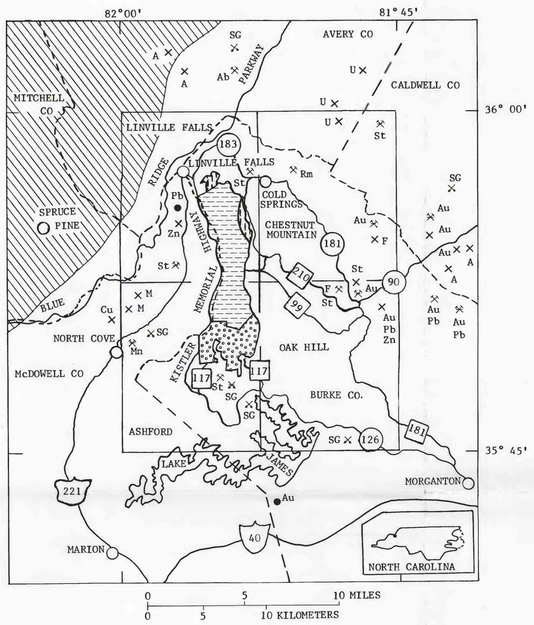
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF–1610–B
PAMPHLET ACCOMPANIES MAP



EXPLANATION

- Active quarry
- Abandoned mine or quarry
- Mineral prospect
- Mineral occurrence
- Active sand and gravel pit
- Inactive sand and gravel pit
- (18) State route
- (117) U.S. Forest Service route

Figure 1.—Index map showing location of the Linville Gorge wilderness (horizontal stippling), proposed extensions (A8–058, northern part, vertical stippling; and L8–058, southern part, circles), and Spruce Pine mining district (slanted stripes). Outlines and names of U.S. Geological Survey 7 1/2-minute topographic quadrangles are shown. Letter designations: A, asbestos; Ab, abrasives (garnet); Au, gold; Cu, copper; F, fluorite; M, mica; Mn, manganese; Pb, lead; Rm, road metal; SG, sand and gravel; St, building stone; U, uranium; and Zn, zinc. Sources are chiefly Reed (1964) and Bryant and Reed (1966).

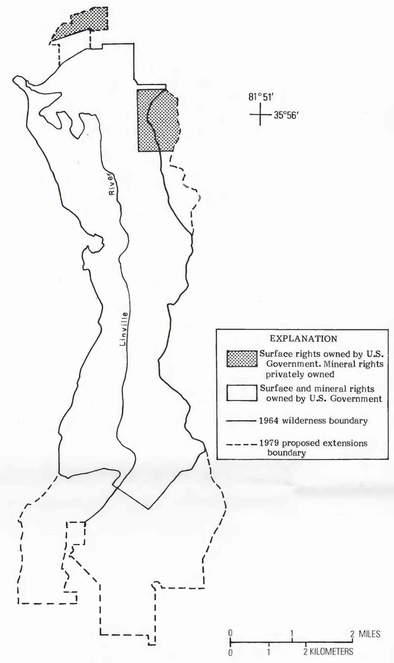
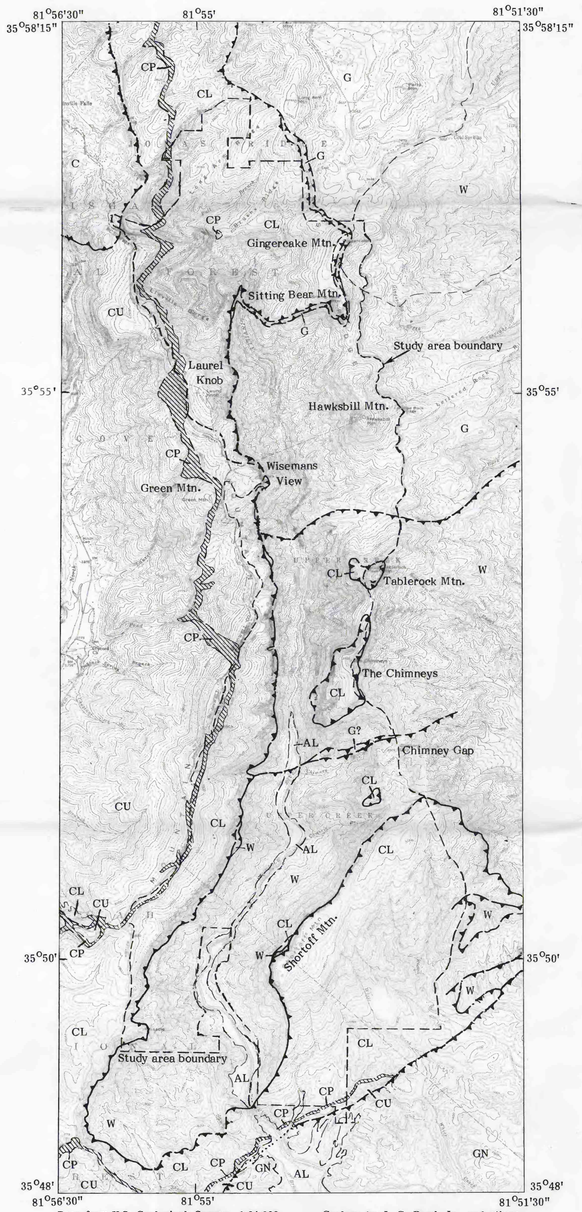


