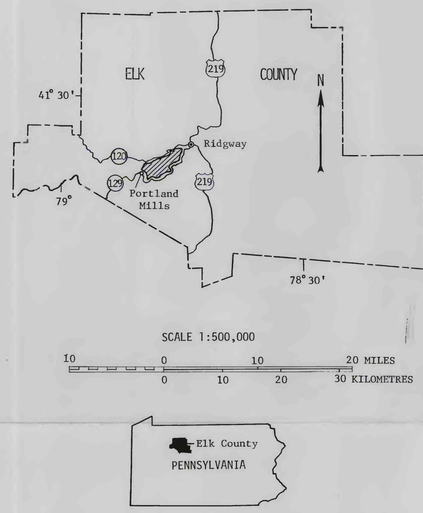
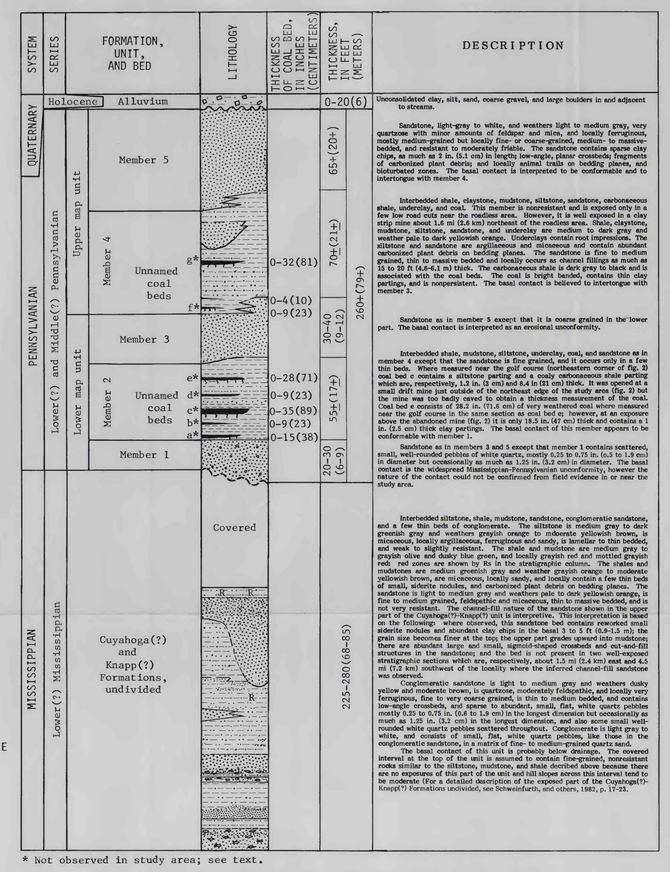


Figure 1.—Index map showing the Clarion River Roadless Area, (shaded), Allegheny National Forest, Elk County, Pa.

Figure 2.—Surface- and mineral-rights ownership.



Unconsolidated clay, silt, sand, coarse gravel, and large boulders in and adjacent to streams.

Sandstone, light-gray to white, and weathers light to medium gray, very quartzose with minor amounts of feldspar and mica, and locally ferruginous, mostly medium-grained but locally fine- or coarse-grained, medium- to massive-bedded, and resistant to moderately friable. The sandstone contains sparse clay chips, as much as 2 in. (5.1 cm) in length; low-angle, planar crossbeds; fragments of carbonized plant debris; and locally animal trails on bedding planes, and bioturbated zones. The basal contact is interpreted to be conformable and to intertongue with member 4.

Interbedded shale, claystone, mudstone, siltstone, sandstone, carbonaceous shale, underclay, and coal. This member is nonresistant and is exposed only in a few low road cuts near the roadless area. However, it is well exposed in a clay strip mine about 1.6 mi (2.6 km) northeast of the roadless area. Shale, claystone, mudstone, siltstone, sandstone, and underclay are medium to dark gray and weather pale to dark yellowish orange. Underclays contain root impressions. The siltstone and sandstone are argillaceous and micaceous and contain abundant carbonized plant debris on bedding planes. The sandstone is fine to medium grained, thin to massive bedded and locally occurs as channel fillings as much as 15 to 20 ft (4.6-6.1 m) thick. The carbonaceous shale is dark gray to black and is associated with the coal beds. The coal is bright banded, contains thin clay partings, and is nonpersistent. The basal contact is believed to intertongue with member 3.

