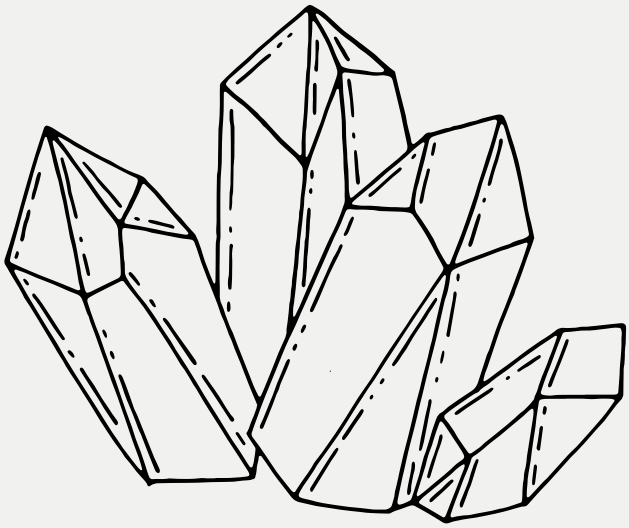

TEACHER MANUAL

MINERALOGY & GEOLOGY OF VIRGINIA

Prepared By:

Friends of Mineralogy Virginia Chapter Inc. (FMVA)
Virginia Transportation Construction Alliance (VTCA)

TABLE OF CONTENTS

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- Friends of Mineralogy Virginia Inc.
- Virginia Transportation Construction Alliance
- The Gem & Mineral Society of Lynchburg, Inc.
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- The Richmond Gem & Mineral Society, Inc.
- Delaware Mineralogical Society
- Tidewater Gem & Mineral Society

VTCA
Aggregate Producers
Foundation for Virginia's Success

FACT SHEET

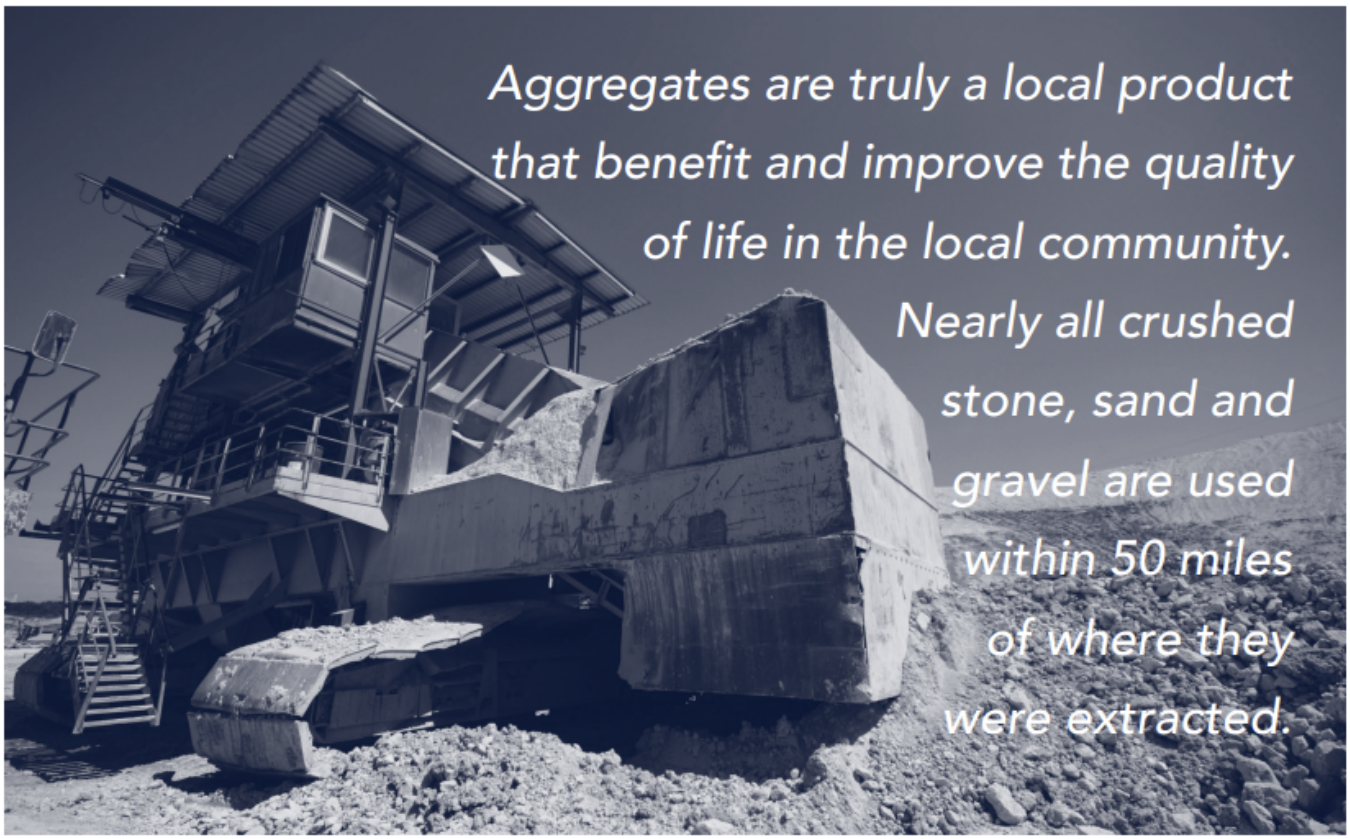
Economic Impact and Community Benefits

Aggregates play a vital role in our daily lives as the primary component in concrete and asphalt which are essential for constructing roads and bridges, homes, businesses, schools, hospitals and places of worship. Aggregates also are used in everyday products such as paper, glass, medicines, and fertilizer.

Similar to the need for other utilities such as water, power, and wastewater treatment, an aggregates operation is an essential component of our community's infrastructure, providing a cost-effective, local source of an essential commodity.

Virginia's Aggregate Producers…

- Provide local jobs and stimulate economic development.
- Employ 2,900 aggregate miners and 8,500 contractors across Virginia.
- Generate a payroll of approximately $128 million annually.
- **Produce 73.1 million tons of aggregate valued at approximately $1.4 billion worth (2021)**
- Contributes to the local tax base. Often, aggregate operations are "net" tax generators to the community; they put little to no burden on public services, i.e. Water, Sewer, Schools, Police, Fire, Rescue, etc.
- Provide green space for local communities as much of the property remains undeveloped and undisturbed. They are a haven for wildlife.
- Are long-term community members.



VTCA
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FACT SHEET

Aggregate Fast Facts

Aggregates play a vital role in our daily lives as the primary component in concrete and asphalt which are essential for constructing roads and bridges, homes, businesses, schools, hospitals and places of worship. Aggregates also are used in everyday products such as paper, glass, medicines, and fertilizer.

Here's just a sampling of how we use aggregate in our everyday lives…

Essential material for residential and commercial structures

Aggregates are present from the concrete in the foundation all the way up to the shingles on the roof—and everywhere in between, like the wallboard, tile, glass and plaster.

Main component in all facets of transportation

Roads and interstates
Bridges and tunnels
Railroad beds
Airport runways, terminals and flight towers
Subway tunnels
Sidewalks
Bike Paths and greenways

Used to protect the environment

Erosion control
Slope protection
Dam construction
Shoreline and navigation channels protection
Limestone aggregates are used in some smokestacks to help clean the air by reducing sulfur dioxide emissions
Water filtration
Sewage control
Wastewater control
Drinking water purification

Did you know?

Every Virginian will need 1.18 million pounds of stone, sand and gravel in their lifetime.

Nearly all crushed stone, sand and gravel are used within 50 miles of where they were extracted, making aggregates a truly local business.

