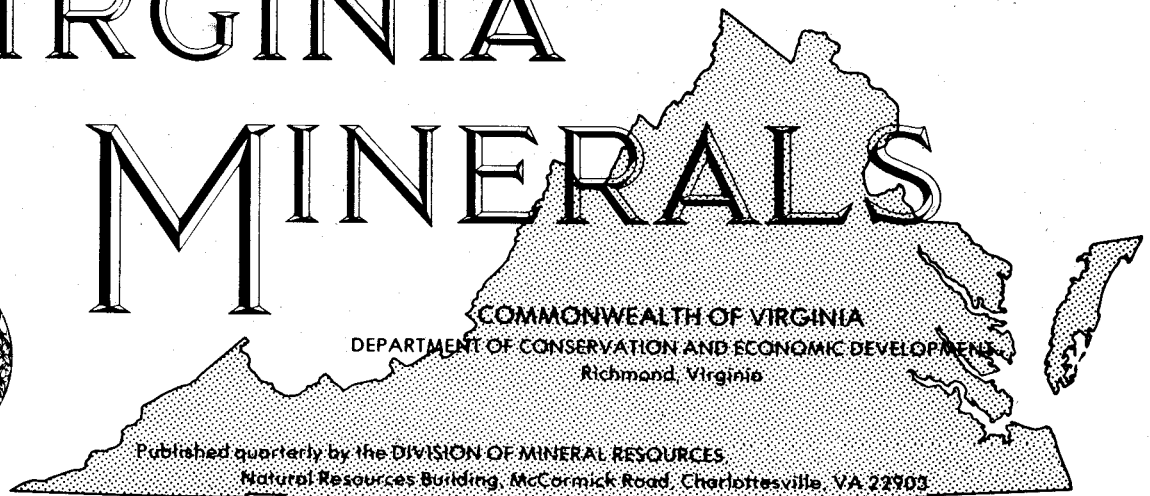


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MINERALS



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INDUSTRIAL ROCK AND MINERAL RESOURCES IN VIRGINIA

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Virginia's total mineral production in 1980 was valued at almost 1.8 billion dollars (figure). Fuel commodities, worth about 1.5 billion dollars, made up most of this figure and consisted of coal (1.43 billion) petroleum and natural gas. The remaining value of approximately 300 million dollars was from the production of nonfuel industrial rocks and minerals and zinc-lead mining. Preliminary figures for nonfuel mineral production in 1981 as provided by the U.S. Bureau of Mines was 277 million dollars. During the past decade, nonfuel mineral production added over 2.1 billion dollars to Virginia's economy and has directly and indirectly created jobs for thousands of the State's citizens.

The economic slowdown that developed during the latter part of 1979 and continued throughout 1980 and 1981, has created a depressed market for a number of the State's mineral commodities. Hardest hit by the slowdown were those commodities used by the construction industry. Both residential and nonresidential construction, important markets for clay products, cement, sand and gravel, and stone, have decreased significantly. Highway construction, one of the largest markets for cement and crushed stone has declined due to federal and State budget cut-backs (Virginia's 1980 highway construction and maintenance budget was \$60 million less than 1979 funding).

In spite of the recessionary effects on the mineral

industry, in 1980 the State led the Nation in the production of kyanite, was the only producer of a feldspar, marketed as "Virginia aplite," and was one of three States mining vermiculite.

Major industrial mineral resources in Virginia are: barite, cement*, clay materials*, diatomaceous sediments, feldspar*, ferrovandium*, gypsum*, iron oxide pigments*, kyanite*, lime*, lithium*, manganese*, ornamental aggregate*, perlite*, potash, sand and gravel*, stone* (crushed and dimension), sulfur*, talc*, tantalum, titanium, and vermiculite* (*indicates presently produced or processed). A number of these mineral commodities—iron oxides, lithium carbonate, magnetite, manganese, mica, perlite, and vanadium pentoxide—are imported into the State and processed.

BARITE

In 1845 barite ($BaSO_4$) was mined in Prince William County at the Cedar Run mine about 200 yards from the Fauquier County line. The barite was dug from fractures along a fault zone in red shale—sandstone of Triassic age. The mine was last operated in 1903, when 1500 tons of ore were produced. Barite mining in Campbell and Pittsylvania counties began in the mid 1870's and was mined from replacement deposits of

1980 Mineral Production in Virginia

Mineral	Quantity	Value (thousands)
Clays thousand short tons . . .	762	\$ 3,172
Coal* (bituminous) thousand short tons . . .	41,009	1,435,311
Gem stones	NA	15
Lead (recoverable content of ores, etc.)-metric tons . . .	1,563	1,463
Lime thousand short tons . . .	824	33,872
Natural Gas* million cubic feet . . .	7,812	20,312
Petroleum* (crude) thousand 42-gallon barrels . . .	10	360
Sand and gravel thousand short tons . . .	8,264	29,508
Stone:		
Crushed thousand short tons . . .	44,615	167,839
Dimension thousand short tons . . .	27	2,287
Zinc (recoverable content of ores, etc.)-metric tons . . .	12,038	9,934
Combined value of cement (masonry and portland), feldspar, gypsum, kyanite, sand and gravel (industrial), talc (soapstone), and vermiculite . . .	XX	57,216
Total	XX	\$1,761,289

NA Not available

XX Not applicable

Production as measured by mine shipments, sales, or marketable production (including consumption by producers.) Figures from U.S. Bureau of Mines and Virginia Department of Labor and Industry (*).

impure metamorphosed calcareous rocks. The Hewitt mine, located south of Lynchburg and southeast of Evington in Campbell County, was worked from 1874 until 1903, when it was closed because of groundwater flooding. The mine had a maximum depth of 160 feet.