Sandstone as in member 5 except that it is coarse grained in the lower part. The basal contact is interpreted as an erosional unconformity.

Interbedded shale, mudstone, siltstone, underclay, coal, and sandstone as in member 4 except that the sandstone is fine grained, and it occurs only in a few thin beds. Where measured near the golf course (northeastern corner of fig. 2) coal bed e contains a siltstone parting and a coaly carbonaceous shale parting which are, respectively, 1.2 in. (3 cm) and 6.4 in (21 cm) thick. It was opened at a small drift mine just outside of the northeast edge of the study area (fig. 2) but the mine was too badly caved to obtain a thickness measurement of the coal. Coal bed e consists of 28.2 in. (71.6 cm) of very weathered coal where measured near the golf course in the same section as coal bed c; however, at an exposure above the abandoned mine (fig. 2) it is only 18.5 in. (47 cm) thick and contains a 1 in. (2.5 cm) thick clay partings. The basal contact of this member appears to be conformable with member 1.

Sandstone as in members 3 and 5 except that member 1 contains scattered, small, well-rounded pebbles of white quartz, mostly 0.25 to 0.75 in. (6.5 to 1.9 cm) in diameter but occasionally as much as 1.25 in. (3.2 cm) in diameter. The basal contact is the widespread Mississippian-Pennsylvanian unconformity, however the nature of the contact could not be confirmed from field evidence in or near the study area.

Interbedded siltstone, shale, mudstone, sandstone, conglomeratic sandstone, and a few thin beds of conglomerate. The siltstone is medium gray to dark greenish gray and weathers grayish orange to moderate yellowish brown, is micaceous, locally argillaceous, ferruginous and sandy, is lenticular to thin bedded, and weak to slightly resistant. The shale and mudstone are medium gray to grayish olive and dusky blue green, and locally grayish red and mottled grayish red; red zones are shown by Rz in the stratigraphic column. The shales and mudstones are medium greenish gray and weather grayish orange to moderate yellowish brown, are micaceous, locally sandy, and locally contain a few thin beds of small, siderite nodules, and carbonized plant debris on bedding planes. The sandstone is light to medium gray and weathers pale to dark yellowish orange, is fine to medium grained, feldspathic and micaceous, thin to massive bedded, and is not very resistant. The channel-fill nature of the sandstone shown in the upper part of the Cuyahoga(?)-Knapp(?) unit is interpretive. This interpretation is based on the following: where observed, this sandstone bed contains reworked small siderite nodules and abundant clay chips in the basal 3 to 5 ft (0.9-1.5 m); the grain size becomes finer at the top; the upper part grades upward into mudstone; there are abundant large and small, sigmoid-shaped crossbeds and cut-and-fill structures in the sandstone; and the bed is not present in two well-exposed stratigraphic sections which are, respectively, about 1.5 mi (2.4 km) east and 4.5 mi (7.2 km) southwest of the locality where the inferred channel-fill sandstone was observed.

Conglomeratic sandstone is light to medium gray and weathers dusky yellow and moderate brown, is quartzose, moderately feldspathic, and locally very ferruginous, fine to very coarse grained, is thin to medium bedded, and contains low-angle crossbeds, and sparse to abundant, small, flat, white quartz pebbles mostly 0.25 to 0.75 in. (0.6 to 1.9 cm) in the longest dimension but occasionally as much as 1.25 in. (3.2 cm) in the longest dimension, and also some small well-rounded white quartz pebbles scattered throughout. Conglomerate is light gray to white, and consists of small, flat, white quartz pebbles, like those in the conglomeratic sandstone, in a matrix of fine- to medium-grained quartz sand.

The basal contact of this unit is probably below drainage. The covered interval at the top of the unit is assumed to contain fine-grained, nonresistant rocks similar to the siltstone, mudstone, and shale described above because there are no exposures of this part of the unit and hill slopes across this interval tend to be moderate (For a detailed description of the exposed part of the Cuyahoga(?)-Knapp(?) Formations undivided, see Schweinfurth, and others, 1982, p. 17-23.

* Not observed in study area; see text.

Figure 3.—Generalized stratigraphic section of rocks exposed in and near the study area.

