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MINERAL RESOURCE POTENTIAL OF THE LOST COVE AND HARPER CREEK ROADLESS AREAS, AVERY AND CALDWELL COUNTIES, NORTH CAROLINA
A SUMMARY REPORT

By

T. M. Crandall and R. B. Ross Jr.
U.S. Bureau of Mines,
and J. W. Whitlow and W. R. Griffitts,
U.S. Geological Survey

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 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 Lost Cove and Harper Creek Roadless Areas, Pisgah National Forest, Avery and Caldwell Counties, North Carolina. The two areas were classified as further planning during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979. For the purpose of this report, the areas will be referred to collectively as the study area.

MINERAL-RESOURCE POTENTIAL SUMMARY STATEMENT

A geologic, geophysical, and geochemical investigation and a survey of mines, quarries, and prospects have been conducted to evaluate the mineral resource potential of the Lost Cove and Harper Creek Roadless Areas, Avery and Caldwell Counties, North Carolina. The study area lies within the Blue Ridge physiographic province and is predominatly underlain by Precambrian age plutonic and metasedimentary rocks of low metamorphic grade. All surface and mineral rights are Federally owned. Permit areas for uranium prospecting cover about 85 percent of the area.

Uranium-rich rock in the Lost Cove and Harper Creek Roadless Areas occurs widely in the Wilson Creek Gneiss and to a minor extent in the Grandfather Mountain Formation. Vein-type deposits and other occurrences of uranium in foliated rocks in the Wilson Creek Gneiss have uranium resource potential. Speculative resources of uranium in vein-type deposits and in supergene-enriched foliated rocks are estimated to total 4 to 8 million pounds of U_3O_8.

Mineral resources having low to moderate potential are gold and minerals of thorium, beryllium, niobium, and copper. Stone has a low economic potential; lead, molybdenum, and titanium have low resource potential. These conclusions are based on results of prospect examination, radiometric survey, geochemical survey of stream sediments, saprolite, and bedrock.

INTRODUCTION

There has been no mining activity within the study area. Two prospects in the Harper Creek Roadless Area and one in the Lost Cove Roadless Area have been investigated by major exploration companies. Twenty-two drill holes and 19 trenches constitute the visible evidence of exploration in the study area. Uranium prospecting permits and areas for which applications for permits were pending in 1981 cover 86 percent of the study area. Prospecting is not a new activity: uranium and thorium were found in and near the study area in the 1950's and the first trenching and drilling soon followed. The North Harper Creek prospect was first drilled then and has been re-examined twice since then. Gold, tungsten, niobium, and beryllium had not been reported in the study area before the investigations leading to the present report, although they had been found elsewhere in the region.

The geochemical sampling, radiometric surveys, and prospect examination for this report were done in 1979 and 1980. We rely upon the reports by Reed (1964) and Bryant and Reed (1970) for most information about the geology of the region and study areas.

Area Description

The Lost Cove and Harper Creek Roadless Areas comprise 5,708 and 7,163 acres, respectively, in Pisgah National Forest, Avery and Caldwell Counties, North Carolina (fig. 1). The areas are contiguous along Forest Service Routes 464, 981, and 982 and have similar geology and mineral potential.

The study area is on the eastern flank of the Blue Ridge Mountains and is characterized by rugged topography comprising a series of east-west-trending ridges interspersed with steep-sided valleys. Elevations range from about 1,500 to 4,000 ft. Major drainages are Gragg Prong, Harper, North Harper, Lost Cove, and Craig Creeks. Access to the area is provided by the Blue Ridge Parkway and Forest Service Routes 464, 981, and 982. Well-traveled foot trails and abandoned logging roads provide interior access.

Previous Investigations

Reports pertaining to mineral resources in and near the study area primarily concern uranium. Radioactive occurrences in the study area were first reported by Stow (1955) as part of a regional investigation sponsored by the U.S. Atomic Energy Commission. Other regional studies include U.S. Atomic Energy Commission and U.S. Geological Survey (1968), Penley and others (1978), and Wagener and McHone (in press). As part of uranium resource investigations in the Blue Ridge region, the U.S. Department of Energy has sponsored hydrogeochemical and stream-sediment surveys (Price, 1976; Baucom and others, 1977; Heffner and Ferguson, 1978) and aerial radiometric surveys (LKB Resources, Inc., 1978; 1979).

Bryant and Reed (1966) investigated uranium occurrences in the Grandfather Mountain window and summarized results of company exploration in the North Harper Creek Prospect (loc. 15, fig. 1). Generalized descriptions of the North Harper Creek prospect and uranium occurrences near Lost Cove Creek (loc. 14, fig. 1) are included in reports by Walker and Osterwald (1963), the Southern Interstate Nuclear Board (1969), Grauch and Zarinski (1976), and Greenberg and others (1977). Detailed studies of uranium mineralization in the study area have been conducted by Galipeau and Ragland (1977), Kasza and Rush (1980), and Fronabarger (1980).

Mineral resource reports concerning gold occurrences in the Grandfather Mountain Formation and Wilson Creek Gneiss include Keith (1903) and Bryant and Reed (1966). Stone in and near the study area is discussed by Bryant (1962) and Bryant and Reed (1966).

Present Investigation

A geologic, geophysical, and geochemical investigation and a survey of mines, quarries, and prospects have been conducted to evaluate the mineral resource potential of the study area. The U.S. Bureau of Mines investigation was focused on the assessment of uranium prospects and associated mineralization. Prospects, drill sites, trenches, and exposures in and near the area were examined. Fieldwork included a preliminary radiometric reconnaissance of the study area followed by detailed examination of 48 areas of high radioactivity (Ross and Crandall, 1982a). One hundred and three rock, saprolite, and sediment samples were collected and analyzed spectrographically for 40 elements. Fluorometric, radiometric, and inductively coupled plasma analysis were performed on selected samples (Ross and Crandall, 1982b). The U.S. Geological Survey conducted a geochemical survey of the region including collection of rocks, stream sediments, and panned panned concentrates for analyses (Griffitts and others, 1982).

