Field Trip to the Skyline Ridge Region in the Santa Cruz Mountains

Trip highlights: fault scarps, sag ponds, vegetation and bedrock contrasts, regional vistas, Quaternary gravels, Tertiary marine rocks, ancient submarine landslide deposits, volcanic rocks (Mindego Basalt), Indian mortar holes in sandstone

This field trip guide includes a collection of stops that may be selected to plan a geology field trip. The field trip stops are along Highway 9 (Saratoga Road) and Highway 35 (Skyline Boulevard) between Castle Rock State Park and La Honda on Highway 84. Most stops are on lands maintained by the Midpeninsula Regional Open Space District. Outcrop and natural areas along the ridgeline crest of the Santa Cruz Mountains west of the San Andreas Fault are featured. Stops also include excursions to the fault itself in the Los Trancos and Monte Bello Open Space preserves, and at the Savannah-Chanelle Vineyards (built directly on the fault). The inclusion of all stops listed below might be possible only with an early start and plans for a long day in the field. Stop descriptions below include information about interesting geologic features in the vicinity, but they may require additional hiking to visit.

Note that rattlesnakes can be encountered anywhere. Poison oak is prevalent, and ticks can be encountered any time of year, but mostly in the spring. The area is also mountain lion habitat. It is advisable to contact the Midpeninsula Open Space District before planning group visits to the preserves; their website is: http://www.openspace.org.