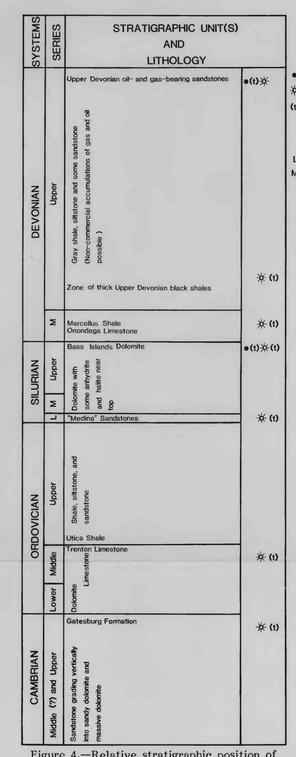


Figure 4.—Relative stratigraphic position of selected subsurface units beneath the Clarion River Roadless Area.

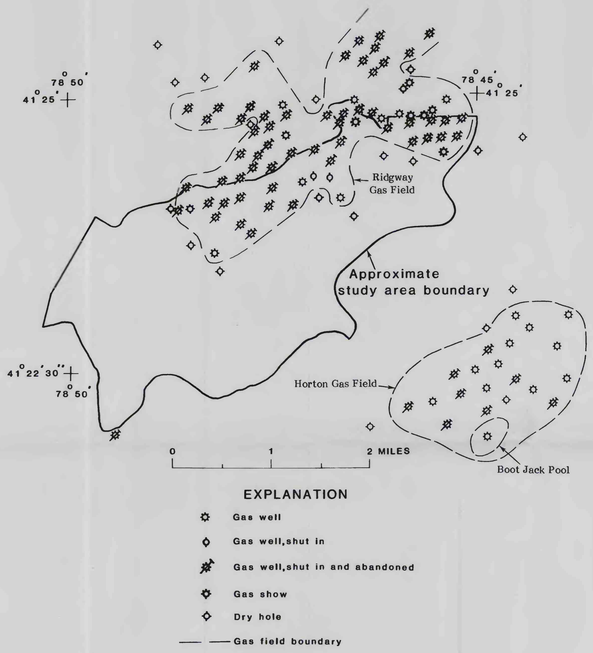


Figure 5.—Natural gas field and well locations.

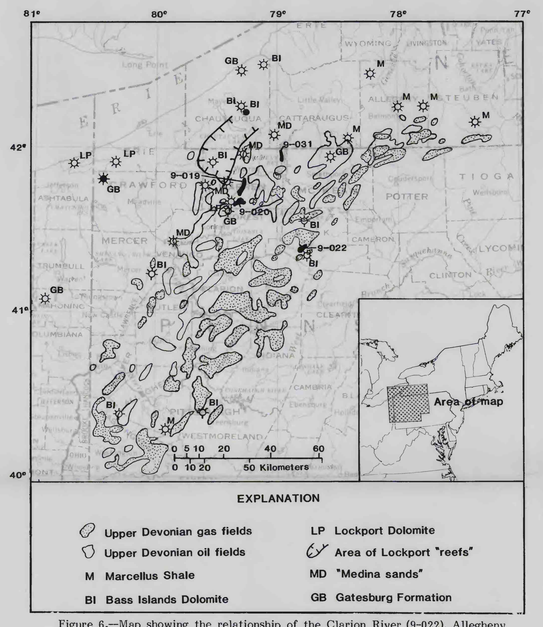


Figure 6.—Map showing the relationship of the Clarion River (9-022), Allegheny Front (9-019), Hickory Creek (9-020), and Cornplanter (9-031) Roadless Areas (solid black) to the oil and gas fields, wells, and exploratory tests discussed in the text. Production or significant shows from formations beneath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

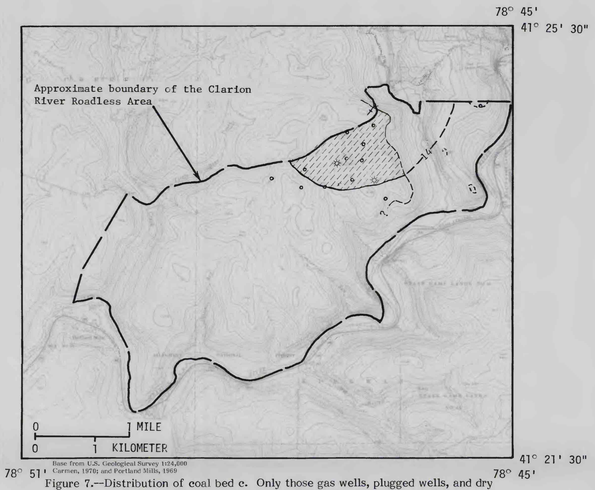


Figure 7.—Distribution of coal bed c. Only those gas wells, plugged wells, and dry holes which appear to penetrate the coal bed are shown; locations were taken from figure 5. No record of coal in any of these holes was kept by the drillers. The holes are shown because they would seriously affect any attempt to develop the coal.