Figure 2.—Status of surface- and mineral-rights ownership in the Linville Gorge Wilderness and proposed extensions.



EXPLANATION

- AL — Alluvium (Holocene)—Sandy silt and clayey silt, with some boulders, in stream terrace; suitable for confined fill

Chilhowee Group (Early Cambrian and Late Proterozoic)—

- CU — Upper quartzite unit—White to gray, medium- to fine-grained, in thin to massive beds; suitable for building stone, marginally suited for glass
- CP — Phyllite unit—Lustrous, blue-gray; suitable for confined fill
- CL — Lower quartzite unit—White to gray, fine- to medium-grained, in massive to thin beds; suitable for building stone, poorly suited for glass
- G — Grandfather Mountain Formation (Late Proterozoic)—Light-colored, fine- to coarse-grained, thin bedded to massive arkose suitable for riprap, building stone, and aggregate; and dark, fine-grained phyllitic beds suitable for confined fill
- GN — Gneiss (Proterozoic)—Massive, layered, and much sheared in places; suitable for building stone and aggregate
- C — Cranberry Gneiss (Middle Proterozoic)—Massive and layered; suitable for riprap, building stone, and aggregate
- W — Wilson Creek Gneiss (Middle Proterozoic)—Massive and layered; suitable for riprap, building stone, and aggregate

