Trail of Geology
16–118.0

From Rails to Trails to Rocks

Geology of the Garrett-to-Rockwood Section of the Allegheny Highlands Trail

by

James R. Shaulis and Thomas W. Jones

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
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This trail guide is a revision of an article published in 2000 by the Pennsylvania Geological Survey in *Pennsylvania Geology,* v. 31, no. 1, p. 12–25. The authors have added information pertaining to the recently discovered Casselman River gorge landslide. Numbered markers found along the trail correspond to the Geological Educational sites described in this guide.

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ON THE COVER: Sixth grade student BJ Nicholas (alias "Clay Stone") holds a piece of calcareous claystone full of the brachiopod *Diaphragmus.* The claystone was found in the Wymps Gap Limestone marine interval at Geological Educational site GR–5.

From Rails to Trails to Rocks
Geology of the Garrett-to-Rockwood Section of the Allegheny Highlands Trail

by James R. Shaulis[1] and Thomas W. Jones[2]

***ALL ABOARD*—INTRODUCTION.** Railroads were once smoky, rumbling pathways that connected us to our mineral and energy resources, our industries, and to each other. Today, along many of these same pathways, the resources are depleted, the industries have disappeared, and the rail beds have been replaced with trails where travelers walk and bicycle instead of ride in passenger-train cars. Even though much has changed, these pathways still serve as connections. They now link us to healthy enjoyment of leisure time.

Through the identification of geologic features found along these pathways, there exists the potential for these former roads of rails to connect us to an educational resource, one that remains to help us better understand our earth and our history. Thus, in addition to the pursuit of fitness and fun, the trails link us to knowledge and understanding of our physical world and environment.

***NOW LEAVING THE STATION*—FIELD TEST.** In the spring of 1998, a "Rails to Rocks" pilot project was launched to develop educational activities in earth and environmental science for grades kindergarten through 12 (K–12). The project was based on geological features found along a 7-mile segment of the Allegheny Highlands Trail (between Garrett and Rockwood in Somerset County) and a 26-mile segment of the Youghiogheny River Trail North (between Connellsville and West Newton in Fayette and Westmoreland Counties). Both trail sections are part of the Great Allegheny Passage, a 150-mile trail corridor that begins just west of Pittsburgh and continues southeastward to Cumberland, Md. At Cumberland, the Great Allegheny Passage joins the C&O Canal Towpath, which extends to Washington, D. C. (see back cover).

The trail sections are located along abandoned railways that have been converted to public hiking and biking trails and are referred to as "rail trails." During the spring and summer of 1998 and 1999, geologically related features visible from the rail trails in these two sections were examined. Rock exposures and other natural features related to the geology of the region and determined to have significant educational potential were described and interpreted. These features were

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designated as Geological Educational sites. Sites for the Garrett-to-Rockwood segment are shown in Figure 1.

Educators from the Pennsylvania State Department of Education and local school districts, Bureau of Topographic and Geologic Survey staff members, Bureau of State Parks Environmental Interpretive Naturalists, Somerset County Parks and Recreation Board members, Youghiogheny River Trail Corporation board members, Rockwood Borough Council and Water Authority members, Youghiogheny River Trail Council representatives, private consultants, and local experts all contributed to this project. Educational materials for use in teacher workshops and outdoor classroom activities for grades K–12 were created (Jones and others, 1999; Jones and Shaulis, 1999).

LET ME HAVE THE WINDOW SEAT. Field trips for earth science students are more important to their mastery of the curriculum than for any other subject because many basic earth science concepts are difficult to demonstrate in the classroom. Even though fossils and minerals can be examined in hand specimens at a student's desk, their connection to the earth can remain abstract until they are seen in a natural exposure. Furthermore, because the geographical areas that rock formations and structures cover can be large, relating to them can be difficult for beginning students. Layers of rock that extend many miles horizontally, or a geologic feature such as an anticlinal fold that extends for hundreds of feet vertically, can only be fully appreciated in the field.

YOU WILL SEE ROCKS AROUND EVERY BEND WHEN YOU RIDE ON THIS "TERRAIN." Earth science educators are handicapped in Pennsylvania because extensive vegetation and thick soil cover obscure the bedrock. Because of this, opportunities to see bedrock geology are primarily limited to exposures along highways, railroads, and rivers, or in quarries, which are commonly noisy, dirty, dangerous, difficult to access, and fraught with liability concerns. Although these places may be suitable for college students and adults, they are not well suited for use by elementary and secondary school students. However, with the conversion of abandoned railroad beds into rail trails, exposures that were previously some of the most difficult and dangerous to visit and study are now the safest and easiest. Rock exposures and other geologically related features located along these rail-trail corridors are quiet, safe, available year-round, liability-free, easy to access by biking or hiking, and can be incorporated into K–12 earth science curricula.

