NCGS FIELD TRIP

Gold Country Field Trip

Saturday June 13 & 14, 2009

Ross Smith, Precious Metals Consulting Geologist
MAP OF CALIFORNIA SHOWING GOLD-BEARING AREAS AND GEOMORPHIC PROVINCES

SCALE

0 40 80 120 Miles

EXPLANATION

I  Klamath Mountains
II  Cascade Range
III  Modoc Plateau
IV  Coast Ranges
V  Great Valley
VI  Sierra Nevada
VII  Basin Ranges
VIII  Mojave Desert
IX  Transverse Ranges
X  Peninsular Ranges
XI  Colorado Desert

=G  Gold-Bearing Area

Figure 2.
Map of Major Rock Units and Lode-Gold Belts, Central Sierra Nevada. The Mother Lode and the related East and West gold belts are shown.
Terminology

**Stope**—An excavation from which ore has been removed in a series of steps. Usually applied to highly inclined or vertical veins.

**Drift**—(Also called an adit). An entry, generally on the slope of a hill, usually driven horizontally into an ore seam.

**Adit**—Entrance. Usually a horizontal or nearly horizontal passage driven from the surface for the working or dewatering of a mine. (If driven all the way through the hill or mountain to the surface on the other side, it would be a tunnel).

**Winze**—A steeply inclined opening, like a shaft, driven to connect one mine level with a lower level. Also called a “raise”.

After touring the mine, cross street to the west and traverse the Melones fault zone trace. The zone is preserved here and shows most of the alteration features associated with this major fault. The best route is to go up the “Stamp Mill Trail” to the left of the access road, and return by the access road. On the trail you will note the typical prospect pit (left). At the end of the trail is the Jenkins Heady stamp mill and a mineral exhibit. If volunteers are on duty, the mill may be turned on and operated as a demonstration. Return to vehicles. Lunch—25 minutes.
CALIFORNIA STATE MINERAL

The accidental discovery of gold in 1848 at Sutter’s Mill in Coloma started a bonanza that brought California fame and gave it the title of the “Golden State.” The Gold Rush of 1849 and the subsequent influx of settlers led to California becoming the 31st state in 1850.

NATURAL OCCURRENCES

The concentration of gold ore, and the market value of gold determine whether a deposit is a mineable orebody. The highest grade deposits are associated with quartz veins. Gold also occurs as disseminated particles incorporated during magmatic rock formation or during subsequent chemical alteration of the host rock. Primary gold occurrences are termed “lode” deposits. Mineralized rock and gold-bearing veins release gold particles during the weathering process. Because of its high specific gravity and resistance to weathering, these sedimentary gold particles are easily concentrated by streams and rivers to form “placer” gold deposits.

MINING METHODS

There are three types of gold mining today: underground mining of high-grade lode and placer deposits, dredging of surface placer deposits, and open-pit mining. A technique called “heap leaching” is commonly used to remove finely disseminated gold from low-grade ore. In this process, mounds of crushed ore placed on an impermeable pad and sprayed with a dilute cyanide solution. The cyanide solution percolates through the ore and dissolves fine gold particles. The gold is then electrolytically recovered from solution and poured into ingots. Gold is also a byproduct of sand and gravel production and base metal (copper, lead, and, zinc) mining.

GOLD DEPOSITS IN CALIFORNIA

California’s most important gold deposits have been found in the Sierra Nevada, Klamath Mountains and Mojave Desert. Significant deposits have also been developed in the Peninsular and Transverse Ranges and the northern Great Valley. Unmined low-grade deposits occur statewide. In the Coast Ranges, low-grade gold deposits are associated with low-temperature mercury mineralization.

GOLD PRODUCTION IN CALIFORNIA

In 1998, California ranked second in the United States in gold production. Approximately 604 thousand troy ounces were produced—worth about $178 million.

PROPERTIES AND USES

Gold is one of the earliest metals known and used by humans. It resists corrosion and chemical interaction. It will not disintegrate when exposed to oxygen, water, salt, or any other naturally-occurring material. Gold’s durability accounts for the almost perfect condition of coins and artifacts fashioned from it thousands of years ago.

Gold’s most important use is in computers, weaponry and aerospace. It is used where consistent, reliable performance under all conditions is essential. The electronics industry has tried to find substitute metals and alloys, but gold’s exceptional resistance to corrosion and tarnish is still unequaled.
SERPENTINE
CALIFORNIA STATE ROCK

Serpentine rock is apple-green to black and is often mottled with light and dark colored areas. Its surfaces often have a shiny or wax-like appearance and a slightly soapy feel. Serpentine is usually fine-grained and compact but may be granular, platy, or fibrous in appearance. The term "serpentine" is commonly used by the general public to refer to the rock type that geologists call "serpentinite." Serpentine occurs in central and northern California—in the Coast Ranges, the Klamath Mountains, and in the Sierra Nevada foothills.

Serpentine rock is primarily composed of one or more of the three magnesium silicate minerals, " lizardite", "chrysotile" and "antigorite." Chrysotile often occurs as fibrous veinlets in serpentine. Chrysotile in fibrous form is the most common type of asbestos. Asbestos is a term applied to a group of silicate minerals that readily separates into thin, strong, and flexible fibers that are heat resistant. Lizardite and antigorite do not form asbestos fibers and instead are plate-like in form. Because serpentine often contains some asbestos, and exposure to asbestos fibers has potential human-health consequences, the Air Resources Board adopted regulations in 1990 restricting the use of this rock type as an unpaved road surfacing material. Further information on restrictions for serpentine use in California can be obtained by contacting Air Resources Board at (916) 322-8285, or the local Air Pollution Control District Offices.

