Geology of the western portion of York County, Pennsylvania

York County Parks Geology Guide #10
May, 2011

Jeri L. Jones
JLJones@york-county.org

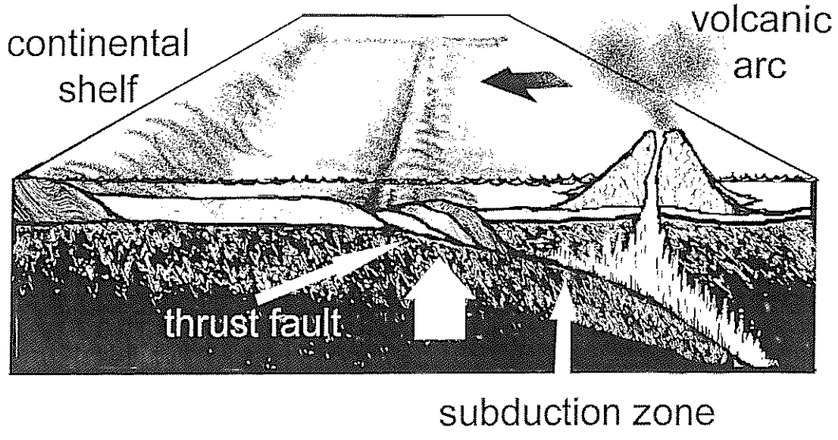
Schedule

9:05 a.m.	Departure Nixon Park
9:30 a.m.	STOP !. Heritage Rail Trail County Park – Octoraro Quartzite
9:55 a.m.	Depart
10:20 a.m.	STOP 2. Frogtown Road – Marburg Schist
10:45 a.m.	Depart
10:55 a.m.	STOP 3. Codorus State Park – Mary Ann Furnace
11:30 a.m.	Depart
11:35 a.m.	Stop 4. Codorus State Park – Martic Line
11:50 a.m.	Depart
12:00 p.m.	Lunch Stop – Bethel UCC, Smith Station
12:30 p.m.	Depart
12:50 p.m.	STOP 5. Vulcan Materials quarry
1:40 p.m.	Depart
1:55 p.m.	STOP 6. Beaver Creek Road – New Oxford fanglomerate
2:20 p.m.	Depart
2:25 p.m.	STOP 7. Beaver Creek Road – Metabasalt
2:45 p.m.	Depart
2:50 p.m.	STOP 8. Pulpit Rock – Chickies Quartzite
3:05 p.m.	Depart
3:10 p.m.	STOP 9. Glatco Lake – Haldeman Bank
3:25 p.m.	Depart
4:00 p.m.	Arrival at Nixon Park

ABOUT YOUR LEADER

Jeri Jones holds a degree in Geoarchaeology from Catawba College in Salisbury, N.C. He returned back home to York, PA after graduation and became employed by the York County Parks where he is currently the Program Coordinator. Within the Parks, he does educational geological and archaeological programs for all ages.

Jeri has been studying the area's geology for 30 years. Although he loves to study the geologic history, mining history and dinosaurs fossils of the region, he loves to pass his knowledge on to others. Everyone one of us is affected by geology, either by the location of our homes, our water supply or all of the products we use in everyday life. Jeri has authored or co-authored four books, numerous articles and hosted a 3-part video series known as TimeWalk. He received the Digman Award in Educational Geology by the National Association of Geoscience Teachers, Eastern Chapter in 2006. He has found a way to combine one of its favorite hobbies with his profession as he analyses and recommends clay to be used on area dirt speedways. He and his wife, Lou Ann resides in the Spring Grove, York County area.



LET'S TALK ABOUT THE PRESENT

Take a moment and think about the landscape in Adams, Lancaster and York counties. We are so used to seeing our home area that we don't stop and appreciate our landforms. You drive from point "A" to point "B" every day, but do you really look at the surroundings? Our landscape is blessed with the famous Appalachian Mountains, elongated ridges, fertile valleys and historic streams and rivers. As viewed from the air, our landscape appears like a ribbon crossing southeastern Pennsylvania in a northeastern-southwestern direction. With topography, relief, geology and even vegetation, we can divide the region into physiographic provinces and sections. In our region, we have the Ridge and Valley Province, South Mountain Section and the Appalachian Piedmont Province which includes the Gettysburg-Newark Lowlands Section, Lowlands Section and the Uplands Section. (Numbers represent elevations in feet above sea level).

