DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1442-B

PAMPHLET ACCOMPANIES MAP

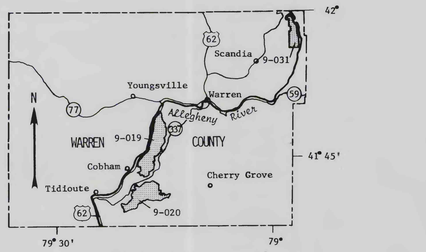

Figure 1.—Index map showing the locations of Allegheny Front (9-019), Hickory Creek (9-020), and Cornplanter (9-031) Roadless Areas, Allegheny National Forest, Warren County, Pennsylvania. Individual tracts (shaded) are designated by their Forest Service numbers. (The Cornplanter area is the subject of a separate report by Lesure and others, 1983.)

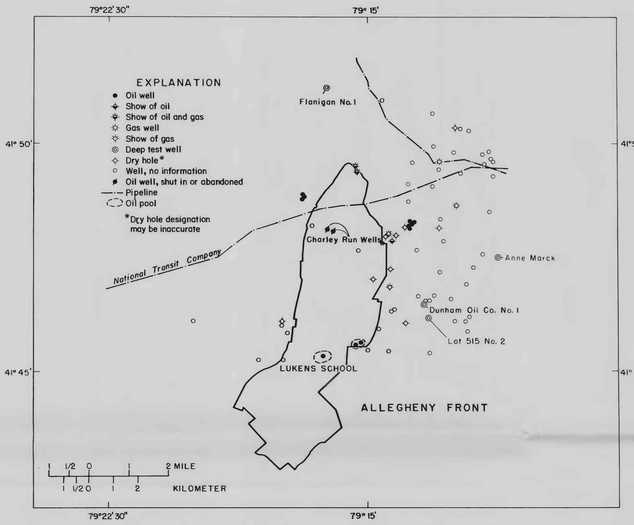

Figure 4.—Oil and gas fields and shallow and deep oil and gas tests in and near the Allegheny Front Roadless Area.

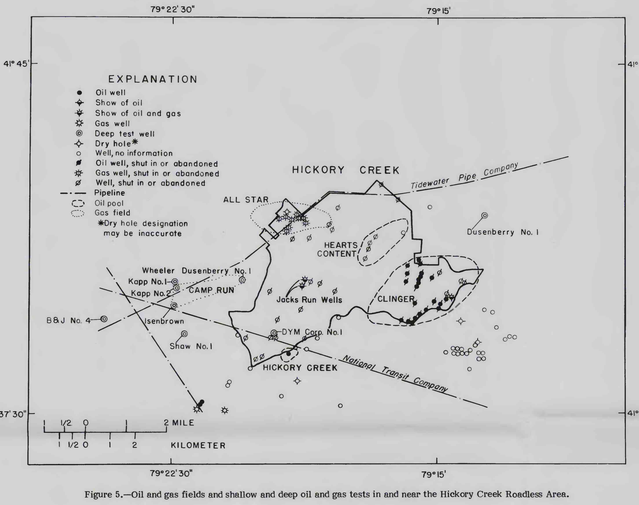

Figure 5.—Oil and gas fields and shallow and deep oil and gas tests in and near the Hickory Creek Roadless Area.

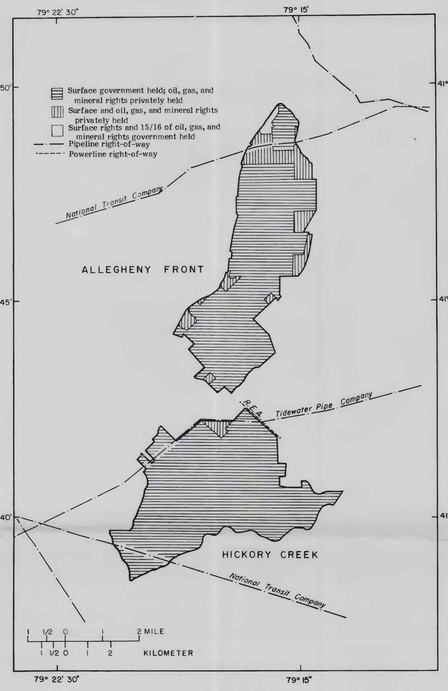

Figure 2.—Surface- and minerals-rights ownership in the Allegheny Front and Hickory Creek Roadless Areas.

