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The contents are provisional and will be
superseded by a paper in the
DMT'11 Proceedings.

See also earlier Proceedings (1997-2010)
http://ngmdb.usgs.gov/info/dmt/

Geology and History of an 19th and early 20th Century Industrial Complex: The Nuttall Mine and Nuttallburg, WV.

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"Endless Wall" area with study area in center.

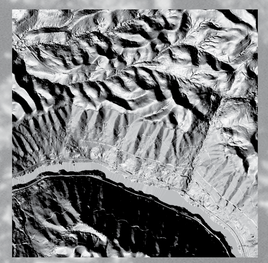
The background photo is an early 1900s coke oven battery in the New River Gorge obtained from the National Park Service in the mid-1980s. It shows that between the 1870s and the 1980s the Gorge was an industrial area producing both coal and coke using almost exclusively old style "beehive" coke ovens although coke production ended long before mining in the 1980s. The photo might have been taken in the lower foreground of the larger photo to the left, as the topography matches and Nuttallburg had a battery of 46 coke ovens. The New River Gorge had many similar coke over batteries in the late 1800s and early 1900s.

Introduction

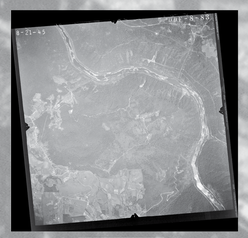
The area between the site of Nuttallburg and Keeney's Creek in the New River Gorge bounded by the river and the canyon rim at first appears to be a pristine, natural, and largely untouched environment, but in reality it is an example of the recovery of a late 19th through 20th century industrial complex given proper climatic conditions and benign neglect. At the same time, subtle and sometimes not so subtle evidence of past mining practices and transportation remains and must be taken into account in creating geologic maps and in considering possible future land use. Areas like this are common in West Virginia given the state's mining and logging heritage.

This project began as we were conducting cooperative mapping on the Fayetteville, WV 7.5 Minute Quadrangle with the National Park Service in the New River Gorge National River area. This is the quadrangle with the New River Gorge Bridge, which is, among other thing the third longest bridge of its kind in the world and the second highest bridge in the Americas. One local event is Bridge Day on the third Saturday in October. During this event the bridge is closed to traffic and open for pedestrians, various vendors, base jumpers, bungee jumpers, and those who wish to rappel from the bridge deck to the bottom of the gorge. This event is preceded by several weeks of preparation including security sweeps around and under the bridge. We had started working in the area, but decided to stay out of the way until after the event. The study area is between two and three miles from the bridge, so we transferred our efforts to the Nuttall Mine area. During the same period we were taking a, rarely offered, Surficial Geologic Mapping Course at West Virginia University. Part of this course involved producing a "local surficial map or map project in student area of interest." We were intrigued with the Nuttall Mine, Nuttallburg, Keeney's Creek area and had access to a new lidar derived DEM dataset, so we decided to propose a joint map in the area. This material will become part of the next version of our New River Gorge field trip guide, but it is also, to an extent, a class project that got out of hand.

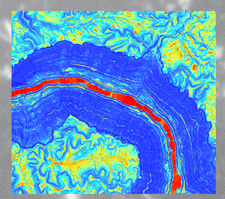
We would like to offer particular thanks to J. Steven Kite of West Virginia University for perservering in offering his Surficial Geologic Mapping Course when his schedule became very full as he assumed the duties of Chairman of the Department of Geology and Geography. It allowed two geologists who had spent much of their careers trying to look around and visualize through surficial deposits to better understand and appreciate surficial geology. Indeed, in this study area, we found the surficial geology much more facinating than the bedrock.



Hillshade of a portion of study area.



