MINERAL RESOURCE POTENTIAL OF THE SHINING ROCK WILDERNESS, HAYWOOD COUNTY, NORTH CAROLINA

SUMMARY REPORT

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and 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 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 Shining Rock Wilderness, Pisgah National Forest, Haywood County, N.C. The area was established as a wilderness by Public Law 88-577, September 3, 1964.

SUMMARY

The Shining Rock Wilderness is in the Blue Ridge Mountains of Haywood County, N. C., and is underlain by complexly folded, high-grade metamorphic rocks. These rocks contain a few small, subeconomic deposits of sheet muscovite mica that have a small potential for scrap mica. Quartz as a source of silica (SiO_2) and gneiss and schist suitable for common building stone and crushed rock are the only identified economic mineral resources. Other minerals and rocks, including kaolin, soapstone, copper, corundum, and dunite, have been prospected or mined nearby, but either they do not occur or have no current economic potential in the wilderness. A possibility exists for the presence of natural gas at depths greater than 5,000 ft (1,500 m).

INTRODUCTION

The Shining Rock Wilderness contains about 13,400 acres (5,423 ha) within the Pisgah National Forest in the Blue Ridge Mountains of western North Carolina. The study area is in Haywood County, 9 mi (14 km) southeast of Waynesville and 20 mi (32 km) southwest of Asheville (fig. 1). The Blue Ridge Parkway forms the southeast boundary. Forest Service road F.S. 816 from the parkway west of milepost 420 provides access to the southern part of the wilderness at Ivestor Gap. Access to the eastern part is from U.S. Highway 276 at the bridge over East Fork of the Pigeon River and from the road up Crawford Creek. On the west side, access is by North Carolina State Roads 215 and 1129 up Little East Fork. The highest point in the wilderness is Grassy Cove Top, about 6,040 ft (1,840 m) above sea level; Shining Rock is 6,000 ft (1,828 m) and Cold Mountain is 6,030 ft (1,837 m). The lowest points are 3,280 ft (1,000 m) above sea level near the parking lot on Little East Fork on the west side and 3,340 ft (1,018 m) above sea level near the parking lot on East Fork on the east side. Slopes are steep and generally overgrown with second-growth hardwoods and scattered pines and hemlock. Ridge tops have a few clearings or balds and some extensive rhododendron thickets. Several well-developed trails and old logging roads provide good access to the high ridges and along major drainages.

Previous Work

Arthur Keith made the earliest study of the geology of the area while mapping the Pisgah 30-minute quadrangle (Keith, 1907). Keith mapped the rocks as part of his Carolina and Roan Gneisses. He reported one mica prospect within the wilderness and several mica mines and prospects, three soapstone deposits, five copper occurrences, two kaolin prospects, and a corundum prospect along West Fork of the Pigeon River, 2-5 mi west of the wilderness. Sterrett (1923, p. 196-197) described two small sheet-mica prospects in the wilderness, the Shining Rock and Middle Old Field prospects (fig. 3 and table 1). Klepper and others (1944) mapped the Little East Fork mica mine in the wilderness, and Lesure (1968, p. 94-97) summarized the available information on these and several other mica prospects in and near the wilderness. Hadley and Nelson (1971) made a reconnaissance study of the area during the mapping of the Knoxville $1^o \times 2^o$ quadrangle. The geology of the southern half of the Cruso 7 1/2-minute quadrangle (fig. 1) has been mapped and described by H. B. Morrow (1977), and that of the Shining Rock 7 1/2-minute quadrangle by Lewis Acker (1976).

Present Work

Maynard L. Dunn, assisted by Lyle E. Harris, conducted field studies for the U.S. Bureau of Mines in October 1978. They collected 7 rock and 16 panned-concentrate samples for analyses, studied mica prospects in the wilderness, and visited other mines and prospects nearby. The U.S. Bureau of Mines, Reno Research Center, Reno, Nev., analyzed the samples.

Frank G. Lesure, assisted by James D. Bliss and Glenn L. Shaffer, mapped and sampled the area, October 18-31, 1978. They collected 94 stream-sediment, 89 soil, and 120 rock samples, which were analyzed in the U.S. Geological Survey Laboratories, Denver, Colo. Complete analyses of these samples are available in Siems and others (1981).

Acknowledgments

We wish to thank Leonard Wiener and Carl Merschat of the North Carolina Geological Survey for helpful discussions

