MINERAL RESOURCE POTENTIAL OF THE LITTLE FROG ROADLESS AREA, POLK COUNTY, TENNESSEE

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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 Little Frog Roadless Area (08-277), Cherokee National Forest, Polk County, Tenn. The area was classified for further planning during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Little Frog Roadless Area contains 4,800 acres of steep-sloped wooded country in the Blue Ridge Mountains immediately west of the Ducktown (Copper Basin) mining district in southeastern Tennessee. Its southern boundary is the Ocoee River gorge.

The rocks in the roadless area belong to two members of the Boyd Gap Formation, part of the Great Smoky Group of Late Proterozoic age. All the rocks are metamorphosed at low grades and deformed to step-shaped folds. A geochemical survey and examination of the remains of extremely sparse prospecting activity revealed no indication of mineralization in the exposed rocks.

A surface tangent to all folds dips northwest at a small angle. Thus, rocks of the Copper Basin which crop out just east of the roadless area may be present at depth in it. If so, the roadless area has a low potential for buried massive sulfide deposits. No other resource occurrence is likely, with the possible exception of a potential for natural gas at great depth.

INTRODUCTION

The Little Frog Roadless Area comprises 4,800 acres of the Cherokee National Forest in Polk County, Tenn. (fig. 1). The steep hills of the area are a southern extension of the Great Smoky Mountains in the Blue Ridge physiographic province. Sassafras Knob, altitude 3,322 ft, is the highest point in the study area and is on its northern margin. The lowest point in the area, altitude 1,230 ft, is on its southwestern margin, which is U.S. Highway 64 at the bottom of the Ocoee River gorge. The study area generally slopes steeply southwest. Little Frog Mountain forms a long spur leading southwest from Sassafras Knob to the Ocoee River. The roadless area is heavily forested and contains locally thick undergrowth. Rock exposure is poor except in streambeds and along Highway 64.

The Ducktown (Copper Basin) mining district forms an intermontane basin immediately southeast of the study area. Massive sulfide deposits there have been mined since 1847.

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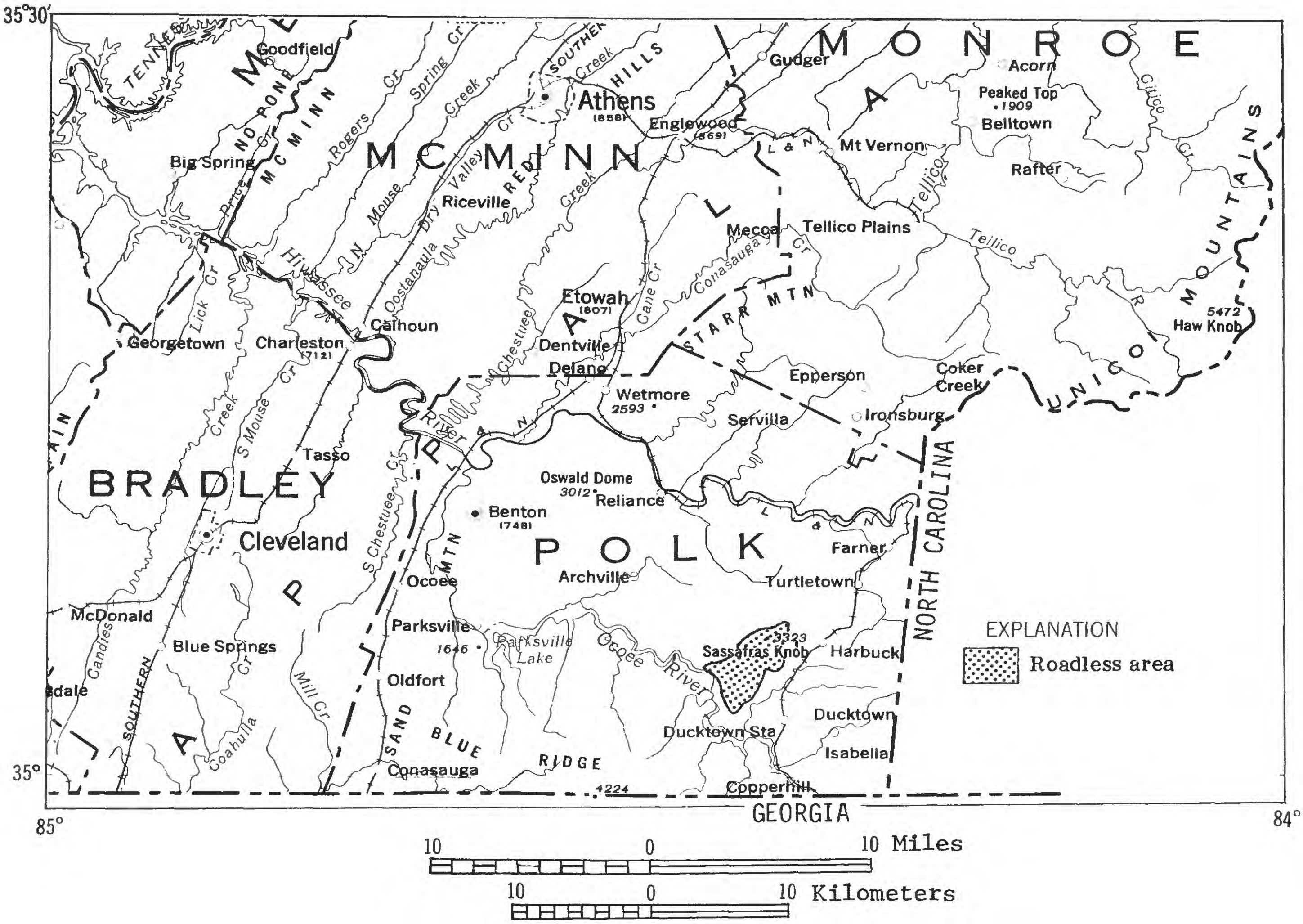