- Ridge and Valley Province
  South Mountain Section
  Adams County: Valleys - 800-1,000 feet; Ridges -1,400-2,100 feet
  York County: Valleys - 600-1,000 feet; Ridges -1,000-1,460 feet

The western portion and extreme northern York County is highlighted by the slopes of South Mountain, the northern extension of the Blue Ridge Mountains, which continues south to form the scenic mountains in Virginia, North Carolina and Tennessee. South Mountain comes to a impressive end near White Rocks, Monaghan Township, York County, about two miles north of Dillsburg. South Mountain is composed of parallel ridges of quartzite, phyllite and volcanic rocks of Proterozoic to Early Cambrian in age. Its narrow valleys are underlain by less resistant Cambrian limestones similar to the limestones of the Great Valley to the west.

- Piedmont Province
  Gettysburg-Newark Lowlands Section
  Adams County: Valleys - 450-600 feet; Ridges - 900 – 1,300 feet
  Lancaster County: Valleys - 400-600 feet; Ridges - 800-1160 feet
  York County: Valleys - 400-600 feet; Ridges - 800-1260 feet

  This section contains some famous man-made and natural landmarks in the area. Localities in Adams County include the Gettysburg National Military Park, Ski Liberty; in Lancaster County, Roundtop, Furnace Hills, Three Mile Island; and in York County, Ski Roundtop, Pinchot State Park and Conewago Mountain.

  Triassic sandstone, shale, conglomerate and limestone conglomerate are joined with diabase and isolated basalt flows of Jurassic age to make up the rock types in this area.

- Piedmont Province
  Lowlands Section
  Adams County: 400-600 feet
  Lancaster and York Counties: 350-550 feet

  The Lowlands Section is characterized with a broad valley with isolated rounded hills. The valley is locally known as the York-Hanover Valley (Adams and York counties) and Conestoga Valley (Lancaster County). To the east, the valley continues to become the Chester Valley. Traveling from west to east, you may follow Pa. Rte. 194 from Littlestown to Hanover and then Pa. Rte. 116 into West York and Rte. U.S. 30 through York and Lancaster counties. In Lancaster County, the Lowlands Section quickly expands to the north, but narrowing back down to a valley at the Chester County line, including much of East Hempfield Township and the U.S. Rte. 222 corridor north to Ephrata.

  This section is underlain by the soft rocks of limestone, dolomite, sandstone and shale ranging in age from Cambrian to Middle Ordovician.

- Piedmont Province
  Uplands Section
  Adams County: 700-800 feet
  Lancaster County: 300-950 feet
  York County: 600-1,200 feet

  In the area, the Uplands Section is divided between several landforms. In Adams County, the section is only found in the southeastern corner east of Littlestown. The southern third of both Lancaster and York counties is composed on this section which is characterized by parallel ridges with narrow valleys. If you have ever driven south on Interstate Rte. 83 from Leader Heights or U.S. Rte. 222 south out of Willow Street, Lancaster County, you know there is very little flat area along the way. This area is composed of phyllites, slate, schists, metabasalts and serpentinite of probable Lower Paleozoic age.

  Acting as a border between the Uplands Section and the Lowlands Section is a conspicuous ridge known in York County as Reservoir Hill. This ridge runs from Codorus State Park south of Hanover; northeastward to the Susquehanna River. Stoverstown, North Codorus Township; Reservoir

Hill above York College of Pennsylvania and Sam Lewis State Park in Lower Windsor Township all sit on this ridge. Sam Lewis State Park is the highest point on this ridge at an elevation of 840 feet.

In Lancaster County, Manor Hills is the eastern extension of Reservoir Hill Ridge. Manor Hills runs from Washington Boro on the Susquehanna River to a point south of Lancaster.

