Tripping Over the Mountain

A Geologic Guide to South Mountain, Adams and Franklin Counties, PA

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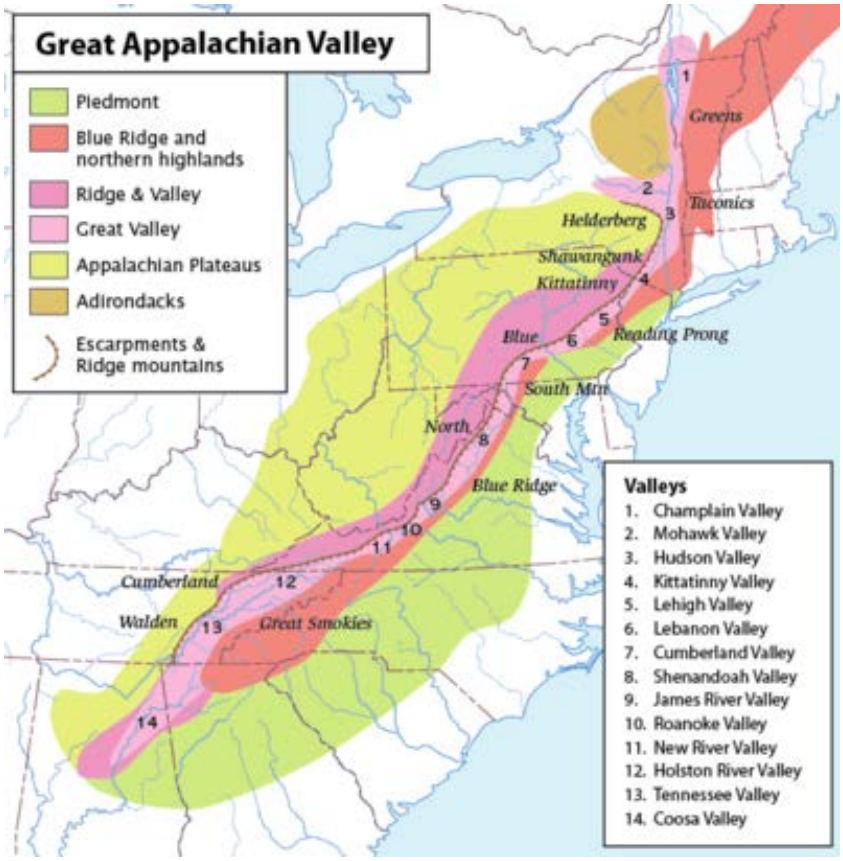
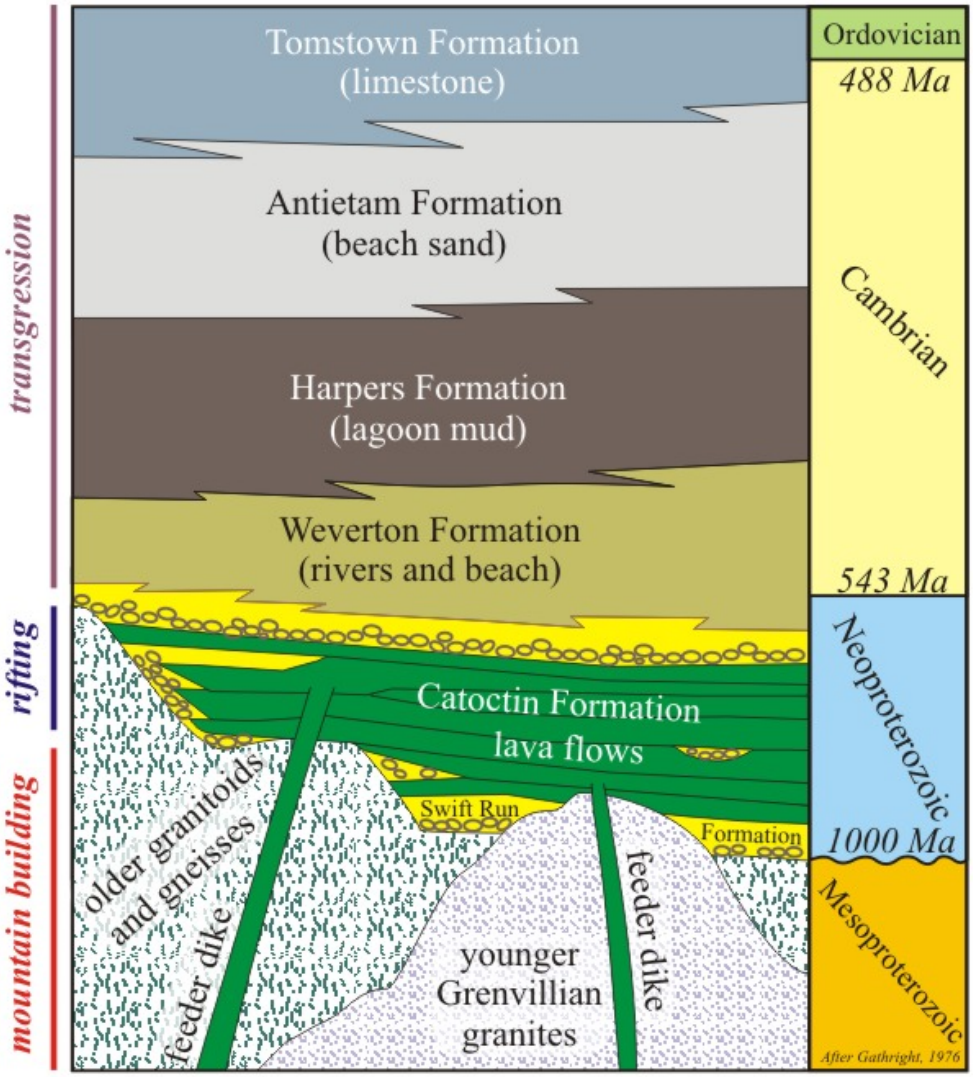
About the Leader

