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MINERAL RESOURCE POTENTIAL OF THE ELLICOTT ROCK WILDERNESS AND ADDITIONS SOUTH CAROLINA, NORTH CAROLINA, AND GEORGIA

By

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Studies Related to Wilderness

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Ellicott Rock Wilderness and additions in the Sumter National Forest, Oconee County, South Carolina; the Nantahala National Forest, Macon and Jackson Counties, North Carolina; and the Chattahoochee National Forest, Rabun County, Georgia. The Ellicott Rock Wilderness was established by Public Law 93-622, January 3, 1975. The Ellicott Rock Extension roadless area (A8031), in Sumter, Nantahala, and Chattahoochee National Forests, was recommended for wilderness; and the Ellicott Rock Expansion (08112) and Persimmon Mountain (L8116) roadless areas, Sumter National Forest, were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Ellicott Rock Wilderness and additions (hereinafter also called study area) comprise about 21,000 acres in the southern Blue Ridge mountains. The potential for large-tonnage ore deposits of the mineral commodities known in the area is low. Only one prospecting permit has been issued, but no development ensued and the permit has lapsed. No mining or development has occurred in recent years.

Gold has been mined from thin, near-surface quartz veins and small scattered placers, but ore potential from these sources is low and probably not more than past production of an estimated 120 oz. The potential for silver and lead, which occur locally in quartz veins, is similarly low.

Prospecting for uranium and thorium has been undertaken on a small scale near Persimmon Mountain. Thorite as minute inclusions in allanite has been identified in rock samples, and anomalous radioactivity has been identified in several small areas by ground radiometric surveys. However, no widespread radioactive horizon or extended vein system has been recognized. The known occurrences indicate that potential for large-tonnage deposits of uranium or thorium minerals is low. The potential for small deposits of ore in veinlets containing thorite or allanite is also low, but perhaps more encouraging than for any other type of deposit.

A few mica-bearing pegmatites in the southern part of the Cashiers pegmatite district occur in the Ellicott Rock Wilderness and Ellicott Rock Extension, but no evidence has been found to suggest that the district has more than low potential for sheet and scrap mica in these areas. The potential for deposits of associated pegmatite minerals such as beryl is insignificant.

Small bodies of ultramafic rocks occur at several locations within the Ellicott Rock Wilderness and additions. These rock bodies have been prospected for asbestos minerals and have been the source of small amounts of soapstone for local consumption. In nearby areas, these rocks contain small quantities of gemstones. The potential for undiscovered deposits similar to known deposits of these commodities is fair or low. The potential for large tonnages of any of the commodities associated with ultramafic rocks in the study area is insignificant.

Deep seismic-reflection profiles have revealed that flat-lying sedimentary rocks occur below thick layers of much-deformed and metamorphosed crystalline rocks in large parts of the southern Appalachian Mountains. The Ellicott Rock Wilderness and additions are within the area where there may be potential for oil or gas in these deeply buried rocks. However, data to assess this potential does not exist.