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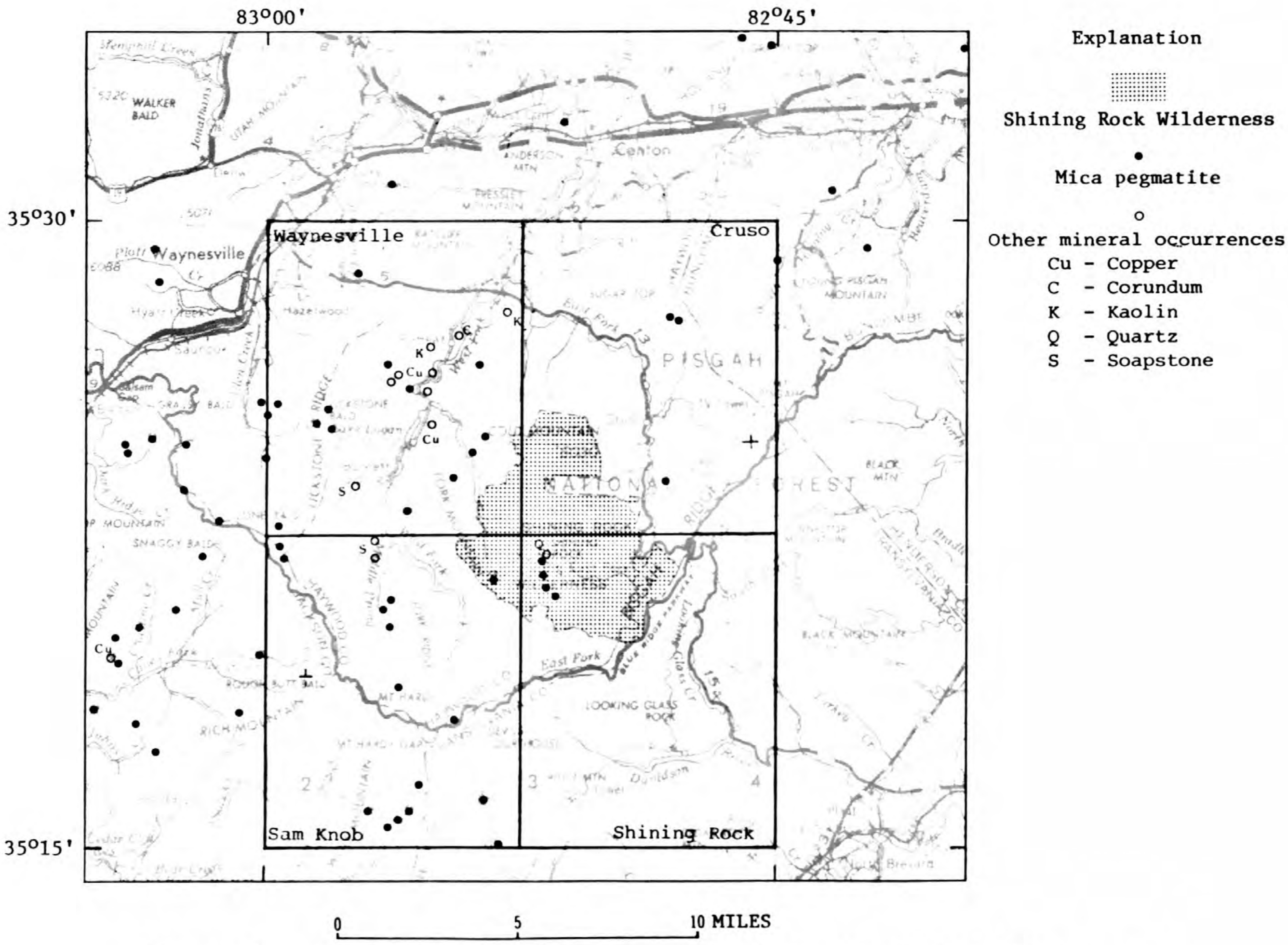


Figure 1.--Index map showing location of Shining Rock Wilderness, pegmatite, and other mineral occurrences. Localities are, in part, from Keith (1907), Olson and others (1946), and Lesure (1968).

