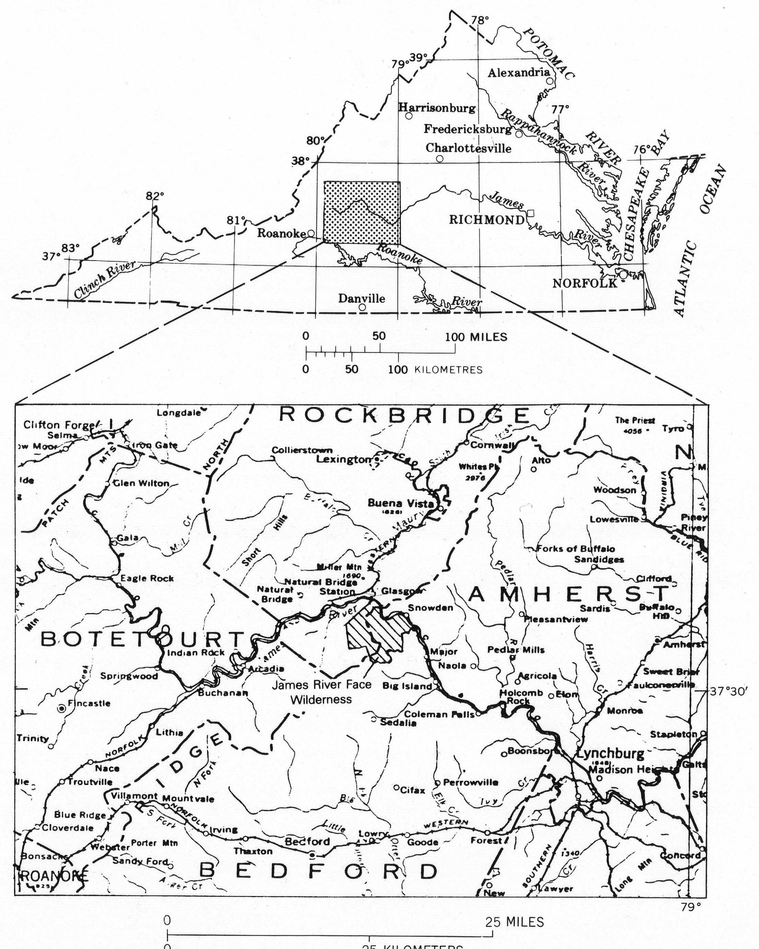

Figure 1.--Location of James River Face Wilderness.