SURFACE AND MINERAL OWNERSHIP

The U.S. Government owns all surface and mineral rights in the Lost Cove and Harper Creek Roadless Areas. Uranium prospecting permits covering portions of the study area were issued to E. J. Longyear in the 1950's, and Continental Oil Company and French American Metals Corporation in the 1970's. Following exploration efforts, there were no subsequent applications to renew permits. As of November 1981, permit areas for uranium prospecting cover more than 11,000 acres, or 86 percent of the study area. Uranium prospecting permits, and areas under consideration for issuance of permits, are shown in figure 2.

GEOLOGY

The Wilson Creek Gneiss of Precambrian or Proterozoic Y age underlies all of the study area except the northwestern third of the Lost Cove Roadless Area. This gneiss consists of metamorphosed plutonic rocks of quartz monzonite to granodiorite composition (Bryant and Reed, 1970; Rankin and others, 1972). Some of these rocks resemble normal granites; others are coarse grained and pegmatitic in texture. Enclosed in these plutonic rocks are a variety of rocks ranging from amphibolite to felspathic or biotitic gneisses and minor metavolcanic rocks (Wagener, 1979). Some of these rock types may be hosts for one or more of the metals or minerals mentioned later in the report, but none of the layers were individually sampled. Phyllonite zones in the Wilson Creek Gneiss are the results of Paleozoic low-grade metamorphism of the Precambrian granitic rocks (Reed, 1964; Bryant, 1966). Nearly all the known occurrences of uranium minerals in the study area are in Wilson Creek Gneiss and associated with phyllonite.

Basal arkosic sandstone and siltstone of the Grandfather Mountain Formation of Precambrian or Proterzoic Z age nonconformably overlies the Wilson Creek Gneiss. These rocks are exposed in the northwestern third of the Lost Cove Roadless Area. Small areas of Precambrian metadiabase (Linville Metadiabase) and diorite underlie a few hundred acres adjacent to the contact between the Wilson Creek Gneiss and the Grandfather Mountain Formation.

URANIUM EXPLORATION

Uranium exploration, in and near the study area, began in 1955 and has continued to the present. The following summarizes exploration conducted by E. J. Longyear Company, Continental Oil Company (Conoco), and French American Metals Corporation (FRAMCO). Data from approximately 7,500 ft of core drilling done in the North Harper Creek prospect and 452 ft near the headwaters of Craig Creek by companies are used in this report.

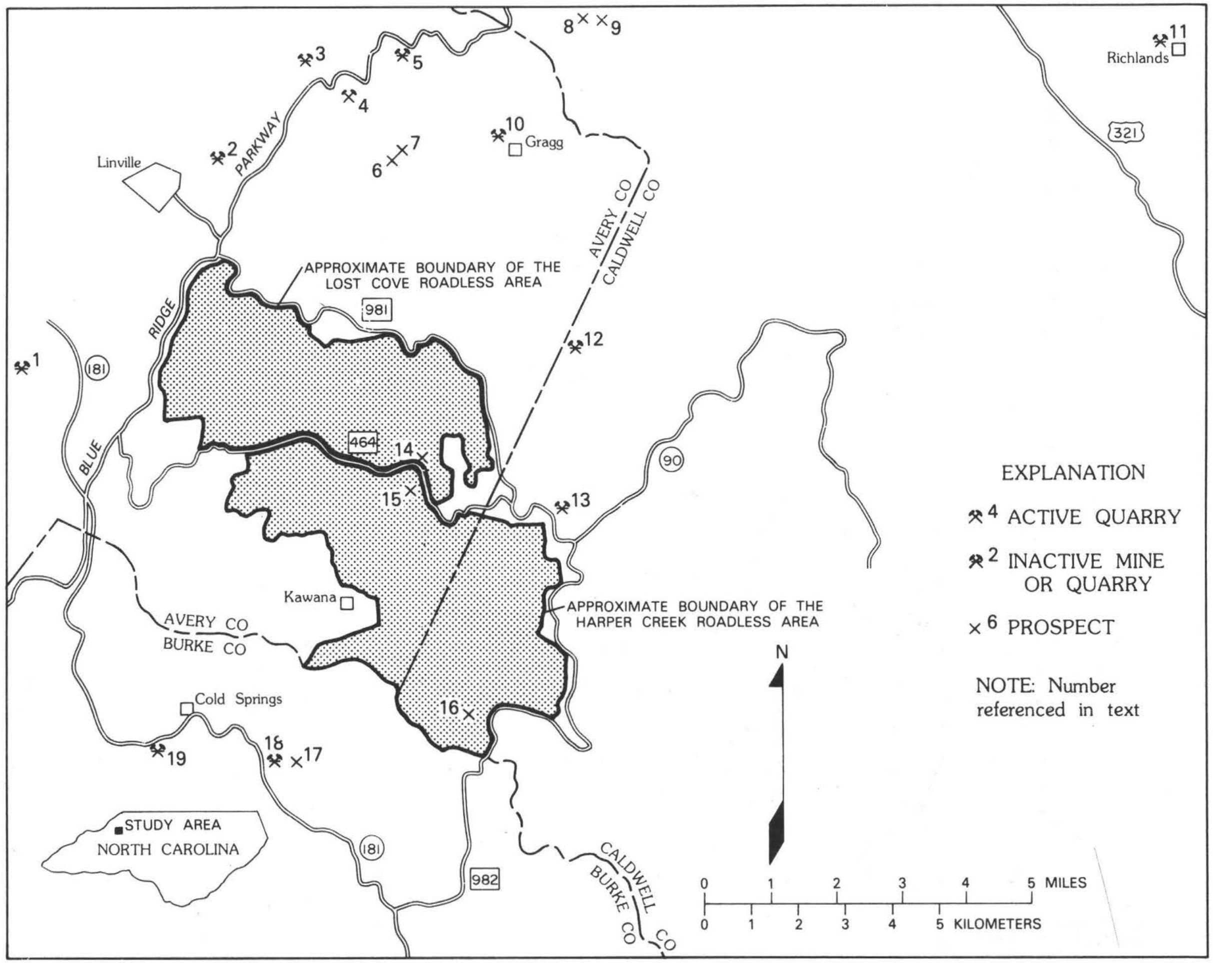
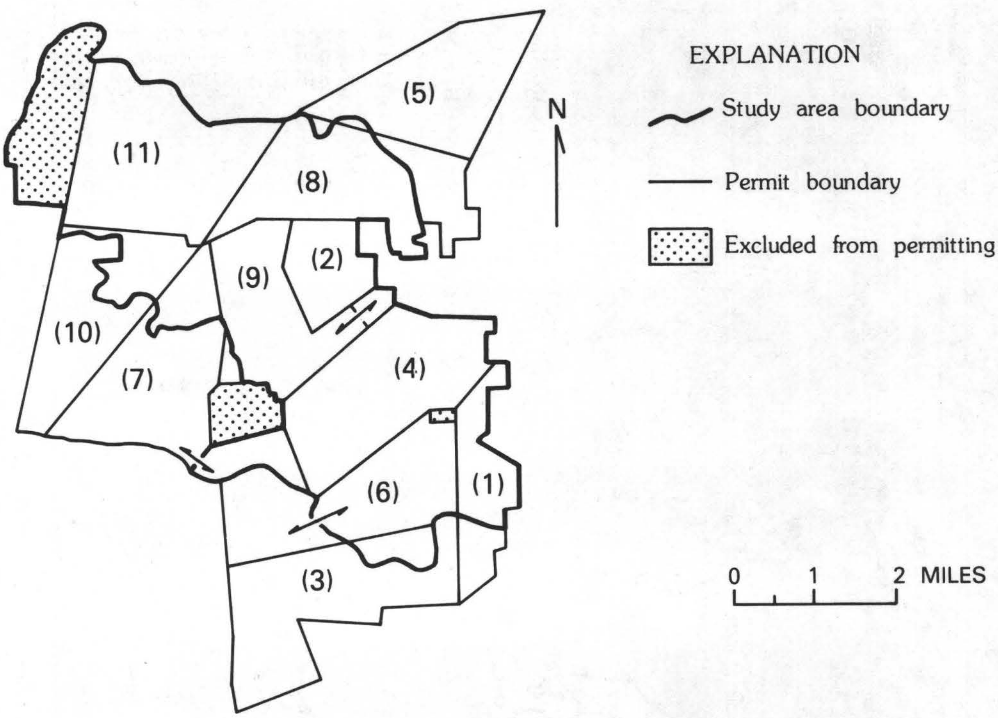