A RAIL-TRAIL GEOLOGICAL EDUCATIONAL FANTASY TRIP—*THE TRAVEL AGENT'S NAME WAS ANN T. CLINE.* Come travel back to a time when the climate was greatly warmer, when oceans were moun-

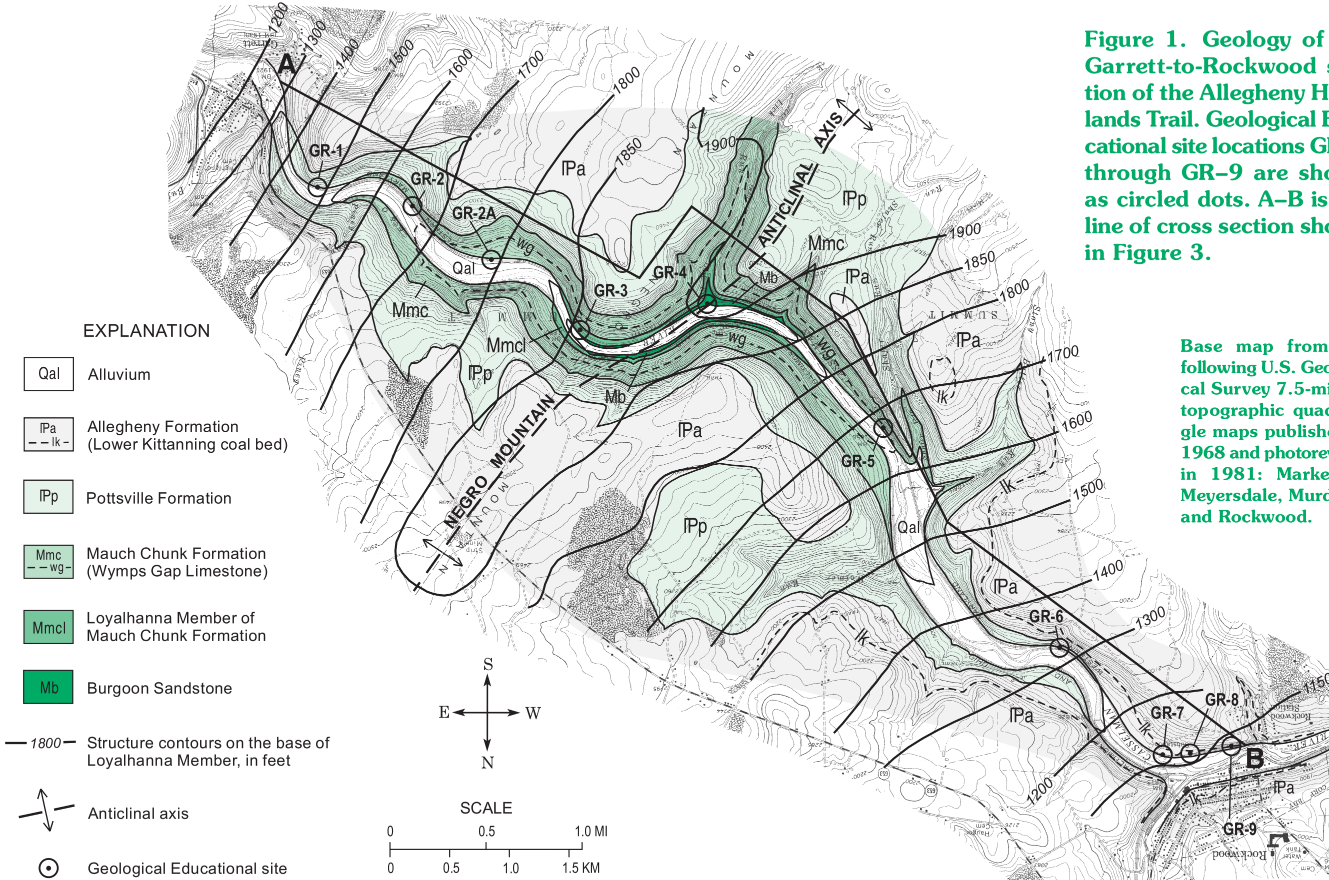

Figure 1. Geology of the Garrett-to-Rockwood section of the Allegheny Highlands Trail. Geological Educational site locations GR–1 through GR–9 are shown as circled dots. A–B is the line of cross section shown in Figure 3.

Base map from the following U.S. Geological Survey 7.5-minute topographic quadrangle maps published in 1968 and photorevised in 1981: Markelton, Meyersdale, Murdock, and Rockwood.

tains and mountains were oceans. See the results of the greatest collision ever experienced by North America. See the effects that more than 200 million years of differential weathering has had on the landscape. Hear an expert guide point out important geologic features and relationships contained in the rock exposures that span 60 million years of geologic history along one of the most scenic routes of the Appalachian Plateaus province. See resources exposed in their natural setting and how society's mining of these natural resources has affected the landscape and the environment.

What follows is a fictional transcript of the recollections of passenger Crystal Lynn from the first leg of a train ride between Garrett and West Newton, Pa. Her notes were limited to comments made by tour guide Gemmy Euhedral Orthorhombic Edingtonite ($BaAl_2Si_3O_{10}\cdot 4H_2O$), geologist/educator, and student Clay Stone.