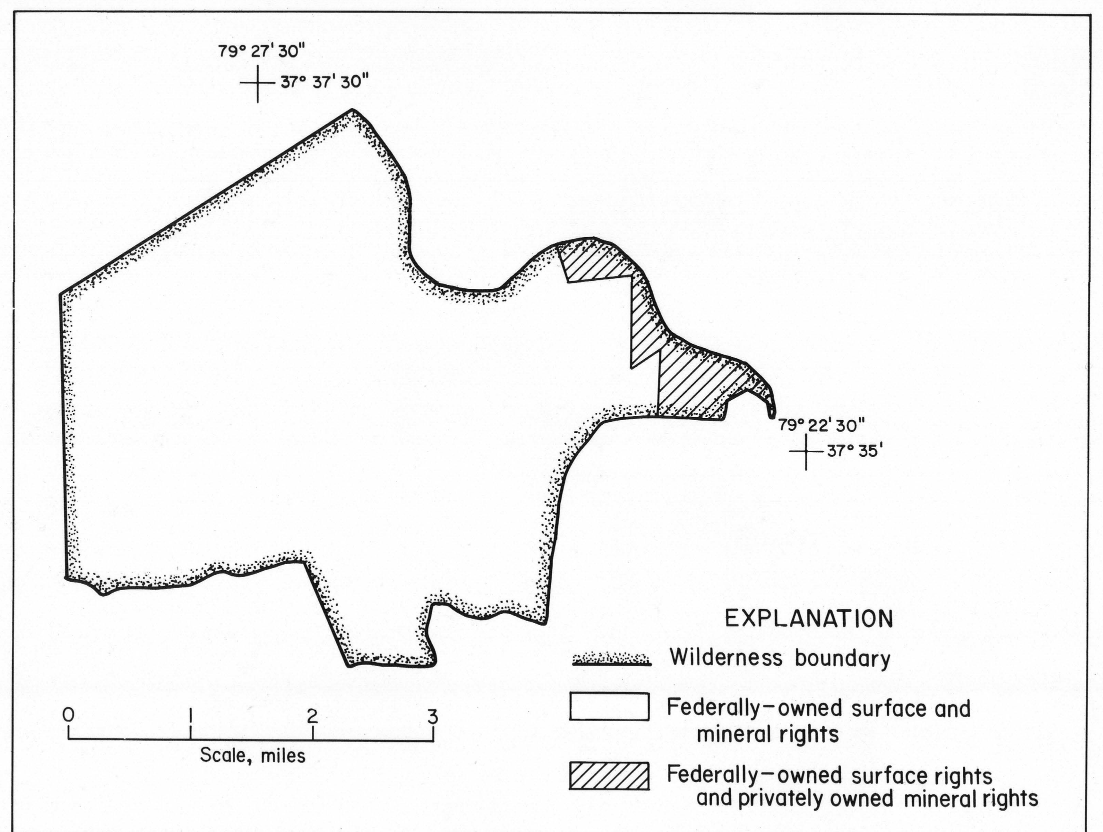

Figure 2.--Surface- and mineral-rights ownership, James River Face Wilderness.

