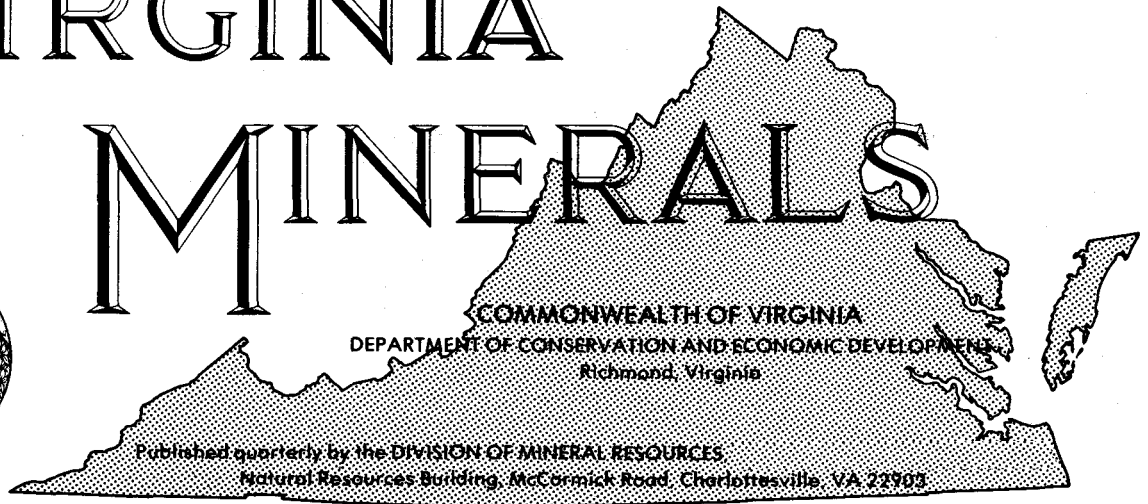


VIRGINIA

MINERALS



Vol. 27

May 1981

No. 2

BLUE QUARTZ IN VIRGINIA

Michael A. Wise¹

In 1885, Robert Robertson described a peculiar variety of quartz from Nelson County, Virginia. This new variety of quartz, as cited by Robertson, "...presents a characteristic waxy luster and a color varying from pale to deep blue. It therefore appears of interest to ascertain to what this color is due." The color is now thought to be due to either minute rutile inclusions or to fractures.

The occurrence of blue quartz has been reported worldwide. Iddings (1904) noted blue quartz in a gray granite porphyry in Llano, Texas. Jayaraman (1939) found blue quartz pebbles occurring in the charnockites and gneisses of the Mysore Province in South India, and Goldschmidt (1954) cited the occurrence of small blue quartz pebbles in the meta-sedimentary rocks of Norway. In the United States, the mineral has been reported from Rhode Island to South Carolina.

Most blue quartz in Virginia is in the Blue Ridge Complex lying east of the Blue Ridge Mountains. The complex extends from Loudoun County in the north to Grayson County in the south. A few occurrences of blue quartz have been reported from the Virginia Piedmont.

The stratigraphic succession of the Blue Ridge Complex includes several rock units consisting of quartz-oligoclase-biotite gneiss, spilitic greenstone, metatuff, quartzites, dolomites and metamorphosed graywackes, arkoses and subgraywackes (Bloomer and Werner, 1955). These units, which range in age

from Precambrian to Cambrian, overlie Precambrian gneiss and granite. The Blue Ridge Complex forms the core of the Blue Ridge anticlinorium. Most of the blue quartz in Virginia is from metamorphosed magmatic rocks of the Blue Ridge Complex (Figures 1 and 2). Figure 3 shows areas and collecting localities of blue quartz.



Figure 1. Old Rag granite at Old Rag Mountain. Gray grains are blue quartz.

¹William W. Whitlock assisted with the field work for this article.



Figure 2. Blue quartz xenolith in the Old Rag granite at Syria.

MINERALOGY

The blue quartz found in Virginia exhibits most of the physical properties of colorless quartz. It has a hardness of 7, displays conchoidal fracture, a white streak and it is infusible before the blowpipe. When heated it retains its color, unlike some smoky or amethystine varieties. The specific gravity of blue quartz is 2.65 or higher depending on the kind and amount of included material. Inclusion-free blue quartz tends to have a lower specific gravity than specimens containing inclusions.

