

THE COMMON ROCKS AND MINERALS OF GEORGIA

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Young mineralogists learn about new mineral localities on a trip with the Georgia Mineral Society.

INTRODUCTION

Georgia is noted for the wide variety of rocks and minerals that are found within its borders. The reason for this diversity of rocks and minerals is apparent when we consider that the state embraces portions of five of the main physiographic provinces of the United States (See Map), and that the rocks included in these provinces were formed during different geologic ages and under different conditions. The rocks of almost every geologic period are represented at the surface in Georgia. Also there is wide distribution of the three great groups of rocks: igneous, sedimentary and metamorphic. The igneous and metamorphic rocks contain the greatest diversity of minerals because many of them are very old and their complexity of composition, in addition to the many periods of intrusion, folding, and metamorphism, tend to produce new minerals and a great variety of them.

The Atlantic Coastal Plain (60% of the area of the state) includes all of the southern half south of the general vicinity of Columbus, Macon and Augusta. It is underlain by sedimentary rocks which include kaolin, fullers earth, lime-

stone, marls, clays of various kinds, bauxite, sand and gravel. These minerals and rocks were transported from the northern part of the state and deposited in the sea that covered this area during Cretaceous, Tertiary, and Recent times.

The Piedmont Plateau and Highland (30% of the state) are underlain by very ancient crystalline rocks of metamorphic and igneous origin. In this district we have a very large variety of minerals.

The Valley and Ridge Province and Look-out Plateau in northwest Georgia (10% of the state) are underlain by old sedimentary rocks (sandstone, shales and limestones) of Paleozoic age. These rocks have all been folded into anticlines and synclines and severely eroded so that the hard layers such as the sandstones, stand out as ridges and the soluble or soft beds (limestones and shales) compose the valleys. Folding becomes less severe towards the west, thus the nearly horizontal rocks of Look-out and Sand Mountains occur in the extreme northwest part of the state where they may

be considered as outliers of the Cumberland Plateau.

A detailed explanation of the meaning of the terms used above or in other places in this discussion may be found in any good encyclopedia, and a brief definition in a good unabridged dictionary.

DEFINITIONS OF MINERALS, ROCKS AND CLAYS

Division of this museum collection into minerals, rocks, and clays was made in order to make their separate natures more understandable to students. A mineral is a natural inorganic substance of definite chemical composition. A rock is a natural portion of the earth's crust. Being usually a variable mixture of minerals, its chemical composition is not definite. Rocks may be further classified as igneous, sedimentary, or metamorphic. An igneous rock is one formed from the solidifying of a molten mass, either deep beneath the surface of the earth as in granites or at the surface if volcanic rocks. A sedimentary rock is one formed by the transportation and the deposition of rock-forming material by streams into lakes, estuaries and oceans. Metamorphic rocks are those that have had their original characteristics changed by heat or pressure or both. They may have been either igneous or sedimentary before metamorphism but the change wrought upon them may be so great that the original nature can no longer be determined. We have distinguished clays from rocks merely in regard to the popular consideration of rocks as something hard and compact. A clay is an earthy aggregate having more or less plasticity when worked with water.

DESCRIPTIONS OF MINERALS

1. **Almandite Garnet**, a silicate of iron and aluminum ($\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$), occurs generally throughout the crystalline area of Georgia, i.e., Piedmont Plateau and Highland. It is a common constituent of the old gneisses and muscovite schists but is found in many other kinds of rocks, particularly chlorite schists of the west-central Piedmont. Where brought to the surface by erosion, it oxidizes rapidly and the iron is released to produce brown iron oxide. Gem quality garnet is known from Paulding County, and garnets solid enough to cut and polish have been found in Fulton County and very likely occur at depth in other localities. Fresh, massive garnet is used in abrasives.