EXPLANATION

- Area where coal is absent or less than 14 in. thick
- Area underlain by coal resources 14 to 28 in. thick
- Approximate outcrop of coal bed; dashed where inferred
- Coal thickness line, approximately located, interval 14 in.; dashed where eroded,
- Abandoned adit
- Gas well
- Abandoned gas well or dry hole

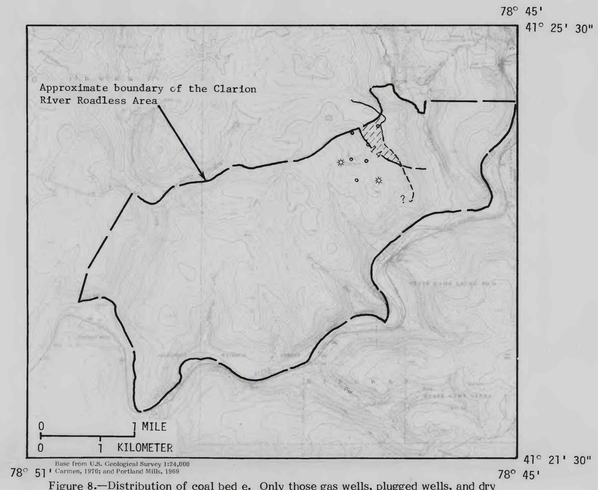


Figure 8.—Distribution of coal bed e. Only those gas wells, plugged wells, and dry holes which appear to penetrate the coal bed are shown; locations were taken from figure 5. No record of coal in any of these holes was kept by the drillers. The holes are shown because they would seriously affect any attempt to develop the coal.

EXPLANATION

- Area where coal is absent or less than 14 in. thick
- Area underlain by coal resources 14 to 28 in. thick
- Approximate outcrop of coal bed; dashed where inferred
- Coal thickness line, approximately located, interval 14 in.; dashed where eroded,
- Gas well
- Abandoned gas well or dry hole

Table 1.--*Estimated original bituminous coal resources covered by less than 1,000 ft of overburden in the Clarion River Roadless Area*
(values in thousands of short tons, as of December 31, 1981)

		Original Resources		
		Measured and Indicated	Inferred	Total
Formation	Coal bed	In beds 14-28 inches thick	In beds 14-28 inches thick	In beds 14-28 inches thick
Lower map unit	e	134	0	134
	c	782	392	1,174
Total		916	392	1,308

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 Clarion River Roadless Area (09-022) in the Allegheny National Forest, Elk County, Pa. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The Clarion River Roadless Area is deemed to have a high potential for gas and a low potential for oil and other mineral resources. Gas is currently the most important mineral resource in the study area. As of 1982, the National Fuel Gas Supply Corp. (NFGC) operated five producing gas wells within the study area. These wells produce gas from Upper Devonian sandstone beds in the Ridgway gas field. Additional gas resources may exist in untested or unstimulated sands of the Upper Devonian and in deeper strata (Wayne Leeper, NFGC, oral commun. 1980). Although the Ridgeway gas field is nearly depleted, it may have future utility as a gas-storage field.

A small amount of coal is probably present in the study area. Although coal beds were not observed within the area, several coal beds thick enough to contain resource[1] quantities of coal were observed nearby. Total original resources of coal in beds c and e in the study area are estimated to be about 1.3 million short tons. However, it is estimated that neither coal bed in the study area exceeds 28 in. in thickness so that neither coal bed may contain reserve base[2] quantities of coal in the study area. The coal is tentatively ranked as high-volatile A bituminous; it is low in sulfur but has a high ash content.

Underclays and shales could be used in structural applications such as floor and building brick or structural tile. Sandstone, sand, and gravel have been utilized locally for construction purposes, but deposits of these materials in the study area have limited extent.

