Earth Science Week 2008

No Child Left Inside

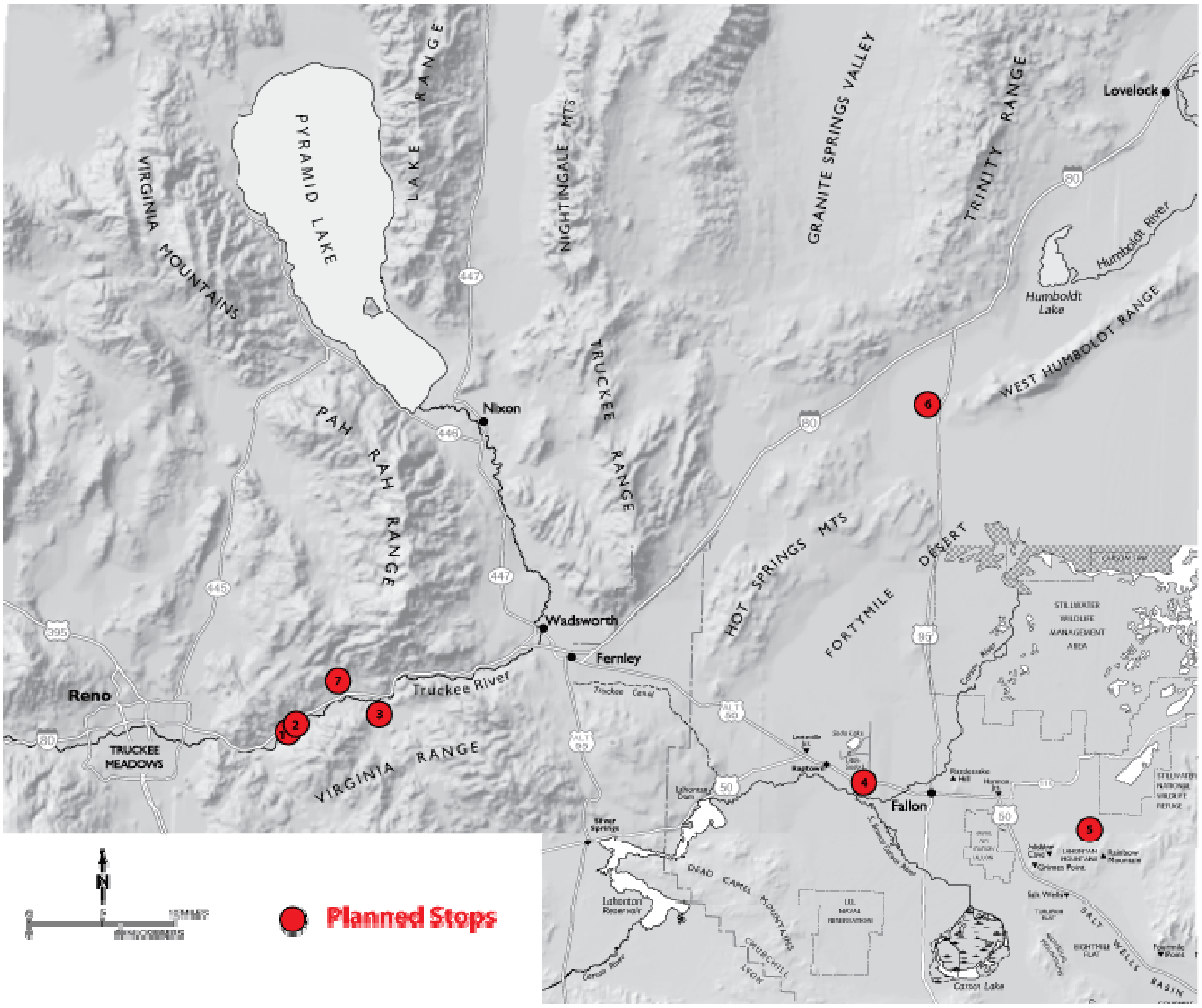
A Field Trip for Families and Rockhounds

Nevada Bureau of Mines & Geology welcomes you to participate in the eleventh annual Earth Science Week field trip. We will make up to seven geological stops and a couple of rest stops, all located within a few miles of Interstate 80, U.S. Highway 50, and U.S. Highway 95. The general route (shown on the accompanying map) will take us from Sparks, Nevada east on Interstate 80 to stops near the Mustang Exit #23 and USA Parkway Exit #32, continuing east to the Fernley East Exit #48 where we will continue east on Alt Hwy US 50 to Fallon. Before town we will turn north on Soda Lake road for one stop, then continue east on U.S. Hwy 50 to the Grimes Point Road where we will make one stop and then retrace the route to Fallon where we will turn north on U.S. 95 to Interstate 80, making one stop along the way at the foot of the Mopung Hills, and then return to Reno via Interstate 80, making one last stop north of the Patrick Exit #28. Entire round trip mileage from Sparks and back will be about 200 miles.