The uniqueness of blue quartz is due to properties that are uncharacteristic in ordinary quartz, opalescence, chatoyancy, and asterism. In addition, all blue quartz specimens are highly fractured and contain inclusions of rutile or other minerals.

OPALESCENCE AND CHATOYANCY

A striking characteristic of blue quartz is its opalescent, or waxy, luster. This waxy to greasy appearance is seen in all blue quartz. Light blue specimens tend to be more opalescent than darker specimens.



Areas underlain by formations containing blue quartz



Blue quartz collecting localities

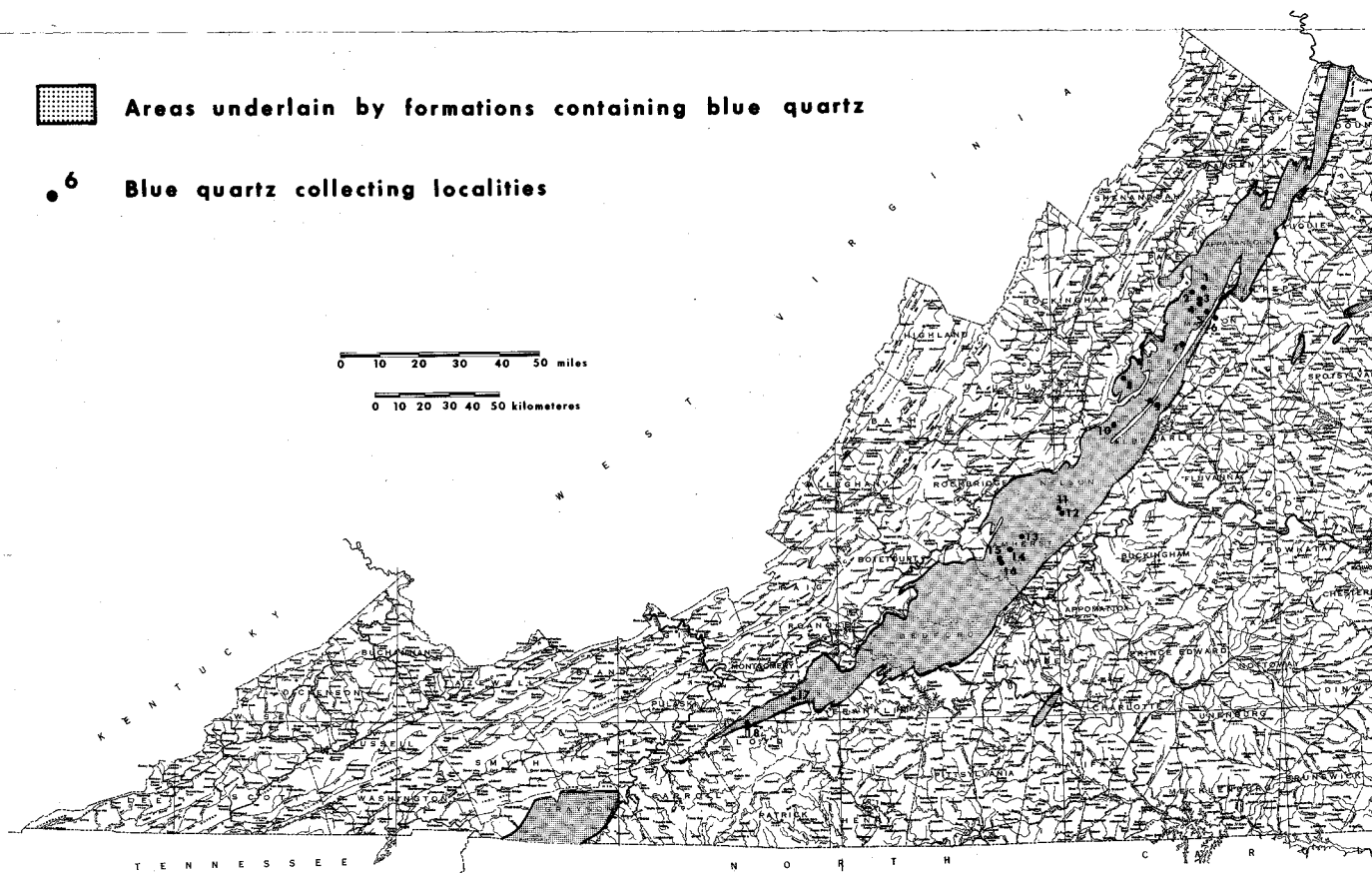
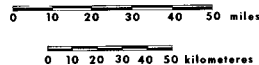


Figure 3. Reported blue quartz localities.

