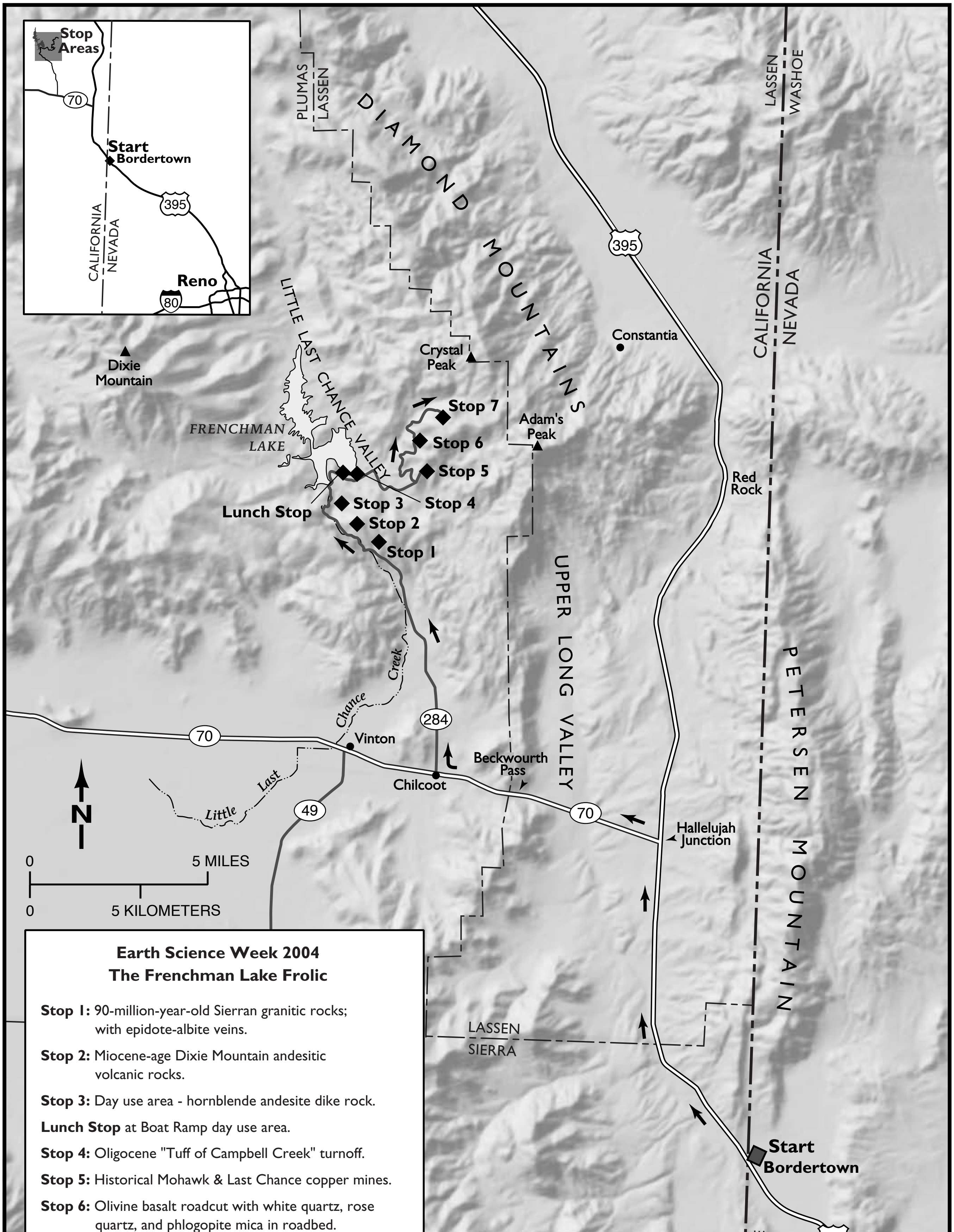
2004 EARTH SCIENCE WEEK FIELD TRIP

October 16 or 17, 2004

The Frenchman Lake Frolic

This year's Earth Science Week public field trip will venture beyond the Nevada state boundary and explore the geologic history of an area around Frenchman Lake in adjacent California. We will have the opportunity to collect samples of a variety of minerals and igneous rocks along the way. This approximately 100-mile round trip will take us to sites located 25–30 miles northwest of Reno near Frenchman Lake (photo 1). All stops are adjacent to paved or gravel Forest Service roads accessible by high-clearance vehicles, but 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 Bordertown Casino parking lot** on the southwest side of U.S. Highway 395 about 10 miles north of Reno. We will depart from there at 9 A.M.