2. Anthophyllite Asbestos is a fibrous form of amphibole, a magnesium-iron silicate. The low tensile strength of the Georgia variety renders it unsuitable for spinning, but it is in demand for insulation, chemical filters, plastics, etc. This mineral associated with olivine, hornblende, chlorite, vermiculite, etc., is found in small bodies of ultrabasic intrusive igneous rock in the Piedmont and Highland regions.

3. Barite, barium sulphate (BaSO_4), is mined extensively in the Cartersville district from ocherous clays which overlie Paleozoic limestones. It is used in the preparation of oil-well drilling muds and in the manufacture of glass, barium chemicals, and lithopone.

4. Bauxite, aluminum oxide ($\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) occurs associated with clays and some iron ores over Paleozoic limestones in northwest Georgia. It was first discovered in the Western Hemisphere in the Hermitage district of Floyd County near Rome in 1887. Bauxite was first described by the Georgia Geological Survey in the Coastal Plain of Georgia in 1909. There it occurs associated with upper Cretaceous deposits, particularly refractory kaolins in a belt which extends practically across the state just south of the Fall Line. Some small deposits occur in the Piedmont of the Pine Mountain district. Bauxite is the ore used in the manufacture of aluminum. High grade bauxites are used in making alum and are calcined for the manufacture of abrasives and high temperature refractories.

5. Calcite, calcium carbonate (CaCO_3) is the principal constituent of cave onyx, limestone and marble. Except for impurities, limestones are composed of finely-crystalline calcite. Veins of pure white calcite are common in the limestones of northwest Georgia. The lime solutions in underground caverns give rise to stalactites and stalagmites of cave onyx, generally in beautiful and fantastic shapes. Caverns are found in limestone areas of northwest Georgia and in the Coastal Plain.

6. Chalcedony (jasper, agate). This is a microscopically crystalline variety of quartz. Red, yellow and brown varieties are generally referred to as jasper and if banded, or conspicuously mottled, are agate. Chalcedony is common in northwest Georgia where pieces may be found loose in the soils, particularly over those of the Knox dolomite. Deeply colored and variegated varieties are common locally upon the Coastal Plain. These varieties of quartz were much prized and used by the Indians for the manufacture of projectile points and other implements.

7. Copper Ore, specimens of this ore usually represent several ore minerals mixed with some rock or gangue material. The principal ore mineral of copper is generally chalcocopyrite (CuFeS_2); pyrrhotite ($\text{Fe}_{11}\text{S}_{12}$), some galena (PbS) the principal ore of lead, and sphalerite (ZnS) the principal ore of zinc,

may occur. Copper and its accompanying sulphides are extensively mined at Copperhill, Tennessee, just north of the Georgia line. Veins and lenses of copper ore occur and have been mined in the Highland and Piedmont areas of the state.

8. Potassium Feldspar ($\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$) is a common constituent of granitic rocks and some gneisses. The alteration of feldspars to kaolin is one of the principal processes in the production of soils. Potassium feldspar is mined from vein-like intrusions of a very coarse type of granite, known as pegmatite, where it may be associated with large books of mica and with quartz. Also it is obtained by grinding and flotation of granite-like rocks. In Georgia it is mined from pegmatites near Monticello in Jasper County. Pure crystalline varieties of this mineral are suitable for making cabochons and are known as moonstone. Feldspar is ground and most of it is used in the manufacture of glass, pottery, enamels and abrasives.

9. Sodium-Calcium Feldspar. Masses of this type of feldspar may occur in pegmatites with potassium feldspar; also, this is a common variety found in many igneous and metamorphic rocks. Its uses are similar to those of potassium feldspar but it is not as desirable; some varieties are moonstone.

10. Gold ore. The metal gold occurs primarily in quartz veins and stringers in the crystalline area of the state. If gold is visible to the naked eye, the ore is very high-grade. Sulphides, particularly pyrite are found with the gold in many veins and when these sulphides oxidize to iron ore the gold-bearing quartz has a rusty appearance. Where veins break down and fragments of quartz and pieces of gold are washed into streams, the sands and gravels become placer deposits. Although gold is reported from many counties throughout the Piedmont and mountain area of the state, the larger mines and major production are from Lumpkin, White, Cherokee, Dawson, Hall and McDuffie counties.

