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A Hiker's Guide to the Geology of Old Rag Mountain, Shenandoah National Park, Virginia

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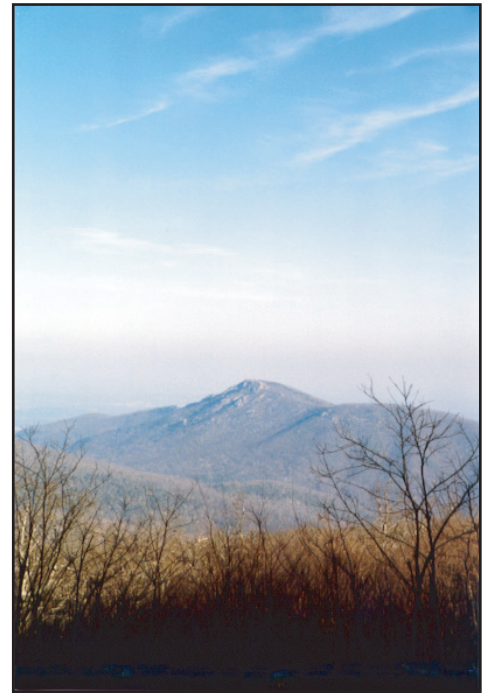
Old Rag Mountain is one of the most popular hiking destinations in Shenandoah National Park and draws thousands of visitors each year from throughout the mid-Atlantic region. The scenic ridge trail along the mountain's rocky crest provides for an invigorating excursion enjoyed by outdoor enthusiasts of all ages, during all seasons of the year.

This presentation is designed as an earth science educational tool that you may use for a visit to Old Rag Mountain. The primary intent is to describe the geological features of the fascinating rock forming the mountain, a formation known as the Old Rag Granite. As you scramble and crawl over outcrops of Old Rag Granite on the mountain's craggy peak, you are treading on the evidence of an ancient mountain-building event that occurred over one billion years ago!



Old Rag Mountain seen from Skyline Drive

A map and walking tour of the ridge trail is included in this guide to help you appreciate the magnificent geological features visible in the rocks of Old Rag Mountain. In addition, you will learn about the physical forces and processes that have shaped the mountain, and a little about the plants and animals that inhabit its rugged slopes.

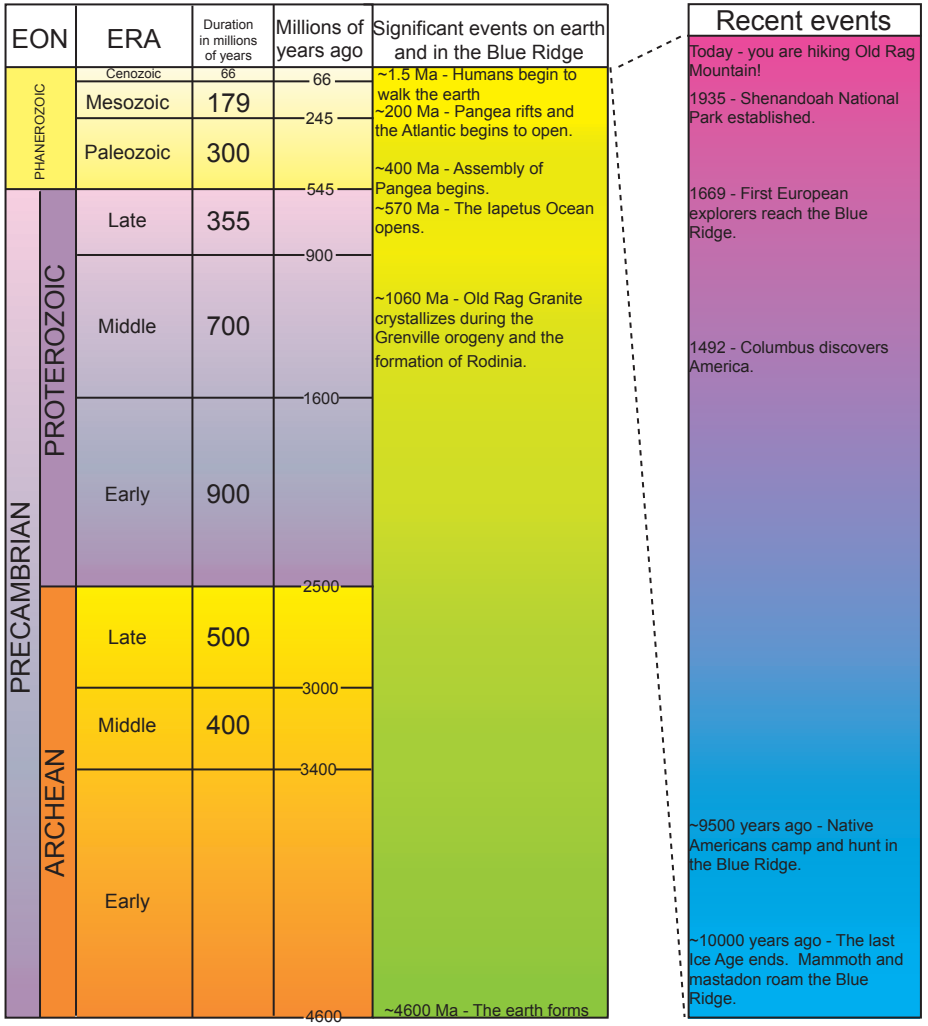
Preservation and conservation of Shenandoah National Park's natural resources are important things to keep in mind during your visit to Old Rag Mountain. The popularity of the Old Rag Mountain ridge trail has resulted in overuse and abuse and has necessitated an intensive effort by the National Park Service to educate visitors in environmental stewardship.

During a visit to this splendid natural monument that is your National Park, it is your civic duty to preserve, conserve, and to leave no trace of your visit, so that future guests in the Park may share its plentiful natural wealth. The beauty of the natural world is your reward for visiting Old Rag, a magnificent scenic resource to cherish and protect.

The Geologic History of Old Rag Mountain

The earth's surface is in a slowly evolving, continuous state of motion. Great mountain ranges are thrust up as ragged, rocky peaks and then slowly erode to gentle, rolling hills. Ocean begin as narrow seas in rift basins and grow to become deep and wide. These processes are described by the theory of plate tectonics, which studies the movement of the earth's cool, rigid crust over the hot and ductile rock of the earth's interior. All of the earth's surface rocks ultimately have their origin in tectonic processes, whether it be the granitic rocks found in mountain belts where the earth's crust moves together, or the basaltic rocks found in ocean basins where the earth's crust moves apart. The rocks on Old Rag Mountain tell us a fascinating story of plate tectonic activity and earth history that reaches over a billion years into the past.

