VIRGINIA GEOLOGICAL RESEARCH SYMPOSIUM

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Poster Presentations

Preliminary Geologic Map of the Dillwyn 30- X 60-minute Quadrangle, Virginia, USAVGRS1

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The Dillwyn 30x60-minute quadrangle encompasses a geologically diverse region of nearly 5,000 km², stretching from the Piedmont of central Virginia northwestward across several regional tectonic boundaries to the Blue Ridge and eastern Valley and Ridge Provinces. Supported by the U.S. Geological Survey's National Cooperative Geologic Mapping Program and the Virginia Department of Energy, this 1:100,000-scale geologic map integrates data from a range of sources, including modern 1:24,000-scale quadrangle maps (30% of the area), unpublished EDMAP-supported mapping (10%), and legacy 1:62,500-scale maps (30%). Approximately 25% of the region lacked adequate geologic coverage, prompting new fieldwork to fill these gaps. LIDAR coverage has proven useful in many areas, highlighting poorly mapped bedrock stratigraphic and structural features, and in mapping surficial deposits. High-resolution airborne geophysical data is currently available only in the easternmost 10% of the map area, but data acquisition is underway for a new airborne survey that will eventually cover much of this area. This quadrangle is notable for its mineral resources, including historic districts such as the Gold-Pyrite Belt, the James River iron-manganese district, the Schuyler-Alberene soapstone quarries, and the Arvonia slate district, which boasts one of the longest-operating mines in the United States. Renewed interest in critical mineral exploration highlights the economic importance of the region. The area also includes a large part of the Central Virginia Seismic Zone, an area of historic and recent seismicity. The map will be released as a GEMs Level three geodatabase, offering a critical tool for understanding regional tectonics, resource distribution, and seismic activity. By synthesizing diverse datasets and providing new data in previously unmapped areas, this work advances regional tectonic synthesis, and supports ongoing mineral exploration and hazard assessment in central Virginia.

A year of immersion in Ocean ScienceVGRS2

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My entry point into midlife oceanography was a STEMSEAS transit from Seattle to Honolulu. STEMSEAS (STEM student experiences aboard ships) is an NSF-funded program that takes advantage of otherwise-unutilized space and time on vessels in the United States research fleet. In this case, STEMSEAS wanted to boost the number of community college applicants to the program and ran one cruise for two-year-college faculty as a way of spreading the word. I was lucky enough to be one of 19 faculty aboard the R/V Thomas G. Thompson on an eight-day transit across the north Pacific. This was a profound experience which included the realization that I had "sea legs," and that my planet's oceans were incredibly voluminous. Now I could hear the call of the sea. I followed that my STEMSEAS cruise with participation in a workshop by the Ocean Observatories Initiative in May 2024 in Wilmington, North Carolina, utilizing real-world data to build undergraduate laboratory activities. I returned to STEMSEAS in July 2024 as co-leader of a six-day student cruise aboard the R/V Sikuliaq from Seward, Alaska, to Nome, Alaska. I pushed the group toward geologic awareness, facilitating a pre-cruise series of field trips looking at rocks, glaciers, and landscapes. I also arranged for a special jaunt via water taxi to examine coastal outcrops of the Resurrection Ophiolite. My co-leader organized several CTD casts and plankton tows. Finally, for two weeks in September 2024, I joined JTRACK, the final IODP drilling expedition, serving as outreach officer on an attempt to drill through the plate boundary at the Japan Trench. Here, I learned about the tricky business of sampling the sub-seafloor, saw the impact of the 2011 tsunami, and created learning activities to highlight the science being done aboard the D/V Chikyu. As someone who has spent most of his career thinking about continental processes and tectonics, these voyages greatly expanded my perspective and understanding. The culmination of these varied experiences is a learning module about the origin and destruction of oceanic lithosphere I call "The Fate of the Plate." This poster highlights each of these experiences with guidance on how to get involved as well as links to the resulting learning objects.

Analyzing heavy mineral sands from offshore of the Virginia coast using SEM-EDS and Raman Spectroscopy VGRS3

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Sandbridge Shoal on the Federal Outer Continental Shelf is a proven sand source for beach re-nourishment needs, and heavy mineral sands constitute an average of 0.85 percent by weight (%) of bulk material. Vibracore drilling at Sandbridge Shoal was performed by Schnabel Engineering, and cores were sampled by Virginia Energy for heavy mineral analyses. In this study we assess the accuracy of mineral identification using spectral and image analysis tools including a Renishaw inVia Raman microscope and a Phenom desktop scanning electron microscope (SEM) on the initial heavy mineral sand fraction. We compare our results to the data reported in Nelson et al. (2024), where the heavy mineral sand fraction was subjected to further separation with heavy liquids and laboratory-intensive electron microbeam, XRD, and LA-ICP-MS analyses performed by SGS Canada.