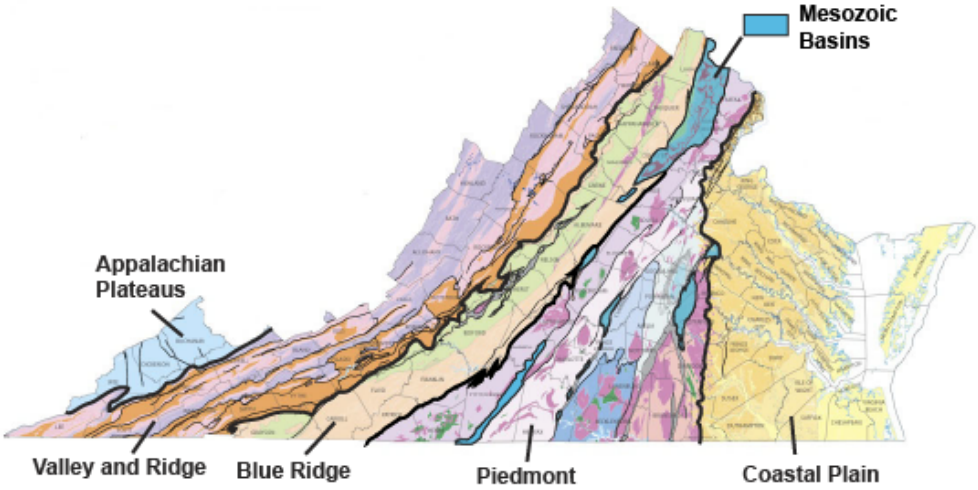
Aggregates make up 94% of asphalt pavement and 80% of concrete.

Approximately 38,000 tons of aggregates are required to construct one mile of a four-lane interstate highway.

About 400 tons of aggregates are required to construct the average modern home.

Hoover Dam was built with 4.5 million cubic yards of aggregates.

GEOLOGY OF VIRGINIA



Appalachian Plateaus:

The Appalachian Plateaus consists of much of the same Paleozoic sedimentary rocks as found in the Valley and Ridge, but are horizontally lying or broadly and gently folded. The Plateau's upper Paleozoic strata are rich in mineral resources including coal, natural gas, and petroleum. Coal formed from organic-rich sediment that accumulated as swamps during the Pennsylvanian period approximately 300 million years ago. Extraction of these resources has played a significant role in the human history of this region.

Valley & Ridge:

The Valley and Ridge consists of Cambrian to Mississippian sedimentary rocks that include carbonates, shales and sandstones that were faulted, tilted, and folded during the Pennsylvanian and Permian periods. A prominent belt of Cambrian and Ordovician carbonate rocks are exposed in the "Great Valley" of Virginia. This includes the Shenandoah Valley, the Roanoke Valley, and the New River Valley.

Blue Ridge:

The Blue Ridge geologic province is a distinctive highland region that also exposes Virginia's oldest rocks (1-1.2 billion years old!). In the southwestern Virginia Blue Ridge, Mount Rogers (1,746 m), forms Virginia's highest peak. Volcanic rocks from 750 million years ago exist in the Mt. Rogers area. In central and northern Virginia, a vast tract of basaltic lavas were flowing between 570 and 550 million years ago. Today, these are the greenstones of the Catoctin Formation which underlie many of the highest peaks in the northern Blue Ridge.

Piedmont:

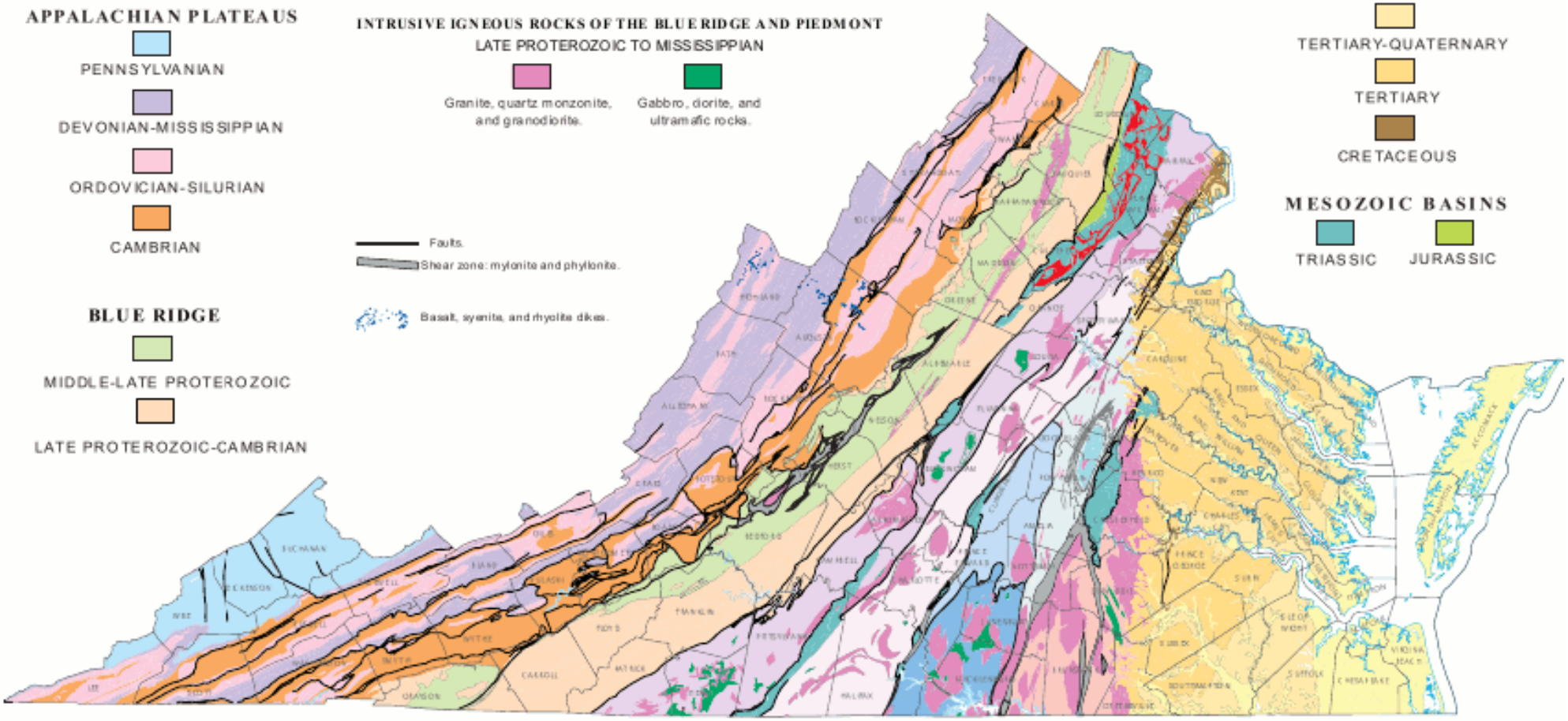
The Piedmont is the largest geologic province in Virginia. It is composed of primarily igneous and metamorphic rocks of Proterozoic to Paleozoic age. Many mineral collectors find beautiful crystals and pegmatites in this area. The rocks are deeply weathered to form a thick soil that covers the bedrock. It is bound on the east by the Fall Zone, which separates the province from the younger strata of the Coastal Plain. Mesozoic Basins are series of separate regions in the physiographic Piedmont formed during the rifting of Pangea and have Mesozoic aged sediments and rocks.

Coastal Plain:

The Coastal Plain is composed of sedimentary rocks of Jurassic to Cenozoic age and contains the youngest rocks in Virginia. The sedimentary rock layers are near horizontal with a slight dip to the east. The sediments are sandy and muddy and contain abundant fossils.

