DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1494
PAMPHLET ACCOMPANIES MAP

Base from U.S. Geological Survey
Shell Knob and Cape Fair, 1974

Geology by W.P. Pratt, 1979,
and K.C. Thomson, 1980

GEOLOGIC, GEOCHEMICAL, AND MINERAL RESOURCE POTENTIAL MAP OF THE PINEY CREEK WILDERNESS, STONE AND BARRY COUNTIES, MISSOURI

By

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1982

CORRELATION OF MAP UNITS

Unit		
Qal		QUATERNARY
Unconformity		
Mrs	Lower Mississippian	MISSISSIPPIAN
Mp		
Mk		
Unconformity		
Oc	Lower Ordovician	ORDOVICIAN

DESCRIPTION OF MAP UNITS

Qal ALLUVIUM (QUATERNARY)--Gravel, sand, and silt filling stream valleys

Mrs REEDS SPRING FORMATION (LOWER MISSISSIPPIAN--OSAGEAN)--Gray to light-brown, thin- to medium-bedded, micritic to finely crystalline limestone. Includes 40-70 percent dark-gray to brown chert as irregular nodules and thin discontinuous beds. Weathers easily to a chert-strewn surface. Outcrops are rare in the Piney Creek area. Where formation is exposed, chert appears in weathered relief on ragged outcrops. Thickness about 80-100 ft (about 25-30 m)

Mp PIERSON FORMATION (LOWER MISSISSIPPIAN--OSAGEAN)--Gray to light-brown, thin- to medium-bedded, fine- to medium-crystalline limestone, with as much as 50 percent gray to dark-gray chert occurring as nodules and beds predominantly in upper part. Generally separated from the Reeds Spring Formation by a thin shale layer. Formation name follows usage of Missouri Geological Survey. Thickness about 50 ft (15 m)

Mk NORTHVIEW AND COMPTON FORMATIONS, UNDIVIDED (LOWER MISSISSIPPIAN--KINDERHOOKIAN)
Northview Formation--Red to gray limestone and green to light-blue-green shale; outcrops rare. Thickness about 1-3 ft (about 0.3-0.9 m)
Compton Formation--Light-gray to light-brown, medium- to thick-bedded, fine- to medium-crystalline limestone with light-green shale partings. Weathers to a characteristic wavy surface. Outcrops fairly common in roadcuts and on steep hillsides. Commonly forms a bench which is easily observed on aerial photographs. Thickness 15-20 ft (5-6 m)

Oc COTTER DOLOMITE (LOWER ORDOVICIAN--CANADIAN)--Light-brown to gray, medium- to thick-bedded, fine-grained dolomite and minor chert. Weathers light or dark gray. Outcrops common along steep hill slopes and in valley floors. Thickness about 200 ft (60 m); base not exposed

APPROXIMATE BOUNDARY OF WILDERNESS

CONTACT--Approximately located

U D 75 FAULT--Long dashed where approximately located, short dashed where inferred. U, upthrown side; D or bar and ball, downthrown side; arrow and number show direction and amount of dip

8 STREAM-SEDIMENT AND PANNED-CONCENTRATE SAMPLE LOCALITY

PC-1 BEDROCK SAMPLE LOCALITY

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 geologic, geochemical, and mineral survey of the Piney Creek Wilderness in the Mark Twain National Forest, Stone and Barry Counties, Mo. The Piney Creek Wilderness was established by Public Law 94-557, October 19, 1976.

SUMMARY

There is no evidence of significant metallic-mineral deposits in the rock units that are exposed at the surface in the wilderness, but there may be some potential for mineral deposits of two different types at depths from 400 ft (120 m) to more than 2,100 ft (640 m) below the surface. Analyses of rock samples from a drill hole 15 mi (24 km) south of the area showed anomalous amounts of several metals in the Derby-Doerun (usage of the Missouri Geological Survey), Potosi, and Eminence Dolomites, which suggests that these units as well as the subsurface Ordovician carbonate units may have a potential for zinc-lead mineralization in the wilderness. Also, a high-amplitude magnetic anomaly may indicate an iron ore deposit in the Precambrian basement rocks at a depth of at least 2,100 ft (640 m) below the surface, probably at least partly outside the boundary of the wilderness. In both cases the significance of the potential cannot be evaluated without deep drilling. In the case of the possible magnetite deposit, drilling should be preceded by a detailed magnetic survey to delineate the anomaly more clearly. The wilderness has little potential for resources of industrial minerals because they are readily available elsewhere in the region, and no known potential for energy resources.