Mr. GEO Ed: My name is Gemmy Euhedral Orthorhombic Edingtonite, but you can call me Mr. GEO Ed. I will be your guide today for the "Negro Mountain Anticlinal Fold and Related Geologic Features" tour.

Could I have your attention please, everyone? We have just left the Garrett Trailhead, which is located geographically on the eastern edge of Negro Mountain, about half a mile west of Garrett, Pa., and geologically on the eastern side of the Negro Mountain anticline (Figure 1). In a moment, we will be at our first stop ***(site GR–1).***

If you look to your left, you will notice room- to car-sized sandstone boulders. The rock making up these boulders was formed about 300 million years ago during the geologic time interval named for Pennsylvania, the Pennsylvanian Period. At that time, sand was eroded from granitic mountains that were located off to the southeast. The sand was carried by high-energy braided streams to this area and then deposited as thick layers of silica sand onto a subsiding submarine platform. About 200 feet of this material eventually accumulated here.

After deposition, silica-rich waters filled the pore spaces between sand grains and formed silica cement, which bound the grains together into rocks that are very resistant to weathering and erosion. The boulders you're looking at have broken loose from a rock outcrop just up the slope that makes up part of what geologists refer to as the Pottsville Formation (Figure 2; also see Figure 5). This rock unit has played a major role in the formation of Negro Mountain.

To explain, let me begin by saying something about the geologic structure we are riding through today, the Negro Mountain anticline. It is a large-scale, elongated, convex fold in the rock layers, and its axis trends in a northeast-southwest direction (Faill, 1998). It was formed

Figure 2. At a workshop sponsored by the University of Pittsburgh at Johnstown Center for Mathematics and Science Education, teachers examine one of many large Pottsville boulders at site GR–1.

when previously horizontal layers of rock were pushed up and folded 200 million years ago during the mountain-building event known as the Alleghanian orogeny.

Since that time, these rock layers have been undergoing weathering and erosion. This process has removed softer rocks that once covered Negro Mountain and has exposed the anticlinal mountain, whose crest and slopes are made up of resistant sandstone layers of the Pottsville Formation and the lower part of the Allegheny Formation. Allegheny Formation rocks lie on top of the Pottsville rocks.

Our route today parallels the Casselman River, which, fortunately for us, has cut through the anticline and exposed it, so we can also see the rocks that are within (Figure 3).

Clay: Mr. GEO Ed, are you sure it's safe for us to be riding through here?

Mr. GEO Ed: Why do you ask, Clay?

Clay: Well, couldn't more boulders break loose up there and come down and hit us?

Mr. GEO Ed: Oh, you don't need to worry about that. I should have mentioned that those boulders probably haven't moved in about 10,000 years (W. D. Sevon, oral commun., 1998). After they broke off from the outcrop, they moved slowly downslope by means of a gravity-driven process that involved freezing of the soil in the winter followed by sliding of the boulders during thawing in the summer. This process was most active during the last glacial period, about 18,000 to 24,000 years ago (W. D. Sevon, oral commun., 1998). Even though there were no glaciers here, the climate was similar to present tundra climates, and freeze-thaw activities on slopes were much more vigorous.

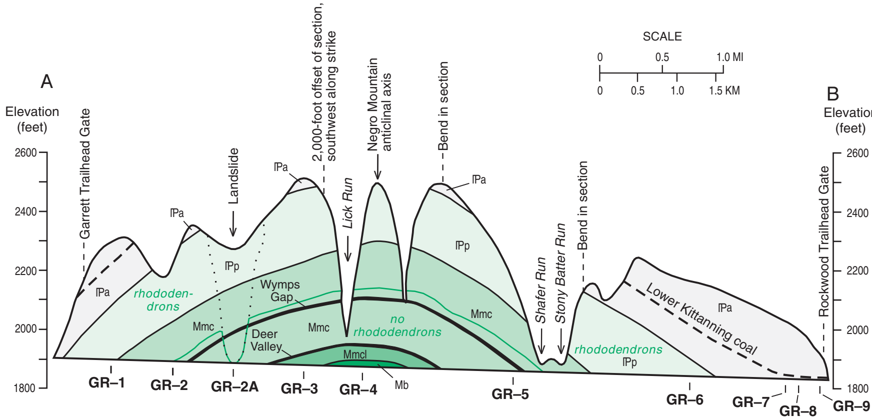

Figure 3. Cross-section A–B through the Negro Mountain anticline shows the geology and topographic profile (vertical exaggeration of approximately 12.5) a visitor to the trail would see when looking at the southwestern side of the Casselman River gorge between Garrett and Rockwood, Pa. The black dots mark the landslide area, and the green line marks the boundary between areas having rhododendrons (above) and having no rhododendrons (below). See Figure 1 for the location of the section and an explanation of the symbols and colors.

