GLOSSARY

Basalt: a fine-grained, dark colored volcanic rock

Contact: the surface or bedding plane between two different kinds of rock

Fen: an ancient wetland consistently saturated throughout the year by groundwater

Moraine: rock debris transported by glacial ice and deposited as ridges along the course of or at the end of a glacier

Pediment: a gently inclined erosional surface capped with alluvial gravels and cobbles

Sedimentary rock: rock formed by the layered accumulation of sediments, deposited either by water or by wind

Talus: angular rock debris accumulated at the base of steep slopes

Till: non-sorted rock debris transported and deposited by a glacier

Toreva block slide: a landslide in which a large, linear mass of largely unbroken rock has a backward rotation along an axis parallel to the face of the scarp

Vent: a small fissure from which lava flows (contrast with the explosive eruptions of a volcano)

REFERENCES

Want to learn more about the geology of Grand Mesa? The following references were used in the preparation of this road log and will provide insight into the natural resources of the area. Some of them are available at the Grand Mesa Visitors Center.

Ellis, Margaret S. and Virginia Gabaldo, 1989, Geologic Map and Cross Sections of Parts of the Grand Junction and Delta 30' x 60' Quadrangles, West-Central Colorado, USGS Coal Investigation Map C-124.

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Young, Robert G. and Joann W., 1968, Geology and Wildflowers of Grand Mesa Colorado, Mesa College, Grand Junction, Colorado

http://geosurvey.state.co.us is the website for the Colorado Geological Survey. Many excellent references on the geology of Colorado are available on-line.

www.usgs.gov is the website for the U.S. Geological Survey. You can order geologic maps and reports as well as topographic maps on-line or by phone at 1-888-ASK-USGS.

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GEOLOGIC ROAD LOG OF GRAND MESA

GRAND MESA NATIONAL FOREST
ALONG STATE HIGHWAY 65

THE TOWN OF CEDAREDGE
TO
POWDERHORN SKI AREA

Photograph by Erica (Gabehart) White

GRAND MESA, LOOKING NORTH FROM THE GUNNISON RIVER VALLEY

GO BACK IN TIME

Grand Mesa rises as a prominent landform above the Gunnison and Colorado River valleys. The lofty alpine tableland appears serene but the geology is dynamic. As you drive across Grand Mesa, you will go back in time and travel across the shoreline of an ancient sea, the expanse of a vast inland lake, the heat of molten lava, and the path of glacial ice. The open road beckons; come and learn!

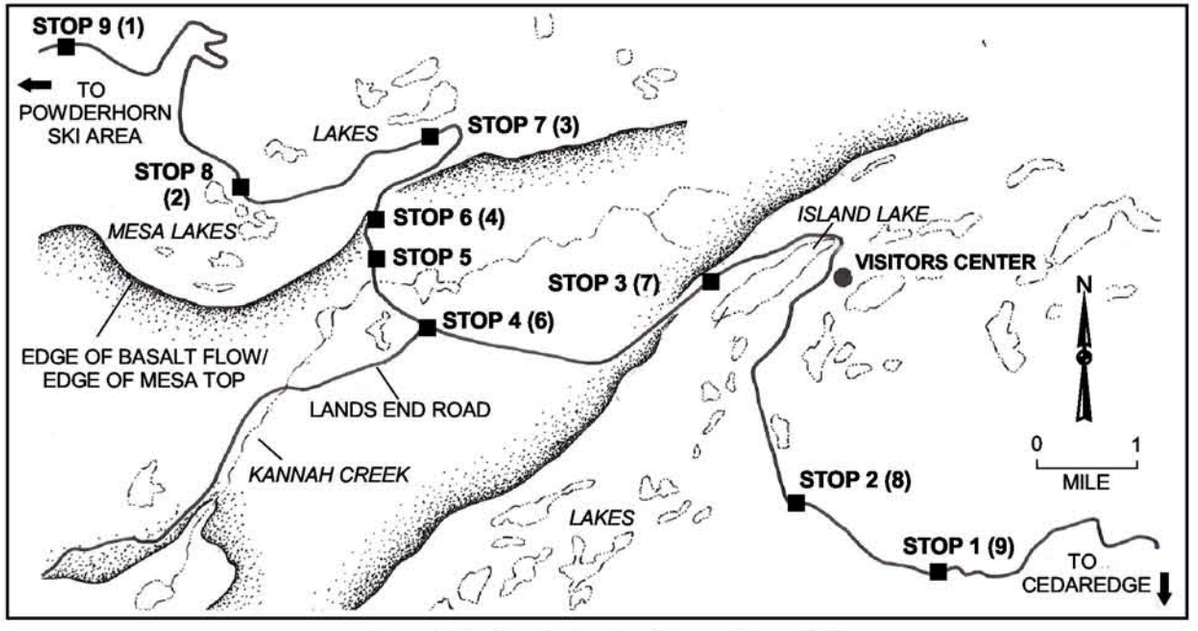
Grand Mesa-Uncompahgre-Gunnison National Forests