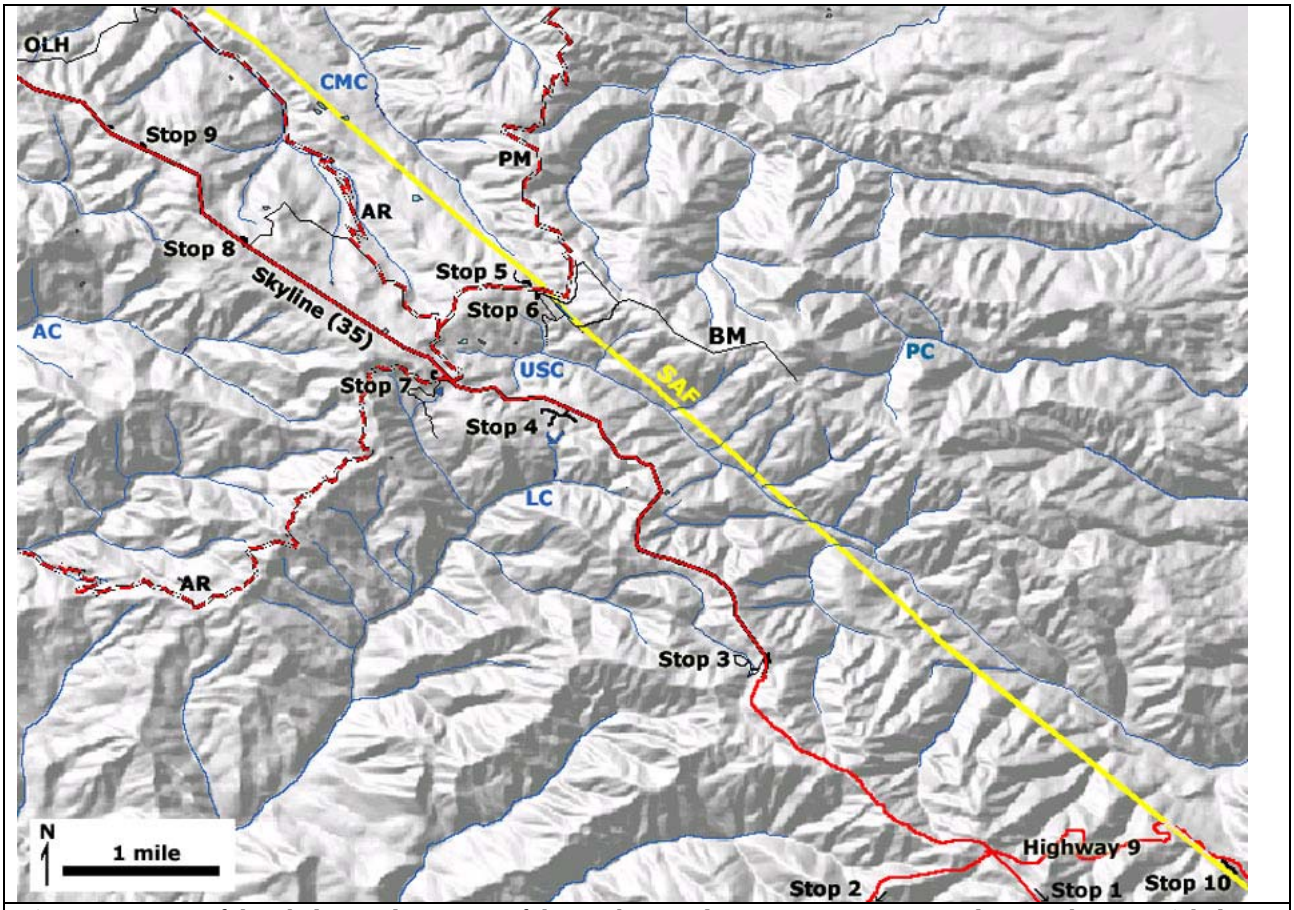

Figure 7-1. Map of the Skyline Ridge region of the north-central Santa Cruz Mountains along Highway 35 (Skyline Boulevard). The yellow line labeled SAF is the main trace of the San Andreas Fault. Stop 1 is at Castle Rock State Park. Stop 3 is a scenic overlook on Highway 9 west of Saratoga Gap. Stop 3 is the Long Ridge Open Space Preserve. Stop 4 is the Skyline Open Space Preserve. Stop 5 is the Los Trancos Open Space Preserve. Stop 6 is the Monte Bello Open Space Preserve. Stop 7 is the Russian Ridge Open Space Preserve. Stop 8 is a vista area near Clouds Rest. Stop 9 is Windy Hill Open Space Preserve. Stop 10 is at the Savannah –Chanelle Vineyards on Highway 9. PM is Page Mill Road; AR is Alpine Road. BM is Black Mountain. Selected streams include Upper Steven Creek (USC), Permanente Creek (PC), Corte Madera Creek (CMC), Lambert Creek (LC), and Alpine Creek (AC).

Geologic maps with descriptions of this region include Brabb and others, 1997, 1998, and 2000. These maps are ideal for field trip discussions. PDF format versions of the maps are available for downloading, plotting, or graphic modification into handout via the USGS San Francisco Bay Region Geology website on-line at http://sfgeo.wr.usgs.gov.

The San Andreas Fault defines the boundary to two distinct geologic terranes in the north central Santa Cruz Mountains. The east side of the San Andreas Fault is characterized by the Permanente Terrane, a belt of ancient oceanic crustal rocks (volcanic and sedimentary) of Cretaceous age that are part of the Franciscan Complex. The Permanente Terrane contains pillow basalt, sandstone, mudrocks, chert, and limestone in varying degrees of metamorphic grade, hydrothermal alteration, and structural shearing from both ancient and modern fault movement. Economic production of limestone is ongoing in the Permanente Creek area on the southeastern flank of Black Mountain in this field trip area. The mine in the Permanente Creek area is about 2 miles directly east of Stop 6 on fig. 7-1.

West of the San Andreas Fault is the Santa Cruz Mountain Block, a complex terrane composed of granitic and mafic igneous basement rocks that have intruded older Paleozoic and Mesozoic metamorphic rocks. These rocks are collectively called Salinian Complex. Salinian rocks are exposed to the southwest on Ben Lomond Mountain and in the north on Montara Mountain. In the Ben Lomond Mountain area, marble was historically mined for lime, and hard-rock aggregate is still actively mined. These crystalline basement rocks are overlain by a thick blanket of latest Cretaceous to late Tertiary sedimentary rocks and some basaltic volcanic rocks. In southern San Mateo and northern Santa Cruz counties this complexly faulted and folded sequence of sedimentary rocks is up to 4,000 m thick and consists of rocks of Eocene, Oligocene, and Miocene age. Miocene-age volcanic rocks (Mindego Basalt) also occur in the Santa Cruz Mountain Block. These rocks of the Santa Cruz Mountains Block are bounded on the east by on the east by the San Andreas and Pilarcitos faults and to the west by the San Gregorio Fault (rocks west of the San Gregorio Fault are part of the Pigeon Point Block). Oil production in the Half Moon Bay area was some of the first in California. There is no active oil production in the region, however, some un-recovered oil (albiet small) may exist, as is suggested by a number of oil seeps in the region, perhaps most noteworthy being seeps along Tarwater Creek, a tributary in the greater Pescadero-Alpine Creek drainage area west of Skyline Ridge.

Page Mill Road generally lies on the boundary between the Peninsula segment of the San Andreas Fault to the north, and the Santa Cruz Mountains segment to the south. The Peninsula segment extends northward of Page Mill Road to offshore of San Francisco. It is characterized by very little seismicity since the massive 1906 earthquake (M=~7.8) ruptured this section of the fault. The Peninsula segment also experienced an estimated M=7.0 earthquake in 1838. Studies of offset alluvial fan deposits near San Andreas Reservoir suggest other major seismic events occurred at 1810 ± 50 years BP (before Present) and 2790 ± 60 years BP as indicated by carbon 14 ages (Prentice and others, 1991). The recurrence interval of major earthquakes on the Peninsula segment is 225 years. Hall and others (1999) report an estimated overall slip rate of 17 ± 4 mm/year for the Peninsula section, but the fault is currently displaying "locked" behavior. The "modern" Peninsula section of the San Andreas Fault runs parallel to, or slightly orthogonal to, the Pilarcitos Fault, which is an inactive ancestral strand of the San Andreas Fault. Whereas more than 300 km of offset is estimated for the San Andreas Fault in the San Francisco Bay region, only about 26 km of offset is accommodated by the modern Peninsula segment of the San Andreas Fault as determined by the offset of a belt of Cretaceous limestone within the Permanente Terrane of the Franciscan Complex (Griscom and Jachens, 1989). The rest of the offset occurred along the Pilarcitos Fault and other faults in the region.

In contrast to the Peninsula segment, the more seismically active Santa Cruz Mountains segment, which extends southward from Page Mill Road to the San Juan Bautista area, has experienced nearly a dozen M=4 to 5 range earthquakes in the two decades proceeding the M=~7.0 1989 Loma Prieta earthquake. This seismicity shows that the plane of the San Andreas Fault dips at a steep angle approaching 75 degrees toward the west in the Santa Cruz Mountains.