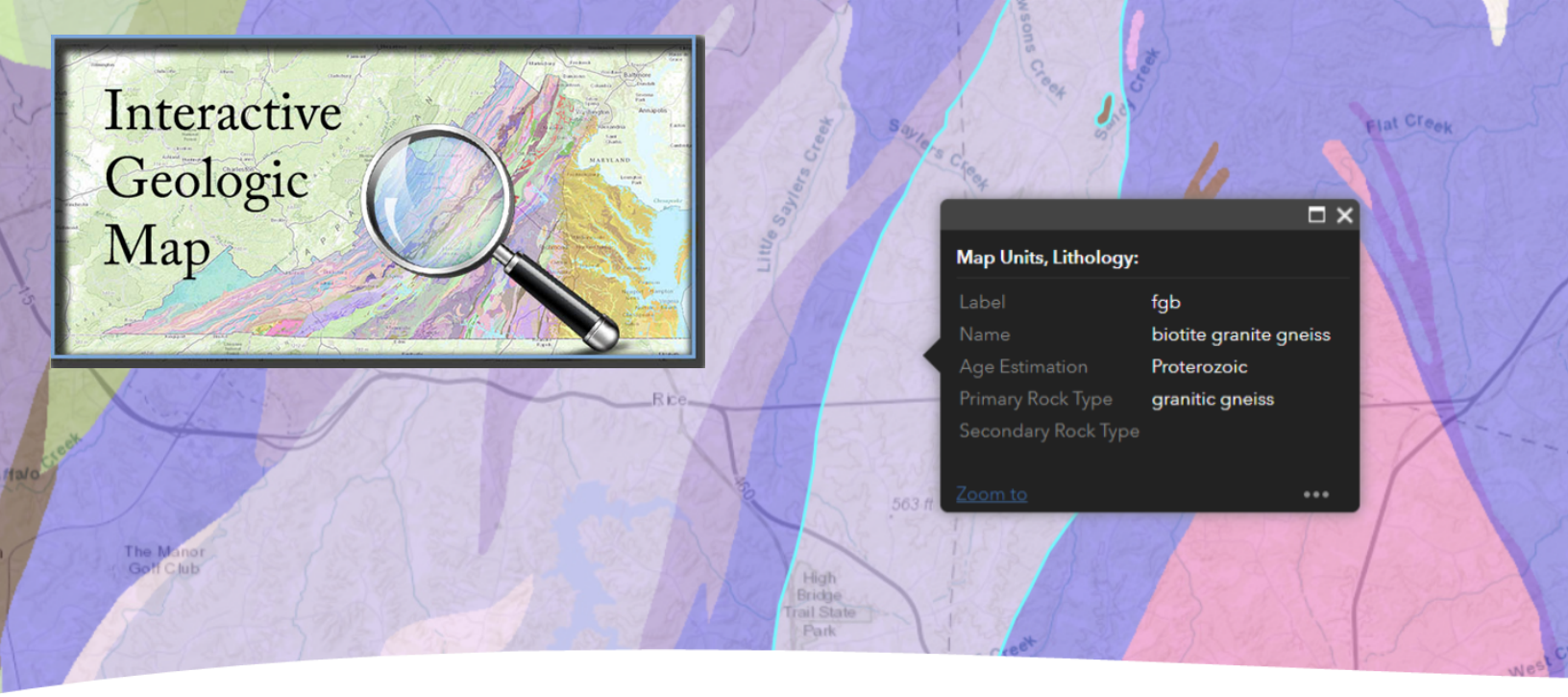
Learn More: http://geology.blogs.wm.edu

GENERALIZED GEOLOGIC MAP OF VIRGINIA



PIEDMONT

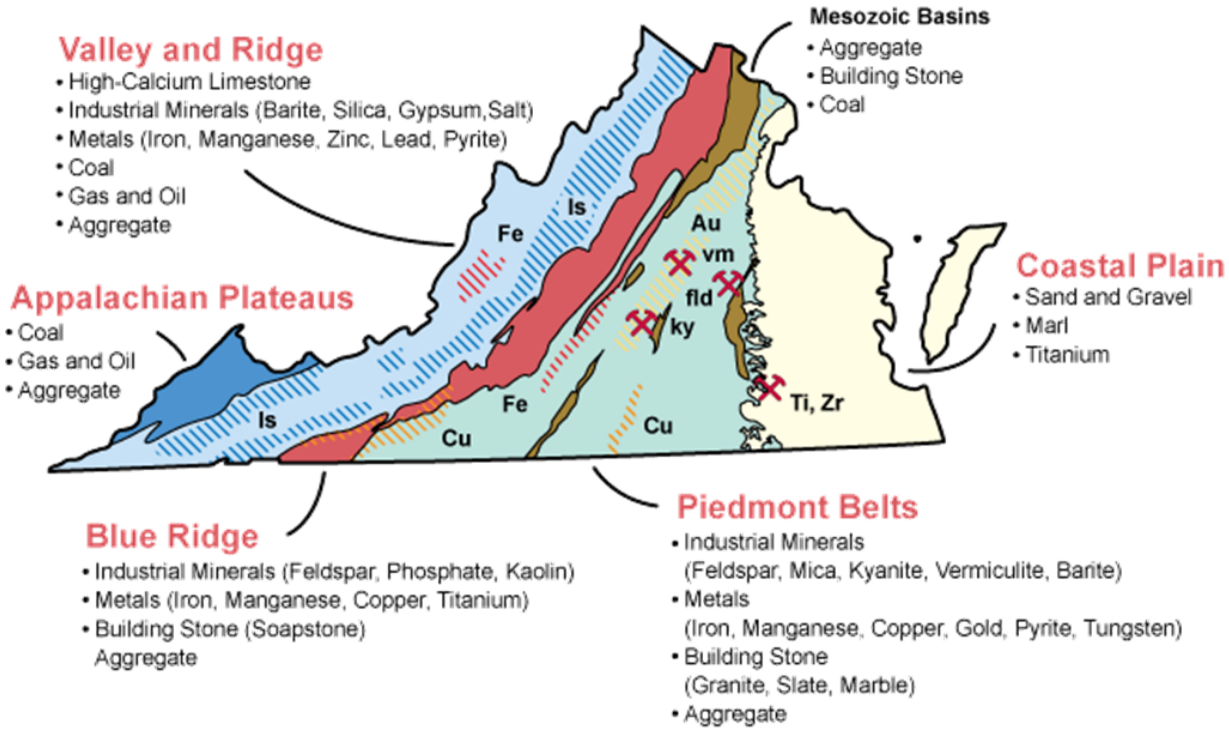
WESTERN PIEDMONT	CENTRAL VIRGINIA VOLCANIC-PLUTONIC BELT	CAROLINA SLATE BELT	CENTRAL PIEDMONT	GOOCHLAND TERRANE	EASTERN PIEDMONT
CAMBRIAN-ORDOVICIAN	CAMBRIAN-ORDOVICIAN	CAMBRIAN	PALEOZOIC ?	MIDDLE PROTEROZOIC	PALEOZOIC ?



DGMR Interactive Geology Map (Link)

- The DGMR interactive geology map is a simple program that provides a basic geology map of Virginia.
- You can type your address in and look at the geology beneath your house! Great for kids and families!

Virginia Mineral Resources (Virginia Energy)



Virginia Aggregates

Basalt

Vulcan Construction Materials
Sanders Quarry – Warrenton, VA

Basalt is a dark-colored, fine-grained, igneous rock composed mainly of plagioclase and pyroxene minerals. It most commonly forms as an extrusive rock, such as a lava flow, but can also form in small intrusive bodies, such as an igneous dike or a thin sill. It has a composition similar to gabbro. The difference between basalt and gabbro is that basalt is a fine-grained rock while gabbro is a coarse-grained rock. Basalt underlies more of Earth's surface than any other rock type. Most areas within Earth's ocean basins are underlain by basalt. Although basalt is much less common on continents, lava flows and flood basalts underlie several percent of Earth's land surface. Basalt is also found on the Moon and on Mars. Basalt is a very important rock: it is crushed and used as a construction aggregate for road beds, buildings, railroad beds (rail ballast), and within dams and levees. It is also used as components of concrete and asphalt.

