BUREAU OF LAND MANAGEMENT

BLACK ROCK DESERT HIGH ROCK CANYON EMIGRANT TRAILS

NATIONAL CONSERVATION AREA

For more information:

The geology of the Black Rock Desert is too rich to cover in this brochure. If you would like to know more, consider these publications:

Geology of the Great Basin by Bill Fiero, University of Nevada Press, 1986.

Nevada Bureau of Mines and Geology, Bulletins
B59 Geology and Mineral Deposits of Humboldt County
B70 Washoe and Storey Counties
B89 Pershing County

Winnemucca Field Office
Bureau of Land Management
5100 East Winnemucca Blvd.
Winnemucca, NV 89445
(775) 623-1500
TDD (775) 623-1588
www.blm.gov/nv

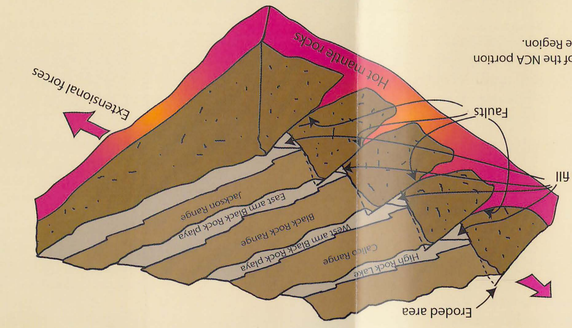
Surprise Field Office
Bureau of Land Management
602 Cressler Street
PO Box 460
Cedarville, CA 96104-0460
(530) 279-6101
www.ca.blm.gov/surprise/index.html

Friends of Black Rock / High Rock
http://blackrockdesert.org
(775) 557-2900

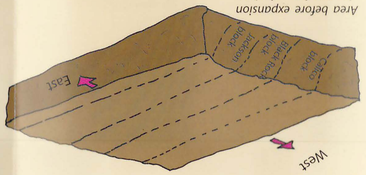
Friends of BLACK ROCK HIGH ROCK

Photos courtesy L. Duforrena, BLM, and National Archives. Illustrations: sadesign.

Basin and Range



A simplified diagram of the NCA portion of the Basin and Range Region.

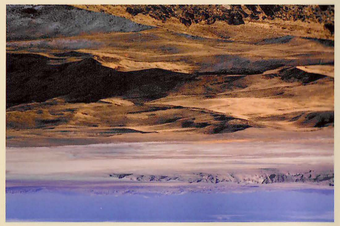


The Emigrant Trail across Nevada was particularly difficult because of the number of mountain ranges the pioneers had to climb over or go around. Nevada has over 300 named mountain ranges, several of which are within the NCA.

Why are there so many ranges? The answer has to do with the stresses on the crust across the entire area between the Sierra Nevada and the Wasatch Range in Utah. This whole area is being stretched thin from east to west.

This stretching broke the crust into fault blocks which tilted and slipped to form a series of basins and ranges. Sediments eroded from the top of the ranges have filled the basins below. The NCA is part of this Basin and Range region.

These faults have been conducts for relatively recent volcanic activity within the NCA. In addition, hot mantle rocks close to the surface heat groundwater which gives the region its many hot springs.



Ancient history

Before dinosaurs roamed the earth, during a time called the Paleozoic Era, much of what is now western North America was not attached to the continent at all. California, Oregon, Washington, and parts of Idaho and Nevada had not formed yet. The coastline ran east of Nevada, splitting it along a northeast-running line. The NCA area was located over the equator.

To the west of this ancient coastline was a subduction zone, a trench where one plate slowly moves under another. In this case, the denser Oceanic Plate melted as it was subducted beneath the North American Plate, resulting in a series of volcanic island chains.

A piece of the Oceanic Plate with a series of volcanic island chains eventually collided with and accreted to the western edge of the North American Plate. This newly attached land contained volcanic rocks interlaced with oceanic sediments, such as the black limestone of the Black Rock. These rocks now make up or underlie much of northwestern Nevada, including the Black Rock, Pine Forest, and Jackson Ranges.

