

Division of Geology
and Mineral
Resources

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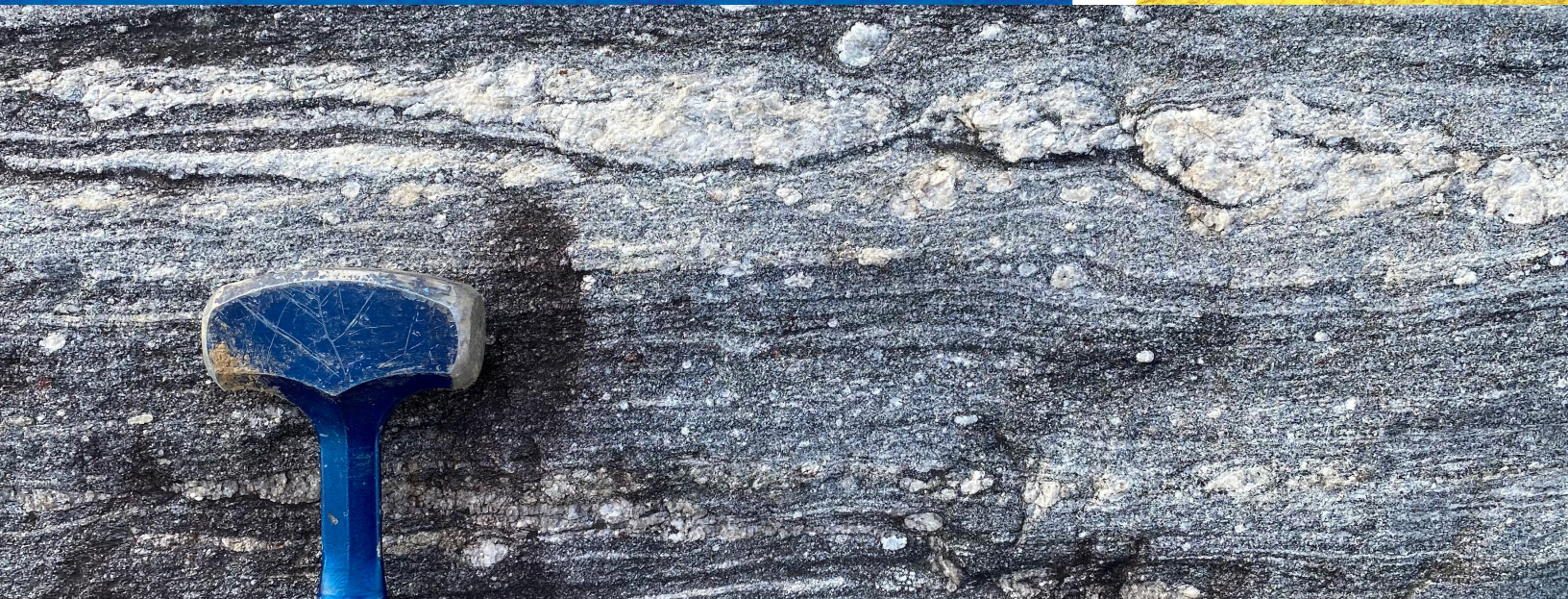




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Division Of Geology and Mineral Resources

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Charlottesville, Virginia 22903

<https://energy.virginia.gov/geology/geologymineralresources.shtml>



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VAEnergy

A Message From Virginia's State Geologist



Matt Heller

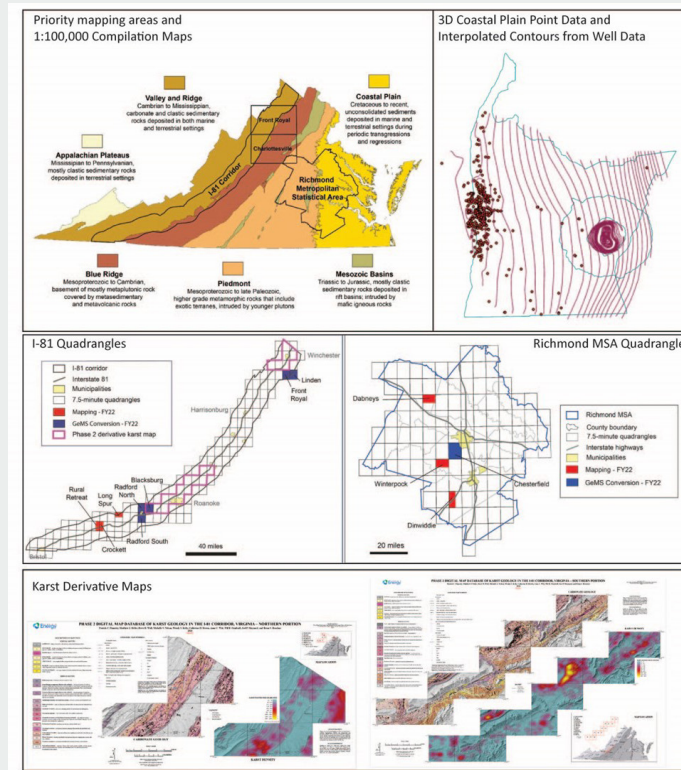
State Geologist/ Director of Geology and Mineral Resources

It has been an exciting year to work for Virginia Energy's Geology and Mineral Resources Program! A nationwide interest in developing domestic supplies of critical minerals is providing opportunities to discover new deposits and evaluate unconventional sources such as beach nourishment sands, mine tailings, and dredge spoils. Our work is being enhanced by statewide LiDAR coverage and the acquisition of high-resolution airborne geophysics by the U.S. Geological Survey. A push to develop a digital framework of geologic information for the Nation and preserve valuable geologic data is providing additional funding for geologic mapping, digital map compilation, the rescue of physical samples, the digitization of maps, reports, and logs, and the development of standardized and accessible databases of geologic information.

