Rockin' in Shenandoah National Park

Touring Through the Unique Geologic History of the Local Blue Ridge

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The ridges and hollows and rich variety of rocks in the Southern Section of Shenandoah National Park reveal a geologic history full of titanic collisions of continents, volcanic eruptions on a grand scale and periods of erosion in between.

Continents large and small and island arcs collided with early North America four times since 1.1 billion years ago, each time pushing up large mountain ranges near or well east of the present Blue Ridge. In the Shenandoah Valley and further west as far as Ohio, regional down warping of the land surface formed basins which filled with shallow seas and then hundreds to thousands of feet of sediments that washed off of the new mountains.

Near the end of the first, Grenville Orogeny(mountain building event) the collision produced a long series of volcanic eruptions that spread out basaltic lava beds over hundreds of square miles.

The final collision, the Alleghenian Orogeny, was the most severe with early Africa colliding with and riding up on top of North America. The resulting mountains rivaled the Himalayas in height.

By Triassic time about 220 million years ago, the two continents began rifting apart and the modern Atlantic Ocean began filling the void.

Road Log :

The southern section of Shenandoah National Park has a larger variety of rock formations accessible than the middle and northern sections. Good examples of igneous, metamorphic and sedimentary rocks can be observed in just a few road

cuts at overlooks and on trails.

As we drive up the mountain on Route 33, most of the outcrops are of the **Catoctin greenstone basalt**. On the last roughly third of a mile near the top, the rocks change to the older **Pedlar granites(granodiorite**) This is the basement rock which underlies all of the Park and is at the surface for most of the first 5 miles driving south on the Skyline Drive. Just before the Swift Run Overlook a slide can be seen on the left. This occurred in a section of highly fractured and weathered Pedlar granite.

Stop 1: Sandy Bottom Overlook – MP 67.8

This overlook provides excellent vistas of the Shenandoah Valley, Massanutten Mountain and the Alleghenies to the west. The further west we look, the younger the rocks are since they were mostly sediments washed off the Blue Ridge or older mountains to the east. The limestones and other carbonates of the Shenandoah Valley were formed by small carbonate shelled organisms that died in a warm shallow sea in Cambrian and Ordovician times.

Across the Drive is a large outcrop of the Pedlar Formation granodiorite, a type of granite, which has many fractures and spheroidal weathering. This weathering is typical of granites and happens as stresses are relieved at the surface and the rock breaks off in layers like an onion. Half Dome in Yosemite is another example.

The Pedlar was formed deep underground during the Grenville Orogeny between 1.1 billion and 800 million years ago.

The nearby outlying ridges, including Rocky Mount on the left and Hanse Mountain on the right are held up by resistant layers of **Erwin-Antietam Formation** sandstones and quartzite. These are the youngest rocks in the Park.

The Swift Run Formation is a narrow band of metamorphosed sediments which

represents the material eroded off of the Pedlar granites before the Catoctin lava flows began. We cross the Swift Run at Smith Roach and Powell Gaps, but the only outcrop is just south of Powell Gap on the left.

Stop 2: Loft Mountain Overlook- MP 74.3

This stop on the east side of Skyline Drive has good views across Rockfish Valley and the Ragged Mountains south of Charlottesville can be seen in the distance. The original Blue Ridge anticline(up-fold) extended to the east side of Charlottesville and the present Rockfish Valley was beneath a mountain range the size of the Himalayas. Sequences of rocks that match those along the Drive are found around Monticello and the ridges north and south of there.

The **Catoctin Formation basalt** from one of the volcanic flows, altered to greenstone by metamorphism, is in the outcrop at the parking lot. Three distinct features of these basalt flows can be seem here. Small pockets in the lava were formed by gas bubbles near the surface and as the magma solidified these were filled with minerals such as quartz, epidote and hematite, called **amygdules**.

The second feature is purple coloring at the surface in some areas where the lavas were exposed to weathering for hundreds of years or more prior to the next lava flow and iron in the rock was oxidized.

The third feature is **slickensides** on the surface where one mass of solid rock slid along another at faults or other stress zones.

These appear as parallel lines or closely spaced shallow grooves and have a slick look and feel.

There are also irregular pods of minerals within the basalt such as pistachio green epidote formed by mineral migration during metamorphism.

The stone wall on the edge of the parking lot has mostly **Erwin-Antietam Formation** sandstone and quartzite and we can see fossilized worm tubes in these rocks known as ***Skolithos***. This rock was brought from the ridges further west in the Park.

Stop 3: Rockytop Overlook- MP 78.1

Here there is a view to the west of Rockytop with extensive outcrops of the Erwin-Antietam quartzite which have eroded and formed talus slopes of loose boulders beneath the outcrops. Large folds in the Antietam layers can be seen in Brown Mountain to the north, revealing some of the heavily folded structure of the Blue Ridge. Several thousand feet of sediments have eroded from above these quartzites.

The road cut here has **Hampton-Harpers Formation** tan and grey sandstones, somewhat younger and more erodible than the Erwin-Antietam. We can see the original layering dipping gently to the right and extensive fracture planes at sharp angles to the bedding. The Harpers also has some shales and phyllites and often rusty weathering due to the iron content.

Stop 4 and Hike: Doyles River Overlook and Appalachian Trail- MP 81.9

Here we take a short hike south on the AT to examine a large outcrop of the **Weverton Formation** sandstones, meta-conglomerates and phyllites.

The outcrop has a series of graded sandstone bedding with coarser pea sized grains in the bottom layers becoming finer as the layers pile upward. These were deposited in a shallow sea, each series probably in a single storm event.

Layers of mud in these sediments first solidified to shale and then these were metamorphosed into phyllites. These have eroded more in some locations, causing overhanging layers of conglomerate and sandstone.

In other areas the phyllites have developed sloping layers at angles to the sandstone bedding. These are not bedding, but are due to the metamorphic alignment of the mica minerals in the rock. Some scouring between beds is also evident where storms eroded out some sand and mud layers before other layers were deposited on top. Some fractures in the sandstones filled in with quartz in later stages of the mountain building.

Recommended Reading Materials

- ‘Geology along Skyline Drive, A Self-Guided Tour For Motorists’, Robert L. Badger, Shenandoah National Park Association, 2012
- ‘Roadside Geology of Virginia’, Keith Frye, Mountain Press Publishing Co., 1991
- ‘Geology of the Shenandoah National Park, Virginia’, Thomas M. Gathright, II, Bulletin 86, Va. Division of Mineral Resources, 1976
- ‘Shenandoah National Park, An Interpretive Guide’, John A. Conners, The McDonald & Woodward Publishing Co., 1988