The Black Rock itself, the namesake of the desert, is a piece of an ancient island chain. From far away its black color fools the eye. It looks like basalt, but the Black Rock is really made up of layers of volcanic rocks and limestone, remnants of those transported island chains. Look closely. You may find marine fossils in the rock!

Shaping the Land

The forces that shape the land are ongoing today, but most of the time they are too slow to see. The processes listed here have created today's landscape in the NCA.

Tectonic movement of the earth's tectonic plates causes broad regional uplift, depression, and/or volcanic activity. In the NCA volcanic activity has moved slowly from east to west.

Later, broad regional stretching of the earth's crust caused the series of fault blocks and valleys found in the NCA and Great Basin.

Erosion by wind and water cuts through rock and soil and deposits this eroded material elsewhere. The Black Rock Playa and alluvial deposits are made of material eroded from surrounding mountain ranges. High Rock Canyon was cut by water erosion which was channeled by a large fault.

Gravity moves material downhill and deposits it. Landslides can cause sudden, dramatic changes to the landscape. High Rock Lake was created when a landslide blocked the outflow of water.

Igneous processes can cover the land surface with erupted material, deflate an area when magma flows out from under it, or blast whole mountains away when a caldera explodes. Many of the rocks in the NCA are of volcanic origin.

Glaciers move and deposit material and can depress the land by their weight. Blue Lake is a cirque lake caused by an old glacier in the Pine Forest Range just outside the NCA boundaries.

Welcome

Pioneers passing through the Black Rock Desert in covered wagons described the harshness of the landscape in their journals. Many of the sites they wrote about are interesting geologically. This brochure includes a map of well-known landmarks along the Emigrant Trail with both geologic and pioneer descriptions for you to enjoy as you explore the National Conservation Area (NCA).

The relative emptiness of the Great Basin makes it easy to see the geologic features that give this land its shape. Geology tells us what is under the surface, too. What is this desert made of? What sort of rocks have long attracted miners seeking their fortunes?

The desert and surroundings have a rich and dramatic geologic history of ancient oceans and colliding island chains. Enormous glacial era lakes once filled the basins and deposited silt beds in what are now dry lake bottoms.

Come explore the geology of the Black Rock basin. See the curiosities that delighted travelers old and new. Learn the history written in the stones that goes back millions of times further than any human journal.

BLM
NEVADA

GEOLOGY of the BLACK ROCK DESERT-HIGH ROCK CANYON AREA

Black Rock Desert - High Rock Canyon Emigrant Trails National Conservation Area

NATIONAL SYSTEM OF PUBLIC LANDS

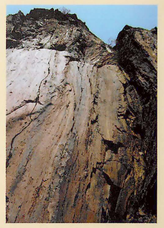
Volcanic activity

A series of volcanic rocks, lavas, ash flows, and breccias blanket the northwest portion of the National Conservation Area. These rocks, dated from roughly 30 to 15 million years ago, also cover parts of the Calico and Black Rock ranges.

The High Rock area contains the remnants of several extinct volcanic calderas. The Soldier Meadows basin is a caldera, formed by an explosion and resulting collapse of a large volcano.

The rocks themselves vary in composition from basalt to rhyolite, which is the volcanic equivalent of granite and is found in High Rock Canyon. Rhyolite eruptions tend to be explosive and violent with more ash than lava.

Take a close look at the rocks that make up the canyon walls to see flow banding. Many people think this is the result of tectonic forces, but it is actually the result of flows from the volcanic eruption that produced the rock. The image to the right is a boulder of this type.

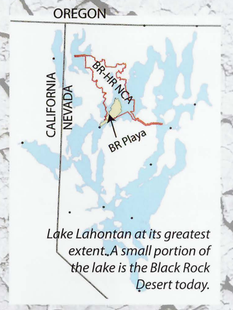


Volcanic rocks commonly bear mineral deposits when altered by hot water. Prospectors have always had hope for this region but economically valuable deposits are comparatively sparse within the NCA.