We have continued our successful collaboration with the Virginia Department of Emergency Management to assess the hazards posed by landslides and are currently working on a statewide landslide inventory study. We are proposing a similar study to look at statewide risk related to radon. In addition, we are applying for funding through a new USGS landslide program to conduct a new county-wide assessment in Grayson County, which was affected by Hurricane Helene. We have also been working on projects to foster coastal resiliency by identifying potential aggregate resources and evaluating our potential to sequester carbon dioxide in geologic reservoirs.

We decided to put together an annual newsletter this year to highlight major accomplishments and new products as a service to our customers, colleagues, and friends. We intend to continue this annual newsletter as a long-awaited sequel to the Virginia Minerals, which was produced from 1955 until 2008. I encourage you to reach out to our knowledgeable staff if you have questions about any of these accomplishments or projects and look forward to sharing our successes in 2025.

Mapping Section



State Map

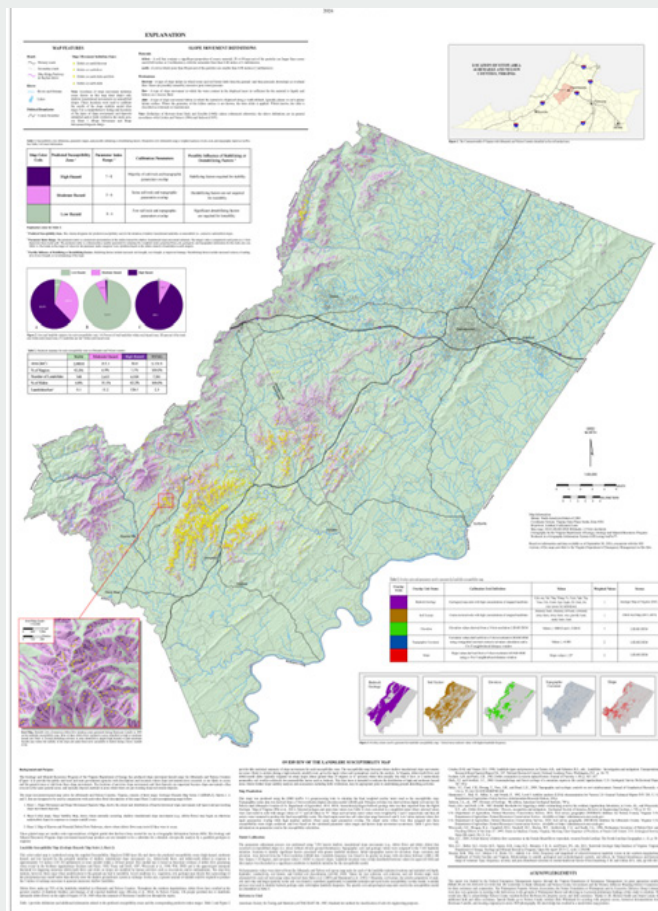
The Division of Geology and Mineral Resources Program just closed out their biggest grant ever, close to \$1.3 million, between federal dollars and general funds match! DGMR staff completed 1:24,000-scale geologic mapping equivalent to three 7.5-minute quadrangles along the Interstate 81 corridor and in the Richmond Metropolitan Statistical Area, two high priority regions of Virginia. DGMR also completed a second phase of work on a karst derivative map and geodatabase for an area encompassing all or part of twenty 7.5-minute quadrangles in the Interstate 81 corridor. This project used an ArcPro tool to automatically detect sinkholes from high-resolution LiDAR DEM data. A technical summary report accompanies the map which looks at carbonate bedrock and sinkhole size and density statistics.

In addition, DGMR completed two GeMS geologic compilation projects in 30-x 60-minute quadrangles (Front Royal and Charlottesville). These 1:100,000-scale maps depict the bedrock geology and contain new surficial geology drawn on a 5-meter LiDAR DEM. We also completed six GeMS conversion projects within the two long-term mapping areas for previously-published 7.5-minute quadrangles. Finally, we completed two correlation projects, one related to Coastal Plain Stratigraphy and one related to surficial deposits. Using water well and borehole data, DGMR generated 3D surfaces for the Crystalline Basement Complex, Calvert Confining Unit, and Potomac Confining Unit.

To learn more about our ongoing work and recently completed maps, visit our [project page](#).