Mileage	**Description**
0.0	Intersection of Saratoga Road with Highway 85.
1.7	Intersection of Saratoga Road with Saratoga-Sunnyvale Road and Saratoga-Los Gatos Avenue (Highway 9) at downtown Saratoga. Proceed south on Highway 9 through downtown Saratoga.
3.5	The Mountain Winery is to the right (uphill about 1.2 miles to the parking area). The Mountain Winery was originally the Paul Masson Winery. The old Paul Masson Winery building is now the back stage area for a 1,000 seat outdoor concert facility and party grounds. The grounds of the winery provide exceptional views of the South Bay region. The hilltop facility is built on a ridge between linear valleys defined by the Berrocal Fault to the east and the San Andreas Fault to the west.
4.2	Bridge over Sanborn Creek. Sanborn Road (to Sanborn Park) is on the left.

5.0	Savannah-Chanelle Vineyards is on the left (this is optional Stop 10 on this field trip). Highway 9 crosses the San Andreas Fault in this vicinity (it is not apparent along the road due to plant and colluvial cover).
9.0	Intersection of Highway 9 and Skyline Boulevard (Highway 35) at Saratoga Gap. Proceed south on Highway 9. **Reset mileage** to zero.
0.0	Saratoga Gap Vista Area is a convenient gathering area at the intersections of Highway 9 and 35. Although the area is frequently patrolled, take things of value with you.
2.6	**STOP 1 - Castle Rock State Park** (see stop description below). Restrooms are available her, albeit primitive. After the stop, return north to Highway 35 at Saratoga Gap.
0.0	Intersection of Highway 35 northwest of Highway 9 at Saratoga Gap; **reset mileage** to zero at the intersection.
1.7	**STOP 2 - Highway 9 Vista Point at Castle Rock State Park** (see stop description below). The overlook is on the left (east) side of the road. A restroom is available at this stop. After the stop, return north to Highway 35 at Saratoga Gap.
0.0	Intersection of Highway 35 northwest of Highway 9 at Saratoga Gap; **reset mileage** to zero at the intersection.
0.7	Saratoga Summit Fire Station is on the left.
1.3	**STOP 3 - Long Ridge Open Space Preserve** (see stop description below). After the stop continue north on Highway 35.
5.4	**STOP 4 - Skyline Ridge Open Space Preserve** (see stop description below). A restroom is available at this stop. After the stop continue north on Highway 35.
6.3	Intersection of Skyline Boulevard (35) with Page Mill Road and Alpine Road. Turn right on Page Mill Road.
7.6	**STOP 5 - Los Trancos Open Space Preserve** (see stop description below). A restroom is available at this stop. Continue to the Monte Bello Preserve across Page Mill Road.
7.6	**STOP 6 - Monte Bello Open Space** Preserve (see stop description below). A restroom is available at this stop. Return to the intersection of Page Mill and Highway 35. The parking area to the Russian Ridge Open Space Preserve is just across Highway 35 on Alpine Road.
8.9	**STOP 7 - Russian Ridge Open Space Preserve** (see stop description below). A restroom is available at this stop.
0.0	Return to the intersection of Alpine Road and Highway 35. Turn left (north) on Skyline Boulevard. **Reset mileage** to zero.
1.1	**STOP 8 - Vista Point along Skyline Boulevard** (see stop description below). After this stop continue north on Highway 35.
4.8	**STOP 9 - Windy Hill Open Space Preserve** (see stop description below). A restroom is available at this stop. **End of Field Trip**. **For location reference only:** north-bound travelers will find the intersection of Skyline Boulevard with La Honda Road (Highway 84) 2.2 miles north of the Windy Gap Open Space Preserve. Highway 84 connects between I-280 at Woodside and Highway 1 along the coast at San Gregorio State Beach. Alice's Restaurant is at the intersection of Skyline Boulevard and Highway 84 (It is not *The Alice's Restaurant*!). Highway 84 provides a better return route to Highway 280 than the narrow, steep, and windy Page Mill Road.
	STOP 10 - Savannah-Chanelle Vineyards [optional stop] (see stop description below). Directions to the Savannah-Chanelle Vineyards: Intersection of Skyline Boulevard (Highway 35) with Highway 9. Turn left (north) on Route 9 toward Saratoga and proceed 4 miles. The vineyard is on the right Please establish a designated driver if this stop is included in your field trip and participants choose to sample the wine. The vineyard's wine tasting room is open daily from 11am to 5pm.

STOP 1 - Castle Rock State Park

Stop highlights: massive Tertiary marine sandstone outcrops, tafoni-style weathering, vistas along Castle Rock Ridge

East of Highway 9, Skyline Boulevard follows Castle Rock Ridge; home of Castle Rock State Park. Castle Rock State Park is most famous for its massive outcrops of *arkosic* (feldspar-rich, lithic-poor) sandstone (lower to middle Eocene age). The Butano Sandstone forms the ridgeline of Castle Rock Ridge and much of Skyline Ridge and other ridges in the Santa Cruz Mountains west of the San Andreas Fault. The Butano Sandstone Formation contains up to 3,000 m of marine rocks that are mostly sandstone but that also include interbedded shale and conglomerate.

It is advisable to call the state park in advance of a field trip. Parking within the state park lot requires a day use fee. Along the road parking is free, but is limited on weekends.

The shortest route to see massive outcrops of Butano Sandstone is a trail to Indian Rock on the east side of the road (about 0.1 mile). Indian Rock provides a view of Sanborn Creek Valley (along the San Andreas Fault). Be aware that the sandstone is slippery when wet and climbing on the rocks without appropriate equipment can be hazardous!