MONROE
MCMINN
BRADLEY
POLK
NORTH CAROLINA
GEORGIA
Athens
Etowah
Cleveland
Benton
Tellico Plains
Ducktown
Copperhill
Sassafras Knob
EXPLANATION
Roadless area
10 0 10 Miles
10 0 10 Kilometers

Index map

Economic Resources, and H. D. Switzer, Cherokee National Forest, for information.

Previous studies

Safford (1856) introduced the name Ocoee (now Ocoee Supergroup) for rocks in the Ocoee River gorge. Previous detailed work in the vicinity includes that of Hurst and Schlee (1962), Milici (1978), and Wiener and Merschat (1978a,b) in the Ocoee gorge, Slack and others (1982) south of the gorge, and Hernon (1968) in three quadrangles which include the gorge, the entire study area, and much of the Ducktown district. Recent studies of the Ducktown district include those by Magee (1968) and Addy and Ypma (1977).

GEOLOGIC SETTING

The rocks of the study area are slates and metasandstones of the Boyd Gap Formation, named by Wiener and Merschat (1978b) for a roadcut exposure at the southern end of the study area. The formation is part of the Great Smoky Group of the Ocoee Supergroup and consists of Late Proterozoic-age clastic sedimentary rocks, partly coarse-grained, that probably originated as turbidites in a marine rift basin. Two members were mapped in the area (Force, 1981), a lower member more than 600 ft thick consisting of dark slate and metagraywacke containing graphite and sulfides, and an upper member more than 1,350 ft thick, which changes from graded beds about 3 ft thick near the base to massive gritty meta-arkosic sandstone containing calcareous concretions and interbedded with gray slate and slate-boulder conglomerate. The lower member is exposed mostly adjacent to the river gorge, in the crests of anticlines (fig. 2).

The rocks are deformed into asymmetric step-shaped folds; however, a surface tangent to all folds of the contact between members dips gently northwest. The rocks have been metamorphosed to the biotite zone of the greenschist facies.

To the east are rocks of the Ducktown mining district, somewhat similar except for having higher metamorphic grades, tighter folds, and important sulfide deposits. They may underlie the study area at depth; the nature of the contact is discussed in a subsequent section.

PROSPECTING ACTIVITY

The Federal Government owns all surface and mineral rights in the study area. The Government has no record of any application for prospecting permits or mining permits for land in the study area, nor is there any record of historic mining activity. During the field examination, one prospect pit was found just outside the study area boundary (fig. 2).