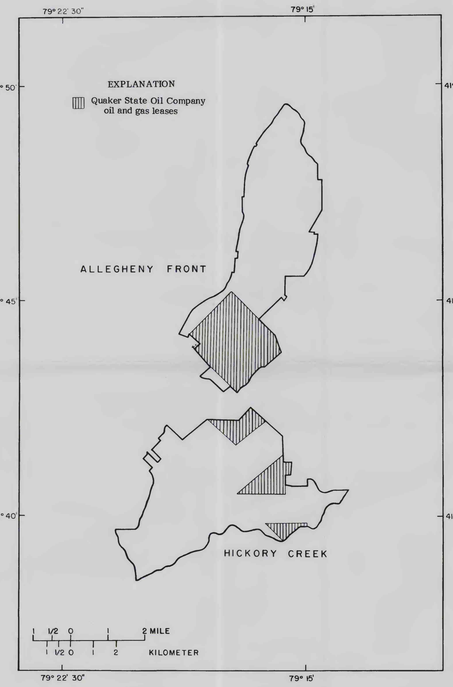

Figure 3.—Oil and gas leaseholdings of the Quaker State Oil Company in the Allegheny Front and Hickory Creek Roadless Areas.

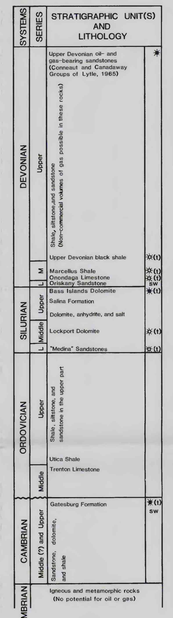

Figure 6.—Relative stratigraphic position of selected subsurface units beneath the Allegheny Front and Hickory Creek Roadless Areas.

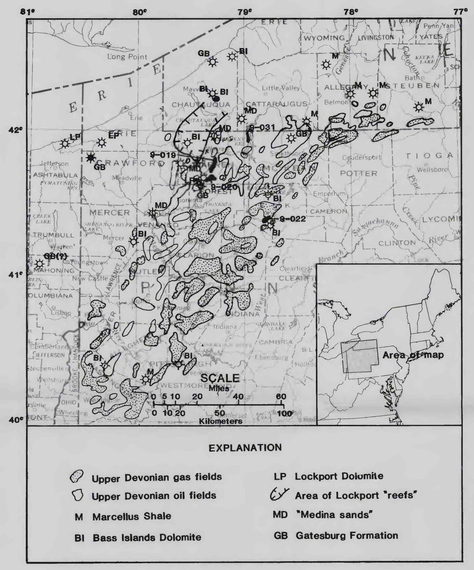

Figure 7.—Map showing the relationship of the Allegheny Front (9-019), Hickory Creek (9-020), Clairon River (9-022), and Cornplanter (9-031) Roadless Areas (solid black) to the oil and gas fields, wells, and exploratory tests discussed in the text. Production or significant shows from formations beneath the Upper Devonian reservoirs are shown by well symbols and block letters indicating individual formations. Well symbols are explained in figures 4 and 5; formations are given in figure 6. (The Clarion River area is the subject of a separate report by Schweinfurth and others, 1983; the Cornplanter area is the subject of a separate report by Lesure and others, 1983.)