Figure 1.--Index map showing location of the Lost Cove and Harper Creek Roadless Areas, Avery and Caldwell Counties, N. C.



ACTIVE PERMITS

Minatome Corporation	(1) ES 16086
Jewell, John	(2) ES 11660
Carolina Uranium Company	(3) ES 21603
do.	(4) ES 21604
do.	(5) ES 21606
do.	(6) ES 21607
do.	(7) ES 21608
Hardeman, William	(8) ES 20625
do.	(9) ES 20627

PENDING PERMITS

Henson, David E.	(10) ES 22405
Slagle, Charles S.	(11) ES 22406

Figure 2.--Uranium prospecting permits, Lost Cove and Harper Creek Roadless Areas, Avery and Caldwell Counties, N. C. (as of November 1981).

E. J. Longyear Company

Uranium exploration, in and near the study area, was begun in 1955 by the E. J. Longyear Company. Initial investigations, summarized by Bryant and Reed (1966) centered on occurrences at Ripshin Ridge, Lost Cove Creek, and north Harper Creek. Uranium mineralization comprising torbernite in schist was identified at the Ripshin Ridge (loc. 17, fig. 1) and Lost Cove Creek localities. Trenching at both sites revealed localized and discontinuous torbernite-rich lenses in schists that occurred as enclaves in granite. In the case of the Ripshin Ridge occurrence, uranium mineralization did not extend below the initial bulldozer cut.

Exploration at the North Harper Creek prospect was more detailed, including excavation of anomalous sites, surface sampling, geologic and radiometric surveying, diamond drilling, and radiometric probing of drill holes. Surface investigations indicated that uranium mineralization was concentrated along three principal zones of shearing oriented parallel to local structural trends. Host rocks of the shear zones are mylonitic schist and were considered to have formed along concordant zones of movement, bounded by nonbrecciated schists and granites. Mineralization comprised disseminated uraninite and uraninite veinlets, parallel to and crosscutting shear zone foliation.

Seven diamond drill holes totalling 3,055 ft, were drilled to evaluate the projected subsurface extensions of exposed shear zones (fig. 3). Results of drilling indicated that the shear zones were either unrecognizable at depth or became dissipated in schists. Moreover, it was concluded that alaskite-pegmatite bodies invading shear zones and adjacent granites were the actual host rocks. The lack of encouraging uranium shows and the assumption that deposits in isolated alaskite bodies would yield low ore tonnages caused Longyear to abondon exploration in 1956.

Conoco

Major exploration in the study area did not resume until 1970 when Conoco acquired five prospecting permits comprising about 11,000 acres. Exploration, summarized in an unpublished Conoco report, included general radiometric prospecting within the permit areas and detailed exploration in the area between and including the North Harper Creek and Lost Cove Creek localities. This detailed investigation consisted of digging 19 trenches (fig. 3) to uncover anomalies, assaying of trench samples, geologic mapping, diamond drilling, and radiometric probing of drill holes.

The object of Conoco's exploration was similar to Longyear's in that zones of sheared bedrock were considered to be the principal hosts for uranium mineralization. Conoco postulated that uranium occurrences at the Lost Cove Creek locality and at Bard Falls represented the north and south extension of mineralized shear zones trending roughly N.30° E.

Following surface investigations, Conoco drilled four holes totalling 2,563 ft to evaluate the strike and dip projections of the presumed shear zones (fig. 3). All holes were inclined at a 40° angle to the west or northwest. Results of core examination and radiometric logging indicated no significant uranium mineralization at depth. It was concluded that surface showings of uranium probably represented supergene concentrations that were not likely to be present at depth. Based on this assumption the prospect was abandoned in 1971 and all permits were released.

FRAMCO

In 1976, FRAMCO began exploration on nine prospecting permits totalling 17,616 acres, that included most of the present study area. Their exploration program consisted of radiometric reconnaissance of the permitted area and detailed investigation of the North Harper Creek area, including core drilling. Preliminary geologic and radiometric work in the North Harper Creek prospect centered on investigation of relatively unweathered bedrock in creek beds. The data gathered during this phase of exploration indicated that uranium mineralization was associated with lenses and pods of quartz-feldspar-rich gneisses that were thoroughly transected by uraninite veins and veinlets. Orientation of uraninite veining was dominantly east-west although paper-thin veinlets parallel to foliation were also observed.