11. Fossil Hematite (Fe_2O_3 when pure). This important ore of iron is found in Dade, Walker, Catoosa, and Chattooga counties around the flanks of the Lookout Plateau of northwest Georgia where it is interbedded with sandstones and shales of Silurian age. In many places the ore consists largely of shells and shell fragments of fossils, especially brachiopods which have been replaced by hematite. Some of the beds contain a high percentage of iron oolites. The iron ore industry of the Birmingham district in Alabama depends on this variety of ore.

12. Specular Hematite (Fe_2O_3) also called micaceous hematite is found in the Piedmont and in the Cartersville Mining District.

13. Hornblende is a complex silicate which contains calcium, magnesium and iron. It is

one of the most important rock-forming minerals and occurs in schists, gneisses and granites of the Piedmont and Highland. It is a very important constituent of hornblende gneisses and locally large crystals are formed in schists near intrusions or where hot sulphide solutions have recrystallized the rocks.

14. Kyanite ($\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$) is an important mineral in the Piedmont and Highland where it occurs as separate crystals in schists or as masses of blue-bladed kyanite in schist or associated with quartz veins. Kyanite crystals in schist have been mined in Habersham County and they are known to be abundant in Rabun County and are recorded from many other counties in the crystalline area. A completely massive, heavy, finely-crystallized variety of kyanite occurs in the schists of Dawson, Pickens and Cherokee counties. Firm, deep-blue crystals from Upson county have been cut and polished for gems. Kyanite is used in the manufacture of refractories.

15. Lazulite. This hydrous aluminum phosphate occurs as blue crystals in muscovite-kyanite-quartz rock in Graves Mountain, Lincoln County, about 40 miles northwest of Augusta.

16. Limonite ($\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$), and **Goethite** ($\text{FeO}(\text{OH})$). These brown iron ores have a brown streak but goethite is massive and crystalline. They are hydrated ferric oxides of iron and occur all over the state. They have been mined since before the War Between the States in Bartow and Polk counties; in recent years on the Coastal Plain in Stewart, Quitman and Webster, etc., counties. Limonite is common as "gossan" over the surface of iron-bearing sulphide deposits. The brown to red color of the soils of Georgia are produced by limonite and hematite which have formed from the weathering and oxidation of iron-bearing minerals.

17. Magnetite ($\text{FeO} \cdot \text{Fe}_2\text{O}_3$). This is a very magnetic ore of iron. It is found in the schists, gneisses and granites of the Piedmont and Highland areas, and being very resistant to weathering, pieces of it may be picked up in cultivated fields. Excellent specimens of magnetite may be found loose in the soils associated with hornblende gneiss in Cobb and Cherokee counties; it is an important constituent of some sandy rocks in Lumpkin County and is common in certain chlorite schists of Paulding and other counties. This heavy black mineral is concentrated in streams and ditches by water action and is one of the common pan sands.

18. Muscovite Mica. This hydrated potassium aluminum silicate is one of the common rock-forming minerals and in small flakes is found in many of the rocks throughout the Piedmont and Highland section of the state. It is one of the common constituents of granite and its flaky character produces the foliation

2C Brick clay is found in many different places over the state. The requirements are good firing range, color, and good working properties. As alluvial clays they are taken from the flood plains of streams and large rivers and under swamp areas; also they overlie shales in the Valley region.

3C Fullers earth is mined in large quantities in Decatur, Grady and Thomas counties near the Florida line and in Jefferson and Twiggs counties in the upper part of the Coastal Plain. It is used in clarifying vegetable and mineral oils, in drilling muds, insecticide carriers, floor sweeps, etc.

4C Marl is an earthy limestone locally containing seashells. It may be used with success as a natural soil conditioner. It is found extensively in the Coastal Plains.