We will be examining evidence for past volcanic activity and ancient lakes, and collecting a wide variety of colorful and interesting rocks.

The field trip is designed to offer a high-quality field-based Earth science educational experience to children of all ages, the "inner child," or life-long learner. It should provide teachers with an array of potential venues for class field trips, and materials and ideas will be shared on how to facilitate field-based learning for K-12 classes.

Parts of this road log are excerpted from earlier NBMG publications referenced below. Mileages are cumulative, resetting to zero after stops where irregular terrain may result in variations in mileage. Vehicle odometers may differ, so keep track of landmarks and lead vehicles. Meet at 0800 on the I-80 side of the parking lot at Scheels sporting goods store at the corner of Lincoln Way and Sparks Blvd in Sparks. The field trip will leave at 0830.



Mileage

0.0 Exit Scheels parking lot on the east side, turning right on Sparks Blvd, then left onto I-80 eastbound.

5.2 Take Exit 23, Mustang. Turn left at stop sign at bottom of the ramp, go under the freeway and turn left again at STOP sign onto frontage road. Bear right at fork (do not reenter I-80!)

Continue north on this road, through the gate at 6.0 miles, into materials pit operated by Martin Marietta Materials. Circle around the pit and park carefully so as not to block access to the entrance road. Exit vehicles and gather around the cut bank at the north side of the pit.

STOP 1 – Martin Marietta Materials Pit – rhyolite and basalt.

What do you observe about the rocks in the north wall of the pit?
You should see layers of light-colored material. Layers often indicate that sedimentary processes have been at work. Of what are the layers composed? You should see a variety of sizes of material from fine sand-sized material to large boulders up to a meter or more in diameter. Are the boulders rounded or do they have rough, angular edges? Rounding

off of edges often indicates that sediments have been transported some distance by fast-moving water (think of the rounded boulders in the Truckee River). More angular blocks indicate a shorter transport distance, perhaps even just falling off a steep slope due to gravity with a short downhill trip, transported by slopewash (rainwater run-off) and/or flash floods. What kind of rock fragments are present? Are they mostly all the same or is there a variety of rock types embedded in the wall? Most of the rock fragments are of one general rock type called “flow-banded rhyolite.” Rhyolite is the lightest-colored, most silica-rich of all volcanic rocks. When molten, it is very viscous or thick and sticky, unlike the low-viscosity fluid basaltic magmas of the Hawaiian islands. Geologists believe that these layers of angular fragments of rhyolitic volcanic rock of various sizes accumulated here at the foot of a rhyolite flow dome emplaced about 10 million years ago, very similar if not identical to the one currently being mined by All-Lite Aggregates at Washington Hill, the highest point in the Virginia Range on the south side of the Truckee River from here. Most of the high-grade construction aggregate and landscape rock in the Truckee Meadows communities originates from this site.

The detritus or sediment shed off this volcanic flow dome as it rose was transported downslope by gravity, streams, and flash floods and deposited in adjacent valleys and lakes as the coarse layers of gravel and boulders that you see here in the gravel pit. Pick up a fragment of the rhyolite that comprises the layers and examine it closely. It is itself finely banded with lighter layers containing more air, ash, and pumice, and darker layers that are denser with less air, ash, and pumice and more glass.

After collecting pieces of the flow-banded rhyolite, walk to the far south end of the “parking lot” and look at both the large boulders of rock piled around the periphery of the pit and at the outcrop walls of the south part of the pit. How is this rock different from the rock in the north wall of the pit? Is it layered in the same way? Are there any interesting shapes to the rocks in the wall or the piles of quarried rock?