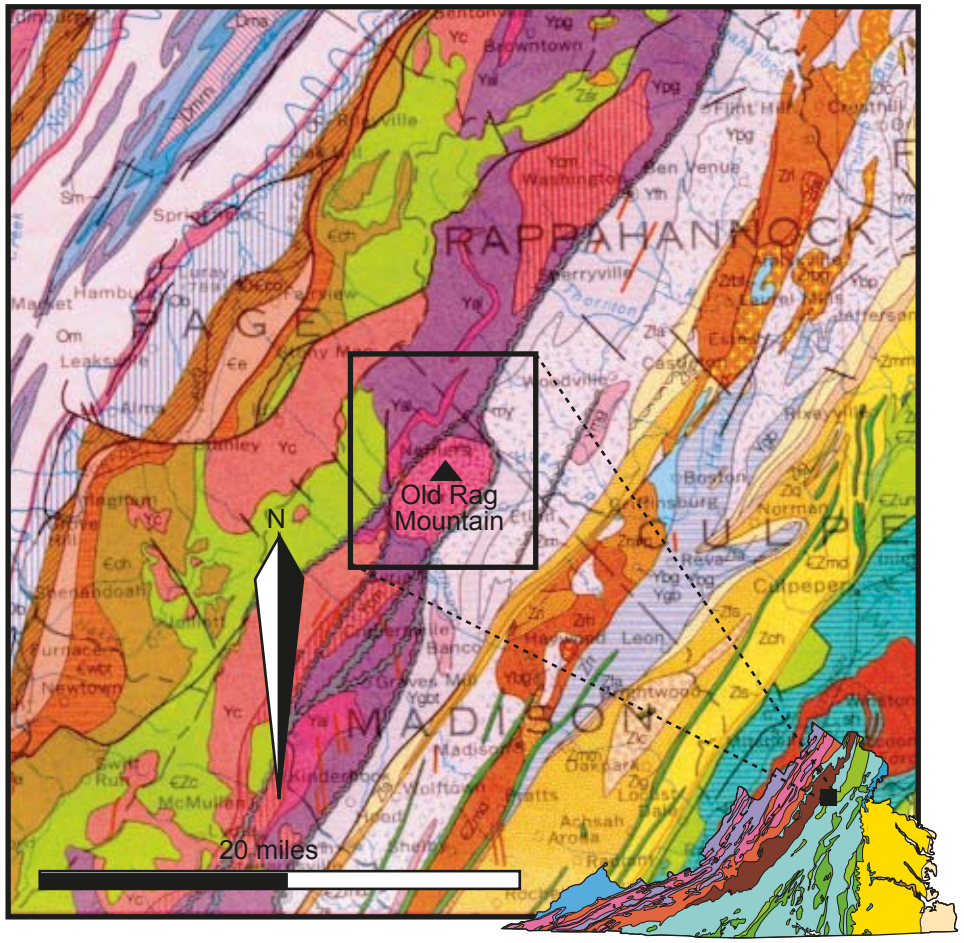
Old Rag Mountain is underlain by a rock called the Old Rag Granite. Old Rag Granite formed just a little over one billion years ago during a mountain-building event known to geologists as the Grenville orogeny. The Grenville orogeny formed a great mountain range that stretched from Mexico to Canada and was perhaps as high as the Rocky Mountains of the western United States. These mountains were formed when parts of the present-day continents of North and South America, India, Australia, and Antarctica slowly collided over tens of millions of years. This slow assembly of the continents resulted in formation of a supercontinent called Rodinia that was surrounded by ocean basins. As the individual continents came together to form Rodinia, intervening crust buckled, warped, and became thicker and thicker as the landmasses moved closer and closer to one another. This same process is creating the Himalaya Mountains today, as India and Asia slowly collide with one another and push up the crust between them into great mountains. Deep within the ancient Grenville mountain range, the pressure and temperature were great enough to melt the rock in places, forming magma. This molten rock slowly ascended through fractures and conduits and eventually crystallized into the rock we now see today at the surface - Old Rag Granite. Although Old Rag Granite is now exposed at the surface of the earth, the rock crystallized several tens of miles below the land surface. We know this because of the minerals and textures found in the granite. For example, as you examine the rocks exposed on the crest of Old Rag Mountain, you will notice the



The geologic time scale - This diagram shows the various eons and eras of geologic time and lists some significant events that have affected the Blue Ridge. The notation "Ma" in the green column means "millions of years ago." Notice that the earth is 4.6 billion years old! However, this great length of time probably is too vast for our minds to fully comprehend. Just imagine; If the age of the earth were only one year, then humans would have started to walk about three hours ago, and Columbus would have "discovered" America about three seconds ago!

large white crystals of a mineral called alkali feldspar. The large size of these crystals indicates that they had plenty of time to form in a magma that cooled slowly, deep below the earth's surface. In contrast, fine-grained volcanic rocks, exposed in narrow conduits called dikes along the crest of Old Rag Mountain, were erupted at or close to the earth's surface, and thus did not have time to form large crystals.

Millions of years after Old Rag Granite crystallized from magma into rock, uplift and erosion of overlying rocks of the Grenville mountain range may have exposed parts of the Old Rag Granite at the surface. We know this because cobbles and pebbles of rock similar to Old Rag Granite were eroded from the ancient land surface by running water and then deposited as sediments on top of the prehistoric landscape. These sediments have since hardened into rock and are known as the Swift Run and Fauquier formations. Since Old Rag Granite crystallized deep within the earth's crust, it may have taken as long as 300-500 million years for uplift and erosion to eventually expose the rock at the earth's surface.



You may wonder why Old Rag Mountain is such a prominent feature in the landscape. This diagram shows a portion of the geologic map of Virginia, depicting the various rock types represented by different colors and patterns. Old Rag Mountain is underlain by the hard and resistant Old Rag Granite, represented by the oval pink shape in the small rectangle above. As you can see, Old Rag Mountain is surrounded by different rock types, rocks which are less resistant than Old Rag Granite. This is the reason Old Rag Mountain stands high to the east of the main Blue Ridge, a topographic landform called a monadnock.