In York County, the Pigeon Hills between Abbottsotwn and Thomasville and the Hellam Hills between Pleasureville and the Susquehanna River west of York are included in the Uplands Section. The highest point in the Pigeon Hills is 1,196 feet at Pulpit Rock in Heidelberg Township. In the Hellam Hills, the highest elevation is 1,057 feet, located east of Tower Road in Hellam Township. These highlands consist of Late Proterozoic and Early Cambrian quartzite, conglomerate, phyllite with older metavolcanic rocks making up the core.

In Lancaster County, the eastern extension of the Hellam Hills is Chickies Ridge with a northern spur called Chestnut Ridge. Along the Susquehanna River at the Chickies Ridge gap is one of the most famous rock outcrops in the area, Chickies Rock. Here Proterozoic quartzite is exposed in an anticline. Within these ridges are the Late Proterozoic and Early Cambrian quartzites and phyllites.

In eastern Lancaster County, there are two other highlands to be mentioned. The Honeybrook Uplands extend from the Earl-East Earl/Salisbury Township confluence eastward into Chester County. This ridge is locally known as the Welsh Mountains. The highest point is 1,101 feet at a point east of Pa. Rte. 872 in East Earl Township near Money Rocks County Park.

Mine Ridge, a region of Proterozoic metavolcanic rock is sandwiched between the carbonate rocks of the Conestoga Valley. Mine Ridge extends from approximately two miles northeast of Quarryville, east-northeast into Chester County, where it runs into the Honeybrook Upland. The highest elevation is 827 feet, located east of Gap, Lancaster County.

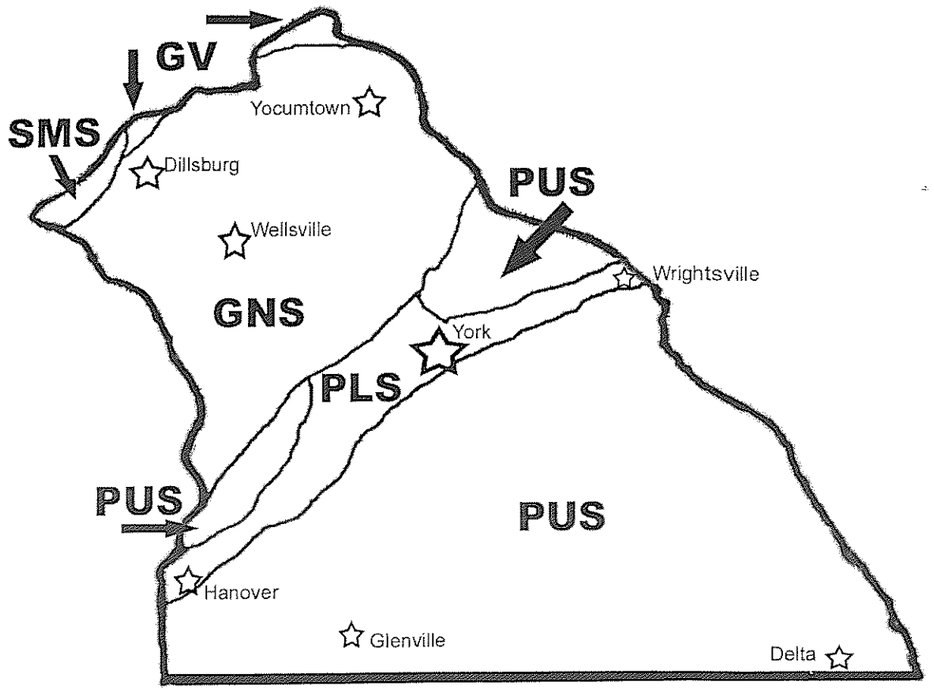
Proterozoic metagabbro, serpentinite, granodiorite gneiss and granitic gneiss make up the core of these two regions. Late Proterozoic quartzites, quartz schists and phyllites surround the older metamorphic and igneous rocks.