If you look out the window here ***(site GR–2),*** you will notice that the layers of rock are tilted to the southeast and differ markedly in appearance from the Pottsville (Figure 4). They are thinly layered, olive-gray siltstones, sandstones, and limestones, or reddish-brown silty claystones. These rocks are in the middle to upper part of the Mississippian Mauch Chunk Formation and are stratigraphically several hundred feet lower than the Pennsylvanian Pottsville sandstone that we just saw (Figure 5).

They are thus geologically older than the boulder-forming rocks. One proof of this is that *Archeopteris* (Gillespie and others, 1978), a fossil

Figure 4. Mauch Chunk strata are dipping 3 to 4 degrees to the southeast at site GR–2, which is located on the eastern flank of the Negro Mountain anticline.

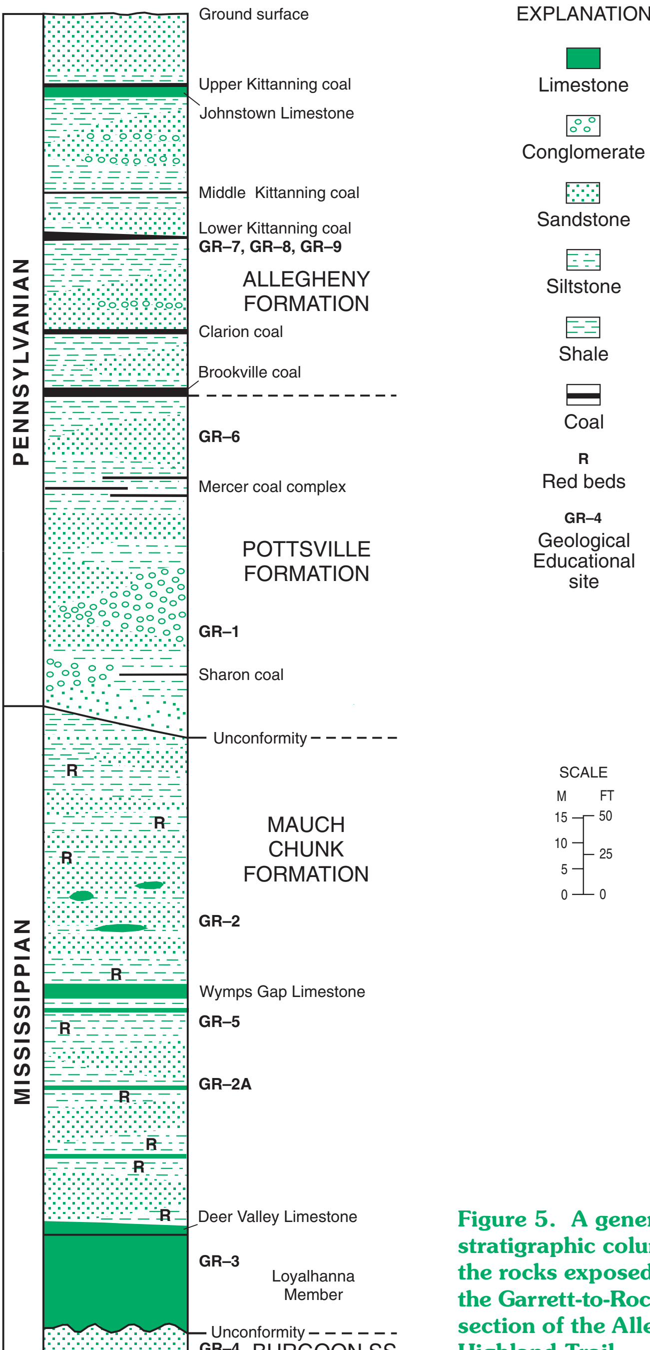

Figure 5. A generalized stratigraphic column for the rocks exposed along the Garrett-to-Rockwood section of the Allegheny Highland Trail.

fern having an age that is limited to the Mississippian (Wagner, 1984), has been found here (Figure 6).

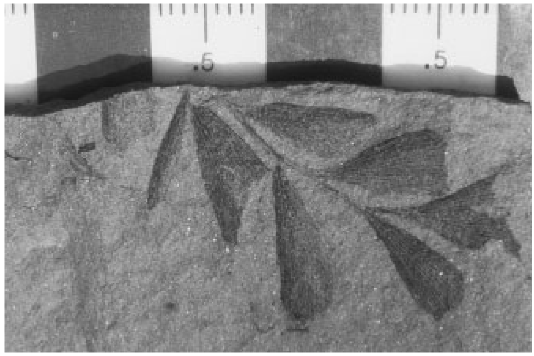

Figure 6. At site GR–2, one of three known sites in Pennsylvania that contain Mississippian-age plant fossils, *Archeopteris* can be found.

Further evidence of our different stratigraphic position is the sudden disappearance of living rhododendron plants as we near the middle of the Mauch Chunk Formation (Figure 7). At this point, a change from noncalcareous to calcareous strata occurs. Rhododendrons flourish in the acidic soil derived from rocks in the upper part of the Mauch Chunk Formation, the Pottsville Formation, and the lower part of the Allegheny Formation, but they do not thrive in the alkaline soil formed on the lower half of the Mauch Chunk Formation (R. C. Smith, II, oral commun., 1998; Figure 3). Therefore, a direct relationship between the rock strata and the flora can be observed while riding through the Negro Mountain anticline. In approaching the axis of the anticline from either side, the rhododendrons disappear as calcareous, less acidic rocks of the Mauch Chunk Formation are exposed.