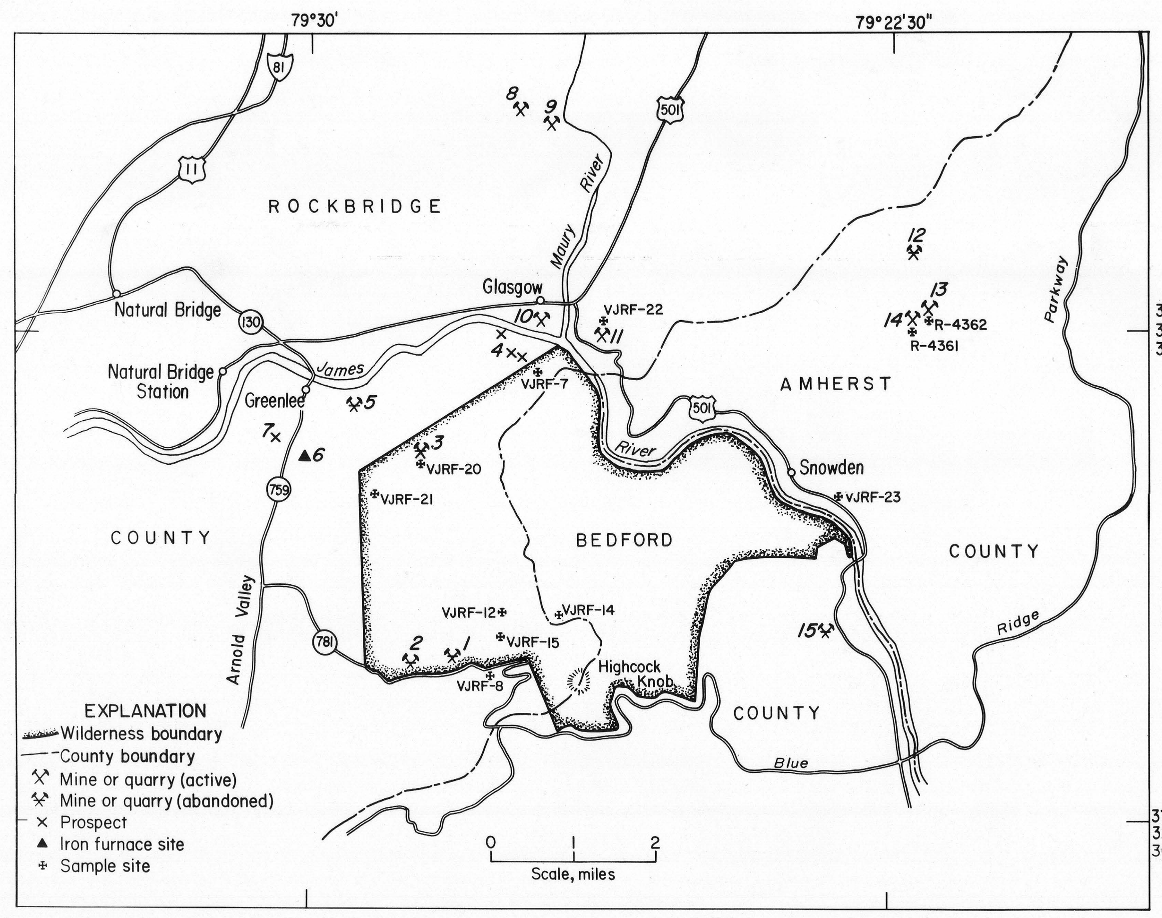

Figure 3.--Quarries, mines, prospects, and sample localities. Numbers beside quarry, mine, prospect, and iron-furnace site symbols refer to descriptions in table 1; analyses or tests for numbered sample sites are found in tables 2 and 3.

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 James River Face Wilderness, Jefferson National Forest, Bedford and Rockbridge Counties, Virginia, which was established as a wilderness by Public Law 93-622, January 3, 1975.

INTRODUCTION

The James River Face Wilderness comprises 8,800 acres in the Jefferson National Forest and occupies parts of Bedford and Rockbridge Counties, west-central Virginia. It is about 2 mi southeast of Natural Bridge Station and 0.5 mi south of Glasgow (fig. 1).

Access is provided by U.S. Route 501, State Route 130, and the Blue Ridge Parkway. Interior access is provided by the Appalachian Trail, other marked foot trails and a graded bridle path.

The area, on the crest of the Blue Ridge Mountains, is drained by small tributaries of the James River. Altitudes range from 600 ft where U.S. Route 501 crosses the James River to 3,073 ft on Highcock Knob.

Past Investigations

Bloomer and Werner (1955) in a study of the Blue Ridge Mountains included the geology of the wilderness area. Other early reports that have discussed the geology of the area include studies of the James River Valley by J. L. Campbell (1882) and H. D. Campbell (1885); a study of the Appalachian Valley of Virginia by Butts (1940); reports by Woodward (1936) and Spencer (1968) on the geology and mineral resources of the Natural Bridge region; and a dissertation by R. B. Leonard (1962) that describes the geology along the western foot of the Blue Ridge.

Present Investigation

The U.S. Bureau of Mines (USBM) field reconnaissance was conducted in the spring of 1980. Twenty rock samples and four panned-concentrate samples were collected during the investigation. All samples were analyzed spectrographically for 40 elements by TSL Laboratories, Ltd., Opportunity, Wash. Atomic absorption, calorimetric, chemical, and petrographic analyses were performed on selected samples. Shale samples were evaluated for ceramic and bloating properties (table 2) by the USBM Tuscaloosa Research Center, Tuscaloosa, Ala.

The U.S. Geological Survey (USGS) mapped the geology in cooperation with Dr. Edgar W. Spencer of Washington and Lee University (Brown and Spencer, 1981). The USGS also made a geochemical survey of soils, rocks, and stream sediments to determine whether significant amounts of metals exist in the area (Brown and Siems, 1982).

GEOLOGIC SETTING

The following discussion is abstracted from the report on the geology of the James River Face Wilderness by Brown and Spencer (1981). Rocks in the wilderness are clastic rocks of the Chilhowee Group that rest unconformably on a basement composed of orthogneisses and igneous intrusive rocks of the Virginia Blue Ridge Complex of Brown (1958) of Precambrian age.

The Chilhowee Group in ascending order includes the Unicoi (Weverton) and Harpers (Hampton) Formations of Early Cambrian(?) age and the Antietam (Erwin) Quartzite of Early Cambrian age. The Unicoi (Weverton) Formation consists of graywacke, pebbly quartzite, shale, and tuffaceous sediments. The Harpers (Hampton) Formation consists of dark-gray shale, siltstone and thin quartzites. Also included in the Harpers (Hampton) are three probably discontinuous quartzite units that are as much as 300 ft thick. The overlying Antietam (Erwin) Quartzite consists mainly of vitreous bluish-gray orthoquartzite. The Shady Dolomite overlies the rocks of the Chilhowee Group but does not occur in the wilderness.

The geologic structure in the James River Face Wilderness and vicinity is essentially a southwest-plunging, broad anticline. The southeast limb of the fold is interrupted by a steeply dipping fault that brings the Harpers (Hampton) Formation down against older beds of the Unicoi (Weverton) Formation. Where the fault crosses the James River, rocks of the Harpers (Hampton) Formation are faulted against gneisses of Precambrian age.