Chatoyancy, or changeable waxy luster, has been noted in some specimens of blue quartz. Pebbles along Byrd Creek in Goochland County show excellent chatoyancy (Dietrich, 1970).

ASTERISM

Asterism, the illusion of a star-like figure within certain minerals, has been known to occur in several blue quartz specimens. This phenomena is only observed in specimens artificially shaped into a sphere or a hemisphere and viewed in reflected light. Most specimens which show asterism display a 6-rayed star, but specimens from Bull Knob in Henry County exhibit a 4-rayed star (Dietrick, 1970).

INCLUSIONS

The majority of the blue quartz specimens of the world contain inclusions of rutile, TiO_2 , but other minerals also exist as inclusions in blue quartz. These include microscopic needles of tourmaline (Parker, 1962), magnetite (Goldschmidt, 1954), apatite and ilmenite (Iddings, 1904) and zoisite (Dietrich, 1971). Rutile needles are the primary mineral inclusion in the Virginia specimens.

THE ORIGIN OF COLOR IN BLUE QUARTZ

The most noticeable property of blue quartz is its color, which ranges from light sky blue to dark grayish blue. The blue color has been attributed to three basic causes: the partial reflection of light from inclusions, the scattering of light by closely spaced microfractures in the quartz, and the occurrence of scattered titanium as a coloring agent. Each of these factors can produce a blue color in quartz.

Color Due To Inclusions: Closely spaced, colloid-size inclusions of acicular or tabular crystals occur in many blue quartz crystals. The size of the inclusions ranges from 0.02 to 1 micron in thickness and from 1 to 500 microns in length. These tiny inclusions selectively scatter visible light of the shorter, or blue, wavelengths (about 480 millimicrons), thus giving a blue color to the quartz. The amount of scattering seems to be a function of the smallest dimension of the inclusions and of the difference between the mean index of refraction of the included material and of the quartz. The particle size producing maximum scattering of light would be 0.2 to 0.5 microns in diameter (Jayaraman, 1939).

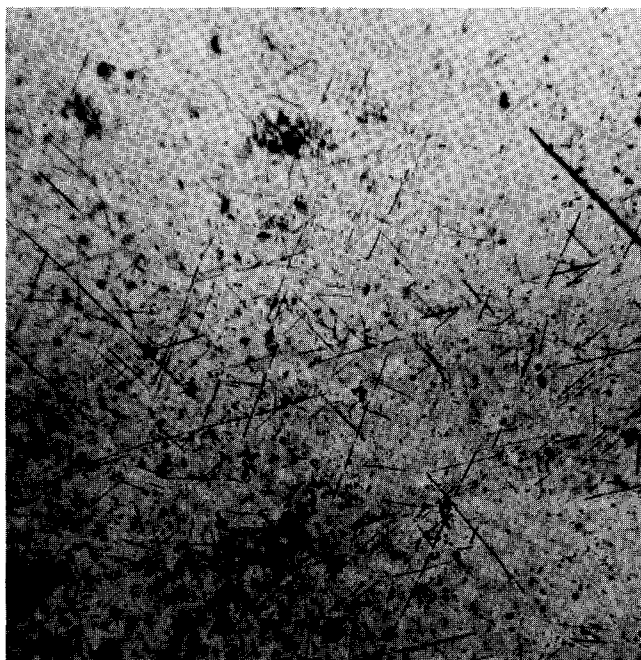


Figure 4. Photomicrograph of blue quartz with inclusions of rutile needles. Note the preferred orientation of the needles. Crossed nicols, 100X.

Photomicrographs have shown that most of the inclusions are slightly oriented (Fig. 4). Antler-shaped zoisite crystals tend to occur in a roughly radiating pattern (Dietrich, 1971). Tourmaline (Parker, 1962) and rutile (Ross, 1941) crystals occur as sets of parallel needles intersecting one another and lying in the basal plane (0001) of the quartz. These preferred orientations are thought to be controlled by the trigonal symmetry of the quartz (Ross, 1941).