Jeri Jones, a native of York attended Catawba College in North Carolina and earned his degree in Geoarchaeology. Jeri owns Jones Geological Services in Spring Grove, PA where he studies the geology of southeastern Pennsylvania. In his 40 years of research, Jeri leads groups on field trips and acts as a consultant to several area quarries. He has traveled throughout the country conducting field trips and programs for all ages. He conducts classes regularly for the OLLI program at Penn State-York. He previously taught at HACC-Gettysburg, York College of Pennsylvania and Messiah College. He received the Digman Award for Geologic Excellence from the Eastern Chapter of the National Association of Geoscience Teachers. His interests include the mining history, geologic history, groundwater resources and southeastern Pennsylvania earthquakes. He has authored four books, narrated a geologic education video series and written numerous articles. Jeri also is a guest columnist for the York Daily Record where he writes about local earth science. Also he operates the weekly Zoom Rock Room where a theme of earth science is discussed.

Introduction Diagrams



Location of the Blue Ridge

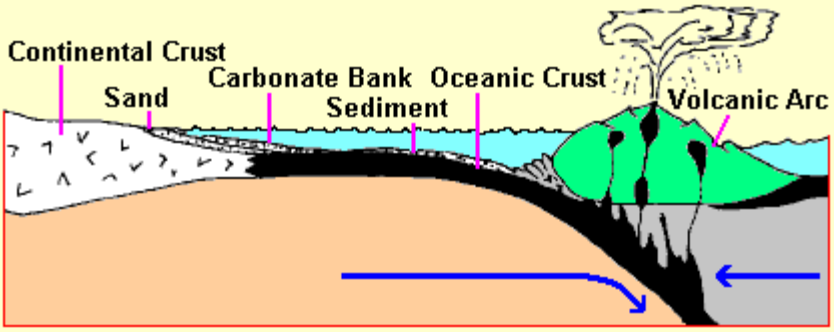


Stratigraphy of South mountain

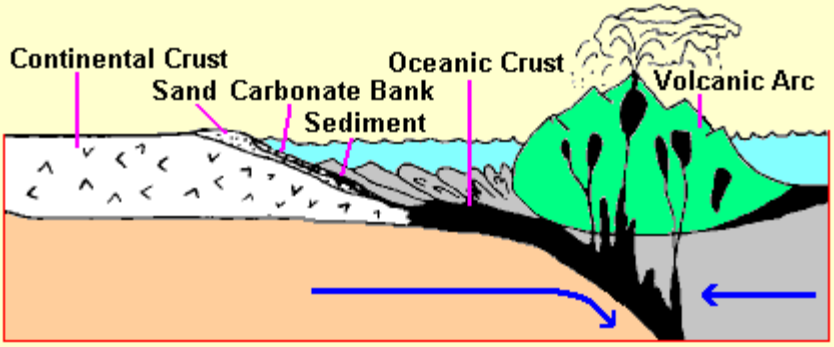
Formation Names and Thickness Encountered On This Trip

Waynesboro Formation	Limestone/sandy dolomite	±1,000 feet
Tomstown Formation	Limestone	1,350 feet
Antietam Formation	Sandstone/phyllite	500-900 feet
Harpers Formation	Phyllite	300-1,000 feet
Weverton Formation	Quartzite	500-1,400 feet
Catoctin Formation	Metarhyolite/metabasalt/schist	3,000-3,200 feet

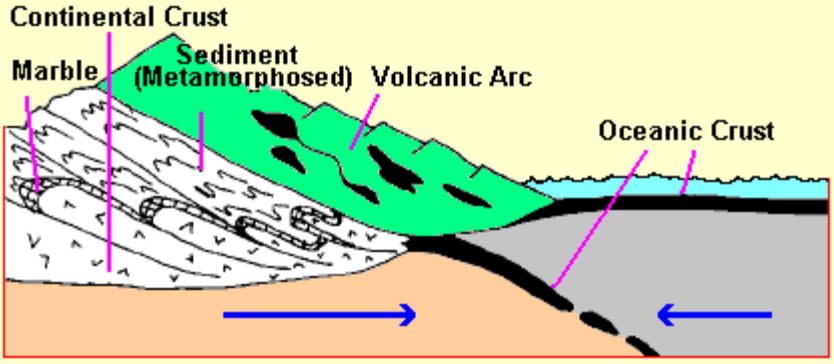
Cross Sections of Eastern North America
(as it may have looked)