Lake Lahontan

Can you see horizontal terraces on the lower slopes of the mountains surrounding the playa? These are old shorelines of Lake Lahontan that once filled the Black Rock Desert and most of the basins of northwest Nevada.

This huge lake was deepest during the last Ice Age around 14,000 years ago. The highest shoreline is 514 feet above the current playa surface. With no outlet, Lake Lahontan slowly dried up when the climate no longer provided it with enough water to maintain the lake.



Lake Lahontan at its greatest extent. A small portion of the lake is the Black Rock Desert today.

(Source: USGS)

Playa

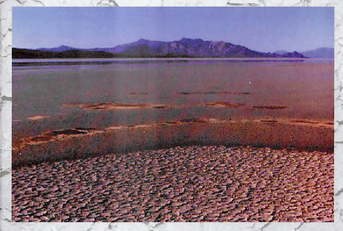
Today, the white playa silt hides the ancient gravel surface of the Lahontan lake bed.

The playa surface covers over 100,000 acres and the playa sediments are over 10,000 feet deep at the thickest point.

The intermittent Quinn River floods the East Arm of the playa seasonally with a small amount of water and fine sediments. In the dry season, the water simply evaporates into the atmosphere again. The evaporation leaves behind dissolved mineral salts, making the playa surface unsuitable for most plants.

As the playa dries, cracks form on the surface because the playa is composed of fine silt and clay minerals. When they are waterlogged, clay minerals expand, and when they dry out, they contract to form the familiar cracked pattern seen on the lake bed.

Lake Lahontan deposited these fine sediments slowly and evenly on the floor of the lake, creating the extremely flat surface that you see today. The coarser eroded materials were deposited quickly in the alluvial fans close to the mountains from which they eroded.



Hot springs

Where does the water come from and why is it so hot? Rain and melted snow trickle down into the ground through rock pores and fractures. The relatively thin crust of the Basin and Range is heated by its proximity to the earth's mantle. Groundwater does not have to go very far before it becomes superheated and rises back to the surface through the plentiful faults of the region.

Trego, Black Rock, and Double Hot springs are aligned with the Black Rock Fault, which is the boundary between the West Arm and raised East Arm of the Black Rock Playa.

Historically the hot springs provided oases for travelers and their animals crossing the Black Rock desert. Today, some Nevada springs are being explored as possible sources for renewable geothermal energy.

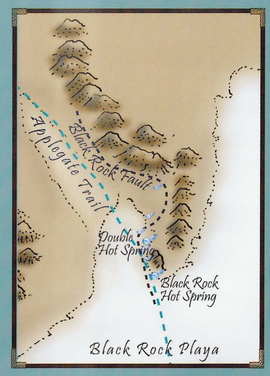
At Soldier Meadows, the springs are extensive and cool enough to support unique snails and fish that are found nowhere else on earth. Soaps and sunscreen can kill unique life forms.

HOT SPRINGS CAN SCALD OR KILL ANIMALS AND HUMANS.

STAY OUT AND STAY ALIVE.

In Trego, Black Rock, Double Hot, and Soldier Meadows springs, bacteria live in water too hot for anything else to survive. These lively microbial ecosystems provide the startling blues and greens in the pools. These bacteria utilize the minerals dissolved in the spring water for nutrients, and sunlight and hot temperatures for energy.

Double Hot springs shows the striking colors created by its micro flora in water that is nearly 180° F.



Fossils

A number of interesting fossils have been found in the Black Rock Desert. At least two mammoths met their end bogged down in the muddy lake shore of the Black Rock Desert. Their fossilized skeletons have been excavated and can be viewed at the Humboldt County Museum and the Nevada State Museum.

In the northern portion of the NCA, layers of volcanic ash contain plant and animal fossils. These include ancient pigs and horses from between 13 and 15 million years ago.