Several hundred million years after the Grenville orogeny the earth's crust began to thin, stretch, and eventually split as Rodinia began to pull apart due to changing plate tectonic forces. Basaltic magmas welled up from the earth's mantle through conduits and flowed onto the ancient land surface as lava about 570-600 million years ago, following deposition of the Swift Run and Fauquier sediments. This lava cooled quickly into rock known as the Catoctin Formation or "greenstone" exposed to the west of Old Rag Mountain along Skyline Drive. Repeated eruptions of lava eventually covered the earth's surface and the Old Rag Granite with thick layers of volcanic rock. Continued splitting and extension of Rodinia eventually resulted in the formation of a deep ocean basin to the east of the Grenville mountain range called the Iapetus Ocean. This ancient ocean was located in the approximate area of the present-day Atlantic Ocean. Rivers draining into the Iapetus Ocean deposited sandy sediments eroded from the Grenville Mountains on top of the Catoctin Formation and underlying Old Rag Granite. These sand particles were later cemented into hard quartzite rock known as the Weverton Formation. As the Iapetus Ocean basin became deeper and wider, finer-grained silty sediments were deposited over the sands of the Weverton Formation and eventually hardened into a rock known as the Harpers Formation, named for rocks exposed at Harpers Ferry, West Virginia. Sands deposited on top of the silts of the Harpers Formation were later turned into rocks of the Antietam Formation, named for exposures of sandstone along Antietam Creek in Maryland. The Antietam Formation contains fossils that are over 500 hundred million years old, the oldest fossils known from Blue Ridge rocks of the northern Virginia area. Eventually, the Iapetus Ocean basin widened to the extent that silt and sand did not influence sedimentation, and instead the tiny shells and skeletons of planktonic marine organisms rained down onto the ocean floor. Millions of these minute creatures, called Foraminifera, lived near the ocean's surface and when they died, their hard calcium carbonate shells fell to the ocean floor to deposit a thick layer of what would later become limestone. Limestones created from the shells of these creatures underlie much of the Shenandoah Valley to the west of the present-day Blue Ridge. During deposition of the rocks of the Swift Run, Fauquier, Catoctin, Weverton,

Harpers, Antietam, and overlying limestone formations, Old Rag Granite probably was buried beneath several miles of rock.

At some point, the tectonic processes that created the Iapetus Ocean reversed and the ocean began to close. This process may have started as long as 450-500 million years ago and lasted several hundreds of millions of years. The final closure of the Iapetus Ocean resulted in formation of a mountain range in much the same way as the formation of the Grenville mountain range about 700 million years earlier. However, the mountains formed by closure of the Iapetus Ocean have a name that we know much better; the Appalachians. The Appalachian Mountains were created when all of the continents again came together to form a supercontinent called Pangea. Tectonic stresses from the slow assembly of Pangea generated the structures of folds and faults that are now evident in the rocks of the Appalachians during a final mountain-building event known as the Alleghenian orogeny. During the Alleghenian orogeny, Blue Ridge rocks were transported westward and locally thrust over limestone rocks of the Shenandoah Valley.

Pangea slowly began to break apart into the earth's present-day continents about 200 million years ago. Geologists think that the breakup of Pangea, and Rodinia earlier, was caused by trapped heat that had risen from the earth's interior and built up underneath the large insulating landmasses. During this time of crustal extension and breakup of the Pangean supercontinent, great rift basins formed to the east of the present-day Blue Ridge. Sediments eroded from the Blue Ridge were deposited in these basins and have since hardened into the sedimentary rocks that underlie the town of Culpeper to the east of Old Rag Mountain. As had happened during the formation of the Iapetus Ocean, basaltic magma intruded the crust and crystallized into rock called diabase, or "traprock."

As Pangea split into the earth's present-day continents, a new ocean basin developed to the east of the Blue Ridge. The name of this basin also is one with which we are very familiar, the Atlantic Ocean. The young Atlantic probably was a very narrow rift, similar to the modern Red Sea between Africa and Saudi Arabia. Widening of the Atlantic has continued to this day and the rocks of the Appalachians, including Old Rag Granite, have passively ridden westward on the eastern edge of this new ocean, without undergoing any additional tectonic processes except for erosion and possibly gentle subsidence and uplift.

Dense summer foliage on Old Rag

The rocks of the Appalachians probably have been at the earth's surface for the last 200 million years, since the breakup of Pangea and the opening of the Atlantic Ocean. Erosion has carved the topography of the present-day Blue Ridge province, carrying sediments east to the Atlantic and south to the Gulf of Mexico. Less resistant, soft rocks like limestone are removed to form lowlands like the Shenandoah Valley to the west of the Blue Ridge. Hard, resistant rocks like the Catoctin and Weverton formations, and the Old Rag Granite, are less susceptible to weathering and erosion and stand tall as mountains. Perhaps, hundreds of millions of years from now, the highlands of the Blue Ridge province will be gone, flattened by erosion. And eventually, long after we are gone, tectonic processes may again create a tremendous mountain range here.

A geologist trying to gain an understanding of the earth's history is a bit like a detective trying to solve a mystery. To decipher geologic history, a geologist must examine different rocks at various places. To crack the case, a detective must search far and wide for different clues. Bits and pieces of the last one billion years of earth history are hidden in the rocks of Old Rag Mountain but to know the whole story of the Blue Ridge you will have to hike many more trails over many other rocks! For the reader who would like to know more about the geologic history of Shenandoah National Park and the Old Rag Granite, a general list of suggested reading material is provided at the end of this presentation.

Your Visit to Old Rag Mountain

A visit to Old Rag Mountain is certain to be a rewarding experience, no matter the weather or time of year you choose to visit. The different seasons offer splendid vistas, each tinged with its own distinct character. Summer brings a warm, humid fullness to the mountain views, and the enchanting sounds of songbirds resonate throughout the hollows. With the arrival of Fall comes the rich color of the changing foliage and a crisp edge to the mountain air. The dead of Winter is fascinating in its own right, as absolute quiet wreaths the scenery. A light dusting of snow accents the landforms and winter storms deck the trees with ice. Spring brings the invigorating smells of budding life and the rich pink blossoms of mountain laurel color the landscape.

The weather will play an important role in your hike. A clear day will amaze you with the vibrant colors transmitted from the distant vistas of surrounding mountains and valleys. A humid day will remind you of how the Blue Ridge acquired its name, as you gaze toward mountain ridges framed in a misty haze. Visits to Old Rag Mountain in rain, fog, or snow offer a unique experience in the outdoors, but you must be extremely cautious. Exposure to the elements is of

serious concern on the rugged trail, and all precautions must be taken to ensure your safety in poor weather. Electrical storms occur in all seasons and lightning strikes are frequent on the upper part of the mountain. Snow and ice are very slippery underfoot and a bad fall can leave you suddenly stranded in a hostile environment. Be sure to dress appropriately for the weather, bring water, and tell someone where you are going if you plan to hike alone.

Perhaps the best time to visit Old Rag is in the winter, when you can gaze through the bare woods and see the lay of the land. Experiencing the stillness, solitude, and rugged inhospitality of the winter landscape is inspiring and instills in one a great respect and reverence for the mountain. A weekday in January may offer complete seclusion for those hikers who most enjoy the beauty of the outdoors away from the crowds. On the other hand, if you are visiting on a weekend during the peak of October foliage or on a beautiful summer day, expect to wait in line on the outcrops above. Nevertheless, the wait is well worth the views and, in addition, offers you the opportunity to converse with like-minded nature-lovers.