543 million years ago, active volcano is offshore

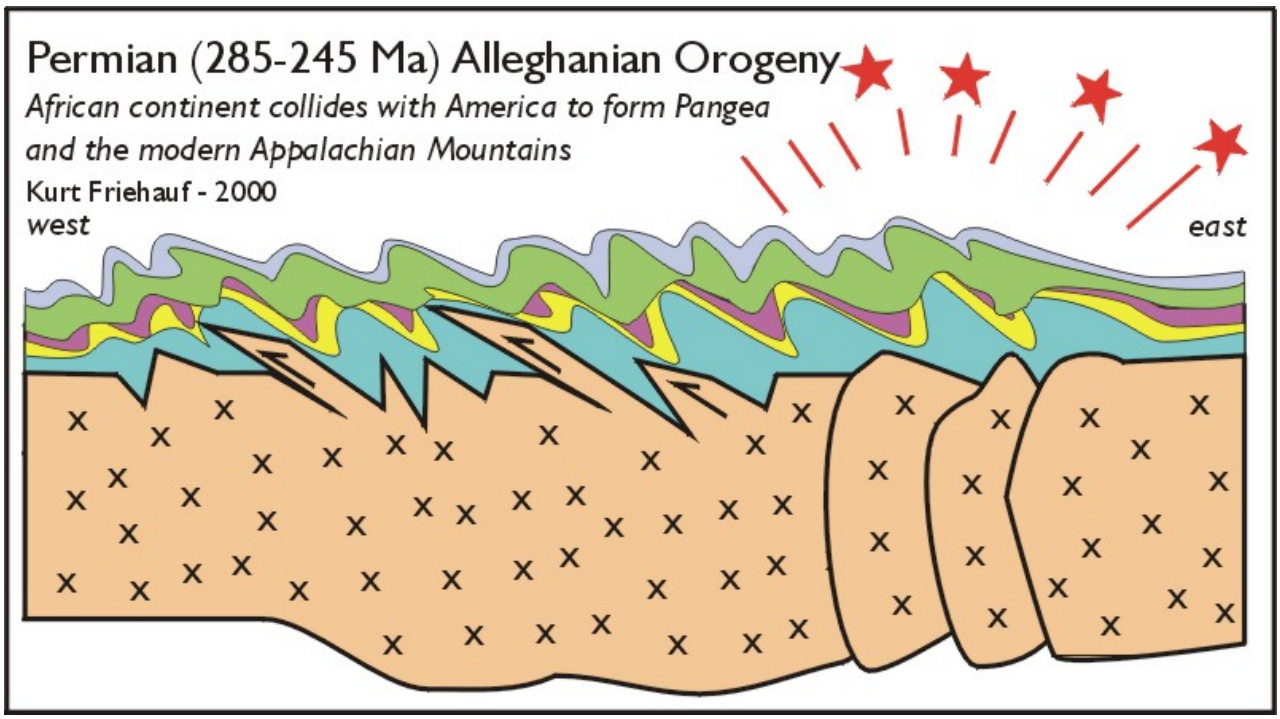


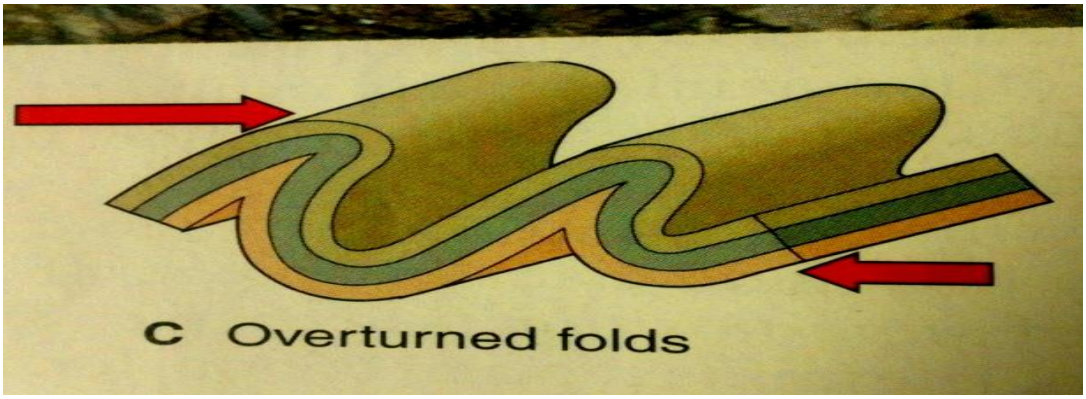
500 million years ago, volcano and pile of sediments scraped off the subducting slab are larger



440 million years ago, collision between the volcanic islands and the ancient continent (Taconic Orogeny) formed a tall mountain range. This range has since eroded leaving its roots exposed in the rolling hills of the Eastern Piedmont

USGS *Topinka, USGS/CVO, 2001; Modified from: Plank and Schenck, 1998, Delaware Piedmont Geology, Delaware Geological Survey*


Permian (285-245 Ma) Alleghanian Orogeny
African continent collides with America to form Pangea
and the modern Appalachian Mountains
Kurt Friehauf - 2000
west
east


C Overturned folds

Starting Point: Penn Dot Maintenance Complex, Stockpile 11, 1025 Waynesboro Pike, Fairfield, PA

Stop 1. PennDot Maintenance Complex

What:	Outcrop of Catoctin Formation metarhyolite containing several metabasalt intrusions
Rock Types:	Catoctin metarhyolite with metabasaltic intrusions

What To See:

This exposure shows several different types of metarhyolite (reddish) and several small metabasalt intrusions (greenish). This exposure is near the east side of South Mountain, meaning that the rocks are dipping toward the east. Notice joints in the rock. A joint is a fracture in the rock where no movement or very little displacement as occurred. Determining the direction of the joints, a geologist can determine the direction of the stress that caused the fracturing. Notice behind the PennDot office sheared (broken) rock termed mylonite is found. This marks the location of a fault.