HOW TO USE THE ROAD LOG

Follow the general directions below to arrive at the starting point of the road log. Zero your odometer and follow the mileage notations to arrive at the geologic points of interest. If you are traveling north from Cedaredge, use the mileage notation on the left; if you are traveling south from Powderhorn and Plateau Creek, use the mileage notation in parenthesis. Pull off the road at the designated stops to look around you and read the descriptions. Some of the descriptions refer to stretches of road, so study the landscape as you travel. Don't hesitate to stop along the way, camp, hike, and enjoy the stunning scenery around you. The road log contains mileage references such as cattle guards, intersections, and trailheads to recalibrate your odometer if you take side trips. A glossary at the end of the log describes the geologic terms used.

From Cedaredge: from the traffic light in Cedaredge, follow Highway 65 north for 12.1 miles to the Grand Mesa National Forest boundary. There is a wide pull-out on the south side of the highway and the Grand Mesa National Forest sign is visible approximately 100 feet up the road. This pull-out is STOP 1 for the north-bound route.

From Plateau Creek and Powderhorn Ski Area: from the turnoff to Powderhorn Ski Area, follow Highway 65 south for 1.5 miles to the Grand Mesa National Forest sign where there is a wide pull-out. This is STOP 1 for the south-bound route.



Map of the Geologic Road Log of Grand Mesa

MILEAGE		DESCRIPTION
0	(17.8)	**STOP 1 (STOP 9):** The Grand Mesa National Forest sign is on the north side of the road. Pull out on the wide pull-out just east (downhill) of the sign and look out over the Gunnison and Uncompahgre River valleys. Directly south in the distance are the lofty San Juan Mountains; to the right, on the western horizon is the swell of the Uncompahgre Plateau. To the far left are the West Elk Mountains. Between the West Elk and San Juan Mountains is the cleft of the Gunnison Gorge, where the Gunnison River exits the Black Canyon to the confluence with the North Fork of the Gunnison in the valley below.

The view from STOP 1 encompasses a vast span of geologic time. Precambrian rock, over 600 million years old, is exposed within the walls of the Gunnison Gorge. Sediments of the next 300 million years (the Paleozoic) are missing, eroded during a time when the Gunnison River valley was once a lofty mountain range. Rocks from the Mesozioc era (248 to 65 million years ago) rest directly on the Precambrian-aged rocks in what geologists call the "Great Unconfomity". These sedimentary rocks exposed in the valley below and on the lower slopes of Grand Mesa, reflect a gradual encroachment and withdrawal of a shallow sea. Cenozoic sediments, from 65 million years to the present, are exposed along the upper slopes of Grand Mesa and reflect the formation of a vast fresh water lake fed by streams and rivers. It was into these river valleys that lava flowed about 9 million years ago. Regional erosion cut through the softer sediments and left the resistant basalt flows as a high mesa. Glacial ice and meltwater during the last 2 million years further defined the slopes of Grand Mesa, and, erosion driven by the force of gravity continues to shape the mesa.