FEMA Grant

New Landslide data for Albemarle and Nelson Counties are now available with the completion of a Federal Emergency Management Agency (FEMA) grant by the Geology and Mineral Resources Team! Anne Witt and Wendy Kelly compiled a geodatabase of almost 8,000 landslides covering an area affected by Hurricane Camille in 1969. In addition to the publicly accessible geodatabase, a three-part landslide susceptibility map series was produced, helping landowners better understand where future landslides may occur and where they could go. Visit our webpage to view the data and learn more: [Virginia Energy - Geology and Mineral Resources - Landslide Hazard Mapping](#)



VA Ocean Plan (DEQ)

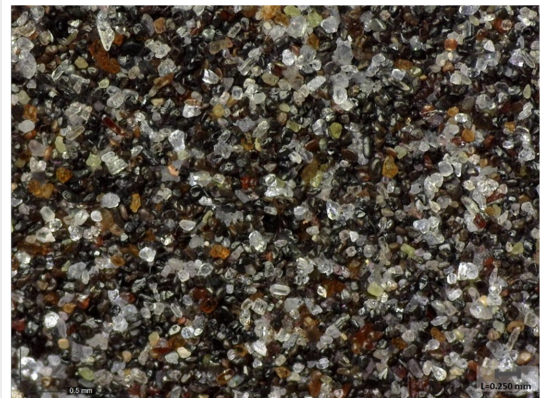
DGMR staff participated in the development of Virginia's first Ocean Plan that is being developed through the Virginia Coastal Zone Management (CZM) Program at the VA Department of Environmental Quality (DEQ). Staff served as members of the Seafloor Resources Workgroup to provide input related to offshore geologic resources and help to identify potential ocean use conflicts, data needs, and discussing potential recommendations for further research. Learn more about the Ocean Plan here: www.deq.virginia.gov/our-programs/coastal-zone-management/ocean-planning/virginia-ocean-planning

BOEM Report

In February 2024, staff in the Applied Geology section in the Geology and Mineral Resources Division completed a 76-page capacity assessment related to offshore critical minerals contained in sand resources. While DGMR has a long history of working with the U.S. Bureau of Ocean Energy Management (BOEM), this work focused on new sampling from previously-collected vibracores from Sandbridge Shoal off the southeastern coast of Virginia (see [OFR 2024-16](#)). The multi-year project covered five main topics.

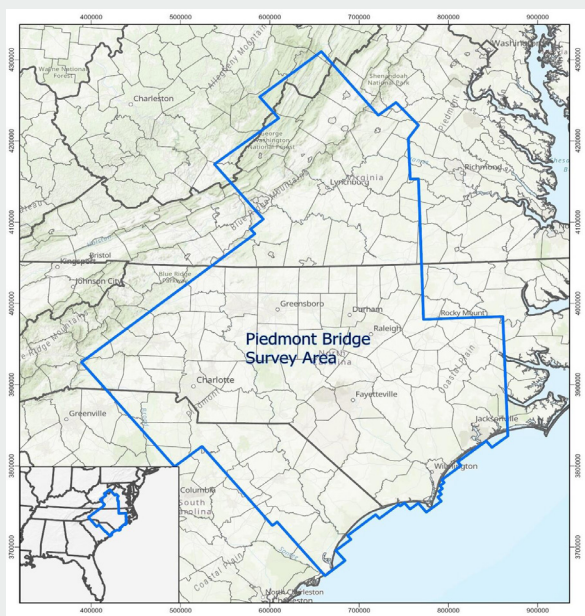
1. The Virginia Energy Mid-Atlantic Marine Heavy Mineral Sand Forum held in 2022 included stakeholder insights on the benefits, drawbacks, and information gaps related to heavy mineral sand separation during beach nourishment (see [OFR 2022-20](#)).
2. Inventory of existing federal and state regulatory and permitting framework surrounding the recovery of non-fuel minerals in offshore sand, which is a novel initiative and will require proactive collaboration between all levels of government as well as public and private entities.
3. The geology of occurrences of heavy mineral sands offshore Virginia, spanning nearly 40 years of research, is provided in an ArcGIS geodatabase. This database contains total heavy mineral content for 640 sediment samples, including heavy mineral type and geochemistry.
4. VA Energy acquired a portable x-ray fluorescence instrument as part of this project, which is used to estimate elemental concentrations in geologic materials. Vibracore sediment samples from Sandbridge Shoal along with onshore sediment samples from heavy mineral sand ore were utilized to develop a rapid screening protocol for detecting critical commodities such as Ti, Zr, and REEs in marine sediment samples.
5. Recommendations for a pilot study to test the feasibility of concentrating and further processing of heavy mineral sands at an inland facility alongside a beach nourishment project. These proposed next steps are meant to provide a starting point for potential future endeavors related to heavy mineral sand recovery from nourishment sands and discussions are already underway for this next phase.

This assessment has already generated interest and discussion of co-extraction feasibility outside of the agency. For example, key findings were presented at the annual Association of American State Geologists meeting in Park City, Utah. Additionally, staff involved with this work were asked to join the seafloor resources working group as part of the Virginia Ocean Plan project led by the VA Department of Environmental Quality.



