View. Look for an empty lot. Walk to the end for a view of part of the Rolling Hills Golf Course.

Here is one of the many branches of the PV fault. It is right-lateral and moves about 3mm/yr. (The San Andreas is also right-lateral but moves 30mm/yr.) The golf balls roll back into a little rill in the fairway.

6. Turn around and take Narbonne (now PV Drive East) up the hill. Turn left at PV Drive North and mention George F. Canyon where a nature walk will lead one to some Catalina Schist (a metamorphic rock formed 15-30km deep in a subduction zone). Take PV Drive to the "5-point intersection and take Anaheim St to the right (Gaffey St is a sharper right turn!) Turn left into Ken Malloy Regional Park.

Lake Machado in Harbor Park is a remanent of an ancient Los Angeles river bed. This was a cutoff meander or oxbow lake. A common progression is from lake to marsh to meadow to woods, till it's all gone! There is probably an underground water channel, although it continues to shrink. It shows us what the south bay area looked like some 50 to 100 years ago. When we go back to the intersection and take a sharp left onto Gaffey Street, the PV fault will run right thru the oil tanks and cross Gaffey St by the Little League baseball field. Here Gaffey Street is the remnant of an ancient river vally that existed some 5,000 years ago. Notice the rising land on either side of the street.

7. Take Gaffey St up into San Pedro all the way toward Point Fermin. After it turns up and right pull over to a viewpoint of the Los Angeles Harbor.

The PV fault cuts across the peninsula being built up next to Terminal Island and goes directly under and between the main supports of the Vincent Thomas Bridge. This along with the Long Beach Harbor is at times the busiest port in the world. If an earthquake crippled this area, there would be significant economic repercussions.

8. Continue south on Gaffey and turn into the 2nd entrance to Angel's Gate Park where there is the Korean Friendship Bell.

So what created the peninsula? (1) 5 mya the plate margin jumped inland to the present San Andreas location. There is now a left bend or restraining bend which originally resulted in the closing up of the LA basin. It continues to close up today. (2) 3 mya the Pacific Plate turned inward (the Pasadena Orogeny). (3) The PV fault is also a factor, and (4) there are probably blind thrust faults beneath the surface which further complicate the problem. Basically, the compressive forces make the peninsula a broad anticline.

300,000 years ago, PV was an island. Notice the wave-cut terraces or benches. The first bench that we are standing on is about 50,000 years old. The evidence that this was an island is that these terraces circle the peninsula.

9. At Point Fermin we walked around the fence (carefully!) to the east. Later we will walk west toward a road cut where we see sedimentary strata.

Here we see an old road end abruptly where we see a slump. The movement started around 1929 and with heavy rains in 1941-2, there was more slippage. Walking back we can see the angle of the strata downward toward the ocean. What saves that point is the fact that the bentonite clay toe is deeper and not exposed to the wave erosion we see in progress.

At the road cut, the tilt of the strata indicate tectonics. Turbidites are submarine landslides (due to earthquakes) of sand, silt, and clays. They may move at 20-30 mph and spread outward. In Santa Monica Bay we have a turbidite sequence which matches California's last two largest earthquakes, 1812 and 1857. Coarse sand is evidence of high energy environments. Cobble-like, rounded concretions like snowballs are similar indicators from a near-beach environment. Shale and silt deposits are evidence of deeper water. The alternating layers indicate that the water was up and down, again and again. (It's submarine and not a river, otherwise there would be rounded pebbles and cobbles.)

Back on the ocean side of the road, the breakers form where the depth is 1/2 the wavelength of the wave. Notice the refraction of the wavefronts.

To the south is Catalina, perhaps rotated 90° by ball-bearing tectonics. (One can't see the lights of Avalon due to the curvature of the earth?)

10. We missed Friendship Park and the Cabrillo Fault on this trip. Instead we head back along PV Drive South thru the Portuguese Bend landslide area.

First of all, notice the lumpy or hummocky nature of the landslide area. In trying to extend Crenshaw Blvd to the coast, an ancient landslide area was exposed. Notice the movement in the road and the water pipes set above the ground for easier repair and maintenance. Dewatering areas have helped reduce the slippage in the bentonite clay.