Barite was mined from replacement deposits of Paleozoic limestone near Marion in Smyth County from about 1877 until 1885. Some mining was done in this area around 1906. Since 1913, most production in Virginia was from three mines in Botetourt, Campbell, and Pittsylvania counties. Until the early 1930's the Ramsey, Berger, and Bennett mines in Pittsylvania County were the largest producers of barite in Virginia.

Production of barite in Virginia, as noted by J.K. Roberts's annotated bibliography, exceeded 130,000 tons. Virginia was the main barite producing state, until 1893, when Missouri became the leading producer. More than 46,000 tons of barite were produced in the years 1901-1905 (Watson, 1907 p. 327).

Ground barite has a high specific gravity and is used to prevent excessive fluid pressures at depth from forcing water and/or clay mud from oil or gas wells. As much as 5 tons of ground barite may be used per 1000 feet when drilling a well. Due to the high level of oil and gas drilling in the United States, domestic demand for barite is expected to increase about seven percent per year from 1980-1985.

Since barite is a bulk material that sells for a relatively low price, its use is greatly influenced by increasing fuel and transportation costs. Thus the locations of markets have much control over which barite deposits are worked. Size of barite veins in the Piedmont Province in Virginia are small compared to the replacement deposits in the southeastern Valley and Ridge Province. Some of the barite fines present around the old barite deposits may be able to be re-processed.

CEMENT

Three companies, located in Warren and Botetourt counties and in the city of Chesapeake, produce cement. Riverton Corporation in Warren County produces masonry cement at their plant at Riverton. Crushed limestone (Athens Formation) is calcined, hydrated, and mixed with portland cement purchased from out-of-State sources. Sales are to building supply dealers in Virginia and surrounding states.

Lone Star Cement Inc. operates a plant west of Tinker Mountain in Botetourt County. The facility, the largest operation owned by Lone Star, produces portland cement from locally mined limestone, shale and sand, and utilizes iron ore from Roanoke Electric Steel

Company. Clinker is manufactured in five coal-fired kilns and ground into cement. Three-quarters of the cement is sold to ready-mix companies and approximately 75 percent of the plant's production is shipped by rail. In January, 1982, 30 percent of the production personnel were laid off for an anticipated two months.

Lone Star La Farge, Inc., operates a cement manufacturing facility in the city of Chesapeake. The company imports crushed quicklime (93-96% CaCO_3) from Allied Products in eastern Alabama. Alumina is purchased on the open market from several aluminum companies. Three types of calcium aluminate cement are produced: low Al_2O_3 (Fondu), medium Al_2O_3 (50-55%), and high (70-80% Al_2O_3) alumina including SECAR 71, and SECAR 80. Advantages of this cement over portland cement include rapid hardening and resistance to wear, high and low temperatures and corrosion.

The slowdown of Virginia Electric and Power Company's pumped storage project in Bath County in western Virginia and in building and highway construction has depressed the cement market in Virginia.

CLAY MATERIALS

Residual and transported clay, shale, phyllite and schists are used as raw material to produce bricks and clay dummies in Virginia. The clay material industry in the western part of Virginia uses Paleozoic shales as a raw material, with the primary end-product being common and face brick. Tazewell Clay Products Company in Tazewell County extrudes clay to produce clay dummies used by the coal industry to tamp shot holes.

Lightweight aggregate is produced by four different companies in Amherst, Botetourt, Buckingham, and Pittsylvania counties. Weblite Corporation in Botetourt County utilizes shale from the Rome Formation and the sintering process to produce lightweight aggregate. The weight of the product is as low as 31 lb./ft.³. Triassic shale in the Danville basin is used by Virginia Solite Company near Cascade, Pittsylvania County to produce lightweight aggregate. Solite Corporation near Arvon in northern Buckingham County utilizes the Arvon slate of Ordovician age, and the Amlite Corporation in Amherst County uses the Hampton Formation (slate) of Cambrian age.

Eastern clay producers mine a variety of materials (Precambrian schists and transported clays) for raw material to produce common and face brick. The old Cold Springs kaolin deposit near Big Levels in

Augusta County, was last operated in 1951. It is surrounded by large waste piles of kaolinitic clay materials and small pieces of bauxite.

When all the plants are working at full capacity, almost half a billion bricks per year are manufactured in Virginia. High interest rates and a shortage of mortgage money, has depressed residential and commercial building construction and has adversely affected clay product sales; production decreased almost 300,000 tons from 1979 figures.

During early 1981, a large occurrence of montmorillonite clay material were discovered in King and Queen County in the Walkerton area of eastern Virginia. Plans were announced by Bennett Mineral Company to mine and process the clays to produce an industrial absorbent. Construction of a \$2 million plant was scheduled to begin in 1981 which would employ 40 to 50 people initially. The processing facility will use wood wastes, instead of oil, as a plant fuel to dry the clay. At the end of 1981, the plant was almost completed, and plans are to begin production in the spring of 1982.

DIATOMACEOUS SEDIMENTS

Diatomite has been produced from marine Miocene age sediments which underlie the western portion of the Coastal Plain from the Potomac River southward to the James River. The sediments consist largely of compact, sandy, diatomaceous mudstone that is dark greenish-gray or white to buff, where weathered. At some localities the mudstone grades vertically into fine-grained buff sands, or into diatomite beds that resemble buff-colored chalk. Prominent exposures occur in nearly vertical cliffs along the Potomac and Rappahannock rivers.