Using Raman Spectroscopy to Characterize TiO_2 Polymorphs in the JMU Mineral Museum VGRS4

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The James Madison University mineral collection includes over 6,000 micromount specimens containing diverse mineral species. This study aims to evaluate the use of Raman spectroscopy to characterize these micromount minerals. A micromount is a small cluster of crystals in a matrix or a single crystal mounted in a protective enclosure. This research has educational, scientific, and museum curation purposes, and potentially provides a valuable resource for undergraduate research at JMU and the wider mineral community. We selected 30 micromounts containing TiO_2 polymorphs (anatase, brookite, and rutile) from the collection to systematically evaluate the potential of Raman spectroscopy for characterizing micromounts. Spectra were collected using a Renishaw InVia Raman microscope with a 532 nm laser. We conducted spectrum searches and created comparative data plots to identify unique spectra corresponding with specific TiO_2 polymorphs.

Geochronology of the Virginia Coastal Plain: A review of ages, techniques, and core sampling for luminescence dating VGRS5

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Geochronology is an important tool for correlating paleoshoreline deposits to mean sea level reconstructions. The elevation of these deposits within the Virginia Coastal Plain are incongruent with expected past sea level due to the displacement and deformation caused by glacial isostatic rebound, and blind Cenozoic faulting. Additionally, the lack of absolute age control makes regional (interstate) correlation challenging and uncertain. Therefore, there is a need for robust geochronologic datasets on mapped alloformations, which represent major intervals of sea level progradation and regression. Currently, there is insufficient age data for the Virginia Coastal Plain to support regional correlations or the development of a local sea-level curve. We provide a review of geochronological techniques that are best suited for inland Coastal Plain, barrier island, and shallow-water shelf materials (i.e., clastic sediments, carbonates, and fossils). The dating techniques covered will include: trapped charge (luminescence and electron spin resonance), radiocarbon, cosmogenic radionuclide, amino acid racemization, Uranium-series, and paleomagnetism. Much of the Coastal Plain is low-relief and subsurface investigations rely on drilling and coring for sample collection. When targeting core samples for luminescence dating, two important factors relate to the integrity of the natural luminescence signal and the representation of the dose rate environment. The equivalent dose sample should remain light-safe such that the burial dose is not reset (zeroed) by light exposure, and the sediment sampled for dose rate must accurately represent all units within at least 15 cm above and below the equivalent dose sample. Examples and discussion of guidelines for sampling sediment core for luminescence dating are discussed, and preferred protocols are dependent on the extraction method, sedimentology, core integrity, and storage conditions.

Lamprophyres in Virginia? Using the Virginia Energy Rock Repository Archives to investigate the petrological and geochemical characteristics of mafic dikes in the Blue Ridge Province of Virginia VGRS6

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Mafic dikes found in the Blue Ridge geologic province of Virginia were identified as possible lamprophyres in historic Virginia Department of Energy mapping publications. Fourteen samples of these dikes from five counties archived in the Virginia Energy Rock Repository were petrographically and geochemically examined. Geochemical analyses were funded by a National Geological and Geophysical Data Preservation grant for critical mineral investigation of legacy samples and provided the impetus for this study. These mafic rocks are reported in the field as cross-cutting dikes ranging in size from several inches to several feet in width intruding within Mesoproterozoic to Neoproterozoic rocks. They are dark colored, fine to medium crystalline, very micaceous (biotite), and have a weak to strong foliation. In thin section, the mineral assemblage is biotite and plagioclase feldspar with minor quartz and opaque minerals. Several samples are amphibole-bearing while the others are muscovite+carbonate-bearing and one