During the winter and spring of 1976-77, nine drill holes totalling 1,964 ft were completed to evaluate the projections of four surface anomalies (fig. 4). In addition to the drilling on North Harper Creek, two holes totalling 452 ft were drilled on Craig Creek (loc. 16, fig. 1) to evaluate, at depth, uraninite disseminations in sericite schist.

Drilling results in the North Harper Creek prospect were considered encouraging with two holes (2A and 7B, fig. 4) encountering intervals of high-grade mineralization. However, the company concluded that more intensive drilling would be required to delineate a commercial deposit.

Despite initial indications that FRAMCO would continue exploration, the company released all permits in November 1977. Inclusion of the Harper Creek and Lost Cove areas in the RARE II program was cited as the reason for abandoning exploration.

ASSESSMENT OF MINERAL RESOURCES POTENTIAL

Uranium

High resource potential for uranium is assigned to the eastern part of the Lost Cove Roadless Area and the central and southeastern parts of the Harper Creek Roadless Area (fig. 5) because:

1. Very high uranium contents were found in rock samples, shown by high radiometric readings and high uranium values, determined chemically.
2. Anomalous uranium contents were found in stream sediment.
3. Uranium mineralization is evident in trenches and drill holes at several prospects.
4. Phyllonite, related to uranium mineralization, is widespread (Reed, 1964).

Moderate potential for uranium is assigned to the central part of the Lost Cove Roadless Area and the northwestern and northeastern parts of the Harper Creek Roadless Area because:

1. High uranium contents were found in several rock samples, shown by radiometric and chemical analyses.
2. Uranium has been found locally concentrated in surface materials.

Low potential for uranium is inferred for the western part of the Lost Cove Roadless Area because it is underlain by the Grandfather Mountain Formation, which is much less favorable as a host rock than the Wilson Creek Gneiss that underlies the rest of the study area.

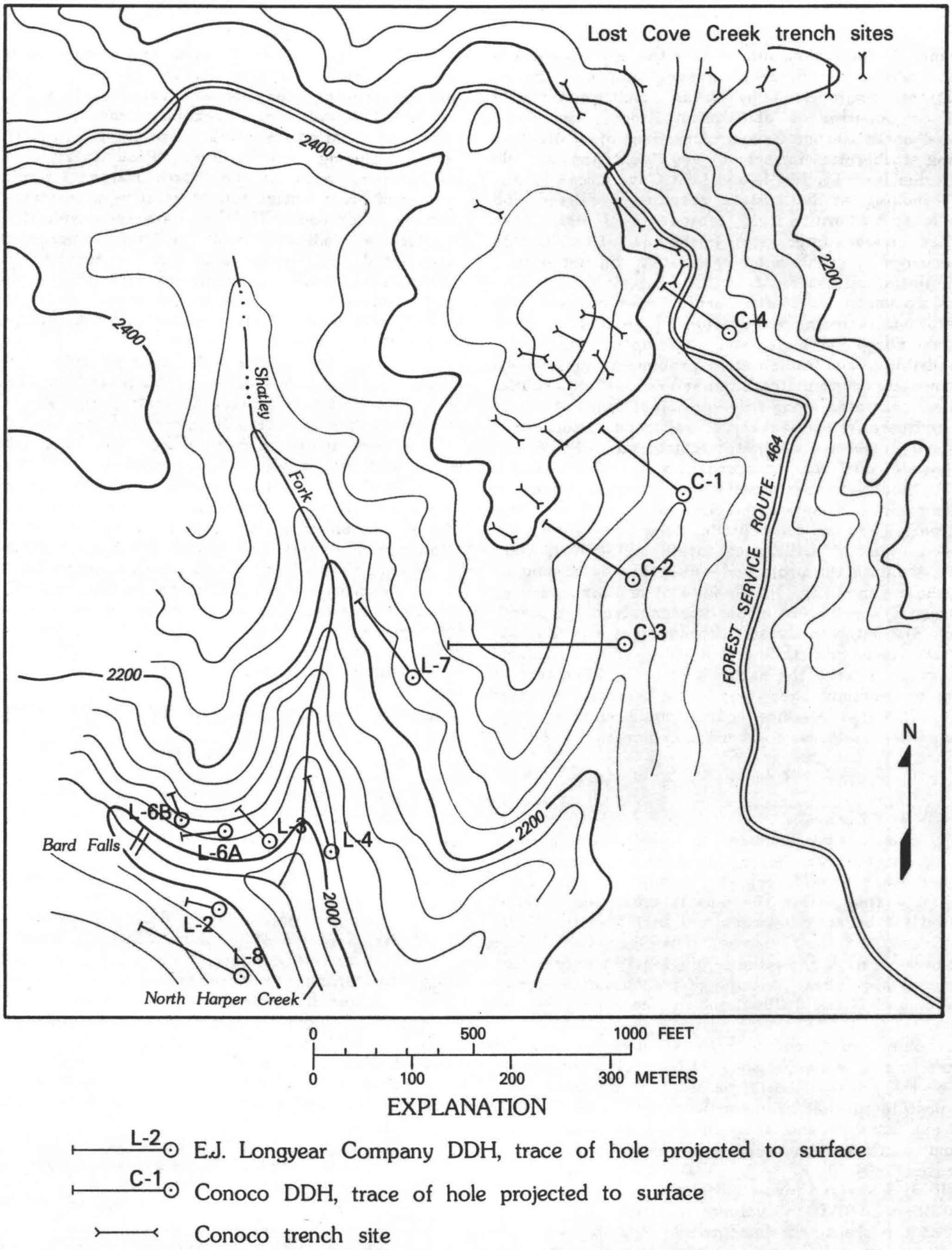


Figure 3.—Longyear Company and Conoco diamond drill holes and prospect trenches, North Harper Creek prospect, Avery County, N. C.