Limestone

The Frazer Quarry Inc.
North Quarry – Harrisonburg, VA

Limestone is a sedimentary rock, composed mainly of skeletal fragments of marine organisms such as coral, forams, and molluscs. Its major materials are the minerals calcite and aragonite, which are different crystal forms of calcium carbonate ($CaCO_3$). About 10% of sedimentary rocks are limestones. The solubility of limestone in water and weak acid solutions leads to karst landscapes, in which water erodes the limestone over thousands or millions of years. Most cave systems form through limestone bedrock. Limestone has numerous uses: as a building material, as an essential component of concrete (Portland cement) and asphalt, as aggregate for the base of roads, as white pigment or filler in products such as toothpaste or paints, as a chemical feedstock for the production of lime, as a soil conditioner, or as a popular decorative addition to rock gardens.

Slate

Arvonia Aggregate–Arvonia, VA

Slate is a metamorphic rock derived from shale. Slate has a dull appearance and occurs in a number of colors including light and dark gray, green, purple, and red. Shale is a sedimentary rock composed of very fine clay particles. Clay forms from the decomposition of the mineral feldspar. Other minerals present in shale are quartz, mica, pyrite, and organic matter. Shale forms in very deep ocean water, lagoons, lakes and swamps where the water is still enough to allow the extremely fine clay and silt particles to settle to the floor. Geologists estimate that shale represents almost ¾ of the sedimentary rocks on the Earth's crust. Geologists are specific about the definition of the rock called "shale." Shale is composed of clay particles that are less than 0.004 mm in size. Slate's foliation allows it to be broken into sheets of any desired thickness; therefore, for centuries it has been used for roofing and for pavement stones around homes, buildings and gardens. This same feature made slate a most suitable material for making pool tabletops, chalkboards, flooring material, gravestones and memorial tablets, and for electrical insulation. Slate can be crushed and used as aggregate for road construction and maintenance.

Diabase (Trap Rock)
Cedar Mountain Stone
Mitchells Quarry – Mitchells, VA

Diabase, also called Dolerite, is a fine- to medium-grained, dark gray to black intrusive igneous rock. It is extremely hard and tough and is commonly quarried for crushed stone, under the name of trap. Although not popular, it makes an excellent monumental stone and is one of the dark-colored rocks commercially known as black granite. Diabase is widespread and occurs in dikes (tabular bodies inserted in fissures), sills (tabular bodies inserted while molten between other rocks), and other relatively small, shallow bodies. Chemically and mineralogically, diabase closely resembles the volcanic rock basalt, but it is somewhat coarser and contains glass. With an increase in grain size, diabase may pass into gabbro. Diabase is crushed and used as a construction aggregate for road beds, buildings, railroad beds (rail ballast), and within dams and levees. Diabase can be cut for use as headstones and memorials: the base of the Marine Corps War Memorial is made of black diabase granite. Diabase can also be cut for use as ornamental stone for countertops, facing stone on buildings, and paving. A form of dolerite, known as bluestone, is one of the materials used in the construction of Stonehenge.

Siltstone
Luck Stone
Culpeper Quarry – Culpeper, VA

The rocks in the Culpeper quarry are sedimentary siltstone, sandstone, and shale. The majority rock type is siltstone, which can grade down in particle size to shale and up to fine-grained sandstone. The sediments making up this rock were eroded from uplands to the west and deposited in a low lying basin that was forming as a result of continental land masses pulling apart. Many of these basins formed from Late Triassic into Jurassic time, but this quarry is located in the largest such basin in Virginia- the Culpeper Basin. Rivers and streams running into this lowland created a shallow sea with wetlands in which sediments spread out and deposited over a broad area. This is why the rock in the quarry is a mostly uniform texture. The reddish color in the lower parts of the quarry resulted from the hematite-cementing agent that bound the sediment grains into rock. Upper parts of the quarry are a gray color where a lack of oxygen in the depositional environment kept the cementing agent from becoming a reddish color.

Vermiculite
Virginia Vermiculite
Louisa, VA

Vermiculite is a platy mineral. Often occurring as an alteration product of biotite mica or chlorite, vermiculite is typically found associated with ultramafic rock types such as peridotite and pyroxenite that have been altered by intrusions of granite, pegmatite, or alkalic rocks. Vermiculite occurrences have been documented in several areas in the Piedmont province of Virginia within Buckingham, Bedford, Charlotte, Franklin, Halifax, Henry, Louisa, and Pittsylvania Counties (Gooch, 1957). To date, only the occurrence in Louisa County has been developed as a commercial deposit. As a hydrous mica-like mineral, vermiculite expands rapidly when heated to temperatures >900° C. It is chemically inert and highly-absorptive, making the material highly valued in construction applications such as plaster and cement premixes, lightweight concrete additives, as an industrial absorbent, and in fireproof and sound insulation.

Quartz Gravel (Natural)

Aggregate Industries

Hayfield Pit – Fredericksburg, VA

Gravel is a loose aggregation of rock fragments. Gravel is classified by particle size and includes size classes from granule- to boulder-sized fragments. In the Udden-Wentworth scale, gravel is categorized into granular (2 - 4 mm or 0.079 - 0.157 in) and pebble gravel (4 - 64 mm or 0.2 - 2.5 in). ISO 14688 grades gravels as fine, medium, and coarse, with ranges from 2 mm - 6.3 mm, 6.3 mm - 20 mm, and 20 mm - 63 mm. One cubic meter of gravel typically weighs about 1,800 kg (or a cubic yard weighs about 3,000 pounds). Gravel is an important commercial product with a number of applications. Many roadways are surfaced with gravel, especially in rural areas where there is little traffic. Globally, far more roads are surfaced with gravel than with concrete or tarmac. Both sand and small gravel are also important for the manufacturing of concrete. Large gravel deposits are a common geological feature formed as a result of the weathering and erosion of rocks. The action of rivers and waves tends to accumulate gravel in large piles. This can sometimes result in gravel becoming compacted and lithified into the sedimentary rock called conglomerate. Where natural gravel deposits are insufficient for human purposes, gravel is often produced by quarrying and crushing hard-wearing rocks, such as sandstone, limestone, or basalt. Quarries where gravel is extracted are known as gravel pits.

Granite

Vulcan Construction Materials

Graham Quarry – Occoquan, VA

Granite is an intrusive igneous rock and is the most widespread igneous rock underlying much of the continental crust. Granites usually have a coarse texture (individual minerals are visible without magnification), because they form from molten material (magma) that flows and solidifies underground, where it cools slowly, allowing larger crystal growth. Eventually, the overlying rocks are removed, exposing the granite. Granites are most easily characterized as coarse grained and light colored. Color variation is a response to the percent of each mineral found in the sample. The crystals in granite provide a variety of mixed colors — feldspar (pink or red), mica (dark brown or black), quartz (clear, pink, white, or black) and amphibole (black). Granite is high in quartz (about 25%), feldspar, and mica. It is widely used for architectural facades, construction materials, ornamental stone, and monuments. Over 40% of dimension stone quarried is granite. Crushed granite is used as a durable construction material in asphalt and concrete used in highway and infrastructure projects. Occoquan Granite has been dated at about 560 million years old.

Granite-Gneiss

Luck Stone

Spotsylvania Quarry, Spotsylvania, VA

The rock quarried here for construction use is a complex blend of igneous and metamorphic rock types. It is referred to as the Po River Metamorphic Suite; the term "suite" meaning more than one type, and "metamorphic" meaning changed from original composition. The overall rock types are granite-gneiss and biotite-gneiss. Many other intrusions of igneous rocks occurred over time in the Po River Complex making it difficult to date as a unit, but some dating has shown rocks older than 410 million years. The granite-gneiss can yield a white to gray color stone while the biotite-gneiss can yield dark gray to black stone. One of the later igneous intrusions is distinctly different in appearance- a reddish granite with large mineral crystals that contrast with the surrounding stone (Massaponax site).