5C Primary kaolin is formed in place by the decomposition of feldspar in granites and pegmatites. The deposits in Georgia are found in the Piedmont and Highland areas of crystalline rocks in numerous places, particularly where pegmatites are deeply weathered. Where the deposits are pure and white enough, this clay may be used in the manufacture of white pottery, refractories and fillers.

6C-7C Hard sedimentary kaolin and soft sedimentary kaolin. These kaolins represent one of the important mineral industries of the state and are mined in a belt just south of the Fall Line, all the way across the Coastal Plain, mostly in Richmond, Glascock, Washington, Wilkinson, Baldwin and Twiggs counties. The white soft kaolins are used as coating and filling for high-grade white paper; also as a base for white porcelain ware, as a filler in rubber, etc. The hard refractory kaolins are used in the manufacture of fire brick, mortar, cements, etc.

8C Ocher is an impure, earthy ore, containing limonite and some clay; bright to orange-yellow colors are preferred; also a variety known as umber, which is of a darker color and contains manganese oxide. Ocher is used as a pigment of paints and mortars and as a filler in linoleum. It is mined east of Cartersville, near the Etowah River.

9C Peat is composed of partially altered vegetation which accumulates at the bottom of semi-enclosed ponds and lakes. It represents the first stage in the formation of coal. Deposits are found scattered over the southern half of the Coastal Plain and are beneath a good portion of the Okefenokee swamp. It is used extensively by nurseries and in landscape gardening.

10C Shale is consolidated sedimentary clay with well-marked laminae parallel to the bedding. Alterations of this type of rock under heat and pressure produce progressively slate, phyllite and mica schist. Shales are excavated extensively in northwest Georgia for uses in

the manufacture of brick, tile, sewer pipe, and etc.

11C Tripoli. Deposits are scattered over the Valley and Ridge province of northwest Georgia. This material is earthy in appearance, white to brown in color, and composed of very fine particles of chalcedonic quartz with some clay. Uses: as a filler and as an abrasive in soaps and scouring powders.

ROCKS

1R Chert or flint is a very finely-crystalline variety of silica, occurring usually with limestone or in the soils which have formed from limestones. This form of quartz is common in the Valley and Ridge province and in the Coastal Plain. Weathered cherts are usually grey, but have a considerable color range. Black, gray, brown, yellow and red colors are common. If the material is dense and solid, the yellow, brown and red varieties are referred to as jasper.

2R Fossiliferous Chert. This term refers to cherts which contain the impressions of shells or other hard parts of marine animals. This type of chert, such as the Fort Payne chert of northwest Georgia or the Tertiary cherts of south Georgia may be secondary, having replaced an original limestone.

3R Coal in Georgia is confined to the Lookout Plateau of Dade and Walker counties where it is of Carboniferous age. Considerable coal has been mined from that district in earlier years.

4R Conglomerate is a rock composed of rounded water-worn pebbles which are cemented together by some mineral substance, usually silica, iron oxide, clay or limestone. Conglomerates are common in the Carboniferous rocks of the Lookout Plateau; also, locally in the rocks of the Valley and Ridge province and in metamorphic rocks of the Piedmont province. They are widespread over the Coastal Plain.

5R Diorite is a coarse-grained, dark colored, igneous rock, consisting of feldspar and hornblende. Intrusions of it occur in the Piedmont and Highland regions.

6R Dolomite, a carbonate of calcium and magnesium ($\text{CaMg}(\text{CO}_3)_2$). Beds of dolomite interlayered with limestones are common in northwest Georgia. At Whitestone in Pickens County, a white dolomite is extensively quarried and used for terrazzo chips, filler, agricultural lime, etc.

7R Dunite is a rock consisting mostly of the green magnesium silicate known as olivine. It occurs as ultrabasic intrusions in the Piedmont and Highland sections of the state. It has been quarried in Rabun County for road construction; other possible uses are a basic refractory and for the preparation of magnesium compounds.