A major thrust sheet extends east-west across the mapped area, then swings northeast near the eastern edge of the wilderness. It truncates the broad, plunging anticline and has placed gneisses of Precambrian age across the southern part of the area.

SURFACE- AND MINERAL-RIGHTS OWNERSHIP

The Federal Government owns all surface rights in the wilderness and all mineral rights except those on about 300 acres along the James River in the extreme eastern part of the wilderness (fig. 2).

MINERAL UTILIZATION IN THE REGION

The Harpers (Hampton) Formation and Antietam (Erwin) Quartzite are or have been the source locally of raw materials for expanded lightweight aggregate, brickmaking, ferrosilicon alloy, and ocher. Iron ore deposits were mined within a mile of the wilderness in the 1800s. The Shady Dolomite is quarried about 3 mi northwest of the wilderness, and gneisses of the Pedlar Formation of Bloomer and Werner (1955) have been used locally as a source of crushed stone. About 20 mi northeast of the wilderness, tin, in the mineral cassiterite, has been produced from Bloomer and Werner's (1955) Pedlar Formation (Ferguson, 1918).

Three now-inactive quarries that produced metallurgical-grade quartzite are the only known mines or prospects within the wilderness boundaries; operations ceased about 1966.

Shale and Slate

Lightweight aggregate is produced from Harpers (Hampton) Formation shale by the Amlite Corp. at two quarries 3 mi northeast of the wilderness (sites 13 and 14, fig. 3). Expanded aggregate is made in a plant adjacent to the quarries by bloating the shale in rotary kilns. Production is substantial and the plant and quarries have been active since the mid-1960s.

General Shale Products, Inc. recently opened a quarry in Harpers (Hampton) shale about 1500 ft north of the wilderness on the north side of the James River near Glasgow (site 11, fig. 3). The quarry supplies raw material for brick kilns located near Natural Bridge Station.

From 1880 to 1904, superior-grade roofing slate was quarried from the Harpers (Hampton) Formation by the Virginia Slate Mining Co. (site 12, fig. 3) about 3.5 mi northeast of the wilderness (Watson, 1907).

Shale of the Harpers (Hampton) Formation is bedrock in a large part of the wilderness, but outcrops are rare and sampling opportunities are limited. Of 6 samples collected in and adjacent to the wilderness, 4 have properties suitable for structural clay products and 1 is marginally useful for lightweight aggregate. Testing results for these samples, preceded by VJRF-, are reported in table 2; samples preceded by R- in the table are from the Amlite quarry sites and are included for purposes of comparison.

Quartzite

Metallurgical-grade Antietam (Erwin) Quartzite was produced from 1945 to about 1966 from three quarries (fig. 3) in the wilderness. The quarries at sites 1 and 2 were operated first by the Mathews-Curtis Co., Inc., then by W. G. Mathews, Jr., Inc. The quartzite was crushed at the company plant at Natural Bridge Station and shipped to the Electro Metallurgical Corp. at Alloy, W. Va., for use in ferrosilicon (Lowry, 1954). Byproducts from the crushing plant included crushed stone and sand which were used for concrete aggregate, road metal, railroad ballast, and in cement and mortar. The Greenlee quarry at site 3, operated by Vulcan Materials Company, also produced metallurgical-grade quartzite which was shipped to Alloy, W. Va. (Sweet, 1981).

Antietam (Erwin) Quartzite is bedrock for the western quarter of the wilderness. Samples taken from the abandoned quarry sites and from random localities in the wilderness show a uniformity of composition (table 3).

Iron Ore

Brown iron ore. The Glenwood Estate iron mine and furnace are within a mile of the western boundary of the wilderness (sites 5 and 6, fig. 3). Three prospect pits, in even closer proximity (site 4, fig. 3), were located during the course of the field investigation. The remains of the Glenwood mine is a pit 40 ft deep and about 150 ft in diameter. Campbell (1882) stated that the ore, as nodular masses of goethite, was mined from residual soil. The deposit is typical "mountain brown ore" which is formed by deposition of iron, usually goethite, in cavities along fault zones. Ore is mined directly from the fault zone or, as at this site, from the overlying residual soil.

The fault zone is not exposed at this site, but is believed to be parallel to and west of the northwest boundary of the wilderness (Spencer, 1968). No indication of similar iron deposits was found in the wilderness.