Serpentine is considered by geoscientists to be the metamorphosed remains of magnesium-rich igneous rocks, most commonly the rock peridotite, from the earth's mantle. The mantle is a thick layer of rock just below the earth's crust. One theory for serpentine formation and occurrence currently in favor with many geoscientists is that peridotite underlying oceanic crustal rocks have been metamorphosed to serpentine in subduction zones that existed at various times in California's past. A subduction zone is an area where ocean crust rocks run into and slide underneath the edge of a continent. Because serpentine has a much lower density than peridotite, it rose toward the surface along major regional thrust faults associated with the subduction zones.

Serpentine is a colorful and distinctive metamorphic rock that has characteristic shiny surfaces in various shades of green. The sample shown here contains veinlets of chrysotile asbestos.
Nevada Geology Services
Gold Country Field Trip
Mileage Log

0.0 Danville Park and Ride
   Exit, turn right on Sycamore Valley
0.1 Immediately right, onto highway 680
14.7 Cross highway 4
18.3 Toll plaza over Benicia Strait
   Continue on 680—Wet lands off to the right (S) is Grizzley Island Wildlife area.
32.0 Exit right onto highway 80
63.0 UC Davis on the left. Continue on 80
73.0 Stay left, merge onto Highway 50 towards South Lake Tahoe.
76. Cameron Park
94.3 Hazel Road exit
117.9 Placerville City limit
119.1 First stop light
119.2 Second stop light
119.6 Third stop light (Bedford Avenue) – turn left onto Bedford Avenue
    Stay to left (Spring Street), following signs to Gold Bug Park.
119.7 Right turn onto Pleasant Street, following signs to Gold Bug Park.
120.5 Entrance to Gold Bug Park (also called Bedford Park).

Parking lot of Gold Bug Park. Go to little museum house, pay entry fee, and take self-guided walking tour of the Gold Bug mine. (See map for the geology).
Formerly the Hattie Mine, opened in 1888, the mine is a typical example hard-rock mine of the era, where gold-enriched quartz veins were the target. The 352 foot drift has wood flooring and lighting as well as internal displays. The mine was mostly worked in the 1920's and 1930's. It was finally closed (as were most mines) by the war orders of 1942.
0.0 Exit Gold Bug Park. Set odometer to 0.0 at the entrance. Turn left, and return towards Placerville.

0.8 Stop light at Bedford Avenue and Hwy 50. Carry on straight across (south), and in a few hundred feet cross Main Street and pull into the pizza parlor parking lot. Very briefly view the Melones Fault behind the pizzeria. Note the vertically dipping, highly foliated and sheared rocks exposed in the hillside. Composed mainly of tala schist, this zone of weakness was often used as the location of mine shafts, which followed the quartz veins (and gold) within the Melones Fault zone. At this point the fault zone is about 1000 feet wide. Return to vehicles, turn left out of the parking lot and continue west on Main Street.

1.1 Turn left onto Highway 49—the Prospectors Trail.

1.3 Right on 49

3.9 Diamond Spring city limits. Go right on 49 at the light.

5.1 Patterson Road. Good gas stop if needed.

5.7 Union Mine Road—stay on 49.

5.9 Entering El Dorado. Continue on Hwy 49

El Dorado Mining District. The main quartz vein system of the Mother Lode is located about a mile east of here. Ophir, Minihaha, and Pocahantas mine sites were located along the ridge off to the right. Nothing left except a few foundations.

6.1 Highway 49 goes left. Enjoy the drive and scenery for several miles. Note the geomorphology is generally reflective of the fault zone, which we parallel, and occasionally cross for the next two days.

Consumnes River crossing and El Dorado County line.

Eureka shaft headframe of Plymouth Consolidated Mines on the left.

15.7 Amador County line.

22.9 Juncture 16 and 49. Bear left, on 49.

23.9 Drytown, the curiously named location of (formerly) 26 saloons. Founded in 1848, this is the site of the first gold found in Amador County. Which was quickly converted into whiskey.
Fremont Mine site. Producer of about 250,000 of ounces of gold. One of over a dozen mines in the Jackson-Plymouth mining district. The mine shaft followed an inclined quartz vein 2950 feet deep on a 51 degree dip. In addition to the gold-bearing quartz veins, large amounts of mineralized country rock ("gray ore") were mined. The history of the Fremont mine is typical, with most gold production between 1900 and 1920. Further activity occurred in the 1920's and late 1930's. Little activity—other than by agents and lawyers—has occurred since that time. Nothing is left here but the old head frame at the mine entrance.

25.9
Left onto historic 49 into Amador City (big sign on left). No highway sign indicates this turn, so stay alert.

26.5
Amador City limits.

26.9
Central historic Amador City

27.0
On left is the old Keystone Mine. The adit is sealed, but the headframe foundation remains for our viewing pleasure.

27.1
Leave historic Amador City

27.9
Depending on our schedule, we could turn left at this point into the Sutter Gold Mine tour. This is an old underground mine (Lincoln Mine) that has been converted to a tourist site. There is a 1-hour underground walk (for about $20) where you can view the old works and geology. Fun for a family, but we will probably skip. It is similar, but more elaborate, than the Gold Bug Mine.

~28.2
Entering Sutter Creek.

~28.4
The green area to the left was the site of the Eureka Mine. The interesting headframe (aka "gallows" frame) was knocked down recently.

~30.0
Turn left onto "new" highway 49.

~30.6
Ridge Road. Continue straight on 49.

~31.5
Junction of Hwy 88 and 49. Continue on south towards Jackson on Hwy 49.