8R Biotite gneiss is perhaps the most abundant and widespread rock of the Piedmont and Highland areas of the state. Produced by the metamorphism of an original sedimentary rock, it composes an important part of the Blue Ridge and Cohutta mountains. It ranges usually from fine to medium-grained and is composed of feldspar and quartz with numerous small flakes of black biotite mica. Other minerals, such as garnet, chlorite and some hornblende may occur. These biotite gneisses are of great geologic age and in many places are intruded by varieties of granites and pegmatites. Where the rock is fresh and unweathered, quarries have been opened, and it has been crushed for road construction.

9R Hornblende gneiss is a dark, granular rock, in which the dark green, cleavable, lustrous mineral hornblende is the most important component. Feldspar, quartz, and biotite may occur with the hornblende. The rock is common as bands interlayered with gneiss and schists over much of the Piedmont and Highland regions. Hornblende gneiss eventually weathers down to form a stiff, red, clay soil.

10R-15R Granites are coarse-grained, intrusive, igneous rocks, composed of potassium feldspar and quartz. However, practically all granites contain muscovite or biotite mica and small amounts of accessory minerals. There are very few true granites according to the definition because practically all of our granites contain an appreciable amount of sodium-calcium feldspar. The granites occur as separate intrusions or as clusters of intrusions in the Piedmont and Highland regions of the state. Even-textured granites, free of inclusions and flaws, are quarried extensively in the vicinity of Elberton for monumental stone. Around Lithonia, in DeKalb County there is a banded granite or granite gneiss referred to as the **Lithonia (13R) granite** which is extensively quarried for crushed stone, building stone, chicken grit, curbstone and other uses. The foliation in this granite is emphasized by the arrangement of flakes of biotite mica. Many of the granites of the state contain biotite mica and the biotite-bearing granites are crushed in many places over the state as a source of aggregate for construction and road building. In some places the granites contain large crystals of potassium feldspar which have grown in the rock after its original emplacement. These are known as **porphyroblastic granites (14R)**. Locally granites may contain garnet (12R). **Stone Mountain granite (15R)** crops out east of Atlanta in DeKalb, Gwinnett and Rockdale counties and is best known by the mountain from which it is named.

16R-17R Hard Limestone formations and limestone beds are common in the folded Paleozoic rocks in the Valley and Ridge province of northwest Georgia. Where pure, limestone is calcium carbonate (CaCO_3) and this is exactly the composition of pure marble and pure calcite; however, limestone occurring in

beds and formations is recognized as a rock. Most limestone contains at least a small amount of magnesium carbonate, and when that amount increases, the rock is known as a magnesium limestone or dolomite. Inasmuch as many limestones are composed principally of shell fragments, most of them are visibly fossiliferous, but fossils are relatively scarce in the thick deposits of Cambrian limestone. Marine Paleozoic brachiopods, bryozoa and trilobites are particularly abundant in our Ordovician limestones and in addition to those mentioned, blastoid and crinoid stems are common in the very fossiliferous Mississippian limestone formations. Hard limestones are crushed for aggregate and ground for agricultural lime. If the magnesium content is low, they are used in the manufacture of Portland cement.

18R-19R Soft Limestone of Tertiary age (mostly Eocene-Oligocene) occurs in a NE-SW belt extending across the northern portion of the Coastal Plain of Georgia, and generally south of the kaolin belt. These rocks are notably fossiliferous and pelecypod (clam), gastropod (snail), echinoid, etc., remains are abundant. These rocks are used for the manufacture of Portland cement, agricultural lime, etc.

20R-22R the famous Georgia marble is quarried in the vicinity of Tate and Marble Hill, Pickens County. It represents a pure, coarsely crystallized marble, of which there are numerous varieties. Creole is a mottled, dark-gray and white variety, and Etowah is pink colored. Pure marble is calcium carbonate (CaCO_3); in this district the marble beds occur interfolded with mica schist in which garnet and staurolite are common.