Geologic History:

These two volcanic rocks reflect the continental rifting of Rodinia during the Late Proterozoic. This site suggests an age relationship between the metabasalt and metarhyolite. Based on the discussion above, what is the conclusion? Metamorphism of these rocks took place during the Taconic Orogeny and some change during the Alleghanian Orogeny. Rifting producing rhyolite is from continental crustal fracturing. Basalt is formed associated with oceanic rifting, so both occur here. With the metabasalt intruding into the metarhyolite meant to suggest that the metabasalt is younger, there is no clearcut evidence in which one of the volcanic rocks is the oldest.

Road Log

0.0 mile	Penndot Maintenance Complex, Stockpile 11. Turn left onto Pa. Rte. 16.
0.4	Turn left onto Pa. Route 116 East
2.3	Turn left into Carroll Valley Municipal Building Parking Lot.

Stop 2. Carroll Valley Municipal Building Parking Lot

What: Float Boulders of New Oxford Formation Fanglomerate and Diabase
The "Border" Fault

Rock Type(s): Sedimentary Breccia (fanglomerate) and Igneous (diabase)

What to See:

The two rocks on either side of the entrance and another down toward the Park near the wooden bridge are nice examples of a rock known as breccia. A breccia contains angular fragments. Here the fragments are limestone that originated from the Great Valley to the west. The reddish matrix is sand. The breccia is Triassic in age. On the west side of the trail heading toward the wooden bridge is a large boulder of diabase, an igneous rock that cooled from magma deep within the Earth during the Jurassic Period. Nicknamed "ironstone" this rock is extremely durable and does support the higher elevations in the Gettysburg-Newark Section of Piedmont, such as nearby Liberty Hill.

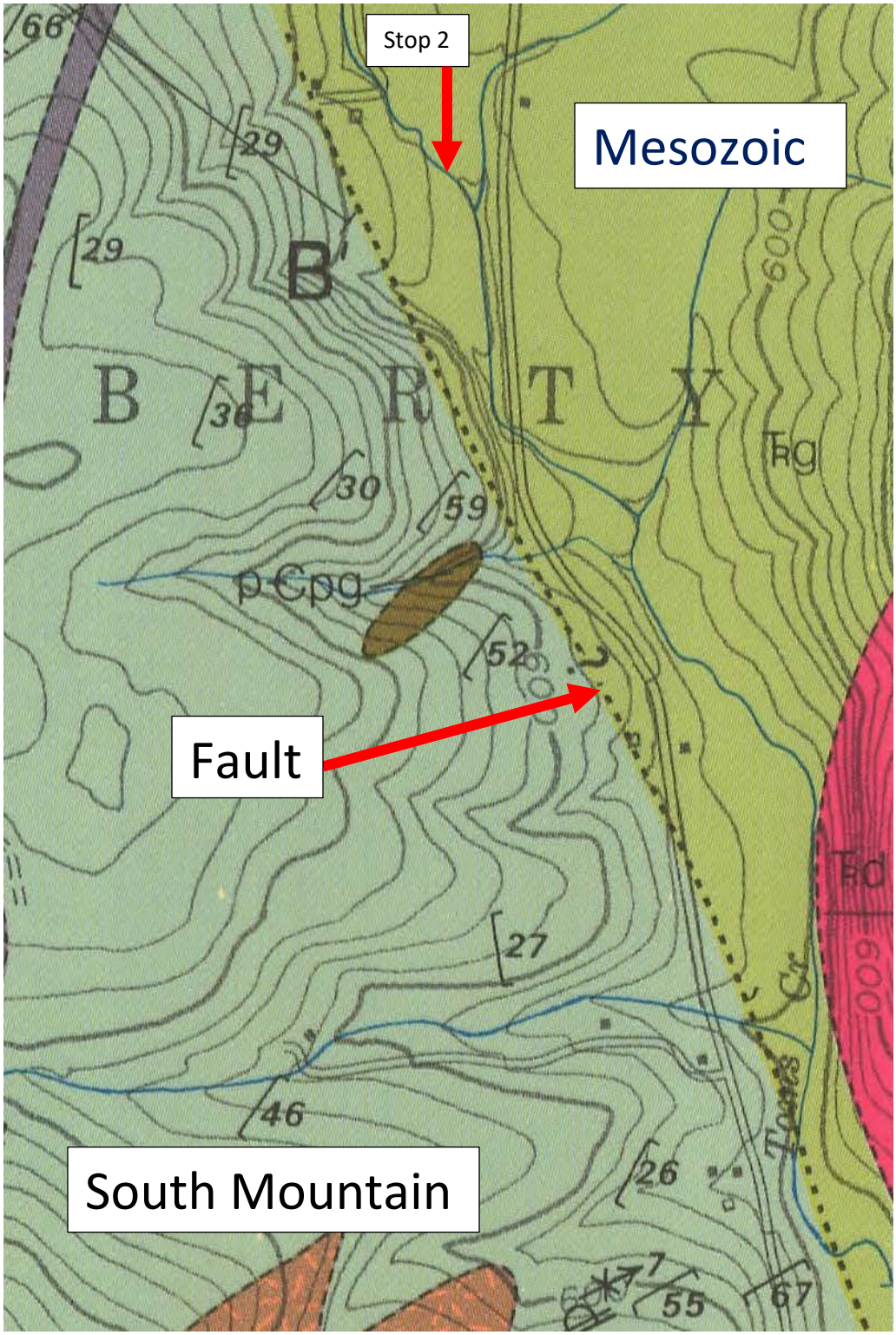
The Border Fault is possibly found in this vicinity. The geologic map of Fauth (1978) only infers that the fault may be present, but no clear evidence was observed. The Border Fault marks the boundary between the older rocks of South Mountain on the west and rocks of the Mesozoic Basin on the east. Pa. Rte. 116 marked its position as we traveled up from Pa. Rte. 16 up until the golf course. The fault turns just west of north-south of the Carroll township Park and is found about 0.25 miles west of here. By theory, if you could stand on the fault, you could place one foot on rocks 540 million years old and the other foot on rocks about 200 million years old. However, a fault is usually not a line in the crust, but a zone of fractured rocks maybe tens of yards wide. The Ramapo Fault was formed during the Early Triassic Period as sediment from the highland to the west was being washed into the rift basin during the breakup of Pangaea. As more sediment was pushing down on the rift basin floor, the crust acted like a hinged door and was pushed downward. Geologists have determined that the depth of the fault here and accompanied sedimentary rocks are about 11,000 feet down.