Microscope image of heavy mineral sand concentrate.

New Airborne Geophysical Survey for VA



DGMR geologists worked with the USGS and other state colleagues late last year to propose areas needing better geophysical data coverage. Airborne geophysical surveys are planned over broad regions of Virginia over the next year. This is part of a larger project spanning parts of West Virginia, North Carolina and South Carolina. The effort is coordinated by the U.S. Geological Survey with the goal of providing images that expand the fundamental knowledge of geology across the region. Low-flying airplane and helicopters affixed with instruments will measure variations in the Earth's natural, low-level radiation created by different rock types beneath vegetation, and changes in the magnetic properties of rocks up to several miles below the surface. Flights will cover the following VA counties: Albemarle, Alleghany, Amelia, Amherst, Appomattox, Augusta, Bath, Bedford, Botetourt, Brunswick, Buena Vista, Buckingham, Campbell, Charlotte, Charlottesville, Covington, Craig, Cumberland, Danville, Fluvanna, Franklin, Goochland, Greene, Halifax, Harrisonburg, Henry, Highland, Lexington, Louisa, Lunenburg, Lynchburg, Madison, Martinsville, Mecklenburg, Nelson, Nottoway, Orange, Patrick, Pittsylvania, Powhatan, Prince Edward, Roanoke, Roanoke City, Rockbridge, Rockingham, Salem, Staunton, and Waynesboro.



The survey will help map rocks and minerals that have limited outcrop due to vegetation and soil cover. Such mapping can improve the understanding of the geologic framework within which the potential mineral resource may occur. In the Virginia Piedmont, the focus will be on rare earth elements, phosphate, barium, and Zn-Cu-Pb volcanogenic massive sulfide deposits. Other applications that will stem from this dataset include evaluating natural hazards such as radon and characterizing legacy mining areas. This data will be incorporated into new geologic maps produced by the Division of Geology and Mineral Resources.

Photo Source:

<https://www.usgs.gov/news/state-news-release/media-alert-low-level-fixed-wing-helicopter-flights-image-geology-over>

Earth MRI Grants - Mine Waste Inventory and Ti-Zr-REE Placer Mapping

The [USGS Earth Mapping Resources Initiative \(MRI\)](#) is a Mineral Resources Program opportunity provided by the 2019 Bipartisan Infrastructure Law. The funding is provided to state surveys to help modernize mapping of the Nation's surface and subsurface, specifically for data in areas with potential critical mineral resources. DGMR completed two Earth MRI-funded projects this year. The first project was a multi-year endeavor that involved 1:100,000-scale mapping of 5 quadrangles, plus geochemical and heavy mineral analyses of rocks and sediments along the Fall Zone near Dinwiddie, Virginia. The map and report will be available soon on the [DGMR Earth MRI page](#).

The second project involved the completion of a mine waste inventory for Virginia. Using aerial imagery and LiDAR data, GMR geologists collaborated with the Mineral Mining program to build a geodatabase of waste piles with detailed mining history and production data of targeted sites. The purpose of this inventory is to inform future land management, planning, and remediation decisions in Virginia by identifying nonfuel mine waste sites that may contain critical mineral resources. To date, we have delineated over 1,000 dumps, spoil piles, and tailing ponds across The Commonwealth. More than 100 of these sites will be published on the USGS USMIN database with detailed information and made available via Virginia Energy's webpage as an interactive map.



Photograph from VA Department of Energy historic collections.

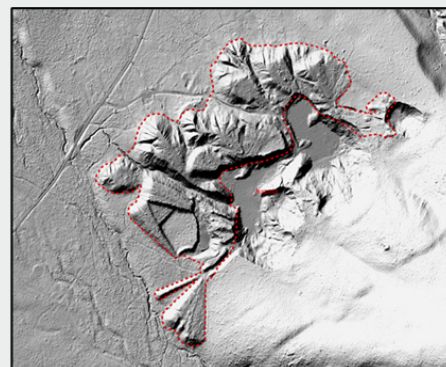
1-m resolution LiDAR of tailings from the Cold Spring Kaolin Mine in Augusta County, Virginia, with potential for aluminum (bauxite) and manganese (manganese oxide).



VA Energy geologists use a Geoprobe corer to collect Coastal Plain sediments, which helps with mapping in eastern Virginia.



Coastal Plain deposits over foliated saprolite. Core was sampled for grain size analysis, geochemistry and geochronology in collaboration with the USGS.



REST Services and Web Map Updates

Did you know, DGMR has a REST services directory for viewing GIS map data online? Here, you can access features such as the digital version of the 1993 state map, 2021 beta version of the updated state map, carbonate rock sample locations, karst features (from Phase 1 and Phase 2 of the derivative project), geothermal sample locations, landslides, mineral resources, and water wells: www.energy.virginia.gov/gis/rest/services/DGMR.