Slightly longer hikes include an uphill (about 0.3 mile) walk to Castle Rock itself. The trail starts in the main parking area. Castle rock also displays spectacular cave-like tafoni weathering. Goat Rock Overlook along the Ridge Trail provides spectacular views of the San Lorenzo River Valley to the west. Goat Rock is perhaps the highest cliff in the park (about 200 feet) and is a more strenuous hike of about 0.6 miles. In addition, Castle Rock Falls is worth the detour from the Ridge Trail.

Note the tafoni-style weathering of the sandstone (Figure 7-2). Tafoni forms from differential weathering of sandstone over time. Precipitation soaks into the sandstone and dissolves mineral cements that then migrate to the rock surface as the rock dries. This produces a hardened patina crust on rock surfaces. The sand that has lost its cement inside the rock easily crumbles when exposed, resulting in the cave-like holes in the sandstone.

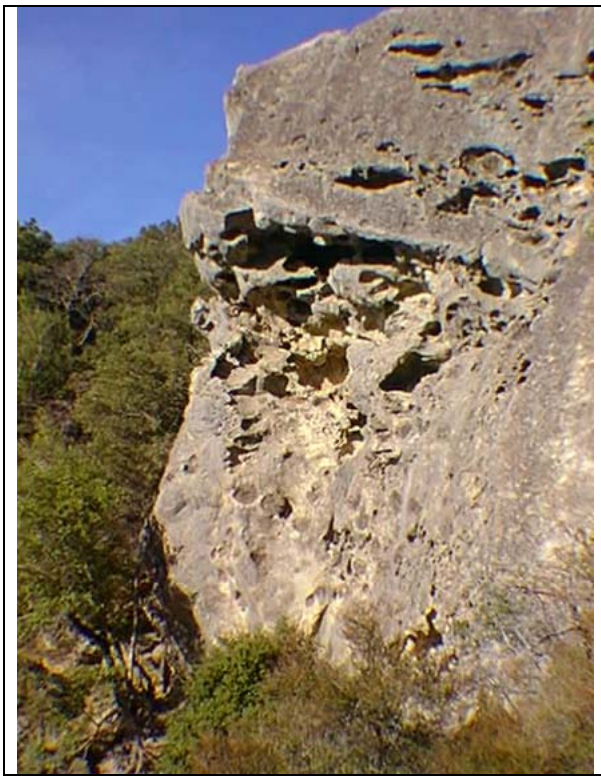

Figure 7-2. Goat Rock is a popular hiking destination in Castle Rock State Park. It is deeply pocketed by tafoni-style weathering.

STOP 2 - Highway 9 Vista Point

Stop highlights: vista of the Monterey Bay region, Ben Lomond Mountain (a fault-bounded block of Salinian basement)

The vista point is located 1.8 miles south of the intersection of highways 9 and 35 at Saratoga Gap. The stop provides views south and west of Castle Rock Ridge toward the southwestern Santa Cruz Mountains and the drainage basin of the San Lorenzo River. Distant views on a clear day include the Monterey Peninsula and Monterey Bay. The valley of the San Lorenzo River is underlain by a complexly folded and faulted sequence of marine sedimentary rocks, mostly shale, of Eocene, Oligocene, and Miocene age. To the west is Ben Lomond Mountain, a massive block of Salinian crystalline basement rock overlain by a discontinuous cover of late Tertiary sedimentary rocks that are bounded on the northeast by the Ben Lomond Fault. Closer by is the southern end of Butano Ridge, a ridge of resistant Butano Sandstone bounded on the northeast by the Butano Fault. Castle Rock Ridge along Highway 35 is also a ridge composed of Butano Sandstone bounded on the northeast by the San Andreas Fault. All three faults, and others in the San Lorenzo River valley, display evidence of Quaternary offset and may be capable of producing earthquakes.

The "Skyline to the Sea" Trail passes through the vista area. The uphill end of the trail begins at Saratoga Summit in Castle Rock State Park. The 18 mile long trail passes through Big Basin State Park and ends at Waddell Creek near Año Nuevo State Park along Highway 1 at the border between Santa Cruz and San Mateo counties.

Figure 7-3. View looking southwest from the vista area along Highway 9 located 1.8 miles south of Saratoga Gap. MB is Monterey Bay; BLM is Ben Lomond Mountain, and BR is Butano Ridge. The entire visible landscape is part of the San Lorenzo River basin. The valley is typically shrouded in fog in the morning hours.

STOP 3 - Long Ridge Open Space Preserve

Stop highlights: Tertiary sandstone outcrops, vista of fault-bounded Butano Ridge, oak and mixed evergreen forest

Long Ridge Open Space Preserve offers trails through grassland bald areas and mixed evergreen forests (consisting of moss-covered live oaks, bay laurels, madrone, and Douglas fir). A 0.25 mile walk from the trail head leads to a rocky outcrop on the ridge line consisting of Butano Sandstone of Eocene age. The view to the west encompasses the straight valley of Pescadero Creek where it follows the trace of the Butano Fault at the base of Butano Ridge. This region is the most extensive wilderness left in the Peninsula region and encompasses Portola, Pescadero Creek, and Butano state parks. Although the region was heavily lumbered in the late 19th and early 20th centuries, many of the redwood groves are returning. Efforts are now underway to restore Pescadero Creek's salmon population.