This rock formation is called the Lousetown Basalt and consists of a volcanic rock that is andesitic to basaltic in composition. That means it has about 50-60 % silica (SiO_2) – far less than the 70% silica of the rhyolite on the other side of the pit. This basalt has the form of a “plug” which means it erupted via a conduit through older rocks onto the earth’s surface and then cooled and hardened, “plugging” the volcanic vent. Other surrounding rocks may have eroded away leaving the plug as a high point. This plug exhibits a common feature of cooled basaltic rocks called columnar jointing. When the rock contracted as it cooled, planes of weakness developed in the rock allowing it to break apart into rough columns. Some excellent, well-known examples of this are Devil’s Postpile near Mammoth Lakes, California; Devil’s Tower, Wyoming; the Palisades Sill in New Jersey; and Giants Causeway in Ireland. Although less spectacularly developed here, you can still make out the columnar jointing pattern and may even find a polygonal boulder in the piles of broken rock eroded from the basaltic plug The “best” columns are hexagonal, like the six sides that are characteristic of mud cracks, which form when mud contracts as it dries out. Radiometric dating of this basalt yields an age of about 6.8 to 7.1 million years. Return to vehicles and exit the pit.

6.4 Gate. Drive down the road to the bottom of the hill.

6.9 Pull off to the right side of the road and park, being careful not to block the road.

STOP 2: Mustang Exit McClellan Peak-age young basalt

Walk over to the dark outcrop east of the road and look closely at the rock. How is it the same or different from rocks we just saw at the last stop? This too is basalt – a dark volcanic rock – probably more of a "true" basalt because this one has a lower percentage of silica than the last one – although both are fine-grained black volcanic rocks. This rock, however has more abundant small visible crystals (called phenocrysts) of minerals such as olivine, $(Mg,Fe)_2SiO_4$, (peridot is the gem-quality variety of olivine)– an olive green color; pyroxene, $(Mg,Fe,Ca)SiO_3$, – greenish-brown to black; and plagioclase feldspar, $(Ca,Na)(Al,Si)_2Si_2O_8$, – white. It also has holes in it called vesicles. The holes originated as gases (mostly H_2O and CO_2) that were dissolved in the molten magma when it was below the earth's surface and exsolved from the lava as it erupted onto the earth's surface. The lava cooled and hardened, trapping the gas bubbles as vesicles in the rock. Think about opening a clear 2-liter bottle of carbonated beverage and how the CO2 bubbles are released once the pressure drops.

This is one of the most recent volcanic rocks in the area, having a radiometric age of about 1.4 million years. The lavas are thought to have erupted from a vent in the Virginia Range to the south and flowed here across the Truckee River, probably temporarily damming it up until the water eroded away parts of the lava flow. When you find these 'end-member' composition volcanic rocks – basalt and rhyolite – it is called a "biomodal" occurrence" typical of rocks that are closely related to the active extension (pulling-apart) of the earth's crust in the Great Basin.

Return to vehicles and retrace route back under the freeway.

7.2 Turn left on frontage road after freeway towards the Chevron Station.

0.0 RE-ZERO ODOMETER as you bear left onto Interstate 80-eastbound onramp.

8.2 Take USA Parkway exit # 32. Turn right at STOP sign and drive south on USA Parkway.

8.7 Pass Eagle Picher diatomite processing plant on the left.

All the mountains in the Virginia Range in front of us to the south are part of the ancestral Cascade Range and are composed primarily of volcanic rocks of intermediate composition, meaning they are intermediate in silica content between the bimodal compositions we saw at the Mustang Exit – rhyolite and basalt.

10.0 Watch for "Pittsburgh" sign and immediately after it, turn left on dirt road, go straight toward water tower.

10.3 Turn left making a loop past construction trailers and park vehicles carefully. Please do not touch or climb on any construction equipment or trailers in this area.

STOP 3: USA Parkway water tower access road; Cascade-age intermediate volcanic rocks

Exit vehicles and examine the rocks in the float along the roadside. Are the rocks all the same in appearance? Are there more than one kind? How are they the same as those at the last stops? How are they different? How many different kinds of rock can you find here? You should be able to find a variety of rock types here – of different compositions and textures, but all volcanic in origin - rock fragments that have been eroded from the

surrounding hills and transported here by a few million years of slopewash activity. Most of the rocks here are called dacite or andesite and are between rhyolite and basalt in composition. You will find some with large crystals or phenocrysts of minerals. Are they the same or different than the phenocrysts in the recent basalt at the last Mustang exit stop? You will probably not find any olivine phenocrysts in the intermediate volcanic rocks but should find abundant white plagioclase feldspar and long black hornblende phenocrysts $(Ca,Na)_{2\text{-}3}(Mg,Fe,Al)_5(Al,Si)_8O_{22}(OH,F)_2$. These are common in dacite and andesite volcanic rocks. Hornblende is one of the most common black minerals found in volcanic rocks. It is often referred to as a “garbage can” mineral because it contains such a wide variety of elements.
Return to vehicles and retrace route to USA Parkway. Turn right and return to Interstate 80.