Color Due To Fractures: The numerous microfractures throughout blue quartz is another probable cause of the blue color. Generally, the fractures are closely spaced and subparallel to one another. Evidence supporting fractures as a cause of the blue color is given by the fact that some inclusion-free samples of blue quartz are blue and that some specimens lose their blue color upon granulation. Dietrich (1971) examined specimens of inclusion-free blue quartz and found that they were highly fractured and strained; in some cases the degree of fracturing was correlated to the depth of the blue color.

Color Due To Titanium: Finely divided rutile is blue as is ilmenite which contains titanium, and inclusions of these minerals in quartz could produce a blue color. However, some specimens of blue quartz contain no titanium. Conversely, some specimens of quartz with substantial titanium are rose and some are clear.

COLLECTING LOCALITIES FOR BLUE QUARTZ

Madison County:

1. From Madison proceed north on State Highway 231 to State Road 643 (approximately 10 miles). Turn left on State Road 643, proceed for 0.6 miles to State Road 645. Turn right on State Road 645, proceed for 1 mile. Blue quartz is in stream gravels of Ragged Run.
2. From Madison proceed north on State Highway 231 to Banco. Turn left on State Road 670 and continue to Syria. Turn right on State Road 600 and proceed for approximately 2.7 miles. Blue quartz is in Old Rag granite on the right.
3. From Madison proceed north on State Highway 231 to Syria. Turn right on State Road 600 and proceed for approximately 0.8 miles (just past the church). Blue quartz is in a large vein on the right.
4. From Madison proceed north on State Highway 231 to Criglersville on State Road 670. Stream gravels along the Robinson River between Criglersville and Syria contain some blue quartz.
5. From Madison proceed north on State Highway 231 to Banco. Blue quartz is in the stream gravels of the Robinson River.
6. From Madison proceed north on State Highway 231 for approximately 0.6 miles to State Road 638. Turn right on State Road 638 and proceed to the bridge crossing the Robertson River (approximately 1.5 miles). Blue quartz is in the stream gravels.

Greene County:

7. From Stanardsville proceed north on State Highway 230 to the county line. Blue quartz is in the stream gravels of the Middle River.

Albemarle County:

8. From Charlottesville, proceed west on State Road 654. Continue west on State Road 601 to State Road 614. Continue west on State Road 614 to Whitehall. Turn right on State Road 810 and continue to Browns Cove. Turn left on State Road 629 to end of the road. Blue quartz is in small veins in country rock.
9. From Charlottesville proceed west on State Road 654. Continue west, then north on State Road 601. Blue quartz is in a roadcut on State Road 601 between the bridges over the Mechums and Moormans rivers.
10. From Charlottesville proceed west on U.S.

Highway 250. Turn left on State Road 824 and continue to the bridge over Stockton Fork. Blue quartz is in a gneiss exposed in stream banks.

Nelson County:

11. From Lovingston proceed southwest on State Highway 56 to State Highway 151. Proceed north on State Highway 151 to its intersection with State Highway 56. Park at the bridge. On the north side of the Tye River approximately 750 yds. from the road blue quartz occurs as stringers and veins in a gneiss.
12. From Lovingston proceed southwest on State Highway 56 to State Highway 151. Proceed north on State Highway 151 to its intersection with State Road 655 (just across the Tye River). Turn right on State Road 655 and continue for approximately 1 mile. Blue quartz is in the roadcut near the intersection of State Road 655 and 724.

Amherst County:

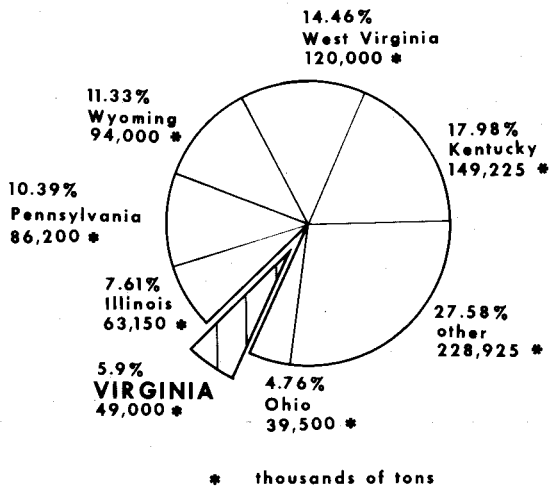
13. From Amherst, proceed west on U.S. Highway 60 and State Road 610. Turn left on State Road 610 and proceed for 0.3 miles to the bridge over the Buffalo River. Blue quartz is in the stream gravels.
14. From Amherst proceed west on U.S. Highway 60 to State Road 610. Turn left on State Road 610 and proceed for approximately 5.5 miles. Blue quartz is in a roadcut on the right.
15. From Amherst proceed west on U.S. Highway 60 to State Road 610. Turn left on State Road 610 and continue to State Road 635. Turn left on State Road 635 to Pedlar Mills and State Road 643. Turn right on State Road 643 and travel to the end of the road. Blue quartz is in the stream gravels of the Pedlar River.
16. From Amherst proceed to Pedlar Mills. Blue quartz is in the stream gravels of the Pedlar River.