GEOCHEMICAL SURVEY

One hundred twenty-seven samples of rock, soil, and stream sediment taken from the study area were analyzed for 31 elements (Force and Siems, in press). No anomalies believed to be of significance and no patterns of elemental enrichment were found. The sulfide-rich lower member of the Boyd Gap Formation has no unusual metal content.

The geochemical data from the study area were compared with similar data from areas having the type of mineralization thought most likely to occur at Little Frog, namely massive sulfides present in the Ducktown district and the Fontana-Hazel Creek areas (Force and Siems, in press). These deposits contain concentrations of copper, lead, and zinc. The study area had essentially no comparable enrichment, with the possible exception of gold and silver; samples from the Little Frog Roadless Area have even lower metal values than those for similar nearby study areas also thought to be lacking in significant sulfide resources (Slack and others, 1982; Gair, 1982).

ASSESSMENT OF KNOWN MINERAL OCCURRENCES

Base-metal sulfides

Graphitic rocks of the lower member of the Boyd Gap Formation contain as much as 10 percent sulfides, mostly pyrite and pyrrhotite. Wiener and Merschat (1978a) record the presence of minor chalcopyrite and sphalerite in these rocks. Our analyses show, however, that the sum of copper, nickel, lead, and zinc values in these rocks is too low to be of interest and in fact is not higher than those of other rocks with less sulfide (Force and Siems, in press). No base-metal enrichment was observed in samples from the one prospect pit just outside the study area (fig. 2). Therefore, we judge the exposed rock sequence to have little indication of base-metal resources.

Gold and silver

Of 58 samples containing detectable gold and (or) silver, 17 (13 rock, 2 soil, and 2 stream-sediment) are considered anomalous (see figure 1 of accompanying map for distribution of gold-bearing samples in and near the study area). The highest concentrations (excluding quartz veins) are 0.25 parts per million (ppm) gold and 10 ppm silver. No orderly distribution by location or geology is apparent.

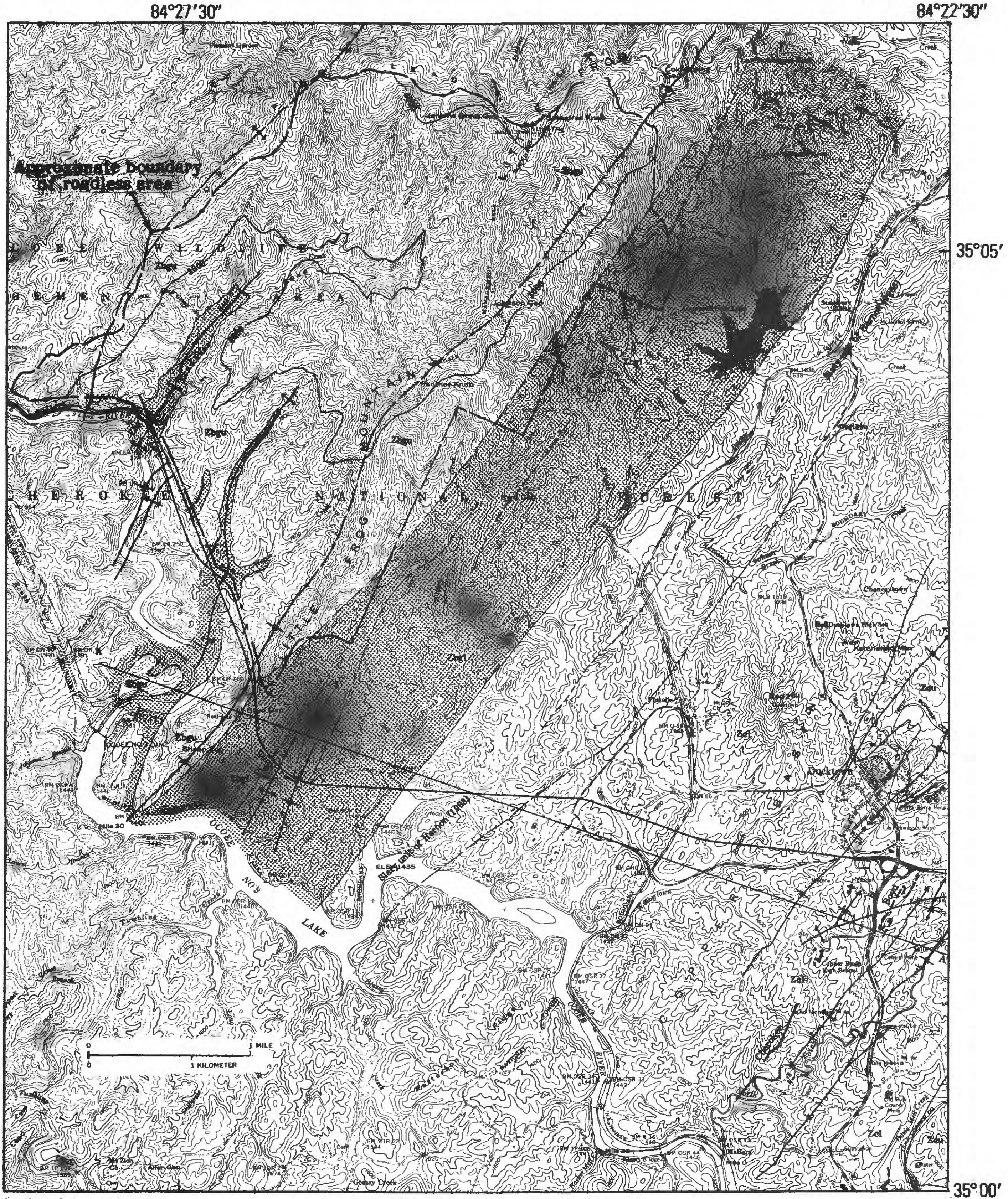
A small gold-mining district, 14 mi northeast of the study area at Coker Creek, Tenn., was active from 1869 to the mid-1930's. Production was mostly from placers. Hale (1974) projected the stratigraphic unit containing the richest quartz veins into the area west of the study area.