New Products

Publication 190

Geology of the Saltville and Broadford quadrangles, Virginia

F.J. Webb Jr. and L.A. Raymond

www.energy.virginia.gov/commerce/ProductDetails.aspx?productID=3104

Open-file Report 2023-01

Carbonate Formations in Virginia

Compiled by M.J. Heller

www.energy.virginia.gov/commerce/ProductDetails.aspx?productID=3102

Open-file Report 2024-16

A capacity assessment on the recovery of critical and economic minerals from sand used for coastal resilience projects

M.S. Nelson, D.W. Hawkins, and W.L. Lassetter

www.energy.virginia.gov/commerce/ProductDetails.aspx?productID=3103

Updated Products

Open-file Report 2022-16

Geologic map of the Fosters Falls quadrangle, Virginia

M.J. Heller and W.R. Swanger

www.energy.virginia.gov/commerce/ProductDetails.aspx?productID=3105

Open-file Report 2022-17

Geologic map of the Hylas quadrangle, Virginia

P.C. Finnerty, D.B. Spears, M.E. Occhi, K.E. Lang, H.E. Mangum, and T.S. Gunn

www.energy.virginia.gov/commerce/ProductDetails.aspx?productID=3107

Field Reviews

For a geologic map to be considered published, a field review is held to discuss and resolve the issues that were identified during mapping. The goals of each review are a better map, improved consistency, and increased staff knowledge. DGMR set a new program record with five field reviews this year: Fosters Falls, Long Spur, Looney, Hylas, and Middlesboro, all of which were recently mapped through the STATEMAP program. Several significant structural and stratigraphic issues were discussed and have largely been resolved. We have a number of map reviews planned for 2025. If you would like to receive announcements related to upcoming field reviews, please email geologymineralresources@energy.virginia.gov with your contact information and request to be added to the list.



1: Bill Swanger sketches a structure he observed in the outcrop at a stop on the field review.

2: Matt Heller orients participants at a stop on the field review.

Fosters Falls and Long Spur Quadrangles

The Fosters Falls and Long Spur quadrangles in the Interstate 81 corridor were recently mapped through the STATEMAP program, and a joint field review of both areas was led by Matt Heller, Bill Swanger, and contract geologist Phil Prince in late March. These map areas are located in the Blue Ridge and Valley and Ridge Provinces and contain significant faults and folds, diverse types of bedrock, and deposits of zinc and manganese which are critical resources.



Hylas Quadrangle

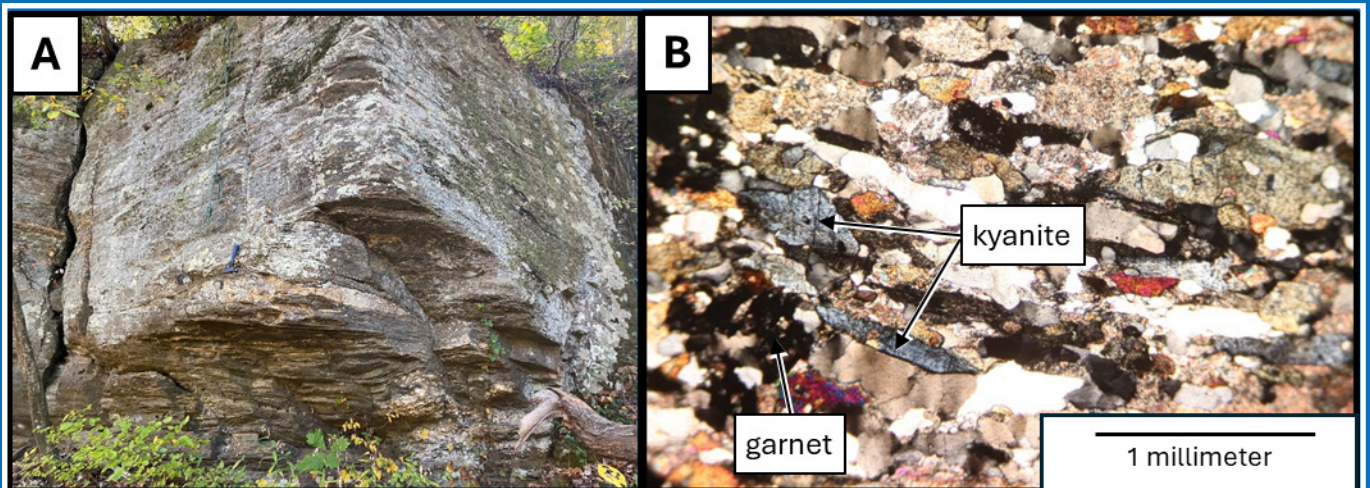
The Hylas field review had a great turnout in May 2024. Led by the map's author Patrick Finnerty, geologists from GMR, VADEQ, USGS, UNC, NCGS and SCGC were guided through the interesting and complex Piedmont geology of the Goochland terrane, shear zones, granite, and Triassic Richmond Basin. The review began virtually in order to capture a larger audience, promote more discussion, and "visit" more outcrops that would otherwise be inaccessible to a large group. A major part of this field review was to discuss new interpretations of the rocks, stratigraphy, and structure of the Goochland terrane. New geophysical, geochemical, and geochronological data were also presented in coordination with the mapping to supplement the new or updated interpretations. The map and authors greatly benefited from the review and, as always, more work is needed to better understand the complexities of the eastern Piedmont!