From the parking area proceed west and then north on the main trail (Hickory Oaks Trail). Butano Sandstone outcrops can be seen on a foot trail that cuts off to the left near the top of the hill. Watch out for rattlesnakes and poison oak. An additional "distraction" is a walk through an amazing oak grove on a spur trail that leads to the left (south) a short distance from the trail head. About 10 vehicles can fit if parked closely along the roadside parking area on Highway 35. Additional space for 6 more vehicles are a short distance north along the road.

Figure 7-4. This view looking toward the northwest shows small outcrops of Butano Sandstone in a grassy "bald" area along Long Ridge. The valley of Pescadero Creek and Butano Ridge are in the distance.

STOP 4 - Skyline Ridge Open Space Preserve

Stop highlights: ancient submarine landslide deposits (Lambert Shale), restored upland habitats

This stop involves a 0.6 mile round-trip walk to Horseshoe Lake at the head of Lambert Creek. Upon entering the preserve, turn right and park in the northernmost parking area. A sign at the trail head says "Ridge Trail to Horseshoe Lake 0.3 mi."

The area along the road was once a Christmas tree farm (soon to be restored to its original oak woodlands and grasslands setting). Horseshoe Lake has a beautiful setting amongst mixed evergreen and Douglas fir forests. Bobcats are frequently seen here, and the area is mountain lion habitat. A small trail next to a wooden bridge leads to the dam spillway and a small outcrop area of Lambert Shale (the destination of this stop). Be cautious handling rocks and plant material because both scorpions and poison oak are found here.

The Lambert Shale is of Oligocene to lower Miocene age and is about 1,460 m thick in the Santa Cruz Mountains. It only occurs west of the San Andreas Fault. The formation consists of dark-gray to pinkish-brown, moderately well cemented siliceous mudstone, claystone, and siltstone. Sandstone bodies as much as 30 m thick, glauconitic sandstone beds and microcrystalline dolomite are present in places. The upper part of the section contains chert. In outcrop, it resembles the Santa Cruz Mudstone and parts of the Purisima Formation (exposed along the coast between Santa Cruz and Half Moon Bay); (Brabb and others, 2000).

This small outcrop at the dam spillway is a typical Lambert Shale outcrop in the Santa Cruz Mountains; there isn't much to see at first. However, closer inspection reveals curious features about this mudrock formation. Note the character of the small sandstone bodies in the outcrop area. The sandstone bodies have unusual shapes ranging from smooth and rounded to elongate or jagged. They suggest that the Lambert Shale accumulated, in part, as massive chaotic units, possibly as massive submarine landslide deposits. The siliceous nature also suggests deposition in offshore areas of upwelling.

Figure 7-5. View of Horseshoe Lake in the headwaters of Lambert Creek. A mixed evergreen and Douglas fir forest grows on the cooler, wetter, north-facing slopes. Chaparral grows in the foreground on the drier south-facing slopes.

STOP 5 - Los Trancos Open Space Preserve

Stop highlights: fault scarps, pull-apart basin with sag pond, view of the San Andreas Rift Valley, Quaternary gravels

Volunteers from Foothill College developed and maintain the "San Andreas Fault Trail" at Los Trancos Open Space Preserve. The trail follows the trace of the San Andreas Fault and associated slump escarpments throughout oak woodlands. Posts have been placed along the lines of ground rupture from the 1906 earthquake. A historic fenceline offset by the strike-slip rupture of the fault has been restored to its original orientation (the original fence has long since deteriorated). Other features include trees that fell during the 1906 earthquake and have since regrown, and scenic vistas along the trace of the San Andreas Fault. The Midpeninsula Open Space District provides brochures for a "San Andreas Fault Trail" which describes nine stops along a 1.5 mile long hiking route. The brouchure can be seen on-line at: http://www.openspace.org/preserves/los_trancos/los_trancos.html. This field trip only utilizes hiking stops one and two of the San Andreas Fault Trail.

Just to the north of the parking area is a chaparral-covered saddle between two hills. During wet periods, water accumulates in a low area here. The saddle represents a small pull-apart basin (with sag pond). Low white-capped posts show the location of surface rupture caused by the 1906 earthquake. However, this is not considered the main trace of the San Andreas Fault. It is one of many areas throughout the Santa Cruz Mountains where intense earthquake shaking caused gravity driven ridge-crest spreading and slumping. The main trace of the San Andreas Fault is several hundred feet to the east of this location.

Hiking Stop One is located at an overlook a short distance beyond the trailhead at the west end of the Los Trancos parking area. This overlook provides a similar vista of the Upper Stevens Creek valley as the one described below at the Monte Bello Preserve. The overlook is along a section of trail lined boulders of conglomerate containing clasts of volcanic rock (andesite porphyry, diorite, and gabbro) imbedded in a tightly cemented sandy matrix. These boulders were derived from Cretaceous-age conglomerates exposed along the Sierra Azul Ridge from Mt. Umunhum and Loma Prieta, nearly 23 miles to the south (and visible from this location). The poorly consolidated sandy gravel bearing the conglomeratic boulders are named the *Corte Madera facies* of the Santa Clara Formation, named after Corte Madera Creek, the drainage just north of this location along the San Andreas Fault. These poorly consolidated sediments are estimated to have been deposited roughly 2 million years ago on an alluvial fan draining from the Sierra Azul and Loma Prieta summit region. Right-lateral movement of the fault has offset these materials from their sediment source area by a minimum distance of about 30 km (19 miles), providing an average long term rate of offset at about 15 mm per year. These ancient deposits are preserved in a massive sliver-like trough within San Andreas Fault Zone that extends from Upper Stevens Creek valley into the Corte Madera Creek drainage. The Corte Madera facies deposits are well drained and preferentially support grasslands and chaparral habitats in contrast to the surrounding rocks that host mixed evergreen forests and oak woodlands.