One of the most common fossils is petrified wood. **The Lund Petrified Forest** is located just outside the boundary of the NCA on Highway 34. A forest of Giant Sequoias grew here 16 million years ago when the climate of the region was very different. A volcanic eruption smothered whole groves of these trees with volcanic ash. The ash preserved them and water-deposited silica replaced the wood so entire stumps and logs remain intact as a fossils today.

THE COLLECTION OF PETRIFIED WOOD AND FOSSILS IS PROHIBITED IN THE LUND PETRIFIED FOREST.

Within the NCA and Wilderness Areas, collection of either petrified wood, common invertebrate fossils, rocks or minerals is limited to 25 pounds per day plus one piece with a maximum collection of 250 pounds per year.

The Black Rock Desert - High Rock Canyon Emigrant Trails National Conservation Area protects a large segment of the Applegate-Lassen Trail, which remains much as it was when the pioneers passed through this area more than 150 years ago. Emigrant journals describe the landmarks that marked their passage through this rugged and difficult land.

Pioneer descriptions and geologic facts are offered here for your self-guided tour of these geologically and historically important features in the NCA. We hope you will enjoy exploring this historic and prehistoric journey.

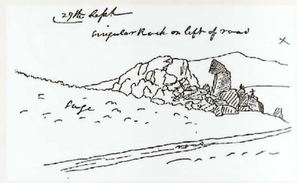
Stevens Camp

Moved our camp a few miles above on account of better water and grass. Here it is concluded to spend a day of rest. Near our camp is one of the most beautiful springs of cold water gushing out of the mountain I have ever seen.

Jonathan Clark September 22, 1849

The water at Stevens Camp springs was the first really good water along the trail since the emigrants entered the Black Rock area. This big spring follows a major fault which channels the water that is collected in the large watershed above it.

Singular Rock



Singular rock on left of road
J. Goldsborough Bruff September 29, 1849

A localized fumarole (vent formed by escaping gases) occurred during the cooling of a thick, but still plastic rhyolite flow. The gases hardened the vent so that it eroded more slowly than the material surrounding it.

Californian

This vertical basalt dyke was a feeder vent for younger flows in the area. The dyke is harder than the older volcanic rocks into which it intruded.

... a very exact caricature of a Californian done in red basalt. He seems to be kneeling at the south end of a long block of stone. His body thrown forward, elbows on his thighs and chin on his hands. A pretty large nose, and a decently long chin, but neither are unnatural. He has a pack on his back, and appears to be addressing a multitude of objects a few yards north, among which I distinguish the head of an ape, and one of a dog.

Israel S. P. Lord September 22, 1849

Painted Canyon

The colorful walls of Painted Canyon resulted from a series of volcanic ash and cinder layers that have been exposed by erosion. The variety of tints are colored by their different chemical compositions.

Descending a couple of miles through a defile, we passed the most beautiful hills of colored earth I ever saw, with the shades of pink, white, yellow and green brightly blended.

Alonzo Delano August16, 1849

... high clay bluffs and hills, of the most delicate and beautiful warm tints, in horizontal strata.

J. Goldsborough Bruff September 20, 1849

Hot Springs

Because the earth's hot mantle rocks are relatively close to the surface in the Great Basin, springs with geothermally heated water are common throughout the region.

Some hot springs in the NCA are particularly interesting because they provide habitat for species that are found nowhere else on earth. These vestiges of Pleistocene life forms have been isolated long enough after the evaporation of Pleistocene lakes to have evolved into distinct species that are found only in those springs.

Some springs are dangerous as they are hot enough to scald. Habitat for rare species can be ruined by pool-building, sunscreen, and soap contamination. Please respect these unique resources.