DRAINAGE

Two drainage basins are involved in Adams, Lancaster and York counties. Adams County contains a small version of a continental divide. All of the streams south and west of an imaginary line from Littlestown, Bonneauville, Biglerville, Aspers and northwest to the Adams-Cumberland County line eventually flow south into the Potomac River. Streams located to the north and east of the divide flow into the Susquehanna River. Major tributaries in Adams County flowing into the Potomac River include from west to east: Antietam Creek, Tom's Creek, March Creek, Rock Creek and Alloway Creek.

All of the streams in York and Lancaster counties belong to the Susquehanna River Basin. Drainage direction is to the north and east in northern and central York County. In the southern portion of York County, drainage is into Muddy Creek. The three tributaries in central and northern York County include Conewago Creek, Codorus Creek and Yellow Breeches Creek.

All of the drainage in Lancaster County flows generally to the south. Major tributaries from north to south include: Conewago Creek, Donegal Creek, Chickies Creek, Pequea Creek, Muddy Run and Octoraro Creek.



York County scale: 1: 400,000

North is toward top of page

GV	Great Valley Section of the Ridge and Valley Province
SMS	South Mountain Section of the Ridge and Valley Province
GNS	Gettysburg-Newark Section of the Piedmont Province
PUS	Uplands Section of the Piedmont Province
PLS	Lowlands Section of the Piedmont Province

PUS (north of Hanover) is the Pigeon Hills
PUS (north of York) is the Hellam Hills

STOP 1 – YORK COUNTY HERITAGE RAIL TRAIL
GLEN ROCK PARKING AREA, QUARTZITE

Theme: Metamorphic rock known as quartzite belonging to the Octoraro Formation
Age: Early Paleozoic

This rock was originally a sandstone (made up of sand-size particles and a sedimentary rock). The sand was deposited in shallow water of the Iapetus Ocean (maybe near shore or sand bar environment). A collision between Africa and north America 350-300 million years ago (mya) known as the Alleghanian Orogeny created much heat, pressure and burial. The rock recrystallized into a quartzite (coarser grained and composed of quartz).

Notice how the rock underlies a small hill. This means the quartzite is more resistant to erosion than the surrounding rock (schst). Also notice the layering (bedding) of the rock. Can you see the direction the layers are tilting into the Earth? The rock has also been fractured, allowing the rock to be removed in a rectangular pattern.

STOP 2. FROGTOWN ROAD SCHIST

Theme: Metamorphic rock known as a schist belonging to the Marburg Formation
Age: Late Proterozoic

This rock was originally formed as a shale in the Iapetus Ocean, but is older than the rock at Stop 1. Shale is composed of clay-sized particles and usually means the sediment was deposited in a deeper water environment. During the Alleghanian Orogeny, the clay in the shale was transformed into mica, a platy mineral. Can you see the sparkles in the rock from the mica? Can you notice any layering in the rock? What you might detect as layering is actually a feature geologists know as foliation. During metamorphism, he various minerals within the rock are aligned parallel to each other, giving the rock the "layered" look.

STOP 3. MARY ANN FURNACE, CODORUS STATE PARK, RUMMEL FARM PARKING AREA

Theme: Iron furnace and community
Age: 1762 – 1803

On this site stood the oldest blast furnace west of the Susquehanna River. Mary Ann Furnace brought vitality to the area as it produced stove plates, weapons and cannonballs and other wares.

Much of the military supplies produced here were used by General Washington's troops. Being one of the earliest furnaces operating, this structure was approximately 20 feet across and stood about 15 feet high.

So how does a furnace operate? Three agents were needed to produce iron implements: iron ore, limestone and charcoal. For Mary Ann Furnace, the iron ore came from the Pigeon Hills (about a 5-7 mile journey by wagon) and from the southern end of Hanover Borough (3-4 miles). Limestone was used as a flux to remove the impurities from the iron ore. The source for the limestone was from Hanover. Charcoal was produced from the slow burning of mostly chestnut trees in the area and surroundings, including the Pigeon Hills. A furnace working properly used about 1 acre of lumber converted to charcoal in 24 hours. The charcoal collier and his team produced 1 acre worth of charcoal in 8-10 days with a single burn.