12.1 Interstate 80 eastbound onramp.
0.0 Turn east toward Fernley, **rezeroing odomete**r at the I-80 on-ramp.
Take Fernley East exit # 48 (the second Fernley exit). Drive to roundabout.
16.8 Take U.S. Alt 50 East toward Fallon (3/4 way around the roundabout).
19.0 The pits on the skyline to the south are freshwater limestone mines that supply Nevada Cement in Fernley with the primary raw material to make Portland Cement for use in concrete.
23.0 Pass Farm District Road on right that leads to diatomite mines of Eagle Picher and Celite World Minerals.
Continue east on U.S. Alt 50. As we reach the Fallon area, watch for Winan’s Yoder Furniture store on the left. Soda Lake road will be right after it.
38.0 Turn left on Soda Lake Road.
40.0 Turn left on Cox Road
40.9 Turn right on an unmarked gravel road immediately after an orange-topped post. Continue north on gravel road to edge of Soda Lake.
41.3 Turn left at edge of lake circle around a loop road to the left and park carefully so as not to block others.

STOP 4. SODA LAKES

Soda Lake and Little Soda Lake are two recent volcanoes, younger than the sediments that were deposited in Lake Lahontan. These are the youngest volcanoes in Nevada, less than 10,000 years old. Geologists call these types of volcanoes maars (pronounced "Mars"), so after this stop you can say that you "have been to maars." The maars are broad, low-relief, nearly circular volcanic craters. They probably formed when magma rose close to the surface, boiled the groundwater, and caused an explosive eruption of basaltic magma through the wet sediments of the lake basin. You can find telltale “basaltic bombs” around the margins of the craters. Look for small crystals of plagioclase feldspar (clear to white), olivine or peridot (green) or pyroxene (brownish black) in these dark vesicular volcanic rocks. The bombs often have corrugated surfaces that formed as they were blown out of the crater through the air.

Are these rocks more similar to the older Lousetown basalt (columnar jointed) that we saw in the Martin Marietta pit, or to the more recent basalt we saw last at the Mustang Exit? Return to vehicles and retrace route back to Cox Road.

41.8 Turn left (east) on Cox Road
42.7 Stop Sign – turn right on Soda Lakes Road. Constellation Energy runs a geothermal power plant just north of here that can produce up to 25 megawatts of energy – enough to power 25,000 residences. For more information about it see their website at: http://sodalake.net/ or at http://www.geo-energy.org/information/plantsNow/nevada/sodaLake1.asp where there is a contact to arrange a tour of the plant as a field trip stop.
44.8 Turn left (east) on U.S. 50 and reset odometer to zero.
0.0 East (left) on U.S. 50.

Our next stop will be a short lunch/rest stop at Grimes Point Archaeological Site 10 miles east of Fallon. If you need to stop briefly in Fallon for any reason, please rejoin the group at Grimes Point rest area.

4.5 Cross Maine Street in downtown Fallon. Continue east.
14.5 Turn left at the road to Grimes Point Archaeological Site and take an immediate left to the rest area by the Petroglyph Trail. Circle the vehicles all around the roundabout here and pull off so as not to block traffic. This will be a brief rest/lunch stop. Return on another field trip to walk the Petroglyph Trail, or include it as a stop on a class field trip.

Prehistoric natives scratched petroglyphs in boulders of andesite lava flows along the shores of the Pleistocene Lake Lahontan. The boulders are coated with rock varnish, a thin layer of dark brown to black iron and manganese oxides. The U.S. Bureau of Land Management has constructed a path along which you can view the petroglyphs on another visit. Do not disturb the petroglyphs or collect rocks at this site.
Exit rest area access road and TURN RIGHT ON GRIMES POINT ROAD. (Do not return to highway 50 yet!) Continue north on graded gravel road.