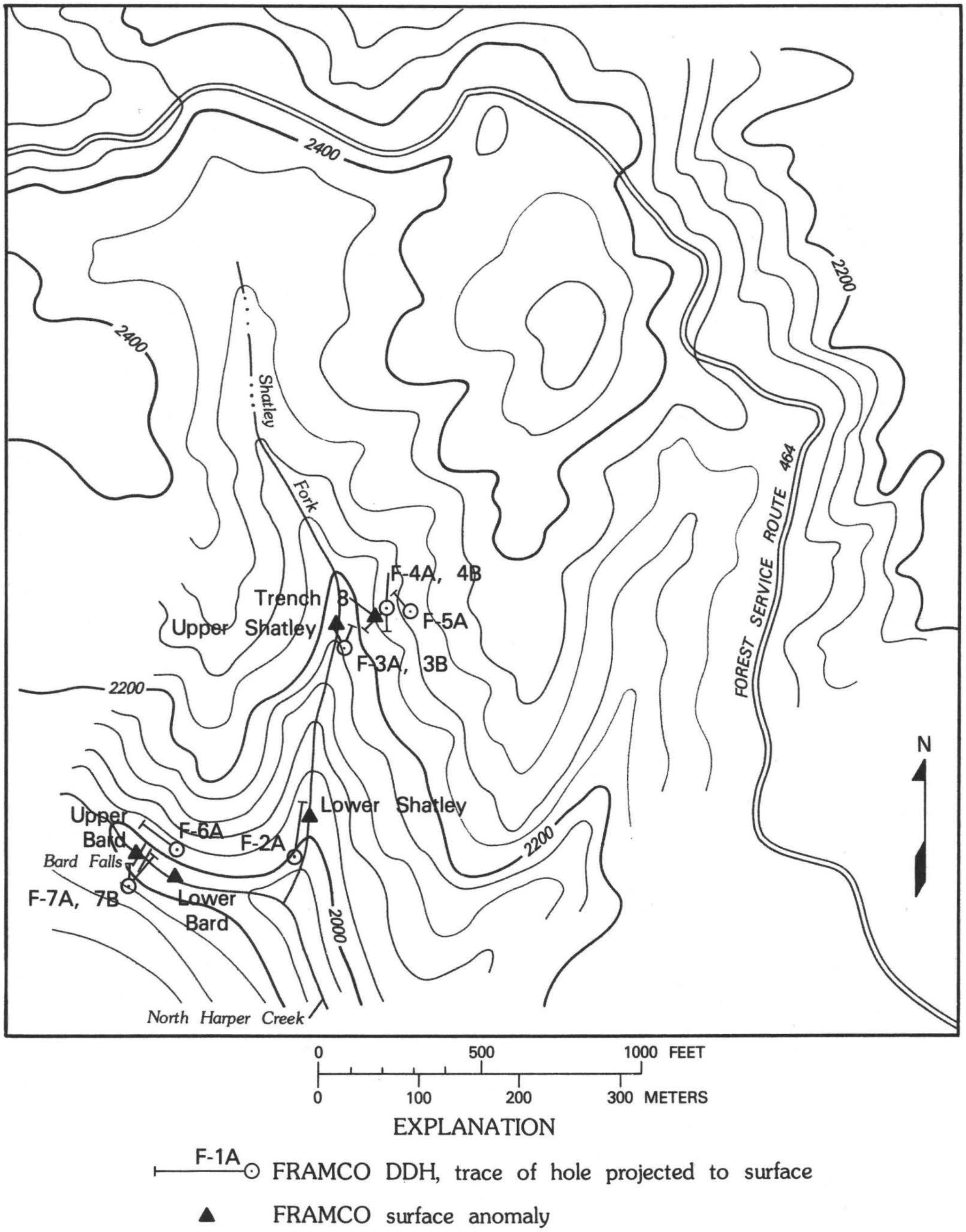
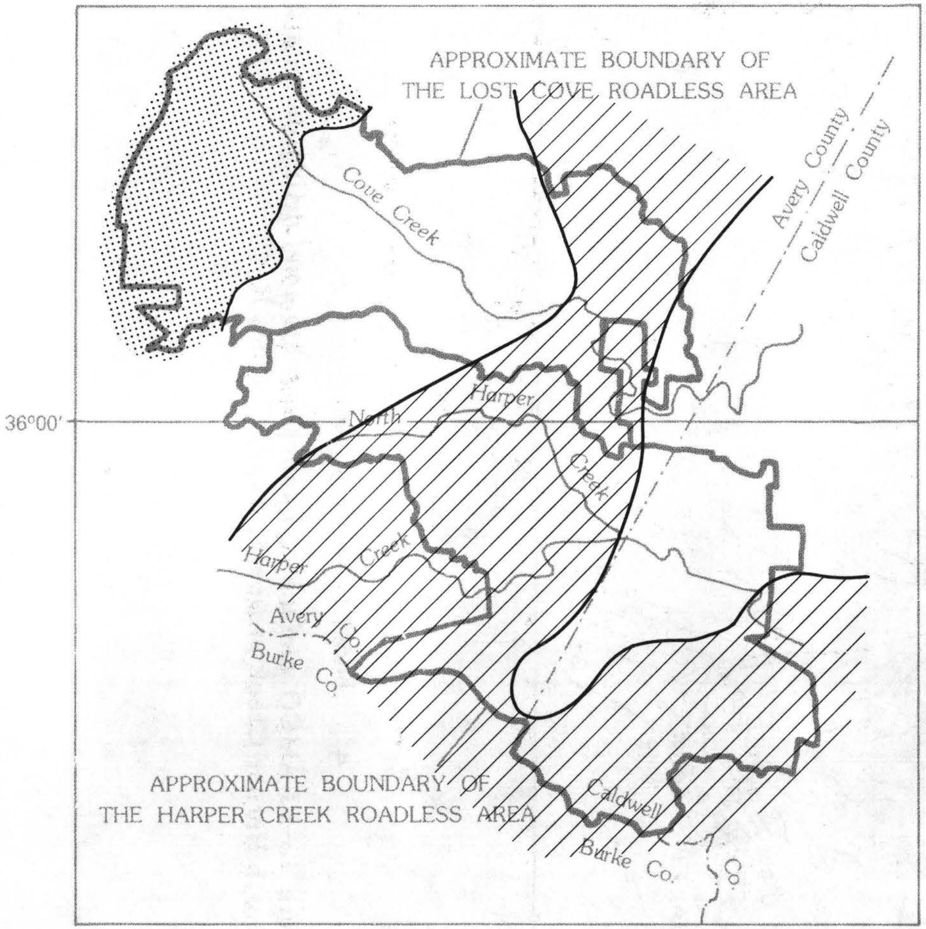


Figure 4.—FRAMCO surface anomalies and diamond drill hole locations, North Harper Creek prospect, Avery County, N. C.