Contact—Dashed where approximately located, gradational, or inferred

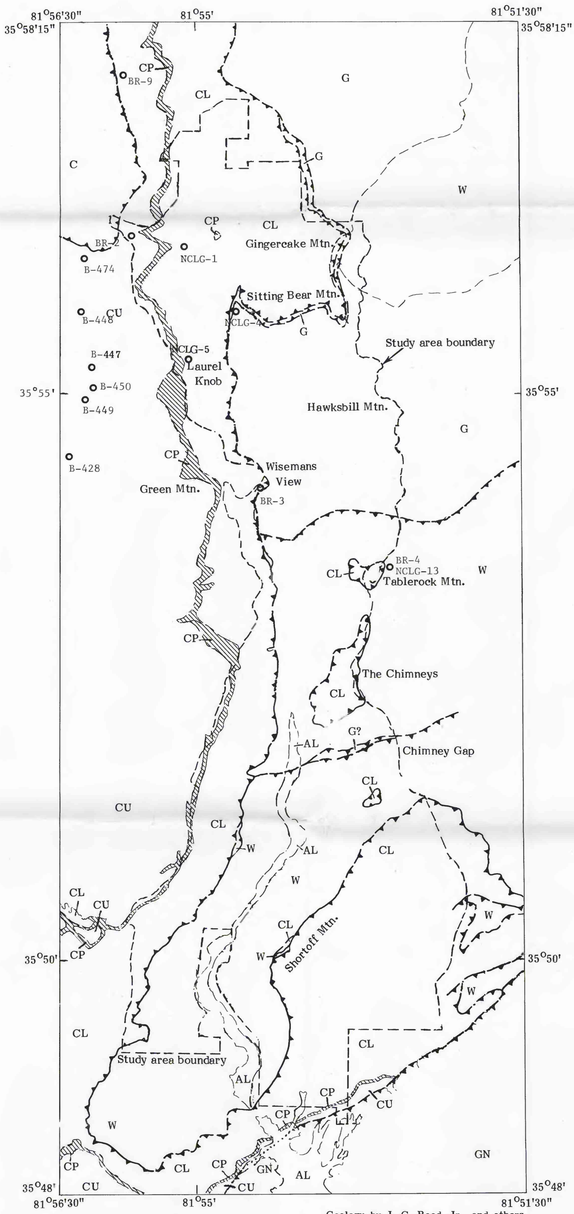
Thrust fault—Dashed where approximately located or inferred, dotted where concealed; teeth on upper plate

Base from U.S. Geological Survey, 1:24,000
Ashford, Chestnut Mountain,
Linville Falls, and Oak Hill, 1956

Geology by J. C. Reed, Jr., and others, 1957–60; modified by J. P. D'Agostino and J. W. Whitlow, 1982

SCALE 1:48 000
1 ½ 0 1 2 3 MILES
1 .5 0 1 2 3 KILOMETERS

Figure 3.—Map showing geology and mineral resource potential of the Linville Gorge Wilderness and proposed extensions.



Geology by J. C. Reed, Jr., and others, 1957–60; modified by J. P. D'Agostino and J. W. Whitlow, 1982

SCALE 1:48 000
1 ½ 0 1 2 3 MILES
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Figure 4.—Localities of Chilhowee Group samples having 90 percent or more silica (SiO_2), taken from the upper (CU) and lower (CL) quartzite units. Sample number prefixes: NCLG, U.S. Bureau of Mines; B, Broadhurst (1949); BR, Bryant and Reed (1970).

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral resource survey of the Linville Gorge Wilderness and proposed extensions. The area is in the Pisgah National Forest in Burke and McDowell Counties, N.C. Linville Gorge Wilderness was established by Public Law 88-577, September 3, 1964; Linville Gorge Extensions, northern part (A8-058) and southern part (L8-058), are roadless areas classified as proposed wilderness during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The mineral resource potential of the Linville Gorge Wilderness and proposed extensions is low. Silica sand is present in the Chilhowee Group but the quality is marginal for glassmaking and the sources are small. Rock suitable for small-size building stone and for crushed aggregate for construction use is abundant, but similar material is more readily accessible elsewhere. Sand and gravel in small amounts are available from alluvial deposits but access to them would be difficult. Significant concentrations of uranium in the Wilson Creek Gneiss are possible but none is known or indicated. Recent seismic data indicate that the Proterozoic and Cambrian metamorphic rocks exposed at the surface are 8,000 to 10,000 ft thick and conceal Paleozoic sedimentary rocks 15,000 to 20,000 ft thick that have an unknown potential for gaseous hydrocarbons and metallic sulfide ores.

INTRODUCTION

The Linville Gorge Wilderness and proposed extensions contain 10,976 acres of Pisgah National Forest land in the Blue Ridge Mountains of western North Carolina. The original wilderness consists of 7,575 acres; the northern extension (A8-058) contains 876 acres and the southern extension (L8-058), 2,525 acres. The study area of combined wilderness and extensions is almost entirely within Burke County; a small portion is in McDowell County (fig. 1). The area is 11 mi north-northeast of Marion and 13 mi west-northwest of Morganton.