Bedded iron ore. Bedded hematite-rich quartzite and quartz sandstones of the Harpers (Hampton) and Unicoi (Weverton) Formations have been mined or prospected near the wilderness (Woodward, 1936). Campbell (1882) described a small mine in a hematitic sandstone of the Unicoi (Weverton) Formation on the west side of Arnold Valley, 1.25 mi west of the wilderness (probably site 7, fig. 3).

A bed of ferruginous quartzite in the Harpers (Hampton) Formation was located in the wilderness by the trail about 1000 ft north of Sulfur Spring. Sample analyses show that it is less than 13 percent iron.

Stone

The Shady Dolomite is being quarried for crushed stone and concrete aggregate about 2 mi north of Glasgow by the Lone Jack Limestone Co. (site 8, fig. 3). This formation is a potential source of high-magnesium dolomite. The Shady Dolomite is poorly exposed near the wilderness, but the contact is believed to be approximately 0.25 mi west of the boundary; the formation does not occur within the wilderness.

Granitic rocks of Bloomer and Werner's (1955) Pedlar Formation have been used locally for crushed stone, but these rocks in the wilderness are either in the inaccessible Big Cove area or are along the Blue Ridge Parkway which has regulations prohibiting commercial traffic. In a survey for dimension stone, Steidtmann (1945) determined that this formation where sampled in the James River gorge was not suitable as building stone.

Ocher

About 50 tons of yellow clay having "some ocher characteristics" was mined (site 15, fig. 3) from a streambed about 1 mi east of the wilderness boundary (USBM war minerals files). No deposits of ocher were seen within the wilderness.

Tin

Tin deposits occur in the Irish Creek district on the western slope of the Blue Ridge Mountains, about 20 mi north-northeast of the wilderness. Cassiterite was mined from two sets of workings during the periods 1883-1885, 1889-1892, and 1918-1919 (Werner, 1966). The host rock is hypersthene granodiorite of Bloomer and Werner's (1955) Pedlar Formation.

In the wilderness, panned-concentrate samples from streams draining the Unicoi (Weverton) Formation do not have anomalous tin values (Brown and Siems, 1982).

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Table 1.--*Descriptions of quarries, mines, and prospects shown on figure 3*

Site number	Name and commodity	Production and development	Remarks
1, 2	W. G. Mathews, Jr., Inc. quarries (quartzite)	Annual production given in U.S. Bureau of Mines statistics as "substantial". Active from 1945 to 1963.	Quarries opened by Mathews-Curtis Co., Inc., later operated by W. G. Mathews, Jr., Inc. Quarry product was metallurgical-grade quartzite used in ferrosilicon produced by Electro Metallurgical Corp., Alloy, W. Va. Byproduct from crushing plant located at Natural Bridge Station was sold as crushed stone for concrete aggregate and sand for use in concrete and mortar (U.S. Bureau of Mines war minerals files).
3	Greenlee quarry (quartzite)	Production unknown but size of quarry indicates large tonnage shipped. Quarrying ceased about 1965 or 1966.	Quarry operated by Vulcan Materials Co. for metallurgical-grade quartzite for use in ferrosilicon produced by Electro Metallurgical Corp., Alloy, W. Va. (Sweet, 1981).
4	Not known (iron)	Probably no production. Three small slumped pits about 10 ft deep and 25 to 35 ft in diameter.	No ore or indication of ore was seen at these sites.
5	Glenwood Estate mine (iron)	Production unknown, but sufficient to support the furnace at site 6. The mine site appears now as a large, badly slumped pit, approximately 40 ft deep and 150 ft across.	The ore mineral is goethite concentrated as fracture fillings in an underlying thrust-fault zone and is typical of a mountain brown ore deposit. Campbell (1882) reported that at the Glenwood Estate mine the ore was found as residual masses in the overlying soil. Associated minerals are psilomelane, manganite, and wad.
6	Glenwood Estate furnace (iron)	Production unknown.	Railroad grade connecting the Glenwood Estate mine with the furnace is still traceable. Forest Service marker at furnace ruins states that ore was smelted here from 1858 to 1865 and shipped to Richmond by barge on the James River canal.
7	Not known (iron)	Production unknown.	Spencer (1968) has indicated a prospect at this site. Campbell (1882) reported that a small mine, 0.25 mi west of the Glenwood furnace, was mined for hematitic sandstone which was smelted at the furnace. Spencer's prospect and Campbell's small mine may be the same location.
8	Lone Jack Limestone Co. quarry (dolomite)	Production data confidential.	Product sold as crushed stone for concrete aggregate, bituminous aggregate, and roadbase.
9	Lone Jack Limestone Co. quarry (quartzite)	Production data confidential.	Product sold as silica sand and crushed stone for concrete aggregate, bituminous aggregate, and roadbase.
10	Locher Brick Co. pit (clay)	Production unknown.	Clays from James River floodplain used for brick manufacture.
11	General Shale Products, Inc. quarry (shale for bricks)	Production data unknown.	Raw material supplies a brick plant located at Natural Bridge Station.
12	Williams Brothers quarry (slate)	Production unknown.	Virginia Slate Mining Co. quarried and milled superior-grade roofing slate at this site from 1880 to 1904 (Watson, 1907). Production ceased when mill burned; reserves remain.
13, 14	Amlite Corp. quarries (shale for lightweight aggregate)	Significant present production. Production data confidential.	Analyses of samples from these quarries (Sweet, 1973) indicate that the shale would also be a suitable raw material for brick and tile.
15	Clarence C. Tinsley tract (ocher, iron)	About 50 tons of ocher shipped. Excavation in streambed was about 10 by 15 ft. A cut of equal size about 200 ft above was reported to have been an iron prospect (U.S. Bureau of Mines war minerals files).	In 1895, a yellow clay with "some ocher characteristics" was mined, washed and shipped to Dingee and Wyman Paint Co., Lynchburg, Va. (U.S. Bureau of Mines war minerals files).