EXPLANATION

[Areas with high resource potential have many sites with high radiometric readings, high uranium contents in rocks and stream sediments, and prospect openings that provide information about uranium mineralization. Areas with moderate resource potential have fewer places with high radiometric readings, fewer rocks or sediments with high uranium contents, and no prospects. Areas with low resource potential have few surface indications of mineralization and are underlain by rocks that are not favorable for mineralization]

AREA WITH HIGH POTENTIAL

AREA WITH MODERATE POTENTIAL

AREA WITH LOW POTENTIAL

0 1 2 3 MILES

Figure 5.—Map showing resource potential for uranium.

Vein-type Uranium Deposits

Mineral resource potential is highest for vein-type deposits such as those present in the North Harper Creek prospect. Exposures in stream channels in the prospect area show that mineralized rock occurs in discontinuous lenses and pods of quartz-feldspar-rich rock in the Wilson Creek Gneiss. These lenses and pods are intercalated with schist on a scale of a few feet to tens of feet.

About 1,200 ft of drilling by FRAMCO in the Harper Creek Prospect disclosed two intervals of ore-grade mineralized rock at depths of 160 to 280 ft in two of the drill holes. The mineralized rock averaged 0.074 percent and 0.08 percent uranium in intervals 26 ft and 20 ft thick, which included four 2 ft thick zones that contain greater than 0.1 percent uranium. Geologic logs indicate the uranium minerals are in veinlets and on fractures that cut across the foliation of lenses and pods of pyritic quartz-feldspar gneiss, sericitic quartz-feldspar-biotite gneiss, and chloritic-sericitic schist, all in the Wilson Creek Gneiss. Mineralized rock averaged greater than 0.05 percent uranium in intervals from 1-6 ft thick in five additional holes. Fluorite, pyrite, and pyrrhotite are associated with pitchblende in the veins. The pitchblende contains tiny particles of galena, which probably formed from radiogeneic lead.

Speculative Resources[1]

Speculative uranium resources in vein-type deposits are estimated to total from 4 to 7 million pounds of U_3O_8 in the study area. In determining this estimate, resources were calculated for the North Harper Creek prospect and were based on the two assumptions: (1) that grade and frequency of occurrences of surface mineralization are repeated at depth, and (2) that vein-type mineralization extends for a depth of at least 300 ft. North Harper Creek resource estimates were calculated for an area 1,200 ft by 350 ft at average uranium concentrations of 0.05 and 0.1 percent and then extrapolated to areas considered favorable for occurrence of similar mineralization.

Disseminated Uranium in Foliated Rocks

Uranium deposits in schists and shear zones have moderate to high resource potential. These deposits are represented at the surface by disseminated uraninite(?) and uranium secondary minerals in weathered foliated rocks, and have the following in common: localized highly radioactive zones 10-15 ft long and less than 2 ft thick along foliation; a concentration of radioactivity and secondary uranium minerals along foliation; a close association of radioactivity with graphite-rich zones; and proximity of lenses of both radioactive and nonradioactive granites and quartz-feldspar-rich gneisses.

Drilling for uranium in schists and shear zones in the study area has totaled about 6,740 ft. The results indicate that the zone of surface oxdiation and supergene processes reach depths of 20-80 ft. Potential primary uranium source rocks may include vein-type deposits or disseminated uranium minerals in foliated rocks. The surface anomalies may represent local concentrations of supergene uranium.

Speculative Resources

Geologic information from FRAMCO indicates that mineralization at Craig Creek, in the southern part of the Harper Creek Area, is disseminated in a sericite schist unit that extends 900 ft along strike, has a surface width of 150 feet, and dips 60° to the southeast. Assuming an average value of 0.05 percent uranium extending to depths of 20 to 80 ft downdip within the schist unit, we infer that speculative uranium resources in supergene-enriched, foliated rocks may total as much as 600,000 pounds of U_3O_8 in three similar deposits within the study area.

Thorium and Rare Earths

Monazite was found in most streams sampled and could readily be recovered if any placer mining is undertaken. Thorite is also present and could be recovered along with the monazite. In the study area, the cerium group of rare earths is in monazite and in the less-common allanite. Florencite is associated with gray monazite in biotite-rich layers in gneiss south of the study area and may well occur with the gray monazite found in the basin of Raider Camp Creek. In districts outside of the study area, gray monazite is exceptionally rich in europium, but that has not been demonstrated in the gray monazite within the study area.

The resource potential for thorium is moderate, but the small market for the metal probably will not permit development of the deposits. Rare-earth elements are so intimately associated with thorium that they are likely to be recovered only as a byproduct with thorium.