1946 SCS Air Photo showing mine dumps

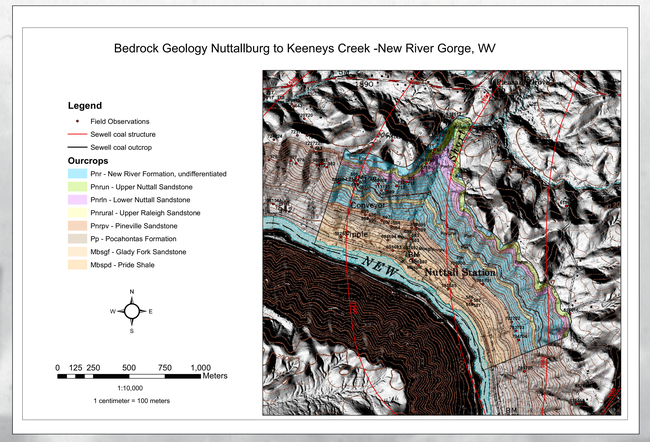


Slope shade of a portion of the study area.

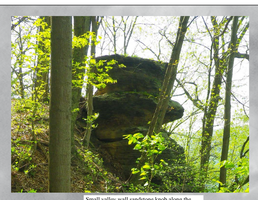
Basic Data

In the Appalachian Plateau portion of West Virginia along with our own field observations we generally have access to large amounts of surface and subsurface geologic information. West Virginia geology was originally mapped at 1:62,500 between around 1900 and 1939, the published data are still useful, but many changes in both geologic theory and technology have occurred in the last 70 years. In addition to the West Virginia Geological Survey's County Report Series we have access to large numbers of unpublish oil and gas well logs, coal exploration core logs, a few additional logs of cores drilled for scientific purposes, thousands of coal mine maps, and data collected during various field studies subsequent to the county reports. We also have access to many sets of air photos, remotely sensed imagery, and digital elevation data including statewide photo derived 1/9 arc second DEMs. Along with basic geologic data the most useful data available for this project have been a collection of very early air photos completed in 1946 and a newly completed extensive lidar dataset collected and processed by the U.S Army Corps of Engineers as part of a flooding study for the Bluestone Lake that provided data all along the gorge. The Corps has released lidar derived DEMs, photos, and point clouds and generously processed much more data than necessary for their original purpose in response to interest from West Virginia's user community.

The availability of lidar derived and other high resolution DEMs provided the opportunity to experiment with sun angles for hillshading along with computing slope and classifying slope to aid in surficial mapping. This coupled with field observations allowed much better interpretations of landforms than just a single hillshade.



Boulder Stream photo taken from trail created from Keeney's Creek Branch railroad bed



Small valley wall sandstone knob along the Nuttall Mine access road

Preliminary Bedrock Geology

Preliminary bedrock geology in the study area is portrayed above. The biggest problem encountered is that in the gorge bedrock exposures are overwhelmed by surficial materials that sometimes bury the bedrock tens of feet deep. The few bedrock exposures that exist are in railroad cuts and occasional exposures along the few permanent roads. One gap in bedrock data generally occurs in the relatively shallow subsurface between the bottom of available core logs and the point in oil and gas well geophysical logs where data collection begins. This is the case with the study area. We suspect that the top of the conglomeratic Princeton Formation might occur in the banks of the New River in the study area, but so far have not been able to find it. It is likely that it is buried by surficial deposits or railroad fill. This unit will be projected down river based on exposures anticipated up stream in areas where field work remains to be completed.

Impact of History on Surficial Geology

The history of the Nuttall Mine, which is typical of West Virginia's first generation of large metallurgical coal mines, was long, included several owner-operators, and involved the evolution of mining technology from hand loading with animal haulage to mechanized mining. Details of this history is well documented in the Library of Congress **Historic American Engineering Record; Mine Complex, North side of New River, 2.7 miles upstream from Fayette Landing, Lookout vicinity, Fayette, WV** (Maddex, 1991), but a few important points bear repeating to better understand the three surficial geologic maps to the right. At this location, mine site preparation began in 1870, and mining began in February 1873 on completion of the main line of the C&O Railroad in the gorge. Completion of the railroad allowed the delivery of heavy equipment and shipment of coal and coke to market. The mine, the conveyor route, most roads, and the company town of Nuttallburg, were built in the gorge between 1870 and 1873 (Maddex, 1991). Development modified the area of the slope above the north bank of the New River to raise the land elevation enough to prevent the tracks from flooding. This railroad construction, of course, significantly impacted the landscape in the area near the tracks. Two natural features directly impacted were the nested fans located at the mouth of Short Creek. The outlines of the original fan can be seen in a shaded relief surface constructed from lidar data. Within this feature a smaller fan formed when the flow of Short Creek was constricted by the bridge that carries the main C&O Railroad across the creek.

