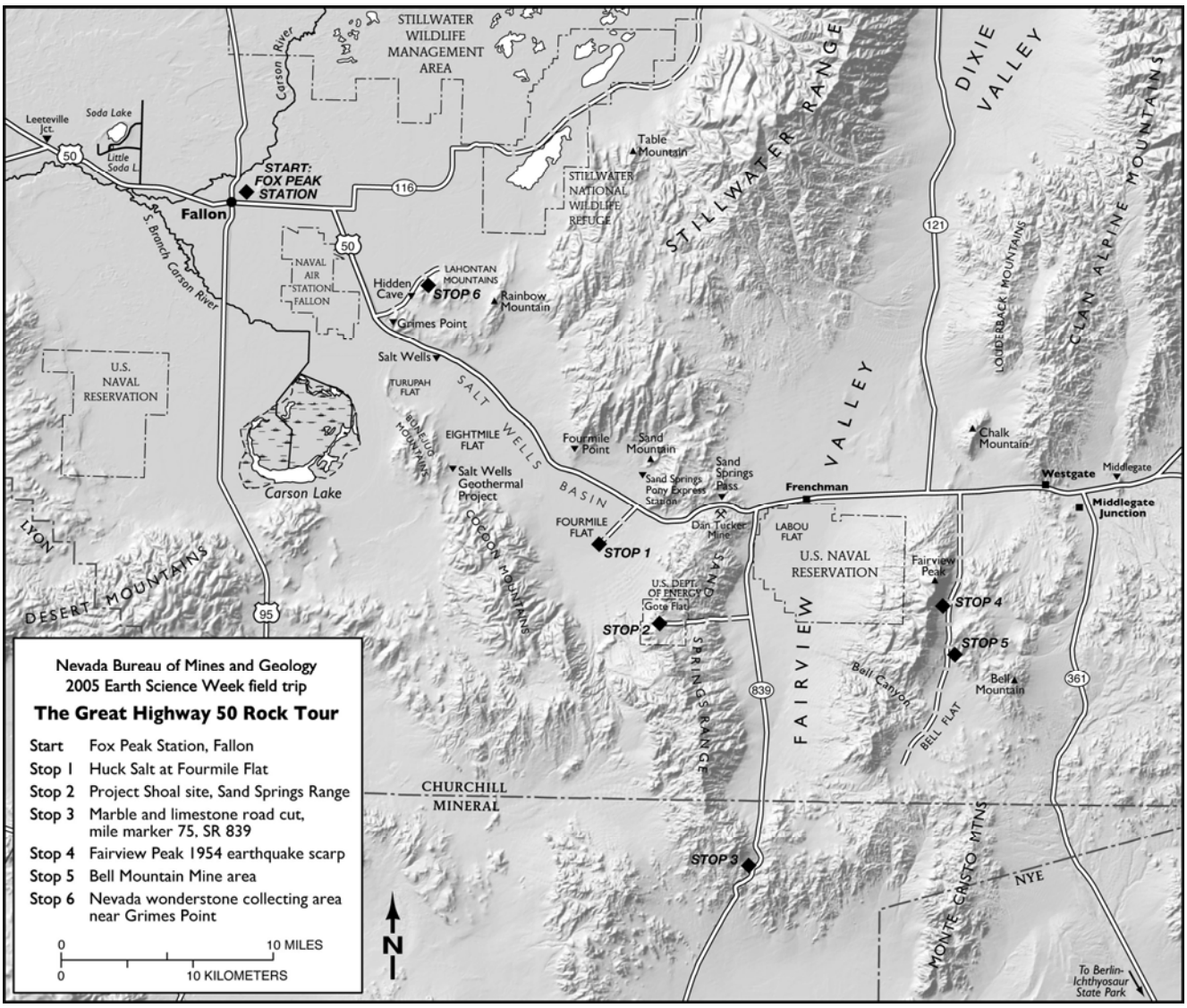
2005 Earth Science Week Field Trip
October 22 or 23, 2005