At the noon halt…were several boiling springs, two of which were great curiosities, the twins standing side by side… they are…about 30 feet in diameter…here we did our washing, and cooked our beans in the spring. (Double Hot) *Isaac Foster August 15,1849*

Encamped at the Black Rock mountain & Boiling Spring…. We passed upwards of thirty waggons to day that were left on this desert in 1849 & Bones of hundreds of Cattle & Blacksmith tools, saw mill Saws & Different kind of machinerys &c. *Solomon Kingery July 31,1852*

High Rock Canyon

The walls of High Rock Canyon are made of layers of thick rhyolite, welded tuffs, and lava flows. The deeply incised canyon was eroded by water which was concentrated and channeled along a structural weakness (fault) in these volcanic layers.

Fires were absolutely necessary for the fingers, mine were never colder even during the rigours of an Atlantic winter. The thermometer at 6 o'clock standing at 11 degrees above zero and by noon it was up to 90! Such is August 29th, 1849!

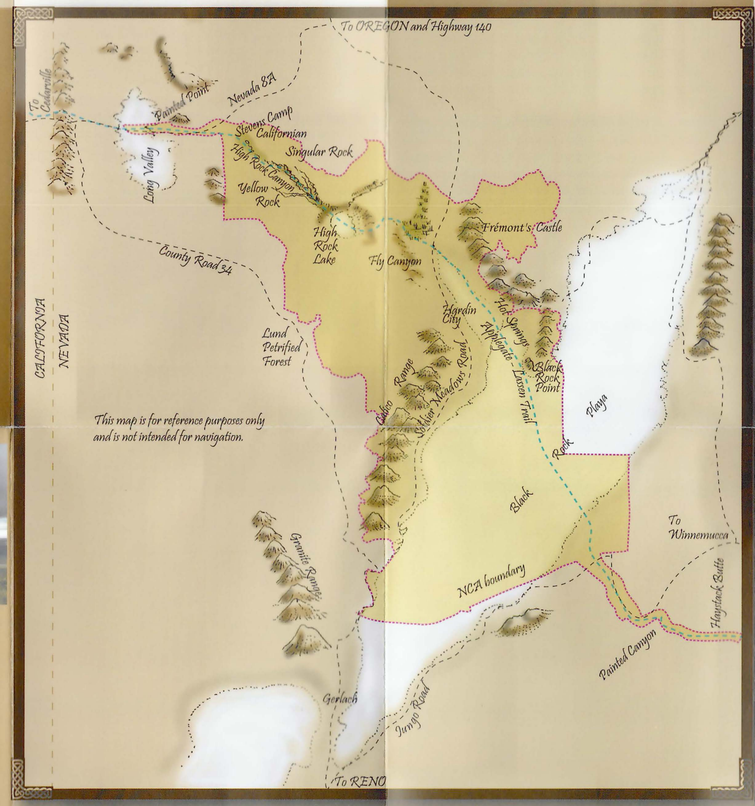
Charles Glass Gray August 29, 1849

On both sides, the mountains showed often stupendous and curious-looking rocks, which at several places so narrowed the valley, that scarcely a pass was left for the camp.

John C. Fremont December 30, 1843

The mocking rocks were apparently ready to join the glee of the boys, for they answered back their words and sent them ringing along from cliff to cliff.

William Swain September 29, 1849



Yellow Rock

This section is broad and has some fine rocks on the right. They are whitish and bright yellow, shaded with light green Stock water at the upper end, and beyond the yellow rock and under some white ones crowned with basalt is a fine spring. Just beyond on the right is the grave of "G. F. Woodin, Jefferson Co. Wisconsin. Died Sept. 2, Aged 40 years. *Israel S.P. Lord 1849*

Here, there is an intersection of two faults which provides a conduit for magma-generated hot waters that are highly mineralized and acidic. These waters chemically altered previously deposited tuffs, forming new minerals which then weathered to produce the variety of colors seen here.

Frémont's Castle

From our position at noon across the valley to the N. by W. was a very remarkable resemblance of a castle or fortress, of a white substance, [probably clay], in the face of a brownish hill, resting on a shelf of the rock, about 1/3 from the plain; This I sketch'd and named it Frémont's Castle. It is about N.W. by W. from Black-Rock.