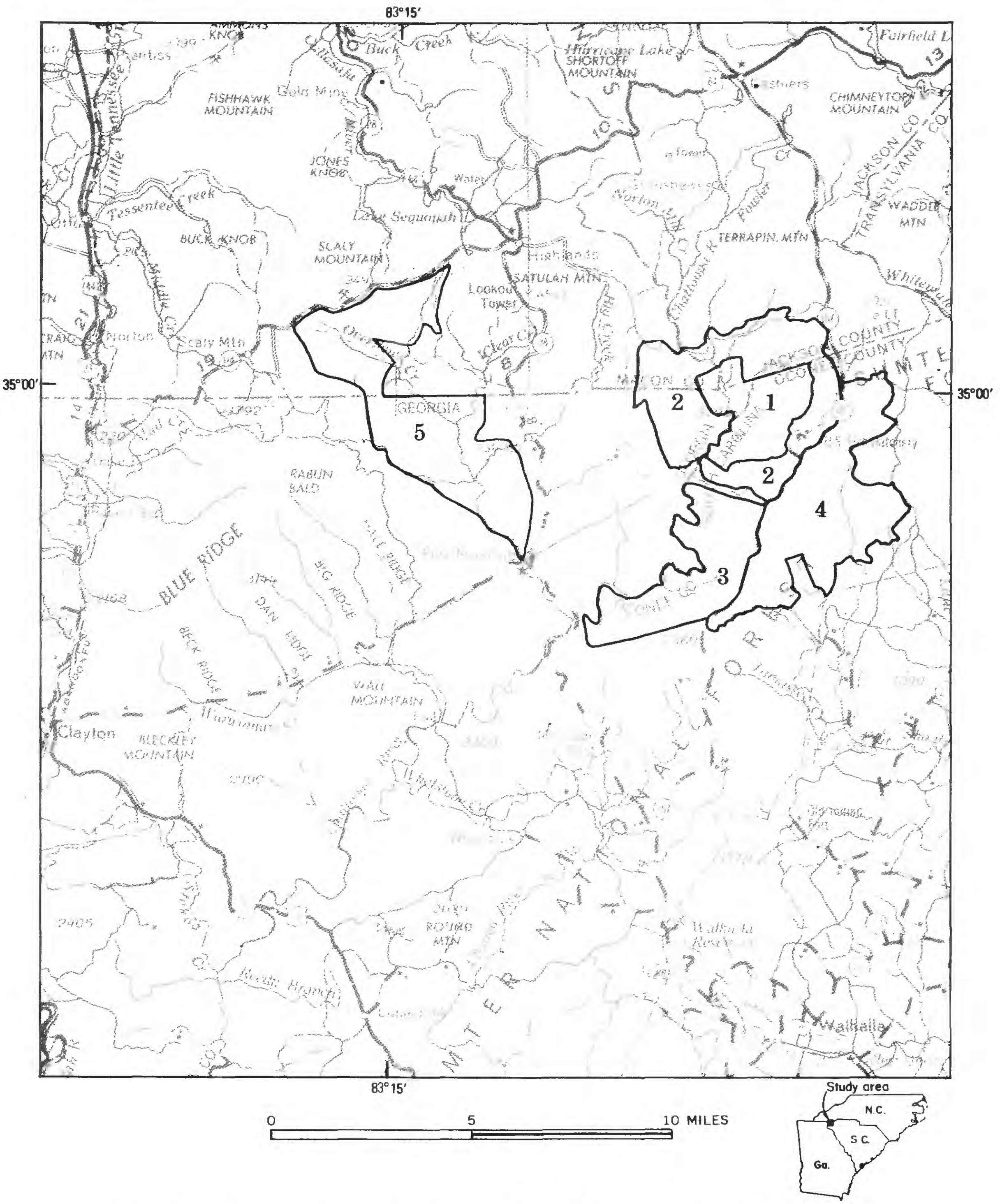

Figure 1.—Index map showing location of the Ellicott Rock Wilderness and additions: 1. Ellicott Rock Wilderness; 2. Ellicott Rock Extension (A8031); 3. Ellicott Rock Expansion (08112); and 4. Persimmon Mountain Area (L8116). The nearby Overflow Roadless Area (5) is also shown.

INTRODUCTION

The Ellicott Rock Wilderness comprises 3,332 acres in parts of Sumter, Nantahala, and Chattahoochee National Forests. The Ellicott Rock Extension roadless area would expand wilderness boundaries in these national forests by 5,600 acres. The other roadless areas, Ellicott Rock Expansion, 5,512 acres, and the Persimmon Mountain Area, 6,678 acres, are both in Sumter National Forest (fig. 1). Nearly all the land in these parcels is owned by the U.S. Government, and with the exception of the Walhalla National Fish Hatchery, is administered by the U.S. Forest Service. The Ellicott Rock Wilderness surrounds the rock on which Andrew Ellicott in 1813 located the common corner of the three states. Access to this area of rugged rhododendron-covered hills and forested mountains is from Cashiers, N.C., Walhalla, S.C., and Clayton, Ga. by means of paved state-maintained roads and by improved roads maintained by the U.S. Forest Service.

There are now no privately owned mineral rights on Federal land in the study area. One prospecting permit in the Persimmon Mountain Area (Bureau of Land Management, number ES-9884) was issued in 1971 to Powhatan Mining Company to prospect for amphibole asbestos (fig. 2, loc. 11), but the prospect was not developed; the permit lapsed and was not renewed.

Previous Studies

Rocks characteristic of the Ellicott Rock Wilderness and additions were divided by early geologists, notably Arthur Keith (1907), into granite, gneiss, and schist, considered to be Precambrian in age, and were separated from schists and phyllites in the topographically depressed Brevard zone. More recently, Hadley and Nelson (1971), Hatcher (1971, 1974, 1977), Roper and Dunn (1970), and Higgins and McConnell (1978) redefined and subdivided the units recognized earlier, with the result that rocks in the study area are now included in the Tallulah Falls Formation of Proterozoic Z and (or) early Paleozoic age and the Toxaway Gneiss of Proterozoic Y age. Rocks in the Brevard fault zone are now commonly considered to be schists and phyllites resulting from cataclasis and retrogressive metamorphism along a high-angle fault.

Yeates and others (1896), Sloan (1908), and Olson (1952) have described some of the mineral resources in the study area, which were more fully reviewed and summarized by the U.S. Geological Survey and the U.S. Bureau of Mines (1968). The results of recent exploration for radioactive mineral deposits near the study area have been reviewed by Price (1976), Penley and others (1978), and Staatz and others (1979).