sample includes garnet. They have variable foliation and metamorphism is at least chlorite-grade. SiO2 content ranges from 37 to 54 wt.% and a LeMaitre (2002) TAS plot shows a wide range of rock types: Foidite, Basanite, Phonotephrite, Basalt, Trachybasalt, and Basaltic Trachyandesite. Many samples have elevated Ba (388-1079 ppm) and Mn (1058-1993 ppm). Sample R-08111, with 37% SiO_2, has enriched Y (111 ppm), Th (25.5 ppm), Rb (1395 ppm) while R-08005, with 48% SiO_2, has enriched Cr (964 ppm) and Ni (600 ppm). Most samples have LREE enrichment (80-1000X chondrites), slight negative to positive Eu anomalies, and smoothly declining HREE depletion. A Hf+Th+Nb/2 discrimination diagram (Krmíček et al., 2011) used to evaluate orogenic and anorogenic petrogenesis, reveals that many samples fall into the anorogenic field while four are near the boundary for the orogenic field. Although our samples are alkalic none of these samples can be truly identified as lamprophyres which have much higher Cr and Ni and more highly fractionated REE patterns. A previous study by Marshall et al. (2014) for samples in Nelson and Albemarle County describes similar rocks and reaches similar conclusions. These dikes may represent intrusive igneous activity during the Neoproterozoic Robertson River Igneous Suite emplacement.

Geochemical and Petrographic Analysis of Metamorphosed Mafic and Ultramafic Rocks of Schuyler Quadrangle, Nelson and Albemarle Counties, Virginia [VGRS7]

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In Albemarle and Nelson Counties, Neoproterozoic metamorphosed mafic and ultramafic rocks—metagabbro, amphibolite, and talc-chlorite schist—outcrop as NE–SW striking lenses in distinct belts. These rocks exhibit significant potential for carbon mineralization, and the talc-chlorite schists display elevated critical mineral concentrations. This study examines these units' petrology, mineralogy, and geochemistry to assess their origin. Field examination reveals that metagabbro is green-grey, medium to coarsely crystalline, and non-foliated whereas amphibolite is dark gray to black, medium coarsely crystalline, and moderately schistose. Talc-chlorite schist is green to dark gray, fine to medium crystalline, and ranges from relatively hard with a weak foliation to soft, soapy, schistosity. Petrographic analysis shows metagabbro consists of amphibole, epidote, and plagioclase feldspar, with minor relict pyroxene and opaque minerals. Amphibolite contains amphibole, pyroxene, epidote, chlorite, and plagioclase feldspar, with minor quartz, biotite, and opaques. Talc-chlorite schist is composed of chlorite, talc, and calcite, with minor quartz and some magnetite. Geochemically, talc-chlorite schist has SiO2 concentrations of 35-46 wt.%, while amphibolite and metagabbros range from 44-47 wt.%. The samples, on a Middlemost (1994) TAS plot, fall in the peridot-gabbro and gabbro fields, suggesting ultramafic origins. Mg-rich samples are talc-chlorite schists, whereas Fe-rich ones are metagabbros and amphibolites. Talc-chlorite schist shows elevated concentrations of Ni (713-1430 ppm), Co (65-115 ppm), and Cr (1710-3590 ppm), whereas amphibolite and metagabbro are Ni (66-73 ppm), Co (42.7-53.2 ppm), and Cr (128-134 ppm). Overall, the samples have LREE enrichment (~20-80X chondrites), slight negative Eu anomalies, and decreasing HREE (~8-40X). The amphibolite and metagabbro show the most elevated LREE (~70-80X). One talc-chlorite sample has enriched Lu (0.19 ppm), possibly indicating REE incorporation in phosphates such as apatite or monazite. Mineralogical and geochemical similarities between the ultramafic rocks of Lynchburg Group to the north and those in the Ashe and Alligator Back metamorphic suites to the south suggest a regional-scale magma enrichment in Ni, Co, and Cr.

Pegmatite prospectivity in the Piedmont Province of Amelia County, Virginia VGRS8

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Granitic pegmatite deposits host a wide variety of mineral commodities, including industrial materials and critical minerals. Historic mines in Amelia County, Virginia produced mica and feldspar from pegmatites; four of these mines exploited Nb-Y-F pegmatites containing such minerals as monazite and columbite-tantalite. Despite this rich mining legacy, many questions remain about the genesis and resource endowment of the pegmatites. By combining legacy information from World War II-era reports with modern surveys, this study reveals new insights about the geologic setting and relationships between pegmatites, host rocks, and mineral prospectivity of the Amelia pegmatite district. Mine and prospect locations from the Mineral Resources Data System (MRDS) (Schweitzer, 2019) were corrected using LiDAR and modern topographic mapping for use as validation sites for prospectivity modeling (Dao and Lederer, 2024). Rock samples collected from the Morefield Mine provide ground truth mineralogy data for calibrating hyperspectral analyses. With increasing pressure for sustainable development and supply security, a better understanding of domestic resource potential for critical minerals such as the Morefield Mine and other pegmatite deposits in Amelia County is crucial for a sound decision-making.