Photo 1. Frenchman Lake from Stop 6 on field trip route.



Stop Areas
70
Start
Bordertown
395
CALIFORNIA
NEVADA
Reno
80
PLUMAS
LASSEN
DIAMOND MOUNTAINS
LASSEN
WASHOE
395
LITTLE LAST CHANCE VALLEY
Constantia
CALIFORNIA
NEVADA
Dixie Mountain
Crystal Peak
Stop 7
FRENCHMAN LAKE
Adam's Peak
Stop 6
Stop 5
Red Rock
Stop 4
Stop 3
Lunch Stop
Stop 2
Stop 1
UPPER LONG VALLEY
PETERSEN MOUNTAIN
Creek
Chance
284
70
Vinton
Beckwourth Pass
Last
Chilcoot
Little
N
49
70
Hallelujah Junction
0
5 MILES
0
5 KILOMETERS
Earth Science Week 2004
The Frenchman Lake Frolic
Stop 1: 90-million-year-old Sierran granitic rocks; with epidote-albite veins.
Stop 2: Miocene-age Dixie Mountain andesitic volcanic rocks.
Stop 3: Day use area - hornblende andesite dike rock.
Lunch Stop at Boat Ramp day use area.
Stop 4: Oligocene "Tuff of Campbell Creek" turnoff.
Stop 5: Historical Mohawk & Last Chance copper mines.
Stop 6: Olivine basalt roadcut with white quartz, rose quartz, and phlogopite mica in roadbed.
Stop 7: Quartz quarry with phlogopite mica.
LASSEN
SIERRA
Start
Bordertown
395
SIERRA
WASHOE

Today, most of Nevada's rivers empty into interior basins, never finding their way to the ocean. During Oligocene time, however, 25–30 million years ago, the Sierra Nevada had not yet formed as a mountain range, and Nevada's rivers and creeks flowed all the way to the Pacific Ocean. This was a time when large explosive volcanoes called calderas erupted in the central Nevada highlands, spewing volcanic material far from its source as fine-grained tuff deposits. Some volcanic sediments and hot ash found their way into the paleochannels, which transported the material farther west where some of it was deposited in what is now California. About 15 million years later in Miocene time, the ancestral Cascade volcanoes erupted in this part of California, causing catastrophic lava flows and volcanic mudflows called lahars that buried the earlier volcanic rocks with thick deposits of andesitic lava and tuff breccia. These deposits have eroded to form the spectacular landscape in the valley of Little Last Chance Creek, along which we will be traveling today (photo 2). These two distinct episodes of volcanism produced rocks that are preserved in the Frenchman Lake area where geologists study them in order to piece together the volcanic and structural history of the western North America.

Local geoscientists will accompany you on the trip to answer questions on any of these topics.

Photo 2. Miocene andesitic lava flows and tuff breccia deposits in the valley of Little Last Chance Creek.

Road Log

Odometer mileage
cumulative

0.0 Leave Bordertown Casino parking lot. Turn left (north) on frontage road.

0.1 Turn right at stop sign and proceed carefully across southbound lanes of U.S. Highway 395

0.2 Turn left onto U.S. Highway 395 north.

We are following Long Valley, which is a fault-bounded valley called a “half-graben” with a major range-front fault on the west side at the foot of the mountains.

0.5 In the stream bank of Long Valley Creek to the left, you can see a lighter layer of sediment about half way down the stream bank. This is a layer of ash that was deposited from the catastrophic eruption of Mount Mazama 7,700 years ago in what is now Oregon. This was one of the eruptions in the sequence of volcanic events that formed Crater Lake. The ash layer was distributed over many western states and serves as a time marker horizon useful in dating other geologic events. Look for this layer in other stream bank cuts along our route for the next few miles. Long Valley Creek was occupied by an arm of pluvial Lake Lahontan for a few hundred thousand years during the Pleistocene. The creek is now cutting down through some of the ancient lakebed sediments. The amount of offset of sedimentary layers exposed by creek erosion has been used to estimate the rate of slip on the Honey Lake Fault, one of several major right-lateral strike slip fault zones that parallel the San Andreas Fault and account for as much as a third of the movement between the Pacific and the North American tectonic plates.