~32.0
Pull off to left at entrance to the Kennedy-Argonaut Mine. The Argonaut was the first discovered, in 1850. The Kennedy Mine was discovered in 1856. The mine shaft goes down 6000 feet, purportedly the deepest in the US. Both of these mines were closed by the war orders of 1942.
The regional geology, according to a Masters Thesis by John Zimmerman (U. Arizona):

"The Geology and Structural Evolution of a Portion of the Mother Lode Belt, Amador County, California". Zimmerman believes the Late Jurassic metavolcanic and metasedimentary island arc rocks of the Jackson area have undergone three deformational events. The first event generated major isoclinal folding and lower greenschist metamorphism, the second produced major strike-slip faulting (the gold zone), and the third resulted in minor reverse faults. The first two events occurred during the Nevadan orogeny. Major gold-quartz veins were generated by shear-zone metamorphism along the Melones fault trace, and the rise of hydrothermal fluids.

This is the Jackson-Plymouth mining district, which was the most productive district of the Mother Lode.

In 1848, Jackson was a village of huts, tents, and brothels called "Bottleas" by the Mexicans, for the many bottles strewn about by those who tarried here. In 1849 it was named Jackson, and the 1850 discovery of the Argonaut Mine propelled it into unconstrained and lively growth. In 1853 Amador County was carved out of Calaveras County, and Jackson became the county seat.

In about 1953, Edmund Brown (Jerry's dad) ran for governor on a ticket which included "cleaning up" Jackson, which was still a very lively place with the same old habits. He won—the music stopped and the fun ended.

We are scheduled to tour the workings (surface). The Kennedy Mine was an early user of the cyanide process to recover gold from the crushed ore. The mine is now owned by a non-profit group, and they supply this interesting view of our history.
Geology. The gold deposits are in a north- and northwest-trending mile-wide belt of gray to black slate of the Mariposa Formation (Upper Jurassic), with some interbedded coarse and occasionally sheared conglomerate and minor sandy and gritty layers (fig. 12). Massive greenstone of the Logtown Ridge Formation (Upper Jurassic) lies west of the belt of Mariposa Formation slate. Metasedimentary rocks, chiefly
EXPLANATION
(For figures 13, 14, and 15)

- Slate of Mariposa Formation
- Greenstone of Logtown Ridge Formation
- Gold-quartz vein

Figure 13 (top left). Section through Argonaut Mine. After Knopf, 1929.
Figure 14 (top right). Section through Kennedy Mine. After Knopf, 1929.
Figure 15 (bottom). Section through Keystone mine. After Logan, 1935.
0.0  Depart Kennedy Mine. Set odometer to 0.0 at the highway. Turn left (south) on highway 49. Pass through Jackson.

2.8  Southern limits of Jackson.

4.0  Old Butte general store ruins on the left.

5.3  Crossing Mokulumne River—the principal source of East Bay MUD water. This is the Calaveras County line.

7.7  Turn left onto historic route 49. This is a brief but interesting look at a dying gold rush town—Mokulumne Hill. The name is derived from a Plains Miwok village near the river of that name.

8.6  Right on “Main Street”.

8.8  Back at “new” route 49. Turn left, and continue south.

12.8-13  Fluvial deposits of the ancient (Tertiary) Mokelumne River are overlain by the tuffs and gravels of the Valley Springs and Mehrten Formations. The modern Mokelumne River cuts obliquely across the ancestral (Tertiary) Mokelumne River that contained substantial auriferous (gold bearing) gravels. The ancient river gravels were hydraulically mined at the Mokelumne Hill mine to the east. This mine is now a state park, and is worthy of a (separate) visit.

This scenario, of a modern west-directed river cutting across an ancient south-west directed river, and scavenging and redepotiting the auriferous gravels, is repeated throughout this area. Note the map, showing the ancient river traces. Such action was the foundation geology of the rich placers exploited by the early argonauts—the 49'ers. See map on next page.

10.1  Note the “coyote hole” prospect drift on the left.

10.2  Chili Gulch placer diggings. The richest placer mining in Calaveras County, extending five miles. Named for Chileans who worked this area in 1848-49, and the scene of the so-called Chilean War. The largest known quartz crystals (in the US) were recovered from a mine on the south side of the gulch. During WWI and WWII, optical grade quartz was recovered in Chili Gulch from crystal-bearing gravels (and from the mine)
Figure 5. Map of Tertiary Channels and Dredge Fields, Sierra Nevada. After Lindgren, 1911, and Jenkins, 1935.
Fluvial deposits of ancient Mokelumne River overlain by tuffs and gravels of the Valley Springs and Mehrten Formations.

Serpentine along Melones fault zone is exposed in the roadcuts.

Passing over the shaft of the Commodore mine, now concealed by the highway 49 bypass.

Keep left at the "Y" of routes 49 and 12, continuing on Highway 49 to the south.

Entering San Andreas.

Waste dumps of the Calaveras Cement mine can be seen in the distance to the right.

Crossing Calaveritas Creek. The Union Mine was off to the right. Nothing left.

Angels Camp northern city limits. Made famous by Mark Twain's story "The Celebrated Jumping Frog of Calaveras County". A pleasant and interesting little town.

Highway 49 at highway 4. Copperopolis copper mines could be seen by driving about 15 miles down highway 4 to the west. They have mostly disappeared, and the old town is of little interest.

Continue south on highway 49.

Angels Camp museum on the left. Fee. Mining relics and mineral displays. A large Pelton wheel and traction engine are displayed out front, along with a three-foot diameter core of serpentinite from the Idaho-Maryland mine, Nevada County. We won't stop to tour this town-owned museum, but it and the town are worth a visit sometime with the family.

The Utica mine site is on the right, and is now a city park. The depression is due to the mine's collapse, killing many. At the north end of the park is the Lightner mine site. Foundations and a little machinery from the 40-stamp mill remain among the brambles (mostly Himalayan Blackberries, an invasive and nasty species).