The production of diatomaceous rocks in Virginia has been on a small scale. Until the early 1900's, the microscopic remains of diatoms were incorrectly regarded by investigators as "Infusoria," and diatomaceous deposits were commonly referred to as "Infusorial earth." The U.S. Geological Survey publication, "Mineral Resources of the United States," for 1900 lists no production for that year, but states that "Infusorial earth" had been mined in past years in Virginia. The 1902, 1903, and 1904 volumes of "Mineral Resources of the United States" indicate an active production of diatomaceous rocks in the State for these years; Virginia is listed as ranking second in domestic production of diatomite in the year 1903. Records also indicate that "diatomaceous earth" or "infusoria" was mined in King George County by the

Vulcan Fire Brick Company of Baltimore, Maryland, during the years 1910, 1911, 1912, 1913, and 1915; by the Quigley Furnace Specialties Company, Inc. of New York City, during 1918; by the Refractory Products Corporation of New York City, during 1921 and 1922; and by the American Diatom Corporation of Virginia, Philadelphia, Pennsylvania, during 1929, 1930, 1933, and 1934. No production of diatomite has been reported in Virginia since 1934. Total recorded production of diatomaceous earth is more than 500 tons (Roberts, 1942 p. 424).

All past mining of diatomaceous rocks by these companies is recorded as being from Wilmont (Wilmont Wharf), King George County, where a brick plant and other processing facilities were located. Mr. J. Cleveland Grigsby, owner of the Bristol Farm which fronts on the Rappahannock River near Wilmont Wharf, recalls mining activity on his farm as early as 1893. He stated that "diatomaceous earth was removed from the bluffs along the river by driving long poles or wedges into the formation from atop the cliffs and hammering against them to topple the material to the river's edge. It was then carried a short distance by barge to Wilmont Wharf where it was stored in racks for drying." Similar mining operations were performed at various other locations down-river from the plant facilities.

Production records do not indicate what products were manufactured from the diatomaceous rocks or the refined state of the material when marketed. Important uses include: as an abrasive, as an additive used with asbestos for the manufacture of boiler coverings, and as an absorbent for nitroglycerine in the manufacturing of dynamite. Some was mixed with Pleistocene clay for use at the Wilmont Brick Plant in the manufacture of fire-proofing, boiler brick, and front brick. Material has also been dug from time to time in the vicinity of Richmond for commercial use.

Due to the clay, silt, and sand, the diatomaceous rocks in Virginia are considered by commercial producers of diatomite as unsatisfactory for many of the diatomite products. Materials tested over the last several years note diatomite content to be no higher than 30-40 percent.

FELDSPAR

In 1981, Virginia was the only state that produced a material marketed as "Virginia aplite". This product has a chemical composition variation from true aplite (light-colored dike rock composed of quartz and orthoclase feldspar). It was sold to the glass industry to

improve the workability of the molten material and impart a chemical stability to the finished glassware.

At the beginning of 1980, two companies produced feldspar for the glass industry. International Minerals and Chemicals (IMC) Corporation operated at Piney River in Nelson County mining anorthosite, thin veinlets of orthoclase (potassic) feldspar in albite (sodic) feldspar. In June 1980 it closed because of a problem with a deteriorating grade of feldspar. With the closing of this operation, feldspar production in Virginia fell below that of 1979. The Feldspar Corporation operates a mine and plant near Montpelier in Hanover County in east-central Virginia. The Feldspar Corporation mines feldspar from pegmatites by open pit methods-ore is trucked to the plant adjacent to the mine for crushing, grinding, classifying, and drying.

In processing the clay, minerals are removed by gravity concentration and a electrostatic process in which magnets remove the iron and other heavy minerals. In 1971 about six to eight thousand tons of heavy mineral sands containing apatite, rutile, ilmenite and sphene were stockpiled. In 1973 heavy minerals were no longer separated but put into the tailings pond. In 1977 the heavy mineral sands were again being separated. Clay and silt in the settling ponds were evaluated in the mid-1960's and found suitable for production of face brick and drain tile.

Feldspar in Amherst County is now marketed as aggregate by the Dominion Stone Plant, Inc. Fines resulting from the crushing of anorthosite are present in Amherst County. This material was marketed for roofing granules but due to its transmission of light, was found unsuitable.

Feldspar has been mined from a number of other counties in the Piedmont, including Amelia, Bedford and Powhatan. The most recent activity, in the early 1970's was in Bedford County.

FERROVANADIUM

Engelhard Minerals and Chemicals Corporation (subsidiary of Chemstone Corporation) produces ferrovanadium (80 percent vanadium) at their Alloys Plant in Strasburg, Shenandoah County, Virginia. Vanadium pentoxide, obtained from out-of-State, is combined with aluminum scrap at a high temperature to produce ferrovanadium, which is used as alloying agent to impart high strength to steel. A residue from this process is alumina concentrate (85-88 percent Al_2O_3 , several percent MgO and 1.5 percent vanadium).

GYPSUM

United States Gypsum Company operates an underground mine at Locust Cove in Smyth County, a plant at Plasterco in Washington County, and a plant in Norfolk. The Locust Cove Mine is a slope entry, multi-level operation. Gypsum, occurring as isolated boulders in the Maccrady shale, is mined by a modified underhand stoping system. Crude gypsum is trucked to the plant at Plasterco where it is made into wallboard.

The Norfolk operation receives crude gypsum from Nova Scotia in company-owned ships; the gypsum is ground and calcined to produce wallboard and other gypsum-based products. The Norfolk facility also receives a few shipments of anhydrite from the Nova Scotia operations for sale to local cement manufacturers.