Floyd County:

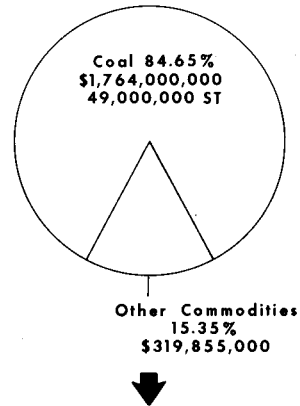
17. From Floyd, proceed northeast on U.S. Highway 221 to State Road 661. Turn left on State Road 661 to State Road 610. Continue east for 0.1 miles then turn left on State Road 653. Continue for approximately 4 miles past the Hemlock Church to the bridge where Goose Creek crosses State Road 653. Blue quartz is in the stream gravels.
18. From Floyd, proceed north on State Highway 8 for approximately 10 miles. Blue quartz is in the stream gravels of Little Camp Creek.

MINERAL ACTIVITY

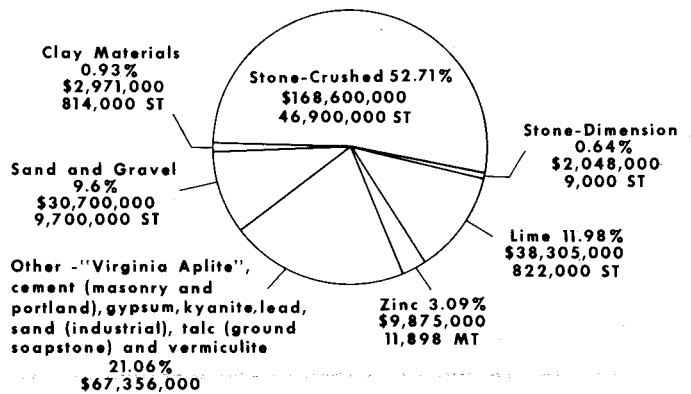
⊗ Virginia coal production for 1981 as of March 28 was 12,955,000 tons. In 1980, 49 million tons of coal (U.S. Department of Energy) were produced in Virginia; an increase of 32.3 percent over 1979 production, which was 37,038,000 tons. Virginia ranked 6th among States in 1980 coal production. In 1980, more coal was exported at Hampton Roads than at any other port. See figures below for details.



U.S. coal production by state for 1980.

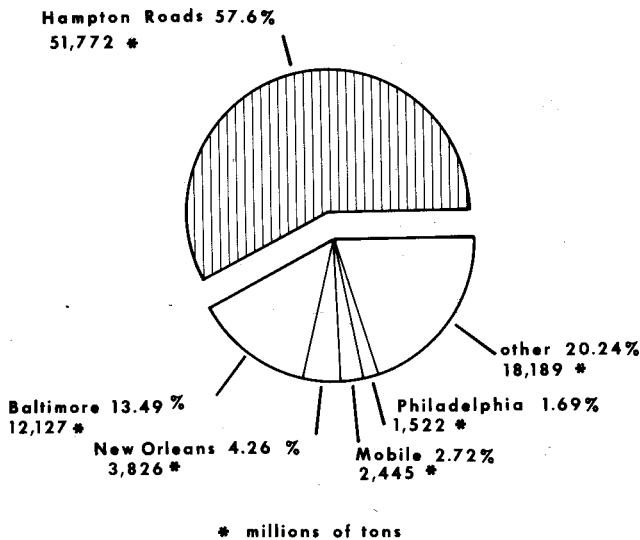


OTHER COMMODITIES



Virginia mineral production for 1980. (excludes petroleum and natural gas)

⊗ Nonfuel mineral production in Virginia for 1980 was more than 3 percent higher in value than in 1979. Quantities of clay materials, lime, sand and gravel, and crushed stone produced in 1980 were all less than in 1979.



U.S. coal exports for 1980.