Park has restrooms if a stop is needed.

Highway 4 goes off to the left. Stay straight on route 49.

Angels Camp southern city limits. Note the quartz vein exposures on the right (west) about 0.2 miles from the city limits.
31.1 **Turn off** to right into Glory Hole Recreation area, our location for tonight's camp. There is a general store and Texaco petrol station at the turnoff, for those needing supplies. We are aiming for the Big Oak campground, so stay left at the Y. (To the right is Angels Creek and Buck Brush). Stop here to receive final directions from trip leader about exact details of campsite.

~35.4 Big Oak campground, entry to left. We probably will be in sites 113-127. You be told otherwise. Camp fees are $9 for seniors, $18 for others. 209-536-9543.
Day Two

0.0  Exit campground, return to route 49. Set odometer to 0.0 at junction  Proceed south on route 49.

Stop

1.8  Tiny community of Carson Hill. We will stop here alongside the highway to view the large quarry visible on the northeast slope of Carson Hill seen to the south (ahead). The open stopes exploited a pair of ore shoots of auriferous schist on either side of a prominently exposed white quartz vein. The vein itself actually contained very little gold. Carson Hill was one of the richest areas along the Mother Lode. Mines were intermittently active from 1850 to 1942, at which time most mines were closed by the war orders. A 195 troy pound mass of 0.900 fine gold, the largest single piece ever found in California, was taken from here (Morgan Hill Mine). Telluride minerals were common in the ore, and calaverite (AuTe2) and melonite (NiTe2) were first found and described from this district. The gold was originally found in the creek just below town in 1840. The mine was closed in 1987 as no longer economic.

There is a crude break in the type of Mother Lode mineralization in this general region. Productive quartz veins are generally characteristic of the Mother Lode to the north, whereas here and to the south there is a prevalence of ore bodies of mineralized country rock, immense persistent barren quartz veins, and enormous bodies of mariposite-bearing carbonate rock.

The interesting story of the Carson Hill Mine involves attempts to reopen for production about 20 years ago. The County and State, being generally anti-business, and very politically correct, placed insuperable obstacles. The owner quickly realized what was happening, and withdrew the application. The politicians went away to pester someone else. Then, a couple years later, the owner made a new application—for a decorative rock quarry. That proposal quickly passed all the necessary commissions, and the mine opened. It still is a decorative rock quarry—with ancillary production of gold.

~3.3  Massive quartz vein exposures to the right and left.
Calaveras County line on Stevenot Bridge, crossing the Stanislaus River. This the New Melones Reservoir, which overlies the Melones Fault. And quite probably nicely lubricates the fault trace.

Tuttletown Recreation Area to the right. Nice camping. Mark Twain cabin off to left.

Tuttletown.

Highway 49 turns east (left). Stay on 49.

On left is limestone of the Calaveras Formation with exhumed karst topography. Here, within a radius of about a mile, $55 million in gold was recovered and shipped between 1853 and 1870, making this one of the richest areas of placer ground in the world. Most of the gold was taken from gravels excavated by hand from potholes and crevices in the irregularly eroded limestone. The gold was coarse and nuggets weighing a pound were common. One nugget weighing 72 troy pounds was found in 1854. The deposits, while rich, were shallow and were soon worked out.

Route 49 at Shaw's Flat Road. Turn right on Shaws Flat Road.

Bear right onto Jamestown Road.

Enter Jamestown. Junction of Jamestown Road and routes 49/120. Set odometer to 0.0 Valero petrol station on the right. You should fill your gasoline tank somewhere around here if you have less than \( \frac{1}{2} \) tank. Reset odometer to 0.0. Jamestown, for a period of time, was known as American Camp.
Jamestown Road at route 49/108. Proceed directly across the highway, onto Main Street of old Jamestown. We're just driving through this interesting old town.

Re-enter route 49. Proceed to left (westerly).

C & C mini-mart station on the right. Off in the distance to the right you can see the large open pit of the Harvard Mine, now closed. Map on the next page.

Along here, off to the right, you can also see the flat-topped Table Mountain (one of several by that name in California) which is the remains of a Tertiary volcanic flow down a sinuous Tertiary river channel. The flow sealed off the auriferous gravels of the ancient river. The resistance to erosion has caused the relief inversion (inverted topography). In this particular case the latite of Table Mountain flowed down the Miocene channel of the Stanislaus River which was carved in bedrock, prevolcanic gravels, and Tertiary pyroclastic rocks.

Here and elsewhere in the western Sierra Nevada, rich placers have been found in auriferous gravels buried under late Tertiary volcanic rocks. These are the so-called "Rivers of Gold". The use of drift mines which pass under the base of the volcanic flows were the usual means of accessing these rich gravels.

Split of routes 49 and 108. Go left on route 49.

Route 49 intersects route 120. Bear left, and proceed south down 49/120.

Town of Chinese Camp. All gulches show evidence of placer mining. Hill on south and east side of road is capped by Tertiary gravels.

The town was settled by Englishmen in 1849 as a settlement for their Chinese employees working the local mines. This was the headquarters for stage lines in the early 1850's, and for several California Chinese mining companies. The first Chinese Tong War in the state was fought here between Sam Yap and Yan Woo Tongs. The present stone and brick post office was built in 1854.

Hummocky ground to the right is evidence of old placer diggings.

Vista Point (no stop). The body of water is the Don Pedro Reservoir, created by damming of the Tuolumne River in 1971 for domestic and irrigation water. "Don Pedro" was Pierre Sainsevain who was a pioneer in the area in 1839 and later a member of the California Constitutional Convention.

