



CORRELATION OF MAP UNITS

Qa	Quaternary	Quaternary
Qm	Quaternary	Quaternary
Tfm	Tertiary	Tertiary
Tq	Tertiary	Tertiary
TKhb	Tertiary	Tertiary
TKrb	Tertiary	Tertiary
TKdb	Tertiary	Tertiary
TKfb	Tertiary	Tertiary
TKf	Tertiary	Tertiary
Kc	Cretaceous	Cretaceous
Ko	Cretaceous	Cretaceous
Kgm	Cretaceous	Cretaceous
Kkb	Cretaceous	Cretaceous
Kk	Cretaceous	Cretaceous
Ku	Cretaceous	Cretaceous
Kfn	Cretaceous	Cretaceous
Kpl	Cretaceous	Cretaceous
Kpn	Cretaceous	Cretaceous
Kd	Cretaceous	Cretaceous
Kp	Cretaceous	Cretaceous
Kz	Cretaceous	Cretaceous
Ym	Yukonian	Yukonian
Yn	Yukonian	Yukonian
Yb	Yukonian	Yukonian
Yc	Yukonian	Yukonian
Yd	Yukonian	Yukonian
Ye	Yukonian	Yukonian
Yf	Yukonian	Yukonian
Yg	Yukonian	Yukonian
Yh	Yukonian	Yukonian
Yi	Yukonian	Yukonian
Yj	Yukonian	Yukonian
Yk	Yukonian	Yukonian
Yl	Yukonian	Yukonian
Ym	Yukonian	Yukonian
Yn	Yukonian	Yukonian
Yo	Yukonian	Yukonian
Yp	Yukonian	Yukonian
Yq	Yukonian	Yukonian
Yr	Yukonian	Yukonian
Ys	Yukonian	Yukonian
Yt	Yukonian	Yukonian
Yu	Yukonian	Yukonian
Yv	Yukonian	Yukonian
Yw	Yukonian	Yukonian
Yx	Yukonian	Yukonian
Yy	Yukonian	Yukonian
Yz	Yukonian	Yukonian

DESCRIPTION OF MAP UNITS

INTRUSIVE ROCKS

PIONEER BATHOLITH

INTRUSIVE ROCK UNITS

SEDI-MENTARY AND METAMORPHIC ROCKS

PROTEROZOIC UNITS

INTRUSIVE ROCKS

SEDI-MENTARY ROCKS

METAMORPHIC ROCKS

CONTACT—Approximately located or inferred

FAULT—Dashed where approximately located; dotted where concealed; quartered where inferred; bar and half on downthrown side; degree and direction of dip may be indicated by arrow and number

THREAT FAULT—Dashed where approximately located; dotted where concealed; quartered where inferred; bar and half on downthrown side; degree and direction of dip may be indicated by arrow and number

CONTACT BRECCIA—Within area of breccia

ANTICLINE—Approximately located; degree and direction of plunge indicated by number and arrow

SYNCLINE—Approximately located

SMALL FOLDS—Approximately located; degree and direction of plunge indicated by number and arrow

QUARTZ VEINING—Within area of veining greater than about 1 per square mile

ALTERATION—Approximate extent; generally quartz and sericite

EXPLANATION OF MINERAL RESOURCE POTENTIAL AREAS

- Ag/Au-1 Areas with silver and (or) gold potential
- M-1 Areas with porphyry-type molybdenum potential
- Tungsten Areas with tungsten potential
- Cu Areas with strata-bound copper potential
- B Areas with barite potential

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 submitted to the President and the Congress. This report presents the results of a mineral resource survey of the West Pioneer Wilderness Study Area in Beaverhead County, Montana. The study area was established by Public Law 85-156, November 1977 and it was later classified as a further planning area during the Second Roadless Act Review and Evaluation (RARE II) by the U.S. Forest Service, January 1978.

SUMMARY

Geologic, geochemical, and geophysical investigations and a survey of mines and prospects have been conducted to evaluate the mineral resource potential of the West Pioneer Wilderness Study Area, Beaverhead County, Mont. (fig. 1). Numerous precious- and base-metal-bearing quartz veins and porphyry-type molybdenum deposits occur in the study area and all of these occurrences have resource potential. Minor amounts of silver and gold occur in the study area. All of the important mineral deposits are related to the later phases of the intrusion of the Pioneer batholith. The study area has moderate to high potential for the occurrence of molybdenum, silver, and gold, and low to moderate potential for the occurrence of copper, tungsten, and barite. The occurrence of tungsten and silver-gold resources.

GEOLOGY

The Pioneer Mountains are located in a region that is geologically complex. A variety of rock types are present and range in age from Early Proterozoic to Quaternary. In the west Pioneer Mountains, these units can be broadly subdivided into five groups plus several smaller units. The Pioneer batholith, polydeformed metamorphic rocks, and Proterozoic sedimentary rocks. Of these groups, allochthonous Middle Proterozoic sedimentary rocks underlie about 80 percent of the area and comprise quartzite, feldspathic quartzite, argillaceous quartzite, argillite, and conglomerate of the Pioneer Group. Highly deformed and metamorphosed Paleozoic and Mesozoic rocks are exposed within structural windows through the Proterozoic sedimentary units. These rocks include Paleozoic and Mesozoic sedimentary rocks, and Paleozoic and Mesozoic igneous rocks. The Pioneer batholith is a large, complex, and highly deformed intrusion of granitic and dioritic rocks. It is composed of several plutons and is intruded by younger rocks. The Pioneer batholith is a large, complex, and highly deformed intrusion of granitic and dioritic rocks. It is composed of several plutons and is intruded by younger rocks.