INTRODUCTION

Location, Size, and Geographic Setting

The Piney Creek Wilderness covers 8,432 acres (3,412 hectares) in Stone and Barry Counties, southwest Missouri, about 40 mi (64 km) southwest of Springfield, Mo., and immediately west of Table Rock Lake. The north, south, and west sides of the wilderness are readily accessible by good State and Forest Service roads. There is a jeep trail along the bottom of Piney Creek, and most ridge tops have drivable roads.

The wilderness is near the western edge of the Salem Plateau of the Ozark uplift. Narrow ridges are the remnants of a maturely dissected upland surface. Piney Creek, which drains the wilderness, flows into the James River arm of Table Rock Lake. Maximum elevation is 1,447 ft (441 m) at the head of Piney Creek. Relief is 547 ft (167 m).

The area is heavily timbered with oak, hickory, and pine. Grassy meadows along Piney Creek were once farms. The surrounding area consists of farms and woodlands.

Previous Investigations

Previous geologic investigations of the wilderness are limited to unpublished outcrop and reconnaissance maps by E. B. Branson in 1938 and J. W. Koenig in 1960 and 1967, in the files of the Missouri Geological Survey, Rolla, Mo.

Present Investigation

The present study includes field and laboratory investigations by both the U.S. Bureau of Mines and the U.S. Geological Survey. Field work for the U.S. Bureau of Mines was done by Clarence Ellis, assisted by Jeanne Coursey, in April 1978. Land status records were checked for ownership of mineral rights at the U.S. Forest Service district office at Cassville. The Missouri Geological Survey's drill-hole logs, mineral-occurrence files, and unpublished geologic maps were checked. The study area was traversed thoroughly to investigate the metallic and nonmetallic mineral potential of the exposed formations. No mineralized rocks were found in the study area.

Field work for the U.S. Geological Survey was done during several periods in 1978-1980. Reconnaissance mapping done by Thomson in 1978 and by Pratt in November 1979 was supplemented by aerial photointerpretation and field checking by Thomson in 1980. Stream-sediment and outcrop samples were collected in April 1980 by Erickson, John G. Viets, and Pratt.

Acknowledgments

We thank District Ranger James Roles of the Cassville Ranger District, Mark Twain National Forest, for his advice on access into the area, and L. E. Cordell of the U.S. Geological Survey for his interpretation of the magnetic map of the area.

GEOLOGY

The wilderness is located on the southwest flank of the Ozark uplift. The rock units exposed are limestones of Mississippian age and dolomites of Ordovician age, which dip very gently northeast. These units are underlain in the subsurface by sedimentary rocks of Ordovician and Cambrian age, and basement igneous rocks of Precambrian age. In descending order the exposed geologic units in the area are as follows: Quaternary alluvium and valley fill, Mississippian Reeds Spring, Pierson (usage of the Missouri Geological Survey), Northview, and Compton Formations, and Ordovician Cotter Dolomite; the base of the Cotter is not exposed, but well data in the area show that the formation is about 200 ft (60 m) thick. The older Ordovician, Cambrian, and Precambrian rocks are not exposed in the Piney Creek Wilderness but can be assumed to be present in the subsurface on the basis of outcrops and drill-hole data in the surrounding region. Underlying the Cotter Dolomite are the following units in descending order, as identified in a drill hole in Carroll County, Ark., about 15 mi (24 km) south of the wilderness (Missouri Geological Survey, unpub. data, 1969): Ordovician Jefferson City Dolomite, 290 ft (88 m) thick; Ordovician Roubidoux Formation, 190 ft (58 m); Ordovician Gasconade Dolomite, 415 ft (126 m); Cambrian Eminence Dolomite, 260 ft (79 m) thick; Cambrian Potosi Dolomite, 125 ft (38 m); Cambrian Derby-Doerun Dolomite (usage of the Missouri Geological Survey), 125 ft (38 m); Cambrian Davis Formation, 35 ft (11 m); Cambrian Bonneterre Formation, 20 ft (6 m); Cambrian Reagan Sandstone, 115 ft (35 m). The total thickness of these units in the Carroll County drill hole is 1,575 ft (480 m). It may be somewhat greater in the Piney Creek area, because the Precambrian basement surface here is interpreted to lie at a depth of about 800 ft (240 m) below sea level (Kisvarsanyi, 1975), which would imply a thickness of about 1,700 ft (520 m) of sedimentary rocks below the base of the Cotter Dolomite. The basement rocks in this area are inferred to consist of alkali-rhyolitic volcanic rocks (Kisvarsanyi, 1979).