Old Rag Mountain is easily accessed by Virginia State Route 600, a two-lane paved road that leads west to the mountain from outside of the Park to the east. The tremendous popularity of the Old Rag ridge trail has necessitated the establishment of an overflow parking area about 0.8 miles before the original trailhead at the end of Route 600. On a crowded weekend, a park ranger will greet you here at the entrance booth of the lower parking area, where you will register for the trail and pay a small fee. The National Park Service has established an honor system by which you can register and pay the hiking fee on days when the booth is not occupied. Your responsibilities as a voluntary environmental advocate for the Park begin here. Hiking fees are used to maintain the trails and Park facilities, and for preservation of historic structures. Once registered, you may continue up Route 600 to the end of the road and the beginning of the trail. The road ends at the trailhead and from there the ridge trail leads up the mountain on an exhilarating journey of discovery.

Parking area along route 600

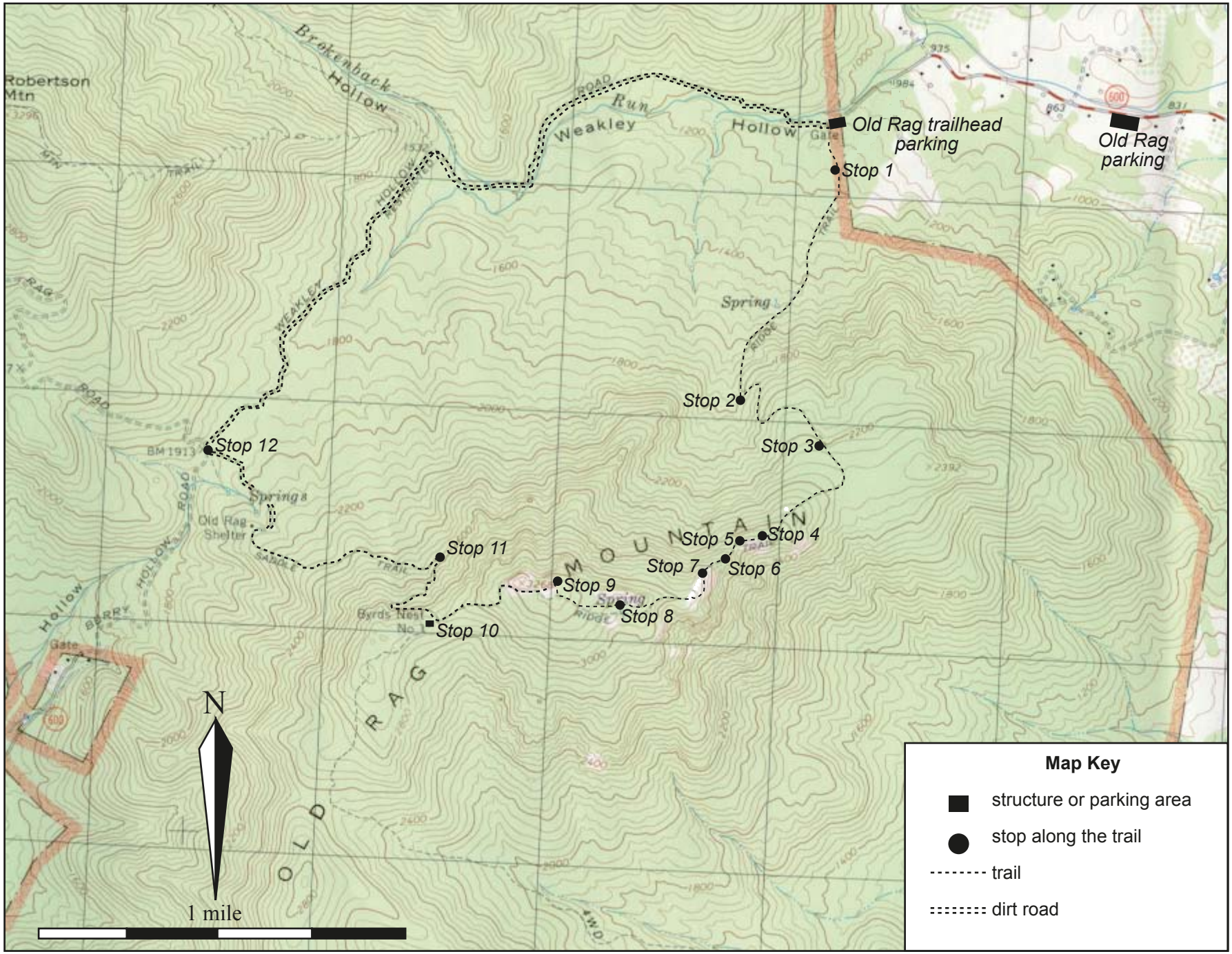

Ranger booth

Camping is not allowed along the Old Rag Mountain ridge trail or summit area. You may camp below the Byrd's Nest shelter on the far side of the mountain but please be sure to follow the rules for backcountry camping. Stay out of sight of the trail and do not build a fire. Use your common sense to make Old Rag Mountain a safe and pleasant place to visit overnight.

The remainder of this presentation provides a walking tour of geological, ecological, and cultural features present along the Old Rag Mountain ridge trail. As you hike, stops along the trail will help you to discover the majesty and splendor of the rocks that underlie the mountain. The walking tour includes landmarks to help guide you along your way and stops are keyed to numbers on the accompanying topographic map of the mountain and trail. All of the mileages in the walking tour begin from the lower parking area. Blue blazes painted on the trees and rocks help to keep you on the trail. Double blazes indicate you are approaching a switchback or trail intersection. Your roundtrip hike will be almost 9.7 miles from the lower parking area and about 7.9 miles from the trailhead parking area. You will climb up and down a total of about 4800 vertical feet. Good luck on your journey!

A Walking Tour of Old Rag Mountain

You begin your hike in dense hardwood forest of oaks, hickories, and maples on the lower slopes of the mountain. This area, as is true for most of the hollows in the Park, once was farmed, and corn grew here instead of trees. The present forest has grown only since Shenandoah National Park was established in 1935. Scattered Eastern Hemlock and Eastern White Pine add green to the forest canopy in the winter, and cast the woods in dense shadow in the summer. The forest in Shenandoah National Park is slowly changing, as disease, insects, and fierce winter storms have killed many trees. As you travel up and over the mountain you will see many recently fallen limbs as



Map of Old Rag Mountain. *This diagram shows a portion of a topographic map made by the U.S. Geological Survey. The brown lines are called contour lines and delineate a constant elevation. In other words, if you were to walk along a contour, you would never go up or down. The contour interval (the difference in height above sea level of adjacent contours) is 40 feet on this map. Notice how close together the contour lines are on the steep sides of Old Rag Mountain! The green areas on the map are wooded; the white areas are cleared fields or rocks. The boundary shown by a tan line with a dashed black line is the Shenandoah National Park boundary. Stay on the trail please!*

well as many standing dead trees. Should you be backcountry camping near Old Rag Mountain on a windy night, be sure to sleep away fromstanding dead timber as these trees could easily topple in a strong gust.