Study the landscape below you and note the broad, flat surfaces. These erosional surfaces are called pediments. If you examined the pediment surfaces, you would find rounded basalt boulders, swept down from Grand Mesa as debris mixed with mudflows during melting of the icecap. Grand Mesa was covered with glacial ice on multiple occasions and each time the ice melted, mud

MILEAGE **DESCRIPTION**

slurries carried basalt rock down drainages. Between each glacial episode, erosion removed finer grained sediments, leaving the basalt boulders as a pediment. Streams later cut below the pediment surface to begin the process anew in a stair-step fashion. Erosion left the oldest pediments as high, isolated mesas and the most recent pediments topographically lower, near modern stream channels. These pediment mesas encircle the slopes of Grand Mesa on the south, west, and north.

0.3 / (17.5) To the north is an exposure of glacial deposits, called till, resting directly on older bedrock deposits of the Wasatch Formation.

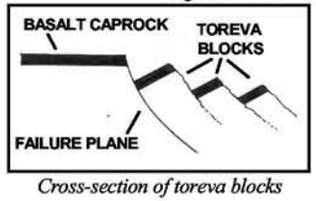
1.4 / (16.4) **STOP 2 (STOP 8):** Pull out at the parking area for the trailhead on the south side of the road, just before the bend in the road to the north. Look around you at the scattered boulders, low hills, and shallow ponds. The upper surface of Grand Mesa is flat and, during the Ice Age, was covered with a vast ice sheet as opposed to the alpine valley glaciers found in other mountains of Colorado. Rather than carve characteristic U-shaped valleys as alpine glaciers do, the ice cap of Grand Mesa flowed down the slopes of the mesa depositing irregular sheets of rock and debris called "till" by geologists. These till deposits are exposed as low ridges, shallow depressions, and hummocky topography that characterize the modern landscape of Grand Mesa. The last ice cap melted around 14,000 years ago.

2.4 / (15.4) Pull-out at Ward Creek Reservoir rest stop.

2.8 / (15.0) On the north side of the road is a large expanse of rockfall from the basalt caprock on Grand Mesa. Although the basalt rock is resistant to erosion, it contains many fissures and cracks that formed as the lava cooled and contracted. Water seeps into these cracks and freezes during winter months, expanding and forcing the fractures to widen. The result is rockfall as seen here.

4.2 / (13.6) Turn-off to Grand Mesa Visitor's Center.

5.2 / (12.6) **STOP 3 (STOP 7):** Turn out to the north to the trailhead for the Crag Crest Trail. Above you to the north is the immense edge of the basalt cap of Grand Mesa. The sheer cliff is actually the scarp of a massive rotational landslide called a "toreva" block. Look across the road to the south where Island Lake is visible through the trees. The ridge on the south side of Island Lake was once part of the mesa top behind you but slid out from the edge of the mesa as a massive slope failure over a mile long and half a mile wide. Island Lake is located in the trough between the landslide block and the mesa.

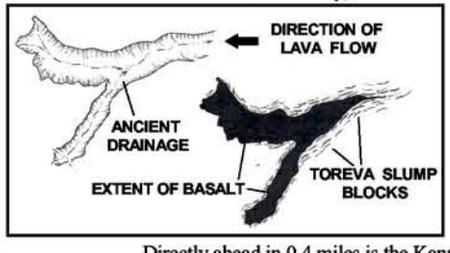


Cross-section of toreva blocks

The slopes of Grand Mesa have been carved away by these immense slope failures. The basalt caprock of the mesa rests directly on soft claystone. Look up at the basalt scarp to the north and imagine the weight of the rock. Note the fractures in the rock, a result of the molten lava cooling. Now imagine the mesa covered with a melting icecap. Water seeped into fractures in the basalt and eventually percolated to the underlying clays. The weight of the basalt pushed down on the weaker claystone, the eroded slopes of the mesa provided little support, and the edge of the mountainside moved, sliding outward. As you travel across the slopes of Grand Mesa you will see many occurrences of these toreva blocks which form a broad landslide bench on the sides of the mesa.