Figure 7. Rhododendrons, nature's "alkalinity indicators," mark the boundary between the upper (less calcareous, more acidic) and lower (more calcareous, less acidic) portions of the Mauch Chunk Formation at site GR–2. A hammer is being held at the uppermost calcareous bed.

The train has now traveled about half a mile further into the anticline without its occupants seeing any additional rhododendron when suddenly Clay calls out.

Clay: Mr. Geo Ed, rhododendrons everywhere you look! What's going on? Are we on the other side of the anticline already?

Mr. GEO Ed: No, Clay. We are still on the eastern flank of the anticline, and the acid-soil-producing rocks are outcropping 300 feet above us ***(site GR–2A).*** These plants shouldn't be here. Maybe the answer to your question can be found by taking a closer look in and around the rhododendron plants. See anything familiar?

Clay: Yes, Mr. Geo Ed. There are several sandstone boulders like the ones we saw earlier, but much smaller, all scattered around where the rhododendrons are. I guess if we had enough of them we could make soil that the rhododendrons would like. Did they get here the same way the larger ones did, by moving slowly down the mountain?

Mr. GEO Ed: You're on the right track Clay; however, in this instance, rather than a few large boulders, a whole section of the mountain came rumbling down at maybe 30 to 50 miles per hour in a large landslide (Figure 8). We are traveling near the toe of the slide where the material has fanned out over the surface. If we could stop the train and

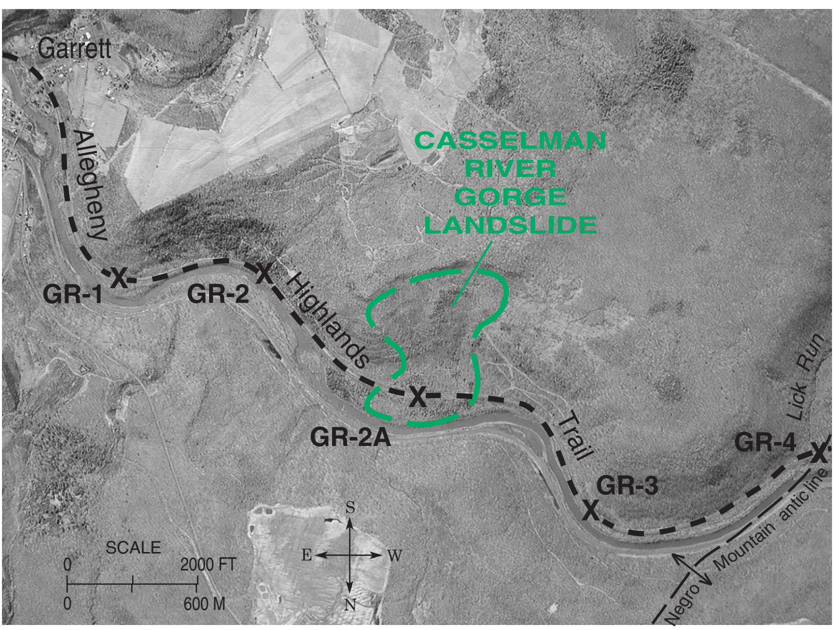

Figure 8. Part of U.S. Geological Survey National High Altitude Photograph 397808 NHAP showing the location of the Casselman River gorge landslide along the Allegheny Highlands trail, on the eastern flank of the Negro Mountain anticline. Photograph taken April 15, 1982.

climb up near the top of the mountain where most of this material came from, we would see the scarp above the head of the slide. The scarp is defined by a 40-foot cliff face and a depression between the bedrock cliff and the upper landslide blocks (H. L. Delano, oral commun., 2000; Figure 9). The landslide probably occurred about 10,000 years ago under the same periglacial conditions of the Ice Age that caused the other boulders to move, but instead of taking hundreds or perhaps thousands of years to travel down the mountain, it may have only taken less than a minute.

As we move deeper into the anticline ***(site GR–3),*** you'll notice that the beds are still inclined to the southeast but to a lesser degree, indicating that we are nearing the anticlinal axis, where the beds will be flat lying.

Clay: Mr. GEO Ed, what is the thick, gray rock layer having crisscross lines all over it?