Hiking Stop Two is several hundred feet farther along the trail and is located at a monument in a grassy field with a spectacular view of the central San Francisco Bay region. This stop provides a view northward along the San Andreas Fault along the Corte Madera Creek drainage and onward to Crystal Springs Reservoir and San Andreas Lake, two reservoirs built in the San Andreas Rift Valley that are visible from here on a clear day. The San Andreas Fault was named for a natural sag pond along the fault that was inundated by the construction of San Andreas Reservoir dam. This overlook provides an opportunity (on a clear day) to reflect on the natural history of San Francisco Bay.

On a clear day Mount Diablo, the East Bay Hills, and the Diablo Range are visible east of the bay. The Hayward Fault runs along the base of the western slope of the East Bay Hills. The bay itself floods an ancient valley system associated with the stream and river system that drains through the bay. During the climax of the last ice age about 18,000 years ago, the sea level was about 350 feet (100 meters) lower, and these river systems merged and flowed into a canyon that is now the Golden Gate.

Return to the parking area and cross the road to the parking lot for the Monte Bello Preserve to continue this walking excursion.

	**Figure 7-6.** This image shows the restored fence offset by the 1906 earthquake. (The original fence has long since decayed.) Right-lateral surface offset from the earthquake was about 5 to 6 feet in this area. This view is along the San Andreas Fault Trail route about a quarter mile from Stop Two mentioned above.
	**Figure 7-7.** Trees like this oak along the San Andreas Fault Trail are a living reminder of the damage caused by the 1906 earthquake. Many older trees in both the Los Trancos and adjacent Monte Bello Open Space Preserve display damage from falling over or being broken during the earthquake.

STOP 6 - Monte Bello Open Space Preserve

Stop highlights: sag pond, fault scarps, vegetation and bedrock contrasts, Franciscan Complex, limestone, conglomerate

Hiking Stop One is at the trail head in the Monte Bello Preserve parking area. Maps of the preserve are on display. Blocks of locally derived serpentinite and conglomerate are around the trail head. The blocks are from the *Corte Madera facies* of the Santa Clara Formation. Vegetation contrasts in the Upper Stevens Creek valley partially reveal that the Corte Madera facies fill a structural graben in the San Andreas Rift Valley. In the Monte Bello Preserve, the Corte Madera facies contains a interesting mix of rock types—cobbles and boulders of serpentinite and mollusk-bearing marine sandstone can be found amongst the blocks and pieces of andesite porphyry-bearing conglomerate that dominate the deposit.

Hiking Stop Two is at the intersection of two paths approximately 0.1 miles south of the trailhead. This location provides an excellent view to the south along the straight valley of Stevens Creek with Mt. Umunhum and Loma Prieta peaks in the distance. The trail to the right descends to Upper Stevens Creek (a good place to observe a mixture of rocks and bedrock exposures along the west side of the valley). A change in vegetation along the east side of this grassy area probably marks the boundary between the Santa Clara Formation gravels under the grasslands and the forest-covered Tertiary sedimentary formations that lie west of the San Andreas Fault (mostly Lambert Shale of Oligocene to Miocene age in this area). This vegetation boundary probably defines the trace of the Pilarcitos Fault, an ancient strand of the San Andreas Fault that splays off the current main strand of the San Andreas Fault at this point. The Pilarcitos Fault extends northward to the Rockaway Beach area on the San Mateo Coast beforing going offshore. However, evidence of a fault in this area is not clear beyond a change in bedrock and vegetation. No fault plane is seen in the stream bed outcrops. In contrast, the active main trace of the San Andreas Fault is clearly visible on the east side of the valley where surficial offset, fresh fault scarps, and other features associated with the fault are obvious.

Four distinct plant communities reflect the underlying geology and soil conditions: mixed evergreen and oak woodlands and chaparral cover the ancient bedrock east of the San Andreas Fault on Black Mountain. Grasslands cover

the alluvial gravels of the Santa Clara Formation under the central valley area, and Douglas fir forest covers the marine shale and sandstone that underlie Skyline Ridge on the west side of the fault valley.

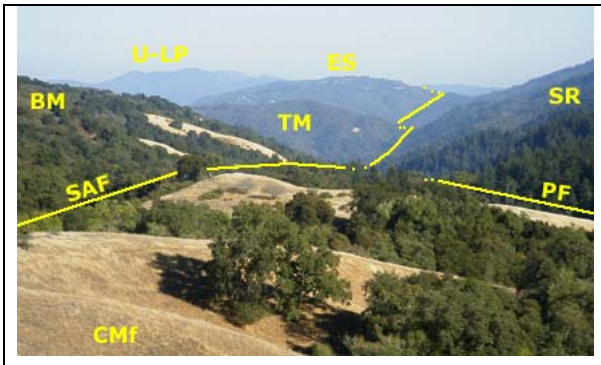

Figure 7-8. This view is looking southeast along the straight valley of upper Stevens Creek that basically follows the trace of the San Andreas Fault (SAF). Black Mountain (BM) is on the left, and Skyline Ridge (SR) is on the right. Table Mountain (TM) and El Sereno Ridge (ES) near Saratoga Gap are in the middle of the image. The fault passes to the right (west) of the Mt. Umunhum Loma Prieta summit area (U-LP) and in the distance. The conglomerate boulders in the Corte Madera facies gravels (CMf) that underlie the grasslands in this vicinity were derived from outcrops in the ancestral summit areas of those two mountains. The Pilarcitos Fault (PF) probably follows the drainage of upper Stevens Creek on the right.