⊗ Marline Uranium Corporation is exploring for uranium resources in Pittsylvania County in the southern Virginia Piedmont as well as in Culpeper, Madison, Orange, and Fauquier counties of the northern Virginia Piedmont. Several forums have been held in the northern Piedmont area to address the questions and concerns of the community.

⊗ Production of diatomaceous sediments for use as an absorbent material is being planned for sites in King and Queen County. A plant to dry the material is planned to open in early 1982; it will utilize wood as a fuel.

SELECTED BIBLIOGRAPHY

- Bland, R. J., Jr., 1965, Some notes on asterated quartz in Virginia: *Rocks and Minerals*, vol. 40, p. 838-839.
- Bloomer, R. O. and Werner, H. J., Part 1, 1955, Geology of the Blue Ridge region in Central Virginia: *Geological Society of America Bulletin* 66, p. 579-606.
- Brown, W. R., 1958, Geology and mineral resources of the Lynchburg quadrangle, Virginia: *Virginia Division of Mineral Resources Bulletin* 74, p. 99.
- Dietrich, R. V., 1965, The general absence of blue quartz in sedimentary rocks of the "Folded Appalachians" of Southwestern Virginia: *Southeastern Geology*, vol. 7, p. 1-8.
- _____, 1970, Minerals of Virginia: VPI Research Div., *Bulletin* 47, p. 325.
- _____, 1971, Quartz-two new blues: *Mineralogical Record*, vol. 2, p. 79-82.
- Emerson, B. K. and Perry, J. H., 1907, The greenschists and associated granites and porphyries of Rhode Island: *U.S. Geological Survey Bulletin* 311, p. 72.
- Furcron, A. S., 1934, Igneous rocks of Shenandoah National Park Area: *Journal of Geology*, vol. 42, no. 4, p. 400-410.
- Goldschmidt, V. M., 1954, *Geochemistry*: Oxford, London.
- Hess, F. L., 1910, Arsenic deposits at Brinton, Virginia: *U.S. Geological Survey Bulletin* 470, p. 205-211.
- Iddings, J. P., 1904, Quartz-Feldspar-Porphyry (graniphyro liparose-alaskose) from Llano, Texas: *Journal of Geology*, vol. 12, p. 225-231.
- Jayaraman, N., 1939, The cause of colour of the blue quartzes of the charnockites of South India and of the Champion Gneiss and other related rocks of Mysore: *Proc. Indian Acad. Sci., Sect. A-9*, p. 265-285.
- Jonas, A. I., 1935, Hypersthene granodiorite in Virginia: *Geological Society of America Bulletin* 46, p. 47-59.
- Legrand, H. E., 1960, Geology and groundwater resources of Pittsylvania and Halifax counties: *Virginia Division of Mineral Resources Bulletin* 75, p. 86.
- Lonsdale, J. T., 1926, A Piedmont Virginia magmatic complex. *American Journal of Science*, Series 5, vol. 11, p. 505-513.
- _____, 1927, Geology of the gold-pyrite belt of the Northeastern Piedmont Virginia: *Virginia Geological Survey Bulletin* 30, p. 110.
- Mitchell, R. S. and Bland, J. R., Jr. 1963, The minerals of Albemarle County: *Rocks and Minerals*, vol. 38, p. 565-570.
- Mitchell, R. S., Swanson, S. M. and Crowley, J. K., 1976, Mineralogy of deeply-weathered perrierite-bearing pegmatite, Bedford County, Virginia: *Southeastern Geology*, vol. 18, p. 37-47.
- Nelson, W. A., 1962, Geology and mineral resources of Albemarle Co.: *Virginia Division of Mineral Resources Bulletin* 77, p. 92.
- Parker, R. B., 1962, Blue quartz from the Wind River Range, Wyoming: *American Mineralogist*, vol. 47, p. 1201-1202.
- Ransom, J. E., 1974, *Gems and minerals of America: A guide to rock collecting*: Harper Row, New York, New York.
- Robertson, R., 1885, An examination of blue quartz from Nelson County, Virginia: *The Virginias*, vol. 6, p. 2-3.
- Ross, C. S., 1941, Occurrence and origin of the titanium deposits of Nelson and Amherst County, Virginia: *U.S. Geological Survey Prof. Paper* 198.
- Ryan, C. W., 1933, The ilmenite-apatite deposits of West Central Virginia: *Economic Geology*, vol. 28, p. 266-275.
- Stose, G. W. and Stose, A. J., 1957, The geology and mineral resources of the Gossan lead district: *Virginia Division of Mineral Resources Bulletin* 72, p. 233.
- Thiesmeyer, L. R., 1938, Plutonic rocks of northwestern Fauquier County, Virginia (abstract): *Geological Society of America Bulletin*, vol. 49, no. 12, pt. 2, p. 1963-1964.
- Watson, T. L., 1907, Occurrence of rutile in Virginia: *Economic Geology*, vol. 3, p. 493-504.
- Watson, T. L. and Taber, S., 1909, The Virginia rutile deposits: *U.S. Geological Survey Bulletin* 430-D, pp. 200-213.
- _____, 1913, Igneous complex of high titanium-phosphorous-bearing rocks of Amherst-Nelson counties, Virginia (abstract): *Geological Society of America Bulletin*, vol. 24, p. 682.
- _____, 1913, Geology of titanium and apatite deposits of Virginia: *Virginia Geological Survey Bulletin* 3-A, p. 308.