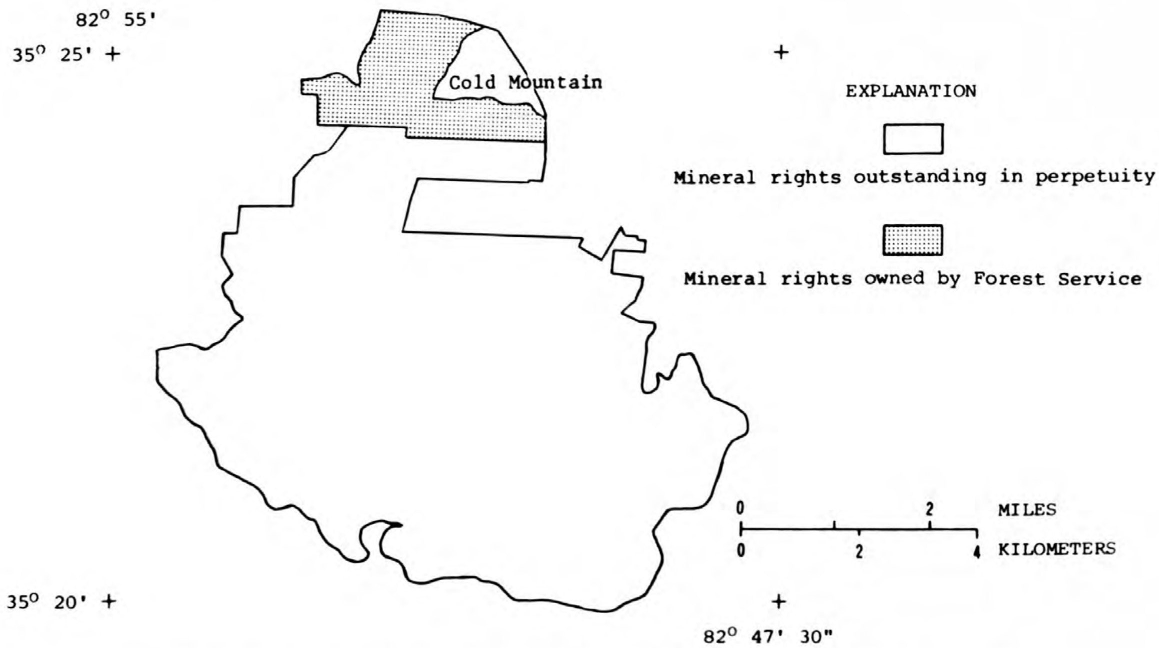


Figure 2.--Status of mineral rights in the Shining Rock Wilderness. Forest Service owns all surface rights.

on the geology of the general area. Cooperation of the U.S. Forest Service and the National Park Service in providing information and assistance is gratefully acknowledged.

SURFACE AND MINERAL-RIGHTS OWNERSHIP

All surface rights in the wilderness are held by the U.S. Forest Service. The Forest Service owns mineral rights on about 1,200 acres (486 ha) on the west and south flanks of Cold Mountain; mineral rights are outstanding in perpetuity on the remaining acreage (fig. 2).

Although prospecting and mining development permits are granted in the Pisgah National Forest, no outstanding permits exist in the wilderness. In the 1950's, a mining permit was issued to Fred Arrowood of Waynesville, N.C., to mine mica at the Little East Fork mica mine (fig. 3), and a Defense Minerals Exploration Administration (DMEA) exploration loan was granted to him to explore for strategic-grade mica in that deposit. Everett L. Poston acquired a lease (BLM-A-024489(NC)) on the old Shining Rock mine or prospect (fig. 3) in August 1952 and also had an exploration loan from DMEA. Conway Revis of Waynesville, N.C., was issued a lease on the Grassy Knob or Revis prospect (fig. 3) in 1952, and also a DMEA exploration loan. None of these explorations was successful, and no certificates of discovery were issued.

GEOLOGY

The Shining Rock Wilderness contains high-grade, regionally metamorphosed sedimentary rocks of probable Precambrian age (Hadley and Nelson, 1971). Most of the area is underlain by mica gneiss containing various amounts of interlayered mica schist, garnet-mica schist, granitic gneiss, amphibolite, and migmatite (Lesure, 1981a). Locally, mica-garnet schist, generally containing sillimanite and less commonly iron sulfides, is the dominant rock type. In other areas the gneiss and schist are intruded by abundant narrow dikes and lenses of granitic material forming a mixture of rock types called migmatite.

The gneiss and schist have been complexly folded and possibly faulted. Small folds, a few feet to more than 30 ft (10 m) in wavelength, plunge northeast, generally at angles of less than 40°. Larger folds are suggested by the outcrop patterns of garnet-mica schist, but were not completely identified in the reconnaissance mapping. No faults were observed, but the presence of sheared mica schist containing retrograde chlorite suggests at least local faulting.

A few quartz veins and small dikes or sills of mica pegmatite and trondhjemite intrude the gneiss and schist. The largest mass of quartz is a complexly folded vein or series of *en echelon* veins about 1,750 ft (530 m) long and 30-60 ft (9-20 m) thick exposed on top of Shining Rock Mountain. The white quartz can be seen from afar and consequently is the "shining rock" from which the mountain and in turn the wilderness take their names.

The pegmatites are medium- to coarse-grained mixtures of quartz, feldspar, and muscovite. They are generally tabular or lens shaped and small. The average size is 1-8 ft (0.3-2.4 m) wide and probably less than 100 ft (30 m) long (table 1). The trondhjemite dikes are light-colored, fine-grained mixtures of mostly feldspar and quartz containing minor amounts of mica.

The rocks of the Shining Rock Wilderness were originally interbedded sandstones and clay-rich shales, possibly intruded by a few basalt sills or dikes. These rocks were metamorphosed under conditions of high temperature and pressure during one or more periods of regional metamorphism in the Precambrian and Paleozoic Era (Butler, 1973). They occur within the sillimanite isograd, so rocks having the appropriate alumina-rich composition contain the mineral sillimanite. The pegmatites were probably intruded into the rocks near the peak of metamorphism, possibly about the time that partial melting produced the zones of migmatite. The trondhjemite dikes were probably intruded somewhat later. Following the peak of metamorphism, the rocks were moved more than 100 mi (160 km) west as part of a large mass called the Blue Ridge thrust sheet (Cook and others, 1979).

Morrow (1977) gives a detailed description of multiple periods of deformation and defines older and younger units of gneiss and schist in the Cruso quadrangle. Acker (1976) did not recognize older and younger units of gneiss and schist in the wilderness along the northern part of the Shining Rock quadrangle where it joins the Cruso quadrangle. Our reconnaissance study was not detailed enough to resolve these differences.