The geologic structure of the area is very simple, consisting of a uniform northeasterly dip of about 50 ft per mile (9.5 m per km). The Shell Knob fault, just west of the wilderness, has a vertical displacement of about 120 ft (37 m), east side down; it is delineated by the displacement of the Compton Formation bench as observed on aerial photographs. About a mile south of the west end of the wilderness, a roadcut in Cotter Dolomite on State Highway 39 exposes several faults over a horizontal distance of about 300 ft (90 m). They strike about N. 75° E., dip about 75° alternately north and south, and show vertical displacements of 1-2 ft (0.3-0.6 m) each, although at least one fault passes into bedding a few feet updip. The net displacement at road level is about 3 ft (0.9 m) down to the north. No evidence of this fault zone was seen in discontinuous roadside outcrops along strike a mile to the west, nor is the fault zone visible on aerial photographs.

GEOCHEMISTRY

Stream-sediment samples and panned-concentrate samples were collected and analyzed from eleven drainages tributary to Piney Creek. Sample localities are shown on the map, and the analyses for selected metals are given in table 1. The analyses show a remarkably uniform content of each metal and indicate that anomalous concentrations of metals probably are not present in the surface formations of the wilderness; bedrock at all sample localities is the Cotter Dolomite. The enhanced metal values detected in the panned-concentrate samples reside in limonitic iron oxide derived from the ubiquitous sparsely disseminated pyrite in the surface formations in the area.

Rock samples of the Reeds Spring Formation and the Cotter Dolomite were collected from excellent exposures along State Highway 39, about 1 mi south of the westernmost part of the wilderness, in order to determine the background geochemistry of these rock units and to determine whether the pyrite present in these rocks contains anomalously high amounts of trace metals. The Reeds Spring Formation is composed of light-gray, fine-grained, well-bedded cherty limestone. Clots and nodules of pyrite, as much as 2 cm across, are sparsely disseminated in both limestone and chert. Spectrographic analyses of a pyrite concentrate (table 2) show that it contains only trace amounts of nickel, lead, and copper. Zinc was detected but is less than the limit of determination, 200 parts per million.

The Cotter Dolomite is composed of very light gray, fine- to medium-grained, partly laminated sandy dolomite. Some of the coarser grained beds are brown and have a petroliferous odor. Light-gray to tan chert bands, as much as 25 cm thick, are present but are not abundant. Commonly, pyrite occurs as fine-grained, discontinuous laminae at the base of sandy lenses and in thread-like vertical seams.

Spectrographic analyses of light-gray dolomite, brown petroliferous dolomite, and breccia from the fault zone on State Highway 39, all show that these rocks do not contain anomalously high amounts of trace metals (table 2). Analysis of an insoluble residue from the light-gray dolomite, composed of quartz grains and pyrite, failed to show any appreciable enhancement of trace-metal content compared to the analysis of the whole rock (table 2, compare PC-2R and PC-2).

The only known mineral prospect in the vicinity of the wilderness, the Wild Cat mine, is located near the head of a hollow in the NW1/4 sec. 29, T. 23 N., R.24 W., in Stone County, about 0.5 mi (0.8 km) east of the wilderness boundary. A small pit exposes about 5 ft (1.5 m) of fine-grained tan dolomite of the Cotter Dolomite. Mineralized rock was not seen in the pit wall but some rock pieces on the small dump show considerable alteration--coarse, clear calcite, drusy quartz, and lemon-yellow to pale-greenish-yellow earthy clay. One specimen of very fine crystalline pinkish-tan dolomite was found that contained a small amount of tabular galena and coarse calcite. Spectrographic analyses of altered rock and of a galena separate (table 2) show that lead and traces of zinc are the only metals present and that the galena is strikingly free of commonly associated trace metals such as silver, arsenic, copper, nickel, cobalt, antimony, and cadmium. The lack of even trace amounts of metals other than lead in these rocks suggests that a well-developed or extensive mineralized system is not present in the area.