The next big construction project in the area was development of the C&O Keeney's Creek branch to aid in development of coal resources on Keeney's Creek and in the Lookout, WV area. Excavations and remaining bridges for this branch zigzag across the lower part of the study area. The first phase from Nuttall Station to Rothwell, completed in 1893, was approximately five miles long (Maddex, 1991). The second phase extended the line two miles to Lookout in 1903 (Maddex, 1991). This construction appears to have significantly altered the topography and surficial deposits along its route, particularly in the study area. One of the most obvious changes across Short Creek on the lower portion of the slope is the fan deposits west of Short Creek which are in contrast to the apron with one small remaining fan east of the creek. We suspect the reason for this difference is that much of the material in any eastern fans was either incorporated into the C&O Keeney's Creek Branch, obscured, or further modified by more than a century of erosion influenced by the presence of the railroad grade.

The other geologically significant features of human origin found in the study area, that are typically not well documented are the mine dumps. One of these has the superficial appearance of a rock glacier, but such a landform is unlikely to be found this far south. We suspected that it might be a mine dump given its location immediately below the Nuttall Mine, and its appearance along with at least five or six others on 1945-46 aerial photography (US Department of Agriculture Soil Conservation Service, 1946) was confirmed by a traverse we conducted along the railroad route to examine all of the mine dumps. It appears that the practice involved dumping mine waste in coves on the slope immediately below a mine railroad that ran from the mine to the ventilation fan house (Maddex, 1991) and then extending roughly along the outcrop of the Sewell coal west of the mine site. The first feature we noted in the mapping area immediately below the mine is probably the oldest as it was initially the easiest place to dump mine waste. We have examined both the photos, mine maps, and various visualizations of the area derived from recently released lidar data obtained by the Corps of Engineers (US Army Corps of Engineers, 2010) and have found no clear evidence that significant mine dumps occur east of the Nuttall Mine. Apparently, mine railroad tracks along a bench that approximately follows the outcrop of the Sewell coal east of the mine were only used as storage for empty underground mine haulage cars (Maddex, 1991), which is reasonable given the danger this would have posed to the C&O Railroad Keeney's Creek branch line. It also appears that the first dump immediately below the mine might have negatively impacted initial construction of the large switchback on this branch line.

We had little time to fully explore some of the harder to reach polygons as our real role in the NERI mapping project is producing bedrock geologic maps. One peculiar area is adjacent to and east of the conveyor route. It is a small cove that appears anomalous, and it is possibly an artifact of the conveyor operation or construction.

Unique Natural Features

One feature that appears common in the New River Gorge is a landform that we have been unable to find in the literature are the rocky knobs that occur on the valley walls on ridges between coves where resistant sandstones crop out. We have called these simply valley wall sandstone knobs, but would welcome a better term.

Another apparently natural feature that we observed in the field is a forking boulder stream in the southeastern part of the study area. We do not understand its origin, but it occurs in the area where the clean hard Lower Nuttall Sandstone begins to be well exposed above the walls of the gorge on the steeply dipping (maximum ~5 degrees) western limb of the Mann Mountain Anticline.

References:

Maddex, Lee B., 1991, Nuttallburg Mine Complex, North side of New River, 2.7 miles upstream from Fayette Landing, Lookout vicinity, Fayette, WV:United States Library of Congress: Historic American Engineering Record series, HAER No. WV-51, http://loc.gov/pictures/item/wv0352/, 121 p, 14 drawings.

US Department of Agriculture, 1946, project AIS 29185, unpublished aerial photos available from National Archives of the United States.

US Army Corps of Engineers, 2009, LIDAR - Bluestone Lake and Downstream, unpublished data set available from WV GIS Technical Center, 292 Gb.