Looking for outcrops along the creek!



Patrick Finnerty setting up the day's tour around Hylas.



Outcrop (A) and photomicrograph (B) of garnet kyanite gneiss within the Goochland terrane recording high grade, upper amphibolite facies metamorphism.

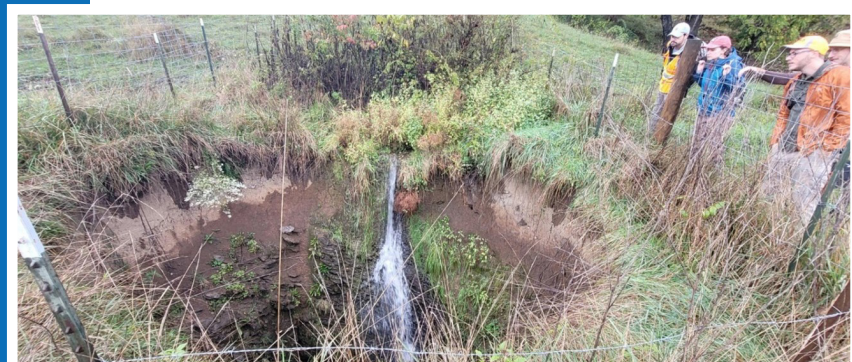
Looney Quadrangle

September 25-26 was a successful 1:24,000-scale geologic map review of the Looney Quadrangle west of Salem. The author, Dr. Philip Prince, led us on a two-day excursion across the map from south to north. A few road stops followed by a 3-mile hike up to the Appalachian Trail led us through Silurian, Devonian and Ordovician sedimentary rocks. The folded and faulted rocks form interesting topographic features tied to bedrock resistance to weathering. Most of the ridge formers are the sandstone and cherty members, while the degraded hillslopes and valleys are underlain by shales and soluble carbonate rocks. These rock units are far traveled up from the south due to large thrust faults such as the Saltville Fault. On the Looney quadrangle, you will find the Cove Mountain and Saltville thrusts, and Miller Cove Fault. Also preserved is an intact landslide where stratigraphy was vertically-displaced, and the stratigraphic layering remains intact. The block slide likely moved along a slippery shale unit overlain by resistant sandstones and carbonates. The timing and mode of displacement (incremental vs instantaneous) is still an unknown. The quadrangle is also unique given the number and size of sinkholes, particularly in the northern portion where limestones and dolomites have thicker map patterns. We visited one such sinkhole that breached the surface a couple of years ago on a farm property. Due to all the rain from Hurricane Helene, we got to see a disappearing waterfall.

1: Philip Prince pointing out the Miller Cove Fault in Pickles Branch on his beautiful Looney map.

2: Looking across the map area to the east. More resistant clastic sedimentary rocks comprise most of and/or cap these ridges in the distance.

3: David Hawkins (VE), Marcie Occhi (VE), Alex Gray (USGS), and Philip Prince (VT) look down into a sinkhole with a disappearing waterfall.





Middlesboro 30 x 60-minute Map

The Middlesboro 100,000-scale surficial field review was the first of its kind for Virginia. After being postponed from October due to Hurricane Helene, lead geologist Katie Lang took attendees to Southwest Virginia near Big Stone Gap on November 13-15, 2024. All three VA Energy offices were represented (Richmond, Charlottesville and Big Stone), as well as a colleague from the Maryland Geological Survey. Despite the cold rain, attendees had a great time observing mapped river, fan, and landslide deposits.



1: Middlesboro field review attendees

2: Conditions for the Middlesboro field review were not ideal.

3: Katie Lang describing features of a surficial deposit on her Middlesboro map.