Geologic Map of the Wytheville 30- X 60-Minute quadrangle, Virginia, North Carolina and Tennessee VGRS9

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A new geologic map of the Wytheville 30- x 60-minute quadrangle, VA–NC–TN, covers folded and faulted Paleozoic sedimentary rocks of the Valley and Ridge (VR) and polydeformed Mesoproterozoic to Paleozoic crystalline rocks of the Blue Ridge (BR). Mapping was funded by the USGS National Cooperative Geologic Mapping Program, FEDMAP and STATEMAP Components. The map incorporates new mapping and legacy map compilation. Cambrian to Mississippian sedimentary rocks of the VR are exposed in map-scale folds separated by several major thrust faults (from NW to SE): Copper Creek-Narrows, Saltville, Pulaski, Max Meadows, and Laswell faults. Near Chatham Hill, VA, there is a restraining bend in the Saltville fault and a thrust splay to the north. Hinterland-dipping culminations at Glade and Lick Mountains expose the Neoproterozoic to Cambrian Chilhowee Group in the Pulaski-Max Meadows thrust sheet. From W to E across the quadrangle, structures change orientation from NE-SW to ENE-WSW to E-W trending in the VR; this structural trend continues into the BR. The Holston Mountain fault thrusts the composite BR over the VR. In the SW, the northern end of the Mountain City window plunges NE beneath the BR thrust sheet. West of the window, the Chilhowee Group is exposed in the SW-plunging Stony Creek syncline. In the Iron Mountains to the NE, the group is faulted and folded into ENE-WSW plunging folds with an axial planar cleavage. The northern French Broad massif consists of 1.3–1.0 Ga orthogneisses and paragneiss; the latter contains detrital zircon of 1.4–1.3 Ga, 1.8 Ga, and ~1.0 Ga metamorphic rims. The Striped Rock Granite (~748 Ma) and mafic and felsic dikes intrude basement gneisses. The Neoproterozoic Mount Rogers and Konnarock Fms. overlie basement. The anastomosing Fries fault zone transects the southeast side of the massif. The Gossan Lead (GL) fault juxtaposes amphibolite-facies rocks of the eastern BR over the massif. Three packages of fault bound siliciclastic rocks are mapped in the GL thrust sheet (NW to SE): graphitic schist and metaconglomerate of the Lynchburg Fm.; metagraywacke, schist, and mafic and ultramafic rocks of the Ashe Metamorphic Suite; and "pin-striped" mica gneiss and schist of the Alligator Back Metamorphic Suite. 40Ar/39Ar ages document deformation at 360–340 Ma, and emplacement of the BR thrust sheet at 340 Ma.

Dye Trace Analysis of the Thermal Karst System of Warm Springs, Virginia [VGRS10]

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The Warm Springs Anticlinorium in Alleghany County, Virginia, is a unique thermal karst system characterized by its complex geology and hydrogeological features which includes the only two known caves in Virginia that contain thermal springs. The ongoing Warm Springs Anticline Cave Survey & Karst Assessment aims to investigate the geology and hydrogeology of the Falling Springs Cove section of the valley, and includes locating and surveying new caves, geologic mapping, temperature surveys, and dye tracing. Dye trace tests conducted on six sinking streams across the eastern and western limbs of the anticlinorium indicate a predominantly southwestward flow of groundwater. Specifically, traces from sinks on the western limb show a hydrologic connection with Rushing Waters Cave and Warm River Cave, eventually resurfacing at Falling Spring. However, the dye bypassed Mot Pot Cave, which is located almost directly between Rushing Waters and Warm River Cave. On the eastern limb, the dye also flowed southeastward ultimately reaching Warm River Cave and reemerging at Falling Spring. These findings suggest that the subsurface water flow from each sinking stream eventually connects within Warm River Cave and is influenced by the structural orientation of the anticlinorium. Moreover, the thermal waters in Mud Pot Cave and potentially Warm River Cave may be significantly older or sourced from different areas, highlighting the complex hydrogeology of this thermal karst system.