Mr. GEO Ed: I'm glad you asked, Clay. The thick gray rock is a festoon-crossbedded, sandy limestone known as the Loyalhanna Member of

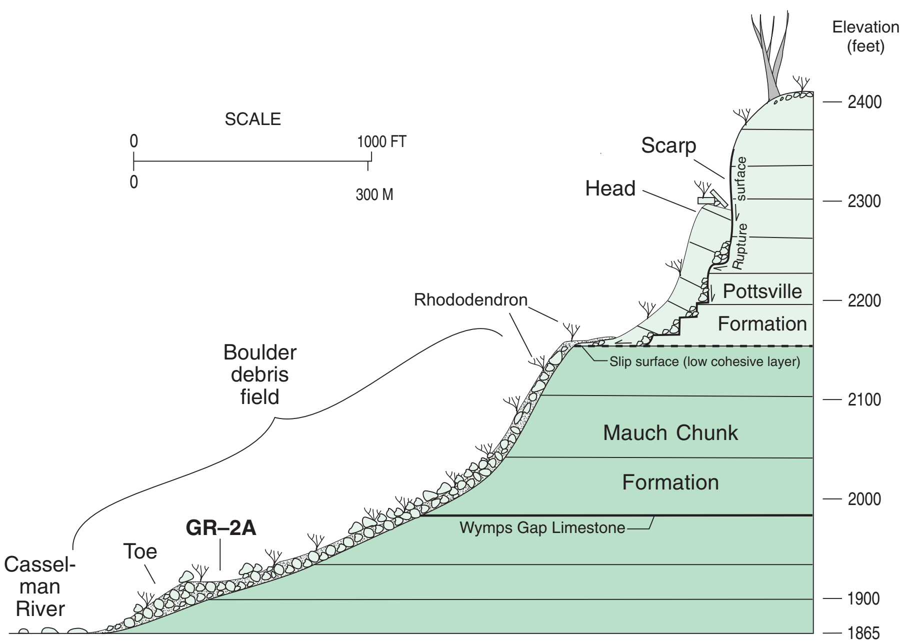

Figure 9. Conceptual cross section of the Casselman River gorge landslide (site GR–2A) looking northwest into Negro Mountain. The cross section shows how an intact rock mass may have moved downslope.

the Mauch Chunk Formation. The festoon crossbedding that you noticed was formed by sand waves or submarine dunes that deposited trough-shaped, thinly layered units that crosscut each other. Variations in the composition of trough layers cause them to weather differentially, creating an uneven surface that delineates the intricate crisscross bedding pattern in the rock (Figure 10).

Exposures of Loyalhanna limestone are visible on both sides of the Casselman River at this site. On the north side, entries to a large underground mine are present. The Loyalhanna limestone was quarried by the railroad for ballast and more recently is being used for road aggregate.

We are now on the anticlinal axis ***(site GR–4).*** It is unfortunate that there are no good outcrops that we can see directly from the train, but if we had time, we could stop and walk up the streambeds in this area, and you would see that the rocks are flat lying.

If you look out the window, you'll see an excavated area adjacent to the trail ***(site GR–5)*** that contains the Wymps Gap Limestone, a special rock unit in the middle part of the Mauch Chunk Formation. The Rockwood Borough Water Authority dug out this site in the spring of 1999 to expose the fossiliferous layers (Figures 11, 12, and 13). The Wymps Gap Limestone has been interpreted to have been deposited in a nearshore marine environment (Brezinski, 1984). However, we are 1,900 feet above sea level now.

Who can explain to me how it's possible for evidence of marine life to be present in the rocks here? OK, Clay, I will see how good your notes are.

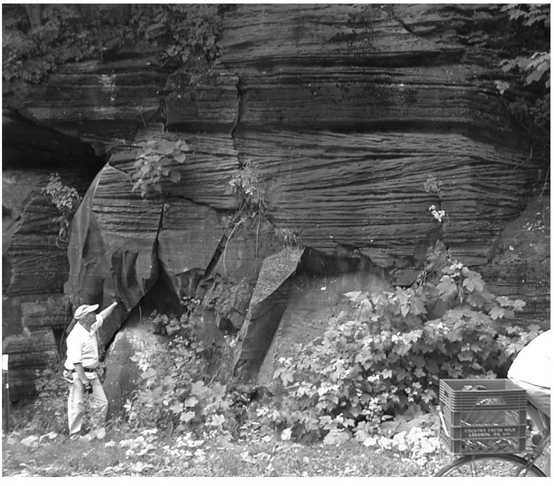

Figure 10. Tom Jones, Rockwood Area Elementary School science teacher, examines the differentially weathered crossbedding in the Loyalhanna limestone near the axis of the Negro Mountain anticline. Paleocurrent direction, indicated by the crossbedding in the strata, is from right to left.

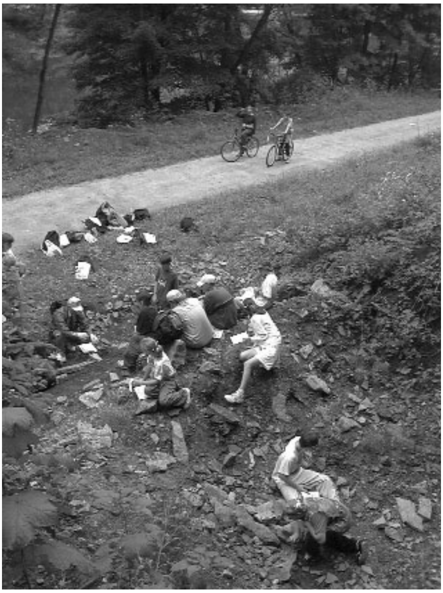

Figure 11. Rockwood Area Junior High School students search for marine fossils at a quarry (site GR–5) developed in the Wymps Gap Limestone by the Rockwood Borough Water Authority in cooperation with the Somerset County Parks and Recreation Board.