Catoctin Greenstone
Luck Stone
Charlottesville Quarry – Charlottesville, VA

Charlottesville mines Catoctin Greenstone, a rock formation created from volcanic lava flows over 500 million years ago. The Catoctin originated as a type of lava called basalt, which contains plagioclase and pyroxene minerals. During the mountain-building processes responsible for the Appalachians, epidote and chlorite infused the formation with its popular green color. Catoctin Greenstone is associated with the Catoctin Formation of Virginia, Maryland, Pennsylvania, and Delaware. It is named for exposures on Catoctin Mountain in Maryland but also has exposures throughout the Blue Ridge Mountains and the Appalachian Basin. The Catoctin Formation is composed primarily of metabasalt, commonly referred to as greenstone due to the rock's greenish tint. Today, uses primarily include road and building construction and for tennis court surfaces. Historically, Native Americans used these rocks for arrowheads and other stone tools.

Industry Partners:

Virginia Vermiculite

Vulcan Materials Company

Cedar Mountain Stone – A Dalrymple Company

Boxley

Aggregate Industries

Luck Stone

the Frazier Quarry incorporated

Rocks of Virginia

Rocks vs. Minerals?

A rock is an aggregate of one or more minerals. A mineral is a bit more complicated. We define a mineral by the following rules (all must be met to classify as a mineral): *Inorganic; Crystalline Solid w/ crystal form; Uniform Chemical Composition; Ordered Internal Structure, and Naturally Occurring*. **Imagine an ice-cream sundae.** The whole sundae is the rock, while the individual ingredients (sprinkles, cherries, banana, ice cream, nuts) are the minerals!

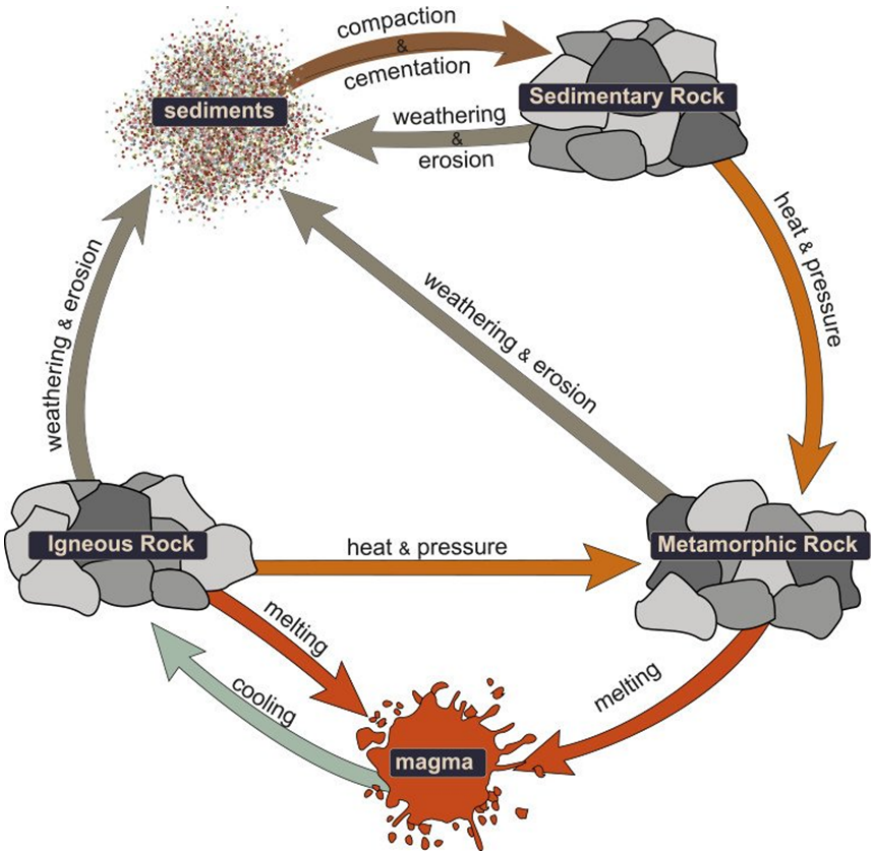
There are three main types of rocks: **Sedimentary, Igneous, and Metamorphic.**

Sedimentary rocks are formed through cementation or compaction of sediment, OR by the chemical/physical weathering or erosion of other rocks.

Igneous rocks are formed through melting & cooling. Think of volcanoes!

Metamorphic rocks are formed by altering other rocks under high heat and pressure, which occurs due to tectonic activity or contact with hot fluids.

Each of these rocks can be melted, heated, and pressurized, or weathered and eroded back into another type of rock,. We call this process the **ROCK CYCLE**.



Rocks of Virginia

Nelsonite (Virginia's State Rock)

Nelsonite is an intrusive igneous rock primarily made up of two minerals: ilmenite and apatite. It was found in Nelson Co., VA and mined during the early 1900s as a source of titanium and calcium phosphate. Although it is no longer mined in the United States, it was voted to become Virginia's state rock in 2016.

Interesting Facts:

- Nelsonite is over 1 BILLION years old!
- Nelsonite is comprised of two primary minerals:
  - **Ilmenite ($FeTiO_3$):** weakly magnetic black or steel-gray mineral, most important ore of titanium *[the black]*
  - **Apatite ($Ca_5(PO_4)_3F$):** a group of phosphate minerals, the most common is fluorapatite *[the white]*
  - Click here to learn more about how Nelsonite became the state rock of Virginia!

Unakite (Metamorphic)

Unakite is a metamorphic rock composed of pink orthoclase feldspar, green epidote, colorless to milky quartz, and minor amounts of other minerals. Named for the Unakas mountain range of North Carolina, it occurs in many locations in the Blue Ridge province of Virginia.

Interesting Facts:

- Used for construction, architecture, and popular in lapidary practices.
- Unakite used to be the unofficial state rock of Virginia.
- Learn More about Unakite Here.

Bog Iron (Sedimentary)

Bog Iron is a type of iron ore that forms in bogs or swamps. Iron-rich groundwater emerges from springs into swampy areas, and the iron precipitates (forms solids) as it comes into contact with oxygen produced by plants. The most common minerals in bog iron are goethite and limonite.

Pegmatite (Igneous)

A pegmatite is an igneous rock with large interlocking crystals that are usually greater in size than 1 cm (0.4 in). Most pegmatites are composed of quartz, feldspar, and mica, with smaller quantities of other minerals. Pegmatites are important because they often contain rare earth minerals used in electronic devices and many other products. They also contain gemstones such as aquamarine, tourmaline, and topaz.

Marble (Metamorphic)

Marble is a metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite. It has been used by civilizations for thousands of years in stonemasonry. Due to marble's carbonate content, it will wear down over time and may discolor. To test marble versus quartzite, use hydrochloric acid. Marble will fizz due to the reaction of acid with the carbonate minerals.

Conglomerate (Sedimentary)

A conglomerate is a sedimentary rock made up of rounded clasts (pieces) that are greater than two millimeters in diameter. The rounded clasts of conglomerates can be pieces of minerals such as quartz or feldspar, or they can be fragments of other sedimentary, metamorphic, or igneous rocks. The matrix that binds the clasts together can be a mixture of sand, mud, and/or a chemical cement of calcite or quartz.

Breccia (Sedimentary)

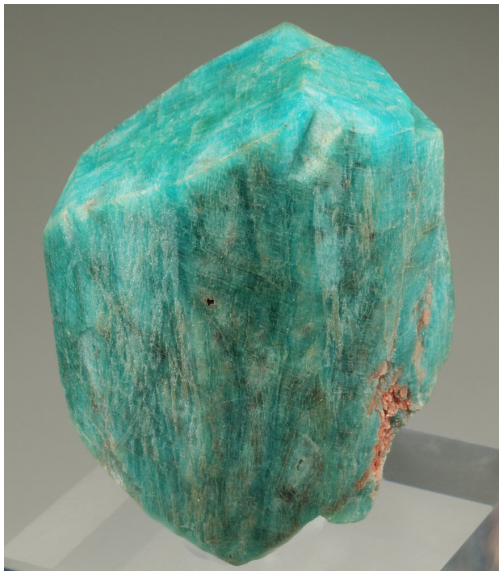
Breccia is a sedimentary rock composed of broken/angular fragments of minerals or rocks cemented together by a fine-grained matrix. It can be confused with conglomerate, so just look at the angular versus rounded pebbles to correctly identify. Since water transport rapidly rounds large clasts, breccias normally indicate minimal transport. They commonly form as rock-fall and debris flow deposits along cliffs and underground along faults or where caves collapse.