Ashley (1911) reported gold-bearing quartz veins on "Johnson's Creek reaching up into Frog Mountain." Two pan concentrates from this stream contained detectable gold. Rove (1926) mentioned reports of several gold localities on Little Frog Mountain north of the study area but did not provide any information about them.

None of the rock samples taken from the study area have sufficiently high concentrations to suggest a potential for deposits of gold or silver in bedrock in the area, and streams within the study area do not have flood plains large enough to suggest a potential for placer gold.

Stone

A small quarry is located along Kimsey Highway in meta-arkose just north of the study area boundary (fig. 2). Presumably, the quarry was opened during



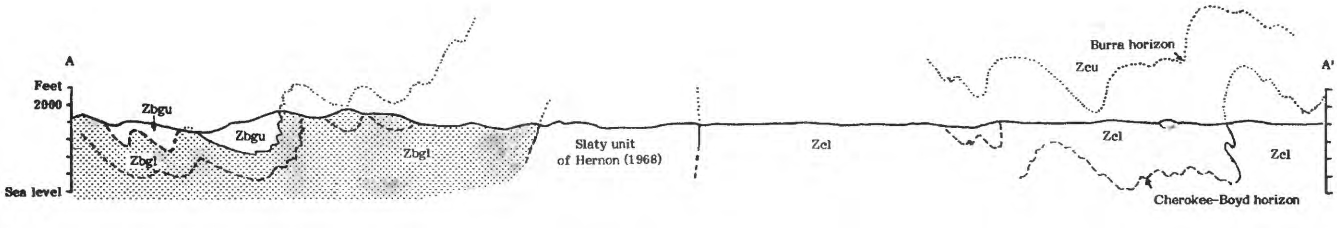
Base from Tennessee Valley Authority and U.S. Geological Survey Ducktown, 1957 (Photorevised 1974)

Geology of the Little Frog Roadless Area from Force (1981) modified along its eastern boundary to include more recent field work by Force for this report. Geology in the southeastern part of the map area from Hernon (1968), with subdivision of the Copperhill Formation and tracing of fold axes by Force and M. P. Foose from information on Hernon's original field sheets. Cross-section (A-A') includes information from Hernon's section C-C'.