Stop 1 - (1.1 miles) Shortly beyond the trailhead you will come upon a tremendous rounded boulder to the right of the trail. This boulder is in a large fan of debris that came to rest here following a tremendous landslide thousands of years ago. The rock may now be creeping downhill at an imperceptibly slow rate because of a process called frost heave. As water in the soil below the boulder freezes into ice and expands, the rock is forced slightly upward. When the ice thaws and melts, the boulder settles back to earth but slightly downhill due to the force of gravity. This process not only moves boulders slowly downward, it helps to break them off from the cliffs above. As water filters into cracks in the rock and then freezes, the expanding ice forces the crack wider, eventually splitting the rock and sending it down slope. This process is continually occurring on all of Old Rag's slopes.

Be on the lookout for wildlife. Shenandoah has an abundance of mammals and here on the lower slopes of the mountain you may see black bears, white-tailed deer, red and gray foxes, striped and spotted skunks, bobcats, groundhogs, chipmunks, and squirrels. Don't be frightened by the possibility of seeing bears - usually a bear will run as soon as it smells you. Although aggressive bears are rare, if one confronts you, the best thing to do is face the bear and slowly back away. Wildlife is best treated by observing quietly from a distance.

Stop 1. *Boulder alongside the ridge trail*

Stop 2 - (1.6 miles) Approximately 1.6 miles into your hike you will reach the first switchback on the ridge trail. This zigzag allows the trail to maintain a gentle gradient instead of going straight up the mountainside. There are several reasons for building the trail this way. Obviously, it makes the hike easier on you. In addition, it reduces the amount of erosion that occurs on the trail surface during storm events. The shallow ditches that cross diagonal to the trail also were built to reduce erosion by funneling runoff of storm water off the trail. Switchbacks present an enticing opportunity to shortcut but please resist the temptation. Shortcutting damages the fragile plants, mosses, and lichens that grow alongside the trail and increases erosion of the mountain. In addition, many hikers, especially children, have become lost in the woods by taking what they thought was an easy switchback shortcut. The Park spends thousands of your tax dollars each year looking for lost hikers, money which could be spent on maintenance of the trail and other park facilities. Please stay on the trail and keep your children with you!

As you continue past another switchback you will see many tremendous boulders down slope to your right. The reason for the abundant boulders here is that you are walking up the west side of a hollow topped by rock outcrop on the mountain above. As the boulders are eroded from the mountain's summit region they are channeled into this hollow similar to water flowing down a stream. Boulder streams such as this are common in the Blue Ridge and were probably initiated by the voluminous snow and ice that covered the landscape here at the end of the last Ice Age about 10,000 years ago.

You may notice a slight change in the forest vegetation as you continue your ascent. The understory begins to contain more mountain laurel, a thick, bushy evergreen. In the spring and

Please stay on the trail!

Following the blazes will help!

early summer, these bushes have beautiful pink blossoms that fill the air with fragrance and color the landscape. Farther upslope you will find the trail weaving through mountain laurel so dense it forms a sort of tunnel. In addition, the forest canopy becomes increasingly dominated by evergreens and you see fewer and fewer oak, hickory, and other broadleaf trees.

Stop 3 - (2.6 miles) A spring! As you head up the north face of the ridge, the trail crosses over water trickling from a spring several tens of yards upslope from the trail. By now you have passed several switchbacks and are at an elevation of over 2000 feet. Water from this spring comes from rain that fell upon the upper slopes of the mountain where it passed through the thin soil and followed joints and fractures in the bedrock to come out at this spot. Although this is a mountain spring it is by no means safe to drink without purification! Giardia bacteria in the water can make you very ill. However, the water is very cold and extremely refreshing to splash on your face on a hot summer's day. Be careful though, as stinging nettles grow here in the wet soil around the spring, identified by their sharply toothed leaves.

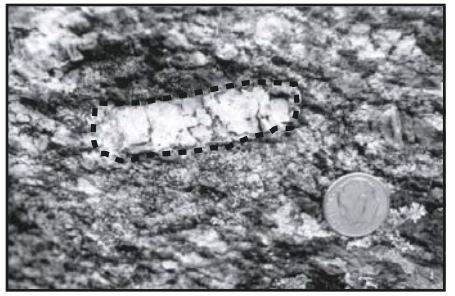
Stop 3. *Stinging nettles*

Stop 4 - (3.3 miles) Not long after the spring the trail becomes significantly steeper and rockier. You are about to come out of the woods and onto the rocks! From this point on to the summit, the trail is almost continuously on rocks. At 3.3 miles into your hike you reach a fantastic view to the northwest. An Eastern White Pine grows from beneath the outcrop here, partially blocking your view of the mountain scenery. A close look at this tree and others in the area illustrates the severity of the winds at this elevation. The pine tree's branches grow away from the prevailing wind direction. This general area is a very good place to take a break and have a close look at the Old Rag Granite. Get down on your hands and knees in a place where hiker's boots have not stained or worn the rock smooth and look very closely at the rock's coarse-grained minerals. Be careful not to get too close to any of the precipitous cliffs on all sides. You will notice two kinds of minerals immediately - a white mineral that is frequently rectangular or square called alkali feldspar, and a blue or gray mineral called quartz. The rectangular or square shape of alkali feldspar is called euhedral crystal form. The large size and perfect crystal form of this mineral indicates that conditions were ideal for its growth in the slowly cooling Old Rag magma. The blue color of the quartz is only found in rocks of similar age to Old Rag Granite and is thought to result from inclusion of minute crystals of titanium-rich minerals called ilmenite and rutile. You may notice that the quartz appears to be strung out into thin bands or "stringers." This structure is called foliation and its orientation is used to determine the direction of applied tectonic stresses that deformed Old Rag Granite in the ancient past. Continued close examination of the rock's surface will reveal the presence of a red mineral called garnet, a semi-precious gemstone. Once you have spotted garnet the first time, you will begin to notice it everywhere, as it makes up about one percent of Old Rag Granite all over the mountain.