GEOCHEMICAL SURVEY

The U.S. Geological Survey (USGS) made a reconnaissance geochemical survey of the Shining Rock Wilderness (Lesure, 1981b) to test for indistinct or unexposed mineral deposits that might be recognized by their geochemical halos. Similar geochemical surveys based on trace-element analyses have been credited with the discovery of many types of mineral deposits (Hawkes and Webb, 1962). Analyses of the samples collected suggest that the rocks in the area contain normal amounts of the 31 elements tested for (table 2). Gold is present in trace amounts, ranging from less than 0.002 parts per million (ppm) to 0.024 ppm in 21 rock samples. Gold was not detected in soil or stream-sediment samples at a detection limit of 0.05 ppm. Copper, according to stream-sediment analysis data, may be somewhat more abundant in the southern boundary area and in the northeastern corner of the wilderness, but copper is more erratically distributed in soil samples. Rock samples containing iron sulfides, which could be expected to contain the most copper, do not have significantly more copper than rock samples without sulfides. The ranges in copper concentrations for the stream-sediment, soil, and rock samples are what should be expected for an area of unmineralized metasedimentary rocks.

Trace elements such as boron, cobalt, and lanthanum seem to be concentrated in a few stream drainages, but correlation with soil and rock samples is not good (Lesure, 1981b). None of these elements appear in unusually large concentrations that might be indicative of mineral resources.

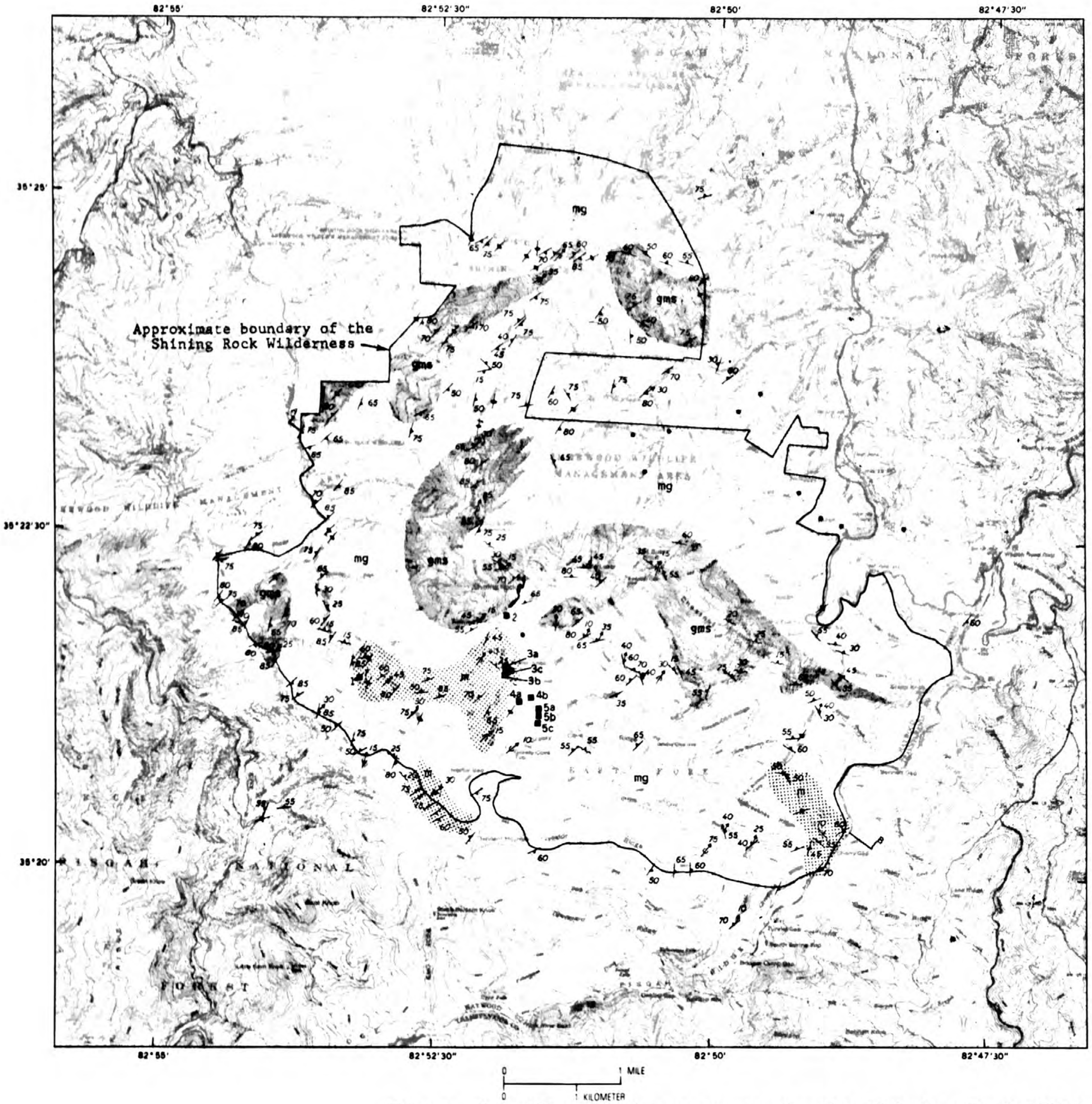
MINERAL RESOURCE POTENTIAL

Quartz (SiO_2) and building stone are the only identified potentially economic mineral resources[3] in the Shining Rock Wilderness. Known deposits of mica pegmatite are too small and of too low grade to be of current economic interest. Other minerals and rocks, such as kaolin, soapstone, or dunite, have been mined or prospected nearby but have no known potential in the wilderness. A possibility exists for the presence of natural gas at great depth.