Mud Pot Cave, Alleghany County, Virginia [VGRS11]

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The Warm Springs Valley is developed along the axis of a breeched anticline that exposes middle Ordovician carbonates along the floor of the valley between Warm Springs, Bath County, Virginia and Falling Springs, Alleghany County, Virginia. Several thermal springs are situated from Bolar, Highland County, Virginia to the north to Falling Spring, Alleghany County, Virginia to the south. The springs are associated with water gaps on the western limbs of the anticlines and are probably on faults that allow the deeply circulating water heated by geothermal gradient to rapidly rise to the surface. Mud Pot Cave is northeast of Falling Spring, between Falling Spring Falls and Valley View. Water emerges from the north end of the cave, flows down gradient for 80 feet, where it disappears in a too tight crack at the south end of the cave. A tracer test of the Mud Pot Cave stream resulted in dye recovery in Warm River Cave, and then at Falling Spring, approximately 0.2-mile away, with a travel time of six hours. Temperatures as high as 100 F have been measured in the northern most pool in Mud Pot Cave, with a rapid drop in temperature in response to storm events of greater than one inch of rain. The oxygen level within the cave was found to be equal to that at 10,000 feet of elevation.

Preliminary Bedrock Geology Map of Falling Springs Valley, Alleghany & Bath Counties, Virginia VGRS12

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Accumulation of phosphorus and potentially toxic elements in stream water, bottom sediments, and suspended sediments in tributaries of Lake Anna, Virginia VGRS13

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Anthropogenic release of potentially toxic elements (PTEs) (As, Cd, Cr, Cu, Ni, Pb, and Zn) and phosphorus (P) may originate from former mine sites or agricultural lands respectively, which occur in watersheds contributing to Lake Anna, Virginia. The purpose of this study is to quantify the amounts of P from agriculture and PTEs in stream waters, bottom sediments, and suspended sediments to understand potential impacts to aquatic life. Water collection and sediment core sampling occurred at 20 locations within 10 distinct watersheds surrounding Lake Anna, Virginia, including the lake's outflowing river, seasonally beginning in March 2024. Elemental concentrations of water and sediments were extracted via strong acid digestion using hydrochloric acid (HCl) and reverse aqua regia (9:1 HNO_3 to HCl) respectively. Results for stream water pH show that the majority of sample sites meet the EPA pH criteria for freshwater on average. One site was found to have a minimum average pH of 2.95 ± 0.04 compared to the regional minimum average of 6.75 ± 0.07. The streams that did not meet the EPA pH criteria had elevated levels of almost all PTEs, though As met guidelines. Seasonal variation of stream water pH and element concentration shows a decrease of pH and increase of potentially toxic element content from Spring to Summer. Results for bottom sediment pH show that most sample sites do not meet the EPA pH criteria for plant growth. Elemental analysis of bottom

sediments shows consistently elevated concentrations of all PTEs at two sample sites. One site was found to have an average Cu concentration of 309 ± 272 ppm, exceeding the Virginia Department of Environmental Quality's freshwater sediment screening value of 149 ppm. Sites that were found to have elevated concentrations of PTEs in stream water also had high concentrations of PTEs in bottom sediments. Elevated concentrations of P (maximum average of 1257 ± 73 ppm) were found in bottom sediments of several sites which also hosted elevated Ca amounts. From our findings, we conclude agricultural land use is associated with excessive amounts of P, and therefore a greater risk of eutrophication. The presence of former mines not properly reclaimed is associated with high amounts of PTEs that likely negatively impact aquatic life in the watersheds of Lake Anna, Virginia.

Variations in Radon production of the Petersburg granite near Richmond, Virginia [VGRS14]

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Radon gas is the second leading cause of lung cancer worldwide. To inform the public of the risks of radon exposure, the EPA created a radon risks map in 1993 which defines the radon risk of different Virginia counties as low, moderate, and high. The map assesses risk level based approximately on geologic provinces, but radon emanation levels vary greatly within the Virginia geologic provinces. The boundary between the Coastal Plain and the Piedmont changes abruptly from low risk in the Coastal Plain to high risk in the Piedmont. In an effort to enhance the scale of the EPA risk map and better inform the public of the risks, this study aims to investigate the radon emanation levels and uranium levels of the major geologic unit separating these two provinces: the Petersburg Granite. The Petersburg Granite consists of four major subunits— the subidiomorphic or massive granite, porphyritic granite, foliated granite, and granitic gneiss—each with varying Zr compositions, which we believe may be a cause of the variability in radon emanation levels due to U-Zr substitutions. We measure the radon emanation of rock and saprolite samples from each of these subunits using a Durridge Rad7 radon detector. Based on emission chamber results from the Rad7 detector, we find that the unit with the highest radon emanation is the massive granite reaching 65.1 pCi/L and the saprolite samples reaching 102.9 pCi/L. We also analyze these samples for ^{238}U and ^{226}Ra using gamma spectrometry and Zr using x-ray fluorescence spectrometry. This research stands to improve our prediction of the radon emanation levels in central Virginia in order to better inform the public about the associated health hazards.