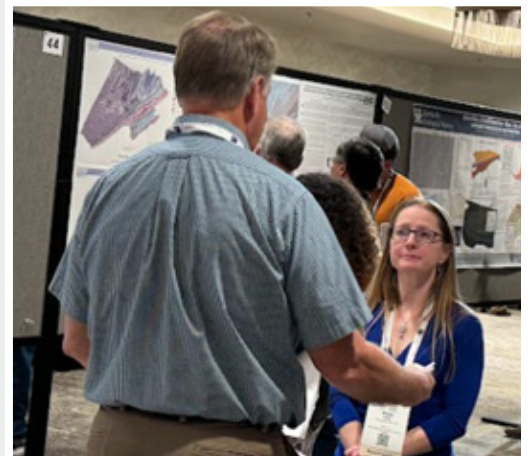
Conferences

SE GSA

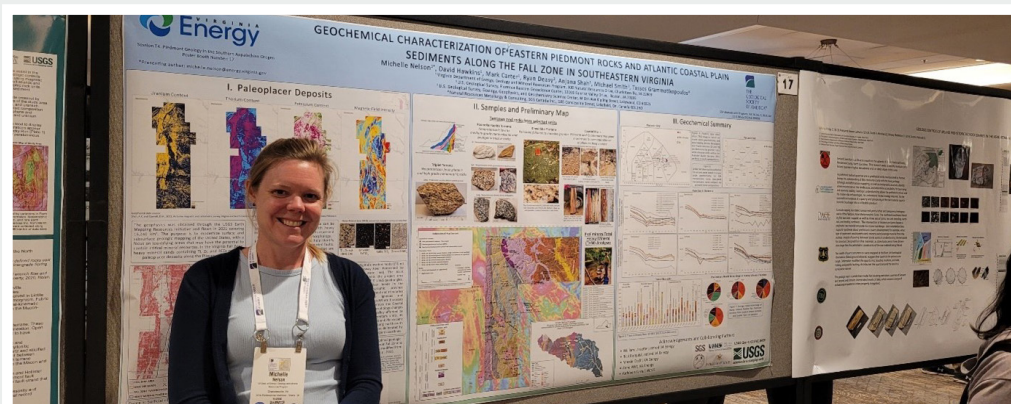
Geologists attended the Southeastern Geological Society of America (SE GSA) Section Meeting April 15-16, 2024, in Asheville, North Carolina. The SE GSA meeting plays a crucial role in fostering collaboration, advancing scientific knowledge, and promoting the geosciences within the southeastern region of the United States. Research presented by Virginia Energy geologists covered oral and poster presentations related to mine waste inventory, geologic mapping and geochemistry in the Fall Zone placer mineral system, carbon mineralization storage potentials in Virginia, and landslide susceptibility modelling in Nelson and Albemarle Counties. Furthermore, many of the geologists in attendance from Virginia Energy chaired sessions related to regional Coastal Plain mapping, landslides, and geochemistry and geochronology. Geologists will be convening sessions, presenting research, and leading field trips at the SE GSA meeting in Harrisonburg, VA



Michelle Nelson and David Hawkins chaired sessions on lab and field applications for mineral resources investigation; Michelle is presenting her work on soil luminescence.



Wendy Kelly discussing with audience of her and co-author's poster on USGS Earth Mapping Resources Initiative Mine Waste Inventory project.



Michelle Nelson showcasing her and her co-authors' work on a current USGS Earth Mapping Resources Initiative project.

DGMR Symposium

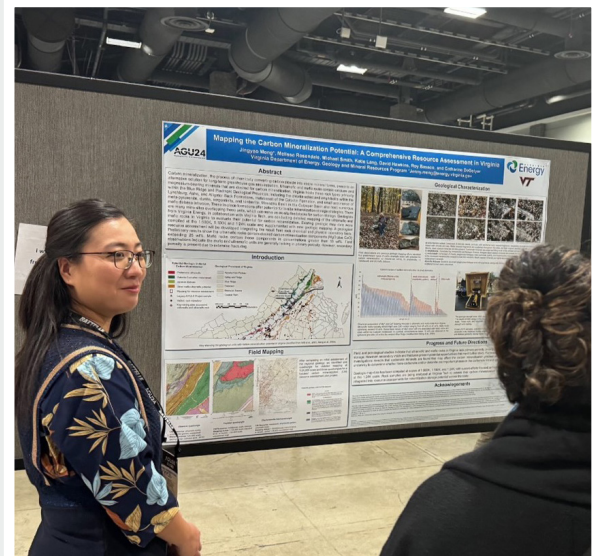
DGMR hosted the 15th annual Virginia Geological Research Symposium on April 26th at the Charlottesville office along with a virtual component. This day-long event brought together more than 100 geoscientists from government, consulting, industry, and academia to network and learn about recent geoscience-related research in the Commonwealth. Invited professional and student presentations covered a range of topics important to Virginia geologists. Four talks this year focused on natural resources including manganese deposits, pegmatites, springs, and caves. Two talks discussed hazards associated with landslides and sinkholes in the Blue Ridge and Valley and Ridge, respectively. Two talks described areas in Virginia with potential for carbon sequestration, and three talks focused on improving our understanding of stratigraphy and ages of geologic formations. The meeting included a poster session which allowed for the sharing of new maps, innovative research, and discussion of ideas and needs for future work. Breakout sessions were provided as networking opportunities for students and early-career scientists, as well as soliciting feedback to improve GMR's map products. The meeting was a success, and geologists left feeling energized about their work and what lies ahead for Virginia geology. We are looking forward to holding our annual geology research symposium this year at our office in Charlottesville on Friday, April 25, 2025. More details and a registration link will be provided by March 3, 2025.



Attendees getting their fill of geology

American Geophysical Union

Two DGMR geologists were among the more than 25,000 attendees at this year's American Geophysical Union (AGU) meeting in Washington, D.C. from Dec 9-13, 2024. AGU is considered one of the largest scientific meetings for geologists, as it is the world's biggest gathering of Earth and space scientists, with attendees from more than 100 countries. Pictured here is Jenny Meng, showing her ongoing collaborative work with Virginia Tech, which focuses on mapping mafic and ultramafic rocks for carbon mineralization studies. Through a U.S. Department of Energy Advanced Research Projects Agency – Energy funded program, Jenny and her team are working to identify and characterize suitable feedstocks in Virginia for the development of carbon mineralization and mineral extraction technology. Ultimately, the mineralization process within these rocks offers opportunities for extracting critical minerals, such as cobalt (Co) and nickel (Ni), thereby enhancing the value of the carbon dioxide storage process. Ni and Co are essential for modern technologies like batteries, smartphones, and solar panels, are highly compatible with minerals found in these rocks.