GEOPHYSICS

The magnetic map of Missouri (Missouri Geological Survey, 1943b) shows a crescentic positive magnetic anomaly of about 400 gammas along the northwest side of the wilderness, based on magnetic readings at 2-mile (3.2-km) intervals along highways. According to L. E. Cordell (oral commun., August 1981), the high amplitude and apparently steep gradient of this anomaly indicate that its source is a body of rock probably some 5 mi (8 km) long and more than 1 mi (1.6 km) wide, occurring at or near the surface of the Precambrian basement, which is about 800 ft (240 km) below sea level or about 2,200 ft (670 m) below the upland surface (Kisvarsanyi, 1975). The basement lithology in this area is inferred to consist of alkali-rhyolite ash-flow tuffs and flows (Kisvarsanyi, 1979). In that context, the shape, amplitude, and steep gradient of the anomaly suggest an intrusive mass not of normal rhyolitic composition, but nothing else can be inferred from the available data. A more detailed magnetic survey of the area should be made to delineate the anomaly accurately before further inferences are made as to its significance.

On the gravimetric map of Missouri (Missouri Geological Survey, 1943a), the wilderness is on the southeast limb of a gentle, oval-shaped northwest-trending positive gravity anomaly of about 100 "gravity units" (10 mgals). The source of this feature must be at a deep level in the Precambrian basement and cannot be identified on the basis of available geologic data. Detailed gravity trends are not resolved within the wilderness because no gravity stations exist within several miles of its boundary.

MINING DISTRICTS AND MINERALIZATION

There is no mining activity within the wilderness at present, no production has been reported, no mineralization is discernible on the surface, and there is no evidence of prospecting in the wilderness. The area is several miles southeast of the Tri-State zinc-lead mining district as broadly defined (Heyl and others, 1966), and is about 12 mi (20 km) from the McDowell deposit, the nearest known deposit of base-metal sulfides (McKnight and others, 1962). The McDowell and other small mines in Barry County have produced 507 tons (460 tonnes) of lead and 1,021 tons (926 tonnes) of zinc. A small prospect named the Wild Cat mine was opened on a show of galena in the Cotter Dolomite in the SW1/4 NW1/4 sec. 29, T. 23 N., R. 24 W., about 0.5 mi (0.8 km) east of the wilderness. Only sand, gravel, and limestone have been produced near the area; some quarries are within 2 mi (3.2 km). Except for 100 acres (40.4 hectares) in the NW1/4 sec. 28, T. 23 N., R. 25 W., all mineral rights in the wilderness have been held by the U.S. Government since 1975. No prospecting permits are on record.

ASSESSMENT OF MINERAL-RESOURCE POTENTIAL

Although the area is near the Tri-State zinc-lead district, there is no evidence of Tri-State type (stratabound) mineral deposits within the wilderness. As discussed under Geochemistry, the stream-sediment samples and panned-concentrate samples collected within the wilderness, representing all the principal drainages, indicate that anomalous concentrations of metals probably are not present in the surface formations of the area. No mineralized rocks were found during traverses of the wilderness. Analyses of galena and altered dolomite from a small prospect just east of the wilderness showed strikingly low amounts of commonly associated trace metals, suggesting that an extensive mineralized system is not present in the area.

The foregoing observations apply to the Ordovician and Mississippian formations that are exposed at the surface, which represent the lowermost of the units known to be mineralized in the Tri-State district. In the Southeast Missouri district, some 150 mi (240 km) northeast of the wilderness, mineral deposits of the same type are concentrated in the Bonneterre Formation of Cambrian age, and theoretically, the Bonneterre and other carbonate units that underlie the Cotter Dolomite in the wilderness could have some potential for zinc-lead mineralization. Analyses of insoluble residues from subsurface Cambrian formations, from drill holes along a traverse that passes about 15 mi (24 km) south of the area, showed anomalous amounts of several metals in the Derby-Doerun, Potosi, and Eminence Dolomites at depths of about 1,500-1,850 ft (450-560 m) below the surface (Erickson and others, 1981). This indicates that metal-bearing fluids passed through these formations over a large area, and in the light of recent studies in the Rolla 1° x 2° quadrangle (Erickson and others, 1978, 1979), suggests that these Cambrian units, as well as the subsurface Ordovician carbonate units, may have a potential for base-metal mineralization in the wilderness. The significance of this potential, however, cannot be evaluated without deep drilling to provide information on the lithology and anomalous metal content of these formations within or close to the wilderness.