Geologic History:

The breccia is the youngest rock within the Gettysburg-Newark Section and was formed as Pangaea was beginning to rift apart. The rift valley had steep sides and a flat bottom where isolated ponds and lakes and small meandering streams were found. As heavy rainfall fell on the land, the water coming down the steep sides were able to carry larger fragments. Once the water flowed onto the valley floor, the speed decreased and had to drop the large fragments into the sandy bottom. The sediment formed an alluvial fan, thus fanglomerate.

The diabase was formed close to the end of the rifting during the Jurassic Period. Our crust had been torn and stresses and the magma intruded up through the older sedimentary rocks to help

heal “Mother Earth.” We think the diabase originally cooled into a rock 4-5 miles below the surface.



Fauth (1978)

Road Log

0.0 mile	Exit Parking Lot and turn left onto Pa. Rte. 116 East
0.3	Turn hard left onto Valley View Road
0.6	Stop Sign. Intersection with Mountain View Trail
0.7	Turn left onto High Trail
0.75	Turn right onto Pine Hill Trail
1.0	Turn left onto Warren Trail
1.26	Turn left onto Gladys Trail and park on left side of road.

Stop 3. Carroll Valley Scenic Overlook

What:	Scenic Overlook into the Piedmont and South Mountain
Rock Type(s):	Catoctin Formation metabasalt
What To See:	(950 feet above sea level)

Just take a moment to take the scenic view in. There are two different locations here that give you a good view. You may also want to walk down the hill a short distance on Warren Trail. To the left, you can see more of the South mountain extending to the north. The furthest point of South Mountain you can see is about a point north of Gardeners and Aspers, a distance of 21.2 miles (azimuth of 21°). Working around to the east, the remainder of the area lies within the Piedmont physiographic province. The Gen On Energy plant, located south of Hunterstown can be recognized by its three towers. Using a compass takes a bearing of about 45° (NE). The plant is about 14.6 miles distant. The plant is located within the Gettysburg-Newark Section of Piedmont. Continuing to the east you will see on a clear day a narrow Hill standing above the landscape. This is the western end of the Pigeon Hills located north of Hanover, York County (74° and a distance of 24.2 miles). The Pigeon Hills is a member of the uplands Section of Piedmont. On the right side of the view is a nearby hill known as Liberty Mountain, only 1.8 miles to the east. If you look to the left of Liberty Mountain on a clear day, a ridge is found along the horizon. This is the Piedmont Uplands Section starting close to Codorus State Park (79° and a distance of 25.2 miles). Another member of Piedmont known as the Lowlands Section runs to the right of the Pigeon Hills, through Hanover down to Littlestown behind Liberty Mountain. Limestone occupies the valley and is not able to be seen from here.

Road Log

0.0 mile	Turn around and backtrack to Pine Hill Trail.
0.25	Turn left onto Pine Hill Trail.
0.3	Turn left onto Jacks Mountain Road.
1.5	Turn right onto Pa. Rte. 16 West
4.5	Enter Blue Ridge Summit. At Sunoco station, turn left onto Fort Richie Access Road.
6.7	Turn right onto Pen Mar Road
7.6	Stop Sign. Continue Straight onto Pen Mar-High Rock Road
7.8	Turn right into Pen Mar County Park parking lot.