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 survey of the Allegheny Front and Hickory Creek Roadless Area in the Allegheny National Forest, Warren County, Pa. The two areas were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The Allegheny Front and Hickory Creek Roadless Areas together comprise 18,123 acres on the western side of the Allegheny National Forest, Warren County, Pa. The Allegheny Front tract comprises 8,696 acres, and the Hickory Creek tract comprises 9,427 acres. The Federal Government owns about 85 percent of the surface rights of the Allegheny Front tract and about 95 percent of the surface rights of the Hickory Creek tract; the remaining surface rights are privately owned. Ninety-six percent of the mineral rights of the Allegheny Front tract and 100 percent of the mineral rights of the Hickory Creek tract are privately owned.

The study areas have a high potential for crude oil, a moderate potential for gas, and a low potential for salt and construction materials; no evidence of a potential was found for coal or metallic-mineral resources.

As of 1980 the Allegheny Front tract contained one and part of a second producing oil pools and the Hickory Creek tract contained part of one abandoned gas field and all or parts of three abandoned oil pools. Production from these fields was from shallow Upper Devonian sands. Oil-field-development drilling to Upper Devonian sands is taking place near the boundaries of the Allegheny Front tract and scattered exploration drilling has been done near both tracts.

A bed of salt more than 50 ft thick occurs in the Silurian-age Salina Formation under the southwestern part of the Hickory Creek tract at a depth of 3,400 ft below sea level.

Shale has potential for use in structual and decorative clay products such as brick and tile, but there is no clay-products industry in Warren County at this time. Sand and gravel have been utilized locally for construction purposes.

Metallic minerals were not observed during the field investigations and none have been reported in the literature. No major chemical anomalies were found as a result of the geochemical survey by Hickling and others (1983) and the areas have a low potential for the occurrence of metallic mineral resources.

A coal bed has been reported to occur near the study area (Butts, 1910; Ingham and others, 1956) but none was observed in the study areas and the potential for resource quantities of coal is very low[1].

INTRODUCTION

The Allegheny Front and Hickory Creek Roadless Areas (fig. 1), hereinafter called the study areas, comprise 18,123 acres on the western side of the Allegheny National Forest, Warren County, Pa. The Allegheny Front tract comprises 8,696 acres, and the Hickory Creek track comprises 9,427 acres.

The study areas lie along the western side of the Allegheny National Forest in Warren County, Pa. The two tracts are about 7 mi and 12 mi, respectively, southwest of Warren, Pa.; they are accessible from Warren via State Route 337 and U.S. Route 62. Several Forest Service and township roads provide additional access to the study areas.

SURFACE- AND MINERAL-RIGHTS OWNERSHIP

The surface rights of approximately 85 percent of the Allegheny Front tract and 95 percent of the Hickory Creek tract are owned by the U.S. Government; the remaining surface rights are privately owned (fig. 2). Private interests own 96 percent of the mineral rights in the Allegheny Front tract and 100 percent of the Hickory Creek tract (fig. 2). Subsurface rights are often subdivided and individual formations underlying a given parcel of land may be held by different parties. Oil and gas ownership changes frequently; therefore, individual ownership and lease status has not been presented in this report. Quaker State Oil Company currently holds large leases in both areas (C. J. Carlson, Quaker State Oil Company, written commun., 1980): 2,400 acres in the Allegheny Front tract and 1,600 acres in the Hickory Creek tract (fig. 3). Rights-of-way for several pipelines cut across several corners of the Hickory Creek tract and one pipeline right-of-way cuts across the north-western end of the Allegheny Front tract (fig. 2).

GEOLOGY

About 900 ft of sedimentary rocks of Late Devonian, Early Mississippian, and Early and Middle Pennsylvanian age crop out in the study area (fig. 4; Schweinfurth and others, 1982), and about 10,000 to 11,000 ft of older Paleozoic sedimentary rocks may be present in the subsurface (Harris, 1975). The basal part of the exposed stratigraphic section consists of about 305 ft of marine clastic rocks of the Upper Devonian Venango formation of Lesley (1892) which crop out in the lower reaches of stream valleys in the western part of the Allegheny Front tract. The rocks immediately overlying the Venango formation consist of mostly marine clastic rocks of the Oswayo Formation and overlying Cuyahoga Formation of Late Devonian and Early Mississippian age. The Oswayo-Cuyahoga sequence thickens irregularly from north to south across the study areas, from about 265 ft to about 460 ft. Rocks of Late Mississippian age are reported to be absent from the study area (Edmunds and others, 1979, fig. 5).