Several roads provide access to the study area (fig. 1), and several good foot trails lead into the gorge and along the Linville River. Cliffs, as much as 900 ft high and several thousand feet long, occur throughout the gorge area and form most of the gorge rim. They create spectacular scenery but also restrict access. Altitudes range from 1,240 ft at river level on the southern boundary to 4,120 ft at the top of Gingercake Mountain on the northeastern boundary, resulting in maximum relief of nearly 2,900 ft.

Linville River, the main drainage, flows south into Lake James, a reservoir on the Catawba River. Small, short tributaries of the Linville River drain the slopes of the wilderness.

SURFACE- AND MINERAL-RIGHTS OWNERSHIP

The U.S. Government owns all of the surface rights and about 96 percent of the mineral rights in the wilderness and proposed extensions. Figure 2 shows the areas of mineral rights held in perpetuity by private parties. Although prospecting and mining development permits are granted in Pisgah National Forest, there is no record of any permit application nor any historical account of prospecting or mining in what is now the Linville Gorge Wilderness and proposed extensions.

GEOLOGY

The Linville Gorge Wilderness and proposed extensions are mostly within a geologically unique feature—the Grandfather Mountain window (Bryant and Reed, 1970). This geologic window is an area in which erosion through several thrust sheets has exposed underlying rocks of different ages. All of the rocks exposed in the study area show strong evidence of deformation and have been moved to their present site from an original location tens of miles to the east. At least three exposed thrust sheets exist (Harris and others, 1981). The unnamed lowest sheet contains the Middle Proterozoic Wilson Creek Gneiss and the overlying Late Proterozoic Grandfather Mountain Formation (Reed, 1964). Above this is the Tablerock thrust sheet, which contains the Late Proterozoic and Early Cambrian Chilhowee Group (Reed, 1964). Overlying this and forming the "frame" of the window is the Blue Ridge thrust sheet, the uppermost thrust sheet, and it contains the Middle Proterozoic Cranberry Gneiss.

The Middle Proterozoic Wilson Creek Gneiss, the oldest rock exposed in the wilderness (fig. 3), is a massive and layered, light-gray to greenish-gray, medium- to coarse-grained, cataclastic granitic gneiss.

The Late Proterozoic Grandfather Mountain Formation, which unconformably overlies the Wilson Creek Gneiss, consists of four members but only two occur in the study area. The first is a basal sericitic arkose, which comprises fine- to coarse-grained, thin to massive beds of green, tan, or gray. The second member overlies the arkose and is a fine-grained, mostly dark, thinly laminated siltstone, phyllite, and phyllitic schist. It is commonly calcareous and contains massive beds of graywacke and graywacke conglomerate.

Overlying the lowest unnamed thrust sheet is the Tablerock thrust sheet, which contains the Late Proterozoic and Early Cambrian Chilhowee Group (Reed, 1964). The Chilhowee is subdivided into three units, the lower quartzite, middle phyllite, and upper quartzite. The lower and upper quartzite units are massive to thin bedded, medium- to fine-grained, and white to gray; the phyllite unit is very thin to 100 ft thick and is lustrous blue-gray.

The Blue Ridge thrust sheet, which overlies the two lower thrust sheets (Reed, 1964), is present in a small area in the extreme northwestern corner of the study area. Of the many rock units contained in the Blue Ridge sheet, only the Middle Proterozoic Cranberry Gneiss occurs within the study area. Where exposed outside the study area it consists of light-colored granitic gneisses interlayered with dark biotite gneiss and biotite schist.