Other nearby areas studied or being studied for mineral resource potential include the Shining Rock Wilderness (Lesure and Dunn, 1982), the Craggy Mountain Wilderness Study Area and Extension (Lesure and others, 1982), and the Overflow Roadless Area, which is shown in figure 1. These are in similar geological settings in the Blue Ridge Uplift of North Carolina and Georgia.

Present Studies

Geological field mapping and sample collecting were done by the U.S. Geological Survey (USGS) in the spring and fall of 1978 and 1979. Semiquantitative spectrographic analyses for 31 elements were made of 103 stream-sediment samples, 76 panned concentrates, and 73 rock samples. More sensitive analyses for gold, zinc, arsenic, and uranium were made for most of these samples by the USGS in Denver, Colo. (Siems and others, 1981). Routine ground gamma-ray radiometric surveys were made along roads in the study area. Geochemical interpretations based on these data and analyses have been made for mineral resource assessment purposes (Luce and others, in press). For the same purposes the available, pertinent aeromagnetic and aeroradiometric data have been interpreted by Luce and Daniels (in press).

The U.S. Bureau of Mines (USBM) did reconnaissance fieldwork and located mines, prospects, and mineral sites in the Ellicott Rock Wilderness during the fall of 1978 and in the adjacent roadless areas during the fall of 1979 (Gazdik, in press). Rock and mineral samples collected total 63. In addition, 10 panned concentrates were collected. These samples were submitted to the USBM Reno Research Center, Reno, Nev., for analyses. Analytical methods included emission spectrographic analyses for 40 elements, fire assays for gold and silver, fluorometric determinations for uranium, radiometric determinations for thorium, and atomic absorption analyses for iron, copper, lead, and zinc. In addition, mineral identification and petrographic descriptions were obtained for many of the samples.

The authors were assisted during the fieldwork by Matthew E. Paidakovich, USGS, and Peter C. Mory, Jay G. Jones, and Michael P. Davis, USBM.

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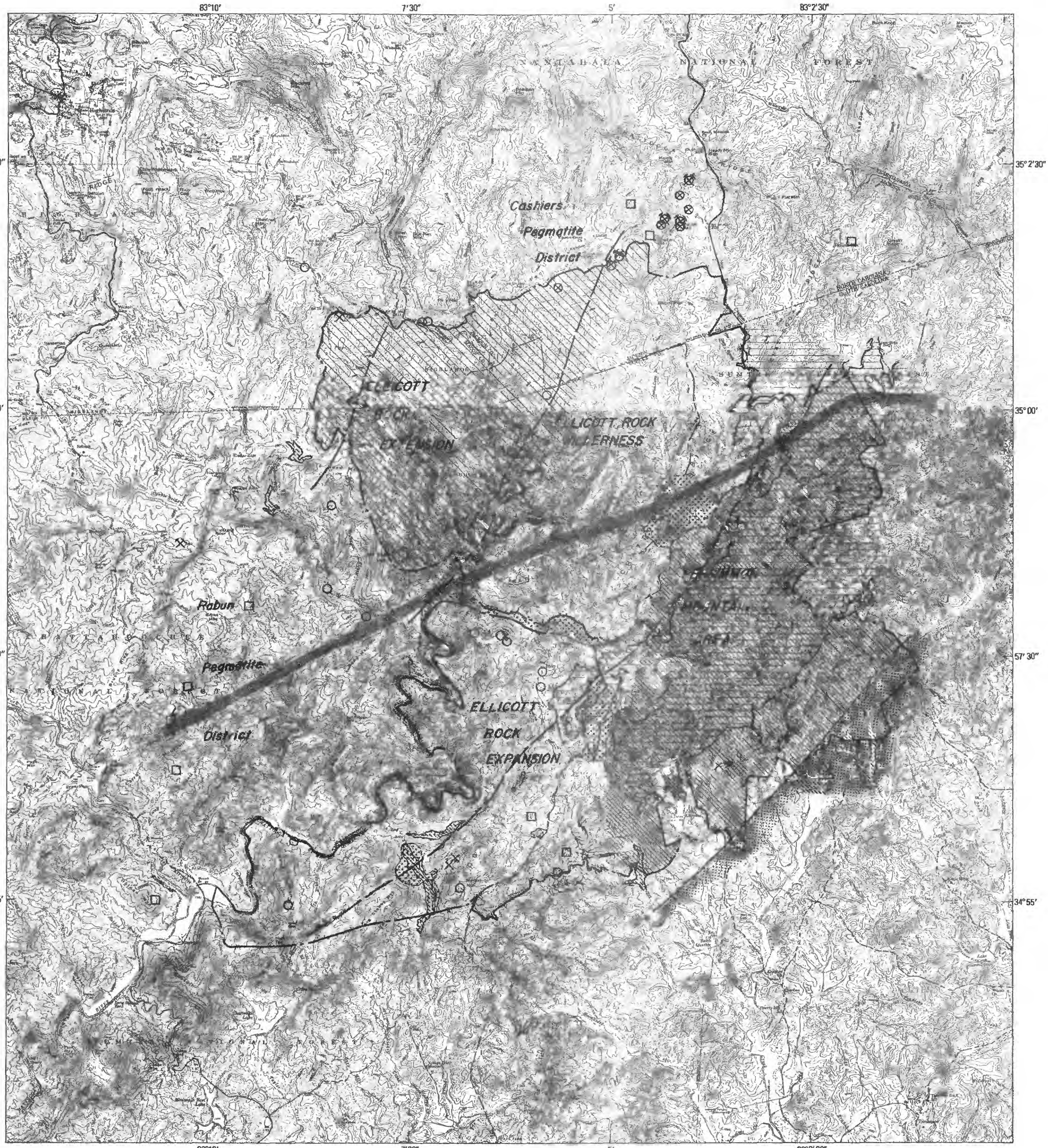
GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS

Geology

Most of the rocks in the study area are of Proterozoic age (Bell and Luce, in press; Hatcher, 1977). The Toxaway Gneiss, a complex mass having granitic to granodioritic composition, is Proterozoic Y in age. It is overlain unconformably by the Tallulah Falls Formation of Proterozoic Z and (or) early Paleozoic age. Four units of the Tallulah Falls Formation were found in the area—gneissic metagraywacke, biotite-muscovite schist, amphibolite, and muscovite-quartz-garnet schist (termed aluminous garnet schist in Bell and Luce, in press)—but were not mapped separately. Both the Toxaway Gneiss and Tallulah Falls Formation are probably metasedimentary rather than igneous in origin.



Base from U.S. Geological Survey, 1:24,000 Cashiers, 1946; Highlands, 1946 (photorevised 1967); Satolah, 1961; and Tamassee, 1959

Geology modified from Bell and Luce, in press

Figure 2.—Areas of mineral resource potential in the Ellicott Rock Wilderness and additions.

EXPLANATION

Areas in which thin quartz veins have a low potential for gold in deposits approximating the grade and tonnage mined nearby. Large-tonnage deposits cannot be expected and the potential for silver and lead associated with gold in quartz veins is insignificant. Area also contains scattered small mica pegmatites that have potential for sheet and scrap mica and possibly beryl. Similar deposits have been mined or prospected to the northeast in the Cashiers pegmatite district (Olson, 1952) and to the southwest in the Rabun pegmatite district (Furcron and Teague, 1943; Lesure and Shirley, 1968, p. 323)

Area of low thorium, uranium, and gold resource potential. Thorium and uranium potential is based on: 1. the presence of a nearby known prospect; 2. rock samples containing anomalous concentrations of thorium and uranium; and 3. anomalous uranium concentrations in stream-sediment samples and at localities showing radiometric readings four to seven times greater than background levels. Low potential for gold deposits is similar to potential described in preceding unit

Ultramafic body having potential for olivine, anthophyllite asbestos, vermiculite, corundum, and soapstone. Similar deposits have been mined or prospected in the surrounding region (Gazdik, in press). Additional similar scattered bodies may be discovered in the study area. Symbol shows mine or prospect; dashed line shows approximate outline of ultramafic body. Numbered prospect (11) is discussed in introduction

15 ⚒ × 14 Gold or silver mine (⚒) or prospect (×). Number indicates mine or prospect mentioned in text and also discussed by Gazdik (in press, table 2)

⊠ ⊗ ○ 29 Pegmatite mine (⊠), prospect (⊗), and occurrence (○). Number indicates mine or prospect mentioned in text and also discussed by Gazdik (in press)

Alluvium

Brevard fault zone rocks (Proterozoic Y to lower Paleozoic)

Tallulah Falls Formation (Proterozoic Z and (or) lower Paleozoic)

Toxaway Gneiss (Proterozoic Y)

Contact between geologic units

Anticlinorium axis

Synclinorium axis

Warwoman lineament; mapped from Landsat imagery and aerial photographs

Boundary of Ellicott Rock Wilderness and additions

Enclave excluded from the wilderness and additions

Small bodies of ultramafic rocks of Proterozoic Z and (or) early Paleozoic age crop out in a northeastward trend near the western contact of the Toxaway Gneiss and Tallulah Falls Formation (fig. 2). Originally olivine-rich, these rocks are mostly altered to talc and anthophyllite, a minor amount of which is asbestiform.