A byproduct of the furnace was slag, the material taken off of the top of the furnace from the impurities in the iron ore. The slag was hauled by wagon a short distance from the furnace and dumped. The west side of Black Rock Road from the tree line directly across from the furnace site northward to the Codorus Creek bridge is covered by slag at an unknown depth. Shiny slag indicated a healthy furnace and a dull, earthy type of slag meant that the temperature was not up to acceptable levels to produce good castings.

Picture here in this small wooded area east of Black Rock Road the furnace and loading platform from above. On the hill behind the furnace (in the area of the telephone pole) were some storage building separately housing the necessary ingredients. A water race came from the Codorus Creek from the south (probably with an dammed pond) to supply the energy to turn a waterwheel to drive the bellows to blow air into the furnace. A tailrace returned to water to the stream toward the north. Within the bank here, one can find iron ore, charcoal (blackness of the soil) and limestone (which is not native to this site).

Associated with the furnace was a casting house to produce the products, an iron masters house watching over the operation and a small village where the workers resided when not working. The location of these structures is not known at this time.

An in-depth surface survey and magnetometer investigation occurred here in 2008. The conclusion of this work was that the furnace was located near this wooded grove. Archaeological excavations occurred here during July and August, 2010 by students of York County Park's Archaeology Weeks program. The research produced nearly 800 artifacts of many iron fragments, cannonballs, and fragments of stove plates, identifiable iron pieces, pottery, iron ore, limestone, charcoal and slag. Upon the completion of the research, the furnace probably sat under Black Rock Road.

STOP 4. CODORUS STATE PARK, BLACK ROCK ROAD PARKING AREA
MARTIC LINE OR MARTIC OVERTHRUST

Theme: Martic Line or Martic Overthrust
Age: Late Paleozoic (Alleghanian Orogeny, 350-300 mya)

Notice the straightness of Lake Marburg running east-to-west here? The Matic Line (or overthrust) runs under your feet here. This prominent geologic feature runs from Maryland and throughout southeast Pennsylvania to near Philadelphia where it intersects with another fault. The Martic Line is believed to be a fault boundary possibly between two crustal plates. The rocks to the south are predominantly metamorphic. The rocks to the north are mostly sedimentary rocks. Unfortunately, there are good exposures of rock to show you proof of its movement.

Sometimes, streams will mark faults. A fault is a fracture in the Earth's surface. Rocks within a fault are broken and erode away faster than surrounding rocks. Streams do not want to work for a living and finding a fault is a natural-made channel to flow in.

STOP 5. VULCAN QUARRY

Theme: Quarrying procedures, safety, regulations and limestones and dolomites belonging to the Kinzers and Ledger formations
Age: Early Cambrian

This is one of the largest quarries in the area. Now owned and operated by Vulcan Materials, the quarry was previously owned by Bethlehem Steel Corporation.
Today, we will be treated to a tour with Vulcan employee Johnny Johnnson, who will describe what is occurring on the site, discuss regulations that must be followed and what occurs after the mineral resources are exhausted here. Johnny, in his own right knows a tremendous wealth of mining history and has assisted in our Archaeology Weeks program.

As you tour the quarry, identify the different levels or sometimes known as "lifts." Also notice any groundwater problems or issues. Because the walls in quarries are dangerous places, we will stay plenty far away of them. The quarry setup a small pile of rock in a "safe" place for you to collect the mineral calcite, the dominant mineral in limestone. Calcite appears as whitish, yellowish or clear cleavages or crystals. Scratch a piece of calcite at home with a nail and pour a small amount of vinegar on it – the calcite should fizz.

The rocks exposed here belong to two geologic formations known as the Ledger and Kinzers formations. Both rock units occur in the York Valley (U.S. Rte. 30) and contain wealthy limestone and dolomite resources. The rocks in the quarry have been intensely faulted and shifted, often times, it is hard to determine which direction layering is going. The occasional-seen white pockets of marble belong to the Ledger Formation. As in Stops 1 and 2, these sedimentary rocks formed within the

Iapetus Ocean. Features found in the rocks give us some clues about their origin. The rocks were formed in a tropical environment. Also, the limestone and dolomite were formed on the continental shelf of ancient North America.