In the Southeast Missouri mining district, several major magnetic iron-ore deposits of past or potential importance occur in Precambrian rhyolitic volcanic rocks, and each of these major deposits is marked by a positive magnetic anomaly of at least several hundred gammas (Kisvarsanyi, 1981). The high-amplitude magnetic anomaly along the northwest side of the Piney Creek Wilderness, together with the inferred presence of rhyolitic volcanic rocks in the Precambrian basement, suggests a potential for a magnetite deposit in this area, but because of the lack of definition of the anomaly as well as the absence of specific data on the lithology of the basement rocks in this area, the only inference possible is that a potential exists. This potential cannot be confirmed or ruled out without a detailed magnetic survey and physical (drilling) evidence of the basement lithology. If the anomaly is indeed caused by a magnetite deposit, the deposit is probably at a depth of at least 2,100 ft (640 m) below the upland surface, and is probably at least partly outside the boundary of the wilderness.

The wilderness has little potential for economic resources of industrial minerals that are not readily available elsewhere in the region. Dolomite and limestone occur within the area, but abundant supplies are available nearby. Sand, gravel, and limestone have been produced near the wilderness, and at the time of this investigation, quarries about 2 mi (3.2 km) south of the wilderness were producing crushed stone from the Cotter Dolomite.

There is no known potential for energy resources in the wilderness. The Ozark uplift is considered to be geologically unfavorable for oil and gas occurrence (Anderson and Wells, 1967). All the known coal-bearing strata in Missouri are of Pennsylvanian age; rocks as young as Pennsylvanian are not present in or near the area, and in general southwestern Missouri is considered unfavorable for coal resources (Robertson, 1971). No evidence of potential for radioactive-mineral deposits or for geothermal-energy sources was found in the wilderness.

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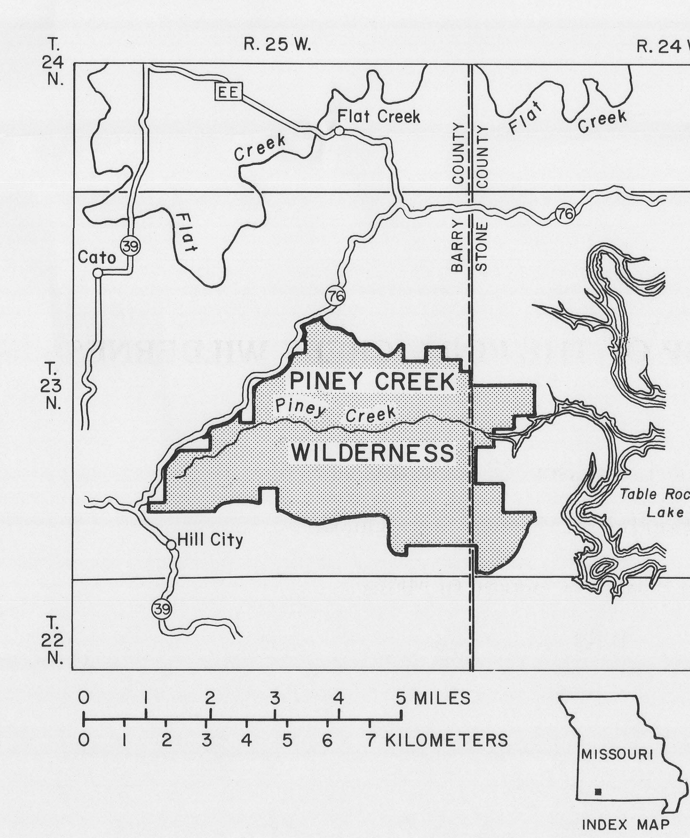