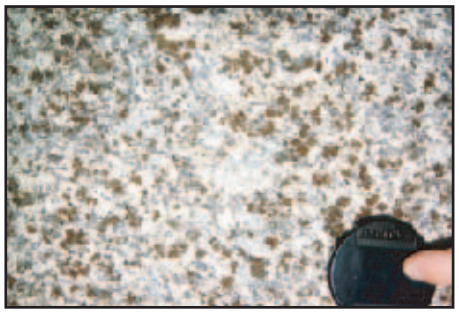
Stop 5 - (3.4 miles) After crossing over several hundred feet of rock the trail descends into a narrow crevice about 8 feet deep. This crevice, which goes right through the mountain, results from preferential weathering and erosion of a rock called diabase that is less resistant relative to the adjacent, harder and more resistant Old Rag Granite. The narrow fissure is called a dike and was a vertical conduit for the diabase magma. When you are down inside the crevice, notice that the rock on the floor appears very different than the Old Rag Granite. If you take a close look at the diabase or "traprock" you will notice that, unlike Old Rag Granite, it is impossible to identify individual mineral grains. This is because the diabase dike intruded Old Rag Granite very close to the surface of the earth, cooled very quickly, and did not have time to grow large mineral crystals.

As you proceed through the fissure toward the north face of the mountain, keep your eyes on the right-hand wall. At the northern end of the crevice there is another dike cutting the Old Rag Granite at about eye-level. This dike also is very fine-grained compared to Old Rag Granite and is about 2 feet thick. It is called biotite granite. You may be able to identify alkali feldspar and quartz in this rock just as you can

Stop 4. *Windblown Eastern White Pine*

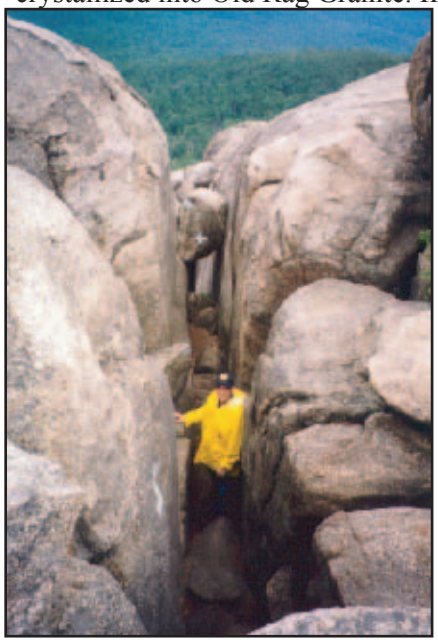


Stop 4. *Euhedral alkali feldspar*



Red garnets in Old Rag Granite

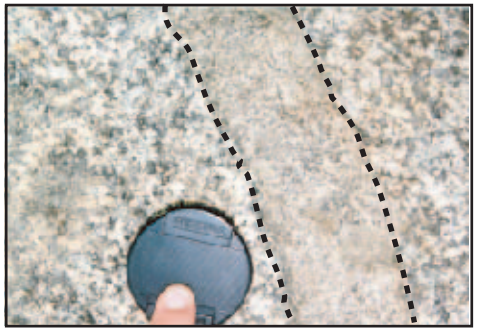
in Old Rag Granite, but the minerals are much smaller in size. The magma that formed this rock probably cut through Old Rag Granite soon after the Old Rag magma had cooled and solidified into rock. Geologists think that magma for this dike was "left over" from the same magma that crystallized into Old Rag Granite. If you look very closely at the dike you may notice very small grains of a shiny black mineral called biotite mica. This mineral is significantly different from other minerals found in the rocks of Old Rag Mountain in that it contains water in its atomic structure.



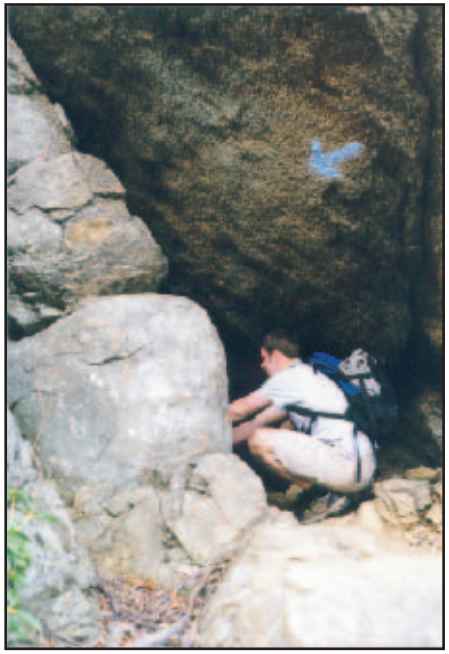
Stop 5. *Diabase dike crevice*

Stop 6 - (3.5 miles) Here the trail goes through a short "cave." As you can tell, this is not really a cave, rather a tremendous crack in the Old Rag Granite. The crack occurred due to a physical process called unloading or exfoliation. As erosion of surface materials slowly exposes Old Rag Granite, the confining pressure is reduced and eventually the rock splits, resulting in cracks oriented perpendicular to the direction of pressure release and parallel to the exposed rock surface. This process is identical to that which produces deadly rock bursts in newly excavated mine shafts and tunnels.

Keep your eyes glued to the trail and your hands out of your pockets as you hike. There are two very good reasons for this. First of all, with your eyes on the trail you are less apt to stumble and, with your hands free, you are better able to arrest your fall when you do. Secondly, as most of the trail at this elevation is over rock, you will be able to spot the more curious looking rocks and, in addition, be able to pick them up for a closer glance (But no collecting please!). Most of the rock is, of course, Old Rag Granite, but you will also see boulders, chips, and pebbles of diabase. If you are very observant you may occasionally notice a rock that has coarse-grained minerals like Old Rag Granite but is much darker in color, almost a dusky-blue compared to the rather whitish color of Old Rag Granite. This rock is called charnockite and is found in several dikes similar in size and shape to the diabase and biotite granite dikes you have seen. The rock to the left of the hiker in the photograph to the right is charnockite. Geologists think that this rock is related to Old Rag Granite by a process that occurs in magmas called fractionation. Fractionation describes how crystallization of minerals from magma changes the composition of leftover magma by removing certain elements which form the crystallizing minerals. Ultimately, this process results in the formation of very different rocks - literally, a succession of rocks with different minerals that have formed from a common "parent" magma.