MINERAL RESOURCES IN BUCKINGHAM COUNTY

Important mineral resources for a part of Buckingham County, central Virginia, are described in a new publication. The 83-page publication is composed of five separate articles about the type of rocks and mineral resources there. A road log of where to see significant features and six geologic and geophysical maps are included. These maps show the distribution of rock types and of significant sulfide zones. Aeromagnetic, aeroradiometric, gravity, and geochemical characteristics, useful in locating mineral resources, are illustrated. Sulfide zones with zinc, copper, and silver are indicated from geochemical studies. The locality of the leading producer of kyanite in North America is in this area. Other resources described are feldspar, mica, coal, copper and manganese. The mineral resources investigation was funded in cooperation with the Piedmont Planning District Commission, Farmville, Va. and the U.S. Coastal Plains Regional Commission. Publication 29 is entitled "Geologic Investigations in the Willis Mountain and Andersonville Quadrangles, Virginia." It can be obtained by mail for \$8.50 from the Division of Mineral Resources, Box 3667, Charlottesville, Va. 22903. A free List of Publications of other publications and topographic maps is available upon request.

GREAT DISMAL SWAMP MAPS

An innovative map-picture of the Great Dismal Swamp in southeastern Virginia is now available. Some 350 square miles, extending from metropolitan Suffolk and the Town of Great Bridge southward approximately three miles into North Carolina, are shown on six adjoining multicolor orthophotomaps. The six orthophotomaps arranged together measure about 5 feet by 4 feet. Orthophotomaps are basically aerial photographs to which colors and symbols have been added to identify features shown. These maps which were developed by the U.S. Geological Survey in cooperation with the Division of Mineral Resources of the Virginia Department of Conservation and Economic Development, are an example of the latest map-making techniques.

Lake Drummond appears as a prominent blue feature surrounded by green swamp and trees on the maps. Because the aerial photograph was taken in the Springtime, when deciduous trees had no

leaves, the shades of green on the map can be used to interpret various types of vegetation. The configuration and slope of the land surface can be interpreted from numbered contour lines. Cultural features include houses, maintained roads, drainage ditches and canals, and railroads. Distances between points of interest can be determined from the map scale. All six orthophotomaps can be obtained for \$7.80, or the separate maps for \$1.30 each, from the Virginia Division of Mineral Resources, Box 3667, Charlottesville, Va. 22903. An index to map coverage is available upon request.

ROCK AND MINERAL SETS

Twenty of Virginia's common rocks and minerals are available packaged in a $1\frac{1}{2} \times 9 \times 11$ inch box. Each numbered specimen is described and placed in individual trays. The set is available from the Division for \$3.12 (add \$2.50 for postage to Virginia addresses and \$3.00 to addresses outside of Virginia).

SUMMER CREDITED ENVIRONMENTAL EDUCATION COURSES

For the twenty-fifth year the Environmental Education Course will be held at Virginia colleges. This three week summer course in June and July is designed to acquaint teachers and others with Virginia's mineral resources, wildlife, forests, soil and water and marine life.

Courses are offered for credit at Virginia Tech, William & Mary, Virginia State, and Longwood. Specialists from the various disciplines offer their time as instructors. Full and partial scholarships are given. By means of classroom discussion and field trips information is given which can assist in making decisions about resource and environmental management. Since these courses began some 2000 teachers and through them 250,000 students have been exposed to a better appreciation of natural resources. The scholarships are supported by contributions from industry, soil and water conservation districts, and various recreational clubs.