IRON OXIDE PIGMENTS

Virginia is one of four States producing iron oxide pigments. Hoover Color Corporation in Pulaski County, the only operation in the United States producing sienna, also produces ocher and umber. Raw pigments are mined by open pit methods and trucked to the company plant at Hiwassee where the pigments are pulverized, dried, ground, graded, blended, and packaged prior to shipping. The finished products, used as coloring agents in a variety of products, are shipped throughout the United States and to Canada and Mexico.

Blue Ridge Talc Company, Inc., imports crude iron oxide pigments from a midwest supplier. The pigments are ground and calcined for use in paints, fertilizers, and cement and mortar coloring. Markets are domestic and foreign.

KYANITE

The first recorded production of kyanite worldwide was in Prince Edward County, Virginia in the 1920's. Currently, the State produces approximately 45 percent of the world's kyanite. Kyanite and calcined kyanite (mullite) are widely used in the refractories and ceramic industry.

Kyanite Mining Corporation operates two surface

mines and processing plants at Willis Mountain and East Ridge (world's largest) in Buckingham County in central Virginia. After mining, the ore is crushed, ground, screened, classified, and washed. Flotation is used to separate pyrite and silica impurities; magnetic separators remove remaining iron contaminants. The Willis Mountain plant processes raw kyanite; kyanite from the Willis Mountain mine used for mullite synthesis is trucked to the East Ridge facility for calcining.

Approximately 40 percent of the output is shipped through the port of Hampton Roads to worldwide customers. The company produces approximately 90,000 tons per year (Dixon, 1980 p. 12). During 1980 the company closed their mine at Baker Mountain in Prince Edward County because of the transportation costs. The company also produces a byproduct sand from kyanite processing. Sales are for golf courses, masonry, concrete, and other applications. Pyrite that is not removed by flotation is chemically converted into magnetite by being roasted in a kiln, removed by electromagnets, and stockpiled on the site.

LIME

Lime sales ranked second in value behind stone in Virginia in 1980. Over the past 10 years, lime sales have added over \$200 million to the State's economy. During 1980 lime production decreased almost 50,000 tons as a result of the slump in the steel industry.

Virginia's lime industry is situated in Frederick, Giles, Shenandoah, Smyth, and Warren counties. In northern Virginia, three companies, Genstar Stone Products Company, W. S. Frey Company, Inc., and Chemstone Corporation, quarry and calcine the high-calcium, New Market Limestone, and one company, Riverton Corporation, quarries the Athens Formation. Two companies in Giles County, Gold Bond Building Products and Virginia Lime Company, operate underground mines in the Five Oaks Limestone. Greer Lime Company in Smyth County quarries the Effna Limestone.

Principal sales of lime are to the paper and steel industries. The paper industry uses lime for regeneration of sodium hydroxide and the neutralization of sulfate water, a byproduct of paper manufacture. Lime is used by the steel industry to control slagging. Other uses include water purification, and in neutralization of acid mine water (over the last couple of years), for mason's lime, sewage treatment and for agriculture.

LITHIUM

Foote Mineral Company processes lithium carbonate from Spruce Pine, North Carolina along with calcium hydroxide from various sources to produce lithium hydroxide at their Sunbright plant in Scott County in southwestern Virginia. Lithium hydroxide is used in multipurpose grease applications. In the past; limestone from an underground mine at this site was utilized and a calcium carbonate precipitate (paste residue) remained. The material remains on the site and may be a valuable waste resource.

MAGNETITE

Two companies, Virginia Lime Company and Reiss Viking Corporation, in Giles and Tazewell Counties in southwestern Virginia process out-of-State magnetite for use in coal preparation. The material is marketed in New York and Pennsylvania.

MANGANESE

Union Carbide Corporation, Battery Products Division, operates a manganese processing facility in the city of Newport News. Manganese ore, imported from South Africa and Ghana, is dried, crushed, and ground, and shipped to other company facilities for use in the manufacture of batteries.

MICA

Asheville Mica Company and affiliate, Mica Company of Canada, process mica, at facilities in Newport News on the coast. Crude mica, mainly from Madagascar and India, is used to produce fabricated plate-mica; Mica Company of Canada uses splittings from Asheville to produce reconstituted plate mica. Mica has been produced from pegmatite bodies in several countries, including Amelia, Henry and Powhatan.

ORNAMENTAL AGGREGATE

Vein quartz from Albemarle, Buckingham, Fluvanna, Greene, and Rappahannock counties, and quartz pebbles from Caroline County are some of the rock materials which have been utilized for ornamental aggregate. Dolomite and quartzite from Botetourt and

Rockbridge counties are presently produced and marketed as exposed aggregate materials. Black limestone (Edinburg Formation) in the Valley and Ridge Province and greenstone (Catoctin Formation) in the Piedmont have been used in terrazzo.

PERLITE

The Manville Corporation operates a plant at Woodstock in Shenandoah County to expand perlite (volcanic glass with high water content and an "onionskin" appearance) from Grants, New Mexico. Expanded perlite is used in the manufacture of a roof insulation board that is marketed throughout the eastern United States. Although sales were off slightly as compared to the previous year, product demand for roofing installation and maintenance was still strong in 1980.

POTASH

Potash (potassium oxide) is used mainly in the agriculture industry as a source for potassium. Orthoclase feldspar (potassium silicate common in igneous and metamorphic rocks) releases potash upon weathering. Chemical analyses of selected granitic materials from Brunswick and Nottoway counties in the southern Piedmont Province indicate potash percentages higher than 10 percent.