A small area of poorly exposed Proterozoic gneiss occurs in the southernmost part of the southern proposed extension. Exposures of the Proterozoic gneiss east and south of the wilderness are described by Reed (1964) as a strongly sheared fine- to medium-grained layered rock commonly containing pods of amphibolite and pegmatite.

The total thickness of the three thrust sheets with rocks of Middle Proterozoic to Early Cambrian age is about 8,000 to 10,000 ft (Cook and others, 1979; Harris and others, 1981). They overlie and conceal a younger Paleozoic sequence of unmetamorphosed sedimentary strata 15,000 to 20,000 ft thick. Part of this sequence underlying the wilderness at depth was horizontally moved tens of miles from the east (Harris and others, 1981).

GEOCHEMICAL SURVEY

A reconnaissance geochemical survey of the wilderness and proposed extensions found no evidence for the occurrence of metallic mineral resources. The samples collected include 32 rock, 58 stream-sediment, and 42 soil that were analyzed for 31 elements by means of semiquantitative emission spectrographic analysis methods in the Denver laboratories of the U.S. Geological Survey (USGS) (D'Agostino and others, in press). In general, the samples contain much less than the usual or normal range of metal concentrations except for boron, barium, and zirconium, which are a small increment above the normal range for similar rocks in the eastern United States (table 1 in pamphlet). The data also show stream sediments and soils that may have about double the amount of copper and lead and one-third the amount of barium as underlying bedrock. The copper and lead concentrations, however, are still trace amounts and are insignificant. Results of the geochemical survey indicate a low potential for metallic deposits in the wilderness and proposed extensions.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The known mineral resources in the Linville Gorge Wilderness and proposed extensions are limited to stone suitable for construction materials, quartzite suitable for low-quality glass sand, and small amounts of sand and gravel. All of these materials are available outside the study area.

Recent geophysical data indicate that Paleozoic sedimentary rocks 15,000 to 20,000 ft thick are covered by 8,000 to 10,000 ft of Middle Proterozoic to Cambrian igneous and metamorphic rocks (Cook and others, 1979; Harris and others, 1981). The areas underlain by the sedimentary rock have an unknown potential for gaseous hydrocarbons and metallic-sulfide ores which can be tested only by drilling.

There has been no mineral production in the study area, although mining has occurred nearby (fig. 1). Beginning 3 mi west of the wilderness is the very large Spruce Pine district which for more than 100 years has been a major producer of mica, feldspar, quartz, and clay (Lesure, 1968), but none of the rocks containing these resources are present in the study area. Other commodities that have been mined or identified as present near the wilderness are asbestos, abrasives (garnet), gold, copper, fluorite, mica, manganese, lead, uranium, and zinc, and rock quarries and sand-and-gravel pits (Bryant and Reed, 1966; Reed, 1964; and Conrad, 1960). Except for uranium and construction materials, these metals and minerals are found in rock types that do not occur in the study area. Analyses of geochemical samples and field inspection of exposed rock did not reveal anomalous amounts of these metals and minerals in the study area.

Geochemical studies of the Wilson Creek Gneiss in the Lost Cove and Harper Creek Roadless Areas in Avery and Caldwell Counties, N.C., about 8 mi east-northeast of the town of Linville Falls, have outlined areas having a potential for uranium (Crandall and others, 1982). The uranium minerals are in phyllonitic zones either as layers in fresh bedrock or as concentrations in surface oxidation zones (Bryant and Reed, 1966; U.S. Department of Energy, 1979). USGS and U.S. Bureau of Mines (USBM) personnel separately traversed areas of similar rock in the Linville Gorge Wilderness and proposed extensions using scintillation counters to measure radioactivity, but neither party found significantly anomalous radiation that might indicate bedrock that could be a source of uranium-ore minerals. Analytical and field studies suggest that the study area has low potential for uranium resources.