23R Pegmatite is an intrusive rock similar to granite in composition but is coarsely crystallized. Potassium and sodium feldspars and quartz are usual minerals. These intrusions form irregular-shaped dike-like bodies in the schists, gneisses and granites of the Piedmont and Highland area. Sheet mica and beryl mined thus far in the state have come from these intrusions. Also, they supply feldspar for glass manufacture and rare earth minerals may be expected in pegmatites.

24R Quartzite is a sandstone, consisting mostly of quartz grains which are cemented by silica. Beds of this rock are scattered over

many parts of the crystalline and Highland regions of the state, as for example: Pine and Oak mountains in the Warm Springs area, Sweat Mountain in Cobb County and Suwanee Mountain in Forsyth County.

25R-26R Sandstone is a sedimentary rock common in the Coastal Plain, and in the Valley and Ridge and Lookout Plateau provinces of northwest Georgia. The sand grains consist of quartz with more or less feldspar, generally some flakes of mica and other minerals in very small quantities. Its color depends on stage of weathering and the impurities contained. In northwest Georgia the best known sandstone beds are associated with the Lower Pennsylvanian coal deposits near and at the top of Lookout and Sand mountains.

Sandstone is used as a building stone and as flagstone. A variety of sandstone or quartzite in which there is a certain amount of play between the interlocking quartz grains is known as **flexible sandstone**. The best known localities for this type in Georgia are the Warm Springs area and the quartzites of Hall County.

27R Garnet-chlorite schist is associated with hornblende schists and gneisses and other igneous and metamorphic rocks, particularly of the Piedmont area.

28R Garnet-mica schist. Garnet mica rocks are extremely common and constitute a well-known metamorphic (metasedimentary) type in the Piedmont and Highland regions of the state. In these rocks biotite and muscovite micas produce a definite cleavage or schistosity and garnet generally with quartz is present. The garnets are usually small in the rocks and gneisses but may be up to the size of peas in the schist and are larger close to some intrusive contacts and mineralized zones. These garnets are generally almandite (the iron garnet).

29R Graphite schist occurs in the Piedmont and Highland areas of the state where sedimentary rocks which contained organic material have been metamorphosed. In the Highland area and in the less metamorphosed rocks of the Piedmont, these rocks are dark-colored to black, slaty, and fine-textured. In other parts of the Piedmont and Highland areas, Hart, Elbert, Franklin, Troup, Madison, Habersham

counties where the original sediments have been metamorphosed enough to produce kyanite and sillimanite, the graphite occurs as distinct flakes. This latter type, if concentrated sufficiently, represents the commercial variety.

30R Sericite schist. Sericite is a very fine flaky variety of muscovite mica. It is formed in the early stages of the metamorphism of such rocks as shales; thus is a common constituent of phyllites and slates. In places, as in Cherokee County, layers of pure sericite schist are mined, ground, and sold as filler for rubber, paint, etc.

31R Black shale derives its color from its carbonaceous content. This particular sample is known as the Chattanooga shale of Devonian-Mississippian age which occurs over northwest Georgia and in Tennessee, Kentucky, and the **Central Interior**. It is radioactive on outcrop.

32R Slate is a fine-grained, slightly metamorphic shale possessing a well-developed cleavage. Commercial slate in Georgia is found on the southern and eastern side of Paleozoic rocks of the Valley and Ridge province, on the west and north side of the Cartersville fault. A dark slate was mined for roofing purposes at Rockmart in Polk County and is now used for lightweight aggregate. Green slate in Bartow, Gordon, and Murray counties was mined in the past for roofing slate and is now mined near Fairmont for roofing granules.

33R Soapstone is an impure talc and the common impurities are the minerals chlorite, asbestos, amphibolite, or pyroxene. Soapstone is derived from the alteration of ultrabasic rocks and is commonly associated with olivine, hornblende gneisses and particularly the minerals mentioned above.