Quartz

The large mass of quartz exposed on Shining Rock

[3] Resource terms are those defined in USGS Circular 831.



DESCRIPTION OF MAP UNITS

(Note: Contacts between map units are not shown because they are gradational and were not clearly defined by our reconnaissance mapping)

Pegmatite or closely spaced group of pegmatites (Devonian?)—Fine- to coarse-grained, tabular, lenticular or irregularly shaped bodies of feldspar-quartz-muscovite-biotite pegmatite. Some are zoned and have plagioclase-quartz-muscovite wall zones and quartz or quartz-perthite-biotite cores. Bodies are generally discordant or partly concordant to layering and structure of wall rocks. Most are small. They range in thickness from 1 to 25 ft (0.3-7.5 m) and may be as much as 100-150 ft (30-45 m) long (Lesure, 1968, p. 94-97). Those shown in Johns Cove and east of Ugly Creek and Roland Ridge are plotted after Morrow (1977)

Quartz (Paleozoic)—Massive white quartz, 30-60 ft (9-18 m) thick and about 1,500 ft (460m) long; a complexly folded vein or a series of en échelon veins

m **Migmatite (Paleozoic and (or) Precambrian)**—Interlayered mica gneiss and schist containing abundant granitic and pegmatitic rock (fine- to coarse-grained quartz, feldspar, and mica) in thin layers, lenses, and irregular masses

gms **Garnet-mica schist (Precambrian)**—Mostly garnet-mica-quartz-feldspar schist interlayered with biotite-quartz-feldspar schist, biotite-quartz-feldspar gneiss, and migmatite. Garnet schist, light- to medium-gray, fine- to medium-grained. Garnets, generally pink, form crystals 0.02-0.2 in. (0.5-5 mm) in diameter. Schist locally contains sillimanite, graphite, and (or) iron sulfides. In some areas, the mica schist is sheared and contains retrograde chlorite. Such rock is greenish gray and fine grained

mg **Mica gneiss (Precambrian)**—Mostly biotite-quartz-feldspar gneiss and quartz-feldspar-biotite gneiss interlayered with mica schist, garnet-mica schist, granitic gneiss, amphibolite, and migmatite. Mica gneiss, light- to medium-gray, very fine- to fine-grained, and thin- to thick-layered. Some gneiss layers contain garnet and iron sulfides

■4 **Named pegmatites**

1. Little East Fork
2. Shining Rock

3 a. Flower Knob, north

3 b. Flower Knob, west

3 c. Flower Knob, east

4 a. Grassy Knob (Revis)

4 b. Unnamed

5 a. Grassy Cove Top, north

5 b. Grassy Cove Top, middle

5 c. Grassy Cove Top, south

Strike and dip of foliation or layering

50 Inclined

Vertical

50 Generalized

30 25 **Strike and dip of inclined foliation or layering—Showing plunge of minor folds or lineation**

Strike and plunge of minor fold axes

75 Synclinal

30 Anticlinal

Figure 3.--Mines and prospects in the Shining Rock Wilderness.

Table 1.—*Summary description of mica pegmatite deposits in Shining Rock Wilderness, Haywood County, N.C.*

[Data are from Lesure (1968, p. 94-97), except as noted]