Pegmatites and quartz veins are common throughout the study area, and many encountered during fieldwork are shown in figure 2. Most are in the Tallulah Falls Formation where they are usually concordant with compositional layering. Although some dikes and veins are discordant, none was seen to crosscut from the Toxaway Gneiss into the Tallulah Falls Formation. They range in thickness from a few inches to several feet. Pegmatites are largest in the northern part of the area, where some have been mined for mica (fig. 2).

Mylonitic schist and graphitic phyllite of the Brevard fault zone of Proterozoic Z and (or) early Paleozoic age crop out in the southeast corner of the study area.

Foliation, lithologic contacts, and fold axial surfaces in the Toxaway Gneiss and the Tallulah Falls Formation generally have a northeastward strike and a moderate dip to the southeast. The formations have been complexly deformed by several periods of folding. A major structural feature in the study area in a northeast-trending anticlinorium (Bell and Luce, in press) which is possibly a nappe or dome (Luce and Daniels, in press; Hatcher, 1977). Another major structural feature is the Brevard fault zone.

Coarse kyanite occurs within the study area in the muscovite-quartz-garnet schist unit of the Tallulah Falls Formation. The layers with the most kyanite contain less than 20 percent by volume. The presence of kyanite, sillimanite, and migmatites of granitic composition in the Toxaway Gneiss and Tallulah Falls Formation indicates that these rocks have been progressively metamorphosed to the amphibolite facies or to an approximate maximum temperature of 650° to 750° C and a pressure of 5.5 to 6.5 kilobars (Miyashiro, 1973, p. 90). Minor retrograde metamorphism is evident in the Brevard fault zone and locally in the adjacent Tallulah Falls Formation.

Geochemistry

Chemical analyses were made of rocks, stream sediments, and panned concentrates (Siems and others, 1981). These have been evaluated by Luce and others (in press) in order to recognize geochemical anomalies that may reflect mineral deposits in the study area.

Most samples analyzed were found to be without anomalous concentrations of metals upon comparison with similar samples from within the study area and elsewhere. Stream-sediment samples, however, in the study area and adjacent areas contained anomalous amounts of gold in concentrations ranging from 0.002 to 4 parts per million (ppm). Intermediate and high anomalous concentrations, by comparison, range from 0.05 to 4 ppm. Anomalies occur in two areas. One is the southeastern part of the study area (Luce and others, in press, fig. 4) and the other is the northwestern part. The gold concentrations found correspond to the range expected for streams draining weakly gold-mineralized areas, such as those described by Fischer and Fisher (1968) in the western United States, and the concentrations are consistent with the weakly mineralized nature of the gold mines and prospects in the Ellicott Rock Wilderness and additions.

A few rock samples from the study area showed traces of various metals including silver, arsenic, bismuth, molybdenum, tin, and thorium. These elements are common trace constituents of sulfide minerals such as pyrite and galena, and other rarer sulfide minerals which occur widely scattered in small amounts in many quartz-rich veins. None of the concentrations are high enough to be significant for potential new ore deposits in large sulfide-rich quartz veins, nor are the concentrations significant as pathfinders for large new ore deposits.

Stream drainage basins having anomalous concentrations of uranium are clustered in the eastern, northwestern, and northern parts of the study area (fig. 3). Stream drainage basins containing anomalous thorium, lead, scandium, niobium, and lanthanum have a distribution similar to those basins showing uranium anomalies. These elements of high or intermediate atomic weight are characteristic of detrital heavy minerals, such as allanite, which are concentrated by natural gravitational sorting in streams and may be recovered in a panned concentrate with gold. The grouping of anomalous concentrations of these elements together in contiguous drainage basins tends to confirm a probable common source for the metals.

Radioactivity was highest at a uranium-thorium prospect (John O'Leary prospect) about 0.5 mi outside the east-central part of the study area (fig. 3). This prospect was chosen as a control site for stream-sediment studies conducted by Savannah River Laboratories (SRL) of the Dupont Company as part of the National Uranium Resource Evaluation (NURE) program (Price, 1976). Many of the streams sampled by SRL drain the study area, and were resampled by the USGS as part of the present investigation (Siems and others, 1981; Luce and others, in press). Uranium anomalies determined from these data are in drainages within the boundaries of the Persimmon Mountain Area (fig. 2). Rock samples BM-42, BM-43, and BM-44 (fig. 3) had uranium concentrations of 11 to 60 ppm and thorium concentrations of 120 to 2160 ppm. Additional evidence of uranium and thorium enrichment was found at rock-sample localities GS-371, GS-372, BM-35, and BM-47; uranium concentrations at these localities ranged from 8.2 to 10.7 ppm, and the thorium concentration at two localities was 30 ppm.