Hiking Stop Three is along the San Andreas Fault. From the trail intersection follow the trail to the west through the old walnut orchard to the Monte Bello Road (trail). Monte Bello Road follows the escarpment of the 1906 rupture of the San Andreas Fault. The size and extent of this escarpment and associated sag pond that fills the fault zone here suggests this fault trace has been experiencing episodic earthquakes for many thousands of years. It also implies that there is a vertical component to fault motion (hence the escarpment). Walk to the south along Monte Bello Road to a park bench adjacent to the sag pond and several large Bay Laurel trees. An interpretive plaque describes the succession of pond formation and filling along the fault. A large boulder of serpentinite is visible next to the pond's shore a short distance south of the park bench. South of the Sag Pond the landscape along the fault zone displays an unusual topography, hinting of a series of fault-bounded grabens and horsts within the fault zone. About 0.8 mile south of the sag pond is a small abandoned quarry in Franciscan limestone.

Hiking Stop Four is located near the intersection of Monte Bello Road (trail) and Page Mill Road. Return via the Monte Bello Road toward the parking area. The outcrop is near where the fault crosses Page Mill Road and is on the east side of the fault. This small outcrop consists of highly sheared greenstone (altered basaltic rock) with pods of dolomitic limestone. These are likely ancient pillow basalt (now sheared and altered) with calcareous marine ooze deposits (dolomitic limestone) of Early Cretaceous age. Massive limestone deposits on Black Mountain and the surrounding area are interpreted as ancient oceanic atoll deposits that were accreted onto the continental margin rather than being subducted during formation of the Franciscan Complex in the region east of the San Andreas Fault. Surficial weathering of these limestone deposits has produced an unusual karst landscape on the top of nearby Black Mountain.

Return to the parking area via the dirt path along the south side of Page Mill Road.

Figure 7-9. Bay Laurels grow on an up-thrust escarpment of the San Andreas Fault next to a long linear sag pond that fills the fault zone. This view is along the Monte Bello Road (trail).

Figure 7-10. These limestone outcrops on the top of Black Mountain display karst weathering. This limestone is mined in the Kaiser-Permanente (Stevens Creek) quarry on the southeastern flank of Black Mountain.

STOP 7 - Russian Ridge Open Space Preserve

Stop highlights: Outcrops of Tertiary marine rocks (Vaqueros Sandstone), Indian grinding mortar holes, oak woodlands

Follow the Old Page Mill Trail to the spillway area of Alpine Lake about 0.1 mile south of the Russian Ridge Open Space parking area at the intersection of Alpine and Skyline roads. Below the dam is a massive outcrop of Vaqueros Sandstone (lower Miocene and Oligocene, roughly 20-to-30 million years old). Oak woodlands and a perennial supply of water made this an attractive area to prehistoric people who utilized the sandstone outcrops for grinding mortars. Examine the outcrop to determine the orientation of the graded bedding of the sandstone and the structural strike and dip of the beds.

An optional loop walk of about 0.4 mile is to continue west on Old Page Mill Trail and take a foot trail to the right that loops around to the main trail. This trail junction is less than 0.1 mile west of the dam. This trail provides vistas of the redwood and mixed evergreen forests in the Alpine Creek drainage basin. The trail leads through a mature old oak woodlands and grass-covered slopes to an outcrop of interbedded sandstone and shale. This rock is part of the Lambert Shale, also of lower Miocene and Oligocene age, or roughly 20-to-30 million years old.

Return via the Old Page Mill Trail to Alpine Lake. A visitor center next to the pond has nature exhibits, an interesting collection of stuffed animals, and at least one snake.

Figure 7-11. These prehistoric Indian mortar holes are in a Vaqueros Sandstone outcrop along Alpine Creek below the dam at Alpine Lake.

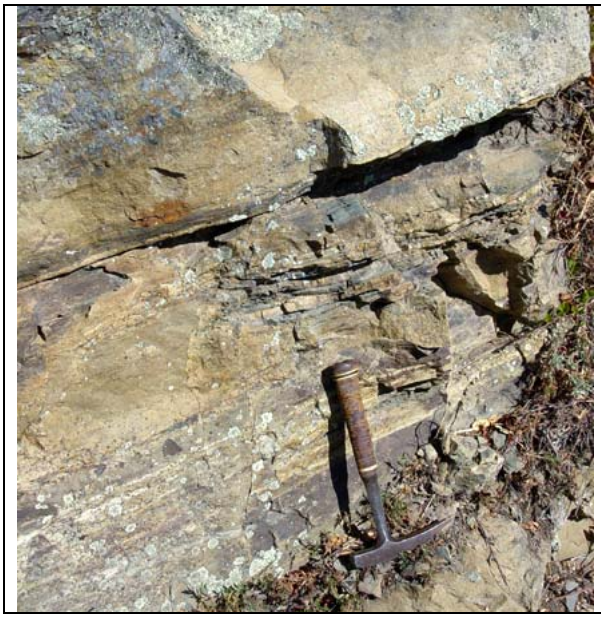

Figure 7-12. Laminated beds in sandstone and shale in the Lambert Shale along the loop trail at Russian Ridge Open Space Preserve.