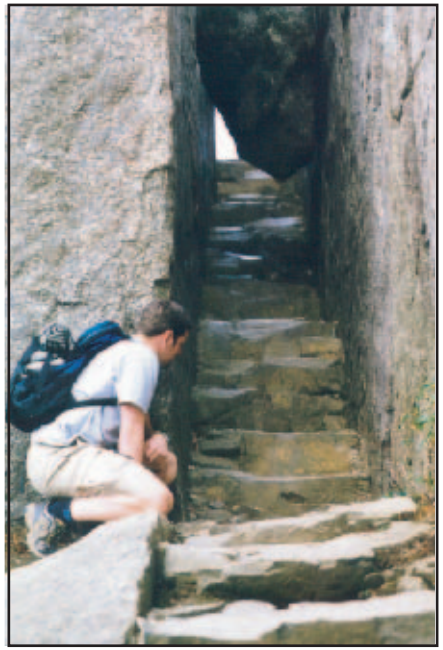
Stop 5. *Biotite granite dike cutting Old Rag Granite*



Stop 6. *"Cave" entrance. Charnockite is to the left of the hiker.*

Stop 7 - (3.6 miles) Here you will find a natural staircase developed on the surface of a weathered diabase dike. The individual steps in the staircase are called columnar joints. These joints developed in the diabase as it cooled and contracted. The

boulder of Old Rag Granite wedged in the staircase was either pushed in by vandals or fell in due to the physical processes of erosion. This location is an excellent spot to observe the contrast between the coarse-grained Old Rag Granite and the fine-grained diabase dike. As explained earlier, the differences in the size of the minerals in the two rocks results from slow cooling of Old Rag Granite at great depths and quick cooling of diabase close to the surface of the earth. The difference in color results from the significantly different chemical compositions of the two rocks. Old Rag Granite contains much more silica, in its pure form commonly known as quartz, and potassium, an important component of alkali feldspar. The diabase has much more iron, magnesium, and calcium than Old Rag Granite, contained in minerals called plagioclase feldspar and pyroxene. These differences in mineralogical and chemical composition can be attributed to the sources of the different rocks. Old Rag Granite was derived by melting of crustal rocks: low-density continental rocks rich in silica that "float" upon the earth's mantle. The diabase was derived by direct intrusion of mantle-derived magma that welled up from the earth's molten interior.



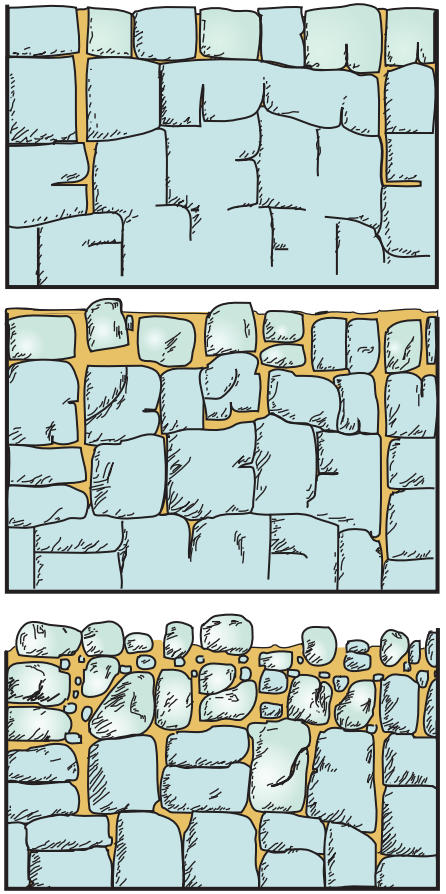
Stop 7. *Natural staircase of columnar joints in diabase*

Stop 8 - (4.0 miles) At this point you will find several tremendous rounded boulders along the trail. These boulders have weathered in place by the forces of wind and water at the mountain's summit. As mentioned earlier, the change in confining pressure causes planar fractures or joints to develop in the rock when it is exposed at the surface. Weathering by wind and water rounded the corners and edges of planar fractures to eventually produce the spherical shape of the boulders you see here.

Take a close look at the abundant lichens growing on the rocks alongside the trail. These curious "plants" are actually algae living inside a fungus. Lichens grow very slowly and may live as long as 4500 years! The tiny plants secrete chemicals that help to break down the rock upon which they grow, one of many processes that is creating the soil on Old Rag Mountain.

Stop 9 - (4.3 miles) At the mountain's summit (approximately 3300 feet above sea level) you will be treated to wonderful views of the Blue Ridge to the north and west if the weather is clear. Due west is the rounded peak of Hawksbill, 5 miles away. At 4049 feet, Hawksbill Mountain is the highest point in Shenandoah National Park. To the northwest, across Weakley Hollow, is Robertson Mountain. The summit elevation of Robertson Mountain is 3296 feet, about the elevation of the Old Rag Mountain summit. Examination of the topographic trail map included in this presentation indicates an elevation of 3268 feet labeled near the summit of Old Rag Mountain. This is the top of the large outcrop of Old Rag Granite just to the west and a little below the mountain's summit.

Stop 8. *Spheroidally weathered boulders*



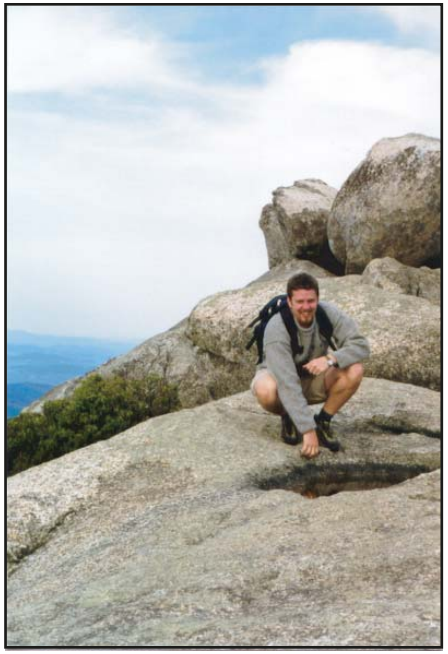
This series of diagrams illustrates how the processes of weathering gradually create the rounded boulders found on Old Rag Mountain's summit. The top diagram depicts freshly exposed rock cut by planar fractures. As water, wind, and organisms such as lichens wear at the rock, edges and corners are worn down to eventually produce spheroidal boulders and a thin soil cover.

On a clear day you will be able to see the sun glint off cars traveling along Skyline Drive to the west, and in the winter you will be able to see the Weakley Hollow fire road in the valley below. In the summer, the thick foliage on the surrounding mountains looks almost like a soft shaggy rug, inviting one to imagine that maybe it would be possible to just step off and leap from mountain to mountain like a giant. On the other hand, you may find that your vista over the surrounding mountains and countryside is severely limited by a thick haze. One of the worst environmental problems facing Shenandoah National Park is that of atmospheric pollution. Airborne particulates and sulfur dioxide, the cause of acid rain, may dramatically decrease the visibility from the mountain's summit.