Figure 2.--Map and cross section showing relation of the Little Frog Roadless Area to the Ducktown district.

EXPLANATION

Zbgu	Upper member, Boyd Gap Formation—Mostly feldspathic metasandstone and gray slate
Zbgl	Lower member, Boyd Gap Formation—Mostly graphitic metagraywacke
Zcu	Upper member, Copperhill Formation as used by Hernon (1968)—Mixed metasedimentary rocks
Zcl	Lower member, Copperhill Formation as used by Hernon (1968)—Mixed metasedimentary rocks including sulfide horizons, blue-black schist, and staurolite schist
3000	Projected depth, in feet, to slaty unit rocks of Hernon (1968), assuming structural concordance of this unit with Great Smoky Group rocks (see fig. 3a.)
	Contact or marker unit—Dashed where approximate or traced from aerial photographs; dotted (in cross section only) where projected above ground
	Fault
	Fold axis, showing direction of plunge—Dashed where approximately located. Paired arrows show facing directions of limbs
×	Prospect pit
	Quarry
Burra	Surface trace of sulfide ore body—Dashed where inferred. In cross section is dotted where projected above ground



construction of the adjacent road and has been abandoned for some time. Similar meta-arkose is common both inside and outside the study area.

Ceramic tests on samples of phyllite, slate, and clay from the Ocoee Supergroup collected by Gazdik for previous mineral resource studies of the Big Frog Wilderness Study Area (Slack and others, 1982) and Cohutta Wilderness (Gair, 1982) showed a low potential for structural clay products. Poor bloating characteristics make these rocks unsuitable for lightweight aggregate.

Because of the extensive occurrence of Ocoee rocks outside the study area and their limited usefulness, there is no foreseeable demand for stone from within the roadless area.

GEOLOGIC INFERENCES OF RESOURCE POTENTIAL

Preceding data show a lack of significant mineral resources in the rocks exposed in the Little Frog Roadless Area. However, if the sequence of rocks in the roadless area structurally overlies rocks of the Copper Basin and deeper gas-bearing sedimentary rocks, the roadless area has a low potential for the occurrence of base metals in massive sulfide deposits and an unknown potential for natural gas.

Base metals

The lower member of the Boyd Gap Formation is exposed repeatedly in small anticlines in the topographically lower parts of the roadless area (Force, 1981). In other words, a surface tangent to the numerous step folds dips northwest at roughly the gradient of the Ocoee River. Between the study area and the Ducktown district, the structural gradient is steeper, and roughly 2,000 ft of the mostly northwest-facing lower member of the Boyd Gap Formation are poorly exposed just east of the study area (fig. 2).

If the contact between Great Smoky rocks of the study area and those of the Copper Basin is concordant, rocks of the Copper Basin should underlie the study area. Available evidence, much of it sketchy, indicates that rocks of the Ducktown district are separated by probably two structures from the Great Smoky Group, but that these structures are concordant to Great Smoky stratigraphy at least in the direction of strike. The sulfide-bearing lower part of the Copperhill Formation as used by Hernon (1968) is adjacent to the slaty unit and Great Smoky Group rocks of the study area. These relations are discussed from west to east (cross-section A-A', fig. 2).

Geologic mapping of poor exposures in the valley of Brush Creek, about a mile east-southeast of the roadless area (Hernon, 1968; Force, 1981; this report), shows that the contact between Hernon's (1968) slaty unit and the Great Smoky Group is concordant along strike and possibly down the dip also. However, the slaty unit contains two prominent foliations and tight refolded folds, whereas the Great Smoky Group contains open step folds and generally only one foliation. This contact thus could be either a thrust fault or an unconformity; no direct evidence was observed.

Another structure apparently cuts out the upper part of the Copperhill Formation against the eastern margin of the slaty unit (fig. 2). It also could be either a thrust fault or an unconformity.

It is not known whether these structures dip concordantly westward under the study area; if so, the slaty unit could be as shallow as 2,000 ft below some parts of the study area. The minimum depth to massive-sulfide-bearing rock sequences is unknown. Alternative versions of regional structure are shown in figure 3.