THE GREAT HIGHWAY 50 ROCK TOUR

by D.D. LaPointe, David Davis, Jon Price, and Beth Price

This year's Earth Science Week public field trip will start in Fallon and travel east as far as the Fairview Peak 1954 Earthquake scarps with side trips to sites of geologic interest along the way. In keeping with the 2005 National Earth Science Week theme "Geoscientists Explore our Earth," we will discuss careers in the geosciences such as exploring for mineral resources, investigating Earth hazards to property and people, and monitoring of environmental change on Earth. We will have the opportunity to collect samples of a variety of minerals and rocks along the way, including halite, granite, marble, limestone, calcite, and Nevada Wonderstone. This approximately 150-mile round trip will take us to sites located 15 to 45 miles east of Fallon. All stops are adjacent to paved or gravel roads accessible by high-clearance vehicles, but some roads may be rocky or rutted. Please keep small children under control as there are steep and dangerous slopes at some sites. Field trip participants should **meet at 8:30 A.M. at the Fox Peak gas station and convenience market parking lot located on the north side of U.S. Highway 50 about a half mile east of Maine Street in downtown Fallon. We will depart from there at 9:00 A.M.**

Geoscientists will accompany us on the trip to answer geological questions about any of the sites we will visit today.



Road Log

Odometer
mileage
cumulative

0.0 Leave the Fox Peak station parking lot. Turn left (east) on U.S. Highway 50.

Rattlesnake Hill is visible to the north. It is a remnant of Quaternary (less than 1.8 million years old) volcano rising above the surrounding lakebed sediments. It is similar in age and composition to the basalt aquifer that lies about 500 feet below the valley floor and is the principal source of drinking water for the Fallon area. We are traveling on the flat lake bottom near the lowest, deepest part of ancient pluvial Lake Lahontan which is estimated to have been about 450 feet deep at this point. The lake reached its last high stand about 12,000 years ago and had largely evaporated by about 10,000 years ago.

4.3 Road to Stillwater on left, Huck Salt sales yard is on the left at the curve in the road.

5.2 Strandlines (wave-cut beaches) of Lake Lahontan are visible at 10–11 o'clock on the hills to the left.

9.7 Grimes Point turnoff to the left will be our last stop of the day this afternoon.

13.8 Salt Wells.

The Bunejug Mountains are to the right (south). About 4 to 5 miles due south of here, near the foot of the Bunejug Mountains, is the relatively new Salt Wells geothermal project. AMP Resources has drilled several new geothermal production wells which will each produce about 5 megawatts of geothermal power once their binary power plant is built. Completion of the first phase of the energy production facility is slated for the end of 2005 with additional capacity planned for 2006. Nevada currently has 12 operating geothermal power plants with a combined capacity of producing 244 megawatts of electricity. This amounts to about 3% of all of Nevada's combined power plant capacity of 8,392 megawatts. A 2001 state law requires that by 2005, 5% of the electricity sold in Nevada must come from renewable sources including geothermal.

Nevada is second only to California in the production of energy from geothermal resources, with more of this clean, renewable power source in the planning stages at several other geothermal areas across Nevada. A wide variety of specialists—exploration geologists, geophysicists, geochemists, hydrogeologists, engineering geologists, and engineers—are employed in the exploration for and development of new geothermal resources.

21.7 TURN RIGHT ON HUCK SALT ROAD. This is a one-lane road with no turn-outs. Please drive carefully and do not drift onto the very soft shoulders of the road.

24.5 STOP AT HUCK SALT OPERATIONS. Park as tightly as possible near the salt stockpiles. John Huckaby will tell us about the history of Huck Salt Company's operations and allow us the opportunity to collect a few salt crystals from a stockpile of the naturally occurring halite he harvests annually from the playa. The salt deposit on Four Mile Flat is a miner's dream—a deposit that renews itself annually and is never mined out. A thin crust of salt crystals (halite, NaCl) forms in the center of the playa as salt-laden groundwater moves to the surface and evaporates. The 99+% pure salt layer is scraped off, kiln-dried, stockpiled, loaded, and shipped to consumers mostly for use as a road de-icing chemical and as a livestock feed additive. Each wet winter season causes more water to move to the surface and evaporate during the warmer months forming a new salt crust layer that can be mined. Between 1863 and 1871, salt from this location was shipped to the Comstock (by camel train for a while) for use in milling the silver ore. Since 1939, three generations of the Huckaby family have operated this salt "mine," harvesting the annual

Huck Salt operations from the salt playa looking north.

"crop" of salt. Huck Salt Company has been producing between 9,000 to 16,000 tons of salt annually in recent years.