Figure 12. Crinoid columnals found in the Wymps Gap Limestone at site GR–5.

Clay: The paradox of the presence of marine life well above current sea level can be explained by the rising of the strata during the Alleghanian orogeny that you mentioned earlier, and the subsequent erosion of the overlying units to expose these strata at the surface.

Mr. GEO Ed: Very good, Clay. Sounds as though we've already molded you into an "A" student.

Do you recognize the massively bedded, hard, gray sandstone beds exposed in this area ***(site GR–6)?*** You've seen them before. The large boulders in the river below came from these layers and should give you a clue. This rock formation is the Pottsville, the same one we saw on the other side of the anticline, except that the beds are dipping to the northwest (Figure 14). Large branches of *Sigillaria,* a fossil tree whose preserved trunks and branches resemble tire tracks, are preserved as casts on the underside of several beds. Notice also that the rhododendrons are growing here and will be with us for the remainder of our journey today.

Clay: Mr. GEO Ed, is that coal?

Mr. GEO Ed: You're close, Clay. The large pile of black material on the south side of

Figure 13. A body fossil of the brachiopod genus *Arthracospirifer* (left) and a trilobite pygidium, probably from the genus *Paladin* (right), extracted from the thin, interbedded limestone and claystone layers that make up the lower portion of the Wymps Gap Limestone marine interval.

the trail ***(site GR–7)*** is waste-rock material produced during the underground mining of the Lower Kittanning coal seam in this area. This material was an impure part of the coal seam not suited for use in the electrical power generation plant, so it was separated and left as a waste pile outside the mine.

Now direct your attention over there to the nonvegetated area in the woods at the base of the slope, which is covered with orange-brown water ***(site GR–8).*** This site is an underground-mine entry on the Lower Kittanning coal seam. The orange-brown water that is flowing out of the hill here is acid mine drainage, or “AMD.”

Before AMD can occur, humid air must come in contact with freshly broken rock surfaces containing pyrite. When this occurs, the follow-

Figure 14. At site GR–6, located on the western flank of the Negro Mountain anticline, Pottsville sandstone beds can be seen dipping 3 degrees to the northwest.

ing reaction takes place: FeS_2 (pyrite) + O_2 + $H_2O \rightarrow Fe(OH)_3$ (solid iron hydroxide that colors the water orange brown) + SO_4^{2-} (sulfate) + H^+ (acid) (Brady and others, 1998). Pyritic surfaces are commonly exposed during the mining of bituminous coal. Groundwater traveling through fractures in the overlying rock percolates down into the mine, encounters these oxidized pyritic surfaces, and becomes acidic, creating AMD. The AMD does not continue on down vertically because immediately under the coal seam lies several feet of claystone that acts as an impermeable barrier. Also, because all the mine workings are up the rock dip from us at this site, groundwater that has found its way into the mine is being discharged here at the lowest opening.

Clay: Mr. GEO Ed, why aren't the layers tilted here ***(site GR–9)?*** Are we on the fold axis again?

Mr. GEO Ed: Good question, Clay. The rock layers in this area appear to be nearly horizontal even though we are still within the western flank of the Negro Mountain anticlinal structure. The reason for this appearance is that, for the first time today, our direction of travel has changed, and we are now traveling parallel to the fold axis. The rock layers thus appear flat even though they are actually dipping down toward you and to the northwest.

Also at this exposure, you can see the Lower Kittanning coal seam, a gray underclay just below it, and a thickly layered, light-gray sandstone immediately above it (Figure 15) (Flint, 1965). These are Pennsylvanian-age rocks that are from the lower portion of the Allegheny Formation. During the time these sediments were being deposited, this area was near the equator in a coastal-plain deltaic environment cov-

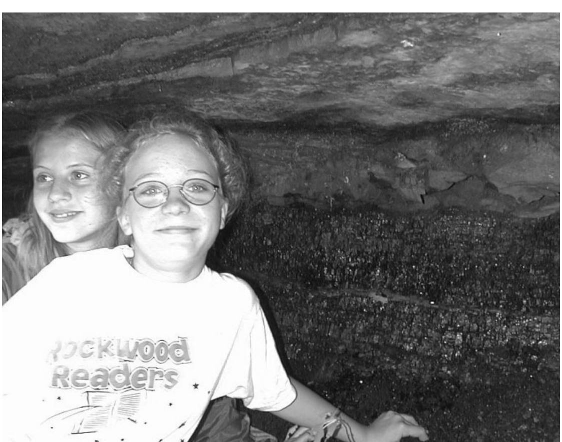

Figure 15. At site GR–9, seventh grade science students examine the Lower Kittanning coal seam that was deep mined along the trail near Rockwood in the Penelec No. 3 mine from 1917 to 1932. The average thickness of the coal seam in the mine was 29 inches.

ered with peat swamps. The peat has been altered through burial and is now present as coal.