The Pennsylvanian Olean and Connoquenessing Formations are the upper-most units of consolidated rock in the study areas and underlie most of the upland surface. The sequence consists of clastic rocks which appear to be partly marine, or at least near marine (i.e., brackish), and partly continental in origin (Schweinfurth and others, 1982). The age of the Pennsylvanian rocks in the study areas ranges from late Early to Middle Pennsylvania (Wanless, 1975, table 2; and Edmunds, and others, 1979, fig. 5).

Deposits of colluvium mantle most valley slopes. Alluvium, consisting of unconsolidated silt, clay, sand, gravel, and large boulders, underlies many floors. The study areas do not contain accumulations of glacial drift (Butts, 1910, p. 7).

A coal bed has been reported to occur near the base of the upper member of the Olean Formation near the study areas (Butts, 1910, p. 6; and Ingham and others, 1956, p. 9). This coal bed was correlated with the Upper Marshburg coal bed of Ashburner (1885, p. 325) by Ingham and others (1956, p. 9), but it was believed to be thin and impure in most of the Sheffield 15-minute quadrangle.

The structure of the study areas is simple. Evidence of faults or other large irregularites of any kind is lacking in the rocks exposed at the surface. The pre-Pennsylvanian strata of the area have been tilted slightly downward to the south-southwest and gently warped into several low-amplitude folds that trend southwest. This trend parallels the regional dip which is only about 20 ft per mile to the southwest. The Pennsylvanian strata of the northern half of the area also dip to the south-southwest but the amount of dip is slightly less than that of the underlying strata. In the southern half of the area the Pennsylvanian strata are essentially flat lying.

GEOCHEMISTRY

Geochemical investigations were conducted by the USGS in October 1980 (Hickling and others, 1983). A total of 37 representative bedrock samples and 44 stream-sediment samples were collected. Each sample was analyzed semiquantitatively for 31 elements, including the common metals having the greatest economic importance, using a six-step, direct-current-arc, optical-emission, spectrographic method (Grimes and Marranzino, 1968). In addition, each sample was analyzed for zinc by means of an atomic-absorption technique (Ward and others, 1969, p. 30). Samples were also scanned for uranium by a fluorometric method, but none was detected. No major chemical anomalies were located by the geochemical survey, and no obviously anomalous chemical-element concentrations related to mineralized rock are indicated by the data.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Oil and gas are the most important mineral resources in the study areas. The potential for additional oil resources is high while that for gas is moderate.

As of 1980 the Allegheny Front tract contained one and part of another producing oil pools (fig. 4) and the Hickory Creek tract contained part of one abandoned gas field and all or parts of three abandoned oil pools (fig. 5). Production from these fields was from shallow Upper Devonian sands. Oil-field-development drilling to Upper Devonian sandstones is taking place near the boundaries of the Allegheny Front tract and scattered exploration drilling has been done near both tracts of the study areas. Recently, seismic surveys have been conducted in the general region of the study areas.

Within the Allegheny Front tract (fig. 4), the Lukens School pool, discovered in 1976 on Clark run, and an unnamed pool to the northeast produce oil from sandstone beds of Late Devonian age. At the northern tip of the Allegheny Front tract two tests had shows of oil and gas. Pennsylvania Geological Survey records show two plugged oil wells on Charley Run; but no specific data are available.

Within the Hickory Creek tract (fig. 5) the Hickory Creek oil pool, discovered in 1978, the Hearts Content oil pool, discovered in 1934, the Clinger oil pool, and the All Star gas field had all produced from sandstone beds of Late Devonian age. Two tests on Jacks Run also had shows of oil. The Camp Run Field, discovered in 1961 and abandoned in 1964, is a deep gas field which is located immediately to the west of the Hickory Creek tract (fig. 5). This field produced gas from the "Medina" sandstone of Early Silurian age.