Greensand (glauconitic marls) materials are located in the Coastal Plain province of Virginia, and exposed along the Potomac, Rappahannock, Pamunkey and James rivers. Glauconite is a hydrous silicate of iron and potash. The potash concentrations, which range from one percent in the impure greensands up to ten percent in the purer greensands, make the glauconitic material potentially valuable for fertilizer.

SAND AND GRAVEL

During the past decade, sand and gravel sales totaled over \$260 million. Historical cost data for sand and gravel in Virginia were compiled in a report by the Division of Mineral Resources (Sweet, 1978). The slump in construction during 1980 curtailed demand for sand and gravel throughout the State. Approximately 130 producers of construction sand and gravel reported a 3.5 million ton drop from the output in 1979. Large tonnages of construction sand and gravel, produced east of Fredericksburg, are shipped by rail to the northern Virginia-Washington, D.C., market area. A large portion of the production by Sadler Materials and Lone Star Cement, Inc. from the James River

below Richmond is barged to the Norfolk area and rail and truck shipments are made to the western part of the State.

J.C. Jones Sand Company mines industrial sand at Virginia Beach for use in casting applications and as a traction medium. Glass sand is produced by Unimin Corporation near Gore in Frederick County, from the Ridgeley Sandstone of Devonian age. CED Process near Gore in Frederick County recrystallizes sand in a rotary kiln to produce cristobalite, which is marketed as a fine grit.

STONE

Crushed: In 1980 stone operators mined and crushed about \$170 million worth of limestone, dolomite, sandstone, quartzite, granite, gneiss, diabase, basalt, amphibolite, slate, feldspar ("Virginia aplite"), marble, and marl. Crushed stone production decreased approximately 6.5 million tons in 1980 from that reported by the industry in 1979.

Limestone, dolomite, and sandstone producers are located in the Valley and Ridge, and Plateau provinces in the western portion of the State. Crushed limestone and dolomite totaled approximately 18.5 million tons in 1980. Principal end uses were for road construction, concrete aggregate, and agricultural application. Very little limestone and dolomite is used as asphalt stone due to their polishing qualities. Tailings from the New Jersey Zinc Company processing plant at Austinville, Wythe County consist of five to six million tons of material containing approximately 20 percent $MgCO_3$. The material might be removed in slurry form and marketed as dolomite limestone, and used as mine safety dust. It contains approximately five percent iron content from pyrite which would be a problem for pure material use. The Honaker dolomite is produced in Scott County for use in the glass industry. Sandstone production, approximately 1.2 million tons, was primarily for road stone, concrete stone, asphalt stone, and manufactured fine aggregate. Quartzite from the Antietam Formation is produced by Locher Silica Company in Wythe County, and marketed as metallurgical flux.

Granite and gneiss, diabase, basalt, amphibolite, slate, and marble are produced in the Piedmont/Blue Ridge provinces of Virginia. Major uses were for roadstone, asphalt stone, concrete aggregate, and manufactured fine aggregate. Diabase, basalt and amphibolite production (non-polishing aggregate) from four counties totaled about six million tons in 1980.

Slate is mined and crushed by three companies in Buckingham County and one in Amherst County.

Two of the companies, Amlite Corporation, and Solite Corporation also produce expanded slate for lightweight aggregate production. Production and sales of crushed slate, a byproduct of past dimension slate operations, increased as a result of local highway construction.

One company, Appomattox Lime Company, Inc. mines a Precambrian marble (Mount Athos Formation) near Oakville in Appomattox County for agricultural lime. Sales, principally to the eastern coastal areas of Virginia and North Carolina, were severely curtailed because of drought conditions.

One company in Clarke County in 1980 and early 1981 and in Frederick County near Winchester in late 1981, mines marl for agricultural applications. The material is mined with a front-end loader, disked and dried before it is sold. Production has increased steadily.

Dimension: Diabase, slate, granite, sandstone, quartzite, and soapstone were produced from nine quarries in the Valley and Ridge and Piedmont provinces. Slate, the leading stone type produced in terms of cubic feet and value, was quarried by the Arvonian-Buckingham Slate Corporation, Inc., and LeSueur-Richmond Slate Corporation, in the Arvonian area of Buckingham County. Arvonian slate production dates from the late 1700's when slate was quarried for roofing tile for the State Capitol in Richmond. Slate producers supply the building trade with a variety of products ranging from material for exterior applications such as roofing tile, deck, and flooring to interior uses such as hearths, window stools and sills, and stair treads. Diabase is produced for use as monument stone at Virginia Granite Company in southern Culpeper County.

Granite is presently produced at only one quarry in Hanover County, while quartzite is produced as flagging material at three quarries: one in Campbell County, south of Lynchburg and two in the Bull Run Mountains in Fauquier County.

Alberene Stone Company produces soapstone for use as speciality laboratory materials, and as panels for the wood-stove industry.

SULFUR

Elemental sulfur was recouped from hydrogen sulfide gas by the Claus process during crude oil refining in York County by Amoco Oil Company. Crude oil is heated in a furnace and fed under pressure into a cylinder where it vaporizes and expands, and condenses into liquid. Hydrogen sulfide is produced which is then reconverted into elemental sulfur.

TALC

Blue Ridge Talc Company in Franklin and Henry counties produce talc for foundry applications. Talc, in a talc-chlorite-dolomite schist is mined by open pit methods and ground for foundry use as a releasing agent in mold coatings. Much of the ground talc is shipped to foundries in the western Pennsylvania area. Talc was formerly used in insecticides. Sales of talc during 1980 were down because of the depressed state of the steel industry.