Locality number	Deposit name	Principal periods worked	Workings	Description of mica	Production	Pegmatite					Wall rock	Weathering	Internal structure, texture, and mineralogy of pegmatite
						Shape	Size	Attitude		Relation to wall-rock structure			
								Strike	Dip				
1	Little East Fork (Arrowood)	World War I, and World War II, 1952-53	4 cuts, 20-40 ft (6-12 m) long; 3 adits, 20-106 ft (6-32 m) long; prospect pits in area 150 by 200 ft (45 x 60 m)	Ruby color, "A" structure, biotite intergrowths, cracked, bent	Less than 100 lbs sheet; 6-7 tons of scrap	Tabular	6-25 ft (2-7 m) thick, more than 160 ft (50 m) long and 70 ft (21 m) deep	Northeast	Northwest	Partly concordant	Biotite gneiss	Partly weathered	Feldspar-quartz-muscovite-biotite wall zone, coarse-grained; perthite-quartz-muscovite-biotite core, coarse-grained; quartz fracture fillings.
2	Shining Rock mine	1900, 1953-54	Cut, 40 ft (12 m) long; shaft, 40 ft (12 m) deep; drift, 54 ft (16 m) long	Ruby color, "A" structure, hard, bent, ruled	Less than 1,000 lbs. mine-run in 1950's	Irregular	3-8 ft(1-2.5m) thick, 100 ft (30 m) long, 40 ft (12 m) deep	Northwest	Southwest	Discordant	Interlayered biotite gneiss and hornblende gneiss	Partly weathered	Kaolinized plagioclase-quartz-perthite-muscovite wall zone, medium-grained; quartz core.
3	Flower Knob prospect, north	1950's (?)	Prospect pit	Clear, bent, ruled, small	Unknown	Tabular	3-6 ft (1-2 m) thick	Northeast	Vertical	Discordant	Biotite gneiss	Partly weathered	Feldspar-quartz-muscovite-biotite pegmatite, medium- to coarse-grained.
3	Flower Knob prospect, west	1950's (?)	Prospect pit, 6 by 9 ft (2x3 m), possibly 6 ft (2 m) deep,caved	Small, bent	Unknown	Tabular	3-6 ft (1-2m) thick	Northeast	Vertical	Discordant(?)	Biotite gneiss	Partly weathered	Quartz-feldspar-muscovite-biotite pegmatite, fine- to medium-grained.
3	Flower Knob prospect, east (Middle Old Field)	1950's (?)	Adit, 6 ft (2 m) long, caving	Small, bent, ruled	Unknown	Lens	1-5 ft (0.3-1.5 m) thick	Northwest	Northeast	Partly concordant	Biotite gneiss	Partly weathered	Feldspar-quartz-muscovite pegmatite, fine- to medium-grained.
4 a	Grassy Knob prospect (Revis)	1952-53	Adit, 86 ft (26 m) long, drift 14 ft (4 m) long	Ruby color, hard, clear, tied, bent, small	None	Small lenses	1-5 ft (0.3-1.5 m) thick, 20 ft (6 m) long (largest)	Northeast	Vertical	Concordant	Biotite gneiss	Unweathered	Plagioclase-quartz-muscovite pegmatite, medium-grained; accessory biotite, garnet, pyrite.
1/ 4 b	Unnamed prospect	1950's (?)	Shallow cut in road bank	Small, bent	Unknown	Lens (?)	1-5 ft (0.3-1.5 m) thick	Northwest	Northeast	Partly concordant	Biotite gneiss	Partly weathered	Feldspar-quartz-muscovite pegmatite, fine- to medium-grained.
1/ 5 a	Grassy Cove Top prospect, north	1950's (?)	Cut, 50 ft (15 m) long	Bent, tied	Unknown	Lens	1-4 ft (0.3-1.2 m) thick	Northwest	Northeast	Partly concordant	Biotite gneiss	Partly weathered	Do.
1/ 5 b	Grassy Cove Top prospect, middle	1950's (?)	Trench, 23 ft (7 m) long, caving	None seen	Unknown	----------	----------	----------	Covered	----------	----------	----------	----------
1/ 5 c	Grassy Cove Top prospect, south	1950's (?)	Cut, 50 ft (15 m) long	Ruby color, bent, tied, ruled	Unknown	Lens	1-3 ft (0.3-1 m) thick	Northwest	Northeast	Partly concordant	Biotite gneiss	Partly weathered	Feldspar-quartz-muscovite pegmatite, fine- to medium-grained.

1/ M. L. Dunn, Jr.(unpub. data, 1980).

Table 2.—*Range and median concentrations of 25 elements in rock, soil, and stream-sediment samples from Shining Rock Wilderness and vicinity compared with the median values for similar samples from Craggy Mountain Wilderness Study Area, Buncombe County, N.C.*

All analyses by means of semiquantitative spectrographic methods by David Siems, except gold and zinc, which were by means of atomic absorption by A.L. Meier. Spectrographic analyses are reported as six steps per order of magnitude (1, 1.5, 2, 3, 5, 7, or multiples of 10 of these numbers) and are approximate geometric midpoints of the concentration ranges. The precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time and within two adjoining intervals on each side of the reported value 96 percent of the time (Motooka and Grimes, 1976). Letter symbols: L, detected but below limit of determination (value shown in parenthesis after element symbol); N, not detected; G, greater than; —, no data. Elements looked for spectrographically but not found and their lower limits of determination (ppm): As(200), Au(10), Bi(10), Cd(20), Sb(100), Sn(10), W(50), and Zn(200).