A bed of salt more than 50 ft thick occurs in the Late Silurian-age Salina Formation under the southwestern part of the Hickory Creek tract. However, this bed lies at a depth of 3,400 ft below sea level.

Shale has potential for use in structural and decorative clay products such as brick and tile, but there is no clay-products industry in Warren County at this time. Sand and gravel have been utilized locally for construction purposes but deposits of these materials in the study areas have low potential.

Metallic minerals were not observed during the field investigations and none have been reported in the literature. No major chemical anomalies were found as a result of the geochemical survey by Hickling and others (1983) and the area has a low potential for metallic-mineral resources.

A coal bed has been reported to occur near the study areas (Butts, 1910; Ingham and others, 1956) but it was not observed in the study areas and the potential for resources of coal in the area is low.

Oil and Gas Potential

About 11,000 to 12,000 ft of Paleozoic sedimentary rocks (Harris, 1975), ranging in age from Middle Pennsylvanian to Middle(?) Cambrian, underlie the study areas. Of these rocks, sandstone beds of the Upper Devonian Conneaut and Canadaway Groups of Lytle (1965), a sequence of lenticular to sheet-like beds of fine- to coarse-grained, locally pebbly sandstones (fig. 6) which were deposited in the shallow Upper Devonian sea adjacent to the Catskill delta complex, have a high potential as oil and gas reservoirs in both areas. These sandstones, the well driller's shallow oil and gas sands (Kelley and others, 1970), are intercalated in a thick sequence of silty marine shales that contain sufficient amounts of organic matter—kerogen—to be the source beds for the oil and gas trapped by the reservoir sandstones. The level of thermal maturation of the source rocks between and below the Upper Devonian sandstones reached temperatures adequate for the generation of both oil and gas as the occurrence of oil and gas fields surrounding the study areas clearly demonstrates (figs. 4, 5, and 7). The potential for additional oil resources from upper Devonian reservoirs is high in the study areas, whereas the potential for gas resources is moderate.

Oil and gas are trapped in the reservoir sandstone by relatively abrupt changes from permeable and porous sandstone to tight, impermeable siltstone and shale—typical stratigraphic traps. Locating and exploiting oil and gas in stratigraphic traps is much more difficult than similar work in structural traps because the locations of stratigraphic traps are commonly not evident from overlying strata. The only sure method to determine if the Upper Devonian sandstone beds contain commercial amounts of oil or gas in the study areas is to drill completely through the sandstone sequence, obtain suites of wire-line geophysical logs, and stimulate zones that may contain oil, gas, or both.

Much of the 2,500 ft of Upper and Middle Devonian rock below the oil-bearing sandstone sequence consists of greenish-gray to black marine shales with many intercalated beds of greenish-gray siltstone in the upper part. These shaly rocks, particularly the black shales, are rich in organic detritus—kerogen—and are moderate to good source beds for oil and gas.

Where naturally fractured, the black Devonian shales may be both sources and reservoir rock for natural gas. Recent work by Van Tyne and Peterson (1978), Harper and Piotrowski (1978), and Schmoker (1980) shows that these black shales contain several percent by weight of organic matter and have been locally gas productive to the north in New York (Kreidler and others, 1972; Van Tyne, 1982) and to the northwest in Pennsylvania (Patchen and others, 1982) (fig. 7). The beds of Devonian black shales under the study areas do not appear to be attractive primary drilling targets because of uncertainties in locating and stimulating fractured zones and the considerable drilling depths; however they are certainly secondary targets to be considered in testing the hydrocarbon potential of more deeply buried formations.

The Middle Devonian Onondaga Limestone, which is about 75 to 150 ft thick under the study areas (Oliver and others, 1971), has produced gas from small pinnacle reefs to the northeast in McKean County, Pa., and Steuben County, N.Y. where the sequence is thinner. The reefs appear to be more common and better developed in New York, and the potential for gas resources in the Onondaga Limestone beneath the study areas is low.