7.2 / (10.6) County Line Trailhead; the top of Grand Mesa. The elevation here is 10,839 feet above sea level.

8.9 / (8.9) **STOP 4 (STOP 6):** Pull off the road on the wide shoulder on the west side of the intersection of Lands End Road with Highway 65. To the west are the two western promontories of Grand Mesa, separated by Kannah Creek. Lands End Road continues to the west and descends the west face of the mesa in a series of switchbacks to intersect with Highway 50 in the Gunnison River valley, below.



From below, Grand Mesa appears as a uniform flat mesa but it is actually in the shape of a Y with the base of the Y pointing east. Two long arms of basalt extend to the west high above the valley below. The molten lava that forms the cap rock of Grand Mesa was not violently ejected from a volcano, but flowed from vents down the course of pre-existing drainages. Gradually, the channels filled with lava which cooled and hardened to a resistant rock called basalt. Regional erosion of the prehistoric landscape cut down though the less resistant sediments, leaving behind the more resistant basalt. The result is an example of inverse topography; the low valleys where the lava flowed are now preserved as a mesa high above the modern valley floor. You are standing on the surface of a prehistoric landscape where the lava flow filled ancient stream channels below you.

Directly ahead in 0.4 miles is the Kannah Creek Fen. There is no pull-out here. Read the description of the fen at STOP 5 and study the fen as you drive past. You can park at STOP 5 and walk down to the fen for a closer look.


Kannah Creek Fen

9.3 / (8.5) Kannah Creek Fen on both sides of road.

9.8 / (8.0) **STOP 5 SKYWAY TRAILHEAD:** Pull off to the parking area of Skyway Trailhead on the east side of the road. The mound of rock ahead of you is a quarry of the basalt "lava" rock that mantles Grand Mesa. The Forest Service issues permits for quarrying this rock, used for landscaping, construction, and moss rock. The Skyway Trailhead provides access for cross-country skiing in the winter and hiking in the summer. The broad expanse of Grand Mesa is used for livestock grazing; water in the many lakes and reservoirs dotting the surface of Grand Mesa is used as municipal water supplies.

The Kannah Creek fen is located in the Kannah Creek drainage south of STOP 5. A fen is fed by groundwater (a bog is fed by precipitation). Approximately 100 fens are located on Grand Mesa. A unique plant community grows in these fens resulting in the formation of peat which accumulates at a rate of 6" to 8"/1000 years. Peat thickness of 16 to 20 feet (5 to 6 meters) has been measured at the Kannah Creek fen; scientists believe that the fen has existed for approximately 16,000 years. The fen provides a unique opportunity for scientists to study past climates. Fossil pollen deep in the fen gives clues to environmental conditions while nearby organic material can date the pollen. The Kannah Creek fen is a time capsule providing insight into Earth's past.

10.0 / (7.8) **STOP 6 (STOP 4) SKYWAY POINT:** Using caution, pull out in one of two pull-outs on the north side of the road. You are looking to the north at the panorama of Plateau Creek and the Colorado River beyond. On the left is the northern promontory of Grand Mesa. Beyond, to the north, are the upper slopes of the Book Cliffs that encircle the Grand Valley at Grand Junction; further to the right on the horizon, is the Roan Plateau. The tumbling surface below you is the landslide bench below the basalt cap of Grand Mesa. Here, a series of massive toreva blocks have slid, stair-step fashion, to create the parallel ridges you see. Compare the topographic map with the view below you to pick out individual toreva blocks and look for lakes nestled in the valleys between the blocks. These sets of slope failures have formed the extensive landslide bench that encircles Grand Mesa.