	Rocks																					Soil				Stream Sediments			
	Schist									Biotite Gneiss				Migmatitic gneiss, augen gneiss, and granitic gneiss				Vein quartz											
	33 samples without iron sulfides			18 samples[1]	7 samples with iron sulfides			15 samples[1]		37 samples			16 samples[1]	27 samples				9 samples			8 samples[1]	89 samples			20 samples[1]	94 samples			30 samples[1]
Element	Low	High	Median	Median	Low	High	Median	Median	Average in shale[2]	Low	High	Median	Median	Low	High	Median	Average in sandstone[2,3]	Low	High	Median	Median	Low	High	Median	Median	Low	High	Median	Median
	Percent																												
Ca (0.05)	0.05	1.5	0.5	0.5	0.3	2	0.7	0.5	2.2	0.1	2	1	0.7	0.2	3	1.5	3.9	L	0.3	L	0.2	L	1	0.2	0.08	0.15	3	1	0.6
Fe (0.05)	5	15	10	7	5	10	7	10	4.7	2	10	5	2.5	1.5	10	5	0.98	L	2	0.15	0.5	0.7	7	5	3	3	10	7	5
Mg (0.02)	1.5	3	2	1.5	1	3	1.5	1.5	1.5	0.5	2	1	0.7	0.5	2	1	0.7	0.02	0.5	0.05	0.05	0.15	2	0.5	0.5	0.5	1.5	1	0.5
Ti (0.002)	0.3	0.7	0.5	0.5	0.3	0.7	0.5	0.7	0.46	0.3	0.7	0.5	0.5	0.2	0.7	0.5	0.15	L	0.05	0.015	0.018	0.2	1	0.5	0.7	0.3	1	0.5	0.7
	Parts per million																												
Ag (0.5)	N	N	N	N	N	N	N	N	0.07	N	1	N	N	N	N	N	[4] 0.0X	N	N	N	N	N	0.5	N	N	N	N	N	N
Au (0.002)	N	L	N	N	N	0.004	L	N	[4] 0.00X	N	L	N	N	N	0.024	N	[4] 0.00X	N	N	N	N	N	N	N	L	[5] N	[5] N	[5] N	N
B (10)	L	70	10	L	L	30	20	L	100	L	20	10	L	L	20	L	20-30	10	10	10	N	L	70	20	18	L	30	15	10
Ba (20)	700	1000	1000	700	700	1000	1000	700	580	300	1500	1080	500	500	2000	1000	300	50	200	100	100	200	1500	500	700	500	1000	700	500
Be (1)	L	2	1	1.5	1	2	2	1	3	L	3	1	1	1	5	1.5	2	L	1	L	L	L	5	2	3	L	2	1.5	1.5
Co (5)	10	100	15	20	10	30	15	20	19	N	15	10	10	N	30	10	0.3	N	L	N	N	N	30	7	18	7	30	15	20
Cr (10)	50	200	100	70	50	150	100	70	90	20	100	50	30	10	200	30	10-20	10	20	10	10	20	200	50	70	30	200	100	50
Cu (5)	15	100	30	30	20	70	50	50	45	N	30	15	10	N	70	10	10-20	N	7	N	10	5	50	15	50	5	50	20	20
La (20)	L	200	100	100	70	200	150	100	92	L	200	50	30	20	150	70	30	L	30	20	N	20	300	100	125	20	700	100	150
Mn (10)	200	G(5000)	1500	1500	700	2000	1500	1500	850	200	2000	700	700	300	1500	500	500	20	700	70	125	100	2000	700	500	500	5000	1500	2000
Mo (5)	N	7	N	N	N	N	N	N	2	N	10	N	N	N	N	N	0.2	N	N	N	N	N	L	N	N	N	5	N	N
Nb (20)	L	30	20	L	L	20	20	L	11	L	20	L	L	L	20	L	[4] 0.X	L	L	L	N	L	30	20	L	L	30	L	L
Ni (5)	5	70	20	30	15	30	20	30	68	L	30	20	15	L	30	20	2	L	7	L	L	N	100	15	40	7	70	20	20
Pb (10)	15	70	30	20	20	50	30	15	20	L	30	20	13	10	50	20	9	N	N	N	L	10	70	50	50	20	100	50	30
Sc (5)	10	30	20	20	20	30	20	20	13	5	20	10	10	L	30	10	1	N	10	N	L	5	20	10	15	7	30	15	15
Sr (100)	100	200	150	150	100	200	200	150	300	100	300	200	180	100	700	200	20	N	N	N	N	L	200	100	L	L	300	150	200
Th (100)	N	N	N	—	N	N	N	—	12	N	N	N	—	N	N	N	1	N	N	N	—	N	N	N	—	N	200	N	—
V (10)	100	150	150	150	70	150	150	150	130	50	150	100	70	30	200	100	10-20	L	15	L	L	70	150	100	150	50	150	100	100
Y (10)	30	100	50	70	30	100	70	70	26	10	70	30	30	10	70	20	40	N	20	N	N	10	100	30	70	15	150	50	70
Zn (5)	35	170	120	90	85	160	80	80	95	25	150	100	40	30	180	85	16	N	5	N	5	20	200	85	100	35	150	100	70
Zr (10)	100	300	200	150	100	200	150	150	160	50	500	200	200	70	500	200	200-250	N	500	N	L	70	700	300	300	70	1000	300	300

[1] Lesure and others (in press).
[2] Turekian and Wedepohl (1961).
[3] Pettijohn (1963, p. S11).
[4] Order of magnitude estimated by Turekian and Wedepohl (1961).
[5] Limit of detection 0.05 ppm Au.

Mountain (fig. 3) is a potential source of almost pure silica (SiO_2). Very pure quartz has many industrial uses that range from special aggregate for pre-stressed concrete to a major ingredient in glassmaking and in manufacturing silicon metal. Wet chemical analysis of two composite samples of quartz from Shining Rock Mountain indicates a silica content in excess of 99.8 percent; spectrographic and atomic-absorption analyses for impurities detrimental to the uses of very pure silica show 0.006 percent iron, <0.0001-0.02 percent magnesium, 0.03 percent aluminum, less than 0.05 percent calcium, and less than 0.03 percent titanium, all within the tolerances and specifications for most uses (Murphy, 1960, p. 661-663).