Owned by the City and County of San Francisco Hetch Hetchy water system. The reservoir inundated the old town of Jacksonville, which had been settled in 1849. Also inundated was the Eagle-Shawmut mine.

Jacksonville was a principal river and supply town, and a gathering center for 1000's of miners in the area working the rich placers of the Tuolumne River.
10.7 Crossing the Tuolumne River bridge.

12.6 Vista Point—**pull off to the left.** Enter.
At this point you can view the reservoir, with well-exposed geology due to the low water level. To the east is the Stent Bridge. At the north end of the bridge is an exposure of limestone, which is part of a large allochthonous limestone block in phyllite. The highly deformed rocks have been interpreted as part of a melange sequence occurring sporadically along the Melones fault zone. Elsewhere, similar limestone blocks have yielded poorly preserved Permian fossils.

At the south end of the Vista area, note the slate/shales of the Mariposa Formation. We are right on the trace of the Melones Fault (hold on).

14.6 Quick view to left, note the tailings along the edge of the creek.

15.1 Split of 120/49. Turn right (south) and continue on highway 49.

Power plant and community of Moccasin on the left. Hetch Hetchy aqueduct and power plant, completed in 1925, and the State fish hatchery are the employers. Very much a "company town". In 1990, rent was about $25/month for a house and utilities, and only project workers can live there.

As is fairly well known, the Hetch Hetchy project began in 1915 with the building of the Hetch Hetchy dam on the Tuolumne River north of Yosemite Park. The reservoir flooded Hetch Hetchy Valley, much to the despair of John Muir. The project took 20 years and $100 million to build seven dams, three powerhouses, and miles of tunnels and power lines. The Sierra Club would like to see it destroyed. The San Francisco population might not be so keen on that.

16.5 Moccasin Creek on the left, a heavily worked placer accumulation.
Tailings go for miles. Moccasin Creek was so named because miners, probably from Georgia, mistook water snakes for water moccasins found in swamps in the South.

16.8 Brief stop to view the tailings, attesting to the prodigious amount of hand labor that was expended in recovering gold from river gravels. Gold is separated from its gangue of quartz by mechanical tumbling in the river bed. Because of gold’s high density (19.3), and the density of 2.6 of the sands and gravels, gravity segregation is a straightforward means of separation, both naturally and by modern miners.

A description by J. D. Borthwick in 1851:

"Along the whole length of the creek, as far as one could see, on the banks of the creek, in the ravines,...were parties of miners, numbering from three or four to a dozen, all hard at work, some laying into it with picks, some shoveling the dirt into the long toms, or with long-handled shovels washing the dirt thrown in and throwing out the stones,
while others were working pumps or baling water out of the holes with buckets. There was a continuous noise and clatter, as mud, dirt, stones, and water were thrown about in all directions; and the men, dressed in ragged clothes and big boots, wielding picks and shovels, and rolling big rocks about, were all workings as if for their lives, going into it with a will, and a degree of energy, not usually seen among laboring men. It was altogether a scene which conveyed the idea of hard work in the fullest sense of the words, and in comparison with which which a gang of railway navvies would have seemed to be merely a party of gentlemen amateurs playing at working pour passer le temps.” Whew!!

17.1 Crossing Moccasin Creek. Note vast tailings to the right.

The route from here on south is directly along the Melones Fault zone. Much serpentinite (“greenstone”), serpentinized ultramafics, and ultramafics of the Coast Range Ophiolite and Franciscan complex. Jurassic metavolcanics and diorite rocks tend to be above the road cuts, and Penon Blanco volcanics below the road cuts. Jurassic Mariposa Formation marine shales and slates are the dominant buff-colored sediments. Extensive quartz veins are prominent.

18.5 Big Jackass Creek. Locus of several recreational mining claims, and still regularly worked for modest gold amounts. Hills on both sides of this fault-defined valley contain quartz veins, which are considered a continuing supply of gold for the creek bottoms.

The drive from here along 49 has many twisting turns, no guard rails, and some stunning vistas. Don't distract the drivers! The fall-away into the valley is steep and long.

20.3 STOP Pull off to the left into the access road.
Old Gharabaldi Mine workings, now a mariposite quarry (abandoned). We will stop briefly for collectors. Previously known as the Haigh Mariposite Quarry.

**Mariposite**-bearing carbonate rock is now quarried for garden stone due to its attractive mottled green and white coloration. Mariposite from this quarry has been dated at 116 my by K-Ar and 115 my by Rb-Sr. Introduction of gold was nearly contemporaneous with the development of mariposite.

Mariposite was almost the State Rock—but widespread serpentine won out. However mariposite is harder, more weather-resistant, and often gold-bearing. In some ways it may have been a more appropriate representative of the Golden State.

Occasionally mariposite rock contains networks of gold and iron sulphide bearing quartz veinlets and stringers. Mariposite rock consists of the mineral mariposite (a bright apple-green chromium rich mica) with a white groundmass of fine-grained glassy quartz.
The genesis of mariposite is hydrothermally altered serpentine. It is classified as a variety of muscovite (basic potassium aluminum chromium silicate). It has a hardness of 2.5-3; a vitreous luster; specific gravity of 2.78-2.81.

21.5 Mariposa County line. 18000 address gate on left.

21.7 Blacks Creek Road, on right.

22.8 Penon Blanco (White Cliffs) Road on right. Haigh Road on left. Stay on 49. The old Penon Blanco Mine was high on the hill to the right, but is not readily visible. This was one of the longest claims on record (5850 feet), its title having been recorded before length limitations on mining claims became US law.