34R Trap Rock. This is an old name for several varieties of fine-grained, black or dark-colored, intrusive, igneous rocks. In the eastern part of the crystalline area of the United States, from Connecticut southward, there are dikes and sills of this rock type which have been classified as of Triassic age in the northern states. In Georgia similar trap rock dikes are found in the Piedmont region and generally strike north to northwest. They weather into round-tough, dark-colored boulders.

or cleavage typical of the mica schists and mica bearing gneisses. As sheet mica it is mined from pegmatites in the Piedmont and Highland regions of the state, particularly from Upson, Lamar, Monroe, Hart, Lumpkin, Cherokee, and Pickens counties. Books of sheet muscovite mica which are not good enough to split and trim for electrical uses are sold as grinding mica. Coarse muscovite granite and muscovite schists are crushed and the mica separated for grinding purposes. Most sheet mica is used for very many different electronic purposes; much of the best grade going into tubes. Dry ground mica is used chiefly in roofing materials, joint cement, well drilling compounds and paint. Wet ground mica is used principally in the manufacture of paint and rubber.

19. Pyrite, iron pyrites (FeS_2) the disulphide of iron. This hard brittle mineral has been called "fool's gold" because its color is generally brassy-yellow, thus causing it to be mistaken for gold. It is found all over the state and most unaltered rocks contain some pyrite. Veins and lenses of it have been mined in the Piedmont and Highland as a source of sulphuric acid. Concretions of pyrite are common in shales, particularly of the Coastal Plain and the mineral is also found in some coal beds.

20. Pyrolusite (MnO_2) and Psilomelane approximately ($\text{MnO}_2 \cdot \text{H}_2\text{O}$). These two important ores of manganese have been mined for many years in the Cartersville district. Both minerals are nearly black in color but pyrolusite is soft and sooty. They may occur together, both minerals in the same specimen. Nodules of psilomelane also contain a considerable amount of limonite. These minerals occur all over the state as coatings on rocks and other minerals. They are always secondary and are derived from other primary manganese minerals. In the Piedmont area these minerals may be found over veins which contain rhodonite (MnSiO_3) or rhodochrosite (MnCO_3) at depth. Manganese is necessary in the production of manganese-steel and ferroalloys; high-grade pyrolusite is used in manufacture of dry cell batteries.

21. Pyrophyllite ($\text{H}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 4\text{SiO}_2$) occurs in pearly-gray iron stained radiating clusters in kyanite-quartz rock of Graves Mountain, Lincoln County. Pure pyrophyllite has many uses, including ceramics, refractories and as fillers.

22. Quartz Crystal (SiO_2). Crystals of quartz occur commonly in veins or open cavities, particularly in the gneisses and schists of the crystalline area. In order of abundance we have rock crystal, amethyst, and smoky rock crystal. All of them are suitable for cutting and polishing, particularly the amethyst and smoky quartz. Clear smoky quartz and rose quartz suitable for cutting and of a massive nature are also common in veins and pegma-

tites in this district. Quartz crystals, clear, cloudy, or milky, may be found in various rocks over the entire state. In northwest Georgia, small, clear crystals, in many cases doubly terminated, are found in Paleozoic rocks. Quartz in its various varieties is the most abundant of the gem minerals.

23. Massive Quartz (SiO_2) occurs as veins and lenses in the schists and gneisses of the crystalline area; also many veins of milky quartz are common to the Valley and Ridge region of northwest Georgia. In the crystalline area, quartz veins may carry many different minerals among which rutile, ilmenite, beryl, hematite, mica, kyanite, gold, pyrite, galena etc., are well known. Vein quartz may consist of interlocking crystals or may be clear massive rock crystal, or smoky, rose, or milky quartz.