Look for characteristic four-sided pyramid-shaped crystals of salt, or "hopper"-shaped crystals that look like a skeletal four-sided hollow basket. More rapid growth at the edges of each crystal face than at the center gives these crystals their characteristic shape. "Hoppering" occurs in other minerals besides salt, such as galena, rose quartz, gold, calcite, and ice. **You may collect a few of the unusual "hopper"-shaped and pyramidal crystals of halite at base of stockpiles, but PLEASE DO NOT CLIMB ON THE SALT PILES AS THESE ARE THE HUCKABY'S FINISHED MARKET PRODUCT.**

Hopper-shaped or pyramid-shaped salt crystals at Huck Salt.

RETRACE ROUTE BACK TO THE PAVED ROAD.

27.3 TURN RIGHT ON U.S. HIGHWAY 50, HEADED EAST.

Sand Mountain is the large sand dune to the north. The hills behind Sand Mountain are composed of basaltic lava flows that dip gently to the north. Etched into the basaltic hills are horizontal wave-cut terraces indicating the former beach lines of Lake Lahontan.

31.2 Pass the turn off road to Sand Mountain. Sand Mountain formed at this spot through a combination of wind and topography. The prevailing wind is from the southwest, and a V-shaped elbow in the south end of the Stillwater Range has acted as a barrier and a trap for wind-blown sand. Wind picks up fine particles from the dry lake bed area to the south and carries them northeast. As the sediment-laden wind begins the climb over the volcanic hills of the Stillwater Range to the northeast, the wind velocity decreases and some of the coarser fraction of the airborne material drops out and is deposited here in the cleft formed by two intersecting ridges of the Stillwater Range. Over thousands of years, this depositional process has amassed the starkly beautiful mountain of sand you see today. Microscopic inspection of the sand grains forming this dune reveals that some of the material has traveled almost 40 miles from its source area on the Walker River delta, where the Walker River discharged into ancient Lake Lahontan more than 20,000 years ago. Persistent southwest winds have continued to shape the dune for thousands of years.

In addition to its scenic and geologic interest, Sand Mountain has another unusual feature; it is one of only a handful of "singing" or "booming" sand dunes known worldwide. When disturbed, the dune sands cascade down its slopes emitting acoustical energy that generates sound that has been variously described as roaring or booming like a kettle drum, foghorn, or low-flying aircraft. It has also been described as a musical singing or vibrating sound like a bass violin or a tuning fork. This phenomenon is best experienced on a day when the dune is free of off-road vehicles.

31.5 We are now climbing up to Sand Springs Pass over the Sand Springs Range, which is a north-south-trending range about 20 miles long and 3 to 5 miles wide, one of many ranges that make up the Basin and Range Physiographic Province. At the top of the pass we cross through the Sand Springs Mining District, a gold and silver mining area with prospects that date from the early 1900s. The shaft hoist visible on the right is that of the Dan Tucker (Summit King) Mine. The deposits in this area formed in a zone of closely spaced parallel quartz veins near the contact zone between a granite intrusion and sedimentary rocks of Mesozoic age (248 to 65 million years ago). The platy black shales in the road cuts on the north side of the road are some of these sedimentary rocks. Rich gold-silver vein deposits were first discovered on the Dan Tucker property in 1905 and have been mined intermittently to the present time producing more than 20,000 ounces of gold and over a million ounces of silver between 1923 and 1952. Three small tungsten mines near the Dan Tucker Mine also produced about 15,000 pounds of tungsten between 1941and 1956, mining scheelite

(tungsten ore) from several skarn deposits that formed along the contact zone between impure limestone and a granitic intrusive body.

37.2 TURN RIGHT ON ROAD TO RAWHIDE, STATE ROUTE 839.

For the next few miles, watch in the Sand Springs Range to the right for rounded knobby outcrops—a weathering pattern that often indicates granite bedrock.

42.2 TURN RIGHT ON A VERY STRAIGHT UNPAVED ROAD.

As we continue up this canyon, you will notice the classic rounded or spheroidal weathering pattern typical of granitic rocks. Look for other patterns indicating different rock types.