3.1 Lassen County line.

7.4 Take Exit 8 off ramp at Hallelujah Junction.

7.7 Turn left at the stop sign on CA Highway 70.

The mountain range in front of us to the west is the Diamond Range. To our left, the mountains are composed of Mesozoic metamorphic rocks (schists) of the Peavine Sequence similar to the rocks on Peavine Mountain. These are some of the oldest rocks in this area. These rocks are intruded by the Sierran granites (about 90 million years old here) like those found around Lake Tahoe and farther south in Yosemite. On top of them are some of the Miocene age (10–12 million year old) andesitic volcanic rocks of the ancestral Cascade Mountains.

9.6 Cross Long Valley Creek.

11.3 Outcrops of spheroidally weathered (rounded) Sierran granitic rocks on the right.

11.6 Beckwourth Pass and the Plumas County line.

12.2 On the hill to our right, two cooling units or layers of Oligocene-age volcanic tuff are visible near the top of the ridge. The calderas that produced these tuffs erupted in central Nevada about 30 million years ago. These rocks overlie Sierran granitic rocks (the knobby outcrops near the base of the hill). The contact between the two rock types represents a gap in time of more than 60 million years.

Sierra Valley, the broad, flat-bottomed valley extending to the south beyond Chilcoot, was occupied by pluvial Lake Beckwourth during the Middle Pleistocene. At its highest stands, the lake covered the road we are driving on to a depth of several tens of meters, and probably spilled over into Lake Lahontan to the east. NBMG geologists and others have been studying evidence for this high stand at about1585 meters and probable spillover that is estimated to have happened about 300,000 years ago.

13.3 Town of Chilcoot. Turn RIGHT (north) on CA Highway 284.

17.3 The rusty-looking outcrop of rock in the road cut on the right here is a biotite-hornblende schist that is part of the Peavine sequence metamorphic rocks that are the oldest basement rocks in this part of the country, predating the Sierran granitic rocks. Light colored quartz-tourmaline veins cut through the dark schist in the outcrop.

18.9 **STOP 1: TURN RIGHT just before the bridge over Little Last Chance Creek.** Go all the way to the end of the dirt road and circle vehicles around and park with vehicles pointing out, without blocking road. The dark gray rock here is called diorite or monzodiorite and is characteristic of the Sierran 90-million-year-old granitic rocks in this area. Lighter aplite dikes cut the darker rock in places. Look for veins of the green mineral epidote bordered by white albite cutting the granitic rock.

19.2 Return to Hwy. 284, turn right, cross the bridge and continue north into the canyon of Little Last Chance Creek. Watch the road cuts within the next few hundred yards to see where the rocks change from the granitic rock we saw at Stop 1 to the overlying andesitic volcanic rocks.

20.3 STOP 2: Pull off into large turnoff on the right. The rocks on the hillsides above are Miocene-age andesitic volcanic rocks – tuff breccia, volcanic mudflow deposits, and finer-grained tuffs (photos 3 and 4). The source of these volcanic rocks was the Dixie Mountain volcano just northwest of Frenchman Lake.

Return to vehicles and continue north on Hwy. 284.

Photo 3. Miocene andesitic lava flows and tuff breccia deposits and Oligocene volcanic tuff in the valley of Little Last Chance Creek.

Photo 4. Miocene age andesitic volcanic rocks – tuff breccia, volcanic mudflow deposits, and finer-grained tuffs.

21.0 **STOP 3: Turn off into large day use area. Drive to end and circle vehicles around facing back towards exit**. Park and walk back to road's edge. Look back over the bridge at the dark gray rock above the guard rail. How do you think this feature formed? The rock is a hornblende andesite dike. Walk across the bridge and over the guardrail to collect pieces of it. Look for shiny black hornblende crystals up to 1 cm long in the gray groundmass of the rock (photo 5).