24. Serpentine ($3\text{MgO} \cdot 2\text{SiO}_2 \cdot \text{H}_2\text{O}$) This mineral is found in Piedmont and Highland regions associated with ultramafic rocks and with such minerals as olivine, asbestos, talc, anthophyllite and hornblende. It is commonly associated with talc, chlorite, etc., in the talc mines of Murray County; also, there is a large mass of it west of Holly Springs which contains talc and is now mined for terrazzo chips. The serpentine of Columbia County has been mined for the manufacture of epsom salts and gelatinous silica. This mineral may be used in the production of sodium silicate, fertilizers and other products.

25. Sillimanite ($\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$) is found in the Highland and Piedmont provinces. It is a mineral produced by high temperatures and found in aluminous rocks which have been highly metamorphosed. The commonest variety consists of light-gray to white needle-like crystals known as **fibrolite**. In Hart and Elbert counties there are bands of schist which contain crystals as large as match sticks. The mineral occurs in schist composed of biotite, muscovite, quartz, graphite etc. This mineral has uses in the production of high temperature refractories.

26. Staurolite is an iron aluminum silicate which contains some water. It is common in both the Highland and the Piedmont and is produced by medium-grade metamorphism of aluminous sediments which contain some iron. The best known collecting grounds are in Fannin and Gilmer counties where well-formed crystals and varieties of crosses produced by twinning occur in numerous localities, particularly in the vicinity of Blue Ridge and Mineral Bluff.

27-28. Talc ($\text{H}_2\text{O} \cdot 3\text{MgO} \cdot 4\text{SiO}_2$) is a common mineral in the Highland and Piedmont regions. Talc produced from basic igneous rocks is generally green and foliated and occurs associated with chlorite, asbestos, vermiculite, etc. White talc derived from the alteration of



An enthusiastic young collector displays minerals which he has found on a field trip.

dolomite occurs locally from Mineral Bluff in Fannin County to Cherokee County, Georgia. Talc production comes from Murray County where the talc is mined in Fort and Cohutta mountains, associated with serpentine, chlorite, dolomite, etc. This mineral has many uses and among the principal ones are paint, as a filler in rubber, and carrier for insecticides, refractory articles, roofing, cosmetics, pencils for steel workers, etc.

29. Tourmaline (a silicate of calcium, aluminum, boron and iron) is a common black, prismatic mineral, in the Piedmont and Highland regions. Crystals are in hard quartz veins and mica pegmatites; rosettes are typical of the Stone Mountain granite.

30. Vermiculite is a micaceous mineral with inelastic laminae; generally brown in color. It is common in the crystalline area (Piedmont and Highland) where it is particularly associated with ultrabasic intrusions and such minerals as hornblende, chlorite, asbestos, and talc. Upon heating, it expands to a marked degree and this property determines its principal uses. It is used in plaster as heat and sound insulator, in insulating cements and in the manufacture of lightweight insulating sheets, blocks, bricks and pipe coverings.

CLAYS AND EARTHY AGGREGATES

1C Bentonite is an extremely plastic clay formed from the alteration of volcanic ash. It is used as a bleaching clay in filtering mineral and vegetable oils and as plastic agents in ceramic work and foundry mold-making. Georgia bentonites are found interbedded with Ordovician limestone of the Valley and Ridge province, especially in Dade, Walker, and Chattooga counties, and in the general vicinity of Trenton.

LOOKOUT PLATEAU

Limestone, shale,
brick and tile
clay, portland
cement, barite,
ocher, iron, man-
ganese, slate,
flagstone, bauxite,
coal, chert, tripoli,
bentonite, sand
and gravel

HIGHLAND

Granite, marble, gold,
copper, iron, asbestos,
talc, mica, feldspar,
beryl, kyanite, graphite,
sillimanite, corundum,
vermiculite, dolomite,
quartzite, quartz, sericite,
olivine, sand and gravel

PIEDMONT

FALL LINE

COASTAL PLAIN

Sedimentary kaolins (paper,
china and refractory clays),
bauxite, brick and tile clay,
fuller's earth, limestone,
marl, portland cement,
iron, chert, peat, sand
and gravel