45.2 AT FORK IN THE ROAD, FOLLOW THE MAIN ROAD TO THE RIGHT.

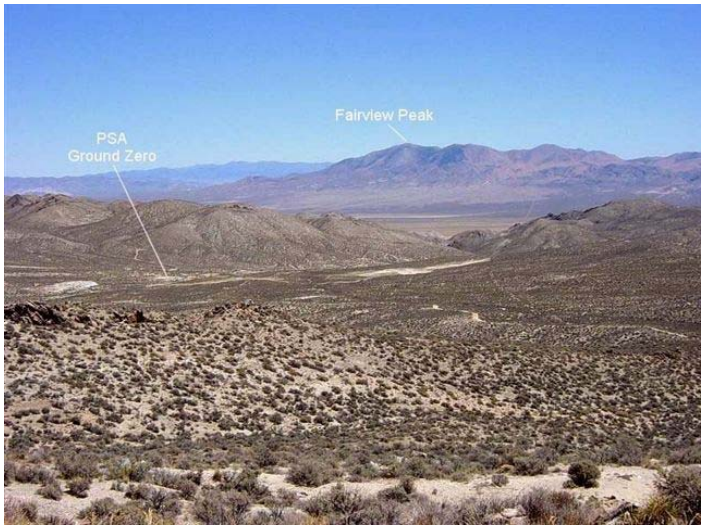
45.5 Note the water well on the right side of the road. This is one of several monitoring wells drilled by the U.S. Department of Energy (DOE) and the Nevada Division of Environmental Protection (NDEP) to monitor groundwater in the Project Shoal area.

45.9 AT FORK IN THE ROAD, STAY TO THE LEFT ON MAIN DIRT ROAD.

46.2 On the left is another groundwater monitoring well.

46.3 TURN RIGHT BY PILE OF BROKEN ROCK AND FIND PLACES TO PARK IN LEVEL AREA.

In 1963, the U. S. Department of Defense (DoD) and Atomic Energy Commission (AEC), now known as the DOE, conducted the Project Shoal underground nuclear test here, in an area called Gote Flat It was part of the Vela Uniform Research and Development Program begun in 1959 to improve US capability of detecting, monitoring, and identifying underground nuclear detonations. Project Shoal was designed to investigate the behavior and characteristics of seismic signals generated by a nuclear detonation in a granite rock formation and to differentiate them from seismic signals generated by naturally occurring earthquakes. Here at Gote Flat, a 12-foot diameter shaft was excavated to a depth of 1,205 feet below the ground surface through solid granite, and a 1,050-foot drift (tunnel) was driven to the east from the bottom of the shaft. A nuclear device with a total yield of 12 kilotons was emplaced



View of the Project Shoal Area on Gote Flat in the Sand Springs Range, looking northeast.

above the end of the drift and on October 26, 1963, it was detonated. For comparison, the atomic bomb dropped on Hiroshima, Japan in 1945, hastening the end of World War II, was about 15 kilotons. The nuclear test created a cavity with an approximate diameter of 171 feet which then collapsed and formed a rubble-filled chimney 356 feet high. The chimney did not propagate to the ground surface and no surface crater was formed. The elevation of the top of the shaft was about 5,240 feet. The bottom of the shaft was at about 4,035 feet. The Huck Salt operation to the west is at an elevation of 3,895 feet. So the nuclear device was detonated in the mountain at a point about 140 feet higher than the floor of Four Mile Flat. Robert C. Horton, mining engineering graduate of Mackay School of Mines, former head of the Nevada Bureau of Mines & Geology, and Director of the U.S. Bureau of Mines under President Reagan, will be accompanying us on the field trip. Mr. Horton was actively involved in the Project Shoal operation and can share his experiences and answer questions about the event.

Later concerns over the possible movement of radionuclides away from the Project Shoal site prompted federal officials to propose that groundwater in the vicinity be monitored, and in 1972, the Long-Term Hydrologic Monitoring Program was initiated by the U.S. Environmental Protection Agency (EPA) Radiation Protection Program in Las Vegas, Nevada. In 1996, the DOE Nevada Site Office (NSO) began environmental restoration activities at the Shoal site. Residual surface hydrocarbons from drilling operations were removed in 1997, and the surface was approved as “clean” in 1998. In 1996, the NSO drilled four water wells at the site to help characterize the groundwater

system. Data from these wells and from four additional groundwater monitoring wells drilled in 1999 were used to construct a groundwater flow and transport computer model to predict the movement of radionuclides in groundwater away from the shot cavity. Continued monitoring consists of sampling these wells and selected surface water sites regularly. Samples are analyzed for tritium (^3H) and cesium-137. Tritium, a radioactive isotope of hydrogen, is considered a reliable indicator of radionuclide contamination. Detection of tritium above background levels would suggest that radionuclides might be moving with ground-water into either Fairview Valley or Fourmile Flat. Monitoring and mitigating hazards from the potential escape of radionuclides from sites such as this require the combined expertise of hydrogeologists (specialists in the geologic framework for ground water), hydrologists (specialists in surface water), geochemists, analytical chemists, health physicists, and engineers.