The extensive and generally gas-productive Oriskany Sandstone (fig. 6), one of the more important gas sands in the Appalachian basin, underlies the study areas as a sheet less than 25 ft thick (Cate, 1962; Oliver and others, 1971). Deep tests in and adjacent to the study areas encountered small non-commercial amounts of gas or oil and generally large amounts of salt water in the Oriskany Sandstone. These data indicate that there is a low potential for resources of gas or oil in the Oriskany beneath the study area.

The Upper Silurian Bass Islands Dolomite (fig. 6), the uppermost formation in the Silurian sequence in north-central Pennsylvania, or its lateral equivalent, the Akron Dolomite in western New York, has produced 531 thousand cubic ft (MCF) of hydrogen sulfide-containing gas per day from the single-well Boot Jack pool in Elk County, Pa. (Lytle, 1974). It has also produced as much as 500 barrels of oil and 65.3 million cubic feet (MMCF) of gas per day from individual wells along a structural trap in Chautauqua County, N.Y. (Copley and others, 1982; Maslowski, 1983; Petroleum Information, 1983). Noncommercial amounts of gas were found in the Bass Islands Dolomite (also called Cobleskille Limestone; Fettke, 1961) or the overlying Helderberg Limestone (Fettke, 1950; 1961) in several deep, cable-tool tests drilled in northwestern Pennsylvania before about 1955 (fig. 7). The use of more advanced stimulation techniques and a higher price for gas might well have made these into commercial wells. Consequently, in the Bass Islands Dolomite there is a low to moderate potential for gas resources beneath the study areas.

The Middle Silurian (Niagaran) Lockport Dolomite (fig. 6) has produced small amounts of gas in southern New York (Van Tyne and Foster, 1980) and western Pennsylvania (Patchen and others, 1982) (fig. 7). A show of gas was encountered in the Biery and Johnson, Kapp No. 1 test well about 2.1 mi west of the Hickory Creek tract (Girol, 1982) (fig. 5). An area of "reefs" in the Lockport Dolomite has been identified about 5 mi northwest of the study areas (Fergusson and Prather, 1968) (fig. 7) and the possibility exists that the reefs may extend southward under the study areas. There is a low potential for gas resources in the Lockport Dolomite beneath the study area.

Several extensive beds of fine-grained, low-permeability, quartzose sandstone, the "Medina" sandstones of western New York and northwestern Pennsylvania and the equivalent Clinton Formation of Ohio, make up much of the lower Silurian sequence underlying the study areas. By common usage these sandstone beds have been identified as the "Medina sands" by well drillers. The "Medina sands" were deposited in a shallow-water, high-energy, near-shore environment adjacent to a large delta complex with an eastern source area for the quartzose detritus. The "Medina" and Clinton sandstone beds have been productive of gas and oil in several parts of the Appalachian basin (fig. 7). Beneath the study areas the "Medina" sandstone beds appear too thermally altered to contain commerical volumes of oil but are well within the limits of thermal maturity for natural gas (Epstein and others 1977). Active drilling for gas from the "Medina sands" in the western half of Warren County (Piotrowski, 1981; Patchen and others, 1982) (fig. 7), and the proximity of the Camp Run-Medina gas field to the western edge of the Hickory Creek tract (fig. 5), together indicate a moderate to high potential for gas resources from the "Medina" beneath the study areas. Although the tightly-cemented "Medina" sandstone beds in northwestern Pennsylvania are known to have low permeability, newly developed and improved well-stimulation techniques, using foam and other types of fluids for hydraulic-fracturing, are being used to develop commercial production from "Medina" tests that would have been abandoned as dry holes before the advent of these techniques.

The Utica Shale, a sequence of dark-brown to black shale beds rich in organic detritus that lies at the base of the Upper Ordovician shale sequence, intergrades with the underlying Trenton Limestone at the top of the Middle Ordovician carbonate-rock sequence (fig. 6). The Utica is a good source rock for hydrocarbons in the northern part of the Appalachian basin. The degree of thermal maturation of the Utica Shale beneath the study areas is within the limits for the generation of gas but too great for the existence of oil (Epstein and others, 1977).