Metallic-mineral deposits were not identified during the study and none have been reported in the literature. No major chemical anomalies were found by the geochemical survey (Hickling and others, 1983), and there is no evidence of a potential for the occurrence of metallic-mineral deposits.

The conclusions presented in this report are based on the results of geologic mapping, the examination of mines, quarries, and prospects, a study of gas and oil well stratigraphic and production data, and a geochemical survey of stream sediments and bedrock.

INTRODUCTION

The Clarion River Roadless Area, hereinafter called the study area (fig. 1), comprises 4,042 acres in the southeasternmost part of the Allegheny National Forest, Elk County, Pa. The study area lies about 1 mi west of Ridgway, Pa. and is accessible from Ridgway via State Routes 120 to 129.

SURFACE- AND MINERAL-RIGHTS OWNERSHIP

The Federal Government owns about 89 percent of the surface rights in the study area. The remaining surface rights and all of the mineral rights are privately owned (fig. 2). Third-party mineral rights, covering 99 percent of the study area, are reserved by National Fuel Gas Supply Corp. A right-of-way for a telephone line cuts across the western side of the study area along Little Bear Creek (fig. 2).

GEOLOGY

About 540 ft of sedimentary rocks of the Lower(?) Mississippian and the Lower(?) and Middle(?) Pennsylvanian series crop out in the study area (fig. 3). Approximately 12,000 to 14,000 ft of older Paleozoic sedimentary rocks may be present in the subsurface (Harris, 1975).

The basal part of the exposed stratigraphic section consists of as much as 280 ft of continental and marine, fine- to coarse-grained clastic rocks which are here assigned to the Cuyahoga(?) Formation and underlying Knapp(?) Formation undivided of the Lower(?) Mississippian Series. These formations are not subdivided in this report because the boundary between the two formations appears to be gradational and because the entire sequence is poorly exposed in and near the study area. The Cuyahoga(?)-Knapp(?) unit is truncated by an erosional unconformity of regional extent (Edmunds and others, 1979, figs. 5, 7, and 8).

Overlying the unconformity is a sequence of alternating units of very coarse-grained, quartzose, clastic rocks and fine- to medium-grained clastic rocks that contain a few thin beds of coal (fig. 3). This sequence reaches a maximum thickness of about 260 ft in the study area. The Pennsylvania Geological Survey (Berg, 1977; Edmunds and others, 1979, figs. 7 and 8; Berg and others, 1980) assigns these rocks to the Pottsville Formation; however, because this sequence is lithologically dissimilar to the type Pottsville of eastern Pennsylvania (Wood and others, 1969, p. 70-78), the term Pottsville is not used in this report. Instead, mappable units in the sequence are identified informally as members 1 through 5, in ascending order (fig. 3; Schweinfurth and others, 1982) because it was not feasible to extend the geologic work from the study area so as to make secure stratigraphic correlations with more normal Pennsylvania and adjacent parts of northwestern Pennsylvania. This was also true for the coal beds observed near the study area; as a result the coal beds are identified in this report by letters a through g in ascending order (fig. 3).

Unmapped deposits of colluvium mantle most valley slopes. Alluvium, consisting of unconsolidated clay, silt, sand, coarse gravel, and large boulders, underlies many valley floors. The study area is south of the southernmost extent of Pleistocene glaciation in this part of Pennsylvania.

The study area lies on the gently dipping southeast limb of the Johnson Run syncline (Berg, 1977), or the "Johnson Run (Fifth) Bituminous Coal Basin" (Ashburner, 1881). The axis of the syncline lies about 1.5 mi northwest of the northwesternmost part of the study area and trends northeast. The strata in the study area dip about 25 to 30 ft per mi to the northwest (Schweinfurth and others, 1982, fig. 4).