TANTALUM

Several pegmatite deposits in Powhatan County have recently been considered as a source of tantalum due to the increased price in tantalite from approximately \$65/lb. in 1979 to \$100/lb. in 1980. However, recent discoveries overseas may lead to increased supplies of this material and may possibly reduce the price.

TITANIUM

Titanium mineralization is present in pegmatites. The titanium minerals, rutile and ilmenite were mined in Hanover County by Metal and Thermit Corporation in 1957 and in the 1960's by Metal and Thermit Chemicals, Inc. (name changed). Heavy mineral production was discontinued in 1968 because of titanium mineralization was not extensive enough for the mine to be operated economically, and the Feldspar Corporation acquired the operation in July, 1969.

The most significant titanium deposit in Virginia occurs east of the Blue Ridge Mountains in Amherst and Nelson counties. Ilmenite and/or rutile occur with apatite in lenticular, tabular or irregular shaped, dike-like bodies, called nelsonite. Ilmenite nelsonite is the most prevalent type found in the area, ranging in analyses as high as 70 percent ilmenite and 25 percent apatite with minor amounts of accessory minerals. Nelsonites occur within an anorthosite host rock and cut across formations. They rarely exceed 1500 feet in length and 30 feet in width, but they are high grade. The anorthosite host rock covers approximately 35 square miles and is an elongated body 16 miles long by two miles wide (average) trending northeast-southwest. Rutile is disseminated within the feldspar host rock.

Ilmenite and rutile have also been recovered from saprolite zones associated with the nelsonite bodies. Reserves in excess of 20 million tons averaging 7 percent titanium dioxide may remain. The earliest re-

corded production activity (for iron) from the deposit was 1878 and the latest was 1971. The American Cyanamid Company closed their Piney River plant in 1971. The company had surface mined a large saprolite ore body since 1944 and produced titanium dioxide pigment as their major product. The majority of the mineral rights for areas containing nelsonite deposits were owned by the American Cyanamid Company and the National Lead Company in 1964. Although Titanium has not been produced from the deposit since 1971, apatite sand (30-35 percent phosphate) was recovered from settling basins, dried and shipped to Canada during 1975-76 for the manufacture of fertilizer. The only other known activity in the area was the removal from the surface of a large "copperas" waste pile and subsequent burial nearby in January, 1981. The waste "copperas", also generated by the American Cyanamid Company, has presented ecological problems. Fish were killed in the Piney River during periods of excessive rainfall by toxic waters from the copperas waste-pile.

VERMICULITE

Virginia is one of three states that mine vermiculite, a hydrated magnesium-iron-aluminum silicate. Virginia Vermiculite, Ltd., operates an open pit mine and processing facility near Boswells Tavern, in Louisa County northwest of Richmond. Material, mined with a backhoe and front-end loader, is trucked to the adjacent plant where desliming, flotation, drying and screening are used to produce four basic size products. Most of the crude vermiculite is shipped by rail in unexfoliated form to North Carolina, West Virginia, Ohio, and other eastern states. Uses for the exfoliated vermiculite include packing, insulation, lightweight concrete and cement aggregate and for use as potting material.

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OIL AND GAS DRILLING

Recent Wildcat drilling in Virginia for gas or oil has centered around the Triassic basin of Chesterfield County in the Piedmont Province and portions of the Valley and Ridge Province in Botetourt, Frederick, Lee, and Rockingham counties.

The following chart gives an up-to-date record of wells completed during the last three months of October, November, and December, 1981.

PROVINCE	COUNTY	OPERATOR	LEASE	WELL NUMBER	TOTAL DEPTH	STATUS
Appalachian Plateau	Buchanan	Cities Service Company	Georgia Pacific	A-1	5202'	Shut In
Appalachian Plateau	Buchanan	Columbia Gas Transmission Corporation	W. Miller Richardson	20040	5765'	Shut In
Appalachian Plateau	Buchanan	Columbia Gas Transmission Corporation	Opal C. Thomas <i>et al</i>	20224		
Appalachian Plateau	Buchanan	Columbia Gas Transmission Corporation	J.S. Richardson <i>et al</i>	20658	5614'	Shut In
Appalachian Plateau	Dickenson	Philadelphia Oil Company	Pittston Company	P-126	4709'	Shut In
Appalachian Plateau	Dickenson	Philadelphia Oil Company	Pittston Company	P-127	4739'	Shut In
Appalachian Plateau	Dickenson	Philadelphia Oil Company	Pittston Company	P-128	4590'	Shut In
Appalachian Plateau	Dickenson	Philadelphia Oil Company	Pittston Company	P-129	4575'	Shut In
Appalachian Plateau	Dickenson	Philadelphia Oil Company	Pittston Company	P-130	5750'	Shut In
Valley and Ridge and Ridge	Rockingham Frederick	Amoco Production Company	Dry River Unit Holliday	1	6620'	Dry
Valley and Ridge	Lee	Virginia Oil and Gas Exploration Inc.	Leslie Terry	VO-3	1810'	Producing
Valley and Ridge	Scott	Highlander Resources, Inc.	Urchel Sourbeer	1-A	5153'	Shut In

STAFF CHANGES

Fred S. Honkala of Alexandria, Virginia, joined the permanent staff of the Division of Mineral Resources on August 16, 1981. Honkala received his Bachelor's degree from the University of New Hampshire, the Master's degree from the University of Missouri, and the PhD degree from the University of Michigan. Some of the posts he has held include Chairman of the University of Montana Geology Department; Dean of the Graduate School at The University of Montana; Director, National Science Foundation's Advanced Science Education Program; President, Yankton College (South Dakota); Dean of Faculty, St. Mary's College of Maryland; Executive Director, American Geological Institute and consultant for a U. S. Senate Committee. He is a fellow of the Geological Society of America, and a member of the American Association of Petroleum Geologists and American Institute of Professional Geologists. He is listed in Who's Who in America.