A Blast from the Past: Archival Imagery that may be Useful in Future Critical Mineral Studies [VGRS15]

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This poster compares color imagery from a high resolution aeromagnetic survey to regional detailed geologic mapping compiled in the Leesville and Altavista area of the Southwestern Virginia Piedmont and published at 1,100,000 scale as a portion of the Roanoke 30 by 60 minute quadrangle (VDMR Pub 148) circa 1997. Acquisition of the color imagery of the magnetic survey was the direct result of a one week field conference between geological staff of COMINCO exploration and the Virginia Tech

DMR office in the late 1990s. Previously geologic mapping in the SW VA Piedmont area was initiated in the 1960s to help explain the origin of high intensity magnetic anomalies in western Piedmont Igneous and metamorphic Rocks of the Smith River Allochthon and in metamorphosed Neoproterozoic rift facies rocks of the Eastern Blue Ridge Lynchburg Group. Correlation between magnetic contour patterns and lithologic units established on the original detailed geologic and magnetic surveys on the Martinsville West, Philpott Reservoir and Bassett quadrangle reports holds up well in the area of the newer more detailed magnetic data. Color patterns outline highly magnetic portions of the Neoproteozoic rift volcanic series that are known to contain stratified volcanogenic sulfides, mineralized pillow lavas, and possible black smoker magnetite bodies previously recognized in drill core from local quarries as well as in CSX railway cuts along the James River in the Lynchburg area to the northeast and along the Norfolk Southern Railway Cuts in the Rocky Mount area to the southwest of the Altavista area. Major fault zones, possible terrane boundaries as well as Mesozoic dikes and cross structures are also recognizable in the color magnetic imagery. The poster is being presented to illustrate the depth and quality of information available from previously archived material as well as the wealth of material that exists in field notes and repository samples from previous mapping projects that were limited in scope due to the constraints on publication of detailed information that was gathered during regional mapping projects. The author is hoping to gain assistance in archiving material from 60 years of field work.

Structural geometry and deformation history of the Spotsylvania high-strain zone, Virginia [VGRS16]

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The Virginia Piedmont is composed of distinctive terranes that vary in lithology, age, and are bounded by faults or high-strain zones. Many of these terranes are suspect or exotic, with a poorly understood provenance. The Spotsylvania High-Strain Zone (SHSZ) is a wide (~10 km) belt of mylonitic rock that separates the Chopawamsic Arc Terrane from the enigmatic Goochland Terrane in the central Piedmont. Previous workers have mapped much of the western Goochland Terrane as the Maidens Gneiss, traditionally interpreted to be Proterozoic. In this study we use new mapping, structural analysis, and U/Pb zircon geochronology to better understand the temporal history of deformation in the SHSZ and the Goochland Terrane. We mapped at two sites located on either side of the SHSZ. At Hidden Rock Park, biotite-garnet bearing mylonitic orthogneiss is crosscut by variably deformed pegmatitic dikes. The mylonitic gneisses experienced high-strain (X/Z >20:1) with a consistent dextral asymmetry in kinematic indicators. U/Pb zircon ages in the mylonitic gneiss range from 330 to 425 Ma, but we interpret a crystallization age for this rock between 385 to 405 Ma. The deformed pegmatite also yields a range of U/Pb zircon ages with peaks at ~320 and ~400 Ma. Collectively, we interpret these data to indicate early Devonian plutonism followed by partial melting, pegmatite generation, and deformation between 300 and 330 Ma during the early Alleghanian. Along the James River near Cartersville, at the western edge of the SHSZ, we collected samples of strongly deformed biotite-rich paragneiss and cross-cutting mylonitic granitic gneiss. These rocks are strongly foliated and gently dipping with a SW plunging strike-parallel elongation lineation. In the paragneiss, U/Pb zircon core ages are dominated by Ediacaran grains with a few young cores between 460 and 475 Ma, while rim ages most range between 330 and 355 Ma. The granitic gneiss had only a few concordant zircons that yielded ages between 330 and 355 Ma. At Cartersville, the sedimentary protolith can be no older than Ordovician, with magmatism and metamorphism occurring between 330 and 355 Ma, consistent with Neoacadian ductile deformation. Our work demonstrates that the Maidens Gneiss is not a Proterozoic unit and that deformation in the SHSZ was protracted from the Neoacadian to the Alleghanian.