GEOCHEMISTRY

The trace elements considered useful for evaluation of mineral resource potential in the West Pioneer Wilderness Study Area are silver, lead, zinc, and copper. These elements were determined for 100 milligram stream-sediment samples of the area. The results of the stream-sediment survey reveal a broad northwest-trending zone across the central portion of the study area upon which is superimposed a north-trending zone. A second northwest-trending belt of high concentrations of these elements occurs across the northern portion of the area. Two other regions of high concentration are located in the southwestern and southeastern corners of the area.

GEOPHYSICS

Magnetic and gravity anomaly data, useful for evaluating the nature of subsurface features, indicate a zone along the eastern portion of the study area that is free of magnetic anomalies and generally free of gravity anomalies. The lack of magnetic anomalies and generally free of gravity anomalies, and the possible occurrence of unmetamorphosed sedimentary rocks that may serve as hydrocarbon reservoirs, are features of the study area. The study area is a large, complex, and highly deformed intrusion of granitic and dioritic rocks. It is composed of several plutons and is intruded by younger rocks.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Within the West Pioneer Wilderness Study Area there is a moderate to high potential for the occurrence of molybdenum, silver, and gold, and low to moderate potential for the occurrence of copper, zinc, and lead. The study area is a large, complex, and highly deformed intrusion of granitic and dioritic rocks. It is composed of several plutons and is intruded by younger rocks.

Silver and Gold

Precious metals occur primarily in small open-space-filling quartz veins. The deposits formed during the emplacement of the Pioneer batholith and probably at the time of formation of porphyry-type deposits. The veins are structurally controlled and occur parallel to northeast- and northwest-trending fault zones.

Tungsten

Tungsten occurs primarily as scheelite in contact-metamorphic skarn deposits formed at the contact of carbonate rocks with hornblende-bearing plutons of the Pioneer batholith (Berger and Hanna, 1981). The most productive skarns in the contact are developed in the Amsden Formation. Production from the Calvert tungsten mine north of the study area has been from this formation. The area with potential for tungsten-bearing skarn deposits is outlined on the map. The skarns occur in the study area in roof pendants on Foolhen Mountain and along Foolhen Ridge. The following criteria were used to define the area:

Criteria used to define areas

- (1) A prominent northeast-trending fault zone near the Foolhen Ridge and Foolhen Mountain.
- (2) The presence of a granodiorite pluton, and
- (3) The reported occurrence by Geach (1972) of scheelite in skarn on Foolhen Ridge.

Comments: No ore minerals were recognized within the study area, although there is evidence of old propylitic alteration. There is a likelihood of low to moderate levels of exploration activity.

Stanniferous Copper

A copper geochemical anomaly occurs in the southwestern corner of the study area (Area C). No evidence has been found to suggest that the anomaly is related to igneous rocks. A possible source for the anomaly is a strata-bound copper deposit in the Middle Proterozoic sedimentary rocks.

Probable Resource Potential Adjacent to the Study Area

There are several areas of indicated and inferred mineral resources adjacent to the study area boundaries. These are the Bryant Creek, Steel Creek, Old Tim Creek, Price Creek, Sepoye Mountain, Steel Creek, and Warm Springs Creek areas.

Small pendants of Paleozoic carbonate rocks with some skarn occur in a tonalite pluton on Foolhen Ridge near the north edge of the study area. The skarn consists of quartz garnet. These occurrences of exploration activity for tungsten mineralization in these skarns, although there is no historical production, are of interest as low-priority exploration targets. The area with potential for tungsten-bearing skarn deposits is outlined on the map. The skarns occur in the study area in roof pendants on Foolhen Mountain and along Foolhen Ridge. The following criteria were used to define the area:

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References

Berger, B. R., Snoe, L. W., and Hanna, W., 1981, *Ag-Au-Cu* Ag-Au-Cu age and geochemical relationships between mineral deposits and plutons of volcanic composition, Pioneer Mountains, Beaverhead County, Montana. U.S. Geological Survey Bulletin 1480, 148 p.

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Snoe, L. W., 1982, *Emplacement and cooling of the Pioneer batholith, Montana*. Unpublished Ph.D. dissertation, The Ohio State University, 239 p.

Streckeisen, P., 1976, *To each plutonic rock its proper name*. Earth Science Reviews, v. 12, p. 1-33.

Base from U.S. Geological Survey 1:250,000 scale maps, Pioneer Mountains, Beaverhead County, Montana, 1978; Western Mountains, Old Tim, Foolhen Hill, Steel Mountain, Stine Mountain, 1978; and 1:62,500 scale maps, 1959.

MINERAL RESOURCE POTENTIAL MAP OF THE WEST PIONEER WILDERNESS STUDY AREA, BEAVERHEAD COUNTY, MONTANA

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