The highest scintillometer reading obtained, 13 times greater than background levels, was also from the John O'Leary prospect. Anomalous readings up to seven times background were found in the Toxaway Gneiss south and west of the prospect (fig. 3). Anomalies three to four times background were found at several locations in the Tallulah Falls Formation south and west of its contact with the Toxaway Gneiss. In the northwestern part of Ellicott Rock Extension, an area of anomalously high uranium was delineated on the basis of chemical analyses of stream-sediment samples collected by the USGS (Luce and others, in press; Siems and others, 1981). Stream-sediment samples from four streams showed values in the range of 0.9 to 1.1 ppm uranium, which is above the median value of 0.6 ppm for all 103 stream-sediment samples in the study area.

Geochemical analyses of stream-sediment samples with copper, cobalt, and chromium concentrations above the median for the study area were reported for scattered drainage basins. These analyses probably reflect abundant hornblende, pyroxene, or olivine with traces of chromite, which may indicate the presence of small undiscovered ultramafic bodies or amphibolite units.

Geophysics

Geophysical data derived from aeromagnetic and seismic surveys has yielded information on subsurface rocks in the Ellicott Rock Wilderness and additions. Interpretation of aeromagnetic anomalies suggests that the Toxaway Gneiss extends northwest and southwest beneath the Tallulah Falls Formation (Luce and Daniels, in press). Recent studies, in which deep seismic techniques (Cook and others, 1979) were used along traverses extending southeastward from North Carolina into Georgia, indicate that the Blue Ridge Province contains a thick sequence of sedimentary rocks, 3,000 to 15,000 ft thick, below the layer of metamorphic rocks 5,000 to 45,000 ft thick, which includes the Tallulah Falls Formation and Toxaway Gneiss.

MINING DISTRICTS AND MINERALIZATION

Data compiled from the records of the USBM and the U.S. Mint (J. H. DeYoung, Jr., M. D. Lee, and J. P. Dorian, USGS, written commun., 1982) show that production from Jackson County, N.C., between 1881 and 1981 was 163 oz of gold and 671 oz of silver, mostly from the Cullowhee mine 18 mi north of the study area; production from Macon County, N.C., 1881-1981, was about 66 oz of gold and 9.7 oz of silver; production from Oconee County, S. C., 1881-1981, was 41.6 oz of gold and 11.7 oz of silver; and production from Rabun County, Ga., 1881-1981, was about 2050 oz of gold and 50 oz of silver, mostly from the western part of the county. Not all gold and silver mined passed directly through the U.S. Mint or Assay offices; some was sold directly to banks or other dealers and is therefore not recorded. It is doubtful that total production of gold and silver in the last hundred years from these counties is significantly greater than twice the recorded production.

Two pegmatite mining districts are in the vicinity of the study area (fig. 2). These are the Cashiers district to the northeast in North Carolina (Olson, 1952) and the Rabun district to the southwest in Georgia (Furcron and Teague, 1943; Lesure and Shirley, 1968). The presence of a few exposed pegmatite bodies and coarse flakes of pegmatitic mica in soil suggests that the zone of pegmatites is possibly continuous through the northwestern part of the study area and that the two pegmatite districts may be connected. Pegmatite bodies in both areas are usually small. Olson (1952, p. 5) reported that 80 percent of those in the Cashiers district are less than 15 ft wide.

Ultramafic bodies, in particular those about 5 mi northeast of the study area near Sapphire, N.C., have been the source of small quantities of corundum gems, usually sapphire, and corundum for industrial purposes. Gemstones generally were found during corundum or asbestos mining, but placer mining and a small shaft have been used to recover rare ruby and sapphire gems. Outcrops of four ultramafic bodies of undetermined size have been located in the study area. Soapstone has been mined for local consumption at two sites and asbestos has been prospected for at another site. These small mining sites do not constitute a significant mining district.

Gold and silver mining has occurred within study area boundaries. Underground and placer gold mining took place in that part of the Ellicott Rock Extension in Macon County, N.C., and the Persimmon Mountain Area is the site of several silver-lead mines and two silver smelters. Sloan (1908) reported the presence of gold mines presumably in the Persimmon Mountain Area, but gold mine sites were identified during this study only outside the area boundaries.