INDEX MAP

Table 1.--Semiquantitative spectrographic analyses for selected elements in stream sediments and panned concentrates, Piney Creek Wilderness, Missouri

[Analyses by E. L. Mosier; in parts per million. N, not detected at value shown]

Sample locality no.	Zn	Ni	Pb	Cu	Mo	Co	Ag
			Stream sediments				
3	N(200)	50	50	20	N(5)	15	N(0.5)
4	do.	70	50	30	do.	20	Do.
5	do.	50	50	20	do.	20	Do.
6	do.	70	50	20	do.	20	Do.
7	do.	50	50	20	do.	20	Do.
8	do.	50	50	20	do.	20	Do.
9	do.	30	30	15	do.	15	Do.
10	do.	70	50	20	do.	20	Do.
11	do.	50	50	15	do.	15	Do.
12	do.	50	50	20	do.	20	Do.
14	do.	70	50	20	do.	20	Do.
			Panned concentrates				
3	1,000	300	150	100	20	50	N(0.5)
4	2,000	500	200	150	50	50	Do.
5	1,000	500	200	100	30	50	Do.
6	2,000	300	200	200	70	50	Do.
7	1,500	500	200	100	30	70	20
8	1,500	500	200	200	70	70	N(0.5)
9	2,000	500	200	200	70	70	Do.
10	1,500	500	200	100	70	50	Do.
11	2,000	300	200	150	70	50	Do.
12	3,000	500	300	200	100	100	Do.
14	2,000	500	200	200	100	70	Do.

Table 2.--Semiquantitative spectrographic analyses and descriptions of samples of rocks and mineral separates, Piney Creek Wilderness, Missouri

[Analyses by M. S. Erickson. Fe, Mg, Ca, Ti in percent, other elements in parts per million. N, not detected at value shown; L, detected but below value shown. Ag(.5), As(200), Au(10), Be(1), Bi(10), Cd(20), Cr(10), La(20), Nb(20), Sb(100), Sc(5), Sn(10), W(50), Y(10) not detected at value shown]

Element analyzed for	PC-1	PC-2	PC-2A	PC-2B	PC-2R	PC-13	PC-13A
	Sample locality no.						
Fe	30	1.5	0.15	0.1	5	0.2	L(0.1)
Mg	0.1	10	10	7	0.15	7	0.1
Ca	0.15	10	10	10	L(.05)	15	0.15
Ti	0.015	0.03	L(.002)	0.002	0.1	0.005	N(0.002)
Mn	50	100	100	70	10	200	N(10)
B	100	20	10	15	20	30	N(10)
Ba	200	50	N(20)	N(20)	300	N(20)	N(20)
Co	30	5	N(5)	N(5)	10	L(5)	N(5)
Cu	30	7	20	L(5)	30	5	20
Mo	10	N(5)	N(5)	N(5)	10	N(5)	N(5)
Ni	150	7	N(5)	N(5)	20	L(5)	N(5)
Pb	50	20	20	L(10)	15	1,500	Major
Sr	N(200)	100	N(100)	N(100)	N(100)	100	N(100)
V	20	10	10	10	10	10	20
Zn	L(200)	N(200)	N(200)	N(200)	N(200)	200	N(200)
Zr	N(10)	20	N(10)	N(10)	100	10	N(10)

Sample locality no.	Description
PC- 1	Pyrite concentrate with chert contamination from Reeds Spring Formation. Roadcut on State Highway 39, NW 1/4 SE 1/4 sec. 32, T. 23 N., R. 25 W.
PC- 2	Light-gray, sparingly pyritic, sandy dolomite from Cotter Dolomite. Roadcut on State Highway 39, NW 1/4 NW 1/4 sec. 4, T. 22 N., R. 25 W.
PC- 2A	Medium- to coarse-grained petroliferous brown dolomite. Location same as PC-2.
PC- 2B	Dolomite breccia from small fault zone. Location same as PC-2.
PC- 2R	Insoluble residue composed of quartz grains and pyrite from gray, sandy dolomite. Location same as PC-2.
PC-13	Weakly mineralized altered rock from Wild Cat prospect, NW 1/4 SW 1/4 NW 1/4 sec. 29, T. 23 N., R. 24 W.
PC-13A	Galena crystal. Location same as PC-13.

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