24.6 CDF fire station on left.

25.6 Coulterville, and junction routes 49 and 132.

Early 1850 store established by George Coulter, to supply miners working the rich placers of Maxwell, Boneyard, and Black Creeks. Originally called Banderita, from the flag flying over Coulter’s store.

Site of the first stamp mill, built by Andrew Goss.

Coulter built the hotel around 1857. Water came from a well, pumped by two Newfoundland dogs walking in endless circles. The hotel is still open during weekends; the dogs are gone.

Whistling Billy, the small steam locomotive beside the road, was used to haul ore a distance of about 4 miles from the Mary Harrison mine to the 40-stamp Potosi mill at the turn of the century. This is a short wheelbase wood burning locomotive built in Pittsburgh, Pennsylvania, and delivered to the Merced Mining Company in 1897. The engine was abandoned in 1904, and left to rust. It was resurrected in the 1930's, and placed here as a landmark by public spirits.
Junction 49 and 132. **Set odometer to 0.0.** Proceed south on route 49.

1.3 Mary Harrison Mine, off to the right. Nothing much to see. Discovered sometime before 1867, in 1895 it passed into the ownership of the Merced Gold Mining Co. The mine was worked to a depth of 1200 feet by shaft and winze. Most of the workings were in the dolomite-ankerite-mariposite-quartz rock which forms a very broad zone along this part of the Mother Lode. Beautifully banded rocks composed of minerals associated with gold ores—mariposite (chrome mica), white quartz, and carbonate materials such as dolomite, ankerite, and calcite can be found north of the Mary Harrison. Worth a repeat visit by collectors.

3.0 **Pull off** to the right, into the (abandoned) Virginia Mine site. Walk a short distance up the road to the right (south). Note on the left the two open adits. Don't fall in. It is fairly clear the miners were chasing along the tilted large quartz vein, seeking pay. This is typical small-mining technique. There are several other open adits in the area. Let us not tarry here—you've now seen it all.

4.7 Good serpentinite plug to right.

5.4 Schilling Road on left. Dramatic vistas to the right.

9.2 Look to the left, up the hillside beside the road. Note the abandoned mine.

9.9 Merced River Bridge. Yosemite Park upriver.

10.0 Bagby Recreation Area to the left. The old town of Bagby was inundated.

10.5 Proceeding up the 49 grade. Hell Hollow is off to the right. Hell Hollow is the type locality of the Mariposa Slate. Named for the numerous accidents along the rough trail of the early days.

12.1 Switchback, with an interesting cavern to the right.

12.6 Old mine entrance road on left and right.

13.0 Switchback. Pine Tree Mine is off to the left. Nothing remains.

13.6 Fremont Fort site. John Fremont, the well-known explorer, was the owner of the Josephine, Pine Tree, and Princeton Mines. While Fremont was away bothering the Indians, his claims and mines were jumped. When he returned he impatiently kicked ass and ran them off. He then built his “fort”, which was to protect the “only access” to the mines.
Figure 1. Location map of Bagby district.

Figure 2. Location of mines of the Bagby district, based on Bowen and Gray (1957) and Clark (1970).
deposits of pyritic metarhyolite in the Mariposa Formation that in places contain gold. These bodies are several miles long and 60 or more feet thick.

**Miners.** Greens Gulch $119,000+; King Midas, Louis, Mr. Ophir $250,000 to $300,000, Mountain View I, Nellie Kahoe, Ortega, Princeton $5 million, Sorrel.

**Bibliography.**

![Figure 18. Geologic Map of Bagby, Mariposa, Mount Bullion and Whitlock Districts, Mariposa County. By O. E. Bowen and J. R. Evans, 1966.](image-url)
STOP
Josephine Mine. Pull off to the right into the road-side area. We will cross the highway, proceed up dirt road, and around the red gate on the left. Walk for about ½ mile, noting the abandoned adit to the right, and viewing the geology and many quartz veins. At the ½ mile point, which is a good viewing area, reverse and return to the vehicles. If you proceed to the head of the ravine you will come to the uninteresting remains of the Josephine mine.

Mariposite, a chromium muscovite that occurs in carbonate rock associated with many gold deposits of the southern Mother Lode, was first described from the the Josephine mine by Silliman in 1868.

At the viewing point (turnaround) a few of the peaks of the high Sierra over 11,000 feet can sometimes be seen rising above the forest covered ridges along the skyline to the northeast. On a clear day the tops of El Capitan, Half Dome, and Clouds Rest of Yosemite can be seen at the head of Merced Canyon. A broad relatively flat area north and east across the Merced Canyon represents an ancient land surface on which Tertiary auriferous gravels were locally deposited. This is the principal source of gold found in the Merced River today.

14.9 Bear Valley limits (N). Bagby mining district.
15.3 Bear Valley limits (S)
19.3 Mt. Ophir Road on right.
21.1 Old Toll Road and Mt. Bullion village on right. Most of the mines of this district are located on Mt. Bullion which is soon visible off to the right.
21.8 Mariposa airport on left.
24.8 Mariposa city limit.
"Place of the mariposas (butterflys), because of their great multitudes, especially at night and morning" (Description from diary entry of Padre Munoz, who accompanied Gabriel Moraga on his expedition through the San Joaquin Valley in 1806).

Mines in this area make up the Mariposa mining district, the southernmost mining district of the Mother Lode gold belt. Mariposa is the county seat.

25.8 Route 49 at route 140. Turn right, towards town.
26.0 History Center on the right. If the hour is after 12:30, we will pull in here and park, then wander around and find a spot to eat lunch. There are many commercial establishments around. After lunch, return to the parking area (restrooms at the end) and view the old stamp mill. Return to vehicles, exit the History Center, and turn right on route 49. If the hour is before 12:30, continue on south. We will return later for lunch.