Honkala has published over 30 articles dealing mainly with stratigraphy. He served in the U. S. Army for four years including service in the Southwest Pacific. He is married and had three children and one grandchild.

D. Allen Penick of Lexington, Virginia, joined the permanent staff of the Division January 19, 1982. Mr. Penick studied geology at Washington and Lee University and the Mackay School of Mines in Reno, Nevada. His work experience includes approximately 20 years in state and federal government and private industry. His most recent position was in the Division of Mined Land Reclamation in Big Stone Gap. Previous to that Mr. Penick spent 10 years working on mineral exploration projects throughout the western United States. He will be working in the Information Services Section. He is married and has a son.

ORTHOPHOTOQUADS

Black and white aerial photographic presentations (orthophotoquads) are now available for approximately 25 percent of Virginia. Each orthophotoquad depicts the same area as a 1:24,000-scale, 7.5-minute, topographic map or about 60 square miles.

There are several advantages of these "orthophotos" over regular aerial photographs. Mapmakers have labeled prominent natural and cultural features and have removed all photographic distortion. Since they are reproduced lithographically on a printing press, they cost about 90 percent less than regular

aerial photographs. Each orthophotoquad has a corresponding topographic map of the same area. These two products complement each other—a case in which a picture is worth a thousand map symbols.

Orthophotoquads are available postpaid from the Division of Mineral Resources, P. O. Box 3667, Charlottesville, VA 22903. They cost \$2.00 each (plus \$0.08 State sales tax for Virginia addresses). The location of the 220 available orthophotoquads are shown on the accompanying index map.

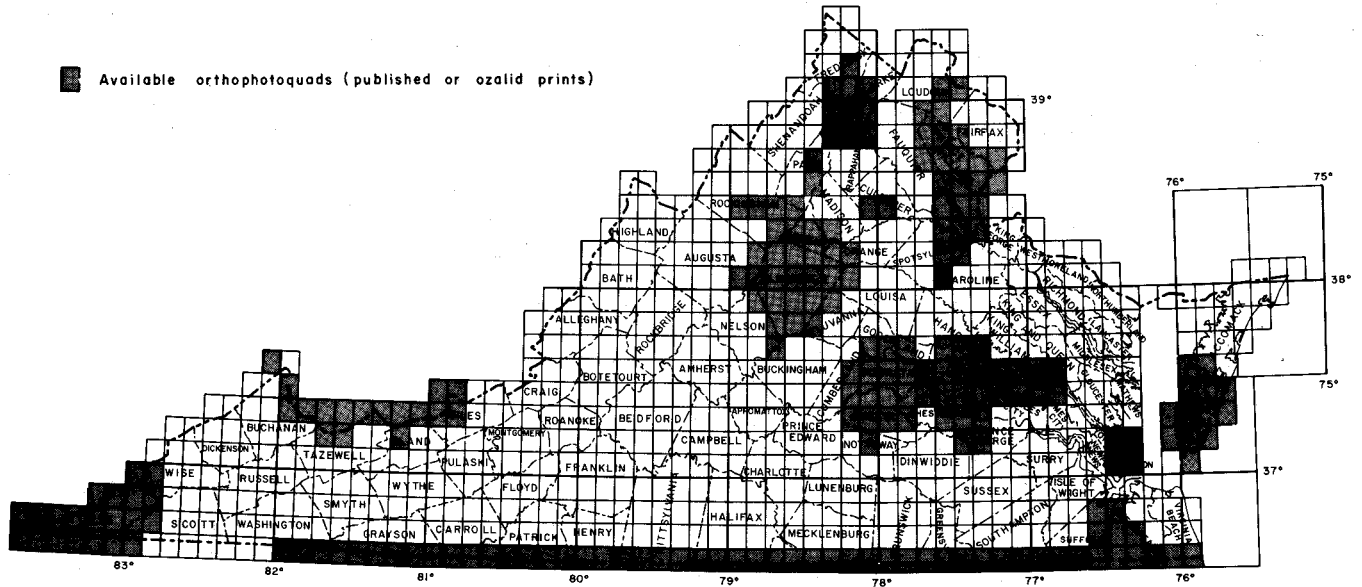
Available Orthophotoquads

Alberene	Chuckatuck
Alton	Chula
Amelia Court House	Claresville
Amonate	*Clarksville South
Anawalt	Claudville
Appalachia	Clayville
Arcola	Cluster Springs
Back Valley	Cobb Island
Ballsville	Coleman Gap
Barboursville	Corapeake
Barley	Covesville
Bastian	*Creeds
*Beach	Crewe East
Benham	Crimora
Ben Hur	Crozet
*Bentonville	Culpeper East
*Big Meadows	Culpeper West
Big Stone Gap	Cumberland
Bluefield	Cumberland Knob
*Bon Air	Danville
Boswells Tavern	Deatonville
Bowers Hill	Deep Creek
*Boyce	*Drewrys Bluff
Boyd Tavern	Duffield
Boykins	*Dutch Gap
*Bracey	Earlysville
Bradshaw	Elkton East
Bramwell	Elkton West
Bridgewater	Elliotts Creek
*Brosville	Esmont
Browns Cove	Evarts
*Cana	Ewing
Cape Charles	Exmore
Cartersville	Fine Creek Mills
Catlett	Fishermans Island
*Charlottesville East	Fletcher
*Charlottesville West	*Flint Hill
Cheriton	Franktown
*Chester	*Fredericksburg
*Chesterfield	Free Union
*Chester Gap	*Front Royal