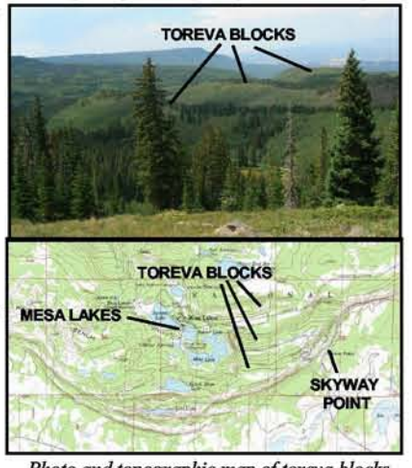


Photo and topographic map of toreva blocks

10.9 to 10.4 / (6.9 to 7.4) You are now descending (ascending) the scarp of the basalt cap. Geologists have determined that there were multiple episodes of lava flows. As you travel along this section, look for a band of reddish rock in the dark basalt. This reddish horizon was once a soil that formed on the lava and was later fired to rock consistency by the heat of the next lava flow.

11.2 / (6.6) Cattleguard.

11.9 / (5.9) View to south of fen through the trees.

12.1 / (5.7) **STOP 7 (STOP 3):** Pull out on the north side of the road for a good view of the basalt scarp above, one of the most prominent landforms on Grand Mesa. Although the basalt appears to be a single unit, geologists estimate that 8 to 9 distinct flows actually occurred. Some flows were up to 50 feet thick and the total thickness of the basalt cap ranges from 200 to 500 feet. The source of the basalt lava was not a volcano but one or more vents located near the eastern side of the mesa where the basalt caprock is thickest and thins to the west.

13.6 / (4.2) Turn-out to Mesa Lake Resort.

13.9 / (3.9) **STOP 8 (STOP 2) MESA LAKES CAMPGROUND:** Turn out to Mesa Lake Campground. Pull out at the wide pull-out or turn in for a side trip through the Mesa Lakes area. The numerous lakes on the slopes of Grand Mesa result fom the slope failures below the mesa rim along what geologists call the landslide bench. The hills surrounding the lakes at Mesa Lakes are large landslide blocks (toreva blocks) that slipped in a stair-step fashion. Geologists have noted that the ridges become increasingly weathered with distance from Grand Mesa, meaning that the furthest ridge is older than the ridges closer to the mesa.

15.0 to 16.2 / (2.8 to 1.6) This section of road crosses the outcrops of the sedimentary rock underlying the basalt cap of Grand Mesa. The rock layers (from the top: the Uinta, Green River, and Wasatch Formations) reflect the formation and subsequent filling of a vast fresh water lake called Lake Uinta. Fish and plant fossils are abundant in the Green River Formation and provide insight into the environment of Colorado 50 million years ago. Recently, a small mammal fossil called *Insectisupial* was found nearby in the Uinta Formation.


Slope failure in Highway 65 on Grand Mesa

Bedrock exposures are rare along this part of the highway due to extensive landslides. These landslides differ from the large rotational blocks higher on the slopes of Grand Mesa in that they are smaller, more recent, and occur lower on the slopes of Grand Mesa near the contact of the Green River and Wasatch Formations. As you travel along the road, look for clues of slope failures in pistol-butted trees, arc-shaped cracks in the pavement, and fresh scarps on hillsides. Maintaining a highway across this active slope failure is a never-ending process. Moisture from precipitation lubricates the soils and, under the pull of gravity, the slope fails.


Pistol butted trees

15.3 / (2.5) Highway 65 passes through a road cut in lake sediments.

17.2 / (0.6) Old Powderhorn Ski Area, also called Old Mesa Creek Ski Area.

17.8 / (0) **STOP 9 (STOP 1):** Wide pull-out on the north side of Highway 65 at the Grand Mesa National Forest sign. You are standing on the Wasatch Formation, which, in turn, overlies the Mesaverde Formation. Together these two formations reflect an environmental shift from marine shoreline to freshwater lake at the end of the Mesozoic era around 65 million years ago. The layers of the Mesaverde Formation, exposed as the steep scarps above the Colorado River in DeBeque Canyon were once beaches, swamps, and marshes along an ancient sea that slowly withdrew to the east. After the sea left, streams meandered across the landscape depositing the river-born sands and silts of the Wasatch Formation.