Quartzite w/ Skolithos

Quartzite is a metamorphic rock formed when quartz-rich sandstone or chert has been exposed to high temperatures and pressures. It is commonly used as a household countertop due to its hardness. In Virginia, there are abundant quartzite deposits that host skolithos fossils, a common trace fossil that is, or was originally, an approximately vertical cylindrical burrow formed by what is assumed to be a worm-like creature over 500 million years ago!

Minerals of Virginia

The are 430 valid mineral species documented in Virginia!



Amazonite

Amazonite is a green to blue-green feldspar mineral. It is a variety of microcline from the potassium feldspar group. It is named for a type locality near the Amazon River but is found in many different countries and states, including Virginia.

- The green color is caused by trace amounts of lead!
- The Morefield Mine in Amelia County is one of the most famous pegmatites in the USA! It is well known for its abundant and large specimens of beautiful amazonite!

Learn more about Amazonite on Mindat!

Kyanite

Kyanite is a blue, white, or silvery gray mineral. It is predominantly formed through the metamorphism of clay minerals. It forms bladed crystals, sometimes arranged as radiated masses. It is one of the few remaining minerals currently mined in Virginia.

- Willis Mountain (Buckingham Co.) is the largest kyanite mine in the United States, producing 90,000 tons of kyanite in 2020!
- Kyanite is used in the manufacturing of bricks, mortars, spark plugs, dentures, and bathroom sinks.
- Kyanite can have two Mohs hardness readings depending on where you test it.

Learn more about Kyanite on Mindat!

Quartz

Quartz is the most common mineral on the earth's surface. It is made of silicon dioxide and can be found in many different colors. Clear quartz is often called rock crystal. Amethyst is purple and can be found primarily in the Piedmont region. Blue quartz is commonly found in streambeds, and the blue color is due the inclusion of rutile in the crystal structure. Other types include Rose quartz (pink) and Smokey quartz (gray). It is important to note that it is rare to find quartz in its crystalline form.

- Quartz has a sub-conchoidal fracture which made it useful for knapping by Native Americans.
- Silica is a major component in the production of semiconductors critical to modern technology.

Learn more about Quartz on Mindat!

Hematite

Hematite is a black to gray/silver mineral that is mined for its iron content. Its name means "bloodlike" after the vivid red powder it produces when crushed. Iron ore, composed primarily of hematite, was critical during the civil war and is one of the most important industrial minerals used today!

- One cool byproduct from iron smelting is slag glass! It can be found in the Valley & Ridge in various colors.
- Learn more about Virginia Iron during the Colonial Era!

Learn more about hematite on Mindat!

Tourmaline (variety: Schorl)

Tourmaline is a boron silicate mineral that occurs in small amounts in igneous and metamorphic rocks. There is a wide variety of chemical compositions and color zoning that make tourmaline one of the world's most popular gemstones. It often grows as an accessory mineral within quartz. In Virginia, Schorl is the primary tourmaline variety, which is a dark black version found often in quartz bordering pegmatites and igneous intrusions.

- Tourmaline crystals can grow quite large. Some crystals weigh over 100 kilograms!
- Tourmaline can be found throughout the Piedmont, but especially in Amelia and Powhatan Counties which are rich in pegmatites.

Learn more about tourmaline on Mindat!

Garnet in Mica Schist

A garnet is a silicate mineral. Most garnets form when a sedimentary rock with high aluminum content, such as shale, is metamorphosed (subjected to heat and pressure). Chlorite is the name of a group of sheet silicate minerals that also form during metamorphism. Most are green and vary chemically but usually contain some amount of magnesium, iron, and aluminum. Schist is a metamorphic rock that started as shale and changed based on the direction of high pressure applied to it. Platy minerals rotate or recrystallize into parallel layers, making schists layered and flaky.

- Garnets are used for industrial blast-cleaning, polishing, filtration, and water jet cutting.
- Garnets are a very popular gemstone and come in a wide variety of colors and six different species!

Learn more about garnet on Mindat!

Beryl

Beryl is an uncommon silicate mineral found in igneous and metamorphic rocks. It typically forms in granitic pegmatites across the state. It used to be mined for its beryllium content (a rare element), but the small amounts obtained became too costly. Beryl is most commonly used today as a gemstone. It has a distinct hexagonal shape and comes in many varieties, the most famous being emerald and aquamarine!

- The name "beryl" comes from the Greek word "beryllos," referring to the "precious blue-green color of sea water."
- New England's pegmatites have produced some of the largest known beryls, including a massive crystal with dimensions 5.5 m by 1.2 m (18 ft by 4 ft) with a mass around 18 metric tons!

Learn more about beryl on Mindat!

Epidote

Epidote is a silicate mineral that is commonly found in regionally metamorphosed rocks of low-to-moderate grade. Epidote usually ranges between yellowish-green to pistachio-green in color. Less often it is brownish-green to black. Two common rocks in Virginia with epidote are unakite and porphyritic basalt.

- Epidote has no industry value and is difficult to cut, but it is popular as natural specimens, cabochons, and as tumbled pieces.

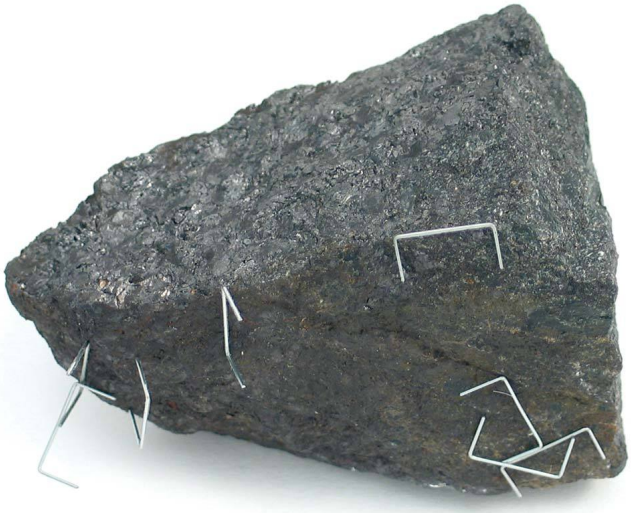
Learn more about epidote on Mindat!

Calcite

Calcite is a carbonate mineral and the most stable polymorph of calcium carbonate ($CaCO3$). It is a very common mineral, particularly as a component of limestone. Calcite defines hardness 3 on the Mohs scale of mineral hardness, based on scratch hardness comparison. A clear calcite crystal laid upon a graph paper with blue lines will show double refraction (double images). Calcite is a highly collectible mineral and has one of the largest abundances of crystal morphologies!

- Calcite is the mineral component of limestone which is used primarily as construction aggregates and in production of lime and cement.
- Clear, ice-colored calcite is called "Iceland Spar."

Learn more about calcite on Mindat!



Magnetite (variety Lodestone)

Lodestone is one of very few minerals that is found naturally magnetized. It is a form of Magnetite and as such, it is attracted to a magnetic field. Unlike ordinary magnetite, lodestone is magnetized and attracts iron to itself. There were many magnetite mines operating in VA in the late 1800s and early 1900s. One of the largest magnetite deposits that has been mined in Virginia is near Pittsville, Pittsylvania County and is credited with a production of over 100,000 tons of ore!

- Magnetite is one of the most commonly mined ores of iron.
- Lodestone was used as some of the first compasses in history!

Learn more about magnetite here!

Galena

Galena is a lead sulfide mineral and is the world's primary ore of lead. It crystalizes in a cubic system, and freshly broken pieces of galena exhibit perfect cleavage (fracture surfaces) at 90º. It is notably dense, and even small pieces can feel quite heavy. Galena was mined historically in Virginia from the Austinville Lead-Zinc district found within dolostone of the Shady formation. It was also found at the Faber Lead Mine in Albemarle County.