Natural gas

Recent seismic studies (Cook and others, 1979) indicate that the southern Blue Ridge is composed of a 5,000- to 45,000-ft thickness of metamorphic rocks in thrust contact over a sequence of younger sedimentary rocks 3,000 to 15,000 ft thick. The metamorphic rocks, of which those of the Little Frog area are a part, supposedly have been moved a hundred miles or more up and over the sedimentary rocks. These sedimentary rocks have an unknown potential for hydrocarbons. The depths at which they occur and their implied degree of metamorphism suggest that any hydrocarbons present would be in the form of natural gas and not oil (Cook and others, 1979, p. 566). Methane in the mines at Ducktown (Magee, 1968; Hatcher, 1982) may have originated this way. Until deep drilling is done in the roadless area, no reasonable estimate of the gas potential can be made.

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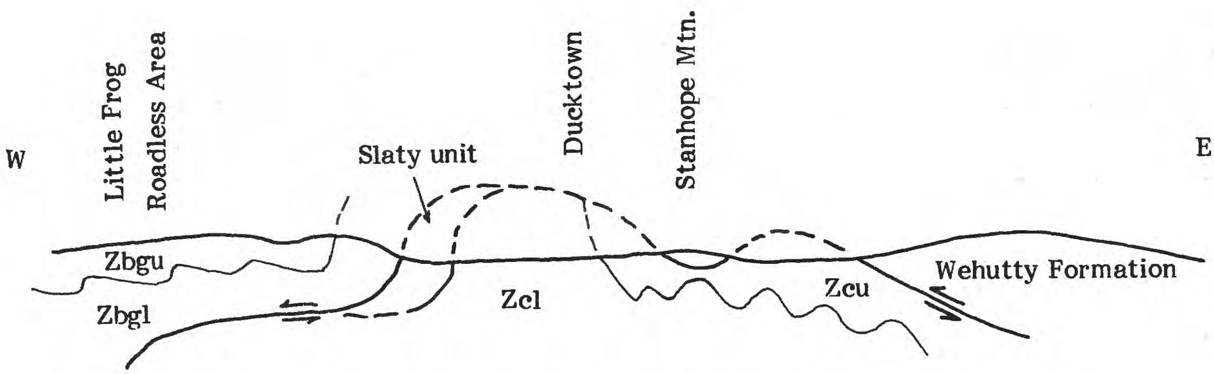
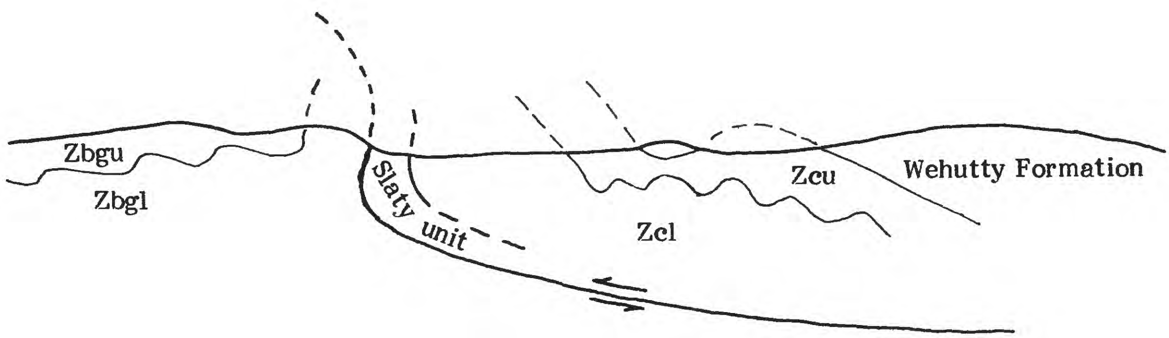


a. Fault concordant to structure of study area thrusts Great Smoky Group rocks over Ducktown district rocks (see also cross section, fig. 2).



b. Fault discordant to structure of study area thrusts rocks of the Ducktown district over Great Smoky Group rocks.

Figure 3.--Sketches of alternative versions of regional structure relating rocks of the study area to those of the Ducktown district. Rock-unit abbreviations are same as in figure 2. Relative direction of movement along thrust faults is shown by arrows. Faults and contacts where projected above ground are dashed. Slaty unit is from Hernon (1968).

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