Information on scholarships can be obtained from: Virginia Resource Use Education Council, c/o Bernard L. Parsons, VPI & SU, Seitz Hall, Blacksburg, VA 24061. Those submitting applications early stand the best chance of getting scholarships at the institution of their choice.

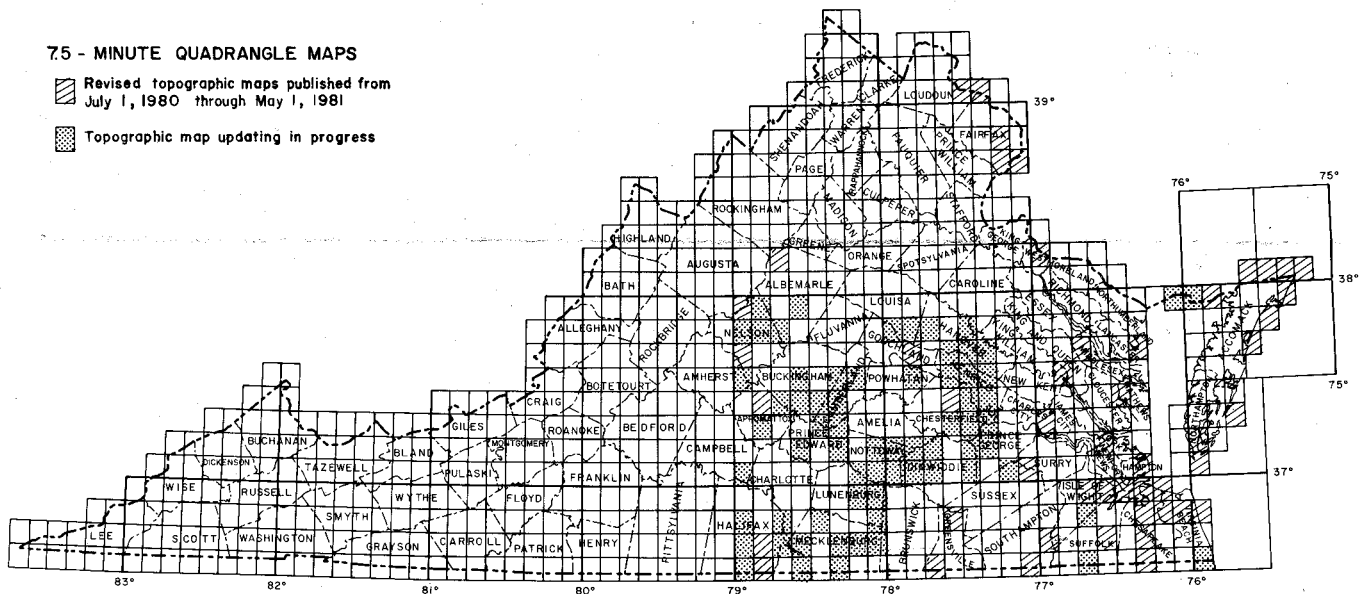
Virginia Division of Mineral Resources
 Box 3667
 Charlottesville, VA 22903

Virginia Minerals
 Second-class postage paid at
 Charlottesville, Virginia
 ISSN 0042-6652

Return Postage Guaranteed

7.5 - MINUTE QUADRANGLE MAPS

-  Revised topographic maps published from July 1, 1980 through May 1, 1981
-  Topographic map updating in progress



Revised 7.5 minute quadrangle maps published from July 1, 1980 through May 1, 1981:

- | | | | |
|----------------------|------------------------|--------------------|-------------------|
| Annandale | Deep Creek | Lake Drummond SW | Smithfield |
| Barley | Fishermans Island | Little Creek | Sterling |
| Benns Church | Fleets Bay | Metomkin Inlet | Suffolk |
| Boxiron | Fort Belvoir | Newport News South | Sunbeam |
| Brandon | Franklin | Omega | Townsend |
| Browns Cove | Girdle Tree | Pocomoke City | Virginia Beach |
| Chrisfield | Great Machipongo Inlet | Princess Anne | Wallops Island |
| Church View | Hampton | Purdy | Ware Neck |
| Colonial Beach South | Kempsville | Seneca | Whittington Point |
| | | | Yorktown |