Pete Sanders, a scientist from the NSO, and Jenny Chapman, hydrologist with the Desert Research Institute in Las Vegas will be on hand at the Shoal site to make a short presentation about the current project and to answer any questions.

For more information about the groundwater monitoring program and proposed remediation program at Project Shoal, please see the website maintained by NDEP on the project at: http://ndep.nv.gov/shoal/shoal1.htm.

The broken rock piles located around the Project Shoal site are left from the excavation of the shaft and tunnel for emplacement of the nuclear device. You may collect samples of this fresh, unweathered granite. There is no need to worry about contamination from the nuclear test. Look closely at the granite and you will be able to discern the different mineral grains that comprise the granite: pinkish potassium feldspar, white sodium feldspar (albite), gray quartz, black needle-like hornblende, and shiny blackish-brown biotite mica. Cleavage faces of the pink feldspar crystals will flash in the sunlight as you turn the rock. In a few places, you may also find samples of a coarser phase of granitic rock called pegmatite. The pegmatite contains larger crystals of the same minerals as granite, and you may be able to find some sizable fragments of white albite and pink potassium feldspar.

Granite containing pink potassium feldspar crystals.

RETURN TO VEHICLES AND RETRACE ROUTE BACK TO THE PAVED HIGHWAY

Watch for a water trough about a mile back down the road from the Project SHOAL site. The rock along the road in this area is a rhyolitic ash-flow tuff, a volcanic deposit from one of several calderas that erupted explosively across north central Nevada about 19 to 25 million years ago. We will see more evidence of this later in the field trip.

50.5 TURN RIGHT (SOUTH) ON STATE HIGHWAY 839.

59.4 Mineral County line.

62.5 ABOUT TWO AND ONE HALF MILES AFTER THE COUNTY LINE, JUST AFTER WE CREST A HILL, LOOK FOR A TURNOUT ROAD ON THE RIGHT. WE WILL PULL OFF ONTO THIS TURNOUT ROAD PARALLELING THE HIGHWAY, PULL UP AS FAR AS POSSIBLE TO THE END OF IT AND PARK. WE WILL WALK A FEW HUNDRED FEET FARTHER DOWN THE ROAD TO A ROAD CUT.

STOP 3: Look at the rocks in road cut on the west side of the highway. Compare the dark gray-black rock with the white rock in the outcrop. Can you scratch either of the rocks with a steel nail, hammer, or pen-knife? The gray rock is limestone and is probably late Triassic to middle Jurassic in age (between 230 and 170 million years old). About 70 to 85 million years ago, during Cretaceous time, magma intruded the sedimentary rocks of this range, cooled, and crystallized to form granite.

Road cut showing contact between dark gray limestone and white marble.

Heat and hot fluids from the magma metamorphosed some of the nearby sedimentary rocks forming new minerals. This is an example of a very simple form of metamorphism, where the heat of the nearby magma recrystallized gray limestone (composed mostly of calcium carbonate with some black, originally organic carbon) to a coarser grained marble, also composed of calcium carbonate (calcite). The color change is due to the driving off of some of the carbon in the original rock as carbon dioxide, resulting in a lighter colored rock, the marble. In other areas along the contact zone between the granitic magma and the older sediments, a rock called skarn formed; it may contain a great variety of colorful minerals such as garnet, diopside, tremolite, actinolite, idocrase, and sometimes tungsten minerals such as scheelite, hubnerite, and wolframite. The Sand Springs Range has many tungsten mines and prospects along the contact zone such as those already mentioned near the Dan Tucker Mine at Sand Springs Pass. Gold deposits are also often associated with igneous/sedimentary contact zones. The contact between the lighter colored granite and the darker colored sedimentary rocks will be clearly visible in the Sand Springs Range to our west after we turn around and retrace our route north back to U.S. Highway 50.