Quartz veins are the major source of gold, silver, and lead in the Ellicott Rock Wilderness and additions. Gold in placer deposits often led to the discovery of lodes and the development of underground mines. Yeates and others (1896) and Sloan (1908) describe the mineralized rock as iron-stained quartz veins varying in thickness from a few inches to 2 ft and containing gold and argentiferous galena. The greater part of the mineralized rock has free gold, some of it as imperfect crystals. Quartz veins, wallrock and dump material collected during fieldwork showed less than 0.2 ppm gold, although early reports (Yeates and others, 1896; Sloan, 1908) indicate that gold in quartz veins occurs locally in considerably greater concentrations. The Ammons Branch Mine (fig. 2, loc. 1) is known to have been a gold mine; mine sites located in the Persimmon Mountain Area are presumably old silver-lead mines. An adit at location 16 (fig. 2) shows two 1-in. quartz veins separated by 15 to 20 in. of a much-weathered, red, gossan-like material. Analyses of vein quartz, wallrock, and dump material for gold showed less than 0.2 ppm in the samples; galena is present in vein quartz on the mine dump. At another site (fig. 2, loc. 15), a few inch-wide black-stained quartz veins occur. Analyses of a small select sample of vein quartz yielded 0.5 ppm silver and no gold. Sloan (1908, p. 94) reports that a 6- to 8-in.-wide quartz vein bearing argentiferous galena was exposed in a streambed probably near locality 14 (fig. 2). However, it was not seen during this study.

Placer deposits of gold in the vicinity of the lodes have been mined, but narrow steep valleys have prevented the formation of large gold-bearing alluvial deposits. Analyses of panned concentrate samples (Siems and others, 1981; Luce and others, in press) show that gold has been concentrated to 4 ppm in some of the streams.

Pegmatites in the two mining districts near the study area have a characteristic mineral assemblage. They commonly produce mica and feldspar and they rarely contain a trace of beryl or high-density minerals, such as allanite, which are resistant to weathering and accumulate with detrital minerals in stream sediments. Mica produced from these districts was mostly green or brownish-green, generally stained, bent or ruled, and of poor quality. A minor amount of clear, good-quality sheet mica was produced from a few mines in the Cashiers district during World War II (Olson, 1952, p. 9). A pegmatite was observed in the Ellicott Rock Wilderness approximately 10 ft from the Chattooga River trail (fig. 2, loc. 29). The exposure is 12 ft high and 5 ft wide and projects 10 ft out from the hillside. Mica, an abundant mineral in the exposure, is in books as large as 3 by 4 in. and 1 in. thick. Although generally free of structural defects and inclusions, the mica is green. Analysis of a sample revealed that the iron content is 1.9 percent.

Pegmatites near the study area have been the source of an occasional gem beryl crystal, and quartz veins at the Ammons Branch mine were reportedly the source of amethyst crystals. The only recorded

Base from U.S. Geological Survey, 1:24,000 Cashiers, 1946; Highlands, 1946 (photorevised 1967); Satolah, 1961; and Tamassee, 1959

0 1 MILE
0 1 KILOMETER

Geology modified from Bell and Luce, in press

Figure 3.--Map showing stream drainage basins having anomalous uranium in stream-sediment and rock samples; spectrometer survey sites where radioactivity is anomalous; and localities of panned-concentrate samples containing more than 1.5 ppm gold.

EXPLANATION

Stream drainage basin containing 0.9 ppm or more uranium in sampled sediment (Luce and others, in press). Symbol shows sample locality

Stream drainage basin showing anomalous radioactivity as reported by Price (1976)

BM-42 — Rock-sample locality showing anomalous uranium-thorium. GS- , USGS sample (Siems and others, 1980); BM- , USBM sample

▲7x — Radiometric survey locality showing radiation measured. 7x, seven times greater than background level

Stream drainage basin from which panned-concentrate samples of stream sediment contain more than 1.5 ppm gold. Symbol shows sample locality

Gold or silver mine (⚒) or prospect (✕)

Alluvium

Brevard fault zone rocks (Proterozoic Y to lower Paleozoic)

Tallulah Falls Formation (Proterozoic Z and (or) lower Paleozoic)

Toxaway Gneiss (Proterozoic Y)

Contact between geologic units

Anticlinorium axis

Synclinorium axis

Warwoman lineament; mapped from Landsat imagery and aerial photographs

Boundary of Ellicott Rock Wilderness and additions production of beryl from local mines was in the Cashiers district at the Sheep Cliff mine approximately 9 mi northeast of the study area (Olson, 1952, p. 12-13). Neither beryl nor amethyst was observed in study area pegmatites during the present investigation.

Analyses of rock samples collected during the present field investigation show that the highest uranium and thorium values are from the John O'Leary prospect. There radioactivity is approximately equal to 0.039 percent equivalent uranium. Although NURE studies of the John O'Leary prospect have been concerned primarily with uranium mineralization, it appears that thorium may be the source of most of the radioactivity. Mineral identifications made by the USGS and the USBM by means of scanning electron microscopes indicate that the radioactivity in fresh rock samples originates in minute grains of thorite which are usually found as inclusions in the mineral allanite. A thorium/uranium ratio of 33 for separated grains is reported (Luce and others, in press).