26.6 Highway splits. Bear left on route 49.

28.3 Turn left into the Fairgrounds. On the left, through the fence, is the California State Mining and Mineral Museum. Small entry fee. We are supposed to be met by a knowledgeable guide. We will be given a tour, and then time to examine the various exhibits. A permanent part of the museum is California’s largest existing Gold Rush specimen of crystallized gold, the **Fricot Nugget**, weighing nearly 13 pounds. Also specimens of benitoite, the California State Gem.

30.7 Return to vehicles and exit the fairgrounds, turning right on hwy 49 to return to Mariposa. We are going to the History Center and Stamp Mill. Various lunch opportunities in walking distance. I can recommend Happy Burger just across the highway.

If we have already had lunch, we will turn left at the 49/140 junction. If this is the case, the mileage numbers below will have to be reduced by 0.6 mi.
Leaving the History Center, turn right onto highway 140. Set odometer to 0.0

0.9 The Mariposa mine and mill were off to the left. Reportedly discovered in 1849 by Kit Carson and two associates, it was more probably found by Mexicans digging placer deposits nearby in 1848. This is the first lode mine recorded in California. The vein is composed of milky quartz up to 4 feet wide with ribbons of quartz on its outer edges. Pay is gold, pyrite, and arsenopyrite. In 1849 John Fremont wrested title to the mine from its original owners when he was given title to the Las Mariposas grant of 44,000 acres. Mines of the Las Mariposas grant also included the Pine Tree, Josephine, Princeton, and many minor workings such as the Penon Blanco. The Mariposa Mine had its heyday between 1900 and 1915. Works reached a depth of about 1550 feet along a 60 degree incline. The quartz veins lie in meta-augite andesite of the Penon Blanco Volcanics, locally called greenstone.

1.0 Leaving Mariposa city limits.

1.3 Note the serpentinite marking the trace of the Melones Fault.

5.3 Note the hydrothermally altered Mariposa Slate (right).

5.5 Exceptionally well exposed Mariposa Slate on the right. Isoclinal folds, smaller drag folds, and graded bedding in graywacke can be seen along the road cut. The foliation trends northwest, parallel to bedding in the east-facing limbs. Joints, some with quartz filling, trend northeast, truncating the foliation. We will be stopping just ahead at a rock shop, and you can walk back to the east and view these exposures at leisure. Watch the ground. I picked up a small nugget while scouting for this field trip!

5.6 Dial's Rock Shop. An interesting, and quite old, accumulation of mining stuff, gold, various collectibles, and an opportunity to pan for gold. For a few dollars the proprietor will sell you a bag of gravel which is pretty certain to contain some gold. (A very small amount of gold!)

For the next six miles or so, the bedrock is mainly black slate which probably represents the southern continuation of the Upper Jurassic Merced Falls Slate.

14.8 Contact aureole of Guadalupe Intrusive complex with metasedimentary rocks of the upper Jurassic Mariposa Formation. The western portion of the complex is gabbroic. The complex has been dated at 140my, setting a lower age limit on the Nevadan orogeny.

Mariposa County line.

Western edge of the Sierra Nevada foothills. The lower foothill region is underlain
in large part by volcanic-derived alluvial sediments of the Miocene Valley Springs and Mehrten Formations.

Junction of Highway 140 and 99. Proceed to Danville. (Hwy 99 to hwy 120 to hwy 5 to hwy 205 to hwy 580. Distance approximately 120 miles.

Thanks. Hope you enjoyed the trip.

Ross Smith,
Nevada Geology Services.

Sources:
California Geology, August 1991.
USGS Open file report 84-169.
Master's thesis, John Zimmerman (U. of Arizona)
AAPG field trip Yosemite and the Mother Lode, 1990
Gold Districts of California, Bulletin 193, CA Division of Mines and Geology
The High Price of Gold Prospecting

This list is copied from a *Leavenworth* (Kansas) *Ledger* article about January of 1859. It states that "The following is a complete outfit necessary for a company of four men for the gold diggings; also a supply of provisions ample for six months, with cost of same in Leavenworth City market."

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 yoke oxen</td>
<td>$150.00</td>
</tr>
<tr>
<td>1 wagon and cover</td>
<td>85.00</td>
</tr>
<tr>
<td>Yokes, chains, etc.</td>
<td>9.00</td>
</tr>
<tr>
<td>1 tent</td>
<td>15.00</td>
</tr>
<tr>
<td>10 pair blankets</td>
<td>40.00</td>
</tr>
<tr>
<td>4 steel picks</td>
<td>6.00</td>
</tr>
<tr>
<td>4 axes</td>
<td>5.00</td>
</tr>
<tr>
<td>4 gold pans</td>
<td>2.00</td>
</tr>
<tr>
<td>3 augers</td>
<td>1.00</td>
</tr>
<tr>
<td>1 inch chisel</td>
<td>.35</td>
</tr>
<tr>
<td>1 handsaw</td>
<td>1.25</td>
</tr>
<tr>
<td>1 drawing knife</td>
<td>.60</td>
</tr>
<tr>
<td>1 12 inch file</td>
<td>.40</td>
</tr>
<tr>
<td>6 pounds wrought nails</td>
<td>.75</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$320.35</strong></td>
</tr>
</tbody>
</table>

Provisions:

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>1,000 pounds of flour</td>
<td>$30.00</td>
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<tr>
<td>400 pounds bacon</td>
<td>40.00</td>
</tr>
<tr>
<td>100 pounds dried beef</td>
<td>12.50</td>
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<tr>
<td>50 pounds salt</td>
<td>.75</td>
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<tr>
<td>8 pounds tea</td>
<td>5.20</td>
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<tr>
<td>50 pounds coffee</td>
<td>7.70</td>
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<tr>
<td>200 pounds sugar</td>
<td>18.00</td>
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<tr>
<td>30 pounds rice</td>
<td>.240</td>
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<tr>
<td>150 pounds of beans</td>
<td>.525</td>
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<tr>
<td>40 pounds dried fruit</td>
<td>4.00</td>
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<tr>
<td>10 pounds pepper</td>
<td>1.20</td>
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<tr>
<td>3 pounds soda</td>
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<tr>
<td>6 pounds cream of tartar</td>
<td>3.00</td>
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<tr>
<td>25 pounds soap</td>
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<tr>
<td>25 pounds gunpowder</td>
<td>9.00</td>
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<tr>
<td>50 pounds lead</td>
<td>5.00</td>
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<tr>
<td>1,000 gun caps</td>
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<tr>
<td>2 gallons pickles</td>
<td>4.00</td>
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<tr>
<td>4 gallons vinegar</td>
<td>1.00</td>
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<tr>
<td>2 gallons brandy</td>
<td>6.00</td>
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<tr>
<td>2 dozen boxes matches</td>
<td>1.00</td>
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<tr>
<td>1 coffee mill</td>
<td>.50</td>
</tr>
<tr>
<td>1 frying pan</td>
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<tr>
<td>3 camp kettles</td>
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<td>6 tin plates</td>
<td>.50</td>
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<tr>
<td>6 tin cups</td>
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<td>1 butcher knife</td>
<td>.25</td>
</tr>
<tr>
<td>1 set spoons</td>
<td>.25</td>
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</table>

**Total** ........................................... **$166.30**

Plus equipment .................................. 320.35

*Total cost ....................................... **$486.65**

*Based on an average 2% inflation rate, the same supplies would cost $6,513.87 in 1992 dollars.
NCGS FIELD TRIP
Gold Country Field Trip
Saturday June 13 & 14, 2009
Leader: Ross Smith, Precious Metals Consulting Geologist

This will be an easy two-day ramble (mostly driving) along Highway 49 through the historic Gold Country of California from Placerville to Mariposa. The spring is a beautiful time to see this magnificent countryside of our Golden State, replete with green hills, running streams, wildflowers, and superb rock exposures.

Because of the strange social policies of this State, there are no remaining working gold mines. However, there are certain sites where we can view the internal workings of a real gold mine, and these are well documented and generally adequately guided. Some have a modest fee. On day one we will do an underground tour of the Gold Bug mine in Placerville, and a surface tour of the Kennedy Mine in Jackson. As we proceed along Highway 49 we will view the great Melones Fault, also known as the Mother Lode, at a number of locations. We will see numerous gold sites, towns, and historical residues. Just south of Angels Camp we will pull into the Glory Hole Recreation area where we will camp. There is small fee of $18 ($9 for seniors) for use of this California State Recreation Area. Hot showers, fire pits, etc. Quite a pleasant place. The NCGS will put on a barbeque dinner. Bring your own breakfast.

On day two we will start early. We will view the Carson Hill gold mine (now an operating rock quarry—a good story here!); the New Melones reservoir (fault-defined), the Columbia limestone placer deposits near Sonora; the Table Mountain (with numerous drift mines—now abandoned) and (from a distance) the open-pit Harvard Mine near Jamestown; the Moccasin Creek placer tailings (miles of them); an abandoned Mariposite quarry (good collecting point for this California mineral); and the abandoned Virginia Mine (careful-open shafts) near Coulterville. We will continue along Highway 49, looking at various exposures and abandoned mine remains. Time permitting we will walk about ½ a mile along an old haul road to view the remains of the Josephine Mine. Around mid-day we arrive at the California State Mineralogy Museum near Mariposa. After lunch in town, we may visit the old Stamp Mill in town. We then go west on Highway 140 to the Dial Rock Shop. Gold panning for those interested, lots of rocks to buy and view, and good exposures along the highway. Then return to Danville (2 hours).

For those who cannot do the two days, or do not wish to camp, they could return to Danville directly from Angels Camp at the end of the first day. For those who hate camping, there are several pleasant motels in Angels Camp—only about 4 miles from our campsite. Our guide is an active commercial gold prospector, a member of the NCGS, and a peripatetic wanderer. He holds a BS in Engineering, with a minor in Geology, and a MS in Geophysics. He spent 30 years in international oil exploration, and for the last 10 years has been a consulting and practicing geologist in precious metals. He will give brief explanations on gold origin, occurrence, and recovery from his modest store of knowledge.

**********************************************************************************Field Trip Logistics**************************************************************************

THIS FIELD TRIP WILL BE LIMITED TO 30 PEOPLE.

Cost: $50/person
Time & Departure: Depart precisely at 8:00 am from Danville Park and Ride (Sycamore Valley Road at I-680) June 13, 2009. Alternatively, or if late, meet us at the Gold Bug Park (aka Bedford Park) in Placerville at 10:30. Call me on my cell phone at 707-548-3268 if you have any problems.

**********************************************************************************REGISTRATION FORM (Gold Country Field Trip)**********************************************************************************

Name: ___________________________ Phone (day): ___________ Phone (evening): ___________
E-mail: _____________________________
Address: ___________________________ (Please check one) Check Amount: ___________

Lunch and Dinner: Regular: ______ Vegetarian: ______

Please mail a check made out to NCGS to: Rob Nelson, 269 College View Drive, Rohnert Park, CA 94928
Carpooling is suggested for this fieldtrip. Please let us know if you can provide a van and NCGS can reimburse your gasoline expenses. Questions: e-mail: ringleo@sbeglobal.net Phone: (707) 795-8090 (evening) (707) 548-3268 (day).