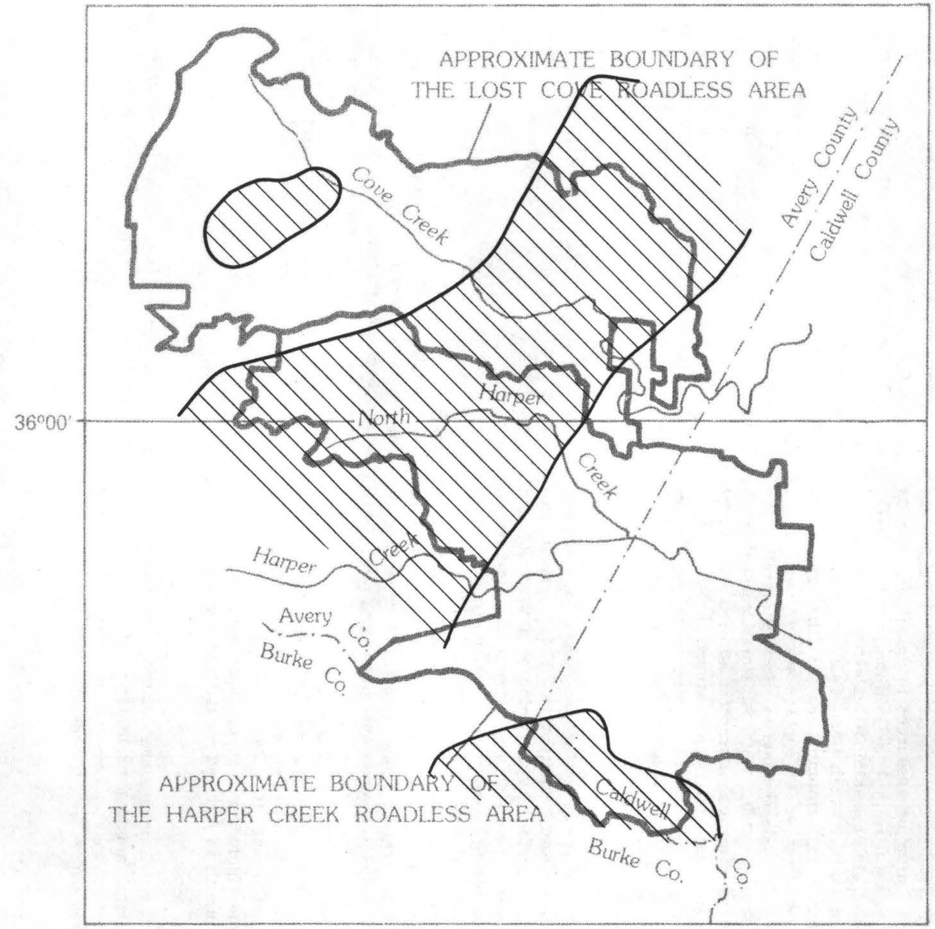
Niobium

Niobium concentrations, as much as 5,000 parts per million (ppm) in heavy-mineral concentrates (fig. 6), indicate that the metal may be mineable as a primary ore or byproduct when its bedrock source is known. The large overlap of the niobium and uranium areas suggests that the niobium might be produced as a byproduct of uranium mining.

Beryllium

The very high beryllium content of 100 ppm, or more, in heavy-mineral concentrates collected in the eastern part of the Lost Cove Roadless Area and the northern part of the Harper Creek Roadless Area probably reflect the presence of beryllium minerals in the bedrock, but none have been sought (fig. 7). Beryllium minerals may be in high enough concentrations to be ore in one or more of the many types of rock present in the Wilson Creek Gneiss. Concentrations containing as little as 20-ppm beryllim may also indicate mineralization.

[1]Speculative resources are defined as undiscovered resources that may occur either in known types of deposits in favorable geologic settings or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources (U.S. Bureau of Mines and U.S. Geological Survey, 1980, p. 3).



EXPLANATION

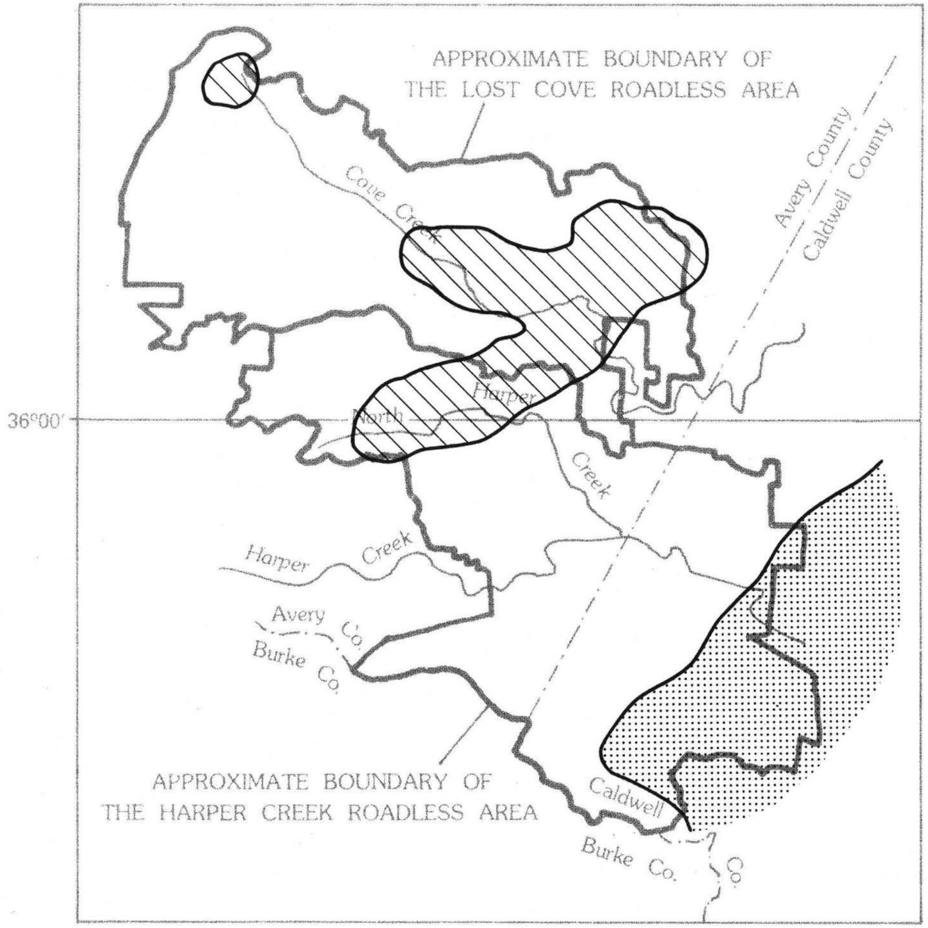
[Areas with high resource potential yield heavy-mineral concentrates containing 200 to 1000 ppm niobium. Areas with moderate resource potential yield concentrates containing 100 to 150 ppm niobium]

AREA WITH HIGH POTENTIAL

AREA WITH MODERATE POTENTIAL

0 1 2 3 MILES

Figure 6.—Map showing resource potential for niobium.