Jenny Meng discussing her research poster with an audience.

VGFC

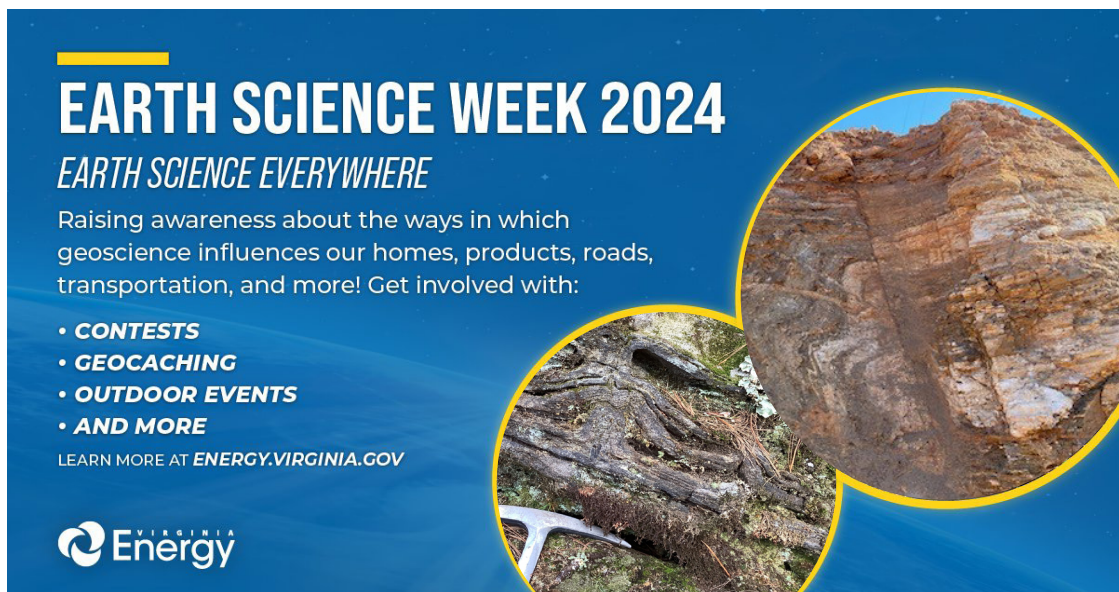
The Virginia Geologic Field Conference was led by GMR geologists Matt Heller, William Swanger, Philip Prince (contractor), and Bill Henika (retired), as well as colleagues Beth McClellan, Skip Watts and Wil Orndorff. The trip took place the first weekend in November and the focus was on rocks, water, and people – establishing connections between geological processes, water and mineral resources, and human activity in the New River Valley of Virginia. Mining-related stops included the reclaimed Hoover Color iron oxide pigment mine and the Hokie Stone quarry. Additional stops highlighted slope stability issues along I-81 and groundwater concerns at Mountain Lake and in Giles County. Learn more about the 2025 conference here: <https://vgfc.blogs.wm.edu/>.



DGMR group at VGFC- Hokie Stone Quarry. From left to right: Bill Swanger, Matthew Heller, Catherine DeGolyer, Roy Basso, Wendy Kelly, Holly Mangum, Catherine Brown, David Hawkins.

Outreach

DGMR continues to host Earth Day and Earth Science Week events, along with welcoming school groups to our building in Charlottesville (Department of Forestry headquarters). This year we hosted approximately 75 students from private schools and homeschool groups ranging from 2nd- 6th grade. We also had staff that visited schools and universities to teach about geologic maps, rock identification, and minerals that are important to Virginia's economy. We hope to inspire the next generation of geologists, and always invite lifelong learners to tour the library and rock and mineral displays.

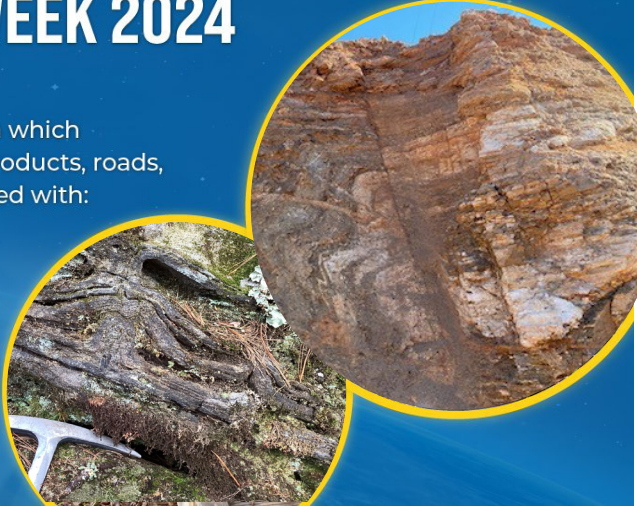



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Earth Day

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