62.5 TURN LEFT (NORTH) ON STATE ROUTE 839 AND RETRACE ROUTE BACK TO U.S. HIGHWAY 50.

79.5 REZERO ODOMETER AND TURN RIGHT (EAST) ON U.S. HIGHWAY 50

0.0 Chalk Mountain is the prominent lone peak on the left side of the highway at 11:00 o'clock. It also hosts a granitic intrusive contact with metamorphosed sedimentary rocks, but here the granitic rock is visible as the dark colored rock area on the west side of the range and the sediments are the light colored rock. Several mines and prospects for gold, silver, lead, zinc, copper, tungsten and molybdenum are located along the contact zone. Although a small amount of mining occurred in the Chalk Mountain mining district in the late 1800s, the main period of production was from about 1923 to 1929. The main producer was the Chalk Mountain Silver-Lead Mining Company, which produced 2,528 tons of ore valued at $120,268 from their mine on the southeast side of the mountain between 1925 and 1927. Exploration for gold, silver, and other minerals continues today in the area.

Thermal metamorphism adjacent to a granitic intrusion has recrystallized limestone into this white marble.

0.5 The flat playa to the south is one of the U.S. Navy bombing ranges.

5.1 Fairview historical marker on the right. The mining camp of Fairview was on the lower northwest flank of Fairview Peak, and the Fairview Mining District covered most of the range south of the highway. Gold-silver mineralization was discovered in the district in 1905, and by 1907, a town had sprung up, boasting about 1,000 people, 27 saloons, two

hotels, two newspapers, banks, assay offices, a post office, a miner's union hall, and a telephone line to the mining camp of Wonder, located 15 miles to the northeast. Most ore production had ceased by 1917, but continued on a small scale until 1950. By then, the district had produced 52,799 ounces of gold, 5,124,369 ounces of silver, 28,353 pounds of copper, and 2,683,233 pounds of lead. Over 80% of the district's production came from the Nevada Hills Mining Company mines between 1911 and 1919. The district now lies partially within the boundaries of the naval bombing range and is off limits to mining exploration.

8.0 A road to the left leads to Dixie Valley, site of the largest geothermal power plant in Nevada with a capacity to produce 62 megawatts of power (2003).

8.9 Drumm Summit.

9.7 Turn right onto dirt road at "Earthquake Faults" sign.

10.1 On the right is the first sign describing the 1954 earthquake scarps and on the hillside to the west one can see what looks like a road etched into the side of the mountain. This is one expression of the ground rupture from the 1954 earthquake.

14.9 Turn right to "Earthquake Faults."

15.5 Turn vehicles around at the circle and head cars back towards main road, parking along the side of the road.

STOP 4: FAIRVIEW PEAK. 1955 EARTHQUAKE FAULT SCARP.

On December 16, 1954, this area was rocked by a magnitude 7.2 earthquake that ruptured the ground on the eastern flank of Fairview Peak for a north-south distance of 40 miles. Four minutes later, a similar magnitude 7.1 earthquake occurred on the east flank of the Stillwater Range, on the west side of Dixie Valley, to the northwest. Surface faulting occurred discontinuously from the northern Gabbs Valley to Dixie Valley, a distance of 63 miles. The largest single fault scarp was about 23 feet high, here near Fairview Peak. Vertical movement of 5 to 15 feet was measured in Dixie Valley. About 7 to 20 feet of vertical movement and about 3 to 13 feet of horizontal movement were measured near Fairview Peak. Because the epicentral region was sparsely populated, these potentially destructive earthquakes caused relatively little property damage, although several chimneys collapsed in Fallon and in Austin 66 miles to the east, and the quake was felt throughout Nevada and parts of adjacent states. Geoscientists converged on the area to make measurements and to try to learn what the earthquakes could tell them about the tectonic framework of this part of the Great Basin.

We will spend some time here exploring the fault scarp and geologic maps of the local area prepared by NBMG geologist Chris Henry. The 1954 Churchill County earthquakes and their effects have been studied in detail by NBMG geologists Craig dePolo, John Bell, and Alan Ramelli in collaboration with other scientists.

Return to vehicles and retrace route back to the main dirt road.

A magnitude 7.2 earthquake in 1954 caused this fault scarp on the east flank of Fairview Peak.