EXPLANATION

[Areas with high potential yield heavy-mineral concentrates that contain 100 ppm beryllium. Areas with moderate potential yield heavy-mineral concentrates that contain 20 to 70 ppm beryllium. Areas with low potential yield heavy-mineral concentrates that contain 20 ppm beryllium]

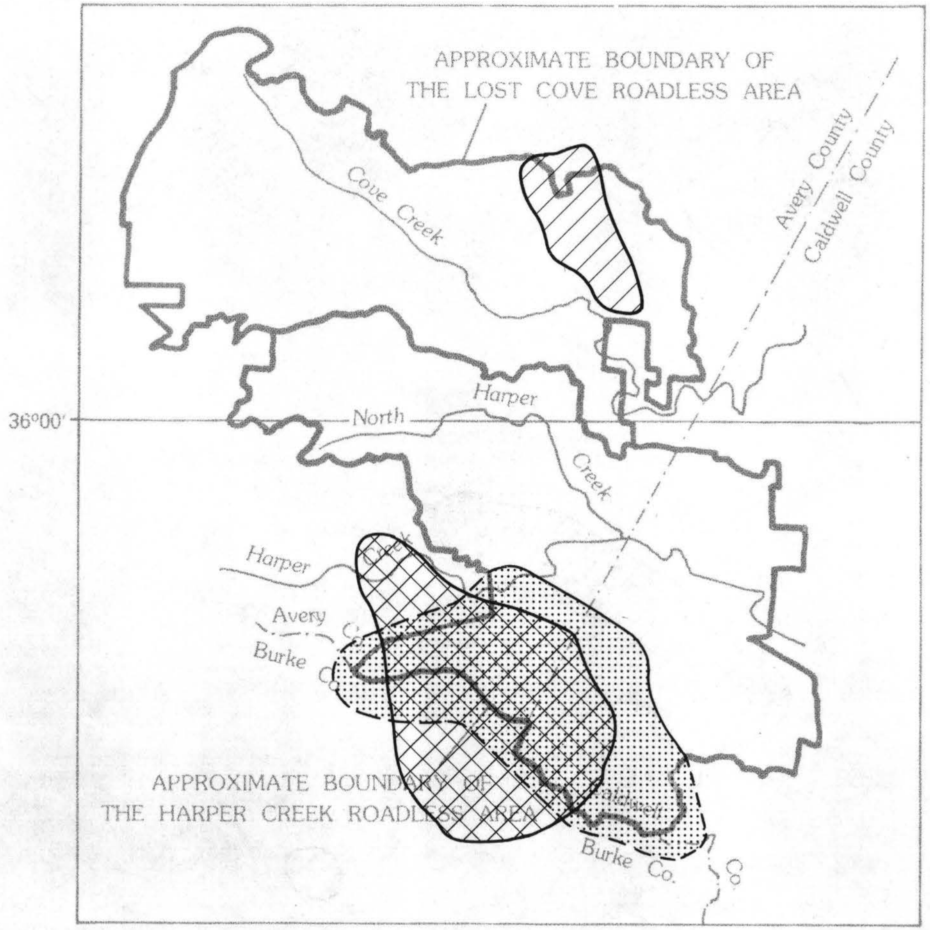
AREA OF HIGH BERYLLIUM POTENTIAL

AREA OF MODERATE BERYLLIUM POTENTIAL

AREA OF LOW BERYLLIUM POTENTIAL

0 1 2 3 MILES

Figure 7.--Map showing resource potential for beryllium.



EXPLANATION

[Areas with moderate potential for tungsten or gold yield concentrates containing visible scheelite ($CaWO_4$) or native gold. Areas with moderate copper potential yield concentrates containing 20 ppm copper]

AREA WITH MODERATE TUNGSTEN POTENTIAL

AREA WITH MODERATE GOLD POTENTIAL

AREA WITH MODERATE COPPER AND TUNGSTEN POTENTIAL

0 1 2 3 MILES

Figure 8.—Map showing resource potential for gold, tungsten (scheelite), and copper.

Molybdenum

Molybdenum was found in association with uranium in many samples from the southern part of the Harper Creek Roadless Area. There is little to indicate a significant potential for discovery of economic deposits of molybdenum. Its presence, however, might be an indicator of uranium minerals where the uranium may have been leached from the outcrops.

Lead

Lead is present in amounts as much as several hundred ppm in many of the geochemical samples (Siems, and others, 1981). Most of it is of radiogenic origin, formed by the disintegration of thorium in monazite and zircon. There is no evidence of significant lead potential in the study area.

Titanium

A magnetite-ilmenite deposit in the Wilson Creek Gneiss near Richlands (loc. ll, fig. 1) has been described by Kerr (1875), Nitze (1893), and Bryant and Reed (1966). We found no evidence of similar titanium deposits in the study area.

Gold, Tungsten (Scheelite), and Copper

Gold and scheelite ($CaWO_4$) are found in a large area near Kawana and near the southwestern boundary of the Harper Creek Roadless Area (fig. 8). Copper was found spectrographically in moderately high concentrations ranging from 20 to 70 ppm in the same areas. Although the gold might form the basis for small placer mines in the study area, and the scheelite may occur in mineable concentrations, the major significance of this mineral assemblage is to indicate that some rocks of the study area are mineralized. The nature and depth of related metal deposits, if any, are unknown.

Gold was produced from the Wilson Creek Gneiss, at the Workman Mine (loc. 10, fig. 1), from 1893 to 1914 (A. R. Coffey, oral commun., 1980). Recent excavations have been made at the site to expose soil and bedrock and the area is operated as a tourist attraction. Country rock near the mine is a chlorite-sericite schist intruded by quartz veins. The mine is near gold-bearing gravels reported by Keith (1903).

Bryant (1962) mapped four gold prospects north of the study area, in the Wilson Creek Gneiss and basal arkose of the Grandfather Mountain Formation (locs. 6-9, fig. 1). The prospects, which date from the turn of the century, are in sericite phyllite and phyllitic siltstone containing quartz veins and pyrite.

Stone

Both the Wilson Creek Gneiss and the basal arkosic unit of the Grandfather Mountain Formation have been quarried nearby for stone (locs. 1, 12, 13, 18, and 19, fig. 1). Stone in the study area has a low economic potential because of an abundance of similar material closer to markets and good transportation routes.

Oil and Gas

Recent seismic surveys provide evidence of extensive sedimentary rocks below the metamorphic rocks of the Carolinas. Sedimentary rocks are exposed about 5 miles west of the Harper Creek Roadless Area. Like any extensive body of sedimentary rock, this one might contain oil or gas. The potential for oil and gas in the study area is unknown.

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