Some of the lighter colored blocks of rock in the andesitic mudflows are older Oligocene tuffs (24.9-million-year-old tuff of Chimney Spring) that underlie the later Miocene age (ten million years old) andesitic volcanic tuff breccia deposits. Blocks of the older tuff were ripped up by the later volcanic mudflows and incorporated into the deposits. Farther up the road are more outcrops of interlayered lava flows and tuff deposits.

22.1 Return to vehicles and continue north on Hwy. 284.

22.2 Turn right over the dam at Frenchman Lake.

Among the archived papers of Dr. Vincent Gianella, professor at Mackay School of Mines and chair of the Department of Geology and Geography from 1935 to 1952, is a short geologic report written by Dr. Gianella after he was called to examine a fossilized log uncovered by workers excavating in the canyon at this site in preparation for the building of the Frenchman Lake dam. The log was embedded in the andesitic volcanic mudflow deposits and was up to 7.5 feet in diameter and was estimated by Dr. Gianella to have been originally more than 200 feet long.

Look for more dark gray andesitic lava flows in the road cuts past the dam.

Photo 5. Hornblende andesite dike rock with shiny black hornblende crystals up to 1 cm long.

23.0 Turn left at BOAT RAMP sign, go down the hill and turn right into day use picnic area

LUNCH STOP

After lunch, return to the paved road and continue east.

23.9 STOP 4. Pull off on dirt roads on the LEFT side of the road. Leader vehicle will stay at turn, rest of the vehicles circle around the road and find parking places.

Look at the rock in this area. What does it look like to you? Is it more similar to the granitic rocks or the volcanic rocks that you have seen today? Use a magnifier if you have one. The quartz in this rock has a distinctive "wormy" texture that identifies it to a geologist as a volcanic tuff unit known as the "tuff of Campbell Creek" named for its type locality in the Desatoya Mountains in central Nevada! This is another of the older Oligocene tuffs that underlie the darker, Miocene volcanic rocks we have seen.

Return to highway and continue east.

24.5 Turn right at the "T" onto dirt road where sign says" Crystal Peak – Mt. Adams"

24.6 Bear right staying on main dirt road.

25.1 Bear left on main dirt road.

26.1 Old wooden loading dock on left, probably associated with early mining activity. Note the position of large trees relative to loading dock. What do they tell you about the age of the most recent use of the loading dock?

26.1 At road junction, continue straight.

26.7 STOP 5. Pull off main road and park along road without blocking road.

This is the site of the old Mohawk and Last Chance copper mines, which were discovered about 1905 and mined sporadically for 20 years or so. Abandoned mines can be very dangerous places. The adits (tunnels) and shafts that were driven to mine these deposits have caved and are no longer accessible. Never enter abandoned mine workings – Stay Out and Stay Alive! We can, however, get a good idea of what was mined here by looking at the waste rock dumps (photo 6). – conical piles of rock that was excavated from the old mine workings as the miners drove adits to reach the veins of ore.

Cross the creek and look carefully on the mine waste rock dumps for evidence of what was being mined here. The host rock here is similar to the granodioritic rock we first saw at Stop 1, but here it has a “fabric” or alignment of dark minerals that is probably related to plutonic emplacement.

Minerals you may find here include:

- Malachite (copper carbonate)
- Azurite (copper carbonate)
- Chalcopyrite(copper sulfide)
- Molybdenite (molybdenum sulfide)
- Scheelite (calcium tungstate)
- Black tourmaline (schorl) in quartz
- Muscovite (white mica)
- Quartz
- Actinolite (a greenish fibrous amphibole)
- Epidote
- Albite

Return to vehicles and retrace route back to the road junction near the loading dock.

27.2 Turn right, following the main dirt road towards Crystal Peak. Road will be winding.

29.2 Bear left at fork in the road. Follow sign towards Crystal Peak (not Mt. Adams/Spring Creek)

29.7 STOP 6. Pull off road on right shoulder and park along road by road cut of dark rock.

Look at the rock in the road cut here. How is it the same or different from other rocks we have seen today? It is olivine basalt, a darker volcanic lava flow with lower silica content than other volcanic rocks we have seen today. If you have a magnifier, use it to look for tiny crystals of greenish-brown olivine in the basalt. Look at the crushed rock in the roadbed. What minerals are present in it? You should be able to find white quartz with smaller amounts of pink rose quartz, as well as flakes of a golden-colored mica called phlogopite (photo 7). It is similar to the more common black mica biotite, but contains more magnesium than biotite typically contains.