While you are at the summit area, take a close look at the thin soil that has developed on the Old Rag Granite. Get down on your hands and knees to get a look at the chips of blue quartz that are readily visible. The abundance of quartz chips illustrates the relative resistance of this mineral to chemical and physical weathering in the surface environment. In other words, quartz does not easily react with water and also is very hard and thus resistant to breakdown by frost action and other physical processes. Rocks of the Swift Run and Fauquier Formations are partially composed of quartz chips and pebbles eroded from the Old Rag Granite over 600 million years ago!

Stop 9. *Blue quartz chips in the soil*

Small circular pits or depressions in the Old Rag Granite are called opferkessels and are created by weathering and solution of the rock by standing water. Geologists think that solution of the very resistant Old Rag Granite is initiated by organic acids derived from the decay of evergreen trees that populate the mountain's summit.



Stop 9. *Opferkessel*

The Old Rag saddle trail leads down from the summit area into Weakley Hollow. The short pines growing on this side of the mountain are called Table Mountain pines or "Hickory pines." The spiny cones of this pine grow in clusters and remain attached to the tree for many years. Table Mountain pines are unique to the Appalachian Mountains and only grow at higher elevations from Georgia to New Jersey.

Stop 10 - (4.9 miles) The Byrd's Nest shelter was built by the Civilian Conservation Corps (CCC) in 1934 using rocks found on Old Rag Mountain including Old Rag Granite, charnockite, and diabase. Flagstones used in the front of the shelter are a type of rock called quartzite and were hauled here from elsewhere. The Byrd's Nest is meant to be used as a place to take a break or shelter in bad weather and no camping is allowed here.

Stop 11 - (5.2 miles) These steps also were built by the CCC, using rocks found scattered about the mountainside. The saddle trail used to be an old, narrow logging trail and these steps are testament to the hard, back-breaking work the Corps accomplished in establishing over 500 miles of trails within the Park. The Potomac Appalachian Trail Club (PATC) now is responsible for maintenance of some trails in the Park and all work done here by this organization is, amazingly, on a volunteer basis. If you should happen upon a PATC volunteer during your hike, make sure to give them a hearty thanks and a pat on the back for doing such a good job.

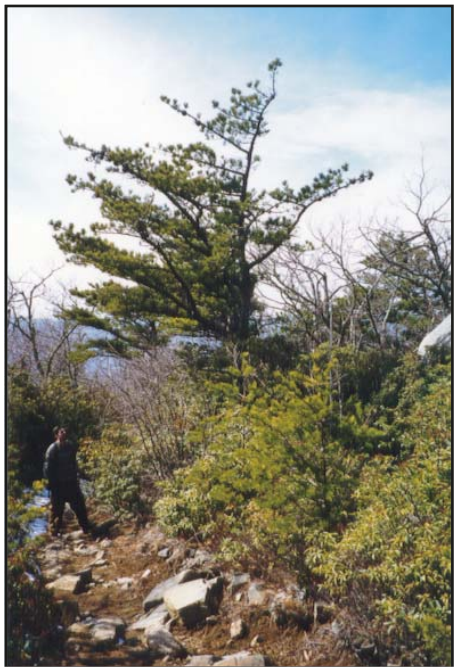


Table mountain pine

Stop 10. *The Byrd's Nest*

Stop 12 - (6.3 miles) Eventually your hike brings you to the intersection of the Old Rag saddle trail, Old Rag road, and the Berry Hollow and Weakley Hollow roads. Be careful here - this is where many hikers make the wrong turn and add many more miles to their Old Rag Mountain hike. Turn right onto the Old Rag road, go about 75 feet and bear right onto the Weakley Hollow road. The Weakley Hollow road leads back to the Old Rag parking areas.

The village of Old Rag, named after Old Rag Mountain (named so because of the irregular outline and unusually rocky nature of the ridge), used to lie here at this cross roads on the western flank of the mountain. This small village was an industrious establishment in its time, and the site of two stores, two churches, a school, a post office, and a number of houses. The road that ran through the hollow initially was established around 1750. The town, and its inhabitants and structures, were removed when Shenandoah National Park was established in 1935. As you meander down the fire road you will see many small piles of rocks to either side, remnants of chimneys, foundations, and fences - all that remains of the many structures that once dotted Weakley Hollow. In the spring you may see a few daffodils growing in the ruins - scarce vestiges of the hardy mountain people who once lived in these hollows.

Stop 11. *Stone staircase on the saddle trail*

Stop 12. *Information board at trail intersection*

The gentle walk through Weakley Hollow is a pleasant way to wind down after the vigorous hike over the rocky summit of Old Rag Mountain. It is by now late in the afternoon and shadows are growing a little longer. If your hike has been in hot humid weather, a cooling late-day summer shower may pleasantly surprise you. If it's cold and the trees are bare, your walk back to civilization will include many wonderful views of the mountain you have just clambered up and over. The walk through Weakley Hollow will take only another hour or so more, depending on your pace, so enjoy the little time you have left in Shenandoah National Park. Sit down and be very quiet for a while - you may be startled by all the sounds that suddenly seem much louder than before. Keep your eyes and ears peeled for wildlife. You may be surprised by the sudden explosion of a grouse taking flight or the staccato knock of a busy woodpecker. Many slithering creatures are found on the ground, including poisonous rattlesnakes and copperheads. Don't be surprised to see a wild turkey strutting boldly down the road - after all, these woods are full of wild creatures. Thanks for visiting Old Rag Mountain. The Park hopes that your hike has been safe, exciting, a learning experience, and above all, a journey that you will make time and time again.

Acknowledgments

This is dedicated to my Dad, who first brought me to Old Rag over 25 years ago, and who continues hiking the mountain with me today.

Suggested Reading

Badger, R. L., 1999, Geology along Skyline Drive, Shenandoah National Park, Virginia: Falcon Publishing, Helena, Montana, 231 p.

Crandall, H., and Engle, R., 1997, Shenandoah: The story behind the scenery, KC Publications, Las Vegas, Nevada, 48 p.

Denton, J. W., 1990, Circuit hikes in Shenandoah National Park: Potomac Appalachian Trail Club, Vienna, Virginia, 106 p.

Gathright, T. M., II, 1976, Geology of the Shenandoah National Park, Virginia: Virginia Division of Mineral Resources Bulletin 86, 93 p.

Heatwole, H., 1988, Guide to Shenandoah National Park and Skyline Drive: Shenandoah Natural History Association Bulletin 9: Luray, Virginia, 226 p.

Virginia Division of Mineral Resources, 1993, Geologic Map of Virginia: Virginia Division of Mineral Resources, scale 1:500,000.

Wuertz-Schaefer, K., 1994, Hiking Virginia's National Forests: Globe Pequot Press, Old Saybrook, Connecticut, 191 p.

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