16.1 TURN RIGHT (SOUTH) ON MAIN DIRT ROAD.

18.6 TURN LEFT ON POORLY MAINTAINED DIRT ROAD. PLEASE DRIVE VERY CAREFULLY OVER THIS NEXT HALF MILE OF ROAD AS IT IS BADLY WASHED OUT, ROCKY, AND RUTTED IN PLACES.

19.1 STOP 5: BELL MOUNTAIN MINE AREA. PULL VEHICLES TO RIGHT AS FAR AS POSSIBLE AND PARK BELOW MINE DUMP AREA.

The first claims in this area were located in 1914 on a large gold-silver-bearing calcite-quartz vein on this property, and the Bell Mountain Mine workings were developed over the next ten years, which included driving a

580-foot adit and 50-foot winze in 1916. In 1927, the mine produced 39 tons of silver ore containing ½ ounce of gold per ton of ore and 16.4 ounces of silver per ton of ore. The vein is up to 30 feet thick in places, trends east-west and is exposed for more than a mile. The calcite vein cuts across a rhyolitic volcanic rock called the Fairview Peak ash flow tuff, which originated from and filled the Fairview Peak caldera. The tuff contains fragments of volcanic rock ejected during a violent volcanic eruption about 19.2 million years ago. The richest ore occurs in what the miners called the "Sphinx Zone," where the main vein is intersected by a cross-structure. The old mine area was prospected again beginning in the 1980s, and drilling indicated the presence of more than a million tons of ore with a grade of 0.055 troy ounces of gold and 1.4 troy ounces of silver per

Adit at the Bell Mountain Mine.

ton of ore, which ranks this deposit in the top 250 significant precious metal deposits in the state. The roads in the area have been used by modern exploration geologists to allow rock core-drilling rigs to drill in to the prospect to determine the subsurface geology. Various scientists and engineers are employed in the minerals industry today, including economic geologists, geochemists, and geophysicists involved in team efforts of exploration; mine geologists and mining engineers who get the ore out of the ground; metallurgists, chemical engineers, and analytical chemists who design and monitor extraction of metals from the ores; and environmental geologists, engineers, and conservation biologists who design and monitor environmental restoration and post-mining land use.

Look around on the waste rock dumps from the old mine workings for specimens of the white calcite vein material as well as the fragmental volcanic tuff host rock. Streaks of gray in the calcite vein material may be silver sulfide minerals**,** such as argentite, which has been reported from this mine. Visible gold has been found in the vein material at this mine, usually associated with dark, purplish brown manganese staining. As with all abandoned mine workings, do not enter adits or approach mine shafts. **STAY OUT AND STAY ALIVE!!**

White calcite vein material and volcanic rock that is cut by a thin calcite vein.

RETRACE ROUTE BACK TO THE MAIN DIRT ROAD.

19.7 TURN RIGHT (NORTH) AND RETRACE ROUTE BACK TO U.S. HIGHWAY 50.

0.0 REZERO ODOMETER AT INTERSECTION WITH HIGHWAY 50 AND TURN LEFT TOWARD FALLON.

31.4 TURN RIGHT AT GRIMES POINT ARCHAEOLOGICAL SITE ROAD.

Some of you may have already visited the BLM Grimes Point archaeological site, and we recommend that you return here to explore the

trail that leads you through the petroglyphs left by Native Americans a few thousand years ago. Today however, (after a brief bathroom stop if you need one) we will continue northeast on the Grimes Point road for another mile or so.

33.4 BEAR RIGHT AT FORK IN ROAD, THEN BEAR LEFT AT NEXT FORK IN ROAD AND PARK IN GRAVEL PIT AREA.

STOP 6. GRIMES POINT "NEVADA WONDERSTONE" LOCALITY

At several places today you have seen hillsides where Lake Lahontan's waves incised horizontal lines indicating former shorelines. Near Grimes Point, the shoreline was stable for a number of years between about 13,000 and 11,000 years ago, long enough for an apron of beach gravel sediment to be deposited. The sediments were derived from years of weathering and erosion of the surrounding mountains made predominantly of older volcanic rock. One of these rock types is informally known as "Nevada Wonderstone," which is actually a rhyolitic air-fall tuff ejected from a volcano about 12 million years ago. The rock was then altered by hot water that deposited pyrite (FeS_2) and silica (SiO_2) in the rock. Rainwater penetrated the rock and oxidized the pyrite in the rock to form parallel bands of red hematite (Fe_2O_3) and orange and brown goethite (FeO(OH)), which are known as ***liesegang*** bands. Erosion broke pieces of the rock from its outcrop, and streams carried pebbles to the shore of Lake Lahontan, where wave action rolled and tumbled the pebbles until they acquired smooth shiny surfaces. Other volcanic rocks also comprise the gravels, but do not have the colorful banding, and lower silica content is not conducive to achieving such a high luster when tumbled.