Silica sand

Chemical analyses indicate that the two prominent units of massive quartzite of the Late Proterozoic and Early Cambrian Chilhowee Group are not of sufficient purity in the study area to have any major potential use as glass sand (Gazdik and Harrison, 1981; Broadhurst, 1949; Bryant and Reed, 1970, table 18). The lower quartzite unit is exposed extensively throughout the wilderness, but analytical data show that the untreated quartzite does not even meet the requirements for 9th-quality amber glass (table 1). The upper quartzite unit is restricted by the wilderness boundary to two narrow mile-long strips paralleling the crest of Linville Mountain and to an isolated fault sliver in the southeast corner. Tests reveal that this unit has only moderately high silica for glassmaking (table 1). Amounts of alumina or iron probably restrict potential use of the upper quartzite unit to 7th-quality green or 9th-quality amber glass unless these constituents could be reduced by metallurgical treatment. Figure 4 shows the localities of samples having 90 percent or more silica, taken from the lower and upper quartzite units of the Chilhowee Group.

Construction materials

There are no rock quarries or sand and gravel pits in the study area. The bedrock units are generally strongly foliated and contain considerable amounts of soft, weak minerals, and thus are prone to rock failure. The bedrock, however, could be used satisfactorily in small structures or for decorative dressing or facing stone where bearing strength is unimportant. Because the rock is relatively soft it would be moderately easy to crush and would be suitable as a wearing surface for roads and for use as confined fill. The presence of soft, weak minerals in most of the bedrock would be deleterious in aggregate used for concrete because they reduce the strength of the concrete, and, upon weathering, quicken its disintegration.

Sand and gravel in limited amounts could be obtained along the gorge bottom from small irregularly spaced alluvial fans composed of silt- to cobble-size material (Reed, 1964). Screening and washing of the fan debris would probably be necessary before use.

Deposits of construction materials within the wilderness and proposed extensions are located mostly away from roads, thus adding to development cost, but similar rocks, and different rocks of higher quality better suited for quarrying, occur adjacent to roads outside the study area boundary (Councill, 1955; McDaniel and McKenzie, 1976). Considerable amounts of sand and gravel are available on the flood plain of the Linville River about 1 mi south of the study area boundary, at the sites of inactive sand and gravel pits (fig. 1).

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Table 1.—*Silica, alumina, iron, and lime-magnesia content of Chilhowee Group samples having 90 percent or more SiO_2*

Sample number[1]	SiO_2	Al_2O_3	Fe_2O_3	CaO+MgO
	percent			
Upper quartzite unit				
NCLG-5	95.9	1.0	0.91	—[3]
B-428	95.6	2.7	.19	—
B-447	91.0	7.2	.17	—
B-448	95.0	3.7	.27	—
B-449	95.4	3.6	.12	—
B-450	94.9	4.1	.16	—
B-474	96.7	3.0	.12	—
BR-9	94.4	1.4	2.50	0.14
Lower quartzite unit				
NCLG-4	92.2	—	—	—
NCLG-13	90.0	—	—	—
BR-2	90.1	4.5	.46	.33
BR-3	90.7	3.7	.92	.20
BR-4	94.0	2.6	.45	.05
	minimum	maximum	maximum	maximum
7th quality, green glass[2]	95.0	4.0	0.3	.5
9th quality, amber glass[2]	95.0	4.0	1.0	.5

[1]Numbers preceded by:
NCLG – Samples collected by U.S. Bureau of Mines in 1978 and 1980 (Gazdik and Harrison, 1981, p. 30).
B – Analyses from Broadhurst, 1949, p. 13, 14.
BR – Analyses from Bryant and Reed, 1970, p. 102.

[2]Specifications for chemical composition of glass sand recommended by American Ceramic Society and National Bureau of Standards.

[3]—, not analyzed.

MINERAL RESOURCE POTENTIAL MAP OF THE LINVILLE GORGE WILDERNESS AND PROPOSED EXTENSIONS, BURKE AND MC DOWELL COUNTIES, NORTH CAROLINA

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