Stop 4. Pen Mar County Park and Lunch Stop

What: Scenic Overlook to the Great Valley and Appalachian Mountains

Rock Type(s): Quartzite

What to See: (1280 feet above sea level)

Welcome to historic Pen Mar Park. You are standing among the beautiful trees of a historic area that has hosted many a weekend evening dance and miniature train rides in its heyday. The Western Maryland Railroad brought visitors from Baltimore and Hagerstown and became one of the largest attractions on the East Coast. The park's single-day attendance record was 20,000 visitors. For more on the park's history go to https://en.wikipedia.org/wiki/Pen_Mar_Park.

From the pavilion, you can see almost a 40° view to the southwest to the northwest. Almost 25 miles of the Great Valley and Appalachian Mountains are visible on a clear day. Starting to the northwest and looking out past South Mountain, you might be able to view Broad Mountain west of Chambersburg, a distance of 25.8 miles (compass bearing of 331°).
At a compass bearing of 298° at a distance of 3.3 miles is a small wooded hill known as Wayne Heights, just east of Waynesboro. The famous ski resort, Deer Mountain, is hidden by a taller ridge which is 21.8 miles away. At a compass bearing of 273°, you are following the Mason Dixon Line in its western advancement. Hagerstown, Maryland is hidden by the trees to the south. The furthest Appalachian ridge that we can see to the southwest is about 24.8 miles away near Clear Spring, Maryland.

The Great Valley and the Appalachian Mountains are sections within the Ridge and Valley physiographic province. In fact, in Pennsylvania South Mountain is considered a section of the Ridge and Valley. The Maryland Geologic Survey considers South Mountain its physiographic province and not a section of the Ridge and Valley. The Great Valley is largely composed of Cambrian and Ordovician aged limestone, dolomite and shale. You can see the topographic expression of different rock types from here. For example, Wayne Heights is composed of the

Waynesboro Formation (limestone). The western side of the Great Valley is a shale unit known as the Martinsburg Formation which is a little bit more resistant to weathering and erosion compared to the limestone, thus forming a noticeable ridge.

The Appalachian Mountains are composed of Paleozoic sandstones and conglomerates in the ridges and softer limestone and shales in the valleys. Both the Great Valley and Appalachian Mountain sections have been intensely folded. Faulting is more common within the Great Valley, offsetting a number of the geologic formations.

We are standing on the western side of South Mountain. The host rock here at Pen Mar Park is the Weverton Formation, composed of Cambrian quartzite. We will take a look at one of the quartzite exposures near the pavilion to discuss what strike and dip are and their importance.

Road Log

0.0 mile	Return to car and turn left onto Pen Mar-High Rock Road.
0.1	Stop sign. Continue straight on Pen Mar Road (MD Rte. 550 south).
1.0	Stop sign. Turn right onto MD Rte. 550 south.
1.4	Cross railroad tracks. MD Rte. 550 turns to the left. Continue onto MD Rte.491.
1.54	Turn right onto Ritchie Road
4.64	Pull off area on right side (high clearance vehicles only). Smaller pull off area is located a short distance down the road on the right. Park here

Stop 5. Raven Rock Hollow Block Stream

What: Boulder Field

Rock Type(s): Quartzite

What to See:

Watch For: Orientation of tabular blocks suggesting movement
Sorting of large and small boulders to form circles
Features resembling the snowplow effect as blocks got pushed

This point of interest is located on Fort Ritchie Road, about 0.7 miles north of MD Rte. 491. The block field is visible from the road and there is a dirt pull-off area on the west side of the road with a path leading back to the locality. Many people, including the author, have known this site as “Devil’s Race Course”. Not to confuse residents, this site was named in a guidebook used by the Field Conference of Pennsylvania Geologists (Sevon and Potter, Jr., 1991). The more notable “Devil’s Race Course” is located on a hillside north of Charmain.

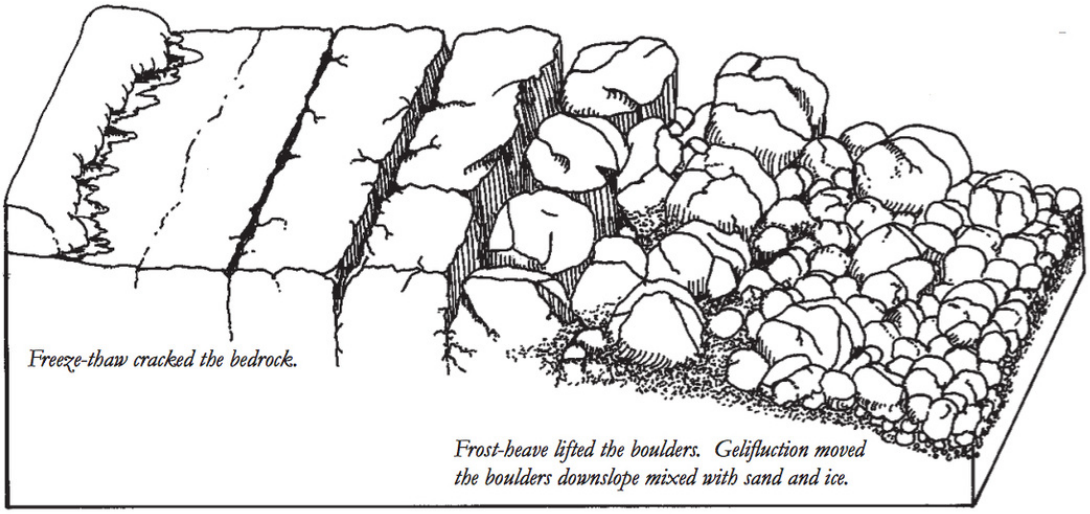
This block field is about 0.80 miles long in a north-northeast to south-southwest direction. The width of the field varies but does not exceed 170 feet wide. Of the black streams that occur in South Mountain, this particular feature has the uniqueness of not supporting vegetation, so observing the features of this field is easy.