The hydrothermal fluids that initially altered the volcanic rock were much like waters in modern hot springs, which are common in Nevada. Such hot waters are used by geothermal power plants to produce more than a million megawatt-hours of electricity annually in Nevada, like at the newly developed Salt Wells geothermal site. This type of hydrothermal alteration is also commonly associated with the gold and silver deposits that have played such an important role throughout Nevada's history. We are in the midst of the biggest gold-mining boom in American history, and Nevada accounts for approximately 87% of current U.S. production. The U.S. is a net exporter of gold, and the only countries that produce more gold are South Africa and Australia**.**

This is the **last stop** on our trip. Retrace the route back to Highway 50 and Fallon.

Wave polished pebbles of Nevada wonderstone in the Grimes Point area.

References

Couch, B. F., and Carpenter, J. A., 1943, Nevada's metal and mineral production; Nevada Bureau of Mines and Geology Bulletin 38, 159 p.

Hess, R. H., 2004, Geothermal Energy, *in* The Nevada Mineral Industry; Nevada Bureau of Mines and Geology Special Publication MI-2003, p. 55-61.

Johnson, Joel, ed., 1984, Exploration for ore deposits of the North American Cordillera: Field Trip Guidebook for a symposium sponsored by Association of Exploration Geochemists, Reno, Nevada.

Nevada Bureau of Mines, Nevada Mining Analytical Laboratory, and Desert Research Institute, 1964, Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada; Final Report for Shoal Event, Project Shade, Vela Uniform Program, Atomic Energy Commission; VUF-1001, Project 33.2, Nuclear Explosions-Peaceful Applications, (TID-4500, 39th Ed.), 372 p.

Stager, H. K., and Tingley, J. V., 1988, Tungsten deposits in Nevada; Nevada Bureau of Mines and Geology Bulletin 105, 256 p.

Tingley, J.V. and Pizarro, K.A., 2000, Traveling America's loneliest road, a geologic and natural history tour through Nevada along U.S. Highway 50: Nevada Bureau of Mines and Geology Special Publication 26, 132 p.

Willden, R., and Speed, R. C., 1974, Geology and mineral deposits of Churchill County, Nevada; Nevada Bureau of Mines and Geology Bulletin 83, 102 p.

Websites

Environmental monitoring website maintained by the Department of Energy:
www.nv.doe.gov/library/publications/emupdate

Geothermal Resources of Nevada, website maintained by Nevada Bureau of Mines and Geology:
www.nbmg.unr.edu/geothermal/gthome.htm

Nevada Geothermal Update, an online newsletter maintained by the Nevada Division of Minerals:
http://minerals.state.nv.us/forms/ogg/ogg_NGU/NVGeothermalUpdate2005.09.pdf

Project Shoal website maintained by the Department of Energy: http://ndep.nv.gov/shoal/shoal1.htm

Thank you for helping us celebrate Earth Science Week, designated the second full week of October by the Governor of Nevada, the U.S. Congress, the American Geologic Institute, and the Association of American State Geologists to recognize the importance of geology and other Earth sciences to society. If you have questions about Nevada geology, natural hazards, mineral or energy resources, please contact the Nevada Bureau of Mines and Geology by telephone (775 784-6691), or on the Internet (www.nbmg.unr.edu). The NBMG offices on the UNR campus are open weekdays, 7:30 a.m. to 4:30 p.m.

This field trip is made possible by volunteers from the Nevada Bureau of Mines and Geology; W.M. Keck Museum, Mackay School, University of Nevada, Reno; Geological Society of Nevada, Nevada DOE Nevada Site Office and the Desert Research Institute in Las Vegas This field trip guide was prepared by D.D. LaPointe, David Davis, and Jon Price of the Nevada Bureau of Mines and Geology, and by Beth Price.