J. Goldsborough Bruff September 23, 1849

This topographic feature is made up of material from a localized and well consolidated ash flow that has been sculpted by erosion.

Haystack Butte

In the middle of the plain to the north, 6 or 7 miles from the road, rose a beautiful mound or peak in the shape much resembling a haystack. On approaching it I found it to be of micaceous granite, something about 100 feet high and 1/2 mile in circumference at the base.

Andrew Lopp Murphy September 6,1849

This distinctive landmark is a 115 million year old chunk of Cretaceous granite that is surrounded by an apron of recent Pleistocene lake deposits. It sits above the surrounding lake deposits because the granite is more resistant to erosion than the softer lake deposits.

Painted Point

I turned and looked back at the mountain we had left, Painted Point. On the west it presents a bold front of white rock, most singularly striped horizontally with yellow and orange. I never before saw anything like it.

Israel S. P. Lord September 25, 1849

Painted Point is an example of inverted topography. Here a basalt flow filled in a topographic depression in older, softer ash deposits. The softer ash eroded away leaving the resistant basalt cap and underlying material.

Long Valley

We had gone on a desert plain about twelve miles, when before us we saw a pond of clear water, perhaps five miles in circumference, and we all hurried to the muddy beach to quench our thirst, and eagerly dipped up our cups full. "Salt." roared one– "Brine," echoed another–"Pickle for pork," said a third; and with thirsty throats, we resumed our toilsome march.

Alonzo Delano August 24, 1849

Long Valley is a classic example of a down-dropped basin that filled with water during the Pleistocene to became Lake Meisner. The valley is filled with these lake bed sediments and alluvium eroded from the surrounding mountains.

The Black Rock Playa is a remnant of Pleistocene-era Lake Lahontan, which was once filled over 500 feet above the present playa surface. The playa itself is made of 10,000 feet of fine materials eroded from the surrounding mountains. As one of the flattest landforms on earth, it was topographically one of the easiest portions of the trail for emigrant travel, yet it was the most feared because of its harsh conditions.

In about 12 miles the greasewood and sage which had been tolerable plenty gave place to a perfectly barren plain called the Salt Plain, from the saline incrustation on the surface of the ground which glistened in the moon beams and had very much the appearance of an endless field of snow.

Andrew Lopp Murphy September 8, 1849

Black Rock Playa

Late in the afternoon we gave our oxen a bucket of water each with about a qt flour stired into it and started across a plain called salt plain said to be 12 miles across.

Anaias Rogers Pond August 25, 1849

....This part of the road might have been traced by the line of dead Cattle. Many were not yet dead but too weak to stand, and many more were reeling over this barren waste in different directions, allured no doubt, as men frequently are, by the illusive mirage which represents lakes of water at no great distance.

Elijah Preston Howell August 24, 1849

Black Rock Point

This major landmark for the Applegate-Lassen Trail is made of andesitic lavas and fossil-bearing limestone, a result of the collision of the Oceanic Plate with the North American Continental Plate. Volcanic material from ancient island chains is interlaced with deposits from the ancient sea that surrounded them. You might find marine fossils in the blackened limestone!

We passed the rocky cape, a jagged broken point, bare and torn. The rocks are volcanic, and the hills here have a burnt appearance–cinders and coals occasionally appearing as at a blacksmith's forge.

John C. Frémont January 3, 1844

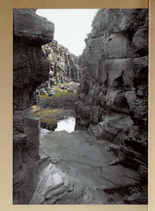
At break of day we reached Black Rock–an immense mass of dark-colored basalt, with high precipitous sides, from beneath which issue large boiling springs, furnished quite a rivulet for the thirsty plains below.

George Edward Hayes September 4, 1849

...At the end of the ridge we found an immense boiling spring from whence the steam was rising like smoke from a furnace. A large volume of water issued from the spring which irrigated several hundred acres of meadow. Although the water was strongly impregnated with alkali, it was fit for use when cooled, and the spot was, on the whole, a very good camping place for the desert.