Table 2.--*Evaluation of shale and slate samples, James River Face Wilderness and vicinity*

[Tests for samples prefixed by VJRF- were performed by the U.S. Bureau of Mines Tuscaloosa Research Center, Tuscaloosa, Ala.; those prefixed by R- were also tested by the Tuscaloosa Research Center and are reported in Sweet (1973). Sample localities are shown in figure 3]

Sample number	Sample type	Raw properties	Slow-firing test: Temp. °C	Color (Munsell)	Moh's hardness	Linear shrinkage (percent)	Absorption (percent)	Apparent porosity (percent)	Bulk density (gm/cc)	Potential use
VJRF-8	5-ft channel	Water of plasticity: 21.2%	1000	7.5YR8/6	3	0.0	22.0	37.2	1.69	Structural clay
		Working properties: short	1050	7.5YR8/6	3	0.0	20.4	35.4	1.73	products (e.g.,
		Drying shrinkage: 0.0%	1100	5YR7/8	3	2.5	16.7	31.2	1.87	building brick
		Dry strength: fair	1150	2.5YR5/6	4	5.0	9.3	19.8	2.14	at 1150°-1200°C)
		pH: 4.3	1200	2.5YR4/4	5	7.5	3.3	7.8	2.38	
		HCL effervescence: none	1250	--	--	melted	--	--	--	
VJRF-14	8-ft channel	Water of plasticity: 20.1%	1000	7.5YR8/6	3	0.0	20.9	36.2	1.73	Structural clay
		Working properties: short	1050	7.5YR8/6	3	0.0	19.6	34.9	1.78	products (e.g.,
		Drying shrinkage: 0.0%	1100	5YR6/8	3	2.5	17.1	31.8	1.85	building brick
		Dry strength: fair	1150	2.5YR5/6	4	5.0	11.9	24.2	2.03	at 1150°-1250°C)
		pH: 5.4	1200	2.5YR4/4	4	7.5	6.7	14.9	2.24	
		HCL effervescence: none	1250	2.5YR3/2	5	7.5	3.9	9.0	2.29	
VJRF-22	Random chip, 20-ft interval	Water of plasticity: 21.2%	1000	5YR8/4	3	0.0	20.5	34.9	1.70	Structural clay
		Working properties: short	1050	5YR7/6	3	2.5	18.4	32.4	1.77	products (e.g.,
		Drying shrinkage: 0.0%	1100	5YR6/8	3	5.0	15.5	29.2	1.88	building brick
		Dry strength: fair	1150	2.5YR5/6	4	7.5	8.2	17.8	2.17	at 1150°-1250°C)
		pH: 5.4	1200	2.5YR4/4	4	10.0	3.5	8.1	2.34	
		HCL effervescence: none	1250	2.5YR3/2	4	10.0	1.9	4.6	2.38	
VJRF-23	10-ft channel	Water of plasticity: 18.1%	1000	5YR8/4	3	0.0	26.7	45.0	1.68	Structural clay
		Working properties: short	1050	5YR7/6	3	2.5	19.0	33.3	1.76	products (e.g.,
		Drying shrinkage: 0.0%	1100	5YR6/8	3	5.0	15.3	29.2	1.90	building brick
		Dry strength: fair	1150	2.5YR5/6	4	5.0	10.1	21.0	2.08	and floor brick
		pH: 5.4	1200	2.5YR4/4	4	7.5	6.4	14.3	2.25	at 1150°-1250°C)
		HCL effervescence: none	1250	2.5YR3/2	5	7.5	3.7	8.6	2.33	
				(descriptive)						
R-3861	Composite of grab samples	Water of plasticity: 23.5%	1050	Med. tan	2	4.2	18.9	--	1.74	Possible as a
		Working properties: short	1100	Lt. red-brown	3	5.5	14.9	--	1.90	nonplastic com-
		Drying shrinkage: 3.9%	1150	Med. brown	6	12.2	6.7	--	2.21	ponent in brick,
		Dry strength: 85 psi	1200	Med. red-brown	>7	15.1	2.6	--	2.43	tile and related
		pH: 7.4								clay products
		HCL effervescence: none								
R-4362	Composite of grab samples	Water of plasticity: 19.3%	1050	Lt. brown	2	3.5	18.1	--	1.72	Brick and tile
		Working properties: excel.	1100	Lt. brown	3	4.0	12.9	--	1.91	
		Drying shrinkage: 1.4%	1150	Med. brown	6	6.0	8.1	--	2.08	
		Dry strength: 29 psi	1200	Red-brown	>7	7.5	7.5	--	2.10	
		pH: 7.0								
		HCL effervescence: none								