Although the Catoctin Formation underlies Fort Ritchie Road and the hollow, the rock making up the block field is the Weverton Formation quartzite. Quartzite is a metamorphic rock composed of quartzite and was originally sandstone. It appears the some of the quartzites traveled from in the forested area on the northwest side of the block stream (Clark, 1991). The contact between the Catoctin Formation and Weverton unit runs nearly parallel and near the axis of the hollow. The slope of the field is 3.5-4.0°

The blocks closer to the quartzite outcrop to the northwest are larger than those further down the hollow. There are blocks covered in vegetation along the western side of the block field. Look for solution pits in the boulders where water can collect today. There are indications that processes within the block stream-oriented some of the tabular blocks on edge. Several surfaces have been ground by movement again another block. Perhaps some of this grinding took place after the main movement took place. Also, there are sorted patterned ground and depressions that are circular or slightly elongated in the direction of flow that may have formed after the main event (Clark, 1991). After high precipitation or a quick snowmelt period, if you visit this site, subsurface running water can be heard. At the south end of the block field, the water emerges as a stream. This stream may have acted as the mechanism for the removal of ground matrix between or under the boulders. Also, the water may have formed interstitial ice that acted as a matrix and a mechanism for block transport.

The boulder stream was believed to have been formed during the Pleistocene Period (Ice Age) and considered a periglacial feature (occurred during a warm period between ice advances). During the Pleistocene, our climate was similar to that of today's Hudson Bay area with alternating cold and warm periods.

The largest boulder field on the East Coast is located at Hickory Run State Park in Carbon County, Pennsylvania. Another smaller boulder field, but very unique is Ringing Rocks in Bucks County, Pennsylvania. Here you may take a hammer and hit the diabase boulders, each boulder having its own tone.



Possible origin of the boulder stream (from Clark 1991)

Road Log

0.0 Mile	Retrace drive north on Ritchie Road to MD Rte. 491.
3.1	Stop Sign. Turn left onto D Rte. 491
3.24	MD Rte. 550 turns to the right. Continue straight onto MD Rte. 550 North.
3.64	MD Rte. 550 north turns to the left (Pen Mar). Follow Fort Ritchie Access Road straight ahead.
5.44	Stop Sign. Intersection with PA Rte. 16. Turn left onto Pa. Rte. 16 west.
6.0	Turn right onto Charmain Road.
6.1	Turn left into Monterey Pass Park parking area. Walk down gravel Road past the playground to the Blue Ridge Summit Lions Club Park and go to Brown's Spring behind the pavilion.

Stop 6. Brown's Spring

What: Natural spring and Groundwater

Rock Type(s): Weverton Formation

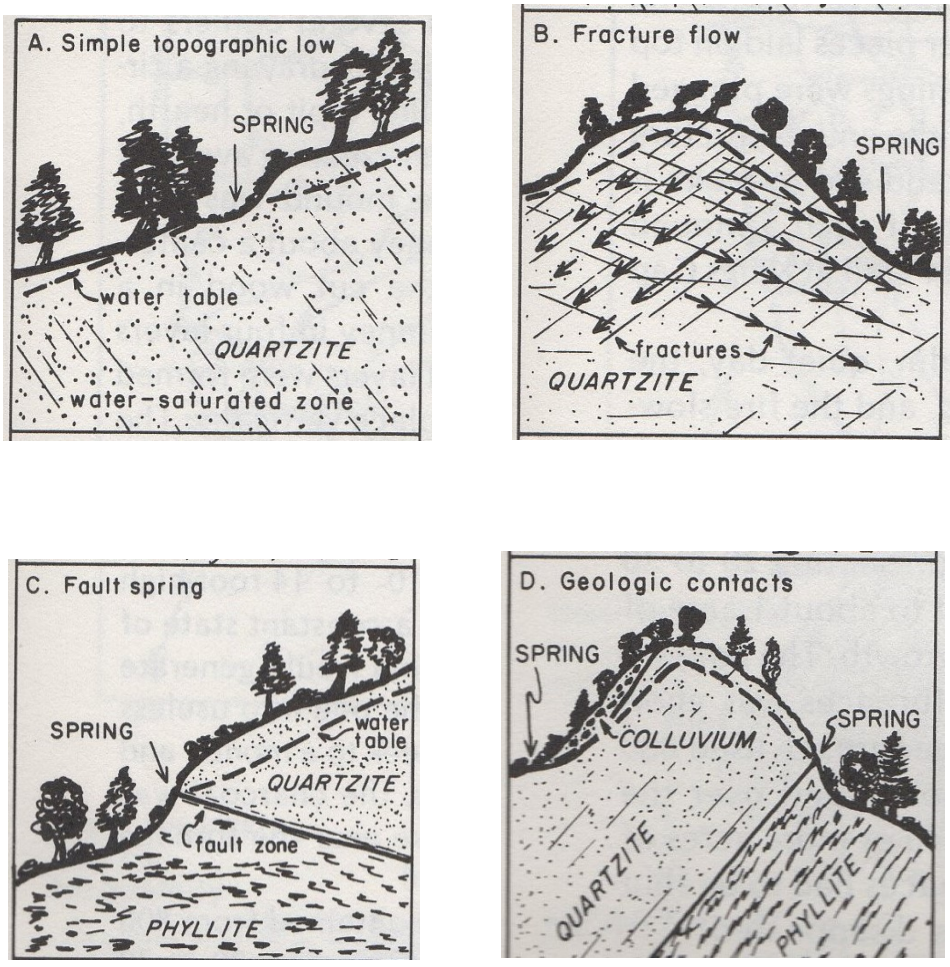
What to See:

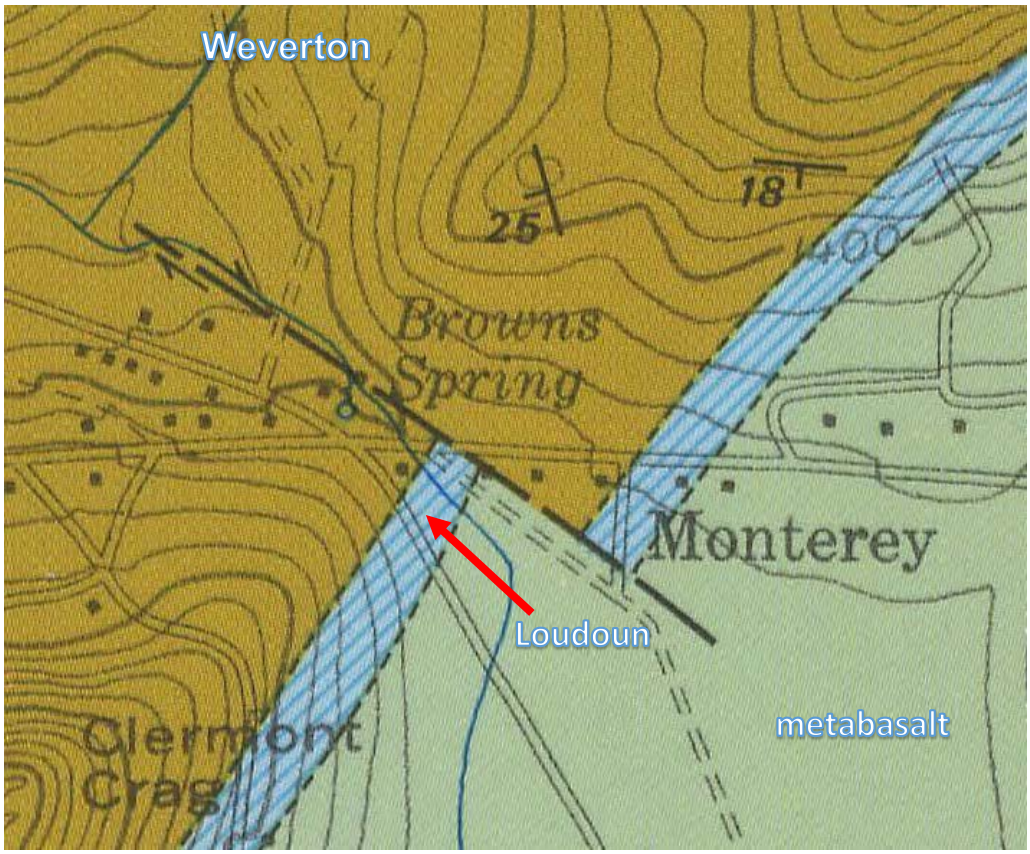
This is a great location to introduce some groundwater terms to you. Springs are common along the western slope of South Mountain because of the geology. Some of you may be familiar with

the Huntsdale Fish Hatchery in Cumberland County. This hatchery is present because of the large number of springs flowing off South Mountain. Over 10,000 gallons of water per minute drain into the Huntsdale facility (Way, 1986).

Several factors are involved here for groundwater to produce a spring. A simple topographic low can be a spring. Regular fracturing in the bedrock, allowing water to flow through the rock can also produce a spring. Perhaps groundwater will easily move along a fracture of weakness or a fault to the surface on a hillside. Finally, a spring can occur at the base of a thick zone of colluvium with bedrock. Since the bedrock is more resistant to allowing water to flow through it, a spring will form along the contact.

Brown's Spring is located within Weverton Formation (quartzite). Usually a quartzite is considered a "tight" rock not having many ways for water to flow through it. A rock that has pore space allowing water to flow through it is called the porosity. The ability for water to flow through a rock is its permeability. Although a rock may have good porosity, it necessarily doesn't have good permeability. Brown's Spring is formed by a northwest-to-southeast trending fault offsetting the Weverton, Loudoun and Catoctin formations. The fault provides an ideal path for groundwater flow.




Weverton
25
18
400
Browns
Spring
Monterey
Loudoun
metabasalt
Clermont
Crag
Fauth (1978)

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