The Middle Ordovician Trenton Limestone has produced gas locally to the northeast of the study areas south of Lake Ontario in central New York. A few deep tests in western Pennsylvania have penetrated the Trenton Limestone without finding gas (Wallace and deWitt, 1975). Consequently there is no evidence of a potential for gas resources in the Trenton Limestone in the study areas.

A relatively small number of deep and ultra-deep oil and gas tests have penetrated into or through the dolomites and sandstones of the Cambrian sequence in western Pennsylvania and adjacent southwestern New York (Wallace and deWitt, 1975) (fig. 7). The upper part of the Cambrian sequence consists mainly of dolomite with some intercalated layers of porous sandstone. Locally in McKean and Crawford Counties, Pa. (fig. 7), the upper unit of the sequence, the Gatesburg Formation (fig. 6), or its lateral equivalents, yields gas from these porous sandstone beds (Harper, 1981). Commonly in Erie County, salt water has been found in close proximity to the gas; several tests found only salt water in the Gatesburg. The thickness and extent of the Gatesburg Formation (Wagner, 1966) suggests that it underlies the study areas. The nearest test to penetrate this formation, the Biery and Johnson #1 Shaw, which was drilled to a depth of 9,410 ft at a site about 1.3 mi west of the Hickory Creek Tract (fig. 5), found only salt water in the sandstone in the upper part of the Gatesburg, although two small noncommercial volumes of gas were recorded in dolomite above the sandstone (Wagner, 1966). These data indicate that the sandy dolomite of the Upper Cambrian sequence underlying the study areas contains natural gas but the potential for gas resources in the study area is low.

In summary, the Allegheny Front and Hickory Creek Roadless Areas have a high potential for oil and a moderate potential for gas resources in the shallow Upper Devonian rocks, a moderate to high potential for natural gas in the upper half of the sequence in the more deeply buried Devonian and older rocks, and a low potential in the Upper Cambrian rocks near the base of the sedimentary rock section.

Salt

The Salina Formation of Late Silurian age contains a bed of salt more than 50 ft thick beneath the southwestern part of the Hickory Creek tract (Fergusson and Prather, 1968). This bed of salt lies about 3,400 ft below sea level. As long as shallower salt deposits remain to be mined in adjacent parts of the Appalachian basin, particularly those contiguous to the Great Lakes, the development of this deposit is unlikely.

Construction Materials

Shale, sandstone, conglomerate, and sand and gravel are potential construction materials that could be utilized in the study area (Girol, 1982). As recently as 1952 Warren County supported a small ceramics industry that produced brick which ranged in quality from common red brick to face brick and tile. The brick and tile manufacturers were located between Warren and Youngsville and used shales of Late Devonian age and Quaternary glacial-outwash clay as sources of raw material. Shale samples collected at two sites along the western edge of the study areas were suitable for the manufacture of red brick (Leighton, 1941; fig. 2). However, because structural clay products are no longer manufactured in Warren County, and shale and clay are no longer mined there, and because there are abundant resources of shale throughout northwestern Pennsylvania that are closer to markets, further production of shale from the study areas is unlikely.

Sandstone and conglomerate from the Pennsylvanian-age Olean and Connoquenessing Formations are abundant in the study area. Potential uses for these materials are limited to rough dimension stones, however, because of impurities and the textural and bedding characteristics of the rocks.

Sand and gravel deposits are present along the lower reaches of the streams that drain the study areas, but sand and gravel deposits outside of the study areas are abundant.

Important constraints on the utilization of construction materials found in the study areas are the cost of hauling raw materials considerable distances to be cleaned and processed.

[1]Resource quantities include beds of bituminous coal 14 in. or more thick that occur at depths of 6,000 ft (U.S. Bureau of Mines and U.S. Geological Survey, 1976).

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