Photo 6. Waste rock dumps of the historical Mohawk and Last Chance copper mines.

Photo 7. Fragments of rose quartz and flakes of golden-colored mica called phlogopite from road bed near Stop 7.

31.0 At fork in the road, bear right up the hill, following the white quartz road bed

31.3 Bear left at fork in road. DO NOT BEAR RIGHT HERE – DANGEROUS HIGH WALL DROP-OFF!!

31.5 STOP 7. PARK IN LARGE FLAT AREA ON LEFT. DO NOT CLIMB ON OR ALLOW CHILDREN TO CLIMB UP ON HIGH WALLS OF THE QUARRY!!! IT IS STEEP AND THEY WILL FALL! STAY ON THE RAMP IN THE BOTTOM OF THE QUARRY!!!

What is the host rock here? Can you determine the contact or outline of the quartz on the quarry walls? What shape is the quartz body? What other mineral(s) can you find here?

This is a recently quarried quartz mine (photo 8). Look for larger flakes or "books" of golden brown phlogopite mica (photo 9) in the mine and on fractures in the quartz in the quarry. The quartz has been crushed, screened, and stockpiled for future shipping probably as decorative landscape rock (photo 10).

Photo 8. Quartz quarry.

Photo 9. Large flake or “book” of golden brown phlogopite mica from the quarry.

Photo 10. Stockpiles of crushed and screened quartz, probably shipped for sale as decorative landscape rock.

The occasional small pieces of rose quartz you see on the ground and in the road bed come from an active mining claim farther up the hill where the mineral rights have been claimed and maintained by a family for several years. While it is permissible to collect loose pieces of rocks and minerals for personal use on public lands, it is ILLEGAL UNDER FEDERAL LAW to dig, hammer on, or excavate rocks and minerals from someone's valid mining claim. Please respect the rights of claimants in this area. It is also illegal to sell rocks and minerals collected on public lands. Please refer to brochures and information distributed by field trip leaders for additional details on collecting on public lands and staking and maintaining mining claims. The publication "Mining Claim Procedures for Nevada Prospectors and Miners" is available free online as NBMG SP6 at the NBMG website:

ftp://comstock.nbmg.unr.edu/pub/dox/sp6.pdf

This is the last stop on our trip. Retrace the route back to Frenchman Lake and south on CA Highway 284, or continue straight at the junction by the loading dock. This road also rejoins paved CA Highway 284 after a few miles.

Suggested References

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Davis, D.A., Henry, C.D., Garside, L.J., and Faulds, J.E., 2000, Eocene-Oligocene paleovalleys cross the Sierra Nevada-Basin and Range boundary, western Nevada and eastern California: Geological Society of America Abstracts with Programs, v. 32, no. 7, p. A167.

Doebrich, J.L., Garside, L.J., and Shaw, D.R., 1996, Characterization of mineral deposits in rocks of the Triassic to Jurassic magmatic arc of western Nevada and eastern California: U.S. Geological Survey Open-File Report 96-9, 107 p., 2 plates.

Garside, L.J., Henry, C.D., and Boden, D.R., 2002, Far-flung ash-flow tuffs of Yerington, western Nevada erupted from calderas in the Toquima Range, central Nevada: Geological Society of America Abstracts with Programs, v. 34, no. 7.

Henry, C.D., Faulds, J.E., Garside, L.J., and Hinz, N.H., 2003, Tectonic implications of ash-flow tuffs and paleovalleys in the western U.S.: Geological Society of America Abstracts with Programs, v. 34, no. 7, p. 346.

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), by e-mail (info@nbmg.unr.edu), 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; American Institute of Professional Geologists; U.S. Bureau of Land Management, and Nevada Mining Association. This field trip guide was prepared by D.D. LaPointe with input from Larry Garside and Jon Price, all of Nevada Bureau of Mines and Geology.

For field trip guide references and for more detailed geologic information area geology, see the web version of this field trip guide,NBMG Educational Series E43, Frenchman Lake Frolic at ftp://comstock.nbmg.unr.edu/dox/e43.pdf.