GEOCHEMISTRY

Geochemical investigations were conducted by the U.S. Geological Survey (USGS) in October 1980. Eighteen representative bedrock samples and 9 bulk stream-sediment samples were collected. These samples were analyzed spectrographically for 31 elements, including the common metals having the greatest economic importance (Hickling and others, 1983). Each sample was analyzed semiquantitatively for 31 elements 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 present in the data.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Gas and Oil

Of the approximately 14,500 ft of Paleozoic sedimentary rock underlying the study area (Harris, 1975), the shallow sandstone beds of the Upper Devonian sequence (Kelley and others, 1970) appear to have the important reservoir rocks for both gas and oil (fig. 4). The study area has a high potential for natural gas in these beds of fine- to coarse-grained sandstones, which accumulated as offshore bars and beaches along the fringe of the large Catskill delta complex, as shown by wells in the Ridgway gas field in the eastern part of the study area and other nearby gas fields (figs. 5 and 6). The study area has low potential for oil, however, because the Upper Devonian rocks of the study area have been subjected to thermal-maturation temperatures near the upper limit for the generation and retention of oil (Epstein and others, 1977, p. 21). A scattering of small oil wells on the north side of the Ridgway gas field demonstrates that some oil may be present in the Upper Devonian sandstones, but significant accumulation of oil in these beds in the area is unlikely. Because thermal-maturation temperatures increase with depth of burial in unfaulted rock sequences, the underlying older Devonian rocks and Lower Paleozoic strata (fig. 4) have almost no potential for oil in the study area but are well within the thermal-maturation range for natural gas.

Drilling is the only method to confirm the presence of gas or oil in the Upper Devonian reservoir sandstone beds because they are lenticular, they are intercalated in a thick sequence of shaly source beds, and because the gas-productive porous and permeable zones are erratic in position within individual beds of sandstone. These conditions define the Upper Devonian reservoir beds as stratigraphic traps in which the extent and thickness of the reservoir depends upon changes in porosity and permeability in the reservoir developed during deposition or during consolidation and lithification of the sands. Stratigraphic traps are much more difficult to locate than structural traps because the position of a stratigraphic trap is rarely reflected in the configuration of the overlying bedrock.

The beds of shale that enclose the shallow Upper Devonian reservoir sandstone beds contain several percent organic matter—kerogen—which is the source materials for gas and oil. The beds of greenish-gray and gray shale are moderately good source beds, whereas the several zones of grayish-black and black shale in the Upper Devonian sequence and the Middle Devonian black Marcellus Shale (fig. 4) are richer in organic detritus and are better source beds. Where it is fractured by faulting, the Marcellus is both a source and a reservoir rock for natural gas in western Pennsylvania and adjacent New York and is potentially gas productive under the study area. However, the characteristic low rate of productivity from fractured shale, the difficulty of locating and stimulating zones of fractures in the Marcellus Shale, and drilling depths of 5,000 to 6,000 ft probably exclude it as a primary drilling target under existing economic conditions. It remains a good possibility as a secondary target, however, in exploratory tests primarily drilled to more deeply buried reservoir rocks.

Gas has been produced from small pinnacle reefs to the north and northeast of the study area in northwestern Pennsylvania and adjacent New York from the Middle Devonian Onondaga Limestone (fig. 4), which is generally less than 100 ft thick beneath the study area (Oliver and others, 1971). The reefs appear to be more abundant in New York, and the possibility of significant gas accumulation from an Onondaga reef beneath the study area seem remote.

The widespread gas-productive Lower Devonian Oriskany Sandstone is absent beneath the study area (Cate, 1962). The absence of this well-known formation decreases the attractiveness of deep drilling in the study area. However, as much as 531 thousand cubic feet (MCF) of sour, hydrogen sulfide-containing gas has been produced per day from the single-well Boot Jack pool (Horton Field) about 2 mi southeast of the study area (fig. 5) from the Bass Islands Dolomite, the uppermost unit in the Silurian sequence (fig. 4). The Bass Islands was found to contain two small-volume zones of gas and some salt water also in the Kane deep test, which was drilled about 13 mi north of the study area in 1928. The Boot Jack Pool and the Kane test suggest that the Bass Islands Dolomite may be gas productive beneath the study area.

Only a few deep tests have been drilled into and through the Silurian rocks in Elk and adjacent counties during the past 100 years, and no deep drilling has been done in the study area. Only noncommercial volumes of gas were found in tests drilled to the basal Silurian sandstones, the "Medina sands" of drillers; however, because most of these wells were drilled before the introduction of well stimulation by hydraulic-fracturing techniques in the Appalachian basin, the possibility of obtaining larger volumes of gas from these tight, low-permeability Silurian sandstones cannot be rejected. Available data suggest, however, that the potential for gas production from this source is low.