16.0 Pass Hidden (Burnt) Cave on the right. This cave is an archaeological site once occupied by prehistoric people and is open for guided tours starting at the Churchill County museum in Fallon on the second and fourth Saturday of each month, or by special arrangement. For more information, go to: http://www.ccmuseum.org/programs/cave.php
16.7 Road forks at TCID ROCK PIT sign. Take RIGHT fork.
17.0 Road forks again – take LEFT fork (by 3 gravel piles)
17.1 Enter gravel pit and circle vehicles around to the left and park so as not to block anyone else.

STOP 5. GRIMES POINT WONDERSTONE LOCALITY

Ancient Lake Lahontan reached its highest water levels at least four times between 75,000 and 10,000 years ago during the Pleistocene epoch. We can see here abundant evidence for this lake, such as shorelines carved by wave action and sediments deposited in the lake. Look carefully in the gravels of the pit area for pebbles of Nevada wonderstone that were tumbled and polished by streams and by wave action along the shore of the lake about 13,000 years ago. This rock had originated as rhyolitic air-fall tuff material ejected from a volcano about 12 million years ago. The rock was altered by hot waters that deposited pyrite (FeS_2) and silica (SiO_2). Rainwater penetrated the rock and oxidized the pyrite to form the concentric and parallel liesegang bands of red hematite (Fe_2O_3) and orange and brown goethite (FeO(OH)). Erosion broke pieces of the rock from outcrops in the hills north of here, and streams carried pebbles to the shore of Lake Lahontan. 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 electricity. Nevada annually produces about $70 million worth of electricity from geothermal power plants. This type of hydrothermal alteration is also commonly associated with the gold and silver deposits that have been so important to Nevada throughout its history. We are in the midst of the biggest gold-mining boom in Nevada and U.S. history. Today Nevada produces about 8% of all the gold mined in the world.

Retrace route back to U.S. 50, reset odometer to zero and turn RIGHT (retracing our route back to the west).

10.1 Turn right at Maine Street in downtown Fallon onto U.S. Hwy 95.
11.0 Kennametal refinery on left
27.8 Turn left by NDOT material piles and carefully park off the pavement.

Exit vehicles and walk to lime kiln to the west.

STOP 6: MOPUNG HILLS – LIME KILN.

Freshwater limestone was mined here about 1900. The rock was calcined (turning limestone into lime and carbon dioxide; $CaCO_3 \rightarrow CaO + CO_2$) in a kiln just to the west, near the railroad grade, and shipped to California, primarily for agricultural use. The ruins of the old lime kiln are still standing (looks like a chimney). The limestone was deposited as tufa along the shore of an ancient precursor to Lake Lahontan that existed here more than a million years ago. It contains fossils of several species of mollusks. Look closely at the rocks on the ground for fossils. There is also a sedimentary rock called conglomerate composed of stream-rounded pebbles cemented by calcium carbonate. Eroded shorelines of Pleistocene Lake Lahontan are visible as horizontal benches on the hillsides in the Hot Springs Mountains to the west. Follow U.S. Highway 95 north for another 4.5 miles to intersection with Interstate 80.

Turn left before the Interstate into the rest area for a quick rest stop and to read the interpretive signs about prehistoric inhabitants and early pioneers.

Exit the rest area, turn left, and go under the freeway to the entrance ramp to Interstate 80 WESTBOUND.

0.0 REZERO odometer at entrance ramp to I-80.
2.0 Wave-cut benches of ancient Lake Lahontan are visible on the hillside to the north.
3.0-5.0 Watch along both sides of the road and the median in this stretch as I-80 climbs in elevation to where Lake Lahontan was shallow enough for tufa to form along its shores, much as it does now along the shores of Pyramid Lake. The "fossil" tufa mounds and small towers from Lahontan's shoreline are still standing in several places.
7.0 More tufa and Lake Lahontan strandlines are visible on the hills to the north.
13.5 Moltan diatomite plant is on the left (southeast) side of I-80. Moltan Co. is the second largest diatomite producer in Nevada, producing cat litter, oil absorbent, and soil conditioner from diatomeous earth and zeolite minerals mined in this area.
16.5-18.0 The operation visible on the southeast side of I-80 is Brady Geothermal Power Plant, owned and operated by ORMAT, the same company that runs the Steamboat geothermal power plant south of Reno off the Mount Rose Highway. The operations here produce about 26 megawatts of clean, renewable geothermal power from several wells that tap a resource of hot water at a temperature of 152°C (306°F). Geothermal exploration drilling began in the 1950s, but it was not until the 1980s that commercially viable production wells were drilled, and the first power plant was built in 1992.