Sample number	Preliminary bloating test: Temp. °C	Absorption (percent)	Bulk density (gm/cc)	Bulk density (lb/ft^3)	Remarks	Potential Use
VJRF-15*	1100	6.2	1.67	104.2	No expansion	Marginal for lightweight
	1150	8.7	1.41	88.0	Partial expansion	aggregate at 1200°C.
	1200	12.7	1.23	76.4	Good pore structure	Slightly heavy: short
	1250	10.4	0.63	39.2	Overfired (sticky)	firing range.
R-4362	1000	6.8	--	136.5	No expansion	Should produce lightweight
	1050	8.3	--	121.4	Laminar expansion	aggregate in the range
	1100	4.9	--	106.5	Laminar expansion	50-55 lb/ft^3 (loose pore
	1150	7.2	--	82.7	Laminar expansion	weight) at 1175-1200°C.
	1200	7.2	--	69.5	Good pore structure	

* Slow-fire tests indicate that this sample is not suitable for structural clay products.

Table 3.-- *Analyses of Antietam Quartzite samples from within the James River Face Wilderness*

[Analyses performed for the U.S. Bureau of Mines by TSL Laboratories, Ltd., Opportunity, Wash.]

Sample number	Sample interval[1]	Calorimetric (percent): [2] SiO_2	Calorimetric (percent): P_2O_5	Atomic absorption (percent): Al_2O_3	Atomic absorption (percent): Fe_2O_3	Atomic absorption (percent): CaO	Atomic absorption (percent): TiO_2	HG-AA[3] (percent): As
VJRF - 7	5 ft	97.5	<.01	0.28	0.31	0.12	0.02	<.01
VJRF - 12	30 "	96.5	.03	.94	.44	.12	.04	<.01
VJRF - 20	15 "	96.5	<.01	.57	.21	.09	.05	<.01
VJRF - 21	40 "	98.5	.02	.19	.21	.09	.02	<.01

[1] All samples are random chip through sample interval.
[2] Accuracy is plus or minus 1 percent of value given.
[3] Hydride generation - atomic absorption.

MAP SHOWING QUARRIES, MINES, PROSPECTS, AND SAMPLE DATA IN AND NEAR THE JAMES RIVER FACE WILDERNESS, BEDFORD AND ROCKBRIDGE COUNTIES, VIRGINIA

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1982
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