Lindsey Applegate July 12, 1846

Fly Canyon



Had some verry stony rodes. One hill we locked both wheels & put on ropes to let our wagons down. All got down safe. Saw some hundum sights along the rocks. Holes maid buy the wind.

Abram Mines August 17, 1849

High Rock Lake

... valley has near the middle a mud bottom, now dry like the great mud lake.

Israel Lord September 21, 1849

Erosion produces dramatic landforms in the desert. The landscape looks like it is unchanging, with most erosion and deposition happening too slowly to see, but sometimes, catastrophic events shape the land suddenly. One of the NCA's most dramatic erosional features is near High Rock Lake. Long ago, a massive landslide in Box Canyon blocked the flow of water to create a natural dam. High Rock Lake formed behind the landslide dam until the water rose to the level of another outlet, Fly Canyon.

Sudden outflows of water from High Rock Lake tore away the rock of Fly Canyon. Violent vortices of water and rock drilled holes in the streambed. Emigrants passing through this canyon noted huge potholes in the stream bottom with one almost one hundred feet wide and undercut twenty feet at the bottom.

Lund Petrified Forest

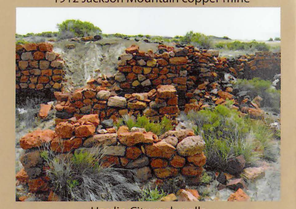
Named after George W. Lund, the first modern naturalist to describe it, the Lund Petrified Forest site consists of over 250 petrified Giant Sequoia stumps with were buried upright by 15 to 16 million year old Miocene rhyolitc ash. The 40 acre site was once part of a forest of these towering giants. One stump is over 4 meters in diameter! Located just outside the NCA boundary, the site has been protected by a BLM fence since 1965. Please note the collecting of petrified wood and fossils is prohibited here.

Mining in the NCA

In1849 James Hardin, a member of a wagon train passing along the Applegate-Lassen Trail, collected ore samples that he believed to be lead, from the nearby Black Rock Range. Years later he had the ore assayed and found it to be high in silver content. In 1858, he and a party of men tried unsuccessfully to relocate the lost silver source. Hardin City was built in the area in 1866 when it appeared that a silver ledge had been located with a waxy black clay that looked like hornsilver (a silver chloride ore of silver) at first glance. A dishonest assayer asserted that he could extract silver from this material using a secret fluxing agent. This "discovery" created much excitement and mills were brought in to process the "ore". The assayer and his secret fluxing agent soon disappeared, and the town site was totally abandoned by the summer of 1868. Foundations of the small settlement of Hardin City still remain.

Since these early mining attempts, prospecting for silver, gold, uranium, opals, sulphur, antimony, tungsten, gypsum, petroleum, and nitrates has taken place within the NCA. Prospects, shafts, adits, mining equipment, mining claim markers, small structures, and foundations can still be found. Today, only traces remain of other towns such as Sulphur, Rosebud, and Scossa that were established in or near the NCA.

1912 Jackson Mountain copper mine



Hardin City rock walls

Glossary of geologic terms:

Rhyolite: a volcanic rock that most commonly resembles granite but can range from pumice to obsidian depending on the rate of cooling.
Welded tuff: volcanic ash that is deposited hot enough to weld together.
Basalt: common fine-grained extrusive volcanic rock. Some basalts cool slowly to form polygonal columns.
Alluvium: geologically young, loose deposits of clay, silt, sand, and gravel that have been eroded, transported, and deposited by water.
Andesite: an extrusive volcanic rock that is characteristic of subduction zones.
Dike: narrow, often vertical intrusions of volcanic material into fissures of older, surrounding rock.

Photos courtesy L. Dufurrena, BLM, Humboldt County Museum, ssdesign
Illustrations from J. Goldsborough Bruff
Map by ssdesign