STOP 8 - Vista Point along Skyline Boulevard (Highway 35)

Stop highlights: Vista of the San Francisco Bay region, boulders of Mindego Basalt, a soil profile

Near this vista parking area is a local road named Clouds Rest. The vista area provides a spectacular view of the mid-peninsula region of San Francisco Bay. On a clear day, visibility extends to Mount Diablo, the highest peak in the northern end of the Diablo Range in Contra Costa County. This area is frequently shrouded in morning fog or especially when a thick marine layer moves in from offshore. The entire Highway 35 passage through the Santa Cruz Mountains can become immersed in dense fog with miserable wet and windy conditions any time of year. It is best to avoid this high section of highway when these conditions persist.

The stop also provides a exposure of a thick soil profile in the cut on the opposite side of the road from the overlook parking area. Here, a thick blanket of colluvium bearing basaltic boulders overlies deeply weathered shale bedrock. The basalt is derived from local sources in the surrounding uplands. The Mindego Basalt and related volcanic rocks occur in the northern Santa Cruz Mountains. These basaltic rocks are both intrusive and extrusive and are of Oligocene and/or Miocene age. The Mindego Basalt has yielded a K/Ar minimum age of 20.2 (±1.2) million years (Brabb and others, 2002). The intrusive igneous rock is medium to coarsely crystalline and is dark greenish gray to orange brown. As in the vista point outcrop, the basalt commonly weathers spheroidally, and crops out as tabular bodies intruding older sedimentary rocks. Minor amounts of sandstone and mudstone are locally included.

Figure 7-13. A thick blanket of colluvium bearing spheroidally weathered boulders of basalt overlies deeply weathered shale bedrock at the Highway 35 vista point near Clouds Rest.

STOP 9 - Windy Hill Open Space Preserve

Stop highlights: vistas of the San Francisco Bay region, the San Mateo Coast, and the San Andreas Fault rift valley

The grass covered hilltops along Highway 35 at Windy Hill Open Space Preserve provide unhindered observation of the northern Santa Cruz Mountains from the Pacific Ocean to San Francisco Bay and beyond. A short trail (about 0.2 mile) starts at the parking area and winds around the side and eventually to the top of the hill just to the north of the parking area. From here, the trace of the San Andreas Fault can be seen from the Monte Bello Preserve area northward to Crystal Springs Reservoir and beyond.

Figure 7-14. The San Andreas Fault follows the valley of Corte Madera Creek on the north side of Black Mountain (the high point in this image).

Stop 10 - Savannah-Chanelle Vineyards

Stop highlights: The San Andreas Fault, a shutter ridge, hillside bench, wine taste and vineyard tours

The San Andreas Fault crosses Highway 9 near the driveway to the Savanah-Chanelle Vineyards. The driveway and parking area and the wine tasting room are probably built right on the fault trace. A good view of the grounds is possible from a picnic area a short walk uphill from the parking area. This vista point provides a view along the trace of the fault to the south towards Sanborn County Park. The trace of the fault follows a hillside bench along Sanborn Creek valley along the lower eastern flank of Castle Rock Ridge (to the west). The bedrock in the hills consists of Eocene and Oligocene age marine sandstone and shale, whereas Quaternary alluvial fan deposits underlie the bench and lowlands in the valley along Sanborn Creek. Rocks of Mesozoic age underlie the forests on El Sereno Ridge on the opposite side of the valley (east of the San Andreas Fault).

The vineyards and tasting room are built right on the San Andreas Fault. Wine tasting costs $5 and includes a variety of local and regional wines sold at the vineyard ($14 to $28 range). Featured wines are mostly reds crafted both locally and from vineyards across the region from Marin County to Paso Robles. Local grapes include chardonnay and zinfandel. The tasting room is open 11am to 5pm daily.

Figure 7-15. The location of the San Andreas Fault is revealed by a side-hill bench along the flank of Castle Rock Ridge in the Sanborn Creek drainage. The vineyard and winery tasting room were built on the trace of the San Andreas Fault in 1912. This section of the fault experienced about 3 to 4 feet of offset in the 1906. McElroy Creek drains from the upland area of Castle Rock Ridge and displays about a 0.3 mile right-lateral offset along the fault before it merges with Todd Creek to the south. El Sereno Ridge on the east side of the San Andreas Rift Valley is in the distance.

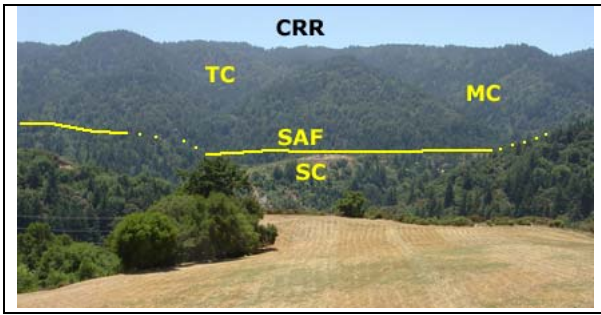

Figure 7-16. This view is looking west from the Mountain Winery parking area toward Castle Rock Ridge (CRR) and the rift valley of the San Andreas Fault (SAF). The Savannah-Chanelle Vineyards (SC) is near the center of the image. On the east flank of the ridge, McElroy Creek (MC) drainage is to the right of the vineyard. Todd Creek (TC) is to the left of center, and Sanborn Creek Valley is to the far left (south). Saratoga Creek valley comes in from the upper right and drains to the lower left.

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