A 0.5-m-thick magnetite-rich layer in the Toxaway Gneiss is exposed about 1 mi east of the Persimmon Mountain Area. Semiquantitative spectrographic analyses of USBM samples indicate that several elements associated with the magnetite have anomalously high concentrations: uranium, 5.9 ppm; gallium, 60 ppm; niobium, 100 ppm; tin, 400 ppm; and vanadium, 600 ppm. USGS samples of similar material show 300 ppm vanadium and 700 ppm lanthanum. The layer has not been traced into the study area and similar rocks have not been recognized there.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

No evidence was found during this investigation to indicate that a potential exists for large deposits of mineral commodities not previously known in the Ellicott Rock Wilderness and additions. A low potential may exist within two areas shown in figure 2 for small additional deposits of a few of the mineral commodities known in the study area. These include gold and silver, radioactive minerals, pegmatite minerals, and commodities associated with ultramafic rocks.

Gold and Silver

Thin quartz veins are the ore-bearing rocks at all the lode gold and silver mines shown in figure 2. Geochemical sampling of alluvium (Luce and others, in press) as well as rock and dump sampling show that gold exists in trace amounts throughout the study area, but that high and intermediate anomalies are in several areas (fig. 3). The grade of gold in the thin quartz veins sampled is approximately the same as that expected from records of past production. Thin quartz veins are common in the study area, mostly in the Tallulah Falls Formation and near the Brevard fault zone. Some undiscovered quartz veins may be gold-bearing in areas where geochemical sampling indicates gold-bearing alluvium. Large-tonnage deposits cannot be expected from thin quartz veins characteristic of the study area, but there is a low potential in the two areas shown in figure 2 for deposits of approximately the same tonnage and grade as have been mined, possibly totalling an estimated 120 oz. The potential for silver and lead associated with quartz veins is similarly low.

Small-tonnage pockets of alluvium in narrow valleys may contain a few nuggets or a few ounces of gold, but larger tonnage placers cannot be expected.

Radioactive Minerals

There has been prospecting for uranium and thorium in the study area but no widespread radioactive horizon or extended vein system has been recognized. The potential for large deposits is low. The potential for small deposits in the area shown in figure 2 is perhaps more encouraging than for any other type of mineral deposit, but it is also low. The assessment of low potential for small deposits is based on: (1) rock samples collected by the USGS and the USBM containing anomalous concentrations of thorium and uranium (fig. 3, samples GS-371, GS-372, BM-35, and BM-47); (2) anomalous uranium concentrations in stream-sediment samples (Siems and others, 1981; Luce and others, in press; Price, 1976); (3) sites having radiometric readings four to seven times greater than background levels (fig. 3); and (4) the presence of the nearby John O'Leary prospect. Figure 3 shows that the localities of samples on which this potential is based are widely scattered within the Toxaway Gneiss and are not restricted to the vicinity of the John O'Leary site. Geologic mapping (Bell and Luce, in press) has delineated the outcrop area of these rocks in the study area, and geophysical data shows that elsewhere in the study area they are deeply buried.

Pegmatite Minerals

The potential for production of mica and other pegmatite minerals such as feldspar, beryl, and allanite from the known and undiscovered pegmatites in the study area is low. Generally, the pegmatites are small, the mica is low-grade, and other minerals such as beryl or allanite are extremely rare. Feldspar has been mined locally, but the development by the USBM in 1946 of a method to concentrate the mineral from feldspar-rich rocks has made production of this mineral from small scattered pegmatites uneconomic. Geochemical analyses of stream sediments from contiguous drainage basins in the area known to contain pegmatites show anomalous concentrations of thorium, lead, scandium, niobium, lanthanum, and uranium. These result from minor accumulations of allanite and have no significance for potential mineral resources.

Commodities Associated with Ultramafic Rock

Figure 2 shows the location of ultramafic rocks in the study area and vicinity. The potential for commodities related to these rocks is low and is confined to the immediate vicinity of the known outcrops and the few similar outcrops that may be discovered. Commodities (mined or prospected) from ultramafic bodies in the region include asbestos, vermiculite, olivine, corundum, and soapstone. The small scale of past operations and the minor production of these high-volume, low-unit-price commodities, as well as the small size of the rock bodies, are the basis for the low potential for commodities related to ultramafic bodies in the study area.

High-Alumina Minerals

Kyanite and sillimanite, minerals with high alumina content useful in the refractory and ceramic industries, occur in the study area, but potential for production is small. Sillimanite in the Tallulah Falls Formation is too fine-grained and too low in abundance to have significant mineral resource potential. Kyanite occurs as coarse crystals containing many degrading inclusions in the muscovite-quartz-garnet schist unit in the Tallulah Falls Formation. Where most abundant the kyanite-bearing layers contain less than 20 percent by volume kyanite. The low grade and low content of kyanite is the basis for its low mineral resource potential.

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