Deep tests in Elk County have not penetrated more than 50 ft into the Queenston Shale, the uppermost unit in the Ordovician sequence underlying the study area (fig. 4). Consequently, the potential for hydrocarbon accumulation in the Ordovician and Cambrian rocks, which are approximately the lowermost 6,000 ft of sedimentary rocks beneath the study area, is largely unknown.

A few deep and ultra-deep tests in western Pennsylvania and adjacent New York have penetrated the carbonate and quartzose rocks that comprise the greater part of the Ordovician and Cambrian sequence in the Appalachians. The Trenton Limestone (fig. 4), which is overlain by several hundred feet of moderately good source beds in the black Utica Shale, has been gas productive on the margin of the Appalachian basin in central New York adjacent to Lake Ontario. However, despite the nearby source beds, the Trenton does not appear to be gas-bearing down dip in north-central Pennsylvania in the vicinity of the study area.

Some of the deep tests that penetrated into or through the Cambrian rocks in western Pennsylvania found gas and oil in the Upper Cambrian Gatesburg Formation (fig. 4) in McKean and Crawford Counties (fig. 6). The Gatesburg is dominantly a dolomite but it also contains beds and zones of sandstone, some of which are porous and permeable. However, salt water commonly occurs in close association with gas in the Gatesburg; in the deep well nearest the study area, the Biery and Johnson #1 Shaw drilled in southern Warren County, (fig. 6) only salt water was found in a sandstone bed at the top of the Gatesburg.

These data on Ordovician and Cambrian rocks suggest strongly that there is a low potential for accumulation of gas in the lower half of the Paleozoic sedimentary sequence beneath the study area.

In summary, the Clarion River Roadless Area has a high potential for natural gas and a low potential for oil in the shallow Upper Devonian rocks, a moderate potential for natural gas in the Devonian and Silurian rocks, and a low potential in the Ordovician and Cambrian rocks. The potential for hydrocarbon accumulations in the Precambrian basement rocks is nil.

Coal

Approximately seven thin, lenticular, nonpersistent coal beds occur in the Pennsylvanian-age strata near the study area. These beds were not correlated with named beds outside of the study area, so they are referred to as coal beds a through g in this report (fig. 3; Schweinfurth and others, 1982). None of these coal beds were observed within the study area, but coal beds c and e, which were observed just outside of the northeastern part of the study area, are locally thick and persistent enough to warrant projecting them into the northeastern part of the study area (figs. 7 and 8). However, neither bed is thick enough (28 in.) within the study area to contain reserve base[2] quantities and reserves of coal. Analyses of weathered samples from beds c and e (Welsh and Behum, 1982, table 3, sample numbers PCR-3, -9, 11, and -12) indicate that both beds are high in ash content (about 18 to 34 percent and about 20 to 33 percent, respectively, on an as-received basis), and low in sulfur content (0.5 to 0.6 percent for both beds, on an as-received basis). Fresh samples of coal from these beds presumably would contain less ash and oxygen because weathering oxidizes the coal and infiltration of soil into fractures in the coal may be reflected as higher ash content in the proximate analysis (Yohe, 1958; Rees, 1966). The coal is tentatively ranked as high-volatile A bituminous (Welsh and Behum, 1982).

The approximate distribution of coal bed c is shown in figure 7 and that of coal bed e in figure 8; thicknesses shown are for coal only. Coal bed c was mined for local use at one small, abandoned adit just outside the northeast corner of the study area (fig. 7), but no mines were observed in bed e either in or near the study area. The amount of coal removed from coal bed c was not estimated because past mining is considered negligible in the study area.

Thicknesses of coal used for the distribution map of coal bed c (fig. 7) were taken from an outcrop about 0.6 mi northeast of the study area where the coal in the bed is 25.4 in. thick (Schweinfurth and others, 1982; Welsh and Behum, 1982) and from an estimate of a minimum coal thickness necessary for underground mining of about 28 in. made by Welsh and Behum (1982, p. 21), for the abandoned drift mine just outside of the study area. Estimated coal resources for bed c (table 1) are based on an average thickness of coal of about 21 in. within the study area.

Thicknesses of coal used for the distribution map of coal bed e (fig. 8) were taken from measurements made at an outcrop of the bed near the abandoned mine symbol where the coal is 17.5 in. thick, and at an outcrop about 0.6 mi northeast of the study area where the coal in bed e is 28 in. thick. The average thickness of coal in bed e great than 14 in. within the study area, is estimated to be about 16 in.