- The lead mined from galena is used in car batteries!
- Galena was utilized for its lead content as early as 3000BC and was used in water pipes, which created major health hazards to these ancient civilizations (i.e. Pompeii).

Learn more about galena here!

Pyrite

The mineral pyrite, or iron pyrite, also known as fool's gold, is an iron sulfide with the chemical formula FeS_2. Pyrite is used to create iron sulfate that is used to make nutritional supplements, ink, lawn conditioner, water treatment and flocculation, moss killer, and many other chemical processes.

- Pyrite was sometimes mistaken for Gold, as they frequently occur together. Gold and Pyrite can very easily be distinguished by simple observation and testing of characteristics.
- Pyrite occurs in numerous shapes and habits, but the most famous is as cubes found in Spain! Yes, they are real!!

Learn more about pyrite here!

Prehnite

Prehnite is a common mineral found in diabase intrusions in the Northern Virginia Trap Rock Quarries. While the mineral is difficult to collect in situ, it is often found in gravel in nearby communities that use the quarry's aggregate. Prehnite forms in both odd and distinct formation habits and can vary in color and luster depending on the quarry. During the 1970s, massive chimneys lined with prehnite were discovered and preserved, many of which are found on the collecting market and displayed in museums across the United States. Apophyllite is a common mineral that occurred with prehnite.

- The largest specimen of prehnite and apophyllite can be found at the Smithsonian museum (specimen to the left). It was originally collected at the Centreville Quarry.

Learn more about prehnite on Mindat!

Limonite

Limonite is a general term for a mixture of fine-grained iron oxides, generally dominated by goethite, but also possibly containing hematite, lepidochrocite, and other minerals. Limonite has been used as an iron ore, a brown earth pigment, and in ancient times as an ornamental stone for small carved items such as beads and seals.

- Limonite Cubes, also known as Jack Rocks, are found in Albemarle Co. and are pseudomorphs (false-forms) of pyrite. The limonite replaced the pyrites' chemical composition, but kept the original form as well-formed cubes!

Learn more about limonite on Mindat!

Mica (variety Muscovite)

Muscovite is the most common form of mica. Its name is derived from "Muscovy Glass," which describes thick sheets of transparent mica that were once used as a glass substitute in Russia. Muscovite is very abundant in Virginia's rocks and is often found as glitter in the weathered clay and soils in the Piedmont. There were a wide variety of Mica mines in Virginia in the early 1900's.

- In the cosmetics industry, its reflective and refractive properties make mica an important ingredient in blushes, eye liner, eye shadow, foundation, hair and body glitter, lipstick, lip gloss, mascara, moisturizing lotions, and nail polish.
- Mica's thin sheet cleavage, high heat resistance, and its transparency provided useful as furnace windows during the 19th and 20th centuries.

Learn more about mica on Mindat!

Common Mineral ID Sheet

LUSTER	HARD-NESS	CLEAVAGE	FRACTURE	COMMON COLORS	DISTINGUISHING CHARACTERISTICS	USE(S)	COMPOSITION*	MINERAL NAME
Metallic luster	1–2	✔		silver to gray	black streak, greasy feel	pencil lead, lubricants	C	**Graphite**
	2.5	✔		metallic silver	gray-black streak, cubic cleavage, density = 7.6 g/cm^3	ore of lead, batteries	PbS	**Galena**
	5.5–6.5		✔	black to silver	black streak, magnetic	ore of iron, steel	Fe_3O_4	**Magnetite**
	6.5		✔	brassy yellow	green-black streak, (fool's gold)	ore of sulfur	FeS_2	**Pyrite**
Either	5.5 – 6.5 or 1		✔	metallic silver or earthy red	red-brown streak	ore of iron, jewelry	Fe_2O_3	**Hematite**
Nonmetallic luster	1	✔		white to green	greasy feel	ceramics, paper	$Mg_3Si_4O_{10}(OH)_2$	**Talc**
	2		✔	yellow to amber	white-yellow streak	sulfuric acid	S	**Sulfur**
	2	✔		white to pink or gray	easily scratched by fingernail	plaster of paris, drywall	$CaSO_4 \cdot 2H_2O$	**Selenite gypsum**
	2–2.5	✔		colorless to yellow	flexible in thin sheets	paint, roofing	$KAl_3Si_3O_{10}(OH)_2$	**Muscovite mica**
	2.5	✔		colorless to white	cubic cleavage, salty taste	food additive, melts ice	NaCl	**Halite**
	2.5–3	✔		black to dark brown	flexible in thin sheets	construction materials	$K(Mg,Fe)_3 AlSi_3O_{10}(OH)_2$	**Biotite mica**
	3	✔		colorless or variable	bubbles with acid, rhombohedral cleavage	cement, lime	$CaCO_3$	**Calcite**
	3.5	✔		colorless or variable	bubbles with acid when powdered	building stones	$CaMg(CO_3)_2$	**Dolomite**
	4	✔		colorless or variable	cleaves in 4 directions	hydrofluoric acid	CaF_2	**Fluorite**
	5–6	✔		black to dark green	cleaves in 2 directions at 90°	mineral collections, jewelry	$(Ca,Na)(Mg,Fe,Al)(Si,Al)_2O_6$	**Pyroxene** (commonly augite)
	5.5	✔		black to dark green	cleaves at 56° and 124°	mineral collections, jewelry	$CaNa(Mg,Fe)_4(Al,Fe,Ti)_3Si_6O_{22}(O,OH)_2$	**Amphibole** (commonly hornblende)
	6	✔		white to pink	cleaves in 2 directions at 90°	ceramics, glass	$KAlSi_3O_8$	**Potassium feldspar** (commonly orthoclase)
	6	✔		white to gray	cleaves in 2 directions, striations visible	ceramics, glass	$(Na,Ca)AlSi_3O_8$	**Plagioclase feldspar**
	6.5		✔	green to gray or brown	commonly light green and granular	furnace bricks, jewelry	$(Fe,Mg)_2SiO_4$	**Olivine**
	7		✔	colorless or variable	glassy luster, may form hexagonal crystals	glass, jewelry, electronics	SiO_2	**Quartz**
	6.5–7.5		✔	dark red to green	often seen as red glassy grains in NYS metamorphic rocks	jewelry (NYS gem), abrasives	$Fe_3Al_2Si_3O_{12}$	**Garnet**

*Chemical symbols:

Al = aluminum	Cl = chlorine	H = hydrogen	Na = sodium	S = sulfur
C = carbon	F = fluorine	K = potassium	O = oxygen	Si = silicon
Ca = calcium	Fe = iron	Mg = magnesium	Pb = lead	Ti = titanium

✔ = dominant form of breakage

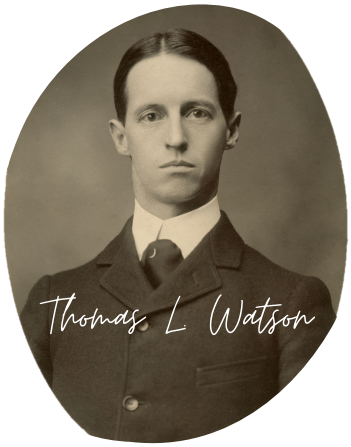
Recommended Reading

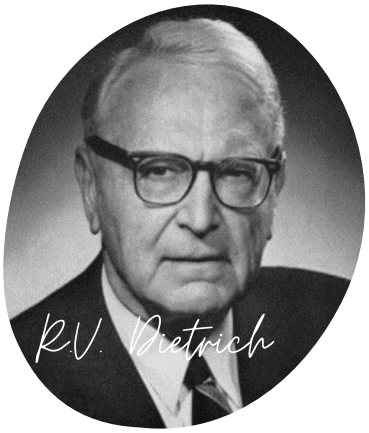
Minerals of Virginia by R.V. Dietrich (1990 &1970): Viewed as the hegemonic text by all Virginia mineral collectors. This publication was produced by R.V. Dietrich who wrote several editions of his famous "Minerals of Virginia" series starting in the late 1950s. The 1990 version and the smaller 1991 addendum is the last seminal work done on the state's mineral deposits. The book breaks down minerals and their recorded locations across the state. While the book is outdated, it keeps its place as an essential field guide to help revisit deposits in the state. We highly recommend having this book!