During the early 1900s, this coal was deep mined and burned in a power plant located near the large waste pile we just saw. If you look on the opposite side of the river, you can see several more waste piles from other Lower Kittanning coal mines. Historically, coal mining has been important to the economy in this area, but not as important as it was to the area we will be visiting next. We are going to stop for a brief layover in Rockwood before continuing on.

The fantasy train ride will continue in a future issue of Pennsylvania Geology, *when Mr. GEO Ed and Clay will examine the geology in the heart of the Pittsburgh coal region, between Connellsville and West Newton.*

MAKING A 1-PERCENT GRADE IS PASSING FOR A LOCOMOTIVE— **FIELD TEST RESULTS.** The geoscience activities applicable to each site along the rail trail are being designed to support the Pennsylvania Department of Education *Academic Standards for Science and Technology* and *Academic Standards for Environment and Ecology.* For example, along the Garrett-to-Rockwood trail section, students can identify various geologic structures and features, such as an anticline at sites GR–2 through GR–6 and sedimentary crossbedding at site GR–3. In addition, they can analyze the availability, location, and extraction of earth resources by studying Lower Kittanning coal seam deposits at sites GR–7 through GR–9 and limestone deposits at site GR–3.

Teachers participating in the “Rails to Rocks” workshops offered during the 1998 and 1999 “Mathematics On Saturday/Science on Saturday” meetings, sponsored by the University of Pittsburgh at Johnstown Center for Mathematics and Science Education, rated the program as extremely useful and effective and suggested that it be made available for other teachers. In future workshops, teachers will apply what they have learned to outdoor classroom instruction by developing on-site lessons and activities applicable to the various rail-trail sites.

> **“We went from the traditional four-walled classroom to the open outdoors where students should be experiencing science. In this setting, teachers have the resources present to realistically back up textbook theory with real evidence.”**
>
> ***—parochial high-school teacher, written commun., 1998***

RAILS TO ROCKS, RESPECT, AND RESPONSIBILITY. Interconnection is the goal of the "Rails to Rocks" project. It is hoped that after participating in educational activities designed for the geologic sites found along these rail-trail routes, students will have learned something about how the geology is connected to the topography, history, ecology, and economy of these regions, and as a result, will be better prepared to make decisions that will affect the earth and its inhabitants.

A white paper drafted in March 1999 for use in the "GEO Beyond 2000" strategic planning process by the Geosciences Directorate of the National Science Foundation contained a recommendation that in the area of education, the number-one priority was to promote K–12 geoscience education to ensure that the next generation of scientists and the general public have a more thorough understanding of the nature and limits of geoscience research (Frodeman and Mitcham, 1999). Charles Jordan, Director of the Portland (Oregon) Parks and Recreation Department, summed it up best: "What they don't understand, they won't appreciate; what they don't appreciate, they won't respect; what they don't respect, they won't value; and what they don't value, they won't protect."[1] Connecting our students to the educational resources found along Pennsylvania's rail trails is a step in a lifelong journey to understanding, respecting, and preserving our earth, which is truly our common wealth.

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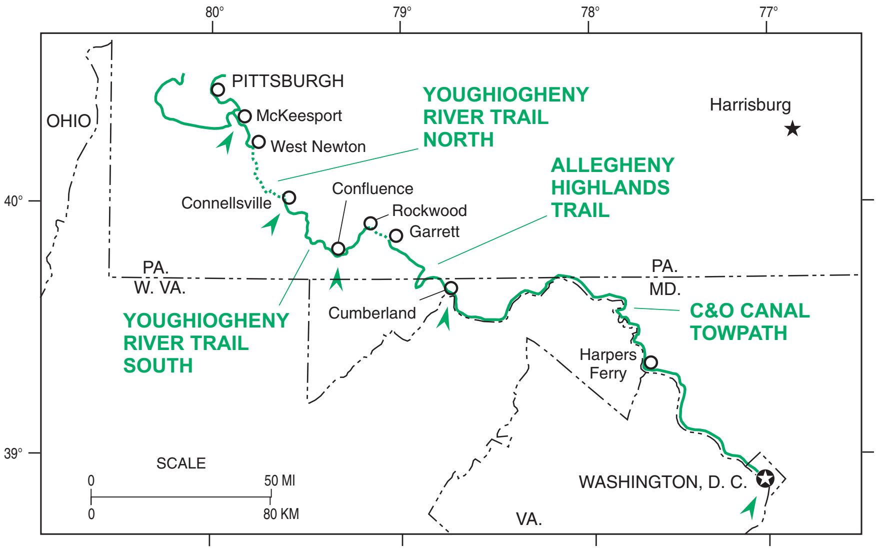
FOUR-HUNDRED-MILE-LONG TRAIL NETWORK FROM WASHINGTON, D. C., TO PITTSBURGH, PA.



Location of trail segments used for “Rails to Rocks” pilot project