STOP 6. BEAVER CREEK ROAD FANGLOMERATE

Theme: New Oxford Formation fanglomerate
Age: 215 mya

We now move into a different geologic setting. Just for a moment we will move well ahead of time up into the Mesozoic Era. This small view of an exciting time in our area centers around the split up of the super continent Pangaea. The Alleghanian Orogeny was the coming together of all of the continents to form Pangaea. From where we are standing and traveling north and west to York Springs and Dillsburg the area was a rift valley. Each side of the rift was attempting to pull apart as Pangaea was splitting. This rift valley was not successful, but if it had pulled apart, the city of York and Borough of Hanover would be a municipality in northwest Africa.

You may be familiar with a rock known as breccia, a sedimentary rock containing angular rock fragments. Well, this rock is classified as breccia, but we can take its origin one step further. Angular rock fragments tell us that they were only transported in water a very short distance. Some of the rocks are those found within the Pigeon Hills and York-Hanover Valley to the east. Visualize this rift valley with steep walls and a flat floor. As streams came down the steep walls with high energy, they picked up larger rocks. When the stream hit the valley floor, they were not able to carry the larger rocks, dropping them. After this process continued, the larger rock fragments got deeper and wider, eventually forming an alluvial fan,
□□

STOP 7. BEAVER CREEK ROAD METABASALT

Theme: Igneous rock known as metabasalt belonging to the Catoctin Formation
Age: Proterozoic

This is the first igneous rock encountered on our trip today. Basalt forms on the oceanic plates throughout the world. Thus, that means that this area must have been ocean bottom at one time. One step further, this was a divergent boundary in the Iapetus Ocean. Think of the Mid-Atlantic Ridge today. This is what this rock tells us about, only about 600 mya. Look for cavities in the rock that were once gas bubbles that never filled in by minerals. That tells you that the rock formed from magma that made it to the surface (lava) and not cooling into an igneous rock beneath the earth's surface. The green color in the rock is from the mineral chlorite (dark green) and a grass-green mineral known as epidote.

With our first look at the Pigeon Hills, just how did this highland get here. As we have discussed today, soft rocks make up the valleys and more resistant rocks occupy the ridges. In this case, during the Alleghanian Orogeny, Pigeon Hills and Hellam Hills were broken off of South Mountain near the Mason-Dixon Line and transported northeast to their current location.

STOP 8. PULPIT ROCK, HIGH ROCK ROAD

Theme: Metamorphic rock known as quartzite belonging to the Chickies Formation
Age: Early Cambrian

At Stop 1, we examined quartzite and a similar rock is found here. This quartzite belongs to the Chickies Formation with a definite time placed on the rock. Remember the exact age of the Octoraro Formation is not known, only being assigned a Early Paleozoic age. This rock also formed in the Iapetus Ocean along the shore. Within this formation worm fossils known as *Scolithus* can be found, indicating a near-shore environment. This rock occupies much of the Pigeon Hills and its twin highland, Hellam Hills to the east.

STOP 9. GLATCO LAKE, HALDEMAN IRON BANK

Theme: 19th iron mining
Age: 1860-1873

At this last stop are the remains of an iron bank (mine). Over 170 mines once existed in York County with the Pigeon Hills area being the site of some of the oldest such operations. As discussed at Stop 3, much of the ore used at Mary Ann Furnace came from this area. According to historic records, this operation only used open pit mining. A gangway took ore cars up and down into the pit removing perhaps one ton of ore at a time. Miners working with picks, shovels and black powder worked the ore out. The ore was the mineral limonite and formed in the soil along the contact between the Antietam Formation (sandstone) and Vintage Formation (limestone). The ore was sent through washers on site to separate it from the soil and than transported by horse and wagon to Jacobs Mill to the railroad.