Virginia Minerals by the Division of Mines, Minerals, and Energy: These publications cover some of the most important mineral discoveries and news during the height of mining and mineral production in the state. The DMME was the former division for geological research until transitioning to Virginia Energy in 2021. All of these publications are FREE for the public. The articles can be found deep within the state archives which will be linked below. We highly recommend downloading these PDFs and printing them for your records. **LINK**

Minerals Resources of Virginia (1907): Viewed as the seminal work on Virginia mineral deposits, this publication by Thomas Watson was the first recorded manuscript on the economic importance of mineral resources in Virginia. This book set the stage for later studies and is a critical text. Some of the localities mentioned in 1907 were taken out of later books. Finding a copy is difficult, but check out this free PDF online! **LINK**

Virginia Mineral Locality Index (1987): Written by Allen Pennick, this short article notes some of the most famous mineral collecting sites during the late 1980s. While many of these sites are closed now, prospectors can monitor nearby construction and exposed dirt for new locations. This is also helpful for looking at deposits at a county level, instead of by the mineral as in Minerals of Virginia. **LINK**





Additional Publications & Articles:

Geology of the Virginias (1884) by William B. Rogers

Roadside Geology of Virginia (1986) by Keith Frye

Mineral Guide to Maryland and Virginia Areas (1967) by Philip Morrill et. al

Pegmatite Deposits of Virginia (1932) by Arthur Pegau

Outline of the Mineral Resources of Virginia (1936) by William M. McGill

Mica & Feldspar Deposits of Virginia (1962) by William Randall Brown

Identification Guide to Common Minerals and Rocks of Virginia (1961) by Gustav B. Baetcke

Contact the VMP for specialized research articles and publications!

Online Resources

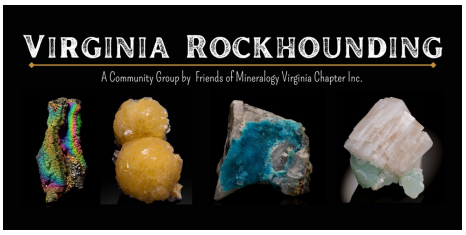
Mindat.org is the world's leading authority on minerals and their localities, deposits, and mines worldwide. Mindat also provides a forum where incredible discussions happen everyday on mineral news, cleaning, research, and mineral storage. Check out the Mindat Learning Center and their incredible mineral quiz with thousands of examples!

Macrostrat is the perfect online geological mapping database that provides stratigraphic, lithological, environmental, and economic data. Interactive applications built upon Macrostrat are designed for educational and research purposes. This provides a global and expansive interactive geology map! Check out their mobile app, **Rockd**, on Android and Apple devices!

Friends of Mineralogy National shares weekly educational posts that are a must for all new rockhounds and those interested in the hobby! Please check out their Facebook and Instagram channels for engaging content!

Virginia Energy, formerly the Department of Mines, Minerals, and Energy, is the state geological survey. They have an incredible database of articles and a really interesting interactive geology map for the state.

The **United States Geological Survey** is the premiere federal geological institution in the United States. USGS hosts a wealth of databases and old publications related to Virginia mineralogy and geology!



Virginia Rockhounding is the official community forum for Virginia's mineral and geoscience community. With over 11,000 members and growing, this is a place where the public, teachers, and experts can come together to ask questions, share finds, and learn more about the hobby!

WHAT IS FMVA?

Friends of Mineralogy Virginia Chapter Inc. (FMVA) is a new branch of the national non-profit organization, Friends of Mineralogy. FMVA's non-profit mandate is to *promote, support, protect, and expand the collecting of mineral specimens, while furthering the recognition of the scientific, economic, and aesthetic value of minerals in society.* Membership includes collectors, museum curators, mineralogists, and earth science educators from Virginia and across the United States. FMVA and our members are affiliated with many of the top mineral organizations including Mindat.org, the Mineralogical Society of America (MSA), the Young Mineral Collectors, and more.

Why should I join FMVA if I am a member of a local club?

FMVA provides a statewide and national perspective on the mineral community. While our initiatives focus on Virginia, our membership is pooled from a vast community across the country. Joining FMVA will enhance your local club experience by getting involved with various clubs across the state and introducing you to organizations and communities across the country. FMVA is proud to host a diverse and young membership base. FMVA provides educational and professional development opportunities through first-class speakers and initiatives that support Virginia education and historical preservation.

What if I live in another state or do not have a local club nearby?

FMVA provides a virtual format to the mineral community. Our organization will continue virtual initiatives after COVID-19 and will allow members to attend speaker series from anywhere in the world. We are dedicated to outreach and expanding our audience through virtual initiatives. A few times in the year, we will host opportunities to meet in a central location in Virginia, where our membership can engage in person!

Virtual Meetings!

FMVA meets virtually on Zoom every last Friday of the month! Zoom meetings are OPEN to the public and you can find meeting dates on our website and social media pages. Becoming a member of FMVA is $15 per year ($10 students; $25 family) and that includes membership in the national organization! Join Now!

Learn More about us on our Social Media:

The Virginia Mineral Project

"Preserving History, One mineral at a time."

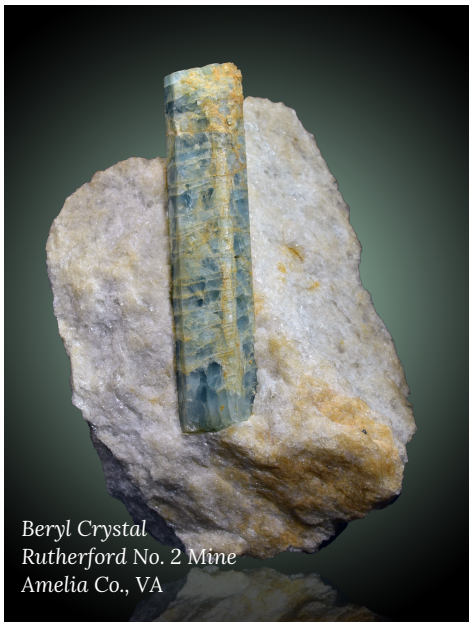
What is the Virginia Mineral Project (VMP)?

The Virginia Mineral Project is a statewide research initiative tasked with recording and preserving the mineral and mining heritage of the state. The VMP produces lectures, documents, and assists the public with questions and information regarding Virginia mineral deposits. The VMP hosts regular lectures for the community, many of which can be seen on YouTube! If you have stories about Virginia mineral and mining history, then please reach out! The ultimate goal of the VMP is to develop a new Minerals of Virginia publication inspired by R.V. Dietrich. The first VMP publication will be released in 2022 and will cover the Northern Virginia Trap Rock Quarries. The VMP now operates as a committee within Friends of Mineralogy Virginia.

The VMP provides a number of services and deliverables to the community:

- Collection preservation, organization, and display techniques
- Museum curation and identification services
- Specialized resources and information on Virginia mineral deposits
- Rockhounding 101 Courses (2x per year for the public)
- Community lectures and events
- Educational materials and assistance with earth science teachers
- Photography of Virginia mineral collections
- Assistance with personal prospecting plans and site research

Reach out if you would like these services:
virginiamineralproject@gmail.com



Beryl Crystal
Rutherford No. 2 Mine
Amelia Co., VA

The VMP is directed by Thomas Hale and is supported by a team of long-time mineral collectors across the state. If you are interested in getting involved, reach out to our team! For questions, inquiries, joining the VMP listserv, or additional requests, email: **virginiamineralproject@gmail.com**

Follow the VMP on Social Media

QUESTIONS? CONTACT US.

Website: https://friendsofmineralogyvirginia.org
Email: friendsofmineralogy.virginia@gmail.com
Phone: +1 (540) 529-4506

Stay updated on social media!