The mass of quartz is a sinuous vein or series of *en echelon* veins about 1,750 ft (530 m) long and 30-60 ft (9-20 m) wide. It is exposed above ground to a height of 3-20 ft (1-6 m) and probably extends an equal or greater distance below ground. We estimate that at least 130,000 short tons (120,000 t) and possibly as much as 500,000 short tons (450,000 t) of quartz is present within 30-100 ft (10-30 m) of the surface on Shining Rock Mountain. No other masses of quartz of similar size are known to exist in the wilderness; small pods and lenses of quartz a few inches to several feet thick and tens of feet long are widely scattered throughout the gneiss and schist but are not considered a resource.

Quartz resources are available outside the wilderness. Large masses of quartz are common in the cores of zoned pegmatite bodies in the Franklin-Sylva pegmatite district, 5-40 mi (8-64 km) southwest of the wilderness (Lesure, 1968, p. 94-121). Similar quartz cores in pegmatite in the Spruce Pine pegmatite district, 50 mi (80 km) northeast, have been mined for quartz.

Stone

Most of the gneiss and schist in the study area is suitable for use as crushed rock or aggregate and rough building stone. The area, however, is too far from large markets for aggregate, and because similar stone is abundant throughout the region, rock in the wilderness has no significant value for the usual uses of stone.

Mica

Within the wilderness, at least ten mica pegmatite deposits have been mined or prospected for sheet muscovite (table 1). Total production of sheet mica from these deposits is less than 2,000 lbs (900 kg), and scrap mica production is about 30,000 lbs (13,600 kg). The value of this production was probably no more than $3000 in 1952 dollars, and the average quality of mica produced was low.

The largest workings are at the Little East Fork mine (Klepper and others, 1944). This deposit was prospected during World War I, mined sporadically from 1942 to 1944, and prospected again in 1952-53 (Lesure, 1968, p. 94-95). The last work was not successful. The deposit has a small potential for mostly scrap-quality mica.

The other known workings—the Shining Rock mine or prospect, three small prospects on Flower Knob, the Grassy Knob prospects, and three prospects north of Grassy Cove Top—have even less potential. All contain small pegmatite dikes that range in thickness from 1 to 8 ft (0.3-2.4 m) and in length from 10 to 100 ft (3-30 m); they have minor concentrations of generally poor quality muscovite. Most of the mica within these dikes is only of scrap quality.

In summary, the Shining Rock Wilderness contains a few scattered mica-pegmatite dikes that are generally small and poorly zoned. Most of the muscovite mica crystals are small and of poor quality. The economic potential is thus judged to be low in the known deposits, and probably is no greater in undiscovered deposits.

Metallic Resources

No metallic mineral resources are known in the Shining Rock Wilderness and no evidence of any economic deposit was found in the geochemical survey. The sequence of rocks exposed in the wilderness contains small deposits of copper-bearing sulfides 10-18 mi (16-28 km) west and southwest of the wilderness (Gair and Slack, 1979). Keith (1907, p. 8) reports minor amounts of copper sulfides and iron sulfides in schist and in quartz veins cutting gneiss near Retreat, 4 mi (6 km) northwest of the wilderness. An old gold mine, the Boylston mine on Forge Mountain, 10 mi (16 km) east of the wilderness (Nitze and Hanna, 1896, p. 181-191), is in metasedimentary rocks of the Great Smoky Group (Hadley and Nelson, 1971) which is probably younger than the rocks exposed in the wilderness.

Nine samples of vein quartz from the wilderness contain less than 10 ppm copper and no trace of gold. Geochemical data for the wilderness and vicinity do not suggest the presence of copper in concentrations that might be economically important. Traces of gold in rock samples are too low to be of commercial interest, and no gold was found in soil or stream-sediment samples. Other metals tested for are present in amounts normal for the rock types exposed (Lesure, 1981b); none was found in concentrations of economic importance. The available evidence, therefore, suggests that the area is not favorable for the occurrence of near-surface metallic deposits but may still be considered geologically permissive, using the definition of Lasky (1947, p. 3).

Oil and Gas

Recent seismic studies (Cook and others, 1979) indicate that the metamorphic rocks of the Blue Ridge Mountains in North Carolina, including the Shining Rock Wilderness, have been thrust at least 100 mi (160 km) up and over a thick sequence of younger sedimentary rocks, 3,000-15,000 ft (900-4,500 km) thick. These sedimentary rocks have an unknown potential for hydrocarbons. The depths at which they occur—5,000-45,000 ft (1,500-14,000 m)—and the implied degree of metamorphism for rocks at such depths suggest that any hydrocarbons present would be in the form of natural gas (Cook and others, 1979, p. 566). Until deep drilling is done to test the results of the seismic studies, no reasonable estimate of the gas potential can be made, but the presence of gas cannot be totally discounted.

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