- | | | | |
|------------------------|---------------------|-------------------|------------------|
| Ft. Belvoir | *Leesburg | Perkinsville | Stafford |
| *Gainesville | Lerona | *Petersburg | Standardsville |
| Gary | *Linden | Peterstown | *Stephens City |
| *Gasburg | Looneys Gap | *Poquoson East | *Sterling |
| Gates | *Luray | *Poquoson West | Stickleyville |
| *Glen Allen | Majestic | Powhatan | Storck |
| Goochland | Manassas | Price | *Strasburg |
| Gordonsville | Mannboro | *Prince George | Stuart SE |
| Grassy Creek | Margarettsville | Princeton | *Studley |
| Grayson | McGaheysville | *Providence Forge | Suffolk |
| Great Machipongo Inlet | Middlesboro North | Quantico | Sunbeam |
| Greenfield | Middlesboro South | Quinby Inlet | Swift Run Gap |
| Guinea | Middleburg | *Quinton | Tazewell North |
| *Hallsboro | *Middletown | Richmond | Thoroughfare Gap |
| *Hampton | *Midlothian | Ringgold | *Toano |
| Harrisonburg | Milton | Riverdale | Townsend |
| *Hopewell | *Mount Airy North | Rochelle | Trenholm |
| Howardsville | Mouth of Wilson | Rose Hill | *Tungsten |
| Hubbard Springs | Moyock | *Roxbury | *Tunstall |
| Independent Hill | Narrows | Salem Church | *Valentines |
| Indian Head | Nassawadox | Schuyler | Varilla |
| Jamesville | Nelson | Scottsville | Virgilina |
| Jetersville | Nettleridge | *Seven Pines | *Walkers |
| *John H. Kerr Dam | *New Kent | Shady Valley | War |
| Joplin | *Newport News North | Ship Shoal Inlet | *Waynesboro East |
| Keokee | Nokesville | Simeon | Waynesboro West |
| Keswick | Northeast Eden | Skippers | *West Point |
| *Knotts Island | Northwest Eden | Sneedville | Whaleyville |
| Kyles Ford | Oakvale | Somerville | Wheeler |
| Ladysmith | Occoquan | *South Hill SE | Whiteville |
| Lake Drummond | Panther | Sparta East | Widewater |
| Lake Drummond NW | Park | Sparta West | *Winchester |
| Lake Drummond SE | *Passapatanzy | Spencer | *Yellow Tavern |
| Lambsburg | Patterson | Spotsylvania | |
| Laurel Bloomery | Pennington Gap | | |

*Printed copies, others as ozalids

Available orthophotoquads (published or ozalid prints)



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MINERAL RESOURCES

Preliminary nonfuel mineral production in Virginia for 1981, as reported by the U.S. Bureau of Mines, was \$277 million. This is a decrease of more than \$28 million from the 1980 figures.

Bennett Mineral Company is nearing completion of its plant near Walkerton, King and Queen County; approximately 60 people will be employed. Diatomaceous sediments including appreciable amounts of montmorillonite clay will be mined, ground and dried in a rotary kiln, which will be fueled by wood waste. Material will then be screened, bagged and marketed as an industrial absorbent.

Marline Uranium Corporation has leased approximately 40,000 acres in Pittsylvania County and 600 acres in the Ridgeway area of Henry County, in southern Virginia. Leases are also held on 15,000 acres in Culpeper, Fauquier, Madison, and Orange counties in north central Virginia. Approximately 200 exploratory holes have been drilled in the Dry Fork area of Pittsylvania County. Offices are open in Danville and one is proposed to be opened in Culpeper in 1982. The Virginia Coal and Energy Commission uranium subcommittee has been formed to evaluate the environmental impact of uranium exploration, mining and milling in Virginia and to determine if additional state regulations are needed to adequately supervise uranium operations. The 23-member commission was suppose to supply recommendations to the General Assembly by the end of 1981.

The New Jersey Zinc Company at Austinville in Wythe County in southwestern Virginia shut down on December 31, 1981. Gulf and Western Industries, Inc., plans to market the property, hopefully to a company

that will continue to produce agricultural material for the southern Piedmont area of Virginia. About 500,000 tons of agricultural material were annually produced as a by-product from the zinc-lead mine.

There has been increased interest in mineral wool and its insulation applications over the last several years due primarily to the energy situation. Many rock materials are suitable for making mineral wool. Granite, basalt, and diabase along with nearby carbonate sources are presently being considered for possible raw materials in northern and northeastern Virginia. United Rockwool, Inc., presently has a plant set up in the Woodbridge area of Prince William County. The operation plans on using granite and some limestone; production of mineral wool is presently scheduled to begin in January, 1982.

Luck Quarries, Inc. has indicated that they would like to open up a quarry in granitic rock about 1 mile north of Ruckersville in Greene County. A public hearing on whether to amend the zoning laws to allow a special use permit will take place on February 6, 1982. The Ruckersville Civic Association is presently protesting the proposed quarry in Greene County.

Several companies continue their basic reconnaissance of base-metal sulfide mineralization, including drilling of some core-holes in the Virginia Piedmont Province along the old Gold-pyrite belt.

Companies are also becoming more interested in high-silica resources available in Virginia. Metallurgical grade flux material is presently being produced in the southwest Virginia area and occurrences of raw material in the central Piedmont are presently being investigated. One company, Saltville Silica, Inc. began setting up a quarry and plant near Saltville, Smyth County, to produce glass grade material, furnace and foundry sand during the later part of 1981.