The scalding water of the original Emigrant Springs here was the cause of much carnage among the livestock of early crossers of the Forty-Mile Desert. In later years a bathhouse and spa were developed on the site along old U.S. Highway 40. A concrete pool built in 1929 remains today in a fenced-off area near the eastbound exit ramp, next to a direct-use geothermal vegetable dehydration plant. The hot springs do not flow at the surface today, although abundant steam vents can be seen from the Interstate on cool days.
32.5 Tufa-encrusted volcanic hills on the right (north) side of the highway.
54.6 Take Patrick exit # 28: WATCH FOR FIRST RIGHT as it is only a couple hundred feet down the freeway off-ramp

Take your first right over a cattle guard and through a gate onto a gravel road. (We will open the gate and close it after passing through). Take left fork after cattle guard and continue on main gravel road as it winds along the base of the hills.
55.5 As the main gravel road goes up a small rocky hill and begins to enter a canyon, TAKE A RIGHT AT FORK IN ROAD onto a lesser gravel road. Continue on gravel road to the east around the nose of the hill. The Tracy power plant will be directly ahead in the distance for a short time.
55.8 When you see to a large metal post in the ground on the left, park vehicles carefully off the road so as not to block anyone else. Walk up the hill to the prospect pit under the power lines.

STOP 7 – PERLITE PROSPECT WITH APACHE TEARS

This area is a prospect for the industrial commodity perlite, which here also contains "Apache tears". Perlite is defined as a hydrated (containing water) volcanic glass with a pearly luster and concentric "onion-skin" fractures. The "Apache tears" are unhydrated cores of obsidian (volcanic glass) occurring at the center of a group of concentric fractures in the perlite. Perlite often occurs at the chilled margins of rhyolitic (light-colored, silica-rich) volcanic flows or shallow intrusive rocks, where the volcanic glass has fractured and allowed meteoric water to enter the glass structure. The extent of hydration of the glass increases with temperature; thus the unhydrated "Apache tear" cores represent the point at which the volcanic rock cooled below the optimum temperature for hydration to occur.

The light grayish white rock in the pit wall and the "sand" eroding from it are composed of perlite, which typically contains 2%-6% water. Companies that mine perlite process it by heating the perlite quickly to temperatures at which the water in the glass vaporizes, causing the perlite to "pop" like popcorn (about 870 degrees C or 1600 degrees Fahrenheit). This produces a product called expanded perlite, with up to 20 times the volume of the original perlite.

Most expanded perlite is used to make lightweight construction materials such as concrete and plaster aggregate, acoustical ceiling tile, and insulation board, but because it is very porous, it is also used to filter industrial effluent, fruit juices, and oils. It is used as a soil conditioner to increase drainage and water retention, and as a filler in paints and an extender in plastics. The United States is the world's foremost producer of perlite; most of the mined deposits are located in New Mexico and other states west of the Rocky Mountains, including Nevada.

The guided field trip ends here - retrace the route back to the Reno-Sparks area!

We hope you enjoyed the trip and that we have whetted your curiosity enough to continue exploring with further geological expeditions along U.S. 50 and other parts of Nevada. Thank you for helping us celebrate Earth Science Week, which has been officially designated as the second full week of October by Nevada Governor Jim Gibbons, the U.S. Congress, and the Association of American State Geologists to recognize the importance of geology and other Earth sciences to society. This field trip is sponsored by the Nevada Bureau of Mines and Geology, Mackay School of Earth Sciences and Engineering, University of Nevada, Reno, and by other geoscience agencies and organizations in northern Nevada. If you have any questions about the geology, natural hazards, or mineral, energy, or other natural resources of Nevada, please feel free to contact the Nevada Bureau of Mines and Geology by telephone (784-6694), e-mail (info@nbmg.unr.edu), or the Web (www.nbmg.unr.edu), or visit the NBMG offices on the UNR campus between 7:30 a.m. and 3:00 p.m., Mon-Fri.

Prepared by D.D. La Pointe and J.G. Price, Nevada Bureau of Mines and Geology, October 2008.

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