The amount of original coal resources in the study area in beds c and e that is greater than 14 in. in thickness and under less than 1,000 ft of overburden is estimated to be about 1.3 million short tons (table 1). Original resources in bed c are similarly estimated to be about 1.2 million short tons and in bed e about 134,000 short tons. The beds are thin and lenticular and the Surface Mining Control and Reclamation Act of 1977 (30 U.S. Code, 1272 (e)) prohibits surface mining of coal on the Federal lands in national forests.

Construction Materials

Underclay and shale associated with coal beds f and g (fig. 4) have been mined 1.8 mi east of the study area (Welsh and Behum, 1982, fig. 2, sample localities PCR-14 and -16). Both this pit and a pit owned by the Yingling-Martin Brick Company, located about seven miles northeast of the study area beside Rt. 219, supplied raw material for local brick manufacturing. The Yingling-Martin Brick Company utilized Mississippian- and Pennsylvanian-age shale to produce common, face, and paving brick during the 1930's (Leighton, 1941).

Clay and shale units correlative with previously quarried units were sampled in and near the study area. Preliminary ceramic evaluations suggest potential structural-clay uses for clay in the study area (Welsh and Behum, 1982, table 5). All clay and shale samples tested were suitable for building-brick raw material. Two shale samples expanded during the preliminary bloating test, but these materials were too heavy for use in light-weight aggregate.

Atomic-absorption analysis of Pennsylvanian-age underclay samples revealed a 30 percent average alumina content, and a sample of a Mississippian-age shale contained 38.54 percent alumina (Welsh and Behum, 1982, fig. 2, locality PCR-26). These alumina percentages are high in comparison to the average for clay or shale, and an alumina content this high has been regarded as a potential future aluminum source (U.S. Bureau of Mines, 1967).

Sandstone has been quarried in the study area for construction, chemical, and foundry applications. Flaggy, olive-gray, Early(?) Mississippian-age sandstone from an abandoned quarry in the northwest corner of the study area was used as road-base material for Laurel Mill Road (State Rt 120) built in the 1930's by the Civilian Conservation Corps (Paul D. Brohn, U.S. Forest Service, oral commun., 1980). In the 1920's, Gardner Sand Company of Ridgway quarried and processed Pennsylvanian-age sandstone near the southeast corner of the study area (Welsh and Behum, 1982, fig. 2, sample site PCR-20). The sandstone product was used for chemical applications and as molding sand in steel foundries (Stone, 1928).

Pennsylvanian-age sandstone was used locally for rough building stone as indicated by its presence in the abutments of a nearby abandoned railroad bridge over Big Mill Creek. However, because textural and bedding characteristics of these sandstones are generally irregular, their future use would probably be confined to rough dimension stone rather than architectural stone. In addition, the iron-oxide content of the sandstone is too high for it to be used as a source of glass sand. Sandstone beds in the southeast part of the study area constitute a potential resource for construction, rip-rap, and road-building material because of the good access to the Baltimore and Ohio Railroad; however, abundant supplies of these materials are readily available elsewhere closer to markets.

Sand and gravel in alluvial deposits of the Clarion River have been used for construction material and molding sand for metal casting. An inactive sand and gravel pit across the Clarion River from the southwestern corner of the study area (Welsh and Behum, 1982, fig. 5) contains limited reserves. Gardner Sand and Gravel Company produced molding sand in the 1920's from river-terrace deposits just south of the study area. The material was shipped by rail for use as molding sand in the casting of radiators, brake shoes, and other machinery (Stone, 1928). However, sand and gravel deposits in the study area are of limited extent and larger and more accessible deposits exist elsewhere along the river.

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MINERAL RESOURCE POTENTIAL MAP OF THE CLARION RIVER ROADLESS AREA, ELK COUNTY, PENNSYLVANIA

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1983

[1] Resource quantities include beds of bituminous coal 14 in. or more thick that occur at depths to 6,000 ft. (U.S. Bureau of Mines and U.S. Geological Survey, 1976).
[2] Reserve base includes beds of bituminous coal 28 in. or more thick that occur at depths to 1,000 ft. The reserve base includes coal from only the measured and indicated categories of reliability (U.S. Bureau of Mines and U.S. Geological Survey, 1976).

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